



Overland
Storage

SnapSAN™ Path Manager Linux

User Guide

S3000/S5000



April 2013
10400424-002



©2013 Overland Storage, Inc. **All rights reserved.**

Overland®, Overland Data®, Overland Storage®, ARCvault®, DynamicRAID®, GuardianOS® (EU), LibraryPro®, LoaderXpress®, Multi-SitePAC®, NEO®, NEO Series®, PowerLoader®, Protection OS®, REO®, REO 4000®, REO Series®, Snap Appliance®, Snap Care® (EU), SnapSAN®, SnapServer®, StorAssure®, Ultamus®, VR2®, and XchangeNOW® are registered trademarks of Overland Storage, Inc.

GuardianOS™, RAINcloud™, RapidRebuild™, SnapDisk™, SnapEDR™, Snap Enterprise Data Replicator™, SnapExpansion™, SnapScale™, SnapScale X2™, SnapServer DX Series™, SnapServer Manager™, and SnapWrite™ are trademarks of Overland Storage, Inc.

All other brand names or trademarks are the property of their respective owners.

The names of companies and individuals used in examples are fictitious and intended to illustrate the use of the software. Any resemblance to actual companies or individuals, whether past or present, is coincidental.

PROPRIETARY NOTICE

All information contained in or disclosed by this document is considered proprietary by Overland Storage. By accepting this material the recipient agrees that this material and the information contained therein are held in confidence and in trust and will not be used, reproduced in whole or in part, nor its contents revealed to others, except to meet the purpose for which it was delivered. It is understood that no right is conveyed to reproduce or have reproduced any item herein disclosed without express permission from Overland Storage.

Overland Storage provides this manual as is, without warranty of any kind, either expressed or implied, including, but not limited to, the implied warranties of merchantability and fitness for a particular purpose. Overland Storage may make improvements or changes in the product(s) or programs described in this manual at any time. These changes will be incorporated in new editions of this publication.

Overland Storage assumes no responsibility for the accuracy, completeness, sufficiency, or usefulness of this manual, nor for any problem that might arise from the use of the information in this manual.

Preface

This user guide explains how to use Path Management - Linux to implement path multiplexing between each server and disk array unit in a system. If a fault occurs on a path, the used path can automatically be switched to another path. In addition, the concurrent use of multiple paths can distribute the load to individual paths. This guide assumes that you are familiar with computer hardware, data storage, and network administration terminology and tasks. It also assumes you have basic knowledge of Internet SCSI (iSCSI), Serial-attached SCSI (SAS), Serial ATA (SATA), Storage Area Network (SAN), and Redundant Array of Independent Disks (RAID) technology.

This guide assumes that you are familiar with computer hardware, data storage, and network administration terminology and tasks. It also assumes you have basic knowledge of Internet SCSI (iSCSI), Serial-attached SCSI (SAS), Serial ATA (SATA), Storage Area Network (SAN), and Redundant Array of Independent Disks (RAID) technology.

Product Documentation and Firmware Updates

Overland Storage SnapSAN product documentation and additional literature are available online, along with the latest release of the SnapSAN 3000/5000 software.

Point your browser to:

<http://docs.overlandstorage.com/snapsan>

Follow the appropriate link to download the **latest** software file or document. For additional assistance, search at <http://support.overlandstorage.com>.

Overland Technical Support

For help configuring and using your SnapSAN 3000/5000, search for help at:

<http://support.overlandstorage.com/kb>

You can email our technical support staff at techsupport@overlandstorage.com or get additional technical support information on the [Contact Us](#) web page:

<http://www.overlandstorage.com/company/contact-us/>

For a complete list of support times depending on the type of coverage, visit our web site at:

http://support.overlandstorage.com/support/overland_care.html

Conventions

This user guide exercises several typographical conventions:

Convention	Description & Usage
Boldface	Words in a boldface font (Example) indicate items to select such as menu items or command buttons.
Ctrl-Alt-r	This type of format details the keys you press simultaneously. In this example, hold down the Ctrl and Alt keys and press the r key.
NOTE	A Note indicates neutral or positive information that emphasizes or supplements important points of the main text. A note supplies information that may apply only in special cases—for example, memory limitations or details that apply to specific program versions.
IMPORTANT 	An Important note is a type of note that provides information essential to the completion of a task or that can impact the product and its function.
CAUTION 	A Caution contains information that the user needs to know to avoid damaging or permanently deleting data or causing physical damage to the hardware or system.
WARNING 	A Warning contains information concerning personal safety. Failure to follow directions in the warning could result in bodily harm or death.
Menu Flow Indicator (>)	Words in bold font with a greater than sign between them indicate the flow of actions to accomplish a task. For example, Setup > Passwords > User indicates that you should press the Setup button, then the Passwords button, and finally the User button to accomplish a task.

Information contained in this guide has been reviewed for accuracy, but not for product warranty because of the various environments, operating systems, or settings involved. Information and specifications may change without notice.

Preface

Chapter 1 - Path Manager Linux

Overview	1-1
What Is PathManager?	1-1
Handling of Path Faults	1-1
Load Distribution Function	1-1
Structure of PathManager	1-2
PathManager Driver	1-2
Pathmanager Operation Commands (mkdd, spscmd, spsadmin, spsconfig)	1-2
Path patrol daemon (dd_daemon)	1-2
Multi Path System	1-2
System Configuration	1-3
Single Server Configuration	1-3
Multiple Server Configuration	1-4
Cluster Configuration	1-4

Chapter 2 - Installation

Setup	2-1
Prepare to Install	2-6
Installing PathManager RPM Package	2-7
Installation by Installer	2-7
Manual Installation	2-8
Shifting to a PathManager Environment	2-14
Starting Operation	2-15
Checking the Condition	2-15
RHEL6	2-15
RHEL4, RHEL5, SLES10	2-16
PathManager Uninstallation	2-18
Shifting to a Non-PathManager Environment	2-18
Uninstalling PathManager RPM Package	2-19
Uninstallation by Uninstaller	2-19
Manual Uninstallation	2-20
Updating PathManager	2-23

Chapter 3 - Functions

Limit of Paths and Disks	3-1
Load Distribution Function	3-1
Load Distribution	3-2
Static Load Distribution (FailoverOnly)	3-2

Static load Distribution (lbstatic)	3-2
Dynamic Load Distribution	3-2
Round Robin Mode (RoundRobin)	3-3
Least I/O Size Mode (LeastSectors)	3-3
Configuration File	3-3
Creating the Configuration File	3-3
File Format	3-4
Changing Configuration of PathManager	3-6
Changing the Path Monitoring Interval	3-8
Changing Environment of PathManager	3-10
Addition and Deletion of LUN	3-10
Initializing Configuration of PathManager	3-14
Log Information	3-15
System Log	3-15
System Log Messages	3-16
proc File System	3-19
Device information	3-19
Path Status Display	3-25
Logical Unit	3-26
Displaying Detail Information ("-v" option)	3-27
Path Patrol Daemon	3-32
Basic Operation of the Path Patrol Daemon	3-32
Script for Operating the Path Control Daemon	3-32
Arguments of the Path Patrol Daemon Operation Script	3-32
Enable/Disable Setting of Path Monitoring	3-33
Messages	3-33
Device Files	3-33
Naming Rules	3-34
Available Maximum number of LUN	3-34
Maximum number of LUN	3-34
Intermittent Error Monitoring Function	3-34
Getting Error History Function	3-37
Details of Output	3-38

Chapter 4 - Operation

Operation in Normal State	4-1
When the Fault Occurs	4-1
Restoration by Rebooting the System	4-4
Restoration using Operation Commands	4-4
Restoration by Scanning All Paths	4-10
Restoration by iscsiadm Command	4-14

Chapter 5 - Cautions and Restrictions

Cautions	5-1
Restrictions	5-1

Appendix A - Commands

Commands of Function Version 5.1.0 or Later	A-1
mkdd command	A-1
spsadmin command	A-1
Command of Function Version Less than 5.1.0	A-7

mkdd command	A-7
spscnd command	A-7

Appendix B - Information Collection

Appendix C - Cluster Mode Setup

Enable/Disable Cluster Mode	C-1
How to Enable the Cluster Mode	C-1
How to Disable the Cluster Mode	C-1

Appendix D - Application Servers

Application Servers X 1.0 to 3.0 / SE Ver3.1	D-1
Updating Server1/Server2	D-2

Appendix E - LVM Setup

Adding/Removing PathManager Devices	E-1
Adding PathManager Devices to LVM	E-1
Removing PathManager Devices from LVM	E-4

Appendix F - kdump Setup

How to Set up kdump	F-1
Red Hat Enterprise Linux 5/6	F-1
Setting up kdump with a PathManager Device	F-1
Resetting the kdump setting	F-2
SUSE Linux Enterprise Server 10	F-3
Setting up kdump with a PathManager device	F-3
Resetting the kdump setting	F-6

Appendix G - Error Messages

Index

Overview

PathManager is a software product for implementing path multiplexing between each server and disk array unit in a system in which a Disk Array Subsystem is used. If a fault occurs on a path, the used path can automatically be switched to another path. The concurrent use of multiple paths can distribute the load to individual paths.

This chapter gives an overview of PathManager, and describes hardware and software configurations and the other basic items and features of PathManager.

What Is PathManager?

Needless to say, to configure a SAN system, availability is important and the availability greatly depends on the disk array units. Each disk array unit may become one of main faulty locations in a system.

For this reason, many methods have been worked out and used to reduce the fault occurrence rate for disk array units and smoothly recover from a fault. The methods include RAID disk, Hot Spare, and replication. These solutions are effective only for media faults, however. If a fault occurs in a host bus adapter, controller, or physical path (such as a fibre channel cable or switch) between a server and a disk array unit, system operation cannot be continued only with the redundancy of spindles. This is because there is no problem with data in the disk array units, but the data cannot be accessed. Any disk array unit that is proud of its strong position is helpless against a path fault.

Handling of Path Faults

PathManager provides an infrastructure to eliminate weaknesses lurking between a server and a disk array unit in a system using path multiplexing.

If a fault occurs on a path and any access to the disk array unit is disabled during system operation, PathManager detects the fault and switches the active path from the path on which the fault occurs to another normal path to continue access to the disk array unit. The path switching causes no I/O loss. The application can continue processing without considering the occurrence of any path fault.

Load Distribution Function

PathManager has a load distribution function which uses the multiplexed paths to distribute the load to individual paths. To make the most of the features, one static load distribution mode and two dynamic load distribution modes, a total of three load distribution modes, are available. You can use the load distribution function for more efficient access.

Structure of PathManager

PathManager runs on a server like Linux and monitors the path between the HBA (Host Bus Adapter) or NIC (Network Interface Card) on the server and the HP (Host Port) on the disk array.

PathManager consists of the following modules:

PathManager Driver

This is a group of drivers that form the core of PathManager. It controls basic functions of PathManager such as multiplexed paths and load balancing.

Pathmanager Operation Commands (mkdd, spscmd, spsadmin, spsconfig)

Commands for setting operation of PathManager. All operation related to PathManager shall be executed with these commands.

Path patrol daemon (dd_daemon)

Path patrol daemon automatically monitors the status of each path. It issues a monitoring request to each path at the specified intervals.

Multi Path System

Each disk array is recognized as a device file named /dev/ddX (X indicates a unit name, a, b, c,...) by the OS. If an unrecoverable fault occurs on the multi path (in the HBA/NIC, FC/SAS/LAN cable, or disk array controller) during an I/O request from an application to /dev/ddX, the PathManager driver automatically switches the active path (*1) to the alternate path to continue I/O processing (Failover).

All fault messages are output to the system log. The path patrol daemon monitors /proc file system which is updated by PathManager driver. And the path patrol daemon directs auto repair (Failback) after the replacement of the faulty device.

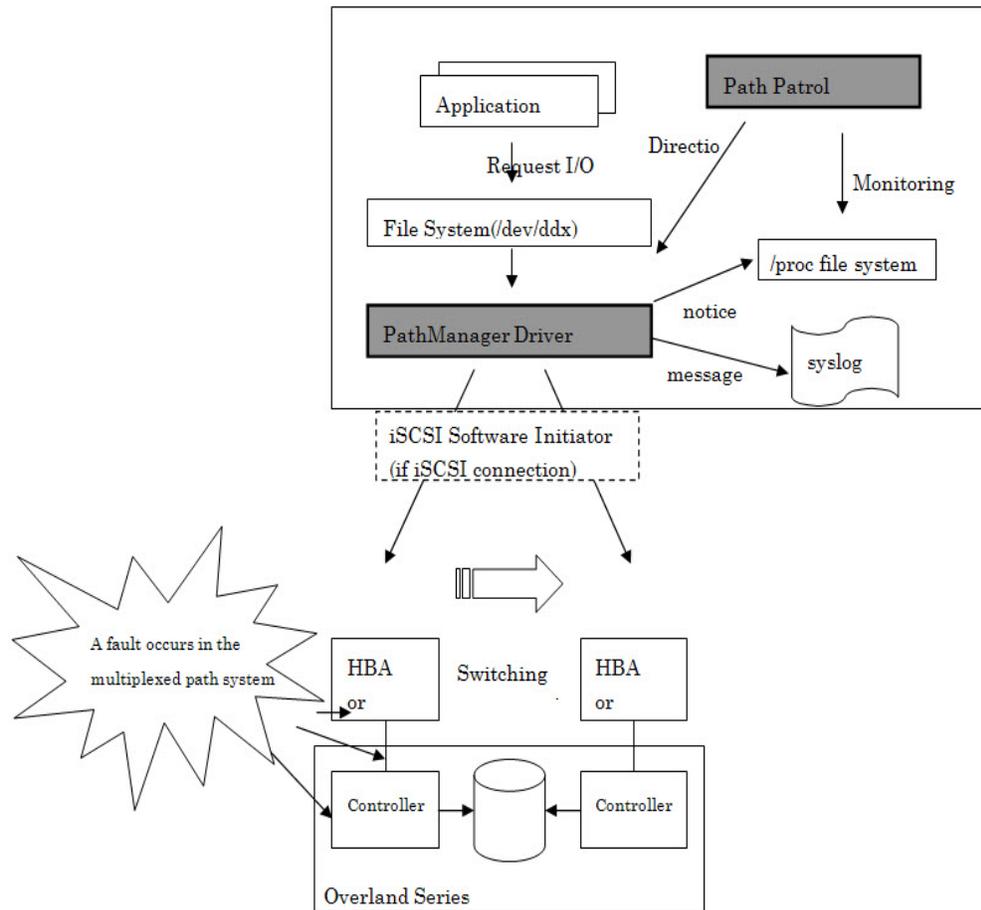


Figure 1-1: Multiplex SCSI Path System

The active path is the path that can currently perform I/O processing. The alternate path is the path to be switched and used as the active path when a fault occurs on the active path.

System Configuration

Examples of basic configurations of systems on which PathManager is installed are shown below.

Single Server Configuration

In this system configuration, a server is directly connected to a server. This configuration is most typical in comparatively small systems.



Figure 1-2: Single Server Configuration

Multiple Server Configuration

In this configuration, multiple servers are directly connected to a Overland. This configuration is used in a system in which multiple servers for different operations share a comparatively large Overland. Exclusive control must be exercised over the logical units used by each server using AccessControl or another component.

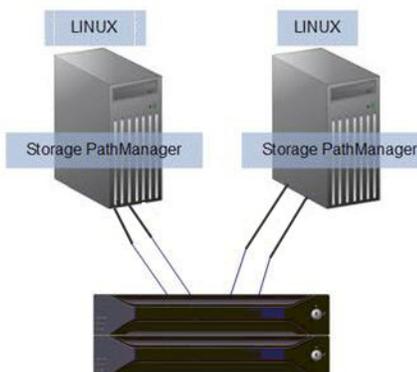


Figure 1-3: Multi Server Configuration

Cluster Configuration

An example of a cluster system configuration is shown below. An FC switch is installed between each server and a SnapSAN S3000/35000 to show the same logical unit from multiple servers.

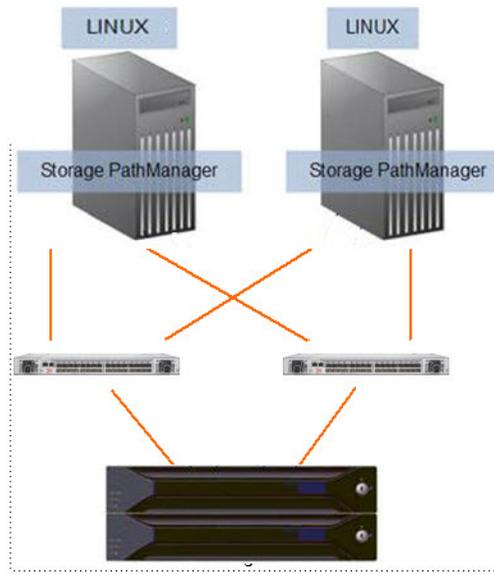


Figure 1-4: Cluster Configuration

Setup

Before starting the setup of PathManager, check the following items:

1. Depending on the connection to a disk array, the following setting has been finished.
[FC/SAS connection]
 - The Fibre Channel (FC) driver or the Serial Attached SCSI (SAS) is set up according to the HBA setup manual.
(You do not have to set up the driver again if you are using the FC driver or SAS driver supplied with your OS.)
[iSCSI connection]
 - The setup of iSCSI initiator has been finished.
The recommendation timeout value of the iSCSI initiator is:
"/etc/iscsi/iscsid.conf"
node.session.timeo.replacement_timeout = 30 (default: 120)
2. Setup the FC-switch when your system uses FC-switch.
3. Cross Call of a disk array is set to "On" if any.
4. A server recognizes a logical disk (unit) of a disk array unit. And the connection between the server and the disk array unit is redundant.
5. In the case you use LVM (Logical Volume Manager), the distribution and kernel version must be one of shown below.
 - Red Hat Enterprise Linux AS/ES 4 (Kernel-2.6.9-42.EL) (IA32/EM64T) or later
 - Red Hat Enterprise Linux 5 (Kernel-2.6.18-53.el5) (IA32/EM64T) or later
 - Red Hat Enterprise Linux 5 Advanced Platform (Kernel-2.6.18-53.el5) (IA32/EM64T) or later
 - Red Hat Enterprise Linux 6 (Kernel-2.6.32-131.0.15.el6) (IA32/EM64T) or later
PathManager does not support LVM when you use the Red Hat Enterprise Linux whose kernel version is earlier than above. And if you use SAN-Boot, PathManager does not support a LVM disk containing an OS area.
6. In the case you use FC connections and iSCSI connections concurrently, the distribution and kernel version must be one of shown below.
 - Red Hat Enterprise Linux 5 (kernel-2.6.18-164.el5) (IA32/EM64T) or later
 - Red Hat Enterprise Linux 5 Advanced Platform (kernel-2.6.18-164.el5) (IA32/EM64T) or later
 - Red Hat Enterprise Linux 6 (kernel-2.6.32-131.0.15.el6) (IA32/EM64T) or later
 - SUSE Linux Enterprise Server 10 (kernel-2.6.16.60-0.57.1) (IA32/EM64T) or later

7. In the case you use the Overland Storage which has both FC and iSCSI connections, the distribution and kernel version must be one of shown below.
 - Red Hat Enterprise Linux 5 (kernel-2.6.18-194.el5) (IA32/EM64T) or later
 - Red Hat Enterprise Linux 5 Advanced Platform (kernel-2.6.18-194.el5) (IA32/EM64T) or later
 - Red Hat Enterprise Linux 6 (kernel-2.6.32-131.0.15.el6) (IA32/EM64T) or later
8. In the case you use SAS connections and FC/iSCSI connections concurrently, the function version of PathManager must be 5.0.5 or later. And the distribution and kernel version must be one of shown below.
 - Red Hat Enterprise Linux 5 (kernel-2.6.18-274.el5) (IA32/EM64T) or later
 - Red Hat Enterprise Linux 5 Advanced Platform (kernel-2.6.18-274.el5) (IA32/EM64T) or later
 - Red Hat Enterprise Linux 6 (kernel-2.6.32-131.0.15.el6) (IA32/EM64T) or later

List of Installation CD Files

Directory/File name	Description
Linux	RPM files
├-- RPMS	
-- RHEL4	Packages of
-- RHEL5	PathManager (*1)
-- 5.1	
-- 5.2	
-- 5.3	
-- 5.4	
-- 5.5	
-- 5.6	
-- 5.7	
-- 5.8	
-- IA32	
-- sps-driver-E-5.0.9-2.6.18.308.el5.i686.rpm	
-- sps-utils-5.0.4-0.el5.i686.rpm	
-- EM64T	
-- sps-driver-E-5.0.9-2.6.18.308.el6.x86_64.rpm	
-- sps-utils-5.0.4-0.el5.x86_64.rpm	
-- RHEL6	
-- 6.1	
-- 6.2	
-- IA32	
-- sps-driver-E-5.1.6-2.6.32.220.4.2.el6.i686.rpm	
-- sps-utils-5.1.4-0.el6.i686.rpm	
-- EM64T	
-- sps-driver-E-5.1.6-2.6.32.220.4.2.el6.x86_64.rpm	
-- sps-utils-5.1.4-0.el6.x86_64.rpm	
├-- SLES10	
-- SP2	
-- SP3	
-- IA32	
-- sps-driver-E-5.0.3-2.6.16.60.0.57.1.i586.rpm	
-- sps-kdump-E-5.0.3-2.6.16.60.0.57.1.i586.rpm	
-- sps-utils-5.0.2-0.sles10.i586.rpm	
-- EM64T	
-- sps-driver-E-5.0.3-2.6.16.60.0.57.1.x86_64.rpm	
-- sps-kdump-E-5.0.3-2.6.16.60.0.57.1.x86_64.rpm	
-- sps-utils-5.0.2-0.sles10.x86_64.rpm	
Linux	PathManager User's
├-- doc	Manual (PDF file)
-- IS202E.pdf	PathManager Install
-- ISRX203E.pdf	Guide (PDF file)

Directory/File name	Description
Linux	For Scalable HA Servers
├-- RPMS	
-- RHEL5	
-- 5.3	
-- EM64T	
-- sps-driver-E-4.2.4-2.6.18.128.el5.x86_64.rpm	
-- sps-mcopt-1.1.0-0.x86_64.rpm (*3)	
-- sps-utils-4.2.2-1.x86_64.rpm	
-- 5.6	
-- EM64T	
-- sps-driver-E-5.0.3-2.6.18.238.9.1.el5.x86_64.rpm	
-- sps-mcopt-1.1.1-0.el5.x86_64.rpm(*3)	
-- sps-utils-5.0.2-1.el5.x86_64.rpm	
-- RHEL6	
-- 6.1	
-- 6.2	
-- EM64T	
-- sps-driver-E-5.1.5-2.6.32.220.0.15.el6.x86_64.rpm	
-- sps-mcopt-1.2.0-0.el6.x86_64.rpm(*3)	
-- sps-utils-5.1.4-0.el6.x86_64.rpm	
Linux	PathManagerUser's Manual (PDF file)
├-- doc	
-- IS202E.pdf	PathManager Install Guide (PDF file)
-- ISRX203E.pdf	
readme.txt	installer (*4)
filelist.txt	
gpl.txt	
install.sh	
install.txt	

*1: Only some of the files of PathManager are described.

*2: RPM files of Ver. 4.2.1 or later are separated according to the functions as follows; sps-utils (utilities), sps-driver (driver), and sps-kdump (kernel dump).

*3: "sps-mcopt" is the package for the cooperation with RENS. It is not need if the PathManager do not cooperate with RENS.

*4: The installation using installer is supported on the following environment.

- Red Hat Enterprise Linux 5.4 (kernel-2.6.18-164.el5) or later
- Red Hat Enterprise Linux 6.1 (kernel-2.6.32-131.0.15.el6) or later
- SUSE Linux Enterprise Server SP3 (kernel-2.6.16.60-0.54.5) or later.

Directory/File name	Description
Linux	RPM files
-- RPMS	
-- RHEL4	
-- RHEL5	Packages of PathManager (*1)
-- 5.1	
-- 5.2	
-- 5.3	
-- 5.4	
-- 5.5	
-- 5.6	
-- 5.7	
-- 5.8	
-- IA32	
-- sps-driver-E-5.0.9-2.6.18.308.el5.i686.rpm	
-- sps-utils-5.0.4-0.el5.i686.rpm	
-- EM64T	
-- sps-driver-E-5.0.9-2.6.18.308.el6.x86_64.rpm	
-- sps-utils-5.0.4-0.el5.x86_64.rpm	
-- RHEL6	
-- 6.1	
-- 6.2	
-- IA32	
-- sps-driver-E-5.1.6-2.6.32.220.4.2.el6.i686.rpm	
-- sps-utils-5.1.4-0.el6.i686.rpm	
-- EM64T	
-- sps-driver-E-5.1.6-2.6.32.220.4.2.el6.x86_64.rpm	
-- sps-utils-5.1.4-0.el6.x86_64.rpm	
-- SLES10	
-- SP2	
-- SP3	
-- IA32	
-- sps-driver-E-5.0.3-2.6.16.60.0.57.1.i586.rpm	
-- sps-kdump-E-5.0.3-2.6.16.60.0.57.1.i586.rpm	
-- sps-utils-5.0.2-0.sles10.i586.rpm	
-- EM64T	
-- sps-driver-E-5.0.3-2.6.16.60.0.57.1.x86_64.rpm	
-- sps-kdump-E-5.0.3-2.6.16.60.0.57.1.x86_64.rpm	
-- sps-utils-5.0.2-0.sles10.x86_64.rpm	
Linux	PathManager User's Manual (PDF file)
-- doc	
-- IS202E.pdf	PathManager Install Guide (PDF file)
-- ISRX203E.pdf	

Directory/File name	Description
Linux	For Linux/Scalable HA Servers
<pre> -- RPMS -- RHEL5 -- 5.3 -- EM64T -- sps-driver-E-4.2.4-2.6.18.128.el5.x86_64.rpm -- sps-mcopt-1.1.0-0.x86_64.rpm (*3) -- sps-utils-4.2.2-1.x86_64.rpm -- 5.6 -- EM64T -- sps-driver-E-5.0.3-2.6.18.238.9.1.el5.x86_64.rpm -- sps-mcopt-1.1.1-0.el5.x86_64.rpm (*3) -- sps-utils-5.0.2-1.el5.x86_64.rpm -- RHEL6 -- 6.1 -- 6.2 -- EM64T -- sps-driver-E-5.1.5-2.6.32.220.0.15.el6.x86_64.rpm -- sps-mcopt-1.2.0-0.el6.x86_64.rpm (*3) -- sps-utils-5.1.4-0.el6.x86_64.rpm </pre>	
Linux	PathManager User's Manual (PDF file)
<pre> -- doc -- IS202E.pdf -- ISRX203E.pdf </pre>	PathManager Install Guide (PDF file)
<pre> readme.txt filelist.txt gpl.txt install.sh install.txt </pre>	installer (*4)

*1: Only some of the files of PathManager are described.

*2: RPM files of Ver. 4.2.1 or later are separated according to the functions as follows; sps-utils (utilities), sps-driver (driver), and sps-kdump (kernel dump).

*3: "sps-mcopt" is the package for the cooperation with RENS. It is not need if the PathManager do not cooperate with RENS.

*4: The installation using installer is supported on the following environment.

- Red Hat Enterprise Linux 5.4 (kernel-2.6.18-164.el5) or later
- Red Hat Enterprise Linux 6.1 (kernel-2.6.32-131.0.15.el6) or later
- SUSE Linux Enterprise Server SP3 (kernel-2.6.16.60-0.54.5) or later.

Prepare to Install

Start the OS with the kernel on which you use PathManager and login as root. Mount the installation CD as the root authority. (If the CD is not mounted automatically, mount manually as follows.)

```
# mkdir -p /media/cdrom
# mount /dev/cdrom /media/cdrom
```

Connect the server to the Overland Storage and check whether the server recognizes a logical disk.

If "Overland" is displayed in "Vendor" item and "Model Name" or "DISK ARRAY" is displayed in "Model" item as the result of execution of the command as follows, the Server is recognized normally. (the shaded part shows it)

```
# cat /proc/scsi/scsi
Attached devices:
Host: scsi0 Channel: 00 Id: 00 Lun: 00
Vendor: NEC Model: DISK ARRAY Rev: 1000
Type: Direct-Access ANSI SCSI revision: 05
```

Installing PathManager RPM Package

The PathManager installation procedures depend on the system configuration (OS distribution / kernel).

OS Distribution	Kernel Version
Red Hat Enterprise Linux AS 4 Red Hat Enterprise Linux ES 4	all
Red Hat Enterprise Linux 5 Red Hat Enterprise Linux 5 Advanced Platform	earlier than 2.6.18-164.el5 2.6.18-164.el5 or later
Red Hat Enterprise Linux 6	2.6.32-131.0.15.el6 or later
SUSE Linux Enterprise Server 10	earlier than 2.6.16.60-0.54.5 2.6.16.60-0.54.5 or later

Installation by Installer

- a. Go to the directory mounted to the PathManager Installation CD.
(If the CD is mounted automatically, go to the corresponding directory.)

```
# cd /media/cdrom
#
```

b. Execute the "install.sh" with "-i" option (as shown by the underlined part below).

*1: If you use the "--silent" option, the installer reboots the server automatically.

(You must reboot before operating the PathManager.)

*2: If the system uses iSCSI connection, pass the "--iscsi" option. If the system uses both FC/SAS and iSCSI connections, also pass the "--iscsi" option. If the system uses iSCSI and you want to reboot automatically, specify the both options "--silent" and "--iscsi".

- If the kernel version is 2.6.18-164.el5 and the system uses FC connection -

```
# sh install.sh -i --silent
===== Precheck for SPS Installation / Uninstallation =====
Distribution   : RedHat
Architecture  : i686
Kernel        : Linux2.6
Kernel Version: Linux2.6
Kernel Details: 2.6.18-164.el5
----- The following packages will be installed. -----
driver : ./Express5800_100_NX7700i/RPMS/RHEL5/5.4/IA32/sps-driver-E-4.3.1-
2.6.18.164.el5.i686.rpm
utils  : ./Express5800_100_NX7700i/RPMS/RHEL5/5.4/IA32/sps-utils-4.3.0-
0.i686.rpm
=====
Preparing...                               ##### [100%]
  1:sps-driver-E                             ##### [100%]
Preparing...                               ##### [100%]
  1:sps-utils                               ##### [100%]
patching file rc.sysinit
Starting up sps devices:
Couldn't open /etc/sps.conf. No such file or directory.
I try auto setting...
Wait.
parsing... device:/dev/dda (OK)
parsing... disk-info:NEC      ,iStorage 1000  ,0000000935000734,00001 (OK)
parsing... LoadBalance:D2 (OK)
parsing... path-info:0 Host:scsi:8 Channel:0 Id:0 Lun:0 Priority:1
Watch:Enable Status:ACT (OK)
parsing... path-info:7 Host:scsi:7 Channel:0 Id:0 Lun:0 Priority:2
Watch:Enable Status:ACT (OK)
Wait until all /dev/ddX is made.....END
dd_daemon (pid 3963) is running...
sps Install Completed.....
#
Broadcast message from root (Thu Feb 25 14:15:57 2010):
The system is going DOWN for reboot in 1 minute!
```

This message appears at the first installation but it does not cause any problem to operation.

c. If the installation is finished normally, the message "sps Install Completed" (the shadowed part in above) will be displayed. If this message is not displayed, that installation is failed.

d. If the installation is finished normally, the system restarts one minute later (if specifying "--silent" or "--reboot" option). And then, confirm that the system restarts normally.

The installation is complete.

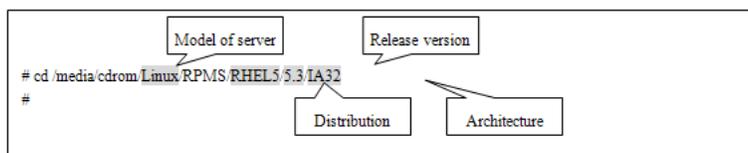
Manual Installation

a. Install the RPM file.

Move to the directory of compatible RPM files. How to specify the directory is shown below.

- If the environment is as follows -

Model of the server	Linux
Distribution	RHEL5
Release version	5.3
Architecture	IA32



Installation Commands

1. RHEL 6

Execute the following command to install the RPM files corresponding to the kernel version you use.

(Shaded part shows the corresponding kernel.)

-In the case if you use the kernel ver.2.6.32-131.0.15.el6 -

```
# rpm -ivh sps-utils-*
sps-utils      #####
# uname -r
2.6.32-131.0.15.el6.i686
# rpm -ivh sps-driver-E-5.1.3-2.6.32-131.0.15.el6.i686.rpm
sps-driver-E   #####
#
```

2. RHEL 5.3 (2.6.18-128.el5) or later / SLES10 SP2 (kernel-2.6.16.60-0.21) or later

Execute the following command to install the RPM files corresponding to the kernel version you use.

(Shaded part shows the corresponding kernel. Even if the displayed kernel version includes "PAE", "default", "smp" or "bigsm", the proper package is the one which doesn't include these words.)

("?" indicates an edition of PathManager. "E" or "S" or "M")

-In the case if you use the kernel ver.2.6.18-128.el5 -

```
# rpm -ivh sps-utils-*
sps-utils      #####
# uname -r
2.6.18-128.el5 .... (*1)
# rpm -ivh sps-driver-?-4.1.3-2.6.18.128.el5.i686.rpm
sps-driver-?   #####
#
```

3. Earlier than RHEL 5.3 (2.6.18-128.el5)

Execute the following command to install the RPM files corresponding to the kernel version you use.

(Shaded part shows the corresponding kernel. Even if the displayed kernel version includes "PAE", "smp", "hugemem" or "largesmp", the proper package is the one which doesn't include these words.)

("?" indicates an edition of PathManager.)

-In the case if you use the kernel ver.2.6.18-92.el5 -

```
# uname -r
2.6.18-92.el5 .... (*1)
# rpm -ivh sps-E-4.1.6-2.6.18.92.el5.i686.rpm
sps-E #####
#
```

*1: If an errata kernel is installed, reconfirm PathManager supports the installed kernel.

-Example of errata kernels on Red Hat Enterprise Linux 5:

The kernel version like "Kernel-2.6.18.29.1.10.el5" is an errata kernel.

With this operation, the following files are installed:

```

/lib/modules/(kernel version)/ kernel/drivers/scsi/dd_mod.ko
/lib/modules/(kernel version)/ kernel/drivers/scsi/sps_mod.ko
/lib/modules/(kernel version)/ kernel/drivers/scsi/sps_mod2.ko (*2)
/sbin/dd_daemon
/sbin/spscmd
/sbin/spsadmin(*9)
/sbin/hotaddpath
/sbin/hotremovepath
/sbin/removearrayinfo
/sbin/recoverpath
/sbin/mkdd
/sbin/spsconfig
/etc/dualpathrc
/etc/init.d/boot.sps (*3)
/etc/rc.d/init.d/dd_daemon (*10)
/etc/rc.d/init.d/sps_loader (*9)
/etc/rc.d/rc0.d/K77dd_daemon (*4)
/etc/rc.d/rc1.d/K77dd_daemon (*4)
/etc/rc.d/rc2.d/S45dd_daemon (*4)
/etc/rc.d/rc3.d/S45dd_daemon (*4)
/etc/rc.d/rc5.d/S45dd_daemon (*4)
/etc/rc.d/rc6.d/K77dd_daemon (*4)
/etc/logrotate.d/sps/sps.logrotate (*8)
/opt/nec/report/inf/dualpath.inf
/opt/nec/report/table/dualpath.tbl
/opt/nec/sps/esm/report/inf/dualpath.inf (*5)
/opt/nec/sps/esm/report/table/dualpath.tbl (*5)
/opt/nec/sps/esm/report/inf/dualpathE.inf (*5)
/opt/nec/sps/esm/report/table/dualpathE.tbl (*5)
/opt/nec/sps/bin/spslog.sh
/opt/nec/sps/bin/sps_setesmtbl.sh (*5)
/opt/nec/sps/patch/rc.sysint.rhel4.diff (*4)(*6)
/opt/nec/sps/patch/iscsi.rhel5.diff (*4)(*7)

```

*2: This file is not installed if PathManager function version is 3.0.5 or earlier.

*3: This file is not installed if the OS is Red Hat Enterprise Linux.

*4: This file is not installed if the OS is SUSE Linux Enterprise Server.

*5: This file is not installed if PathManager function version is 3.0.8 or earlier.

*6: The file name is different by distribution.

*7: This file is installed if PathManager function version is 4.1.1 or later.

*8: This file is installed if PathManager function version is 4.4.2 or later.

*9: This file is installed if the OS is Red Hat Enterprise Linux 6.

*10: The Path Patrol daemon is not installed as `/etc/rc.d/init.d/dd_daemon`, but installed as `/etc/init.d/dd_daemon`.

Execute the following command to check that no error is displayed.

```
# depmod -a `uname -r`
#
```

Be sure to type the backquotes (`) at the beginning and end of `"uname -r"`.

Setup the auto startup.

Skip this procedure if your system is following:

- Red Hat Enterprise Linux 6 and FC/SAS connection
- SUSE Linux Enterprise Server 10

You must modify the OS initialization script (`/etc/rc.d/rc.sysinit`) to make PathManager driver start when OS starts.

Additionally, if you use iSCSI connection, you must also modify the iSCSI initiator startup script (`/etc/rc.d/init.d/iscsi`). To modify the OS initialization script, apply the patch file as follows. If you use both FC/SAS and iSCSI connections, apply the iSCSI patch.

The old OS initialization script which is before applying the patch file is left as `/etc/rc.d/rc.sysinit.orig`.

And the old iSCSI initiator startup script is left as `/etc/rc.d/init.d/iscsi.orig`.

If the patch file was applied before, re-applying is not required.

<Example of Red Hat Enterprise Linux AS/ES 4>

```
# cd /etc/rc.d
# patch -b -p0 < /opt/nec/sps/patch/rc.sysinit.rhel4.diff
#
```

<Example of Red Hat Enterprise Linux 5 (FC/SAS connection)>

```
# cd /etc/rc.d
# patch -b -p0 < /opt/nec/sps/patch/rc.sysinit.rhel5.diff
#
```

<Example of Red Hat Enterprise Linux 5 (iSCSI connection)> (*1)

```
# cd /etc/rc.d
# patch -b -p0 < /opt/nec/sps/patch/iscsi.rhel5.diff
#
```

*1: A patch file modifies the both files (`/etc/rc.d/rc.sysinit` and `/etc/rc.d/init.d/iscsi`).

When you execute the patch command, an error message may appear and the patch file may not be normally applied. In this case, add the lines beginning with the character "+" in the patch file to the `/etc/rc.d/rc.sysinit` or to the `/etc/rc.d/init.d/iscsi`.

<Example of Red Hat Enterprise Linux 6 (iSCSI connection)>

```
# spsconfig -auto-run-enable iscsi
#
```

(iv) If you want ESM_{PRO} to send a message in English, please execute the `sps_setesmtbl.sh` with option "E".

In the case you use Japanese (default setting) or you do not use ESM_{PRO}, this procedure is not required.

```
# /opt/nec/sps/bin/sps_setesmtbl.sh E
Stopping ESMamvmain:           [ OK ]
Starting ESMamvmain:          [ OK ]
Stopping ESMamvmain:          [ OK ]
Starting ESMamvmain:          [ OK ]
#
```

If iSCSI connection, follow the procedures shown below.

Skip this procedure if your system is following:

- Red Hat Enterprise Linux 5.4 or later
- Red Hat Enterprise Linux 6
- SUSE Linux Enterprise Server 10

- (1) Check the `sg_tablesize` of iSCSI host.

```
# cat /sys/class/iscsi_host/host*/device/scsi_host:host*/sg_tablesize
255
255
```

In the above example, `sg_tablesize` is 255.

- (2) Add the `sps_sg_tablesize`, which is an option of `sps_mod2`, to `/etc/modprobe.conf`.

1. Open the `/etc/modprobe.conf` by an editor.
2. Add the description as below at the tail of the file.
 - * The `sps_sg_tablesize` value must be 1 less than the `sg_tablesize` value which you checked on (1).

```
alias eth0 e1000
alias eth1 e1000
alias eth2 e1000
alias eth3 e1000
alias scsi_hostadapter mptbase
alias scsi_hostadapter1 mptsas
alias scsi_hostadapter2 aic7xxx
alias scsi_hostadapter3 ata_piix
options sps_mod2 sps_sg_tablesize=254
```

Add this line.

3. Save the file and quit the editor.

- (3) Confirm the `/etc/modprobe.conf`.

```
# cat /etc/modprobe.conf
alias eth0 e1000
alias eth1 e1000
alias eth2 e1000
alias eth3 e1000
alias scsi_hostadapter mptbase
alias scsi_hostadapter1 mptsas
alias scsi_hostadapter2 aic7xxx
alias scsi_hostadapter3 ata_piix
options sps_mod2 sps_sg_tablesize=254
```

Reboot the system and check that it starts up normally.

```
# sync
# shutdown -r now
```

The installation is complete.

If you use LVM, set LVM according to "Adding PathManager Devices to LVM" section.

If any application or setting file uses the standard SCSI device of storage as `/dev/sdX`,

Shifting to a PathManager Environment

If any application or setting file uses the standard SCSI device of SnapSAN Manager as `/dev/sdX`, follow the procedures below.

<Example to modify `/etc/fstab`>

If you want to use the disk mounted as `/mnt/work` with PathManager:

```
# vi /etc/fstab
...
/dev/sdf1      /mnt/work     ext3 defaults 0 0
...
```

See the device information of /dev/sdf using "sg_scan" command.

Search /dev/ddX device which corresponds to /dev/sdf. The procedures are different according to the function version of PathManager.

Execute "spsconfig" command with "-chk" option, then you can see the corresponding device. The following example shows that /dev/sdf corresponds to /dev/ddd.

```
# spsconfig -chk /dev/sdf
/dev/sdf -> /dev/ddd
#
```

(iii) Modify the /etc/fstab file. The following example shows making backup file and shifting the device file from /dev/sdf to /dev/ddd, which was shown at (ii).

```
# cp -p /etc/fstab /etc/fstab_sps
# vi /etc/fstab
...
/dev/ddd1      /mnt/work     ext3 defaults 0 0
...
```

You must not write the mount-target device (the shaded part above) by "label name" or "by device ID (the device name in /dev/disk/by-id)". Write it by the PathManager device name (/dev/ddX).

(iv) If the system uses the SnapSAN Manager as the standard SCSI device (/dev/sdX) in the application or things like that, modify those settings in the same way as (iii).

Restart the system.

The shifting is complete.

Starting Operation

Checking the Condition

After installation of PathManager, restart the system to make PathManager automatically recognize the target disk unit and paths and start operation. To check whether PathManager is normally running, follow the procedures described below.

RHEL6

This section shows how to check the condition using PathManager command (spsadmin).

Execute the following steps.

1. Open the terminal.
2. Type "spsadmin --lun" and press the return key
3. Check the output.

If PathManager works normally and conditions of all paths are normal, plural lines of path information appear under the "LoadBalance" line. The following example is the output when three logical units exist in a disk array unit and there are two paths. For the detail of output items, refer to "PathManager for Linux User's Manual".

If the number of paths under the "LoadBalance" line is only one or "[Normal]" is not displayed in "LogicalUnit" line, check the environment such as the connection between the server and disk array unit, the condition of FC driver module, and the Cross Call settings of disk array unit.

```
# spsadmin --lun
+++ LogicalUnit 4:0:0 /dev/dda [Normal] +++
  SerialNumber=0000000000000000, LUN=0x00000
  LoadBalance=LeastSectors
  0: ScsiAddress=2:0:0:0, ScsiDevice=/dev/sdb, Priority=1, Status=Active
  1: ScsiAddress=3:0:0:0, ScsiDevice=/dev/sdc, Priority=2, Status=Standby

+++ LogicalUnit 4:0:1 /dev/ddb [Normal] +++
  SerialNumber=0000000000000000, LUN=0x00001
  LoadBalance=LeastSectors
  2: ScsiAddress=2:0:0:1, ScsiDevice=/dev/sdd, Priority=1, Status=Active
  3: ScsiAddress=3:0:0:1, ScsiDevice=/dev/sde, Priority=2, Status=Standby

+++ LogicalUnit 4:0:2 /dev/ddc [Normal] +++
  SerialNumber=0000000000000000, LUN=0x00002
  LoadBalance=LeastSectors
  4: ScsiAddress=2:0:0:2, ScsiDevice=/dev/sdf, Priority=1, Status=Active
  5: ScsiAddress=3:0:0:2, ScsiDevice=/dev/sdg, Priority=2, Status=Standby
```

RHEL4, RHEL5, SLES10

Check that installed PathManager supports the kernel you use.

Check that the kernel version (A) displayed under `uname -r` and the kernel version (B) displayed under `rpm -qi` are the same.

```

# uname -r (Check the kernel version)
2.6.X-XX
# rpm -qa | grep sps
sps-xxx-yyyy
# rpm -qi sps-xxx-yyyy
Name       : sps-X-XXX      Relocations: (not relocatable)
Version    : 4.X.X         Vendor: Overland Storage Inc.
Release    : 2.6.XX.XX     Build Date: YYYY/MM/DD HH:MM:SS
Install date: YYYY/MM/DD HH:MM:SS Build Host: nec.co.jp
Group      : Utilities/System Source RPM: sps-X-XX.X.src.rpm
Size       : XXXXXX       License: XXXXXX
Signature  : (none)
Packager   : OverlandCorporation
Summary    : SCSI multi-path driver and utilities for OverlandiStorage
Description:
-----
This package contains a driver, daemon and some utilities.
The driver (dd_mod,sps_mod) provides the redundant SCSI-path for
OverlandiStorage Disk Array System.
The daemon (dd_daemon) supervises the driver.
And, some utilities work for the maintenance.
This Driver works on Red Hat Enterprise Linux X [Kernel:2.6.X-XX].
-----
#

```

Kernel version you use (A)

Kernel version supported by PathManager (B)

Check /proc/scsi/sps/ddX (X takes a value of a, b, c, and so on to indicate the number of LUNs created on the disk array). If "partition-info:" is NML, the paths are normally multiplexed. If nothing is displayed, a disk array is not recognized by either path. Check the connection between the server and disk array, application status of the FC driver, Cross Call settings and the other settings of the disk array.

```

# cat /proc/scsi/sps/dda
device:/dev/dda
disk-info:SNAPSAN MANAGER ,iStorage 2000 ,0000000931000013,00000
device-info:Host:scsi:2 Channel:0 Id:0 Lun:0 Status:NML
LoadBalance:S
path-info:0 Host:scsi:0 Channel:0 Id:0 Lun:0 Priority:1 Watch:Enable Status:ACT
path-info:1 Host:scsi:1 Channel:0 Id:0 Lun:0 Priority:2 Watch:Enable Status:HOT
#

```

Check whether dd_daemon is active.

When dd_daemon is active, the following message appears.

```
# /etc/rc.d/init.d/dd_daemon status
dd_daemon (pid XXX) is running ...
#
```

PathManager Uninstallation

Shifting to a Non-PathManager Environment

PathManagerChange the configuration from using PathManager devices (/dev/ddX) to using SCSI devices (/dev/sdX) corresponding to PathManager devices.

For example, the following procedure shows how to change the /etc/fstab.

```
# vi /etc/fstab
...
/dev/dda1 /mnt/work ext3 defaults 0 0
```

1. PathManagerCheck the SCSI devices corresponding to the PathManager devices using the "spsconfig" command.

A command example is shown below.

More than one SCSI device corresponding to a PathManager device may be displayed, because the paths to the device are multiplexed.

```
# spsconfig -chk /dev/dda
/dev/dda
|-- /dev/sdb
 \- /dev/sdc
```

2. Modify the description of /etc/fstab. Back up the /etc/fstab, and replace the description of the PathManager device with the SCSI device.

Specify a SCSI device among the some SCSI devices corresponding to /dev/dda.

```
# cp -p /etc/fstab /etc/fstab.sps
# vi /etc/fstab
...
/dev/sdb1 /mnt/work ext3 defaults 0 0
```

With that, the shifting to a non-PathManager environment is complete.

Uninstalling PathManager RPM Package

The PathManager uninstallation procedures depend on the system configuration (OS distribution / kernel).

PathManager

OS Distribution	Kernel Version
Red Hat Enterprise Linux AS 4 Red Hat Enterprise Linux ES 4	all
Red Hat Enterprise Linux 5 Red Hat Enterprise Linux 5 Advanced Platform	earlier than 2.6.18-164.el5 2.6.18-164.el5 or later
Red Hat Enterprise Linux 6	2.6.32-131.0.15.el6 or later
SUSE Linux Enterprise Server 10	earlier than 2.6.16.60-0.54.5 2.6.16.60-0.54.5 or later

Uninstallation by Uninstaller

The uninstallation using uninstaller is supported on the following environments.

- Red Hat Enterprise Linux 5.4 (kernel-2.6.18-164.el5) or later
- Red Hat Enterprise Linux 6.1 (kernel-2.6.32-131.0.15.el6) or later
- SUSE Linux Enterprise Server SP3 (kernel-2.6.16.60-0.54.5) or later.

If your system does not match above environments, uninstall manually.

3. Change directory to "/opt/nec/sps/installer".

```
# cd /opt/nec/sps/installer
#
```

4. Execute the "uninstall.sh". (A command example is underlined.)
 - * If you use the "--silent" option, the installer reboots the server automatically. (You must reboot before operating the PathManager.)

If the kernel version is 2.6.18-164.el5 and the system uses FC connection -

```

# sh uninstall.sh --silent
===== Precheck for SPS Installation / Uninstallation =====
Distribution : RedHat
Architecture : i686
Kernel Version: Linux2.6
Kernel Details: 2.6.18-164.el5
----- The following packages will be uninstalled. -----
driver : sps-driver-E-4.3.1-2.6.18.164.el5
utils : sps-utils-4.3.0-0
=====
patching file rc.sysinit
sps Uninstall Completed.....
#
Broadcast message from root (Thu Feb 25 14:38:01 2010):

```

PathManager"sps Uninstall Completed" (the shadowed part in above) is the sign of that the uninstallation has finished normally.

When the uninstallation is finished normally, the system is going to restart in a minute (If specifying "--silent" or "--reboot" option). And then, confirm that the system restarts normally.

(To complete the uninstallation of PathManager, you must restart the system)

PathManagerIf the message "sps Uninstall Completed" (the shaded part) is not displayed, that uninstallation is failed.

PathManager The uninstallation is complete.

Manual Uninstallation

1. PathManager Use the following command to check that PathManager is installed in the environment you use. Confirm and remember the package name of installed PathManager.

PathManager **RHEL 5.3 (2.6.18-128.el5) or later / SLES10 SP2 (2.6.16.60-0.21) or later**

- In the case if you use the kernel ver.2.6.18-128.el5 -

```

# rpm -qa | grep sps
sps-utils-4.2.1-0
sps—driver-E-4.2.4-2.6.18.128.el5
#

```

PathManager **Earlier than RHEL 5.3. (2.6.18-128.el5)**

- In the case if you use the kernel ver.2.6.18-92.el5

```
# rpm -qa | grep sps
sps-E-4.1.6-2.6.18.92.el5
#
```

2. Delete the description of PathManager from `/etc/modprobe.conf`.
 - a. Open the `/etc/modprobe.conf` by any editor.
 - b. Delete the "sps_mod2" line added in installation.

```
alias eth0 e1000
alias eth1 e1000
alias scsi_hostadapter megaraid_sas
alias scsi_hostadapter1 ahci
alias scsi_hostadapter2 aic7xxx
alias scsi_hostadapter3 ata_piix
options sps_mod2 sps_sg_tablesize=254
```

Delete this line.

3. Save the data and quit the editor.

```
# cat /etc/modprobe.conf
alias eth0 e1000
alias eth1 e1000
alias scsi_hostadapter megaraid_sas
alias scsi_hostadapter1 ahci
alias scsi_hostadapter2 aic7xxx
alias scsi_hostadapter3 ata_piix
```

4. PathManager Unpatch the startup script.

Skip this procedure if your system is following:

- Red Hat Enterprise Linux 6.1 or later
- SUSE Linux Enterprise Server 10 (connected by FC)

<Example of Red Hat Enterprise Linux AS/ES 4>

```
# cd /etc/rc.d
# patch -R -p0 < /opt/nec/sps/patch/rc.sysinit.rhel4.diff
..
```

<Example of Red Hat Enterprise Linux 5 (FC connection)>

```
# cd /etc/rc.d
# patch -R -p0 < /opt/nec/sps/patch/rc.sysinit.rhel5.diff
..
```

<Example of Red Hat Enterprise Linux 5 (iSCSI connection)>

```
# cd /etc/rc.d
# patch -R -p0 < /opt/nec/sps/patch/iscsi.rhel5.diff
..
```

PathManager When you execute the patch command, the message "Unreversed patch detected! Ignore -R? [n]" may appear. In such case, answer "n". Next, "Apply anyway? [n]" appears. Answer "y" to this question.

If an error message appears, the unpatching is failed. In that case, edit `/etc/rc.d/rc.sysinit` or `/etc/rc.d/init.d/iscsi` and delete the all that appropriate lines. (Refer to the applied patch file regarding which lines should be deleted. The lines whose first character is "+" are exactly that.)

5. Execute the command specifying the PathManager package name (checked at Step (1)) to uninstall PathManager.

RHEL 5.3 (2.6.18-128.el5) or later / SLES10 SP2 (2.6.16.60-0.21) or later

- If the kernel ver.2.6.18-128.el5 is used-

```
# rpm -e sps-driver-?.4.2.4-2.6.18.el5
# rpm -e sps-utils-4.2.1-0
..
```

B. Earlier than RHEL 5.3 (2.6.18-128.el5)

- In the case if you use the kernel ver.2.6.18-92.el5 -

```
# rpm -e sps-?.4.1.6-2.6.18.92.el5
#
```

- (vi) Execute the **depmod** command and confirm that no error results.

```
# depmod -a `uname -r`
#
```

- (vi) Reboot the system and check normally to startup system.

```
# sync
# shutdown -r now
..
```

- (vii) Delete the configuration file (/etc/sps.conf) if it exists.

```
# rm /etc/sps.conf
#
```

The uninstallation is complete.

Updating PathManager

To update PathManager, uninstall PathManager and then install PathManager.

Particularly, how to update PathManager when you update the kernel is described below.

1. Uninstall the current PathManager.

To continue using the current settings without changing device configuration settings, however, it is not necessary to execute Step (vi) "Delete the configuration file (/etc/sps.conf) if there is one". It is possible to inherit the current settings by leaving the current configuration file as is. PathManager. When PathManager uninstalled, /dev/ddX devices become unavailable. Therefore, stop the application that uses /dev/ddX devices before updating. Do not access /dev/ddX devices while updating.

2. PathManager Update the kernel.
3. PathManager Start the OS in the updated kernel.
4. Install the new version of PathManager.

Updating is complete.

This chapter describes PathManager functions. For PathManager, you can make a configuration file available to associate device files with paths. You can also use the system log and proc file system to check information and status.

The following sections describe the PathManager configuration file and how to check information and status.

Limit of Paths and Disks

The following table shows the limit number of paths and logical disks using by PathManager.

Paths/Disks	(FC / iSCSI/SAS)	(FC / iSCSI)	(FC / iSCSI)
Paths / a Disk	32 paths (FC)	32 paths (FC)	4 paths
	8 paths (iSCSI)	8 paths (iSCSI)	
	2 paths (SAS)		
Number of Disks	512 disks	512 disks	512 disks
Number of paths (Detected by the OS)	1024 paths / 512 paths*	1024 paths / 512 paths*	1024 paths / 512 paths*
Size of a Disk	8TB	8TB	8TB

* If the function version of PathManager is earlier than 5.0.0, the number of paths (detected by the OS) is 512.

Load Distribution Function

PathManager has two types of load distribution, static and dynamic. You can select the load distribution mode by the configuration file. And you can also set the path priority by the configuration file. In addition, PathManager automatically distinguishes the model of Overland and automatically selects the load distribution mode based on the model (*1).

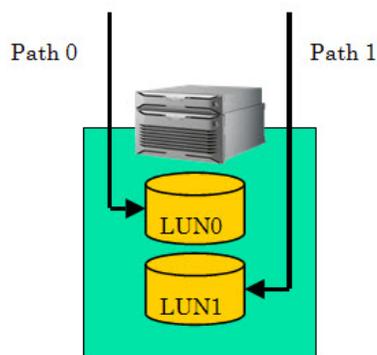


Figure 3-1: Static Load Distribution

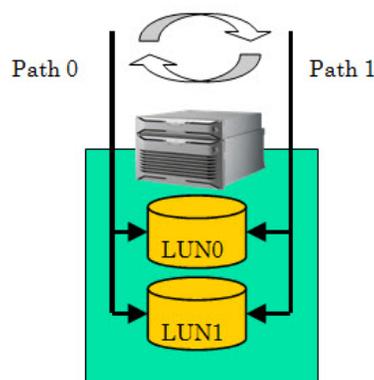


Figure 3-2: Dynamic Load Distribution

PathManager does not support the automatic setting of load distribution mode. And this function works only when no configuration file exists.

Load Distribution

Static Load Distribution (FailoverOnly)

The mode of load distribution (FailoverOnly).

Static load Distribution (lbstatic)

Load distribution is performed by assigning different paths to each LUN. This load distribution sets the priorities of paths automatically for the best throughput by judging the information from the connected disk array unit. The active path is the highest priority path.

Dynamic Load Distribution

Load distribution is performed by changing the path to which each I/O request is issued.

Round Robin Mode (RoundRobin)

The path to which each I/O request is issued is changed sequentially from the higher priority path to the lower priority path. After an I/O request is issued to the lowest priority path, the next request is issued to the highest priority path.

Least I/O Size Mode (LeastSectors)

The path to which each I/O request is issued is changed to the path whose total I/O size is least.

Configuration File

PathManager can associate a device file with the LUN by using the configuration file (/etc/sps.conf). After the start of operation, you can change the setting using mkdd command.

```
Format:1.3
Watch: CHK:600s FLT:180s SACT:300s
MonitorMode:Disable
device:/dev/dda
    disk-info:NEC    ,iStorage 1000 ,0000000000000000,00000
    Loadbalance:S
    path-info:auto Watch:Enable

device:/dev/ddb
    disk-info:NEC    ,DISK ARRAY ,00000000000000001,00000
    Loadbalance:D2
    path-info:auto Watch:Disable
```

Creating the Configuration File

Configuration file is created automatically when the server starts at first after installation. And when you execute mkdd command, the configuration file is also created if it doesn't exist. To change the setting, change the configuration file and execute mkdd command.

When the configuration file is created automatically, PathManager driver detects the disk arrays and assigns the device file for each disk array in order of detection. And PathManager driver also detects the paths and sets priorities of paths to every device.

And PathManager sets load distribution mode based on the model of detected disk array (*1). The load distribution is least I/O size mode (leastsectors) for the models that support a dynamic load distribution, and static load distribution mode (lbstatic) for those that don't support a dynamic one (*2).

The format of automatically created configuration file is different in each function version of PathManager.

Format and Reference of automatically created configuration file

Function Version	Configuration File Format
4.4.2 or later	1.3

Function Version	Configuration File Format
4.1.1 to 4.3.X	1.2
3.0.2 to 4.0.X	1.1

*1: The automatically created setting is not necessarily the best according to the environment. So select the best load distribution mode by measuring the I/O performances if needed.

*2: The models that don't support dynamic load distribution are as follows:

- Overland E1-10

File Format

The name of the PathManager's configuration file is `/etc/sps.conf`. Each entry of the configuration file is described below.

Setting	Name (summary)	Description
Format:	File Format	Write the version of configuration file format.
Watch:	Monitoring entry	<p>Write the interval of path monitoring. The information to be written includes:</p> <ul style="list-style-type: none"> • CHK: Intervals to monitor the active path and alternate path • FLT Intervals to try recovery processing on the faulty unit. • SACT: Time to monitor the path that recovered from a fault (Default Value [CHK: 60sec(*), FLT: 180sec, SACT: 300sec]) <p>The value of time until 999 hours or less can be specified. And the value is sequentially enumerated from the left next to the above items. The specified value that attaches ahead of "s", "m", "h" is interpreted respectively as a second and a minute and an hour. If no character attaches to the value, the value is interpreted as a second.</p> <p>* If the function version of PathManager is earlier than 5.1.0, it is 600 sec.</p>
MonitorMode:	Monitoring entry of Intermittent Error	<p>Write a "valid"/"invalid" state about Intermittent-error-monitoring function. The information to be written includes:</p> <ul style="list-style-type: none"> • MonitorMode: Valid/Invalid of Intermittent-error monitoring <p>(This is available in format 1.3 or later)</p> <p>The value of MonitorMode must be "Enable" or "Disable".</p> <p>At MonitorMode, specify "Enable" to monitor intermittent error, or specify "Disable" not to monitor.</p> <p>The default value of MonitorMode is "Disable".</p>
device:	Device entry	Write the name of a device file to be registered with its full path.

Setting	Name (summary)	Description
disk-info:	Disk entry	Write disk array information used for the device entry. The information to be written includes: - Vendor name - Product name - Serial Number - LU Number LUN WWN (in the case that the file format is 1.2) List these items from the left separating with a comma (,).
LoadBalance	Load distribution entry	Write the load distribution mode used by the device written as the "Device entry".
path-info:	Path entry	Write information of each path connected to the disk array written as a "Disk entry". The information to be written includes: <ul style="list-style-type: none"> • Watch: Enable/Disable of path monitoring At "Watch", specify "Enable" to monitor the path, or specify "Disable" not to monitor. The default value of "Watch" is "Enable".

Modifiable items are as follows.

- "Watch:" row
- "MonitorMode:" row
- "device:" row
- "LoadBalance:" row
- "Watch" of "path-info:" row

Don't modify the items other than above. If you set invalid values to those, PathManager can not recognize disk array unit.

Setting	Item Name	Description
disk-info:	Vendor name	Supplier of connected disk array
	Product name	Product name of connected disk array
	Serial Number	Serial number of connected disk array
	LUN Number	Number that disk array assigns to the logical disk number (LDN) allocated to disk array. Displayed in hex.
	LUN WWN	Unique identifier of logical disk number.
path-info:	Watch:	Enable/Disable of path monitoring

An example of the configuration file for two devices is shown below:

LoadBalance Setting	Sign of Displaying Path Status (*2)	Distribution mode
S	FailoverOnly	Static load distribution
D1	RoundRobin	Dynamic load distribution (round robin mode)
D2	LeastSectors	Dynamic load distribution (least I/O size mode)

<Example>

-- When the initial status (/dev/dda) is as follows:--

```
< RHEL 6 >
# spsadmin -lun /dev/dda
+++ LogicalUnit 4:0:0:0 /dev/dda [Normal] +++
  SerialNumber=0000000931000013, LUN=0x00000
  LoadBalance=FailoverOnly
  0: ScsiAddress=0:0:0:0, ScsiDevice=/dev/sdb, Priority=1, Status=Active
  1: ScsiAddress=1:0:0:0, ScsiDevice=/dev/sdc, Priority=2, Status=Standby
  2: ScsiAddress=2:0:0:0, ScsiDevice=/dev/sdd, Priority=3, Status=Standby
  3: ScsiAddress=3:0:0:0, ScsiDevice=/dev/sde, Priority=4, Status=Standby

< RHEL 4, RHEL 5, SLES 10 >
# cat /proc/scsi/sps/dda
device:/dev/dda
disk-info:NEC ,iStorage 1000 ,0000000931000013,00000
device-info:Host:scsi:4 Channel:0 Id:0 Lun:0 Watch:Enable Status:NML
LoadBalance:S
path-info:0 Host:scsi:0 Channel:0 Id:0 Lun:0 Priority:1 Status:ACT
path-info:1 Host:scsi:1 Channel:0 Id:0 Lun:0 Priority:2 Status:HOT
path-info:2 Host:scsi:2 Channel:0 Id:0 Lun:0 Priority:3 Status:HOT
path-info:3 Host:scsi:3 Channel:0 Id:0 Lun:0 Priority:4 Status:HOT
# cat /etc/sps.conf
Format:1.3
Watch: CHK:600s FLT:180s SACT:300s
MonitorMode:Disable
```

1. Change the load distribution entry in the configuration file (the shaded part should be changed).

```
Format:1.3
Watch: CHK:600s FLT:180s SACT:300s
MonitorMode:Disable
device:/dev/dda
disk-info:NEC ,iStorage 1000 ,0000000931000013,00000
LoadBalance:D1
```

2. Use the mkdd command to change the load distribution mode from static load distribution (S) to dynamic load distribution - round robin mode (D1).

```
# mkdd
#
```

The path status is changed as follows (the shaded parts are changed):

```
< RHEL 6 >
# spsadmin --lun /dev/dda
+++ LogicalUnit 4:0:0:0 /dev/dda [Normal] +++
  SerialNumber=0000000931000013, LUN=0x00000
  LoadBalance=RoundRobin
  0: ScsiAddress=0:0:0:0, ScsiDevice=/dev/sdb, Priority=1, Status=Active
  1: ScsiAddress=1:0:0:0, ScsiDevice=/dev/sdc, Priority=2, Status=Active
  2: ScsiAddress=2:0:0:0, ScsiDevice=/dev/sdd, Priority=3, Status=Standby
  3: ScsiAddress=3:0:0:0, ScsiDevice=/dev/sde, Priority=4, Status=Standby

< RHEL 4, RHEL 5, SLES 10 >
# cat /proc/scsi/sps/dda
device:/dev/dda
disk-info:NEC      ,iStorage 1000 ,00000000931000013,00000
device-info:Host:scsi:4 Channel:0 Id:0 Lun:0 Watch:Enable Status:NML
LoadBalance:D1
path-info:0 Host:scsi:0 Channel:0 Id:0 Lun:0 Priority:1 Status:ACT
```

Changing the Path Monitoring Interval

- To change the path monitoring interval, change the configuration file (`/etc/sps.conf`), and then execute the `mkdd` command to reflect the settings.

<Example>

-- When the initial status (`/dev/dda`) is as follows:--

```
# cat /etc/sps.conf
Format:1.3
Watch: CHK:600s FLT:180s SACT:300s
MonitorMode:Disable
device:/dev/dda
disk-info:NEC      ,iStorage 1000 ,00000000931000013,00000
LoadBalance:S
```

- Change the `Watch` entry in the configuration file `/etc/sps.conf` (the shaded part should be changed). The following example shows how to change the path monitoring interval from 600 seconds to 900 seconds.

```
Format:1.3
Watch: CHK:900s FLT:180s SACT:300s
MonitorMode:Disable
device:/dev/dda
disk-info:NEC ,iStorage 1000 ,0000000931000013,00000
LoadBalance:S
path-info:auto Watch:Enable
```

5. Use the `mkdd` command to reflect the above setting.

```
# mkdd
..
```

You can see the changed status if you refer to `/proc/scsi/sps/interval`.

```
# cat /proc/scsi/sps/interval
CHK:900 FLT:180 SACT:300
..
```

Changing path monitoring interval is complete.

Enable/Disable setting of Path Monitoring

6. To change the enable/disable setting of path monitoring, change the configuration file (`/etc/sps.conf`), and then execute the `mkdd` command to reflect the settings.

<Example (configuration file format 1.2/1.1) >

You can change enable/disable setting of path monitoring for each device.

-- If the initial status (`/dev/dda`) is as follows:--

```
# cat /etc/sps.conf
Format:1.3
Watch: CHK:600s FLT:180s SACT:300s
MonitorMode:Disable
device:/dev/dda
disk-info:NEC ,iStorage 1000 ,0000000931000013,00000
LoadBalance:S
```

7. Change the path monitoring entry in the configuration file `/etc/sps.conf` (the shaded part should be changed). The following example shows that setting of path monitoring is disabled.

```
# cat /etc/sps.conf
Format:1.3
Watch: CHK:600s FLT:180s SACT:300s
MonitorMode:Disable
device:/dev/dda
disk-info:NEC ,iStorage 1000 ,0000000931000013,00000
```

(ii) Use the mkdd command to reflect the above setting.

```
# mkdd
#
```

```
# cat /etc/sps.conf
Format:1.3
Watch: CHK:600s FLT:180s SACT:300s
MonitorMode:Disable
device:/dev/dda
disk-info:NEC ,iStorage 1000 ,0000000931000013,00000
```

(ii) Use the mkdd command to reflect the above setting.

```
# mkdd
#
```

Changing path monitoring interval is complete.

Enable/Disable setting of Intermittent Error Monitoring

- To change the enable/disable setting of intermittent-error monitoring, change the configuration file (/etc/sps.conf), and then execute the mkdd command to reflect the settings.

Changing Environment of PathManager

If you add/delete LUNs, execute the procedures shown below.

Execute the procedures in this section without any I/O to the paths. This section refers to the FC connection, but the procedures are the same with the iSCSI connection. When using iSCSI connection, replace "HBA" by "iSCSI software initiator".

Addition and Deletion of LUN

The procedures to add LUNs are different depending on the function version of PathManager.

(If the function version is 3.0.5 or later, PathManager can add LUNs dynamically without a reboot.)

When you delete LUNs, rebooting the OS is necessary.

Addition of LUN

The procedure of each function version is shown in following example.

<Example>

- When you add "Lun:03" -

<Adding procedure for function version 4.0.1 or later>

Execute scsi-rescan command so that the OS detects the added LUN.

```
# scsi-rescan
```

Scanning SCSI subsystem for new devices

The scsi-rescan command is included in the rpm package named "sg3_utils". "sg3_utils" package may not be installed depending on its designation when installing the OS. If "sg3_utils" is not installed, get the sg3_utils rpm package from OS installation CD or WEB site of each distribution. Then, install the rpm package. (In the case of SLES, this command is not included in the rpm file named "sg3_utils" but in the rpm file named "scsi".)

- (ii) Stop the path patrol daemon

```
# /etc/rc.d/init.d/dd_daemon stop
Shutting down dd_daemon: [ OK ]
```

- (iii) Rename the configuration file to make the backup. (file name can be decided arbitrarily)

```
# mv /etc/sps.conf /etc/sps.conf.bk
#
```

- (iv) Execute **mkdd** command so that the PathManager driver recognizes the added LUN.

```
# mkdd
Couldn't open /etc/sps.conf.
Error=No such file or directory.
I try auto setting...
```

- (v) Start the path patrol daemon.

```
# /etc/rc.d/init.d/dd_daemon start
Starting dd_daemon: [ OK ]
```

- (vi) Confirm that the description of device corresponding to the added LUN is added into the configuration file. (the shaded part is added part)

```
# cat /etc/sps.conf
Format:1.3
Watch: CHK:600s FLT:180s SACT:300s
MonitorMode:Disable
device:/dev/dda
    disk-info:NEC ,iStorage 1000 ,0000000927900431,00000
    LoadBalance:S
    path-info:auto Watch:Enable

device:/dev/ddb
    disk-info:NEC ,iStorage 1000 ,0000000927900431,00001
    LoadBalance:S
    path-info:auto Watch:Enable

device:/dev/ddc
    disk-info:NEC ,iStorage 1000 ,0000000927900431,00002
    LoadBalance:S
    path-info:auto Watch:Enable
```

<Adding procedure for function version from 3.0.5 to 4.0.0>

- (i) Execute the `spscmd` command to scan paths.

```
# spscmd -scan
#
```

- (ii) If a new path is found, the following message outputs to the system log (the shaded part).

```
sd scan:host1.
dd scan:host1.
sps: Info: Attached path to /dev/ddd (1) host:1 channel: 0 id: 0 lun: 3
sd scan:host0.
dd scan:host0.
```

- (iii) Follow procedures starting from (ii) of <Adding procedure for function version 4.0.1 or later>.

<Adding procedure for function version 3.0.4 or earlier>

- (i) Reboot the OS, and then confirm that each HBA recognizes the added LUN. (The shaded part is added part.)

```
# cat /proc/scsi/scsi
Attached devices:
Host: scsi0 Channel: 00 Id: 00 Lun: 00
  Vendor: Overland Storage Inc.   Model: iStorage 1000  Rev: 2300
  Type: Direct-Access             ANSI SCSI revision: 02
Host: scsi0 Channel: 00 Id: 00 Lun: 01
  Vendor: Overland Storage Inc.   Model: iStorage 1000  Rev: 2300
  Type: Direct-Access             ANSI SCSI revision: 02
Host: scsi0 Channel: 00 Id: 00 Lun: 02
  Vendor: Overland Storage Inc.   Model: iStorage 1000  Rev: 2300
  Type: Direct-Access             ANSI SCSI revision: 02
Host: scsi0 Channel: 00 Id: 00 Lun: 03
  Vendor: Overland Storage Inc.   Model: iStorage 1000  Rev: 2300
  Type: Direct-Access             ANSI SCSI revision: 02
Host: scsi1 Channel: 00 Id: 00 Lun: 00
  Vendor: Over  Model: iStorage 1000  Rev: 2300
  Type: Direct-Access             ANSI SCSI revision: 02
Host: scsi1 Channel: 00 Id: 00 Lun: 01
  Vendor: Overland Storage Inc.   Model: iStorage 1000  Rev: 2300
  Type: Direct-Access             ANSI SCSI revision: 02
```

- (ii) Follow procedures starting from (ii) of <Adding Procedure for function version 4.0.1 or later>.

(2) Deletion of LUN

When you delete any LUN, please stop the path patrol daemon and delete the information of dd device corresponding to deleted LUN.

An example is as follows.

<Example>

- When you delete "Lun:03" -

(i) Stop the path patrol daemon

```
# /etc/rc.d/init.d/dd_daemon stop
Shutting down dd_daemon:          [ OK ]
```

(ii) Edit the configuration file using vi or else, delete the information of the dd device associated with deleted LUN (the shaded part is a part to be deleted).

```
# cat /etc/sps.conf
Format:1.3
Watch: CHK:600s FLT:180s SACT:300s
MonitorMode:Disable
device:/dev/dda
    disk-info:Overland Storage Inc. ,iStorage 1000
    ,0000000927900431,00000
    LoadBalance:S
    path-info:auto Watch:Enable

device:/dev/ddb
    disk-info:Overland Storage Inc. ,iStorage 1000
    ,0000000927900431,00001
    LoadBalance:S
    path-info:auto Watch:Enable

device:/dev/ddc
    disk-info:Overland Storage Inc. ,iStorage 1000
    ,0000000927900431,00002
    LoadBalance:S
    path-info:auto Watch:Enable
```

(iii) Reboot the system and check that the system starts normally.

```
# sync
# shutdown -r now
```

Initializing Configuration of PathManager

For initializing the configuration of PathManager, remake the configuration file and make PathManager rediscover the disks. Follow the procedures below.

- (i) Rename the configuration file to make the backup. (file name can be decided arbitrarily)

```
# mv /etc/sps.conf /etc/sps.conf.bk
#
```

- (ii) Reboot the system and check that the system starts normally.

```
# sync
# shutdown -r now
```

- (iii) Check the configuration file (/etc/sps.conf) has been remade.

```
# cat /etc/sps.conf
Format:1.1
Watch: CHK:600s FLT:180s SACT:300s
MonitorMode:Disable
device:/dev/dda
    disk-info:Overland Storage Inc. ,iStorage 1000 ,0000000931000013,00000
LoadBalance:S
```

The assignment of PathManager devices may be changed by initialization.

If the new assignment is different from the backup file of /etc/sps.conf, put the "device:" lines in correct order and reboot the system.

Concretely, the assignment may be changed in following cases:

- The order of disks (LUNs) detected by OS is different from the one when configuration file was created last time. (Because of a expansion of disk array unit, or adding/deleting LUNs, etc.)
- In previous setting, the assignment of PathManager devices is changed on purpose after auto configuration.

Log Information

System Log

If an event such as a path fault occurs during issuance of an I/O request, the PathManager driver outputs a message to the system log. The path patrol daemon refers to the message and directs the PathManager driver to execute auto repair and the other processing.

System Log Messages

Event	System log message Phenomenon	Handling (Table)
Failover	sps: Warning: Failover /dev/ddX (p) host:h channel:c id:s lun:/ Warning: A fault occurred on the active path and the active path is switched.	I
Failback	sps: Info: Failback to /dev/ddX (p) host:h channel:c id:s lun:/ Information: The faulty path has recovered and returned to be the active path.	-
Recovery from an alternate path fault	sps: Info: Recover HOT path /dev/ddX (p) host:h channel:c id:s lun:/ Information: The alternate path has recovered.	
All-path fault	sps: Error: All path fail /dev/ddX Error: All redundant paths have become faulty.	I
Recovery from an all-path fault	sps: Info: Recover all path fail /dev/ddX (p) host:h channel:c id:s lun:/ sps: Info: Remain failed path /dev/ddX (p) host:h channel:c id:s lun:/ Information: Either or all of the redundant paths have recovered.	-
Failover	sps: Warning: Detect ACT path fail /dev/ddX (p) host:h channel:c id:s lun:/ Warning: A failure occurred on the active path, and the active path has been switched.	I
Alternate path fault	sps: Warning: Detect HOT path fail /dev/ddX (p) host:h channel:c id:s lun:/ Warning: A fault occurred on the alternate path.	
Monitoring path fault	sps: Warning: Failover in inspection /dev/ddX (p) host:h channel:c id:s lun:/ Warning: A fault occurred on the monitoring path.	
Too many fault in monitoring	dd_daemon: Warning: Failover in inspection at 3times. stopped Failback of path:p Warning: The monitoring path becomes the path not to be recovered. Because fault occurred 3 times.	
End of monitoring	sps: Info: Finish path inspection /dev/ddX (p) host:h channel:c id:s lun:/ Warning: Monitoring after recovery from a fault has ended, and the monitored path has become the active path.	-
Alternate path remove	sps: Info: Remove HOT path /dev/ddX (p) host:h channel:c id:s lun:/ Information: Removed the alternate path.	
Path detection fault (auto)	sps: Warning: Path not found /dev/ddX Warning: Because all paths corresponding to /dev/ddX were not found, you cannot use this device.	I
Path detection fault (manual)	sps: Warning: Path not found /dev/ddX (p) host:h channel:c id:s lun:/ Warning: One of redundant paths cannot be detected and the system starts up with a path faulty.	

Event	System log message Phenomenon	Handling (Table)
Path overflow	sps: Warning: Path overflow (support to 32) /dev/ddX (p) host:h channel:c id:s lun:/ Warning: The number of paths to 1 device overflowed. You can use up to 32 paths.	II
Path overflow (all devices)	sps: Warning: Path count overflow (support to 256) /dev/ddX (p) host:h channel:c id:s lun:/ Warning: The number of paths to all devices overflowed. Only 256 paths can be used.	

System Log Messages

Event	System log message Phenomenon	Handling (Table)
Not supported disk array	sps: Error: SSS is not supported. Error: SSS is a disk array which is not supported	III
Only 1 path when OS starts	sps: Warning: Attached /dev/ddX only 1 path. Warning: Attached /dev/ddX only 1 path.	I
Serial is Invalid	sps: Error: iStorage's Serial is NULL. Error: Overland whose serial number is Invalid (NULL) was detected.	IV
Dynamic Load Balancing is not supported	sps: Warning: Dynamic Load Balance (D1/D2) is not supported on /dev/ddX. Warning: Dynamic Load Balancing is not supported on this device.	V
The path is already used	sps: Error: scsi:h channel:c id:s lun:/ is already created. Error: Specified path is already used (created) by another. (overlapping)	VI
The disk is already used	sps: Error: vendor:v model:m serial:se lun:/ is already created. Error: Specified disk is already used (created) by another. (overlapping)	
The device is already used	sps: Error: /dev/ddX is already created. Error: Specified device name is already used (created). (overlapping)	
Invalid LoadBalance	sps: Warning: Invalid LoadBalance: vendor:v model:m serial:se lun:/ lbmode:lb Error: Invalid LoadBalance is specified.	VII
Invalid monitoring	sps: Error: Invalid watch type: path:p watch:w Error: Invalid setting of monitoring is specified.	
Not Assigned Owner	sps: Warning: Not assigned owner on /dev/ddX (p) scsi:h channel:c id:s lun:/ Warning: The owner of LU was changed, so PathManager will switch the active path.	-

Event	System log message Phenomenon	Handling (Table)
Changing the LU Owner was failed	sps: Error: Trespass failed /dev/ddX (p) host:h channel:c id:s lun:l Error: Changing the owner of LU was failed	I
Active path is changed	sps: Info: Change ACT path/dev/ddX (p) host:h channel:c id:s lun:l Info: The active path is changed by spscnd command.	-
Stop the auto recovering	sps: Warning: Intermittent errors occurred. stopped Failback of path:p Warning: Count of intermittent error of a path is reached to threshold value (default: 3 times), so the path is gotten off the list of auto recovering.	I
Path Status was changed	sps: Info: Asymmetric access state was changed. (/dev/ddX)	-

In each message, X indicates an arbitrary number, p,h,c,s,l indicates a specific path, v,m,se,l indicates a specific disk, lb, w, pr indicates an attribute of path respectively. Each symbol description is as follows:

Path/Disk	Message	Description
p	path	Path number
h	host	Host number
c	channel	Channel number
s	scsi-id	SCSI ID
l	lun	LUN number
v	vendor	Vendor name
m	model	Product name
se	serial	Serial number
lb	lbmode	LoadBalance mode
w	watch	Monitoring setting
pr	priority	Path Priority
st	status	Path Status

Handling List

Number	Handling
I	A failure may be occurred on a path between a server and a disk array unit. Get rid of the cause and restore.

Number	Handling
II	The number of paths is over the limit of PathManager. Review the system and reduce the number of paths which a server detects.
III	Use the supported disk array.
IV	No serial number is registered to the Overland. It is likely to be configuration failure.
V	This disk array unit does not support the dynamic distribution mode. Use it in static load distribution mode.
VI	<p>This error is caused by an invalid entry in the configuration file (<code>/etc/sps.conf</code>). It may be occurred by modifying the entry which is not allowed to do.</p> <p>Check whether there are any mistakes in the configuration file. If yes, correct the settings and then execute the <code>mkdd</code> command to apply.</p> <p>In addition, the following procedures can reset the configuration file to initial condition.</p> <ul style="list-style-type: none"> • Backup the configuration file by renaming it. (file name is arbitrary) <pre># mv /etc/sps.conf /etc/sps.conf.bk</pre> <p>Reboot the system.</p> <pre># sync</pre> <pre># shutdown -r now</pre>
VII	<p>The configuration file (<code>/etc/sps.conf</code>) may have a mistake. Check whether the configuration file has some mistakes and if it has, fix it.</p> <p>And then, reflect the setting.</p>
-	PathManager works normally. No handling is necessary.

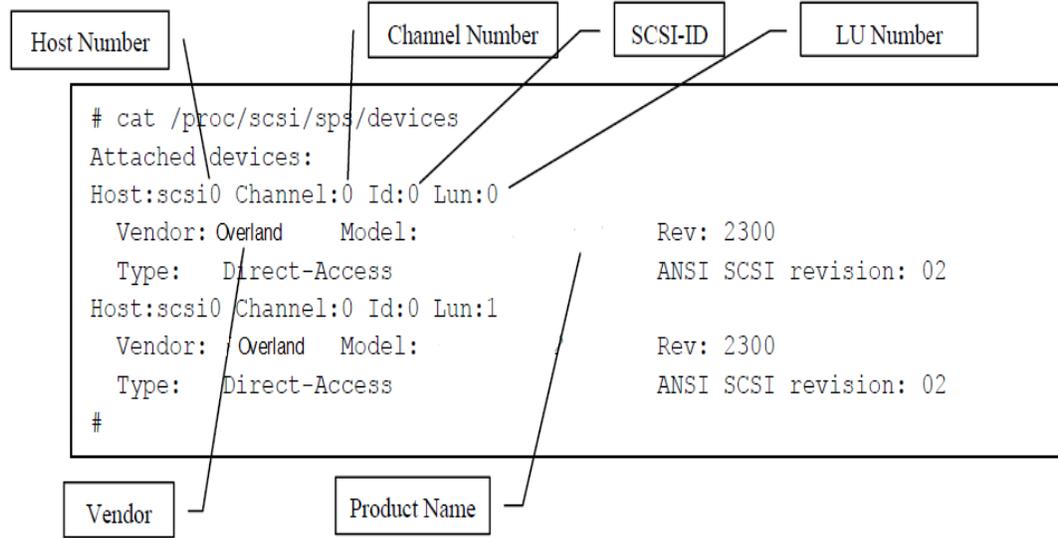
proc File System

PathManager outputs path information to the proc file system. The path patrol daemon reads the latest status of the PathManager driver from the proc file system and monitors the path status.

The proc file system provided by the PathManager driver is `/proc/scsi/sps`. This directory contains the following files.

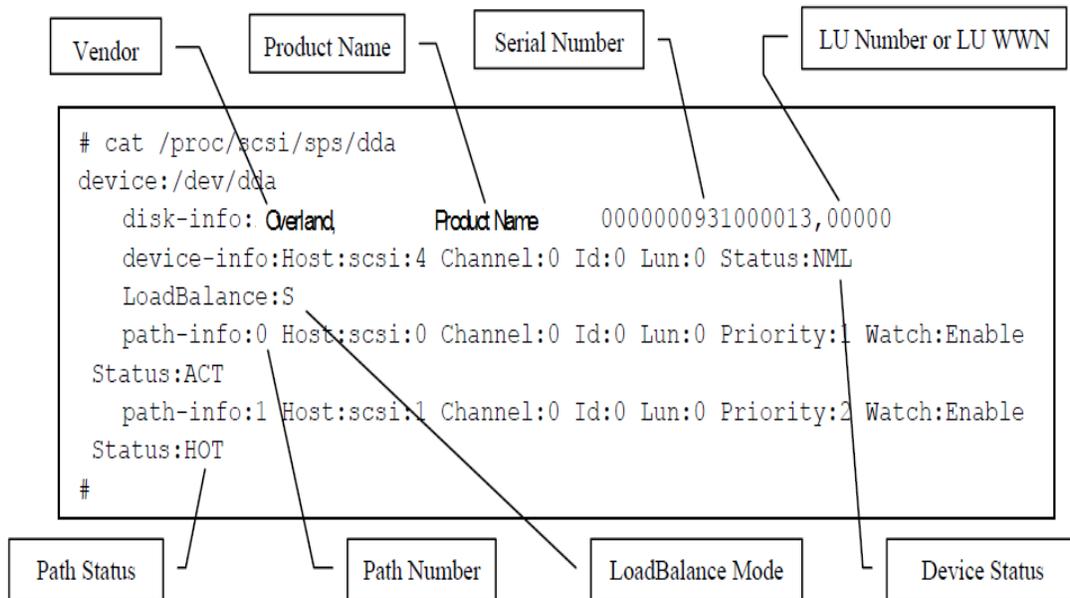
Device information

To check the device information of the disk array detected by the PathManager driver, refer to the `/proc/scsi/sps/devices` file.



Path information

To check the path information of the PathManager driver, refer to the /proc/scsi/sps/ddX (X indicates the unit name such as a, b, c,...) file.



Meaning of each entry displayed in (1) is same as /proc/scsi/scsi provided by OS.

Meaning of each entry displayed in (2) is same as configuration file (without device status and path status).

Device Status

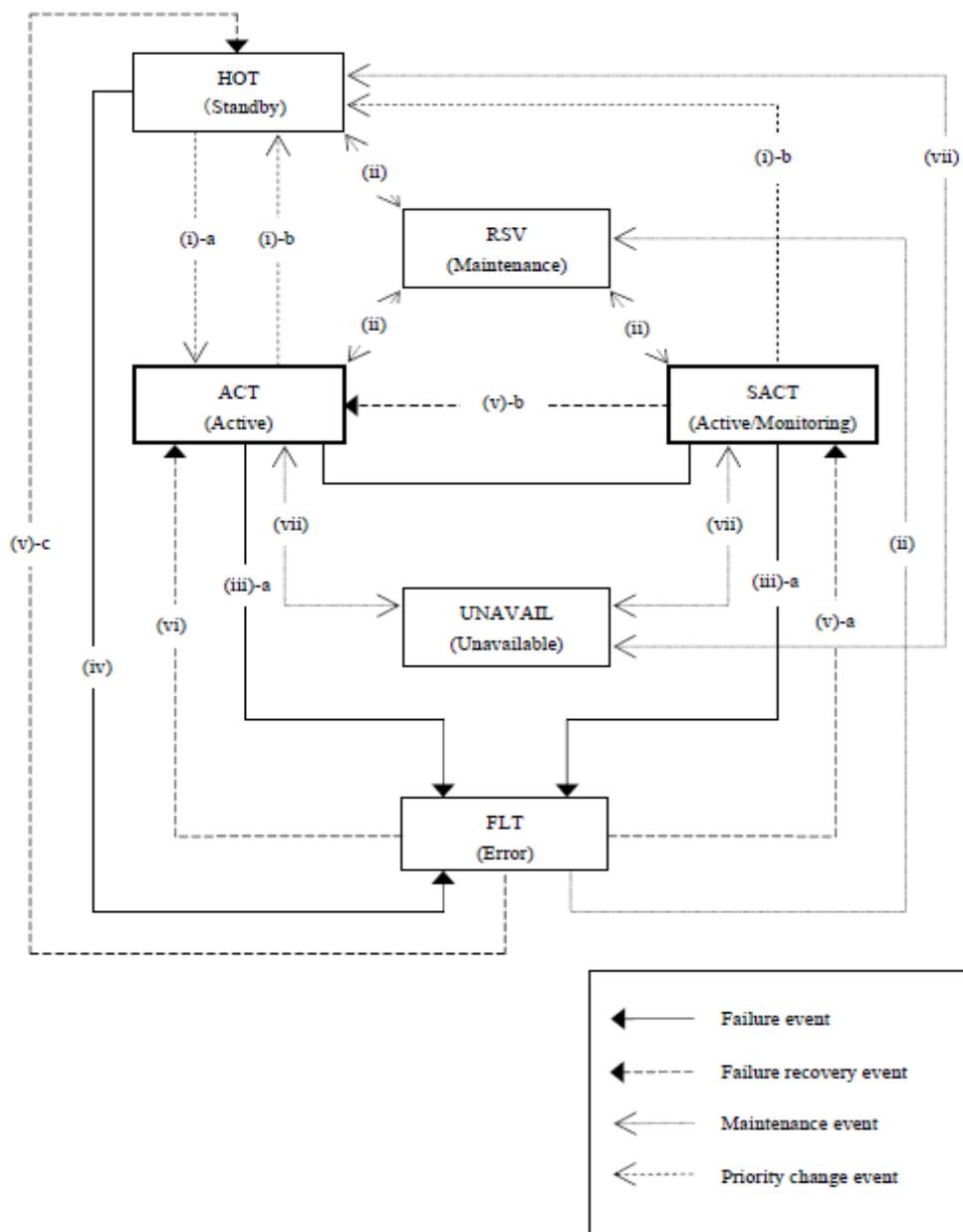
Device status *	Description
NML (Normal)	Abbreviation for NORMAL. Indicates that the operation status is normal.
FLT (Degraded)	Abbreviation for FAULT. Indicates that one (or some) of the paths is faulty. All paths are not faulty.
ALL (Dead)	Abbreviation for ALL fault. Indicates that all the multi paths are faulty. In this case, one of the paths that fell in an error status last of all is set to the ACT status for trying I/O processing.

Path Status

Path Status *	Description
ACT (Active)	Abbreviation for Active. This indicates the active path that is normally operating. This path is used for I/O processing.
HOT (Standby)	Abbreviation for Hot Standby. This indicates the alternate path that is normally operating. If a fault occurs on the active path during I/O processing, this alternate path changes to the active path.
FLT (Error)	Abbreviation for Fault. This indicates the path is in the fault status. All SCSI commands terminate abnormally. In this status, recovery from the fault is checked periodically (3 minutes by default).
SACT (Active/Monitoring)	Abbreviation for Supervising Active. This indicates the active path is monitored. When recovery from a fault is confirmed on a path that was in a fault status, the path shifts to this status and it is monitored for the specified period (5 minutes by default).
UNAVAIL (Unavailable)	Abbreviation for Unavailable. This indicates the path is unavailable. This status is caused by the setting of a disk array unit.
RSV (Maintenance)	Abbreviation for Reserve. This indicates the path is disconnected and maintained. When an alternate path is disconnected for maintenance or another purpose or when a faulty path is disconnected for restoring at fault occurrence, the path shifts to this status.

* "()" in the "Device status" and "Path status" column means the status display of the "spsadmin --lun" command.

Path State Transition



Events Related to Path State Transition

Number	Event	Description
(i)	Active path change	<p>If the load distribution mode is static, an alternate path becomes ACT ((i)-a) when one of the following is occurred;</p> <ul style="list-style-type: none"> • path disconnection • path changing by an operation command • fault <p>And it becomes HOT ((i)-b) when one of the following is occurred;</p> <ul style="list-style-type: none"> • path recovery • path changing by an operation command <p>In addition, when the priority is changed in the static load distribution mode, the highest priority path enters the ACT ((i)-a) status and the other paths enter the HOT status ((i)-b).</p>
(ii)	Path detaching / attaching (command)	You can detach a path using the maintenance command. The detached path in the RSV status does not change the status if a fault occurs on the active path. When you attach the path by the maintenance command, the path changes the status to ACT/HOT from RSV. You cannot attach the faulty path.
(iii)	Active path fault	If a fault is detected when an I/O request is issued, the active path changes its status. If no SCSI command is found when a fault is detected, the active path immediately enters the FLT status ((iii)-a).
(iv)	Alternate path fault	If a fault is detected on the alternate path, it enters the FLT status.
(v)	Recovery from a single path fault	<p>When the cause of a fault is removed, the path that was in the fault status recovers. If the path recovers to be the active path, it enters the SACT ((v)-a) status first and then the ACT ((v)-b) status after being monitored for the specified period. If the path recovers to be the alternate path, it immediately enters the HOT ((v)-c) status.</p> <p>However, if path faults at I/O issue occurred twice or more at SACT, the status does not change to SACT ((v)-a) even after the fault cause is removed from the relevant path. The status remains FLT until the maintenance command is executed.</p>
(vi)	Recovery from an all-path fault	If an all-path fault occurs, the path recovers from the fault in the order of removal of the cause of the fault. The path that recovers first immediately enters the ACT status ((vi)).
(vii)	Setting unavailable / available by the disk array unit	A path is changed to UNAVAIL status when the disk array unit set it. When the disk array unit set a path available, the path is changed from UNAVAIL to ACT / HOT.

The state transition examples in each load distribution mode are described below.

In case of static load distribution

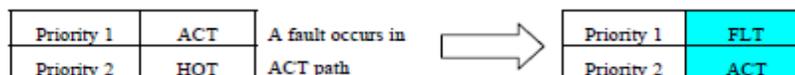
[2-path configuration example]

The path with Priority 1 is ACT and that with Priority 2 is HOT during operation in normal state. If a fault occurs and the ACT path fails over, the ACT path changes to FLT and the HOT path changes to ACT.

■ In case of static load distribution

[2-path configuration example]

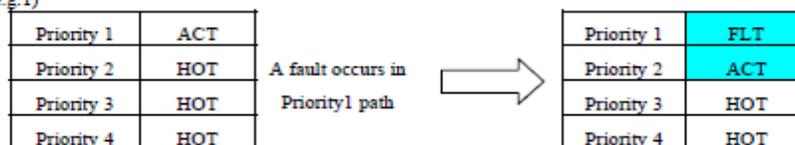
The path with Priority 1 is ACT and that with Priority 2 is HOT during operation in normal state. If a fault occurs and the ACT path fails over, the ACT path changes to FLT and the HOT path changes to ACT.



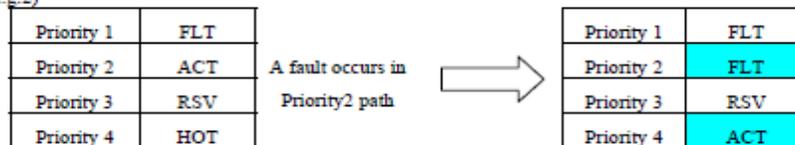
[4-path configuration example]

The path with Priority 1 is ACT and all other paths are HOT during operation in normal state. If a fault occurs and the ACT path fails over, the ACT path changes to FLT and the one with the highest priority of all HOT paths changes to ACT.

(e.g.1)



(e.g.2)



- In case of dynamic load distribution (in case of NEC Storage M/D series)

[2-path configuration example]

The path with Priority 1 is ACT and that with Priority 2 is HOT during operation in normal state. If a fault occurs and the ACT path fails over, the ACT path changes to FLT and the HOT path changes to ACT.

Priority 1	ACT	A fault occurs in Priority1 path	⇒	Priority 1	FLT
Priority 2	HOT			Priority 2	ACT

[4-path configuration example]

The path with Priority 1 is ACT and other paths are HOT during operation in normal state. If a fault occurs and the ACT path fails over, the ACT path changes to FLT and other paths do not change.

Priority 1	ACT	A fault occurs in Priority2 path	⇒	Priority 1	FLT
Priority 2	ACT			Priority 2	ACT
Priority 3	HOT			Priority 3	HOT
Priority 4	HOT			Priority 4	HOT

Next, if a fault occurs on the Priority 2 path and the ACT path fails over, the ACT path changes to FLT and HOT paths change to ACT.

Priority 1	FLT	A fault occurs in Priority2 path	⇒	Priority 1	FLT
Priority 2	ACT			Priority 2	FLT
Priority 3	HOT			Priority 3	ACT
Priority 4	HOT			Priority 4	ACT

If the disk array unit set the controller which is high priority into unavailable, the Priority 1 and 2 paths change to UNAVAIL. (For example, on firmware update)

Priority 1	ACT	When you start the firmware update	⇒	Priority 1	UNAVAIL
Priority 2	ACT			Priority 2	UNAVAIL
Priority 3	HOT			Priority 3	ACT
Priority 4	HOT			Priority 4	ACT

Version information Check

To check the version of PathManager, execute as shown below.

< RHEL 6 >

```
# spsadmin --version
```

```
Utility Package: X.X.X
```

```
Driver Package: X.X.X
```

< RHEL 4, RHEL 5, SLES 10 >

```
# cat /proc/scsi/sps/version
```

```
X.X.X
```

Path Status Display

This section describes the path status display function.

This function is the most basic function of PathManager. For each logical unit, this function lists the status of the paths that are managed by PathManager.

PathManager command (spsadmin) is available at PathManager function version 5.1.0 or later.

Logical Unit

To check the path statuses of all logical units managed by PathManager, use the "--lun" option of PathManager command. It shows the condition such as the active path, faulty path, and the configuration of the load distribution mode. You can execute the command on the terminal.

An example of execution is shown below.

If you execute "spsadmin --lun", path list per logical unit is displayed. In this example, there are two logical units and two paths are recognized per logical unit.

```
# spsadmin --lun
+++ LogicalUnit 4:0:0:0 /dev/dda [Normal] +++
  SerialNumber=0000000000000000, LUN=0x00000
  LoadBalance=LeastSectors
  0: ScsiAddress=2:0:0:0, ScsiDevice=/dev/sdb, Priority=1, Status=Active
  1: ScsiAddress=3:0:0:0, ScsiDevice=/dev/sdc, Priority=2, Status=Standby

+++ LogicalUnit 4:0:0:1 /dev/ddb [Normal] +++
  SerialNumber=0000000000000000, LUN=0x00001
  LoadBalance=Round Robin <Unoptimized>
  2: ScsiAddress=2:0:0:1, ScsiDevice=/dev/sdd, Priority=1, Status=Active
  3: ScsiAddress=3:0:0:1, ScsiDevice=/dev/sde, Priority=2, Status=Standby
```

The meaning of each item in the example above is shown below.

```
+++ LogicalUnit #1:#2:#3:#4 #5 [#6#7] +++
  SerialNumber=#8, LUN=#9
  LoadBalance=#10 #11
  #12: ScsiAddress=#13:#14:#15:#16, ScsiDevice=#17, Priority=#18, Status=#19
```

Position Number	Meaning
#1	Host number of SCSI address of the PathManager device
#2	Channel number of SCSI address of the PathManager device
#3	SCSI-ID of SCSI address of the PathManager device
#4	LUN of SCSI address of the PathManager device
#5	Device name of the PathManager device (/dev/ddX)

Position Number	Meaning
#6	Status of the PathManager device Normal: All of the paths corresponding to this device are normal. Degraded: One or more paths corresponding to this device are faulty. Dead: No path corresponding to this device exists. Or all of the paths are faulty (all-path-fault).
#7	Redundant status of the pathways of this PathManager device "no sign": Redundancy is keeping <No-Redundant>: This device has no redundant path
#8	Serial number of the Overland
#9	LUN (Logical Unit Number) of the Overland
#10	Mode of Load Balancing (load distribution) FailOverOnly: Static Load Distribution mode RoundRobin: Round-robin mode LeastSectors: Least sectors mode
#11	Status of optimizing I/O performance "no sign": Condition is enough to deliver the optimized I/O performance. <Unoptimized>: Condition is inadequate to deliver the optimized I/O performance.
#12	Sequential number given to every path by PathManager This number is given in order of detecting by PathManager. It may change when the OS restarts.
#13	Host number of SCSI address of this path
#14	Channel number of SCSI address of this path
#15	SCSI-ID of SCSI address of this path
#16	LUN of SCSI address of this path
#17	Device name of a SCSI device of this path
#18	Priority order of a path The number of priority order is from 1 to 255, a smaller number means higher priority.
#19	Path status

* The entries of SCSI address is an internal value of OS. So it is not guaranteed to keep the same value when the system restarts.

You can also use "-v" option to display more detail information using this command.

Displaying Detail Information ("-v" option)

Spsadmin can display detail path information by using "-v" option with "--lun" option.

The result is different depending on the connection, FC/SAS or iSCSI.

An example is shown below. "/dev/dda" is a case of FC connection, "/dev/ddr" is a case of iSCSI.

```

#spadmin --lun -v
+++ LogicalUnit 6:0:0:0 /dev/dda [Normal] +++
Vendor      : Overland
ProductID   : DISK ARRAY
SerialNumber: 0000000000000000
LUN         : 0x000000
LoadBalance : LeastSectors
0: HostNo=2, Channel=0, TargetID=0, Ldn=0, ScsiDevice=/dev/sdb
Priority=1, Status=Active, Detail=None
BusID=0000:00:00.0, HBA_WWPN=10:00:00:00:00:00:00:00
Storage_WWPN=00:00:00:00:00:00:00:00, HD=00, Port=00, Protocol=FC
1: HostNo=3, Channel=0, TargetID=0, Ldn=0, ScsiDevice=/dev/sdc
Priority=2, Status=Standby, Detail=None
BusID=0000:00:00.0, HBA_WWPN=10:00:00:00:00:00:00:00
Storage_WWPN=00:00:00:00:00:00:00:00, HD=01, Port=00, Protocol=FC

+++ LogicalUnit 7:0:0:0 /dev/ddr [Normal] +++
Vendor      : Overland
ProductID   : DISK ARRAY
SerialNumber: 0000000000000000
LUN         : 0x000000
LoadBalance : FailoverOnly
2: HostNo=4, Channel=0, TargetID=0, Ldn=0, ScsiDevice=/dev/sdd
Priority=1, Status=Active, Detail=None
InitiatorIPAddress=000.000.000.000
TargetIPAddress=192.168.1.22, HD=00, Port=00, Protocol=iSCSI
3: HostNo=5, Channel=0, TargetID=0, Ldn=0, ScsiDevice=/dev/sde
Priority=2, Status=Standby, Detail=None
InitiatorIPAddress=000.000.000.000
TargetIPAddress=000.000.000.000, HD=01, Port=00, Protocol=iSCSI

# spadmin --lun
+++ LogicalUnit 4:0:0:0 /dev/dda [Normal] +++
SerialNumber=0000000000000000, LUN=0x000000
LoadBalance=LeastSectors
0: ScsiAddress=2:0:0:0, ScsiDevice=/dev/sdb, Priority=1,
Status=Active
1: ScsiAddress=3:0:0:0, ScsiDevice=/dev/sdc, Priority=2,
Status=Standby

+++ LogicalUnit 4:0:0:1 /dev/ddb [Normal] +++
SerialNumber=0000000000000000, LUN=0x000001
LoadBalance=Round Robin <Unoptimised>
1: ScsiAddress=2:0:0:1, ScsiDevice=/dev/sdd, Priority=1,
Status=Active
2: ScsiAddress=3:0:0:1, ScsiDevice=/dev/sde, Priority=2,
Status=Standby
    
```

The meaning of each item in the case of FC/SAS connection is shown below.

```

+++ LogicalUnit #1:#2:#3:#4 #5 [#6#7] +++
Vendor      :#8
ProductID   :#9
SerialNumber:#10
LUN         :#11
LoadBalance :#12 #13
#14: HostNo=#15, Channel=#16, TargetID=#17, Ldn=#18, ScsiDevice=#19
Priority=#20, Status=#21, Detail=#22
    
```

Meaning of Each Item in the example ("-v" version (FC))

Position Number	Meaning
#1	Host number of SCSI address of the PathManager device
#2	Channel number of SCSI address of the PathManager device

Position Number	Meaning
#3	SCSI-ID of SCSI address of the PathManager device
#4	LUN of SCSI address of the PathManager device
#5	Device name of PathManager device (/dev/ddX)
#6	Status of the PathManager device Normal: All of the paths corresponding to this device are normal. Degraded: One or more paths corresponding to this device are faulty. Dead: No path corresponding to this device exists. Or all of the paths are faulty (all-path-fault).
#7	Redundant status of the pathways of this PathManager device "no sign": Redundancy is keeping <No-Redundant>: This device has no redundant path
#8	Vendor name of the Overland
#9	Product ID of the Overland
#10	Serial number of the Overland
#11	LUN (Logical Unit Number) of Overland
#12	Mode of Load Balancing (load distribution) FailOverOnly: Static Load Distribution mode RoundRobin: Round-robin mode LeastSectors: Least sectors mode
#13	Status of optimizing I/O performance "no sign": Condition is enough to deliver the optimized I/O performance. <Unoptimized>: Condition is inadequate to deliver the optimized I/O performance.
#14	Sequential number given to every path by PathManager This number is given in order of detecting by PathManager. It may change when the OS restarts.
#15	Host number of SCSI address of this path
#16	Channel number of SCSI address of this path
#17	SCSI-ID of SCSI address of this path

Position Number	Meaning
#18	LUN of SCSI address of this path
#19	Device name of a SCSI device of this path
#20	Priority order of a path The number of priority order is from 1 to 255, a smaller number means higher priority.
#21	Path status
#22	Detail information of the path status Monitoring: monitoring state Lost: This path is lost.

Position Number	Meaning
#23	Bus ID associated with the HBA
#24	WWPN of the HBA
#25	WWPN of a port of the Overland
#26	Host Director Number of the Overland
#27	Port Number of the Overland
#28	Protocol of the Overland FC: Fibre Channel SAS: Serial Attached SCSI

The entries of SCSI address is an internal value of OS. So it is not guaranteed to keep the same value when the system restarts.

The meaning of each item in the case of iSCSI connection is shown below.

```
+++ LogicalUnit #1:#2:#3:#4 #5 [#6#7] +++
Vendor      :#8
ProductID   :#9
SerialNumber:#10
LUN         :#11
LoadBalance :#12 #13
#14: HostNo=#15, Channel=#16, TargetID=#17, Ldn=#18, ScsiDevice=#19
Priority=#20, Status=#21, Detail=#22
```

"-v" version (iSCSI)

Position Number	Definition
#1	Host number of SCSI address of the PathManager device
#2	Channel number of SCSI address of the PathManager device
#3	SCSI-ID of SCSI address of the PathManager device
#4	LUN of SCSI address of the PathManager device
#5	Device name of PathManager device (/dev/ddX)
#6	Status of the PathManager device Normal: All of the paths corresponding to this device are normal. Degraded: One or more paths corresponding to this device are faulty. Dead: No path corresponding to this device exists. Or all of the paths are faulty (all-path-fault).
#7	Redundant status of the pathways of this PathManager device "no sign": Redundancy is keeping <No-Redundant>: This device has no redundant path
#8	Vendor name of the Overland

Position Number	Definition
#9	Product ID of the Overland
#10	Serial number of the Overland
#11	LUN (Logical Unit Number) of Overland
#12	Mode of Load Balancing (load distribution) FailOverOnly: Static Load Distribution mode RoundRobin: Round-robin mode LeastSectors: Least sectors mode
#13	Status of optimizing I/O performance "no sign": Condition is enough to deliver the optimized I/O performance. <Unoptimized>: Condition is inadequate to deliver the optimized I/O performance.
#14	Sequential number given to every path by PathManager This number is given in order of detecting by PathManager. It may change when the OS restarts.
#15	Host number of SCSI address of this path
#16	Channel number of SCSI address of this path
#17	SCSI-ID of SCSI address of this path

Position Number	Definition
#18	LUN of SCSI address of this path
#19	Device name of a SCSI device of this path
#20	Priority order of a path The number of priority order is from 1 to 255, a smaller number means higher priority.
#21	Path status
#22	Detail information of the path status Monitoring: monitoring state Lost: This path is lost.
#23	IP address of the port of iscsi initiator
#24	IP address of the port of target
#25	Host Director Number of the Overland
#26	Port Number of the Overland
#27	Protocol of the Overland (iSCSI)

The entries of SCSI address is an internal value of OS. So it is not guaranteed to keep the same value when the system restarts.

Path Patrol Daemon

Basic Operation of the Path Patrol Daemon

The PathManager driver automatically performs path switching if a fault occurs. The driver requires an external trigger to restore a faulty path. This trigger is given by the path patrol daemon. You can also give this trigger using a maintenance command. The path patrol daemon also monitors the paths. This makes it possible to detect a fault on the alternate path.

If the path patrol daemon detects an indication of path status change when reading the proc file system, it directs the driver to perform path repair and the other necessary processing.

Script for Operating the Path Control Daemon

For operation such as starting or stopping the path patrol daemon, use the script file (`/etc/rc.d/init.d/dd_daemon`). Use this script file to stop monitoring by the path patrol daemon for maintenance purposes and in the other cases.

Execute the script file specifying an argument string. The execution of this script requires the root authority.

Arguments of the Path Patrol Daemon Operation Script

Argument String	Operation
<code>start</code>	Start
<code>stop</code>	Stop
<code>restart</code>	Restart
<code>status</code>	Status display

The example of executing the script file is shown as follows.

Root authority is necessary to execute the script file.

```
# /etc/rc.d/init.d/dd_daemon restart
Shutting down dd_daemon:           [ OK ]
Starting dd_daemon:                 [ OK ]
# /etc/rc.d/init.d/dd_daemon status
dd_daemon (pid xxx) is running...
#
```

Monitoring Paths

The path patrol daemon monitors active paths and alternate paths at regular intervals. When it detects a fault or recovering from fault, notices to the PathManager driver.

Setting of Monitoring Interval

There are some types of monitoring interval as follows. You can change the setting at Watch entry in the configuration file (`/etc/sps.conf`).

Entry	Description	Default	Minimum setting
CHK (*1)	Intervals to monitor the active path and alternate path	60 seconds(*2) 600 seconds(*2)	10 seconds(*3)
FLT	Intervals to try recovery processing on the faulty unit	180 seconds	10 seconds
SACT	Time to monitor the path that recovered from a fault	300 seconds	10 seconds

*1: If the disk array is under heavy load, it takes about one second per path to a LUN to monitor the paths. Therefore, the CHK value should be more than the product of the number of paths (to monitor) and that of LUN. If you set the CHK less than that value, the load by path patrol daemon may be continually heavy, and may cause a bad effect on the system operation.

*2: If the function version of PathManager is 5.1.0 or later, the default value is 60 seconds. If the function version of PathManager is from 3.0.1 to less than 5.1.0, the default value is 600 seconds.

*3: You can set 0 to the CHK by way of exception. If you set 0 to the CHK, the daemon does not patrol on active paths and alternate paths.

Enable/Disable Setting of Path Monitoring

You can set Enable/Disable setting of path monitoring to each path.

You can change the setting at Watch part of path-info: entry in the configuration file (/etc/sps.conf). Settings of all paths is set "enable" at default.

Variable	Description
Enable	Enable the path monitoring (default).
Disable	Disable the path monitoring.

Messages

When the daemon detects a fault on the path, it outputs the following message in the system log.

```
sps: Warning: Detect ACT path fail /dev/ddX (p) host:h channel:c id:s lun:l
```

When the daemon detects a fault on the alternate path.

```
sps: Warning: Detect HOT path fail /dev/ddX (p) host:h channel:c id:s lun:l
```

Device Files

Each device file used by the PathManager driver has a name in the following format like an ordinary SCSI disk

base-name + unit-name + partition-number

Naming Rules

Type	Symbol	Remarks
Base name	dd	Fixed
Unit name	a,b,c...x,y,z aa,ab,ac...ax,ay,az ba,bb,bc...	One-to-one correspondence with LUNs
Partition number	1 to 15	Entire LUN when no number is specified

For example, the device file for the first partition of the first LUN is named /dev/dda1. About major number, PathManager uses 245.

The number of LUN that PathManager can use depends on its function version.

Available Maximum number of LUN

m: the number of multiplexed paths per a device

[]: truncate after the decimal point

Maximum number of LUN

(in the case the number of redundant paths is 2, 4, 6, or 8)

Number of Redundant Paths on a device. Function Version	2	4	6	8
5.0.0 or later	512	256	170	128
from 3.0.2 to less than 5.0.0	256	128	85	64

PathManager cannot recognize the path information exactly with an environment exceeding the above limitation.

Don't use PathManager on the environment over the limitation.

Intermittent Error Monitoring Function

Intermittent Error Monitoring Function prevents PathManager from continuing to use the intermittent error path. "Intermittent error" means that some failures occurred but I/O is succeeded by retrying some times.

If this function is set enabled, PathManager blocks a path which is suspected of being failed and configures the path not to be recovered automatically. This prevents the system from decreasing the I/O performance.

If you use this function, change the configuration because the default value of this function is "Disable".

*If the statuses of all paths come to fault and there are some paths which is blocked by this function, PathManager tries to recover the blocked paths and use it.

*If the path detected an intermittent error is the last active (ACT) path, this function doesn't block the path to avoid the situation that no I/O path is active.

Intermittent Error Monitoring Function is available with PathManager function.

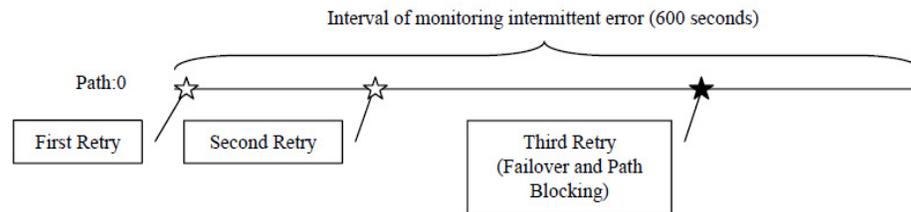
This function monitors the intermittent errors with the parameters, "Interval of monitoring intermittent error (600 second)" and "Threshold retry count of blocking the path (3 times)".

[A case of blocking by Intermittent Error Monitoring Function]

If the number of retry(*) reaches to the threshold retry count of blocking the path (3 times) during the interval of monitoring intermittent error, this function will block the path and get it off the list of auto recovering.

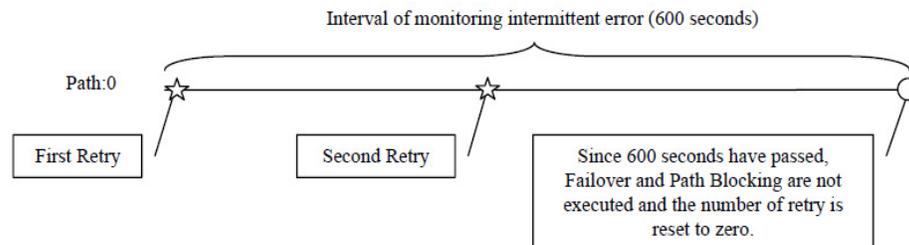
*: The number of success as the result of retrying I/O to the path on which I/O failed

- ☆ : Retry
- ★ : Retry (Path Blocking)
- : Retry Counter Reset



[A case of not blocking by Intermittent Error Monitoring Function]

If the number of retry doesn't reach to the threshold retry count of blocking the path (3 times) during the interval of monitoring intermittent error, this function will reset the number of retry to zero and continue to monitor.



Enable/Disable Setting of the Intermittent Error Monitoring

Option Name	Description	Default Value	Value Set
Monitor Mode	Enable/Disable setting of Intermittent Error Monitoring Function	Disable	Enable / Disable

Enabling the Intermittent Error Monitoring

To enable the intermittent error monitoring function, follow the procedures below.

Replace the "Monitor Mode" entry of configuration file (/etc/sps.conf) into "Enable".

```
Format:1.3
Watch: CHK:600s FLT:180s SACT:300s
MonitorMode:Disable
device:/dev/dda
    disk-info:NEC      ,iStorage 1000  ,0000000935000734,00001
    LoadBalance:S2
    path-info:auto Watch:Enable
```



```
Format:1.3
Watch: CHK:600s FLT:180s SACT:300s
MonitorMode:Enable
device:/dev/dda
    disk-info:NEC      ,iStorage 1000  ,0000000935000734,00001
    LoadBalance:S2
    path-info:auto Watch:Enable
```

(2) Reflect the setting by executing the `mkdd` command.

```
# mkdd
parsing.. Format:1.3 (OK)
parsing.. Watch: CHK:600s FLT:180s SACT:300s (OK)
parsing.. MonitorMode:Enable
parsing.. device:/dev/dda (OK)
parsing.. disk-info:NEC      ,iStorage 1000  ,0000000935000734,00001 (OK)
parsing.. LoadBalance:S2 (OK)
parsing.. path-info:auto Watch:Enable (OK)
#
```

Disabling the Intermittent Error Monitoring

To disable the intermittent error monitoring function, follow the procedures below.

(1) Replace the "Monitor Mode" entry of configuration file (/etc/sps.conf) into "Disable".

```
Format:1.3
Watch: CHK:600s FLT:180s SACT:300s
MonitorMode:Enable
device:/dev/dda
    disk-info:NEC      ,iStorage 1000  ,0000000935000734,00001
    LoadBalance:S2
    path-info:auto Watch:Enable
```



```
Format:1.3
Watch: CHK:600s FLT:180s SACT:300s
MonitorMode:Disable
device:/dev/dda
    disk-info:NEC      ,iStorage 1000  ,0000000935000734,00001
    LoadBalance:S2
    path-info:auto Watch:Enable
```

(2) Reflect the setting by executing the `mkdd` command.

```
# mkdd
parsing... Format:1.3 (OK)
parsing... Watch: CHK:600s FLT:180s SACT:300s (OK)
parsing... MonitorMode:Disable
parsing... device:/dev/dda (OK)
parsing... disk-info:NEC      ,iStorage 1000  ,0000000935000734,00001 (OK)
parsing... LoadBalance:S2 (OK)
parsing... path-info:auto Watch:Enable (OK)
#
```

Message of Path Blocking when Intermittent Error Occurs

When a path is blocked because of intermittent errors, the message shown below is output into the system-log in addition to a failover message.

```
sps: Warning: Intermittent errors occurred. stopped Failback of path:p
```

p: path number

Getting Error History Function

This is the function to get the history of errors in the paths.

The history of errors includes not only the error which causes a failover but also the minor error which does not cause a failover.

It is not rare that a minor error which does not cause a failover now is a foreboding of an important failure.

But you cannot detect the occurrence of an important failure with the default operations of an OS.

If you use this function, you can know the occurrence of a minor error which does not cause a failover, and you will get a chance to handle the error which is hard to detect, and this prevents an important failure which may occur in the future.

Getting Error History Function is available with PathManager function version 4.4.2 or later.

You can get the history of errors to execute the following command.

```
< RHEL 6 >
```

```
# spsadmin --err
```

```
< RHEL 5, SLES 10 >
```

```
# spscmd -geterr
```

Details of Output

This section describes the details of output. The format of error history is as follows.

```
-- Path Information --
[path information]
-- Errors Detail -----
[entry of error history]
[entry of error history]
```

Examples of error history are shown below.

<Example 1>

```
< RHEL 6 >
# spsadmin --err 0

< RHEL 5, SLES 10 >
# spscmd -geterr 0
-- Path Information --
/dev/dda (0) host:1 channel: 0 id: 0 lun: 0
-- Errors Detail -----
2010/08/27 11:10:17 result=0x000e0008 sense_key=0x00 asc=0x00 ascq=0x00 (0/5)
2010/08/27 10:41:06 result=0x000e0008 sense_key=0x00 asc=0x00 ascq=0x00 (0/5)
-----
```

<Example 2> (verbose option)

```

< RHEL 6 >
# spsadmin --err -v 0

< RHEL 5, SLES 10 >
# spscmd -geterr -v 0
-- Path Information --
/dev/dda (0) host:1 channel: 0 id: 0 lun: 0
Protocol:FiberChannel Status:SDEV_ACT
HBA-WWPN:0x1000000c981xxxx HBA-BUSID:...
iST-WWPN:0x220000169712xxxx iST-SERI:000000093490xxxx iST-PORT:00-01
iST-LUNWWN:0000x
-- Errors Detail -----
2010/08/27 11:10:17 result=0x000e0008 sense_key=0x00 asc=0x00 ascq=0x00 (0/5)

```

The details of [path information] and [entry of error history] are shown below.

(1) [path information]

[path information] is output in the following format:

```
/dev/ddX(path_no) host:hostchannel: channelid: id lun: lun
```

X : PathManager device name (from "a" to "iv")
path_no : path number
host : host number
channel : channel number
id : SCSI ID
lun : logical unit number

If "spscmd -geterr" command is executed with "-v" options, [path information] is output in detail.

In that case, [path information] is output in following format:

< path with FC connection >

```
/dev/ddX(path_no) host:hostchannel: channelid: id lun:lun
Protocol:protocol Status:status
HBA-WWPN:hba_wwpn HBA-BUSID:bus_id
iST-WWPN:ist_wwpn iST-SERI:serial iST-PORT:hd-port
```

X : PathManager device name (from "a" to "iv")
path_no : path number
host : host number
channel : channel number
id : SCSI ID
lun : logical unit number (given by OS)
protocol : type of connection (Fibre Channel / iSCSI / SAS)
status : path status
hba_wwpn : WWPN of HBA
bus_id : ID of BUS which the HBA is connected
ist_wwpn : WWPN of Overland
serial : serial number of Overland
hd-port : number of host director and port number of it
lunwwn : logical unit number (given by Overland) or WWN

< path with iSCSI connection >

```
/dev/dddX(path_no) host:host channel:channel id:id lun:lun
Protocol:protocol Status:status
SVR-IP:svr_ip
iST-SERL:serial iST-PORT:hd-port
```

```
X          : PathManager device name
path_no   : path number
host      : host number
channel   : channel number
id        : SCSI ID
lun       : logical unit number (given by OS)
protocol  : type of connection (Fibre Channel or iSCSI)
status    : path status
svr_ip    : IP address of NIC on the side of the server
serial    : serial number of Overland
hd-port   : number of host director and port number of it
lunwwn   : logical unit number (given by Overland) or WWN
```

(2) [entry of error history]

You can select the mode (format) of [entry of error history] among the following 3 modes:

- simple mode
- detail mode
- counts mode

If you don't specify any option among them, the mode is set to simple.
The information which is output by each mode is described below.

+ simple mode

You can get [entry of error history] in simple mode as follows:

```
Y/M/D h:m:s result=result sense_key=sense_key asc=asc ascq=ascq (retry/max)
```

```
Y          : year (e.g. 2010)
M          : month (e.g. 04)
D          : day (e.g. 09)
h          : hour (e.g. 20)
m          : minute (e.g. 04)
s          : second (e.g. 32)
result     : result of I/O
sense_key  : SENSE KEY
asc        : Additional Sense Code
ascq       : Additional Sense Code Qualifiers
retry      : number of retry on the I/O which error occurred
max        : maximum number of retry on the I/O which error occurred
```

+ detail mode

You can get [entry of error history] in detail mode as follows:

```

Y/M/D h:m:s
Host Byte   : host_byte (host_byte_n)
Status Byte : status_byte (status_byte_n)
Driver Byte : driver_byte (driver_byte_n)
Message Byte : msg_byte (msg_byte_n)
Sense Key   : sense_key (sense_key_n)
Asc         : asc

Y          : year (e.g. 2010)
M          : month (e.g. 04)
D          : day (e.g. 09)
h          : hour (e.g. 20)
m          : minute (e.g. 04)
s          : second (e.g. 32)
host_byte : Host Byte character string      (e.g. DID_BO_CONNECT)
host_byte_n : Host Byte value (e.g. 0x01)
status_byte : Status Byte character string  (e.g. GOOD)
status_byte_n : Status Byte value (e.g. 0x00)
driver_byte : Driver Byte character string  (e.g. DRIVER_OK)
driver_byte_n : Driver Byte value (e.g. 0x00)
msg_byte : Message Byte character string   (e.g.
COMMAND_COMPLETE)
msg_byte_n : Message Byte value (e.g. 0x00)
sense_key : SENSE KEY character string    (e.g. UNIT
ATTENTION)
sense_key_n : SENSE KEY value (e.g. 0x6)
asc : Additional Sense Code
ascq : Additional Sense Code Qualifiers
retry : number of retry on the I/O which error occurred
max : maximum number of retry on the I/O which error occurred

```

+ counts mode

Counts mode displays the total number of errors.

You can get [entry of error history] in counts mode as follows:

```

ErrorCount: n

n          : total number of error of the specified path

```

Operation in Normal State

PathManager recognizes the target disks and each path automatically after installation and PathManager starts to operate. Then PathManager starts automatically when the system boots, and stops automatically when the system stops.

When the system starts up, PathManager automatically groups the paths to the same LUN and conceals the paths from applications (to make only one path visible).

When the Fault Occurs

When a path fault occurs, if it is temporary fault, the path patrol daemon restores the path automatically. You don't have to act anything to restore the path. But when the path patrol daemon does not restore the path, the fault is not temporary. In this case, replace the failed module and follow the procedures below.

Path restoration can be made either by rebooting the system or using operation commands. If the system is rebootable, restoration by rebooting the system is recommended. If the system is not rebootable (cannot stop), execute restoration using operation commands.

The types of faults are largely divided into the following two:

- Path fault ...Some of the redundant paths with PathManager get faulty.
- All-path fault ...All redundant paths with PathManager get faulty.

<How to check>

This example assumes that the normal path status is as shown below and a path fault occurred at the shaded path.

```

< RHEL 6 >
# spsadmin --lun /dev/dda
+++ LogicalUnit 2:0:0:0 /dev/dda [Normal] +++
  SerialNumber=0000000931000013, LUN=0x00000
  LoadBalance=LeastSectors
  0: ScsiAddress=0:0:0:0, ScsiDevice=/dev/sdb, Priority=1, Status=Active
  1: ScsiAddress=1:0:0:0, ScsiDevice=/dev/sdc, Priority=2, Status=Active
  2: ScsiAddress=0:0:1:0, ScsiDevice=/dev/sdd, Priority=3, Status=Standby
  3: ScsiAddress=1:0:1:0, ScsiDevice=/dev/sde, Priority=4, Status=Standby

< RHEL 4, RHEL 5, SLES 10 >
# cat /proc/scsi/sps/dda
device:/dev/dda
disk-info: Overland ,Product Name ,0000000931000013,00000
device-info:Host:scsi:2 Channel:0 Id:0 Lun:0 Watch:Enable Status:NML
LoadBalance:D2
path-info:0 Host:scsi:0 Channel:0 Id:0 Lun:0 Priority:1 Status:ACT
path-info:1 Host:scsi:1 Channel:0 Id:0 Lun:0 Priority:2 Status:ACT
path-info:2 Host:scsi:0 Channel:0 Id:0 Lun:0 Priority:3 Status:HOT
path-info:3 Host:scsi:1 Channel:0 Id:0 Lun:0 Priority:4 Status:HOT

```

-- Fault Pattern I --

1. If the path info line of the faulty path is displayed (as the shaded part).Go on to the "YES" route.

```

< RHEL 6 >
# spsadmin --lun /dev/dda
+++ LogicalUnit 2:0:0 /dev/dda [Degraded] +++
SerialNumber=0000000931000013, LUN=0x00000
LoadBalance=LeastSectors
0: ScsiAddress=0:0:0, ScsiDevice=/dev/sdb, Priority=1, Status=Active
1: ScsiAddress=1:0:0, ScsiDevice=/dev/sdc, Priority=2, Status=Active
2: ScsiAddress=0:0:1:0, ScsiDevice=/dev/sdd, Priority=3, Status=Standby
3: ScsiAddress=1:0:1:0, ScsiDevice=/dev/sde, Priority=4, Status=Error

< RHEL 4, RHEL 5, SLES 10 >
# cat /proc/scsi/sps/dda
device:/dev/dda
disk-info: Overland, Product Name ,0000000931000013,00000
device-info:Host:scsi:2 Channel:0 Id:0 Lun:0 Watch:Enable Status:NML
LoadBalance:D2
path-info:0 Host:scsi:0 Channel:0 Id:0 Lun:0 Priority:1 Status:ACT
path-info:1 Host:scsi:1 Channel:0 Id:0 Lun:0 Priority:2 Status:ACT
path-info:2 Host:scsi:0 Channel:0 Id:0 Lun:0 Priority:3 Status:HOT
path-info:3 Host:scsi:1 Channel:0 Id:0 Lun:0 Priority:4 Status:FLT

```

-- Fault Pattern II --

2. If the path info line of the faulty path is not displayed (as the shaded part). Go on to the "NO" route.

```

< RHEL 6 >
# spsadmin --lun /dev/dda
+++ LogicalUnit 2:0:0:0 /dev/dda [Degraded] +++
SerialNumber=0000000931000013, LUN=0x00000
LoadBalance=LeastSectors
0: ScsiAddress=0:0:0:0, ScsiDevice=/dev/sdb, Priority=1, Status=Active
1: ScsiAddress=1:0:0:0, ScsiDevice=/dev/sdc, Priority=2, Status=Active
2: ScsiAddress=0:0:1:0, ScsiDevice=/dev/sdd, Priority=3, Status=Standby
████████████████████████████████████████████████████████████████████████████████

< RHEL 4, RHEL 5, SLES 10 >
# cat /proc/scsi/sps/dda
device:/dev/dda
disk-info:Overland, Product Name ,0000000931000013,00000
device-info:Host:scsi:2 Channel:0 Id:0 Lun:0 Watch:Enable Status:NML
LoadBalance:D2
path-info:0 Host:scsi:0 Channel:0 Id:0 Lun:0 Priority:1 Status:ACT
path-info:1 Host:scsi:1 Channel:0 Id:0 Lun:0 Priority:2 Status:ACT
path-info:2 Host:scsi:0 Channel:0 Id:0 Lun:0 Priority:3 Status:HOT
████████████████████████████████████████████████████████████████████████████████

```

Restoration by Rebooting the System

3. If a path fault occurs, shut down the system, replace the faulty part, and then reboot the system. Rebooting the system restores PathManager. When the system is rebooted, execute step (v) described in next section "Restoration using operation commands" to confirm that restoration is successful.

When you use application servers, return the server to the cluster system, after executing the above procedures.

Restoration using Operation Commands

Restoration of the Specified Path (fault in one or more paths):

An example of recovery from a path fault using operation commands is shown below.

<Example>

-- When the initial status before occurrence of the fault is as follows: --

```

< RHEL 6 >
# spsadmin --lun /dev/dda
+++ LogicalUnit 2:0:0:0 /dev/dda [Normal] +++
  SerialNumber=0000000931000013, LUN=0x00000
  LoadBalance=FailoverOnly
  0: ScsiAddress=0:0:0:0, ScsiDevice=/dev/sdb, Priority=1, Status=Active
  1: ScsiAddress=1:0:0:0, ScsiDevice=/dev/sdc, Priority=2, Status=Standby

< RHEL 4, RHEL 5, SLES 10 >
# cat /proc/scsi/sps/dda
device:/dev/dda
disk-info:Overland, Product Name ,0000000931000013,00000
device-info:Host:scsi:2 Channel:0 Id:0 Lun:0 Watch:Enable Status:NML
LoadBalance:S

```

- (i) If a fault occurs, the following message is displayed in the system log. From this message, you can tell that a fault occurred on path number 0 and host number 0 and the active path is switched.

```
sps: Warning: Failover from /dev/dda (0) host:0 channel:0 id:0 lun:0
```

- (ii) Execute the "spsadmin --lun" or refer to the /proc/scsi/sps/dda file to confirm the fault. After checking the status of path number 0 is FLT (the shaded part), remove the cause of fault on the path.

```

Path Number
< RHEL 6 >
# spsadmin --lun /dev/dda
+++ LogicalUnit 2:0:0:0 /dev/dda [Degraded<No-Redundant>] +++
  SerialNumber=0000000931000013, LUN=0x00000
  LoadBalance=FailoverOnly
  0: ScsiAddress=0:0:0:0, ScsiDevice=/dev/sdb, Priority=1, Status=Error
  1: ScsiAddress=1:0:0:0, ScsiDevice=/dev/sdc, Priority=2,
  Status=Active

< RHEL 4, RHEL 5, SLES 10 >
# cat /proc/scsi/sps/dda
device:/dev/dda
disk-info:Overland, Product Name ,0000000931000013,00000
device-info:Host:scsi:2 Channel:0 Id:0 Lun:0 Watch:Enable Status:FLT
LoadBalance:S
path-info:0 Host:scsi:0 Channel:0 Id:0 Lun:0 Priority:1 Status:FLT
path-info:1 Host:scsi:1 Channel:0 Id:0 Lun:0 Priority:2 Status:ACT

```

- (iii) After removing the cause of the fault, execute the spscmd command as shown below to restore path number 0.

```

Path Number
< RHEL 6 >
# spsadmin --failback 0

< RHEL 4, RHEL 5, SLES 10 >
# spscmd -recover 0

```

- (iv) If the path is successfully restored, the following message is output to the system log.

```
sps: Info: Failback to /dev/dda (0) host:0 channel:0 id:0 lun:0
```

The restored path immediately enters the monitored (SACT) status. The path is monitored for 5 minutes by default. If no fault occurs within 5 minutes, the path gets out of the monitored status and enters the active status.

```

< RHEL 6 >
# spsadmin --lun -v /dev/dda
+++ LogicalUnit 6:0:0:0 /dev/dda [Normal] +++
Vendor   : Overland
ProductID : Product Name
SerialNumber: 0000000931000013
LUN      : 0x00000
LoadBalance : LeastSectors
0: HostNo=2, Channel=0, TargetID=0, Ldn=0, ScsiDevice=/dev/sdb
  Priority=1, Status=Active, Detail=Monitoring
  BusID=0000:00:00.0, HBA_WWPN=10:00:00:00:00:00:00
  Storage_WWPN=00:00:00:00:00:00:00:00, HD=00, Port=00, Protocol=FC
1: HostNo=3, Channel=0, TargetID=0, Ldn=0, ScsiDevice=/dev/sdc
  Priority=2, Status=Standby, Detail=None
  BusID=0000:00:00.0, HBA_WWPN=10:00:00:00:00:00:00
  Storage_WWPN=00:00:00:00:00:00:00:00, HD=01, Port=00, Protocol=FC

< RHEL 4, RHEL 5, SLES 10 >
# cat /proc/scsi/sps/dda
device:/dev/dda
disk-info: Overland   , Product Name,0000000931000013,00000
device-info:Host:scsi:2 Channel:0 Id:0 Lun:0 Watch:Enable Status:NML
LoadBalance:S
path-info:0 Host:scsi:0 Channel:0 Id:0 Lun:0 Priority:1 Status:SACT
path-info:1 Host:scsi:1 Channel:0 Id:0 Lun:0 Priority:2 Status:HOT

```

```

< RHEL 6 >
# spsadmin --lun -v /dev/dda
+++ LogicalUnit 6:0:0:0 /dev/dda [Normal] +++
Vendor   : Overland
ProductID : Product Name
SerialNumber: 0000000931000013
LUN      : 0x00000
LoadBalance : LeastSectors
0: HostNo=2, Channel=0, TargetID=0, Ldn=0, ScsiDevice=/dev/sdb
  Priority=1, Status=Active, Detail=None
  BusID=0000:00:00:0, HBA_WWPN=10:00:00:00:00:00:00
  Storage_WWPN=00:00:00:00:00:00:00:00, HD=00, Port=00, Protocol=FC
1: HostNo=3, Channel=0, TargetID=0, Ldn=0, ScsiDevice=/dev/sdc
  Priority=2, Status=Standby, Detail=None
  BusID=0000:00:00:0, HBA_WWPN=10:00:00:00:00:00:00
  Storage_WWPN=00:00:00:00:00:00:00:00, HD=01, Port=00, Protocol=FC

< RHEL 4, RHEL 5, SLES 10>
# cat /proc/scsi/sps/dda
device:/dev/dda
disk-info: Overland   , Product Name,0000000931000013,00000
device-info:Host:scsi:2 Channel:0 Id:0 Lun:0 Watch:Enable Status:NML
LoadBalance:S
path-info:0 Host:scsi:0 Channel:0 Id:0 Lun:0 Priority:1 Status:ACT
path-info:1 Host:scsi:1 Channel:0 Id:0 Lun:0 Priority:2 Status:HOT

```

To recover from the monitored status, the path patrol daemon must be running.

Restoration of the Specified Path (all paths fault):

An example of recovery from an all-path fault using operation commands is shown below.

<Example>

-- When the initial status before occurrence of the fault is as follows: --

```

< RHEL 6 >
# spsadmin --lun /dev/dda
+++ LogicalUnit 2:0:0:0 /dev/dda [Normal] +++
  SerialNumber=0000000931000013, LUN=0x00000
  LoadBalance=FailoverOnly
  0: ScsiAddress=0:0:0:0, ScsiDevice=/dev/sdb, Priority=1, Status=Active
  1: ScsiAddress=1:0:0:0, ScsiDevice=/dev/sdc, Priority=2, Status=Standby

< RHEL 4, RHEL 5, SLES 10>
# cat /proc/scsi/sps/dda
device:/dev/dda
disk-info:Overland, Product Name ,0000000931000013,00000
device-info:Host:scsi:2 Channel:0 Id:0 Lun:0 Watch:Enable Status:NML
LoadBalance:S
path-info:0 Host:scsi:0 Channel:0 Id:0 Lun:0 Priority:1 Status:ACT
path-info:1 Host:scsi:1 Channel:0 Id:0 Lun:0 Priority:2 Status:HOT

```

If all paths enter the faulty status, the following message is output to the system log. From this message, you can tell that all paths are faulty.

```
sps: Error: All path fail /dev/dda
```

If many messages as shown below are output, all paths may be faulty. If many messages like this are output, the above message may not be output. If you see many messages like this, refer to `/proc/dualpath/ddX` to check the path status.

```
SCSI disk error: host x channel x id x lun x return code =xxxxxx
```

```
I/O error: dev xx:xx sector xxxxxx
```

Execute the "spsadmin --lun" or refer to `/proc/scsi/sps/dda` to check the occurrence of fault. If the device status is "Dead" or "ALL", `/dev/dda` is unavailable.

```

< RHEL 6 >
# spsadmin --lun /dev/dda
+++ LogicalUnit 2:0:0:0 /dev/dda [Dead] +++
  SerialNumber=0000000931000013, LUN=0x00000
  LoadBalance=FailoverOnly
  0: ScsiAddress=0:0:0:0, ScsiDevice=/dev/sdb, Priority=1, Status=Error
  1: ScsiAddress=1:0:0:0, ScsiDevice=/dev/sdc, Priority=2, Status=Error

< RHEL 4, RHEL 5, SLES 10>
# cat /proc/scsi/sps/dda
device:/dev/dda
disk-info:Overland, Product name ,0000000931000013,00000
device-info:Host:scsi:2 Channel:0 Id:0 Lun:0 Watch:Enable Status:ALL
LoadBalance:S
path-info:0 Host:scsi:0 Channel:0 Id:0 Lun:0 Priority:1 Status:FLT
path-info:1 Host:scsi:1 Channel:0 Id:0 Lun:0 Priority:2 Status:FLT

```

I/O request is not generally issued to a faulty path. If all paths are faulty, however, I/O request is tried on the path that became faulty last of all (path number 0 in the above example). This may leave a large number of I/O errors in the system log.

(iii) After removing the cause of the fault, execute the `spscmd` command as shown below to restore path number 0. There is no restriction on the order in which paths are to be restored. You can restore paths in any order.

```
< RHEL 6 >
# spsadmin --failback 0

< RHEL 4, RHEL 5, SLES 10>
# spscmd -recover 0
```

When the command is executed successfully, the following message is output to the system log:

```
sps: Info: Recover all path failed /dev/dda (0) host:0 channel:0 id:0 lun:0
sps: Info: Remain failed path /dev/dda (0) host:0 channel:0 id:0 lun:0
```

Execute the "`spsadmin --lun`" or refer to `/proc/scsi/sps/dda` to check that path number 0 has returned to the ACT status and the partition status has returned to FLT. This shows that `/dev/dda` has been restored and available.

```
< RHEL 6 >
# spsadmin --lun /dev/dda
+++ LogicalUnit 2:0:0:0 /dev/dda [Degraded<No-Redundant>] +++
  SerialNumber=0000000931000013, LUN=0x00000
  LoadBalance=FailoverOnly
  0: ScsiAddress=0:0:0:0, ScsiDevice=/dev/sdb, Priority=1, Status=Active
  1: ScsiAddress=1:0:0:0, ScsiDevice=/dev/sdc, Priority=2, Status=Error

< RHEL 4, RHEL 5, SLES 10>
# cat /proc/scsi/sps/dda
device:/dev/dda
disk-info:Overland, Product Name ,0000000931000013,00000
device-info:Host:scsi:2 Channel:0 Id:0 Lun:0 Watch:Enable Status:FLT
LoadBalance:S
path-info:0 Host:scsi:0 Channel:0 Id:0 Lun:0 Priority:1 Status:ACT
path-info:1 Host:scsi:1 Channel:0 Id:0 Lun:0 Priority:2 Status:FLT
```

(vi) After path number 0 has recovered, restore path number 1 next. Remove the cause of the fault on path number 1, and restore it using the `spscmd` command as shown below.

```

< RHEL 6 >
# spsadmin --failback 1

< RHEL 4, RHEL 5, SLES 10>
## spscmd -recover 1

```

(vii) When the command is executed successfully, the following message is output to the system log: sps: Info: Recover HOT path /dev/dda (1) host:1 channel:0 id:0 lun:0

(viii) Execute the "spsadmin --lun" or refer to /proc/scsi/sps/dda to check that path number 1 has returned to the HOT status and the partition status has returned to NML. This shows that /dev/dda has been restored to the normal status.

```

< RHEL 6 >
# spsadmin --lun /dev/dda
+++ LogicalUnit 2:0:0:0 /dev/dda [Normal] +++
  SerialNumber=0000000931000013, LUN=0x000000
  LoadBalance=FailoverOnly
  0: ScsiAddress=0:0:0:0, ScsiDevice=/dev/sdb, Priority=1, Status=Active
  1: ScsiAddress=1:0:0:0, ScsiDevice=/dev/sdc, Priority=2, Status=Standby

< RHEL 4, RHEL 5, SLES 10>
# cat /proc/scsi/sps/dda
device:/dev/dda
disk-info: Overland, Product Name ,0000000931000013,000000
device-info:Host:scsi:2 Channel:0 Id:0 Lun:0 Watch:Enable Status:NML
LoadBalance:S
path-info:0 Host:scsi:0 Channel:0 Id:0 Lun:0 Priority:1 Status:ACT
path-info:1 Host:scsi:1 Channel:0 Id:0 Lun:0 Priority:2 Status:HOT

```

Restoration by Scanning All Paths

An example of recovery from a path fault (or all-path fault) using operation commands is shown below.

If you execute the "Rescanning the path" and the "Restructuring the PathManager devices" on the procedures in this section, I/O performance may be decrease temporarily.

Therefore, operate without any I/O to the PathManager devices if possible.

- This restoration procedures are for FC or SAS connection.

<Example>

-- If the initial status before the fault is as follows and the fault occurred on the shaded path. --

```
# cat /proc/scsi/sps/devices
Attached devices:
Host: scsi0 Channel: 00 Id: 00 Lun: 00
  Vendor: Overland   Model: Product Name  Rev: 2800
  Type: Direct-Access   ANSISCSIrevision: 04
Host: scsi0 Channel: 00 Id: 01 Lun: 00
  Vendor: Overland   Model: Product Name  Rev: 2800
  Type: Direct-Access   ANSISCSIrevision: 04
Host: scsi1 Channel: 00 Id: 00 Lun: 00
  Vendor: Overland   Model: Product Name  Rev: 2800
  Type: Direct-Access   ANSISCSIrevision: 04
Host: scsi1 Channel: 00 Id: 01 Lun: 00
  Vendor: Overland   Model: Product Name  Rev: 2800
  Type: Direct-Access   ANSISCSIrevision: 04
```

```
< RHEL 6 >
# spsadmin --lun /dev/dda
+++ LogicalUnit 2:0:0:0 /dev/dda [Normal] +++
  SerialNumber=0000000931000013, LUN=0x000000
  LoadBalance=LeastSectors
  0: ScsiAddress=0:0:0:0, ScsiDevice=/dev/sdb, Priority=1, Status=Active
  1: ScsiAddress=1:0:0:0, ScsiDevice=/dev/sdc, Priority=2, Status=Active
  2: ScsiAddress=0:0:1:0, ScsiDevice=/dev/sdd, Priority=3, Status=Standby
  3: ScsiAddress=1:0:1:0, ScsiDevice=/dev/sde, Priority=4, Status=Standby

< RHEL 4, RHEL 5, SLES 10 >
# cat /proc/scsi/sps/dda
device:/dev/dda
disk-info: Overland   , Product Name ,0000000931000013,00000
device-info:Host:scsi:2 Channel:0 Id:0 Lun:0 Watch:Enable Status:NML
LoadBalance:D2
path-info:0 Host:scsi:0 Channel:0 Id:0 Lun:0 Priority:1 Status:ACT
path-info:1 Host:scsi:1 Channel:0 Id:0 Lun:0 Priority:2 Status:ACT
path-info:2 Host:scsi:0 Channel:0 Id:1 Lun:0 Priority:3 Status:HOT
path-info:3 Host:scsi:1 Channel:0 Id:1 Lun:0 Priority:4 Status:HOT
```

-- After the fault, the status is shown as below. --

```
# cat /proc/scsi/sps/devices
Attached devices:
Host: scsi0 Channel: 00 Id: 00 Lun: 00
Vendor: Overland , Product Name Rev: 2800
Type: Direct-Access ANSI SCSI revision: 04
Host: scsi0 Channel: 00 Id: 01 Lun: 00
Vendor: Overland , Product Name Rev: 2800
Type: Direct-Access ANSI SCSI revision: 04
Host: scsi1 Channel: 00 Id: 00 Lun: 00
Vendor: Overland , Product Name Rev: 2800
Type: Direct-Access ANSI SCSI revision: 04
```

```
< RHEL 6 >
# spsadmin --lun /dev/dda
+++ LogicalUnit 2:0:0:0 /dev/dda [Normal] +++
SerialNumber=0000000931000013,LUN=0x00000
LoadBalance=LeastSectors
0: ScsiAddress=0:0:0:0, ScsiDevice=/dev/sdb, Priority=1, Status=Active
1: ScsiAddress=1:0:0:0, ScsiDevice=/dev/sdc, Priority=2, Status=Active
2: ScsiAddress=0:0:1:0, ScsiDevice=/dev/sdd, Priority=3, Status=Standby

< RHEL 4, RHEL 5, SLES 10 >
# cat /proc/scsi/sps/dda
device:/dev/dda
disk-info: Overland , Product Name ,00000000931000013,00000
device-info:Host:scsi:2 Channel:0 Id:0 Lun:0 Watch:Enable Status:NML
LoadBalance:D2
path-info:0 Host:scsi:0 Channel:0 Id:0 Lun:0 Priority:1 Status:ACT
path-info:1 Host:scsi:1 Channel:0 Id:0 Lun:0 Priority:2 Status:ACT
path-info:2 Host:scsi:0 Channel:0 Id:1 Lun:0 Priority:3 Status:HOT
```

- (i) After removing the cause of the fault, execute the **spscmd** command as shown below to rescan the paths.

```
< RHEL 6 >
# spsadmin --scan

< RHEL 4, RHEL 5, SLES 10 >
# spscmd -scan
```

- (ii) If the **spscmd** recognizes the path which can be restored, the following message is output to the system log (as the shaded part).

```
sd scan:host1.
dd scan:host1.
sps: Info: host:1 channel:0 id:0 lun:0 is already created
sps: Info: Attached path to /dev/dda (1) host:1 channel: 0 id: 0 lun: 0
sd scan:host0.
dd scan:host0.
sps: info: host:0 channel:0 id:0 lun:0 is already created.
sps: info: host:0 channel:0 id:1 lun:0 is already created.
```

The meaning of each message is shown as below.

Message	Definition
sd scan:hostX.	Rescanning under the hostX
dd scan:hostX.	Registering the path which is recognized by rescanning under the hostX.
sps: Info: Attached path to /dev/dda (1) host:1 channel: 0 id: 0 lun: 0	Information about the path which has been recognized by PathManager. If the path doesn't exist in the configuration file, PathManager Device File Name is displayed as "unknown sps device".
sps: info: host:0 channel:0 id:0 lun:0 is already created.	Information about the path which is already recognized by PathManager.

Execute as shown below to `/proc/scsi/sps/devices`, and confirm that the path which could be restored is recognized.

In the following example, you can confirm that the path [scsi1 Channel: 00 Id: 00 Lun: 00] is recognized.

```
# cat /proc/scsi/sps/devices
Attached devices:
Host: scsi0 Channel: 00 Id: 00 Lun: 00
  Vendor: Overland , Product Name Rev: 2800
  Type: Direct-Access ANSI SCSI revision: 04
Host: scsi0 Channel: 00 Id: 01 Lun: 00
  Vendor: Overland , Product Name Rev: 2800
  Type: Direct-Access ANSI SCSI revision: 04
Host: scsi1 Channel: 00 Id: 00 Lun: 00
  Vendor: Overland , Product Name Rev: 2800
  Type: Direct-Access ANSI SCSI revision: 04
Host: scsi1 Channel: 00 Id: 01 Lun: 00
  Vendor: Overland , Product Name Rev: 2800
  Type: Direct-Access ANSI SCSI revision: 04
```

- (iv) Execute the `mkdd` command as shown below to build the recognized path into the PathManager device

```
# mkdd
parsing... Format:1.3 (OK)
parsing... Watch: CHK:600s FLT:180s SACT:300s (OK)
parsing... device:/dev/dda (OK)
parsing... disk-info: Overland , Product Name 0000000931000013,00000 (OK)
parsing... LoadBalance:D2 (OK)
parsing... path-info:auto Watch:Enable (OK)
Wait until all /dev/ddX is made...END
```

Execute the `"spsadmin --lun"` or refer to `/proc/scsi/sps/dda` to check that a path is added. In the following example, you can confirm that the path [scsi1 Channel: 00 Id: 00 Lun: 00] is added.

```

< RHEL 6 >
# spsadmin --lun /dev/dda
+++ LogicalUnit 2:0:0:0 /dev/dda [Normal] +++
SerialNumber=0000000931000013, LUN=0x00000
LoadBalance=LeastSectors
0: ScsiAddress=0:0:0:0, ScsiDevice=/dev/sdb, Priority=1, Status=Active
1: ScsiAddress=1:0:0:0, ScsiDevice=/dev/sdc, Priority=2, Status=Active
2: ScsiAddress=0:0:1:0, ScsiDevice=/dev/sdd, Priority=3, Status=Standby
3: ScsiAddress=1:0:1:0, ScsiDevice=/dev/sde, Priority=4, Status=Standby

< RHEL 4, RHEL 5, SLES 10 >
# cat /proc/scsi/sps/dda
device:/dev/dda
disk-info: Overland , Product Name ,0000000931000013,00000
device-info:Host:scsi:2 Channel:0 Id:0 Lun:0 Watch:Enable Status:NML
LoadBalance:D2
path-info:0 Host:scsi:0 Channel:0 Id:0 Lun:0 Priority:1 Status:ACT
path-info:1 Host:scsi:1 Channel:0 Id:0 Lun:0 Priority:2 Status:ACT
path-info:2 Host:scsi:0 Channel:0 Id:1 Lun:0 Priority:3 Status:HOT
path-info:3 Host:scsi:1 Channel:0 Id:1 Lun:0 Priority:4 Status:HOT

```

Restoration by iscsiadm Command

An example of recovery from a path fault (or all-path fault) using iscsiadm command is shown below.

This restoration procedures are for iSCSI connection.

<Example>

-- If the initial status before the fault is as follows and the fault occurred on the shaded path.

```
# cat /proc/scsi/sps/devices
Attached devices:
Host: scsi0 Channel: 00 Id: 00 Lun: 00
  Vendor: Overland , Product Name Rev: 0223
  Type: Direct-Access ANSI SCSI revision: 04
Host: scsi1 Channel: 00 Id: 00 Lun: 00
  Vendor: DGC Model: RAID 5 Rev: 0223
  Type: Direct-Access ANSI SCSI revision: 04
#
```

```
< RHEL 6 >
# spsadmin --lun /dev/dda
+++ LogicalUnit 2:0:0 /dev/dda [Normal] +++
SerialNumber=SL7E1074800027,
  LUN=60:06:01:60:85:f0:1e:00:58:df:7c:bd:55:f5:dc:11
LoadBalance=FailoverOnly
0: ScsiAddress=0:0:0:0, ScsiDevice=/dev/sdb, Priority=1, Status=Active
1: ScsiAddress=1:0:0:0, ScsiDevice=/dev/sdc, Priority=2, Status=Standby

< RHEL 4, RHEL 5, SLES 10 >
# cat /proc/scsi/sps/dda
device:/dev/dda
  disk-info: Overland , Product Name ,SL7E1074800027 ,60:06:01:60:
85:f0:1e:00:58:df:7c:bd:55:f5:dc:11
  device-info:Host:scsi:2 Channel:0 Id:0 Lun:0 Watch:Enable Status:NML
  LoadBalance:S
  path-info:0 Host:scsi:0 Channel:0 Id:0 Lun:0 Priority:1 Status:ACT
  path-info:1 Host:scsi:1 Channel:0 Id:0 Lun:0 Priority:2 Status:HOT
```

-- After the fault, the status is shown as below. --

```
# cat /proc/scsi/sps/devices
Attached devices:
Host: scsi0 Channel: 00 Id: 00 Lun: 00
Vendor: Overland , Product Name Rev: 0223
Type: Direct-Access ANSI SCSI revision: 04
#
```

```
< RHEL 6 >
# spsadmin --lun /dev/dda
+++ LogicalUnit 2:0:0 /dev/dda [Degraded<No-Redundant>] +++
SerialNumber=SL7E1074800027,
LUN=60:06:01:60:85:f0:1e:00:58:df:7c:bd:55:f5:dc:11
LoadBalance=FailoverOnly
0: ScsiAddress=0:0:0:0, ScsiDevice=/dev/sdb, Priority=1, Status=Active

< RHEL 4, RHEL 5, SLES 10 >
# cat /proc/scsi/sps/dda
device:/dev/dda
disk-info: Overland , Product Name ,SL7E1074800027 ,60:06:01:
60:85:f0:1e:00:58:df:7c:bd:55:f5:dc:11
device-info:Host:scsi:2 Channel:0 Id:0 Lun:0 Watch:Enable Status:NML
LoadBalance:S
path-info:0 Host:scsi:0 Channel:0 Id:0 Lun:0 Priority:1 Status:ACT
#
```

After removing the cause of the fault, execute the `iscsiadm` command as shown below to recover the paths.

Some error messages may output (*1, *2), but they don't mean any problems with PathManager.

```

# iscsiadm -m node --loginall=all
Logging in to [iface: default, target:iqn.1992-04.com.emc:cx.sl7e20743
00010.b0, portal: 192.168.11.3,3260]
Logging in to [iface: default, target:iqn.1992-04.com.emc:cx.sl7e20743
00010.a1, portal: 192.168.1.13,3260]
Logging in to [iface: default, target:iqn.1992-04.com.emc:cx.sl7e20743
00010.b1, portal: 192.168.11.4,3260]
Logging in to [iface: default, target:iqn.1992-04.com.emc:cx.sl7e20743
00010.a0, portal: 192.168.1.12,3260]
Login to [iface: default, target: iqn.1992-04.com.emc:cx.sl7e207430001
0.b0,portal: 192.168.11.3,3260]: successful
iscsiadm: Could not login to [iface: default, target:iqn.1992-04.com.
emc:cx.sl7e2074300010.a1, portal: 192.168.1.13,3260]:
iscsiadm: initiator reported error (8 - connection timed out)
iscsiadm: Could not login to [iface: default, target:iqn.1992-04.com.
emc:cx.sl7e2074300010.b1, portal: 192.168.11.4,3260]:
iscsiadm: initiator reported error (8 - connection timed out)
iscsiadm: Could not login to [iface: default, target:iqn.1992-04.com.
emc:cx.sl7e2074300010.a0, portal: 192.168.1.12,3260]:
iscsiadm: initiator reported error (15 - already exists)
iscsiadm: Could not log into all portals. Err 15.

```

the restored path

not connected path (*1)

normal (online) path (*2)

When the kernel recognizes the path which is ready to use, the messages like below are output to the system log.

- (iii) Execute as shown below to `/proc/scsi/sps/devices` to check that a path which is ready for use is recognized. In the following example, you can confirm that the path `[scsi1 Channel: 00 Id: 00 Lun: 00]` is recognized.

```
# cat /proc/scsi/sps/devices
Attached devices:
Host: scsi0 Channel: 00 Id: 00 Lun: 00
Vendor: Overland , Product Name Rev: 0223
Type: Direct-Access ANSISCSIrevision: 04
Host: scsi1 Channel: 00 Id: 00 Lun: 00
Vendor: Overland , Product Name Rev: 0223
Type: Direct-Access ANSISCSIrevision: 04
#
```

- (iv) Execute as shown below to `/proc/scsi/sps/dda` to check that a path is added. In the following example, you can confirm that the path `[scsi1 Channel: 00 Id: 00 Lun: 00]` is added.

```
< RHEL 6 >
# spsadmin --lun /dev/dda
+++ LogicalUnit 2:0:0:0 /dev/dda [Normal] +++
SerialNumber=SL7E1074800027,
LUN=60:06:01:60:85:f0:1e:00:58:df:7c:bd:55:f5:dc:11
LoadBalance=FailoverOnly
0: ScsiAddress=0:0:0:0, ScsiDevice=/dev/sdb, Priority=1, Status=Active
1: ScsiAddress=1:0:0:0, ScsiDevice=/dev/sdc, Priority=2, Status=Standby

< RHEL 4, RHEL 5, SLES 10 >
# cat /proc/scsi/sps/dda
device:/dev/dda
disk-info: Overland , Product Name ,SL7E1074800027 ,60:06:01:60:
85:f0:1e:00:58:df:7c:bd:55:f5:dc:11
device-info:Host:scsi:2 Channel:0 Id:0 Lun:0 Watch:Enable Status:NML
LoadBalance:S
path-info:0 Host:scsi:0 Channel:0 Id:0 Lun:0 Priority:1 Status:ACT
path-info:1 Host:scsi:1 Channel:0 Id:0 Lun:0 Priority:2 Status:HOT
```

Cautions

You should note the following cautions when you use PathManager.

1. When you execute the following commands, the LUN PathManager recognizes and the LUN the OS recognizes may not match. To avoid this situation, do not execute the following commands.

```
echo "scsi add-single-device x x x x" > /proc/scsi/scsi
```

```
echo "scsi remove-single-device x x x x" > /proc/scsi/scsi
```
2. If too many messages are output to the system log exceeding the output buffer for the system log in the Linux system, some messages may not be output to the PathManager driver's system log.
3. The different number of paths in each device cannot be specified.
4. In rare case, SCSI status with I/O error may be returned if ioctl using SG_IO is issued with invalid argument. When SCSI status is set I/O error, PathManager recognizes disk fault so that all path fault occur. If this phenomenon occurred, wait the auto failback by path patrol daemon or use spscmd -recover command manually.
5. PathManager does not support a path switch during the Diskdump / kdump operations. Hence, if the path failure occurs during Diskdump / kdump, Diskdump / kdump will stop.
6. If you use application servers, a cluster failover may occur because of a disk monitoring error on a path failback. To prevent this, you can increase the number of retries of disk monitoring by application servers.
7. When you write the PathManager device (/dev/ddX) to "/etc/fstab", do not use either a LABEL name or a "by Device ID" (a device name under /dev/disk/by-id/) to specify the device to mount. Or, OS cannot recognize the device to mount. Use the PathManager device name "/dev/ddX".
8. If you use both PathManager device (/dev/ddX) and standard SCSI device (/dev/sdX) concurrently for the same disk, I/O processing may not be done correctly due to conflict with those devices. Therefore, if a disk is used with PathManager device, don't use such disk with a standard SCSI device.

Restrictions

PathManager has the following restrictions:

1. PathManager corresponds with LVM (Logical Volume Manager) on the OSes below.
 But, a disk array units connected via iSCSI are not supported.
 - Red Hat Enterprise Linux AS/ES 4 (Kernel-2.6.9-42.EL) or later

- Red Hat Enterprise Linux 5 (Kernel-2.6.18-53.el5) or later
 - Red Hat Enterprise Linux 5 Advanced Platform (Kernel-2.6.18-53.el5) or later
 - Red Hat Enterprise Linux 6 (Kernel-2.6.32.131.0.15.el6) or later
 - SUSE Linux Enterprise Server 10 (Kernel-2.6.16.60-0.21) or later
- PathManager does not correspond with Red Hat Enterprise Linux AS/ES 4 whose kernel is earlier than the above.
2. PathManager supports Diskdump if the function version of PathManager is 3.0.9 or later and on the OSes shown below. But, a disk array units connected via iSCSI are not supported.
The function version of PathManager is 3.0.9 or later.
 - Red Hat Enterprise Linux AS/ES 4 (Kernel-2.6.9-42.EL) or later.
 - Red Hat Enterprise Linux 5 (Kernel-2.6.18-53.el5) or later.
 - Red Hat Enterprise Linux 5 Advanced Platform (Kernel-2.6.18-53.el5) or later.
 - Red Hat Enterprise Linux 6 (Kernel-2.6.32-131.0.15.el6) or later.
 - SUSE Linux Enterprise Server 10 (Kernel-2.6.16.60-0.21) or later
 3. PathManager does not support VxVM (Veritas Volume Manager) and VxFS (Veritas File System).
But if DMP (function of VxVM) manages VxFS, PathManager supports the concurrent use with VxVM, VxFS and PathManager on the following OSes.
 - Red Hat Enterprise Linux 5 (Kernel-2.6.18-53.el5) or later
 - Red Hat Enterprise Linux 5 Advanced Platform (Kernel-2.6.18-53.el5) or later
 - SUSE Linux Enterprise Server 10 (Kernel-2.6.16.60-0.21) or later
 4. The maximum LUN size which PathManager can manage is 2TB (terabyte) on the following OSes.
 - Red Hat Enterprise Linux AS/ES 4 (Kernel-2.6.9-55.EL) or before
 5. If you use PathManager,
 - PathManager does not support in combination with PowerPath (by EMC Corp.).
 6. If you use PathManager with any disk array unit of iSCSI connection,
 - a. iSCSI-HBA is not supported.
 - b. PathManager does not support to use PathManager device as an output device of kdump.
 - c. LVM is not supported.
 7. The system has restrictions on using multiple kinds of disk array unit.

System Requirements to Use Multiple Connections Concurrently

Connection	Kernel (Red Hat)	Kernel (SUSE)
FC	2.6.18-92.el5 or later	2.6.16.60-0.21 or later
iSCSI	2.6.18-164.el5 or later	-
FC / iSCSI		-

Connection	Kernel (Red Hat)	Kernel (SUSE)
FC	2.6.18-194.el5 or later	2.6.16.60-0.57.1 or later
iSCSI		-
FC / iSCSI		-
FC		2.6.16.60-0.57.1 or later
iSCSI		-
FC / iSCSI		-
FC		2.6.16.60-0.57.1 or later
iSCSI		-
FC / iSCSI		-

8. PathManager supports the Overland which has both FC and iSCSI connections if the function version of PathManager is 4.4.2 or later and on the OSes shown below.
 - Red Hat Enterprise Linux 5 (Kernel-2.6.18-194.el5) or later.
 - Red Hat Enterprise Linux 5 Advanced Platform (Kernel-2.6.18-194.el5) or later.
 - Red Hat Enterprise Linux 6 (Kernel-2.6.32-131.0.15.el6) or later.

If you use it on the OS other than above, you can use only one connection type (FC / iSCSI) to a server. Manage the Overland to limit the connection to one server by using "Overland Storage" or modify the system environment.
9. PathManager does not support in combination with dm-multipath.
10. The event of "The dd device of no redundant paths was detected."
 - SUSE Linux Enterprise Server 10 (kernel-2.6.16.60-0.21 or later)

Commands of Function Version 5.1.0 or Later

This appendix describes the maintenance commands. A root authority is required to execute these commands. This section refers to the following OSes

- Red Hat Enterprise Linux 6

mkdd command

[Name]

mkdd - Start operation and change setting of the multiplexed path system

[Syntax]

```
# mkdd
```

```
# mkdd -c
```

```
# mkdd -f filename
```

[Description]

The mkdd command notifies the PathManager driver of the contents of the configuration file (/etc/sps.conf) and directs the PathManager driver to start operation of the multi path system. If no configuration file is found, the PathManager driver attempts to automatically detect the paths. You can execute this command to change the setting.

[Options]

mkdd accepts the following options, listed alphabetically.

```
mkdd
```

Directs to PathManager driver to start operation.

```
mkdd -c
```

Only checks the configuration file. Does not notify the PathManager driver.

```
mkdd -f filename
```

Uses the file specified for filename as the configuration file.

If you execute the mkdd command, I/O performance may be decrease temporarily.

Therefore, operate without any I/O to the PathManager devices if possible

spsadmin command

[Name]

spsadmin - Controlling PathManager device / path and displaying its status.

[Syntax]

```

spsadmin --active target
spsadmin --err [-m {simple | detail | counts}] [-t number | -a] [-v] target
spsadmin --failback target
spsadmin --help
spsadmin --lun [-v] [target]
spsadmin --mode
spsadmin --rollback target
spsadmin --standby [-v] target
spsadmin --version
spsadmin --suspend target
spsadmin --resume target
spsadmin --scan

```

[Description]

It is used to make settings for Overland PathManager and to display its status.

[Options]

"spsadmin" accepts the following options.

How to specify the target argument is described later.

```
spsadmin --active target
```

Turns the target path to active state.

```
spsadmin --err [-m {simple | detail | counts}] [-t number | -a] [-v] [target]
```

Displays error history of path specified in target.

If target is omitted, "spsadmin" displays a history for all paths.

- -m : displays in specified mode.

simple as normal, detail as detail, counts as number of errors only.

- -t : the number of errors to display of each path.

The default value is ten without using this sub-option. The maximal value is 1024.

- -a : displays all errors of each path. This option can not be used with -t option.
- -v : displays detail path information.

```
spsadmin --failback target
```

Failbacks the path specified in target.

```
spsadmin --help
```

Displays how to use.

```
spsadmin --lun [-v] [target]
```

Displays the information of the path specified in target.

If target is omitted, "spsadmin" displays the information of all paths managed by PathManager.

By using `-v` suboption, displays in detail.

```
spsadmin --mode
```

Displays the settings shown below.

1. Cluster mode (Enable / Disable)
2. Intermittent Error Monitoring mode (Enable / Disable)

```
spsadmin --rollback target
```

Sets the path state (active / standby) of the logical unit specified in target into the initial state.

```
spsadmin --standby [-v] target
```

Sets the path specified in target into standby.

By using `-v` option, checks whether the specified target can change to standby.

The actual state of specified path does not change when using `-v` suboption.

```
spsadmin --version
```

Displays the versions of PathManager RPM packages.

1. Utility package
2. Driver package
3. Mcoption package (if installed)

```
spsadmin --suspend target
```

Sets the path specified in target into a reserve (RSV) state.

```
spsadmin --resume target
```

Restores the path specified in target from a reserve (RSV) state.

```
spsadmin --scan
```

Scans the devices and the paths on the system.

[How to specify target]

The argument "target" accepts four types of specifying.

1. SCSI address description

This type is described with four items which are HostNo, Cannel number, TargetID, Logical unit number.

Specify the each item dividing by colon as shown below.

```
3:0:0:1
```

Each item is omissible. Omitted items are treated as wildcards.

For example, the following expression means the all paths whose HostNo is 3 and Channel number is 0.

```
3:0::
```

And the following one means All the paths managed by PathManager.

```
:::
```

And the following format can be accepted. Omitted items are treated as wildcards.

```
--host 3 --channel 0 --id 0 --ldn 1
```

2. Physical address description

A SCSI address may be changed by rebooting a server. By contrast, physical address description uses physical location information not affected by such a case.

An example is shown below.

```
P:3f:0:0003000433204223:1:0:3
```

Leading character "P" is the symbol that represents the description is physical address one. And the items after "P" are PCI bus number, PCI slot number, serial number of storage unit, host director number of storage unit, port number of host director and logical disk identifier.

Omitted items are treated as wildcard like as SCSI address description.

Storage Processor should be specified instead of host director number. And logical unit identifier can not be used, therefore logical unit identifier is always treated as wildcard. An example is shown below.

```
P:3f:0:SLES3000433204223:A:0:
```

And the following format can be accepted. Omitted items are treated as wildcards.
`--busid 0000:3f:09.0 --serial 0003000433204223 --hd 1 --port 3`

3. Logical disk description

This format is used to specify a logical disk.

If this description is used for a option that affects per path, such as "--active", all the paths on the specified logical unit are set into target.

The following two formats can be accepted in logical disk description.

```
D:0003000433204223:3
```

```
D:12:34:56:78:90:12:34:55:67:78:23:12:45:67:34:12
```

Leading character "D" is the symbol that represents the description is logical disk one.

In the upper one, two items are serial number of storage unit and logical disk number. But, logical disk number can not be used as same as the physical address description.

To specify the logical disk on Overland SnapSAN S3000/S5000, use the lower description. It consists of only logical disk identifier (LunWWN).

And the following format can be accepted

```
--lunwwn 00:00:00:00:00:00:00:00
```

4. Device file description

This format is described with a device file name (`/dev/sdX`, `dev/ddX`). Only the device file beginning with `/dev/sd` or `/dev/dd` can be accepted. If the device file is described with `/dev/sd`, the target is a corresponding path. If described with `/dev/dd`, the target is a corresponding logical disk.

To specify the plural device files, enumerate the device file names or use wildcard.

5. Path number description

This format is described with a path number (decimal integer).

[command mapping with older version]

The following table shows the command examples to handle the several cases using newer command (`spsadmin`) and older command (`spscmd`).

Command Mapping	
Recover a faulty path	
old	spscmd -recover [<i>path</i> [<i>serial</i>]: <i>HD</i>]
new	spsadmin --failback [<i>path</i> [--serial <i>serial</i>] --hd <i>HD</i>]
Suspend a path	
old	spscmd -rm [<i>path</i> [<i>serial</i>]: <i>HD</i>]
new	spsadmin --suspend [<i>path</i> [--serial <i>serial</i>] --hd <i>HD</i>]
Resume a suspended path	
old	spscmd -add [<i>path</i> [<i>serial</i>]: <i>HD</i>]
new	spsadmin --resume [<i>path</i> [--serial <i>serial</i>] --hd <i>HD</i>]
Change the active path	
old	spscmd -active [<i>path</i> [<i>serial</i>]: <i>HD</i>]
new	spsadmin --active [<i>path</i> [--serial <i>serial</i>] --hd <i>HD</i>]
Scan to find a path	
old	spscmd -scan
new	spsadmin --scan
Change to the standby state (verifying)	
old	spscmd -verifystandby [<i>path</i> [<i>serial</i>]: <i>HD</i>]
new	spsadmin --standby -v [<i>path</i> [--serial <i>serial</i>] --hd <i>HD</i>]
Change to the standby state	
old	spscmd -standby [<i>path</i> [<i>serial</i>]: <i>HD</i>]
new	spsadmin --standby [<i>path</i> [--serial <i>serial</i>] --hd <i>HD</i>]
Roll back the path setting to the condition of system starting	
old	spscmd -avail [<i>path</i> [<i>serial</i>]: <i>HD</i>]
new	spsadmin --rollback [<i>path</i> [--serial <i>serial</i>] --hd <i>HD</i>]
Get a error history	
old	spscmd -geterr [sub-options(*1)] [<i>path</i> [<i>serial</i>]: <i>HD</i>]
new	spsadmin -geterr [sub-options(*1)] [<i>path</i> [--serial <i>serial</i>] --hd <i>HD</i>]

*1: sub-options have no difference between old and new.

[Name]

spsconfig - Setting the auto startup and checking the correspondence of devices

[Syntax]

spsconfig -auto-run-enable [fc | iscsi | sas]

spsconfig -auto-run-disable

spsconfig -kdump-cfg-add [-blank c] target

spsconfig -kdump-cfg-del target

spsconfig -kdump-cfg-list [target]

```
spsconfig -sanboot-cfg-add
```

```
spsconfig -sanboot-cfg-del
```

```
spsconfig -chk target
```

[Description]

It is used to set the auto startup and set the SAN-Boot environment.

And it is used to check the correspondence between PathManager devices and SCSI devices.

[Options]

"spsconfig" accepts the following options.

```
spsconfig -auto-run-enable [fc | iscsi | sas]
```

Sets the configuration of auto startup.

```
spsconfig -auto-run-disable
```

Cancels the configuration set by "-auto-run-enable".

```
spsconfig -kdump-cfg-add [-blank c] target
```

Displays the configuration of kdump for the PathManager device appointed by target.

If the "-blank c" sub-option is used, the blank characters are replaced by 'c'.

```
spsconfig -kdump-cfg-del target
```

Displays the configuration of kdump that should be deleted for the PathManager device appointed by target.

```
spsconfig -kdump-cfg-list [target]
```

Displays the list of configuration of kdump which had been set up.

```
spsconfig -sanboot-cfg-add
```

Enables to use a PathManager device as a root device on SAN-Boot environment.

```
spsconfig -sanboot-cfg-del
```

Cancels the configuration set by "-sanboot-add".

```
spsconfig -chk target
```

Displays the correspondence between PathManager devices and SCSI devices.

In the case a SCSI device is specified in target, displays the corresponding PathManager device.

In the case a PathManager device is specified in target, displays the corresponding SCSI devices.

To use the "-chk" option, sg_scan command is required.

The sg_scan command is included in the rpm package named "sg3_utils". "sg3_utils" package may not be installed depending on its designation when installing the OS. If "sg3_utils" is not installed, get the sg3_utils rpm package from OS installation CD or WEB site of each distribution. Then, install the rpm package. (In the case of SLES, this command is not included in the rpm file named "sg3_utils" but in the rpm file named "scsi".)

Command of Function Version Less than 5.1.0

This section refers to the following OSes

- Red Hat Enterprise Linux AS/ES 4
- Red Hat Enterprise Linux 5 (Advanced Platform)
- SUSE Linux Enterprise Server 10

mkdd command

[Name]

mkdd - Start operation and change setting of the redundant path system

[Description]

The mkdd command notifies the PathManager driver of the contents of the configuration file (/etc/sps.conf) and directs the PathManager driver to start operation of the multi path system. If no configuration file is found, the PathManager driver attempts to automatically detect the paths. You can execute this command to change the setting.

[Syntax]

```
# mkdd [ [-c] [-f filename] ]
```

[Argument]

None

[Option]

- -c Only checks the configuration file. Does not notify the PathManager driver.
- -f Uses the file specified for filename as the configuration file.

If you execute the mkdd command, I/O performance may be decrease temporarily.

Therefore, operate without any I/O to the PathManager devices if possible.

spscmd command

[Name]

spscmd - Control the multi path system

Controlling Device / Path Option

[Description]

This is the option to control the device/path of PathManager.

[Syntax]

```
# spscmd {options} [path | [serial]:HD]
```

[Option]

-recover...Recovers the fault path.

Use it to recover the fault path after removing the fault factor in the fault condition. Specify the path number to recover into path_num. Because the order of recovering path is not restrict, you can recover any path. No matter what type of path (active path/ alternate path).

-rm...Removes the path.

Use it to remove the path. The removed path becomes reserve condition (RSV). If a path is removed and become reserve condition, the path will not operate as alternate path.

Specify the path number to remove into path_num.

-add...Builds in the reserve (RSV) path.

Use it to build-in the path of reserve condition (RSV).

Specify the path number to build-in into path_num.

-active...Changes the active path. (*1)

Use it to change the active path to a LUN of static load distribution mode.

-scan...Rescans the path. (*2)(*3)

Use it to build-in the path recovered during operations.

To build-in a recovered path, execute the spscmd -scan command, and then do the mkdd command.

verifystandby...Verifies if the specified paths can be set to standby. (*5)

Use it to verify the target paths can be set to standby. This option does not change the status of paths actually.

-standby...Changes the path state to standby. (*5)

Use it to change the state of the target paths to standby.

-avail...Rolls back the state of the active paths to the boot. (*5)

Use it to roll back the active paths to the boot if those paths are changed after a boot by using a command and so on.

[Argument]

path ...Specify the path number of the target path.

[serial]:HD ...Specify the device serial number of the target storage unit in serial. And specify the host director number of the target controller in HD. You can confirm the serial number and host director number from the configuration of Overland storage.

Serial is omissible. If serial is omitted, controllers whose number is specified with HD on all storage units in the system become target. (*4)

*1: *1: You can use -active option with the function version 4.1.5 or later.

*2: You can use -scan option only if the configuration file format of PathManager is ver.1.1 and the function version of PathManager is 3.0.5 or later.

*3: The I/O performance might decrease temporarily when spscmd -scan command is executed.

So,execute this command when I/O traffic is as less as possible.

*4: You can specify using [serial]:HD with PathManager function version 4.3.0 or later.

*5: You can use -verifystandby, -standby and -avail options with the function versions shown as below.

- Red Hat Enterprise Linux 4: PathManager ver. 3.1.0 or later.
- Red Hat Enterprise Linux 5: PathManager ver. 4.3.1 or later.
- SUSE Linux Enterprise Server 10 : PathManager ver. 4.3.1 or later.

Getting Error History Option (*6)

[Description]

This is the option to get the history of errors using PathManager.

[Syntax]

```
# spscmd -geterr [sub-options] [path | [serial]:HD]
```

[Sub-Option]

-a...Displays all of the error history.

-m {MODE}...Set the mode (format) of error history.

When this parameter is omitted, works as simple mode.

-t {NUM}...Displays the latest NUM errors.

When this parameter is omitted, displays the latest 10 errors.

-v...Displays verbosely.

[Argument]

MODE...Displays all of the retry information.

...simple - displays simply

detail - displays in detail

counts - displays only the total number of errors.

NUM...Specify the number of error information.

The maximum value is 1024.

path...Refer to previous page "(1) Controlling Device / Path Option".

[serial] : HD...Refer to previous page "(1) Controlling Device / Path Option".

spsconfig command

[Name]

spsconfig - Display the optional setting

[Description]

The spsconfig command is used to set a PathManager device as a root device for SAN boot environment or a destination of the dump file of kdump. This command can also be used to confirm a correspondence between a PathManager device and a SCSI device.

[Syntax]

```
# spsconfig { -list [dddev] | -chk {sddev | dddev} | [-add dddev [-blank c]][-del dddev] }
```

[Option]

-list [dddev]...Displays the list of set option.

When dddev is specified, this command shows only the specified device.

-chk{sddev | dddev}...Displays the PathManager devices corresponding to sddev if the SCSI devices are specified.

Displays the SCSI devices corresponding to dddev if the PathManager devices are specified. (*2)

-add dddev...Displays the optional setting to add the PathManager devices specified in dddev.

-del dddev...Displays the optional setting to delete the PathManager devices specified in dddev.

-blank c...Displays the optional setting to set the character specified in c as a blank character.

[Argument]

None

*1: -chk option needs the sg_scan command.

sg_scan command is included in the rpm package named "sg3_utils". "sg3_utils" package may not be installed depending on its designation when installing the OS. If "sg3_utils" is not installed, get the "sg3_utils" rpm package from OS installation CD or WEB site of each distribution. Then, install the rpm package.

*2: You can use dddev with function versions shown as below.

- Red Hat Enterprise Linux 4: PathManager ver. 3.1.0 or later.
- Red Hat Enterprise Linux 5: PathManager ver. 4.3.1 or later.
- SUSE Linux Enterprise Server 10: PathManager ver. 4.3.1 or later.

"root device" means the disk which is necessary to start the OS.

Information Collection

When trouble occurs in the system where PathManager is used, collect information for prompt investigation and resolution. In this case, follow the information collection procedures below.

```

# cd workdir ← Moves to the directory for which the user has the write permission.
# /opt/nec/sps/bin/spslog.sh ← Executes the information collection script (*1).
-----
system information. done
mount information. done
boot information. done
scsi information. done
sps information. done
dd_daemon information. done
lvm information. done
san boot information. done
-----
spslog060227170043.tgz was created.
#
  
```

} Execution log (*2)(*3)

Executing this command automatically collects necessary information and creates a file compressing results. Since the resulting file is created in the current directory, move the directory for which you have the write permission before executing the command.

The year, month, day, hour, minute, and second when the command is executed are added to the file name of collection results. (In this example, information is collected at 17:00:43 on Feb 27 2006.)When the command is executed, the execution log is displayed on the screen.If collection is successfully completed, no error is displayed as in the example. However, if the file to be collected does not exist or if you do not have the copy permission, an error is displayed.In case that an error is displayed, take measures appropriate for the error and then execute the command again by the same procedures.

*1: Execute the command with the root privilege.

*2: Contents of execution log may vary depending on the function version of PathManager.

*3: If you execute the command on the following condition, some I/O error messages may be output. But there is no problem with the command execution and the system.

- Some paths are failed on using FC connection.

Enable/Disable Cluster Mode

When a higher priority path is recovered from a fault on a static load distribution LUN, PathManager automatically switches the active path (the higher priority one becomes active).

If "Cluster Mode" is enabled, PathManager always sets a restored path to an alternate (HOT) with static load distribution LUN except for a total path failure.

(*1) If you use application servers use Cluster Mode.

How to Enable the Cluster Mode

Follow the procedures below to enable the Cluster Mode.

(i) Specify the following option into `/etc/modprobe.conf` as `sps_mod2` module option.

```
options sps_mod2 sps_clustermode=1
```

(ii) Execute the following command and check that no error occurs.

```
# depmod -a `uname -r`  
#
```

(iii) Reboot the system and check that the system starts normally.

```
# sync  
# shutdown -r now  
#
```

(iv) Check that the following log is output to system log.

```
sps: Info: ClusterMode: Enable
```

How to Disable the Cluster Mode

Follow the procedures below to disable the Cluster Mode.

(i) Delete the following line from `/etc/modprobe.conf`.

```
options sps_mod2 sps_clustermode=1
```

(ii) Execute the following command and check that no error occurs.

```
# depmod -a `uname -r`  
#
```

(iii) Reboot the system and check that the system starts normally.

```
# sync  
# shutdown -r now  
#
```

(iv) Check that the following log is not output to system log.

```
sps: Info: ClusterMode: Enable
```

Application Servers X 1.0 to 3.0 / SE Ver3.1

When newly introducing PathManager into the application servers X1.0 to 3.0 / SE Ver3.1 system

1. Check the following two points in advance with WebManager.
All servers are in the normal status (= Green).
2. Manual activation of application servers (for PathManager introduction operation)
Execute the following operations on each server to deactivate the auto startup of application servers so that clusters are not affected by rebooting of PathManager or the others.
application servers is configured not to start automatically when OS starts at next time.
Confirm that the above commands are executed on all servers, and then go to the next procedure.
3. Cluster shutdown
Shut down (reboot) the cluster with WebManager.
4. PathManager installation
5. Modifying the cluster configuration
Modify the following contents of configuration using the Builder / trekking tool.
 - a. Modifying the device name of disk resource e.g. "sdb2" (before modifying)>>>"dda2" (after modifying)
 - b. Modifying the device name of disk monitor e.g. "sdb1" (before modifying)>>>"dda1" (after modifying)
 - c. Modifying the device name of disk heartbeat e.g. "sdb1" (before modifying)>>>"dda1" (after modifying)

[if you use application servers X 1.0 (Version 1.1.0-1 or later) to 3.0]

[if you use application servers X 1.0 (until Version 1.0.3-1)]

[if you use application servers SE Ver3.1]

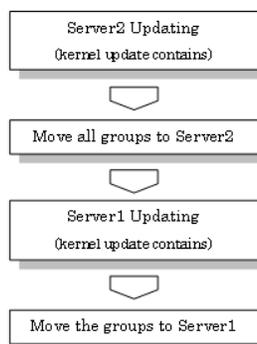
6. Reflecting the cluster configuration
 - a. Start the following services manually on each server.
 - b. Execute the cluster creating command on the master server.
 ![if you use application servers X 1.0 (Version 1.1.0-1 or later) to 3.0]
 [if you use application servers X 1.0 (until Version 1.0.3-1)]
 [if you use application servers SE Ver3.1]

7. Activation of application servers auto startup
Execute the following command on all the servers:
application servers is configured to start automatically when OS starts at next time.
Confirm that the above commands are executed on all servers, then go on the next procedure.
8. Rebooting the server
Reboot the all servers in the cluster using shutdown command (or any other command) of OS.
9. Check the behavior of all failover groups and the actual operation of application such as Oracle to verify that there is no problem.

Updating the kernel and PathManager in the application servers X 1.0 to 3.0 / SE Ver3.1 system where PathManager is already installed

Before execution,check that no error occurs by moving groups.

Updating Server1/Server2



Server2 Updating

1. When any group is operating on the server2, move all of the groups starting on the server2 to the server1 using WebManager.
If you don't use WebManager, move groups using clpgrp command on the server2.
2. Execute the following command on the server2 to modify the starting configuration of services.
application servers is configured not to start automatically when OS starts at next time.
Check that above (1)-(2) procedures are executed on the server2. After checking, go on to the next procedures.
3. Shutdown the server2 using WebManager.
If you don't use WebManager, shutdown using clpdown command on the server2.
4. Reboot the server2 and login as root.
5. Update the kernel and the PathManager. When you want to update the kernel,update at this stage.
After updating, reboot the server2 using shutdown or reboot command, login as root.

6. Execute the following command to modify the starting configuration of services.
application servers is configured to start automatically when OS starts at next time.
Check that above (iii)-(vi) procedures are executed on the server2. After checking, go on to the next procedures.
7. Reboot the server2 using shutdown or reboot command.
The update is complete.
8. Proceed to server1 update.

Server2

1. Move all of the groups to server2
2. Move all of the groups starting on the server1 to the server2 using clpgrp.
3. Terminate the browser connecting to WebManager, and clear the Java cache, then restart the browser.
4. Check that all of the groups operated on server1 were moved and that each resource of all groups is operating normally by using WebManager.

If you don't use WebManager, check using clpstat command on any server.

For checking that the applications on the groups are operating normally, check by each application.

Verify steps (1)-(3) are executed. After checking, go on to the next procedures.

Server1 Updating

1. Execute the following command on the server1 to modify the starting configuration of services.
application servers is configured not to start automatically when OS starts at next time.
Check that above (1) procedures are executed on the server1. After checking, go on to the next procedures.
2. Shutdown the server2 using WebManager.
If you don't use WebManager, shutdown using clpdown command on the server2.
3. Reboot the server2 and login as root.
4. Update the kernel and the PathManager. After updating, reboot the server2 using shutdown or reboot command, login as root
5. Execute the following command to modify the starting configuration of services.
application servers is configured to start automatically when OS starts at next time.
6. Check that above (ii)-(v) procedures are executed on the server1. After checking, go on to the next procedures.
7. Reboot the server1 using shutdown or reboot command.
The server1 update is complete.
8. Move the groups to server1

It is not necessary to execute following (1)-(2) procedures unless you need to move the groups to server1.

Server1

1. Move the groups you want to execute on server1 to server1 from server2.
If you don't use application servers, execute `clpgrp` command on server2 to move the groups.
2. Check that each resource of moved groups is operating normally by using WebManager.
If you don't use WebManager, check using `clpstat` command on any server.
For checking that the applications on the groups are operating normally, check by each application.
The update is complete.

Adding/Removing PathManager Devices

This section shows how to set and reset the setting to use PathManager device using LVM.

If you use LVM on PathManager devices, you must use the OSes shown below:

- Red Hat Enterprise Linux AS/ES 4 (kernel 2.6.9-42.EL or later)
- Red Hat Enterprise Linux 5 (kernel-2.6.18-53.el5 or later)
- Red Hat Enterprise Linux 5 Advanced Platform (kernel-2.6.18-53.el5 or later)
- Red Hat Enterprise Linux 6 (Kernel-2.6.32-131.0.15.el6 or later)
- SUSE Linux Enterprise Server 10 (kernel-2.6.16.60-0.21 or later)

Adding PathManager Devices to LVM

To add PathManager devices to LVM, follow the procedures described below.

Execute the `sg_scan` command and confirm the SCSI disks recognized by the OS.

If "Overland Storage" and "Model Name" are displayed, this SCSI disk is Overland (shown by the shaded part).

"Product Name" is displayed.

In the following example, `/dev/sda` and `/dev/sdb` are local disks, and `dev/sdc` is the Overland.

```
# sg_scan -i /dev/sda
/dev/sda: scsi0 channel=0 id=0 lun=0 [em]
  xxx  xxxxxxxxxxxxxxxx  xxxx [rmb=0 cmdq=1 pqual=0 pdev=0x0]

# sg_scan -i /dev/sdb
/dev/sdb: scsi0 channel=0 id=0 lun=0 [em]
  xxx  xxxxxxxxxxxxxxxx  xxxx [rmb=0 cmdq=1 pqual=0 pdev=0x0]
```

The `sg_scan` command is included in the rpm package named "sg3_utils". "sg3_utils" package may not be installed depending on its designation when installing the OS. If "sg3_utils" is not installed, get the `sg3_utils` rpm package from OS installation CD or WEB site of each distribution. Then, install the rpm package. (In the case of SLES, this command is not included in the rpm file named "sg3_utils" but in the rpm file named "scsi".)

(ii) Modify the setting file of LVM. (follow the procedures below)

1. Make a backup copy of setting file of LVM.

Make a backup copy of `/etc/lvm/lvm.conf` to `/etc/lvm/lvm.conf.sps`.

2. Modify the "filter" entry in "devices{}" area.

In "filter" entries, "a" means accept, "r" means reject.

You must specify the all partitions managed by LVM.

For example, if sda2 and sdb1 are local disks managed by LVM, set as follows.

(a) Write "a|/dev/sda2|", "a|/dev/sdb1|" at the "filter" entry.

(b) Write "a|/dev/dd.*|" to accept all PathManager devices.

(c) Write "r|/dev/.*|" to reject any other devices.

3. Add the "types" entry in "devices{}" area.

Add "types = ["dd", 16]"

```
# cp -p /etc/lvm/lvm.conf /etc/lvm/lvm.conf.sps
# vi /etc/lvm/lvm.conf
...
# This section allows you to configure which block devices should
# be used by the LVM system.
devices {
...
# By default we accept every block device except udev names:
filter = [ "a|/dev/sda2|", "a|/dev/sdb1|", "a|/dev/dd.*|", "r|/dev/.*|" ]
# Exclude the cdrom drive
# filter = [ "r|/dev/cdrom|" ]
...
# Advanced settings.
# List of pairs of additional acceptable block device types found
# in /proc/devices with maximum (non-zero) number of partitions.
# types = [ "fd", 16 ]
types = [ "dd", 16 ]
...
}
```

If there are some contradictions with accept/reject patterns, the first one is valid. This is because of specification of LVM. For example, if a reject pattern for all devices (like "r|.*)" and some accept ones are written in that order, the latter ones are not valid. So be sure to write a reject patterns at the end. The format of lvm.conf is a bit different from Regular Expression.

For example, if you write "a/dd.*/" into filter entry to manage the ddX devices, LVM will not work as intended. Be sure to refer the setting examples of lvm.conf file.

Make the logical volume on PathManager device. After that, add the entry of the logical volume name into /etc/fstab. (For example: The logical volume name you made is /dev/vg0/lv0)

```
# vi /etc/fstab
...
/dev/vg0/lv0 /mnt/work ext3 defaults 0 0
```

Don't write the PathManager device name (ddX) to `/etc/fstab`. Write the logical volume name which is made by PathManager devices.

Restart the OS.

```
# sync
# shutdown -r now
...
```

After the OS is restarted, confirm that LVM recognizes the PathManager devices by using `pvdisplay` and `lvmdiskscan` command.

In the following example, `/dev/sda2` and `/dev/sdb1` are local disks managed by LVM, `/dev/sda1` is a PathManager device managed by LVM on the Overland.

```
# pvdisplay
... Physical volume ...
PV Name      /dev/sda2
VG Name      VolGroup00
PV Size      33.77 GB / not usable 25.25 MB
Allocatable  yes
PE Size (KByte)  32768
Total PE     1080
Free PE      1
Allocated PE  1079
PV UUID      2Toe3W-qwxZ-YNLV-s4n9-uvLa-DbRA-03JByM

... Physical volume ...
PV Name      /dev/sdb1
VG Name      VolGroup00
PV Size      16.62 GB / not usable 1.98 MB
Allocatable  yes
PE Size (KByte)  4096
Total PE     4255
Free PE      4255
Allocated PE  0
PV UUID      QafExI-VCu3-LV14-1084-pq5k-KKmj-Gul2B0

... Physical volume ...
PV Name      /dev/sda1
VG Name      vg0
PV Size      16.62 GB / not usable 1.98 MB
Allocatable  yes
PE Size (KByte)  4096
Total PE     4255
Free PE      2463
Allocated PE  1792
PV UUID      OTYnJ1-YIPG-bkbd-krzS-FxVf-Zzon-Ho1E2
```

```
# lvmdiskscan
/dev/sda1 [ 101.94 MB]
/dev/sda2 [ 33.77 GB] LVM physical volume
/dev/sdb1 [ 16.62 GB] LVM physical volume
/dev/sda1 [ 16.62 GB] LVM physical volume
X disks
X partitions
X LVM physical volume whole disks
X LVM physical volumes
#
```

If the alert message shown below is displayed as a result of `pvdiskdisplay` or `lvmdiskscan` command, both the PathManager device (`/dev/ddX`) and the SCSI device (`/dev/sdX`) come from the same device are accepted in the "filter" entry of LVM setting file. In this case, modify the LVM setting file so that only the PathManager device (`/dev/ddX`) is accepted.

(Alert Message)

"Found duplicate PV 8MScmu8H6OG1Lr0JSOJ9cKPnXltZJHKh: using `/dev/sdX1` not `/dev/ddX1`"

The procedure to add PathManager devices to LVM is complete.

Removing PathManager Devices from LVM

To remove PathManager devices from LVM, follow the procedures described below. (The LVM setting file which was backed up in the procedure (ii) of the previous section "Adding PathManager Devices from LVM" is needed.)

- (i) Reset the LVM setting file which was backed up in the procedure (ii) of the previous section "Adding PathManager Devices from LVM".

```
# mv /etc/lvm/lvm.conf.bps /etc/lvm/lvm.conf
#
```

- (ii) Reset the mounting description of `/etc/fstab` modified in the procedure (iii) of the previous section "Adding PathManager Devices from LVM".

```
# vi /etc/fstab
...
/dev/vg0/lv0          /mnt/work            ext3    defaults    0 0
....
```

- (iii) Restart the OS.

```
# sync
# shutdown -r now
....
```

- (iv) After restarting OS, confirm that LVM doesn't recognize the PathManager devices.

```
# lvmdiskscan
/dev/sda1 [      101.94 MB]
/dev/sda2 [      92.77 GB] LVM physical volume
/dev/sdb1 [      16.62 GB] LVM physical volume
/dev/sdc1 [      16.62 GB] LVM physical volume
/dev/sdd1 [      16.62 GB] LVM physical volume
X disks
X partitions
X LVM physical volume whole disks
X LVM physical volumes
#
```

The procedures to remove PathManager devices from LVM are complete.

How to Set up kdump

This section shows how to set and cancel the setting to use PathManager device using LVM.

Red Hat Enterprise Linux 5/6

If you use kdump with PathManager devices, you must use the OS shown below:

- Red Hat Enterprise Linux 5 (Kernel-2.6.18-53.el5 or later)
- Red Hat Enterprise Linux 5 Advanced Platform (Kernel-2.6.18-92.el5 or later)
- Red Hat Enterprise Linux 6 (Kernel-2.6.32-131.0.15.el6 or later)

* PathManager does not support the kdump via iSCSI connection.

Setting up kdump with a PathManager Device

To set up kdump with a PathManager device, follow the procedures described below.

Example) If you make kdump output to "/dev/dda1" (filesystem: ext3).

Modify the "/etc/kdump.conf" file.

Making a backup copy of kdump.conf. (This will be used to reset.)

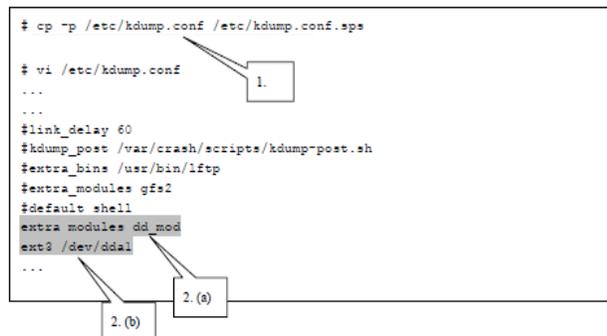
1. Make a backup copy of "/etc/kdump.conf" to "/etc/kdump.conf.sps".
2. Write the setting that kdump loads the "dd_mod".
3. Write the setting that the target of kdump is /dev/dda1.

```

# cp -p /etc/kdump.conf /etc/kdump.conf.sps

# vi /etc/kdump.conf
...
...
$link_delay 60
#kdump_post /var/crash/scripts/kdump-post.sh
#extra_bins /usr/bin/lftp
#extra_modules gfs2
#default_shell
extra modules dd_mod
ext3 /dev/dda1
...

```



<Red Hat Enterprise Linux 6>

Execute "spsconfig" command with "-kdump-cfg-add" option.

```
#spsconfig -kdump-cfg-add /dev/dda >> /etc/kdump.conf
```

Next, go to Step 4.

<Red Hat Enterprise Linux 5>

Modify the "/etc/modprobe.conf" file

1. Making the backup copy of modprobe.conf. (This will be used to reset)
Make the backup copy of "/etc/modprobe.conf" to "/etc/modprobe.conf.sps".
2. Update of modprobe.conf.
Update "/etc/modprobe.conf" executing the spsconfig command with "-add" option so that "/dev/dda1" is built into the kernel.
3. Confirming modprobe.conf.
Open "/etc/modprobe.conf", and confirm that the shaded part shown below is added.

```
# cp -p /etc/modprobe.conf /etc/modprobe.conf.sps
# spsconfig -add /dev/dda >> /etc/modprobe.conf
# cat /etc/modprobe.conf
...
# Please add the following line to /etc/modprobe.conf
options sps_mod dda=NEC_____,iStorage_2000_____,0000000929200235,00000
...
```

(iv) Restart kdump to rebuild the boot RAM disk image.

```
# /etc/rc.d/init.d/kdump restart
Stopping kdump: [ OK ]
Detected change(s) the following file(s):

/etc/kdump.conf
Rebuilding /boot/initrd-2.6.18-53.el5kdump.img
Starting kdump: [ OK ]
#
```

Setting up kdump with a PathManager device is complete.

Resetting the kdump setting

To reset the setting of kdump with a PathManager device, follow the procedures:

The backup copies (made at (1) and (2) in "Setting up the kdump with a PathManager Device") are used to reset.

4. Reset kdump.conf and modprobe.conf by the backup copies which are made in "Setting up the kdump with a PathManager Device".

```
# mv /etc/kdump.conf.sps /etc/kdump.conf
#
# mv /etc/modprobe.conf.sps /etc/modprobe.conf
#
```

(ii) Restart kdump to rebuild the boot RAM disk image.

```
#!/etc/rc.d/init.d/kdump restart
Stopping kdump: [ OK ]
Detected change(s) the following file(s):

/etc/kdump.conf
Rebuilding /boot/initrd-2.6.18-53.el5kdump.img
Starting kdump: [ OK ]
#
```

The resetting the kdump setting is complete.

SUSE Linux Enterprise Server 10

The following three RPM packages are required to use PathManager device as kdump output.

Install them before setup from installation CD of OS or web site of each OS distribution.

Example) in the case of kernel-2.6.16-60-0.39.3

- kernel-kdump-2.6.16-60.0.39.3.*.rpm
- kdump-0.3.0-8.9.*.rpm
- kexec-tools-1.101-32.48.*.rpm

PathManager driver package for kdump (sps-kdump-*.rpm) should be installed after setting up kdump with a PathManager Device. Do not change the order of setup.

Do not specify a device of disk array unit connected via iSCSI.

Setting up kdump with a PathManager device

To set up kdump with a PathManager device, follow the procedures.

Example If you make kdump output to "/dev/ddc1".

Modify the "/etc/sysconfig/kernel" file.

1. Making a backup copy of "/etc/sysconfig/kernel".

Make a backup copy of "/etc/sysconfig/kernel" as "/etc/sysconfig/kernel.sps".

2. Write the setting that kdump loads the "dd_mod.ko".

(* Place the text "dd_mod" in the end of "INITRD_MODULES" line.)

```

# cp -p /etc/sysconfig/kernel /etc/sysconfig/kernel.sps
#
# vi /etc/sysconfig/kernel

## Path:      System/Kernel
## Description:
## Type:      string
## Command:   /sbin/mkinitrd
#
# This variable contains the list of modules to be added to the initial
# ramdisk by calling the script "mkinitrd"
# (like drivers for scsi-controllers, for lvm or reiserfs)
#
#INITRD_MODULES="piix aic79xx lpfc processor thermal fan reiserfs add
dd_mod"
...

```

If you specify an in-use partition as a destination of kdump, kdump breaks the file system of it when dumping. Therefore, be careful to set the configuration.

(iii) Modify the "/etc/modprobe.conf" file.

1. Making a backup copy of "/etc/modprobe.conf".

Make a backup copy of "/etc/modprobe.conf" as "/etc/modprobe.conf.sps".

2. Updating the "/etc/modprobe.conf" file.

Execute the "spsconfig" command with "-add" option to update the "/etc/modprobe.conf" file. (with specifying the device name (/dev/ddc) of the destination of kdump)

3. Confirming modprobe.conf.

Open "/etc/modprobe.conf", and confirm that the shaded part shown below is added.

```

# cp -p /etc/modprobe.conf /etc/modprobe.conf.sps
#
# #spsconfig -add /dev/ddc >> /etc/modprobe.conf
#
# cat /etc/modprobe.conf
...
# Please add the following line to /etc/modprobe.conf
options sps_mod ddc=NEC ,iStorage_2000 ,0000000929200235,00002
...

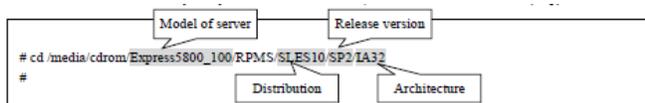
```

(iv) Installation of PathManager driver for kdump

1. Install the RPM file of PathManager driver for kdump

Move to the directory of compatible RPM files in installation CD-ROM. How to specify the directory is shown below.

- If the kernel version of your system is 2.6.16-60-0.39.3, and its architecture is IA32 (smp) -



Execute the following command to install the RPM files corresponding to the kernel version you use.

(Shaded part shows the corresponding kernel.)

```
# uname -r
2.6.16.60-0.39.3-smp
# rpm -ivh sps-kdump-E-4.2.4-2.6.16.60.0.39.3.i586.rpm

Preparing... ##### [100%]
 1:sps-kdump-E ##### [100%]
Setting up /lib/modules/2.6.16.60-0.39.3-kdump
Root device: /dev/disk/by-id/scsi-35000cca002d49f14-part2 (/dev/sda2)
(mounted on / as reiserfs)
Module list: piix aic79xx lpfc processor thermal fan reiserfs edd
dd_mod (xennet xenblk)
Kernel image: /boot/vmlinuz-2.6.16.60-0.39.3-kdump
Initrd image: /boot/initrd-2.6.16.60-0.39.3-kdump
Shared libs: lib64/ld-2.4.so lib64/libacl.so.1.1.0
lib64/libattr.so.1.1.0 lib64/libc-2.4.so lib64/libdl-2.4.so
lib64/libhistory.so.5.1 lib64/libncurses.so.5.5 lib64/libpthread-2.4.so
lib64/libreadline.so.5.1 lib64/librt-2.4.so lib64/libuuid.so.1.2
lib64/libnss_files-2.4.so lib64/libnss_files.so.2 lib64/libgcc_s.so.1

Driver modules: ide-core ide-disk scsi_mod sd_mod piix scsi_transport_spi
aic79xx scsi_transport_fc firmware_class lpfc processor thermal fan edd
sps_mod2 sps_mod dd_mod libata ahci ata_piix
Filesystem modules: reiserfs
Including: kdump initramfs fsck.reiserfs
No bootsplash for kernel flavor kdump
17422 blocks
```

Check dd_mod is displayed in the list

Check both sps_mod and sps_mod2 are displayed in the list

2. Execute the following command to check that no error is displayed.

```
# depmod -a `uname -r`
#
```

3. Modify the bootloader configuration file to add the "crashkernel=64M@16M" as a boot option.
(* If that has already been described, skip here.)

```
# vi /boot/grub/menu.lst
# Modified by YaST2. Last modification on Mon Aug 24 14:00:59 JST 2009
default 0
timeout 8
##YaST - generic_mbr
gfxmenu (hd0,1)/boot/message
##YaST - activate

###Don't change this comment - YaST2 identifier: Original name: linux-
2.6.16.60-0.39.3-smp###
title SUSE Linux Enterprise Server 10 SP2 - 2.6.16.60-0.39.3 (smp)
root (hd0,1)
kernel /boot/vmlinuz-2.6.16.60-0.39.3-smp root=/dev/disk/by-id/ata-
Maxtor_2F040L0_FLHQF6GE-part2 vga=0x317 resume=/dev/hda1 splash=silent
showopts crashkernel=64M@16M
initrd /boot/initrd-2.6.16.60-0.39.3-smp

###Don't change this comment - YaST2 identifier: Original name:
failsafe-2.6.16.60-0.39.3-smp###
title Failsafe -- SUSE Linux Enterprise Server 10 SP2 - 2.6.16.60-0.39.3
(smp)
root (hd0,1)
kernel /boot/vmlinuz-2.6.16.60-0.39.3-smp root=/dev/disk/by-id/ata-
Maxtor_2F040L0_FLHQF6GE-part2 vga=normal showopts ide=nodma apm=off
acpi=off noresume nosmp noapic maxcpus=0 eed=off 3
initrd /boot/initrd-2.6.16.60-0.39.3-smp
...
```

4. Execute the "chkconfig" command to check that auto startup configuration of kdump is "on"
(* If all configuration items are off as shown below, please turn on with "-add" option.)

```
# chkconfig --list kdump
kdump 0:off 1:off 2:off 3:off 4:off 5:off 6:off
# chkconfig --add kdump
kdump 0:off 1:on 2:on 3:on 4:off 5:on 6:off
#
```

5. Reboot the system and check that it starts up normally.

```
# sync
# shutdown -r now
#
```

6. Check the status of kdump to check that it starts up normally.

```
# /etc/init.d/kdump status
kdump kernel loaded
#
```

With that, installation of PathManager driver for kdump is complete.

Resetting the kdump setting

To reset the setting of kdump with a PathManager device, follow the procedure:

The backup copies are used to reset.

- (i) Reset the backup copies which are made at (i), (ii), and (iii) in "Setting up the kdump with a PathManager Device".

```
# mv /etc/sysconfig/kernel.sps /etc/sysconfig/kernel
#
# mv /etc/sysconfig/kdump.sps /etc/sysconfig/kdump
#
# mv /etc/modprobe.conf.sps /etc/modprobe.conf
#
```

- (ii) Uninstall the RPM file of PathManager driver for kdump.

```
# uname -r
2.6.16.60-0.39.3-smp
# rpm -e sps-kdump-E-4.2.4-2.6.16.60.0.39.3

Setting up /lib/modules/2.6.16.60-0.39.3-kdump
Root device: /dev/disk/by-id/scsi-35000cca002d49f14-part2 (/dev/sda2) (mounted on /
as reiserfs)
Module list: piix aic79xx lpfc processor thermal fan reiserfs edd (xennet xenblk)

Kernel image: /boot/vmlinuz-2.6.16.60-0.39.3-kdump
Initrd image: /boot/initrd-2.6.16.60-0.39.3-kdump
Shared libs: lib64/ld-2.4.so lib64/libacl.so.1.1.0 lib64/libattr.so.1.1.0 lib64/libc-2.4.so
lib64/libdl-2.4.so lib64/libhistory.so.5.1 lib64/libncurses.so.5.5
lib64/libpthread-2.4.so lib64/libreadline.so.5.1 lib64/librt-2.4.so
lib64/libuuid.so.1.2 lib64/libnss_files-2.4.so lib64/libnss_files.so.2
lib64/libgcc_s.so.1

Driver modules: ide-core ide-disk scsi_mod sd_mod piix scsi_transport_spi aic79xx
scsi_transport_fc firmware_class lpfc processor thermal fan edd libata ahci
ata_piix
Filesystem modules: reiserfs
Including: kdump initramfs fsck.reiserfs
No bootsplash for kernel flavor kdump
16680 blocks
#
```

- (iii) Execute the following command to check that no error is displayed.

```
# depmod -a `uname -r`
#
```

- (iv) Restart the kdump

```
# /etc/init.d/kdump restart
Unloading kdump done
Loading kdump done
```

The resetting the kdump setting is complete.

This section shows the description and handling of each error message from installer (install.sh/uninstall.sh).

Error Message List

Error Message Description	Handling No.* (refer to Handling List)
ErrCode:[1-01] sps doesn't support iSCSI connection with RENS. Installer cannot accept both option "mcopt" and "iscsi".	1 (PARAM)
ErrCode:[1-02] sps-kdump need not to be installed on RedHat. If the system is Red Hat Enterprise Linux, sps-kdump is unnecessary. Use the built-in kdump.	
ErrCode:[1-03] sps doesn't support iSCSI connection on SuSE. PathManager doesn't support iSCSI connection on SuSE.	
ErrCode:[1-04] sps-mcopt doesn't support on SuSE. PathManager doesn't support sps-mcopt on SuSE.	
ErrCode:[1-05] sps-mcopt is only supported on x86_64 architecture. PathManager supports sps-mcopt only on x86_64 architecture.	
ErrCode:[2-01] sps doesn't support this kernel. This kernel is not supported by PathManager's installer.	2 (STATUSERR)
ErrCode:[2-02] This installer is for RHEL5.4 or later and SLES10 SP3 or later. This installer is for RHEL5.4 or later.	
ErrCode:[2-03] Some of sps rpm packages are already installed. Some of PathManager RPM packages are already installed.	
ErrCode:[2-04] Failed to read the media. Failed to read the media. When installation, the current directory should be the one where the installer exists in the media.	

Error Message	Handling No.* (refer to Handling List)
Description	
ErrCode:[3-01] Couldn't find sps-driver-xxx.rpm in this media. Couldn't find the PathManager driver RPM package corresponding to the kernel of this system.	3 (RPMPKG)
ErrCode:[3-02] Couldn't find sps-utils rpm in this media. Couldn't find the PathManager utils RPM package corresponding to the kernel of this system.	
ErrCode:[3-03] Couldn't find sps-mcopt rpm in this media. Couldn't find the sps-mcopt RPM package corresponding to the kernel of this system.	
ErrCode:[3-04] Couldn't find sps-kdump rpm in this media. Couldn't find the sps-kdump RPM package corresponding to the kernel of this system.	

Error Message	Handling No.* (refer to Handling List)
Description	
ErrCode:[4-01] mcl-rens-kernel rpm is needed by sps-mcopt. mcl-rens-kernel should be installed before installation of sps-mcopt.	4 (EXTERNAL)
ErrCode:[4-02] mcl-rens-base rpm is needed by sps-mcopt. mcl-rens-base should be installed before installation of sps-mcopt.	
ErrCode:[4-03] kernel-kdump rpm is needed by sps-kdump. kernel-kdump should be installed before installation of sps-kdump.	
ErrCode:[4-04] kdump rpm is needed by sps-kdump. kdump should be installed before installation of sps-kdump.	
ErrCode:[4-05] kexec-tools rpm is needed by sps-kdump. kexec-tools should be installed before installation of sps-kdump.	
ErrCode:[4-06] iscsi-initiator-utils rpm is needed by iSCSI connection. If PathManager connects via iSCSI, iscsi-initiator-utils should be installed.	
ErrCode:[4-07] Stop spsmonitor(spsmon) by RENS command before uninstallation. spsmonitor (spsmon) should be stopped by RENS command before installation of sps-mcopt.	

Error Message	Handling No.*
Description	(refer to Handling List)
ErrCode:[5-01] Failed to modprobe. Failed to probe the sps driver.	5 (DRIVER)
ErrCode:[5-02] dd_mod.ko isn't found. Couldn't find the dd_mod.ko.	
ErrCode:[5-03] sps_mod.ko isn't found. Couldn't find the sps_mod.ko.	
ErrCode:[6-01] Failed to mkdd. Failed to build the PathManager device.	6 (MKDD)
ErrCode:[6-02] /proc/scsi/sps or /sbin/mkdd isn't found. Couldn't find the files related to mkdd.	

Error Message	Handling No.*
Description	(refer to Handling List)
ErrCode:[7-01] Failed to dd_daemon. Failed to start dd_daemon.	7 (DDDAEMON)
ErrCode:[7-02] /sbin/dd_daemon or /etc/init.d/dd_daemon isn't found. Couldn't find the files related to dd_daemon.	

Error Message	Handling No.* (refer to Handling List)
Description	
ErrCode:[8-01] Failed to patched for FC. Failed to apply a patch for fibre channel in installation.	8 (PATCH)
ErrCode:[8-02] Failed to patched for iSCSI. Failed to apply a patch for iSCSI in installation.	
ErrCode:[8-03] Couldn't find /opt/nec/sps/patch directory. Couldn't find /opt/nec/sps/patch directory in installation.	
ErrCode:[8-04] Failed to depatched for FC. Failed to unpatch (depatch) for fibre channel.	
ErrCode:[8-05] Failed to depatched for iSCSI. Failed to unpatch (depatch) for fibre channel.	
ErrCode:[8-06] Couldn't find /opt/nec/sps/patch directory. Couldn't find /opt/nec/sps/patch directory in uninstallation.	
ErrCode:[9-01] Couldn't find patch for FC. Couldn't find the patch file for fibre channel in installation.	
ErrCode:[9-02] Couldn't find patch for iSCSI. Couldn't find the patch file for iSCSI in installation.	
ErrCode:[9-03] Couldn't find patch for FC. Couldn't find the patch file for fibre channel in uninstallation.	
ErrCode:[9-04] Couldn't find patch for iSCSI. Couldn't find the patch file for iSCSI in uninstallation.	
ErrCode:[10-01] Failed to sps-driver rpm installation. Failed to install the sps-driver RPM package.	
ErrCode:[10-02] Failed to sps-utils rpm installation. Failed to install the sps-utils RPM package.	
ErrCode:[10-03] Failed to sps-mcopt rpm installation. Failed to install the sps-mcopt RPM package.	
ErrCode:[10-04] Failed to sps-kdump rpm installation. Failed to install the sps-kdump RPM package.	

Error Message Description	Handling No.* (refer to Handling List)
ErrCode:[11-01] Failed to sps-kdump rpm uninstallation. Failed to uninstall the sps-kdump RPM package.	9 (UNINSTALL)
ErrCode:[11-02] Failed to sps-mcopt rpm uninstallation. Failed to uninstall the sps-mcopt RPM package.	
ErrCode:[11-03] Failed to sps-utils rpm uninstallation. Failed to uninstall the sps-utils RPM package.	
ErrCode:[11-04] Failed to sps-driver rpm uninstallation. Failed to uninstall the sps-driver RPM package.	

* "Handling No." is an exit code of installer, and used as handling number.

Handling List

Handling No.	Meaning	Detail and How to do
1 (PARAM)	Parameter Error	Specify the correct parameters and execute the installer again.
2 (STATUSERR)	Status Error or Environment Error	<p>[Status Error]</p> <ul style="list-style-type: none"> There are some installed RPM packages related to PathManager. Uninstall them and try again. Failed to read the media. Perhaps installer was executed from wrong directory. On installation, the current directory should be the one where the installer exists in the media. <p>[Environment Error]</p> <ul style="list-style-type: none"> Check the environment. PathManager is supported to work on Red Hat Enterprise Linux and SUSE Linux Enterprise Server. You can use installer on Red Hat Enterprise Linux 5.4 or later / SUSE Linux Enterprise Server 10 SP3 or later. Don't use on other OS distributions.
3 (RPMPKG)	Search RPM Package Error	<p>Installation may start on a non-supported kernel. Check whether the kernel is the one on which PathManager can be supported.</p>
4 (EXTERNAL)	External Cause Error	<p>[Red Hat Enterprise Linux] (in Installation)</p> <ul style="list-style-type: none"> iscsi-initiator-utils RPM package should be installed before PathManager work with iSCSI. <p>[SUSE Linux Enterprise Server] (in Installation)</p> <ul style="list-style-type: none"> The kdump modules are required for PathManager kdump driver to install. Install the modules.

Handling No.	Meaning	How to do
5 (DRIVER)	Driver Error	sps-driver may fail to start, or some files related to sps-driver may be missing. Uninstall the PathManager and then install it again.
6 (MKDD)	MKDD Error	<ul style="list-style-type: none"> • Check whether FC/LAN cables are connected correctly. If incorrect, connect correctly. • If iSCSI, check whether the iscsi-initiator starts normally. If abnormal, restart the iscsi-initiator. • Check whether /etc/sps.conf (which was created before) exists. If it exists, rename it and execute mkdd command. If same error still occurred in the above execution, probably some files related to mkdd are missing. Uninstall the PathManager and then install it again. <p>- Check whether the server recognizes the logical disk of SnapSAN Manager . If the server does not recognize correctly, check the configuration of SnapSAN Manager so that the server recognizes it. After that, restart the server. Then PathManager will work correctly. (Because the installation was complete.)</p>
7 (DDDAEMON)	dd_daemon Error	Restart the path patrol daemon (dd_daemon). # /etc/init.d/dd_daemon restart If same error still occurred in above procedure, probably some files related to dd_daemon are missing. Uninstall the PathManager and then install it again.
8 (PATCH)	Failed to apply / release a patch	Failed to apply / release the auto-startup patch file. (in installation) Apply the auto-startup patch according to and check whether it was applied correctly. Unpatch the auto-startup patch according to "Uninstallation" in PathManager User's Manual. And check whether it was unpatched correctly.
9 (UNINSTALL)	Uninstallation Error	Failed to uninstall the RPM package. Try again.

A

Adding PathManager Devices to LVM **E-1**
 Addition and Deletion of LUN **3-10**
 Addition of LUN **3-10**

B

Basic Operation of the Path Patrol Daemon **3-32**

C

Cautions **5-1**
 Cautions and Restrictions **5-1**
 Changing Configuration of PathManager **3-6**
 Changing Environment of PathManager **3-10**
 Changing the load distribution mode **3-6**
 CHK **3-4, 3-33**
 chk **2-15**
 Cluster Configuration **1-4**
 cluster configuration **D-1**
 configuration file **2-23, 3-1**
 conventions, typographical **PR-iv**
 Creating the Configuration File **3-3**
 customer support **PR-iii**

D

dd_daemon **3-16, 3-32**
 Deletion of LUN **3-10**
 device **3-4**
 Device Files **3-33**
 Device information **3-19**
 Disabling the Intermittent Error Monitoring **3-36**
 disk-info **3-5**
 Dynamic Load Distribution **3-2**
 dynamic load distribution **3-3, 3-4**

E

Enable/Disable setting of Intermittent Error Monitoring **3-10**
 Enable/Disable setting of Path Monitoring **3-9**
 Enable/Disable Setting of the Intermittent Error Monitoring **3-35**
 Enabling the Intermittent Error Monitoring **3-35**

F

File Format **3-4**
 FLT **3-4, 3-21, 3-33**
 Format **3-3, 3-4**
 format **3-4**

G

Getting Error History Function **3-37**

H

Handling of Path Faults **1-1**
 How to Enable the Cluster Mode **C-1**
 How to Set up kdump **F-1**

I

Initializing Configuration of PathManager **3-14**
 Installing PathManager RPM Package **2-7**
 Intermittent Error Monitoring Function **3-34**
 Interval of monitoring intermittent error **3-35**

L

Least I/O Size Mode (LeastSectors) **3-3**
 Limit of Paths and Disks **3-1**
 Load Distribution Function **3-1**
 LoadBalance **3-5, 3-6**
 Log Information **3-15**

M

Manual Uninstallation **2-20**
 Message of Path Blocking when Intermittent Error Occurs **3-37**
 Messages **3-16**
 Monitoring Paths **3-32**
 MonitorMode **3-4, 3-5**
 Multi Path System **1-2**
 multi path system **A-7**
 Multiple Server Configuration **1-4**

O

operation of PathManager **1-2**
 Overland Technical Support **PR-iii**
 overview of PathManager **1-1**

P

Partitioning Function **A-1**
 Path information **3-20**
 path information **2-16, 3-19**
 Path Patrol Daemon **3-32**
 Path Status Display **3-25**
 path-info **3-5, 3-33**
 Pathmanager Operation Commands **1-2**
 proc File System **3-19**
 product documentation **PR-iii**

R

Removing PathManager Devices from LVM **E-4**
 Resetting the kdump setting **F-2**
 Restoration by Rebooting the System **4-4**
 restoration by rebooting the system **4-1**
 Restoration using Operation Commands **4-4**
 restoration using operation commands **4-1**
 Restrictions **5-1**
 Round Robin Mode (RoundRobin) **3-3**

S

SACT **3-4, 3-21, 3-33**
 Server1 Updating **D-3**
 Server2 Updating **D-2**
 Setting of Monitoring Interval **3-32**
 Setting up kdump with a PathManager Device **F-1**

Single Server Configuration **1-3**
 software update **PR-iii**
 sps.conf **2-23, 3-4**
 spsconfig command **A-9**
 static load distribution **1-1**
 Static Load Distribution (Failover Only) **3-2**
 Structure of PathManager **1-2**
 SUSE Linux Enterprise Server **2-1**
 system configuration **2-19**
 System Log **3-15**
 System Requirements to Use Multiple Connections Concurrently **5-2**

T

technical support **PR-iii**
 typographical conventions **PR-iv**

U

Uninstallation by Uninstaller **2-19**
 Uninstalling PathManager RPM Package **2-19**
 Updating PathManager **2-23**
 Updating Server1/Server2 **D-2**

V

Version information Check **3-25**

W

Watch **3-4**
 What Is PathManager? **1-1**