

Oracle FS Path Manager 4

Solaris Installation Guide



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Preface

Oracle Resources

Important: For the latest version of this document, visit the *SAN Storage – Oracle Flash Storage Systems* section at the Oracle Help Center (<http://www.oracle.com/goto/fssystems/docs>).

Table 1: Oracle resources

For help with...	Contact...
Support	http://www.oracle.com/support (www.oracle.com/support)
Training	https://education.oracle.com (https://education.oracle.com)
Documentation	<ul style="list-style-type: none">• <i>SAN Storage – Oracle Flash Storage Systems</i>: (http://www.oracle.com/goto/fssystems/docs)• From Oracle FS System Manager (GUI): Help > Documentation• From Oracle FS System HTTP access: (<i>system-name-ip</i>/documentation.php where <i>system-name-ip</i> is the name or the public IP address of your system)
Documentation feedback	http://www.oracle.com/goto/docfeedback (http://www.oracle.com/goto/docfeedback)
Contact Oracle	http://www.oracle.com/us/corporate/contact/index.html (http://www.oracle.com/us/corporate/contact/index.html)

Typographical Conventions

Table 2: Typography to mark certain content

Convention	Meaning
<i>italics</i>	Within normal text, words in italics indicate one of the following items: <ul style="list-style-type: none"> • Hypertext, as in a URL • A reference to a book title • New terms and emphasized words • Command variables
<code>monospace</code>	Indicates one of the following, depending on the context: <ul style="list-style-type: none"> • The name of a file or the path to the file • <i>Output</i> displayed by the system on the command line
<code>monospace</code> (bold)	<i>Input</i> provided by an administrator on the command line.
>	Indicates a menu item or a navigation path in Oracle FS System Manager (GUI). For example, “Click SAN > Storage > LUNS > Action > Clone ” means to click the Clone link on the SAN page in the GUI.
...	Indicates that one or more steps have been omitted from the path or menu structure. The ellipsis is used within an expression of a navigation path or within a cascading menu structure. For example, in the SAN > Storage > LUNS > ... > Clone menu structure, the ... implies that one or more menu items have been omitted.

Command Syntax Conventions

Table 3: Typography to mark command syntax

Typographic symbol	Meaning
[]	Square brackets. Delimits an optional command parameter or a set of optional command parameters.
{ }	Braces. Delimits a set of command parameters, one of which must be selected.
	Vertical bar. Separates mutually exclusive parameters.
...	Ellipsis. Indicates that the immediately preceding parameter or group of parameters can be repeated.
<code>monospace</code>	Indicates the name of a command or the name of a command option (sometimes called a <i>flag</i> or <i>switch</i>).
<i>italic</i>	Indicates a variable for which you need to supply a value.

Command parameters that are not enclosed within square brackets ([]) are required.

Important: The above symbols (and font styling) are based on the POSIX.1-2008 specification. These symbols are used in the command syntax only to clarify how to use the command parameters. *Do not enter these symbols on the command line.*

Introduction to Oracle FS Path Manager

The following information provides an overview of the Oracle FS Path Manager (FSPM) and its features.

FSPM Requirements

For updated information on which product versions are supported, refer to the *Oracle FS Path Manager Release Notes*.

Note: In this document, references to an Oracle FS System also refer to a Pillar Axiom System unless specifically noted. References to the Oracle FS System Controller also refer to a Pillar Axiom System Slammer Control Unit unless specifically noted.

For Oracle Solaris operating systems, the Oracle Solaris I/O multipathing features must be configured and enabled to support multipathing. Information is provided on this topic later in this document.

Note: The Solaris I/O multipathing features were formerly referred to as the *StorageTek Traffic Manager Software (STMS)*. The STMS provided the same data path management functionality provided by the Solaris I/O multipathing features. STMS was also referred to as Leadville, MPxIO, scsi_vhci., and Sun StorEdge Traffic Manager Software. Additionally, in the *Oracle Solaris Administration: SAN Configuration and Multipathing* document, the term MPxIO is used as well as the phrase Solaris I/O multipathing features to describe the multipathing software.

This release supports both FC and iSCSI Controllers. You can connect your host to FC or iSCSI ports on Controllers, and you can connect your host through iSCSI-to-FC routers to FC ports on Controllers.

The Pilot provides an interface for the FSPM software to communicate with the Oracle FS System through port 26012, or with a Pillar Axiom system through port 26004. These ports are enabled by default and must remain open.

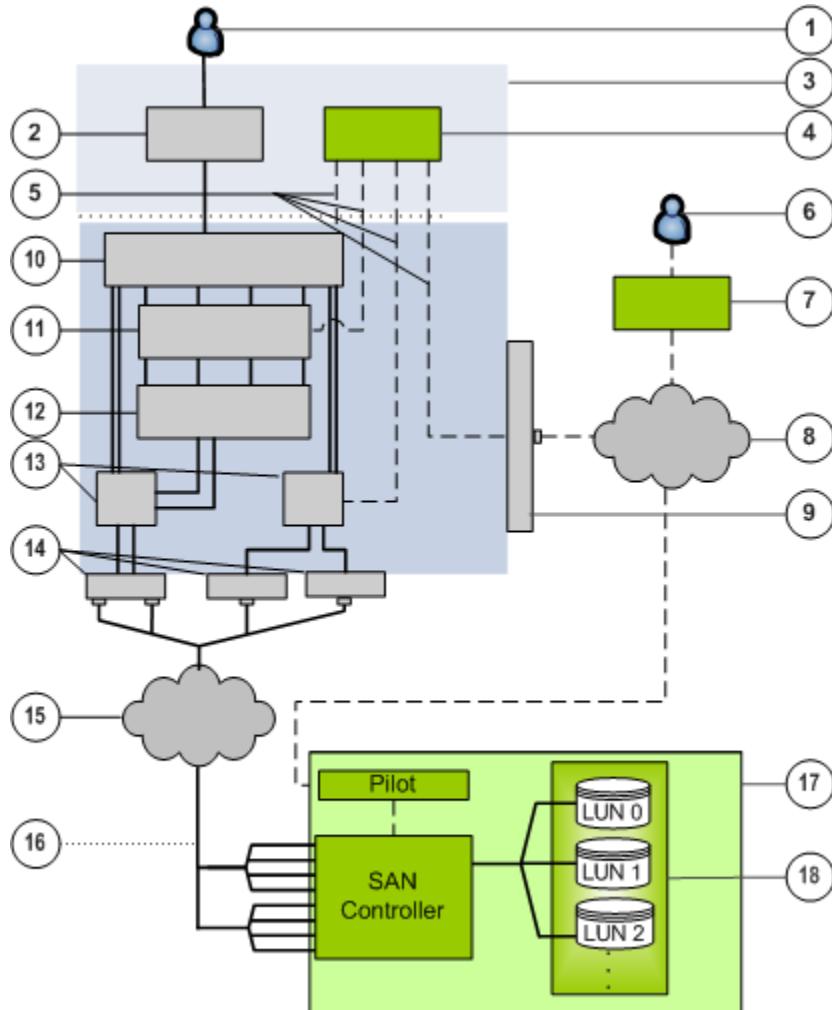
FSPM Architecture for Solaris

The Oracle FS Path Manager (FSPM) for Oracle Solaris works with the Solaris I/O multipathing features to manage SAN paths to Oracle FS System , and to integrate with the Oracle FS System Manager to provide information on the SAN paths. The communication between the FSPM and the Oracle FS System is provided by a Control Path that is separate from the Data Path. The Solaris I/O

multipathing features manage the LUN data access path. FSPM (not the Solaris I/O multipathing feature) manages the Control Path.

The following figure illustrates how the FSPM software installed on a SAN host interacts with an Oracle FS System.

Figure 1: FSPM interaction with an Oracle FS System



Legend

1 User	10 Solaris I/O multipathing features
2 User application	11 iSCSI software initiator (iSCSI)
3 User space	12 TCP/IP driver (iSCSI)
4 FSPM service, fspmd	13 HBA driver (FC) or NIC driver (iSCSI)
5 Control path (all dashed lines)	14 HBA (FC) or NIC (iSCSI)
6 Oracle FS System administrator	15 SCSI over Fibre Channel (FC) or iSCSI over IP (iSCSI)
7 Oracle FS System command line interface (CLI) or Oracle FS System Manager (GUI)	16 Data path (all solid lines)
8 Encrypted messages over TCP/IP	17 Oracle FS System
9 Network card	18 Drive Enclosure storage pool

The following table describes meanings of the lines and colors used in the figure.

Table 4: Line and color key for FSPM interaction diagram

Graphic element	Description
—	Data path
----	Control path
[Yellow Green]	Oracle FS System hardware and software
[Grey]	Non-Oracle FS System hardware and software
[Blue]	SAN host kernel space
[Light Blue]	SAN host user space

Related Links

[Control Path](#)

[Data Path](#)

[Solaris I/O Multipathing Features](#)

Control Path

The FSPM control path to the Pilot of an Oracle FS System provides a separate path from the data path to the Controller of an Oracle FS System to manage multipathing and communication.

FSPM uses a daemon to control multipathing and communication. The FSPM daemon uses the control path to perform these actions:

- Get information from the Pilot management controller
- Get FC and iSCSI port information from the HBA and CNA drivers and iSCSI initiators
- Configure the Solaris I/O multipathing features
- Send information such as host attributes and statistics to the Pilot management controller and, if requested, collect logs from the host

The FSPM daemon sends a description of the host to the Pilot on each connected Oracle FS System. In the Oracle FS System Services, this description creates a definition for the host that includes FC ports in the host.

The Oracle FS System Manager (GUI) and Oracle FS CLI list the World Wide Names (WWNs) of the FC ports and if iSCSI is configured, the iSCSI initiator name and IP addresses from the host used to make iSCSI connections to the Oracle FS System.

If you use iSCSI on the host to connect to a Controller through an iSCSI-to-FC router, these connections are described as FC connections. Within Oracle FS System Manager (GUI) and Oracle FS CLI, the iSCSI connections are displayed as originating from the FC ports on the switch that is assigned to the host iSCSI initiator. The port WWNs are displayed as FC HBA ports on the host. The HBA model associated with these ports is displayed in the GUI as **iSCSI-FC router**.

To establish the control path to an Oracle FS System host, the host must be able to connect to the Oracle FS System over the data path. As part of the connection sequence, the Controller returns the IP address of the Pilot to the FSPM host over the data path. The host uses the IP address of the Pilot to establish the control path to the Oracle FS System.

Data Path

FSPM uses the Solaris I/O multipathing features to provide paths for reading and writing data to LUNs on the Oracle FS System.

Solaris I/O multipathing features have the following capabilities:

- Controls and manages all data paths to the Oracle FS System LUNs
- Groups multiple data paths to an Oracle FS System LUN and presents this group to the host operating system as a single LUN or drive
- Determines which data paths to use
- Identifies and uses optimized data paths when possible
- Handles data path failover and failback
- Manages data path errors

A path that provides the best performance is referred to as an optimized path and is the preferred path for data transfer.

Related Links

[FSPM Architecture for Solaris](#)

Solaris I/O Multipathing Features

FSPM consists of a daemon that runs on the host system along with the Solaris Input/Output (I/O) multipathing features. These features prevent multiple paths from being presented as multiple drives. Every Oracle FS System LUN that is configured with multipath access is presented to the operating system as a single drive.

The Solaris I/O multipathing features driver supports failover and fallback across redundant paths. The FSPM daemon uses the control path to send and receive information about the hosts. The daemon runs at the user level as a background process to perform management tasks. The daemon sends host attributes to the Pilot. The Solaris I/O multipathing features take control of the paths, hide the actual paths from the operating system, and present a single virtual path to each LUN.

Note: For more information on the Solaris I/O multipathing features, refer to the documentation that corresponds to your Oracle Solaris version. The documentation is listed in the following table.

Table 5: Oracle Solaris multipathing documentation

Oracle Solaris 10	Oracle Solaris 11
Oracle Solaris SAN Configuration and Multipathing Guide (http://docs.oracle.com/cd/E18752_01/html/820-1931/index.html) September 2010	Oracle Solaris Administration: SAN Configuration and Multipathing (http://docs.oracle.com/cd/E23824_01/html/E23097/index.html) February 2012
Oracle Solaris SAN Configuration and Multipathing Guide (http://docs.oracle.com/cd/E26505_01/html/E35235/index.html) January 2013	Oracle Solaris 11.1 Administration: SAN Configuration and Multipathing (http://docs.oracle.com/cd/E26502_01/html/E29008/index.html) November 2012
	Managing SAN Devices and Multipathing in Oracle Solaris 11.2 (https://docs.oracle.com/cd/E36784_01/html/E36836/index.html) December 2014
	Managing SAN Devices and Multipathing in Oracle Solaris 11.3 (https://docs.oracle.com/cd/E53394_01/html/E54792/index.html) November 2016

Related Links

[FSPM Architecture for Solaris](#)

FSPM Features

FSPM works with the Solaris I/O multipathing features to provide the following functions:

- Routes I/O to Oracle FS System LUNs using the best available data paths
- Allocates traffic among the available paths to ensure that access to the LUNs is not interrupted if a path fails
- Automatically configures the host information in the Oracle FS System Manager (GUI), and updates the host configuration information if the host information changes

Automatic configuration of host information enables the GUI to report information about the instance of FSPM running on the host (for example, the number of working paths reported to the GUI from FSPM). In some environments, automatic configuration includes features such as load balancing.

Each FSPM release provides different features, and the features provided for each platform vary. The following table describes the specific features implemented in FSPM 4.

Table 6: FSPM for Oracle Solaris features

Feature	Benefit
Automatic data path failover	(Working with Solaris I/O multipathing features) Automatically switches to the most suitable path available after a path failure or failback.
Automatic recognition of SAN hosts by the Oracle FS System services	Sends a description of the host to each Pilot management controller on connected Oracle FS Systems, enabling the Oracle FS System Services to create a host definition. This definition provides information including the world wide names (WWNs) for each host FC port, iSCSI Initiator Names associated with the hosts, and the version of FSPM running on the host.

Table 6: FSPM for Oracle Solaris features (continued)

Feature	Benefit
Call Home log collection	<p>When an Oracle FS administrator uses Oracle FS System Manager (GUI) to collect system information, the Oracle FS System can be instructed to send a request to each connected FSPM host. The FSPM host collects diagnostic information and sends the information to the Oracle FS System, where the information is bundled with any other requested information.</p> <p>The Oracle FS System can transmit this information to Oracle Customer Support. The following information is collected from each FSPM host:</p> <ul style="list-style-type: none"> • Log files from the FSPM components • Configuration and status information from the operating system • System and error logs from the operating system <p>No customer data is transmitted.</p> <p>Note: For more information on Call-Home, refer to the <i>Oracle Flash Storage System Administrator's Guide</i>.</p>
Support for FC connections to Controllers	Makes connections to Oracle FS System storage arrays over a high-speed FC network infrastructure.
Support for iSCSI connections to Controllers	<p>Makes connections to Oracle FS System storage arrays over long distances using an IP network infrastructure.</p> <p>Note: iSCSI connections to FC ports on Controllers require iSCSI-to-FC routers.</p>
Support for clustering	Clustering is supported as supported by the Oracle Solaris I/O multipathing features.
Support for Boot from SAN	Boot from SAN is supported as specified by Solaris I/O multipathing features on Oracle Solaris.
FCoE CNAs	FC over Ethernet (FCoE) Converged Network Adapters (CNAs) are supported on the host.

Related Links

[Boot From SAN](#)

[FSPM and Clustering on Oracle Solaris](#)

Boot From SAN

Oracle supports booting the host using a LUN on an Oracle FS System as the system drive. Boot from SAN is supported using the Oracle Solaris I/O multipathing features.

The hardware dependencies and deployment scenarios involved in setting up a SAN with boot technology are not described in this document. For information on system requirements and configuration for an Oracle Solaris system to boot from a multipathed SAN-attached drive, refer to the *Oracle Solaris SAN Configuration and Multipathing Guide*. Refer to the *Oracle FS Path Manager Release Notes* for updated document information.

Note: For more information on the Solaris I/O multipathing features, refer to the documentation that corresponds to your Oracle Solaris version. The documentation is listed in the following table.

Table 7: Oracle Solaris multipathing documentation

Oracle Solaris 10	Oracle Solaris 11
<i>Oracle Solaris SAN Configuration and Multipathing Guide</i> (http://docs.oracle.com/cd/E18752_01/html/820-1931/index.html) September 2010	<i>Oracle Solaris Administration: SAN Configuration and Multipathing</i> (http://docs.oracle.com/cd/E23824_01/html/E23097/index.html) February 2012
<i>Oracle Solaris SAN Configuration and Multipathing Guide</i> (http://docs.oracle.com/cd/E26505_01/html/E35235/index.html) January 2013	<i>Oracle Solaris 11.1 Administration: SAN Configuration and Multipathing</i> (http://docs.oracle.com/cd/E26502_01/html/E29008/index.html) November 2012
	<i>Managing SAN Devices and Multipathing in Oracle Solaris 11.2</i> (https://docs.oracle.com/cd/E36784_01/html/E36836/index.html) December 2014
	<i>Managing SAN Devices and Multipathing in Oracle Solaris 11.3</i> (https://docs.oracle.com/cd/E53394_01/html/E54792/index.html) November 2016

Note: For Oracle FS System only, if you are going to use a LUN as a system drive, you must enable the **Use as a boot LUN** option. Navigate to **SAN > LUNs > Actions > Create LUN** and select or click **Use as a boot LUN** to enable the option.

FSPM and Clustering on Oracle Solaris

FSPM works with cluster configurations that are configured and enabled to use the Solaris I/O multipathing features on Oracle Solaris.

Refer to the Solaris Cluster documentation for configuring Solaris I/O multipathing features on the *Solaris Cluster Product documentation* website (<http://www.oracle.com/technetwork/server-storage/solaris-cluster/documentation/>).

Oracle Solaris Supported Hardware

FSPM 4 for Oracle Solaris supports the following hardware.

Table 8: Supported hardware and software

Hardware	Supported
Servers	All servers qualified for use with Oracle Solaris 10 and higher
FCoE CNAs	All Fibre Channel over Ethernet (FCoE) Converged Network Adapters (CNAs) supported by Solaris I/O multipathing features
HBAs	All FC HBAs supported by Solaris I/O multipathing features
iSCSI	All iSCSI configurations supported by Solaris I/O multipathing features

Supported iSCSI-to-FC Routers

iSCSI-to-FC routing features enable a host to use iSCSI to access LUNs through FC ports on Oracle FS System Controllers.

Oracle FS Path Manager supports the iSCSI-to-FC routing features of the Cisco MDS 9000 family of multi-layer directors and fabric switches. The only supported iSCSI-to-FC routing solution is the solution provided by this family of switches.

The iSCSI-to-FC features were tested on Cisco MDS SAN-OS Release 3.0 (2a).

For more information on these features, go to the [Cisco](http://www.cisco.com) website (<http://www.cisco.com>) and search on the product family, Cisco MDS 9000.

Oracle Virtual Networking Overview

Oracle Virtual Networking host software and the Oracle Fabric Interconnect hardware provide Ethernet and Fibre Channel (FC) emulation over InfiniBand.

The FC ports on the Oracle Fabric Interconnect must connect to the FC fabric through an N_Port ID Virtualization (NPIV)-aware FC switch. Direct connection of the Oracle Fabric Interconnect to the Oracle FS System is not supported.

In addition to FC emulation, Oracle FS Path Manager (FSPM) also supports the Ethernet emulation provided by the Oracle Fabric Interconnect. The Oracle Fabric Interconnect virtual Ethernet network interface controllers (NICs) are supported the same as hardware Ethernet NICs.

Refer to the [Oracle Virtual Networking](http://www.oracle.com/us/products/networking/virtual-networking/overview/index.html) website (<http://www.oracle.com/us/products/networking/virtual-networking/overview/index.html>) for general information on Oracle Virtual Networking.

Refer to the [Oracle Virtual Networking Documentation](http://docs.oracle.com/cd/E38500_01/index.html) website (http://docs.oracle.com/cd/E38500_01/index.html) for instructions on setting up and configuring the Oracle Fabric Interconnect and associated components that are part of the Oracle Virtual Networking solution. The InfiniBand host channel adapters (HCAs) and other equipment required for this solution are specified in the documentation.

Supported Oracle Virtual Networking Host Drivers

Oracle Virtual Networking host drivers are required for use with Oracle FS Path Manager.

Refer to the *Oracle FS Path Manager Release Notes* for information about required Oracle Virtual Networking host drivers.

Operating Limits for FSPM Software

FSPM provides access over multiple data paths to LUNs defined on an Oracle FS System.

FSPM and the Oracle FS System operating software limits are described in the following table.

Table 9: FSPM operating limits

FSPM capabilities	Maximum value
Target storage systems	Eight for each FSPM host in any combination of Oracle FS Systems and Pillar Axiom systems
Connect to LUNs	Up to 256 for each Pillar Axiom system and 4096 for each Oracle FS System
Handle data paths	32 to each LUN
Handle FC HBA ports	32 for each SAN host

Important: Not all combinations of the operating limits were tested. If you configure an operating system to operate at or near these limits, the system might not work properly when these limits are used concurrently with each other.

Install FSPM

The following information describes the process to install and configure FSPM.

Prepare to Install the FSPM Software

Oracle recommends that you install FSPM on the host or hosts as part of the process of the initial connection. You connect the host or hosts to the Oracle FS System through the SAN and then assign storage to the host. The sequence of steps in this document assumes that there are no configuration entries in the Oracle FS System Manager (GUI) for a SAN host. If there are host configuration entries, these entries must be deleted as described in this document before you install FSPM.

To ensure a successful installation of FSPM, perform the following tasks:

- 1 Refer to the *Oracle FS Path Manager Release Notes* to verify which version of Pillar Axiom or Oracle FS System software is required for FSPM.
- 2 Ensure that the required operating system patches and updates are installed. Refer to the *Oracle FS Path Manager Release Notes* for further information.
- 3 If you are using Fibre Channel (FC) or FC over Ethernet (FCoE) connections, verify that your FC SAN components and HBAs are supported by FSPM, and that the FC SAN components and HBAs are installed according to the manufacturer's instructions.
- 4 If you are using iSCSI connections, verify that your iSCSI configurations are supported by FSPM and installed according to the manufacturer's instructions.
- 5 Perform the installation tasks in the order in which the tasks are presented in this chapter. For example, before installing FSPM, it is important to verify port access and preconfigure SAN host for Oracle FS System. Installing FSPM first will cause installation problems.

Related Links

[Management Network Requirements for Solaris](#)

[Oracle Solaris Supported Hardware](#)

[FSPM Requirements](#)

[Operating Limits for FSPM Software](#)

[Configure SAN Host Connections](#)

Delete SAN Host Before FSPM Installation

Before you install the FSPM software on a SAN host, you need to delete any SAN host entries that were manually created on the Pillar Axiom system or the Oracle FS System.

During installation, FSPM automatically creates a host entry for the host in the Oracle FS System Services, and associates the host's initiators with that host entry. If you had manually associated any of the host's initiators with a host entry and mapped LUNs to that host, you must delete that host entry before installing FSPM on the host. Since existing LUN mappings are deleted during FSPM installation, you must recreate the LUN mappings after installing FSPM.

Note: References to GUI screens in this section refer to the layout of the Oracle FS System Manager (GUI) version 6.1. Other GUI versions are organized differently, but all versions offer equivalent functionality. Refer to the *Oracle Flash Storage System Administrator's Guide* for details about how to access the features in older versions of the GUI.

- 1 From the GUI, navigate to **SAN > Storage > Hosts**.
- 2 Select the host that you want to delete.
- 3 Navigate to **Actions > Delete Host**.
The **Delete SAN Host** dialog displays.
- 4 On the Delete SAN Host dialog, make sure **Delete mappings and initiators?** is not checked. This action saves the associated LUN mappings to the host which FSPM restores as part of the FSPM installation process.
The Delete SAN Host dialog is shown in the following illustration.

Figure 2: Delete SAN Host dialog



- 5 Click **OK** to delete the SAN host.

You can also delete the SAN host using the Oracle FS CLI. Refer to the *Oracle FS CLI Reference Guide* for further information.

Configure SAN Host Connections

Before you install the FSPM software, configure your SAN host connections for the Oracle FS System.

Prerequisites:

Verify that your host and the Oracle FS System meet the following requirements:

- There are available FC ports or iSCSI ports on an Oracle FS System Controller or Pillar Axiom Slammer.
- Supported HBA and converged network adapter (CNA) drivers are installed.
- Ethernet connections exist to the management ports on the Pilot.
- A network configuration exists that enables an application on the SAN host to connect to an Pillar Axiom storage system TCP port 26004 or Oracle FS System TCP port 26012 on the Pilot. Make sure these TCP ports are open.

Prepare your SAN host components to connect with the Oracle FS System.

Note: In this section, all references to GUI screens refer to the layout of the Oracle FS System Manager (GUI) version 6.1. Other GUI versions are organized differently, but all versions offer equivalent functionality. Refer to the *Administrator's Guide* for details on how to access the features in older versions of the GUI.

- 1 Verify that all FC and iSCSI components and software are installed on the SAN host.
- 2 Set up the SAN (physical connectivity and any required switch zoning) so that there is at least one path through the SAN host and a Controller port on each Oracle FS System.

This enables the FSPM Service to discover the Oracle FS System and automatically create host entries in the Oracle FS System Manager. Proper setup is necessary so that all required host ports can access the Controller ports on the Oracle FS System.

- 3 If you are using iSCSI connections, verify that your network is configured for iSCSI multipathing, and the iSCSI software initiator is configured correctly. See the instructions in this document on configuring an iSCSI SAN. If you are using the iSCSI-to-Fibre Channel routing features of the Cisco MDS 9000, review the configuration information on iSCSI-to- FC Router in this document.
- 4 From the GUI, navigate to **SAN > Storage > Hosts**.
- 5 Verify the SAN connections.

When hosts first make SAN connections to the Oracle FS System, all initiators that are not yet associated with a host entry are listed under a false host name **Unassociated**. Fibre Channel initiators are listed by their

Port WWNs and iSCSI initiators are listed by their Initiator Names, as shown in the following illustration:

Figure 3: Host ports under unassociated host name

Hosts		Oracle FS Path Manager			HBA	
HostName	Controller-Initiator Connect...	Number of LUNs Mapped	Status	Version	Host IP Address	HBA Alias Name
Unassociated						
10:00:00:00:C9:76:63:F4	Connected					
10:00:00:00:C9:76:63:F5	Connected					
10:00:00:90:FA:11:B5:54	Connected					
10:00:00:90:FA:11:B5:55	Connected					
21:00:00:E0:9B:84:14:9C	Connected					

Configure the iSCSI-to-FC Router

Oracle FS Path Manager (FSPM) supports the iSCSI-to-Fibre Channel routing features of the Cisco MDS 9000 family of multi-layer directors and fabric switches. These features require configuration to work with FSPM.

For more information on these features, refer to the [Cisco documentation](http://www.cisco.com/en/US/products/ps10495/products_installation_and_configuration_guides_list.html) website (http://www.cisco.com/en/US/products/ps10495/products_installation_and_configuration_guides_list.html).

- 1 Present the Oracle FS System Controller or Pillar Axiom Slammer ports as iSCSI targets.

Choose **Dynamic Mapping** or **Static Mapping**. Oracle recommends that you use dynamic mapping because the main Cisco features for static mapping requirements are supplied by FSPM and the Oracle FS System Manager (GUI).

- 2 Present the iSCSI hosts as virtual FC hosts.

The hosts must be presented in transparent initiator mode (not in proxy-initiator mode). When you assign World Wide Names (WWNs) for the iSCSI initiators, use the static mapping mechanism.

After you configure the switch, FSPM on the iSCSI hosts interacts with the Oracle FS System or Pillar Axiom system in exactly the same way as when both hosts and Controllers or Slammers use the same SAN protocol.

Management Network Requirements for Solaris

FSPM communicates with the Pilot using secure encrypted messages. The SAN host where the FSPM software is installed requires a TCP/IP connection for communication with Oracle FS System Manager (GUI).

The network configuration must enable the SAN host to connect to a Pillar Axiom storage system using TCP port 26004 or to an Oracle FS System using TCP port 26012. These ports are used to connect the Control Path to the Pilot management Ethernet interfaces.

Network firewalls might be running on the host or in the network between the host and the Pilot. Firewall settings can block access to ports 26004 or 26012. Changes to the firewall settings can block a port that was previously open.

To resolve the blocked port, first determine if TCP port 26004 on a Pillar Axiom storage system or TCP port 26012 on an Oracle FS System is open and not blocked. You can test connectivity from the host to the system by using the `telnet` command to access the Pillar Axiom storage system or the Oracle FS System. No data is returned if you can successfully access the system; the port is open and not blocked. If you successfully access the Pillar Axiom storage system or the Oracle FS System with the `telnet` command, quit or escape from the `telnet` session.

To access the Pillar Axiom storage system or the Oracle FS System with `telnet`, you need the IP or DNS name of the Pillar Axiom storage system or Oracle FS System, for example:

- `telnet axiom_ip_or_dns_name 26004`
- `telnet oraclefs_ip_or_dns_name 26012`

If the `telnet` command fails, then unblock TCP port 26004 on a Pillar Axiom storage system or TCP port 26012 on an Oracle FS System. After unblocking the TCP port, verify that the TCP port is open using the `telnet` command.

FSPM Download and Installation

After you prepare your SAN for FSPM, you can download and install the FSPM package from the Oracle Technology Network (OTN).

Once FSPM is downloaded and installed, you configure access from the SAN host to the Oracle FS System LUNs.

Related Links

[Download the FSPM Software](#)

[Install the FSPM Software on Solaris](#)

[Upgrade From Earlier Versions of APM or FSPM](#)

[Remove the FSPM Software on Solaris \(Optional\)](#)

[Configure SAN Host Access to LUNs](#)

[Configure Load Balancing](#)

Download the FSPM Software

The software and documentation are distributed as a single zip archive that is available for download from the Oracle Technology Network (OTN).

To gain access to software and documentation downloads, join the [Oracle Technology Network](#) (<http://www.oracle.com/technetwork/community/join/why-join/index.html>).

Follow these steps to access and download the software:

- 1 On the OTN, open the [Oracle Flash Storage and Pillar Axiom Downloads](http://www.oracle.com/technetwork/server-storage/san-storage/downloads/index.html) page (<http://www.oracle.com/technetwork/server-storage/san-storage/downloads/index.html>) in a web browser.
- 2 From Oracle FS System and Pillar Axiom Downloads, select **Accept License Agreement**.
- 3 Locate and select the name of the software package to download.
- 4 Extract the contents of the software bundle archive to a local drive connected to the SAN host.

The archive contains software installation packages for all supported hardware platforms, as well as documentation, for the specified version. Extract the package on a local drive for your hardware platform and the documentation.

After you download the software, you can install it on your host system.

Install the FSPM Software on Solaris

FSPM uses the Oracle Solaris I/O multipathing features to support multiple physical paths to storage. The FSPM daemon works with Oracle Solaris I/O multipathing features to make the LUNs visible to Oracle FS Path Manager without manual configuration.

Prerequisite: This procedure describes how to install FSPM for the first time where no previous versions of Axiom Path Manager or FSPM were installed. Information on installing an edition of FSPM to replace Axiom Path Manager or upgrade FSPM is provided later in this document.

Before you install FSPM, if necessary activate the Oracle Solaris I/O multipathing features.

Many Solaris I/O multipathing options depend on the details of your system requirements and setup. In addition, many differences exist between the different operating system releases and between Solaris SPARC and Solaris x86 systems. Please read the appropriate Solaris multipathing documents to obtain information about how to enable MPxIO in your specific Solaris environment.

Note: For more information on the Solaris I/O multipathing features, refer to the documentation that corresponds to your Oracle Solaris version. The documentation is listed in the following table.

Table 10: Oracle Solaris multipathing documentation

Oracle Solaris 10	Oracle Solaris 11
<i>Oracle Solaris SAN Configuration and Multipathing Guide</i> (http://docs.oracle.com/cd/E18752_01/html/820-1931/index.html) September 2010	<i>Oracle Solaris Administration: SAN Configuration and Multipathing</i> (http://docs.oracle.com/cd/E23824_01/html/E23097/index.html) February 2012
<i>Oracle Solaris SAN Configuration and Multipathing Guide</i> (http://docs.oracle.com/cd/E26505_01/html/E35235/index.html) January 2013	<i>Oracle Solaris 11.1 Administration: SAN Configuration and Multipathing</i> (http://docs.oracle.com/cd/E26502_01/html/E29008/index.html) November 2012
	<i>Managing SAN Devices and Multipathing in Oracle Solaris 11.2</i> (https://docs.oracle.com/cd/E36784_01/html/E36836/index.html) December 2014
	<i>Managing SAN Devices and Multipathing in Oracle Solaris 11.3</i> (https://docs.oracle.com/cd/E53394_01/html/E54792/index.html) November 2016

Note: After you activate the Solaris I/O multipathing features, LUNs from Oracle FS Systems and Pillar Axiom systems are automatically recognized as multipath devices. You do not need to configure them as third-party storage devices.

To install FSPM, complete the following steps:

- 1 Log in as root.
- 2 Change to the directory to the location where you downloaded the installation package.
- 3 To install the FSPM software, use one of these commands:
 - For SPARC servers, use the command
`pkgadd -d FSPM-sparc-version.pkg`
 .
 - For x86 servers, use the command
`pkgadd -d FSPM-i386-version.pkg`
 .

Note: In the commands above,
version
depends upon the name of the FSPM release version you downloaded.

Configure SAN Host Access to LUNs

Verify that the SAN host communicates with the Oracle FS System LUNs after installing the FSPM software.

Note: In this section, all references to GUI screens refer to the layout of the Oracle FS System Manager (GUI) version 6.1. Other GUI versions are organized

differently, but all versions offer equivalent functionality. Refer to the *Administrator's Guide* for details on how to access the features in older versions of the GUI.

To use the Oracle FS System Manager (GUI) to validate the LUN configuration, perform these steps:

- 1 In the GUI, navigate to **SAN > Storage > Hosts**.
- 2 Verify that the individual entries for the host ports are grouped under the host name.

Examples of before and after FSPM installation are shown in the following illustrations.

Figure 4: Host ports before FSPM installation

Hosts		Oracle FS Path Manager			HBA	
HostName	Controller-Initiator Conn...	Number of LUNs Mapped	Status	Version	Host IP Address	HBA Alias Name
Unassociated						
10:00:00:00:C9:76:63:F4	Connected					
10:00:00:00:C9:76:63:F5	Connected					
10:00:00:90:FA:11:B5:54	Connected					
10:00:00:90:FA:11:B5:55	Connected					
21:00:00:E0:8B:84:14:9C	Connected					

Figure 5: Host ports after FSPM installation

Hosts		Oracle FS Path Manager			HBA	
HostName	Controller-Initiator C...	Number of LUNs Mapped	Status	Version	Host IP Address	HBA Alias Name
co-fsol-01						
10:00:00:90:FA:11:B5:54	Not Connected					
10:00:00:90:FA:11:B5:55	Not Connected					
21:00:00:24:FF:46:ED:6A	Connected					
21:00:00:24:FF:46:ED:6B	Connected					
ign.1985-03.com.sun.01:0010e0203b36.5212b476	Not Connected					
						co-fsol-01.us.oracle.com

Note: The following Oracle FSPM Status and Controller-Initiator Connectivity messages can be displayed on the Hosts page:

FSPM Status

Communicating: The host control path is logged in to the Pilot.

Note: Communicating status is required for the FSPM Control Path to report path status and use the Oracle FS System to collect FSPM diagnostic logs.

Not Registered: A Control Path from an FSPM with this name has never logged in to the Pilot.

Not Communicating: The FSPM host Control Path was logged in to the Pilot but is not now logged in to the Pilot.

Controller-Initiator Connectivity

Connected: The host SAN connection is logged in to a Controller on the Oracle FS System.

Not connected: The host SAN connection is not logged in to a Controller on the Oracle FS System.

See the Oracle FS Manager Online Help for information about the remaining fields on the Hosts page.

- 3 Create new LUNs on the Oracle FS System for this host and set up mappings of LUNs to the new host entry.

- 4 Verify that all mapped LUNs are available as drives on the host.

If the LUNs do not appear automatically on the host within one or two minutes, run the following command:

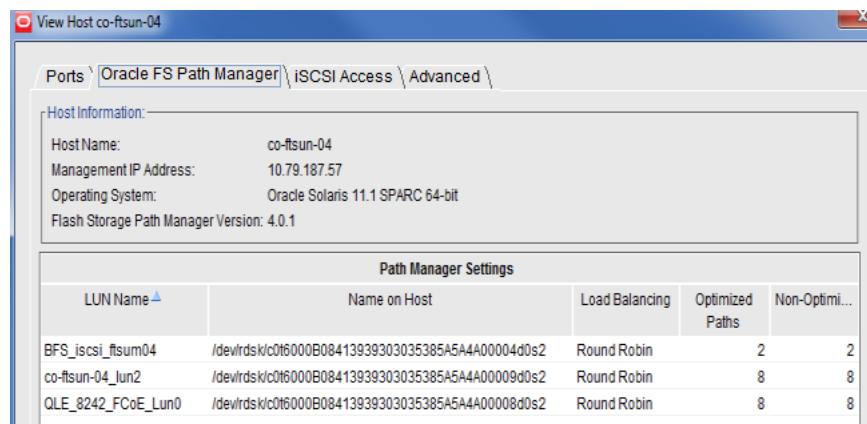
```
devfsadm
```

.

The LUNs are displayed as drives on the host. If the drives do not appear on the host after running the `devfsadm` command, restart the host.

- 5 Select the name of the new host and then select **Actions > View Host > Oracle FS Path Manager** to verify the installed FSPM version information. The operating system and FSPM versions shown in the illustration can differ from your configuration.

Figure 6: Detailed FSPM information



- 6 Review the LUN names on the Oracle FS System under the LUN Name column.

The column titled **LUN Name on Host** shows the name that Oracle Solaris I/O multipathing features has allocated to the LUN device on the host.

Note: After you map a LUN to the host, it can take two or three minutes for FSPM to make the LUN accessible at the host and report the LUN name and other information to the GUI. You might need to refresh the GUI screen to see the information when it is reported, as there can be a delay between the time the configuration change was made and when the change is displayed on the GUI.

- 7 Review the load balancing algorithm being used for each LUN to determine if you need to change the current load balancing setting.

- 8 Review the numbers of optimized and non-optimized paths currently reported by FSPM under Optimized Paths and Non-Optimized Paths.
- 9 Navigate to **SAN > Storage > Host-LUN Mapping** and verify that the host and LUN connections are as expected.
The Host-LUN Mapping tab should display the LUNs that are mapped to the host and information about the LUN. Verify that the following information is displayed:
 - Each LUN name as allocated by Oracle Solaris on the host.
 - The LUN numbers used to make the LUN visible to the host..
 - An indication whether each SAN port on the host has a connection to at least one port on the Controller.

Configure Load Balancing

Load balancing is managed and configured using the Solaris I/O multipathing features at the host, not on the Oracle FS System. Depending upon the system version, there are differences in how load balancing is displayed in the GUI.

On an Oracle FS System, the load balancing setting being used by the Solaris I/O multipathing features is displayed in the Oracle FS System Manager (GUI), but you cannot change it from the GUI. Solaris settings that use a single path are displayed as Static. Solaris settings that use the best paths in turn are displayed as Round Robin. Other Solaris settings are displayed as Unknown.

On Pillar Axiom systems, the setting displayed in the GUI is not related to the setting being used by the Solaris I/O multipathing features. The GUI allows you to change the setting, but the value set in the GUI is ignored.

Refer to the load balancing options and configuration mechanisms section of the following documents. Refer to the *Oracle FS System Release Notes* for updated references to Oracle Solaris documentation.

Note: For more information on the Solaris I/O multipathing features, refer to the documentation that corresponds to your Oracle Solaris version. The documentation is listed in the following table.

Table 11: Oracle Solaris multipathing documentation

Oracle Solaris 10	Oracle Solaris 11
Oracle Solaris SAN Configuration and Multipathing Guide (http://docs.oracle.com/cd/E18752_01/html/820-1931/index.html) September 2010	Oracle Solaris Administration: SAN Configuration and Multipathing (http://docs.oracle.com/cd/E23824_01/html/E23097/index.html) February 2012
Oracle Solaris SAN Configuration and Multipathing Guide (http://docs.oracle.com/cd/E26505_01/html/E35235/index.html) January 2013	Oracle Solaris 11.1 Administration: SAN Configuration and Multipathing (http://docs.oracle.com/cd/E26502_01/html/E29008/index.html) November 2012

Table 11: Oracle Solaris multipathing documentation (continued)

Oracle Solaris 10	Oracle Solaris 11
	<i>Managing SAN Devices and Multipathing in Oracle Solaris 11.2</i> (https://docs.oracle.com/cd/E36784_01/html/E36836/index.html) December 2014
	<i>Managing SAN Devices and Multipathing in Oracle Solaris 11.3</i> (https://docs.oracle.com/cd/E53394_01/html/E54792/index.html) November 2016

Path Selection on Solaris

The Solaris I/O multipathing features select the best paths to access Oracle FS System LUNs.

Path selection is based on three factors:

- Path optimization state
- Path performance
- Path availability

The path optimization state depends on whether the LUN is currently homed on the Controller to which the path is connected. An *optimized path* is a path that connects through the Controller where the LUN is resident or *homed*. A *non-optimized path* is a path that connects through to a Controller where the LUN is not resident (homed) on the that Controller. Optimized paths are always preferred, but if an optimized path is not available, the non-optimized path is used temporarily for I/O traffic.

Path performance is determined by how quickly and reliably a path transfers I/O traffic to and from a LUN.

Path availability is determined by the ability of the path to transfer I/O traffic. An available path is fully functional; however, if the path stops working, the path is considered unavailable.

These factors determine how the paths to each Oracle FS System LUN are divided into groups.

The Solaris I/O multipathing features group the paths in the following order of preference:

- First, FC and iSCSI Optimized
- Next, FC and iSCSI Non-optimized

For each LUN, the currently configured load balancing algorithm is used to select paths from the most preferred group that has paths available. Only paths from a single group are used at any one time.

When an active path fails, I/O traffic is transferred to a different path. I/O performance is reduced for a short time while the operating system recognizes the failure and makes the path transfer. After the path transfer is complete, I/O performance improves.

If the failed path is optimized and the new path is non-optimized, I/O performance can continue to be reduced after path transfer because a lower-performance path is in use. Within a few minutes of traffic being transferred to a non-optimized path, the Oracle FS System attempts to move the LUN to the appropriate Controller for path optimization. After transfer to an optimized path succeeds, I/O performance improves.

Stop and Start the FSPM Service

Follow these instructions to stop or start the Oracle FS Path Manager (FSPM) service (also referred to as a daemon) that runs on the host where FSPM is installed.

FSPM installs a service which monitors status and manages the Control Path connections to an Oracle FS System. The service is configured to start automatically when the host is booted up, and to remain running until the host is shut down. (When the host is restarted, the service is restarted.) Generally, you do not need to stop or start the service after installation. As part of troubleshooting procedures, Oracle Customer Support can request you to stop and start the service. Do not stop the service unless requested by Oracle Customer Support since stopping the service can cause diagnostic information to be lost.

The following information describes how to determine if the FSPM service is running. This information also describes how to restart the service, stop the service, and start the service.

Note: Stopping or restarting the service can delete diagnostic information which is useful when investigating problems. You should only stop or restart the service if you are performing troubleshooting procedures, or if you are requested to do so by Oracle Customer Support. If you are trying to resolve a problem with FSPM, collect logs from the Oracle FS System before restarting the service. Make sure you include the FSPM host in the collected set of system logs. See the *Oracle Flash Storage System Administrator's Guide* or the Oracle FS System Manager (GUI) online help for information on how to collect system logs.

- 1 Verify that you have administrator privileges to restart, stop, and start services.
- 2 To verify the status (running or stopped) of the FSPM service on the host, run the following command from the command line:
`svcs fspmd`
If the FSPM service is stopped, you need to start the service.
- 3 To restart the FSPM service, run the following command from the command line:

```
svcadm restart fspmd
```

After restarting the FSPM service, verify that the service status is running.

- 4 To stop the FSPM service, run the following command from the command line:

```
svcadm disable -t fspmd
```

After stopping the FSPM service, verify that the service status is stopped by repeating the previous steps.

- 5 To start the FSPM service, run the following command from the command line:

```
svcadm enable fspmd
```

After starting the FSPM service, verify that the service status is running by repeating the previous steps.

Host Reconfiguration Overview

Once you have installed Oracle FS Path Manager (FSPM) and the host is using LUNs from the Oracle FS System, you might need to reconfigure the host.

Reconfiguring the host in any of the following ways affects how the Oracle FS System recognizes connections from the host.

- Add, remove, or replace a Fibre Channel (FC), FCoE, or iSCSI HBA
- Add, remove, or change an iSCSI initiator name used by the host
- Add, remove, or change IP addresses the host uses to connect through iSCSI
- Add, remove, or change IP addresses the host uses to connect to the Pilot management controller
- Rename the host

If you need to make any of these changes, refer to the following sections for instructions.

Updating FC or iSCSI Initiators Information

Follow these instructions if you add, remove, or replace a SAN initiator identifier in the host.

Changes to Fibre Channel (FC) HBAs installed in the host, and changes to iSCSI initiator names used by the host, affect how the Oracle FS System recognizes connections from the host. When the SAN initiators used by the host are changed, the Oracle FS System definition of the host must be updated to match, and any LUN mappings to the host must be adjusted. Oracle FS Path Manager (FSPM) does most of this automatically when you follow these steps.

- 1 Make the changes to the configuration.

FSPM tries to ensure that the changes are automatically passed to the Oracle FS System when the FSPM daemon is restarted.

2 Complete one of the following actions:

- Reboot the host as part of reconfiguring the HBAs.
No further action is needed.
- Do not reboot the host as part of the reconfiguration (for example, if you use a “hot plug” method to change HBAs).
Restart the FSPM software after the reconfiguration is completed.

The FSPM daemon discovers the change when it starts up after the system reboot or after being explicitly restarted. The FSPM daemon updates the Oracle FS System management software. The LUN mappings to the host are automatically adjusted to match the new SAN connections from the host.

Related Links

[Stop and Start the FSPM Service](#)

iSCSI HBAs or IP Addresses Change

If you change an iSCSI HBA and do not change the iSCSI initiator name or IP address that the host uses to make iSCSI connections to the Oracle FS System, no further changes are required.

Rename the FSPM Host

Follow these instructions to rename a host where Oracle FS Path Manager (FSPM) is installed, and to ensure that the new host name change is updated in the Oracle FS System configuration information.

FSPM installs a service that monitors status and manages the Control Path connections to an Oracle FS System. When the FSPM service running on a host makes a Control Path connection to a Pilot, the service sends the host name that FSPM discovered from the host to the Oracle FS System. That host name is used as the name of the host entry in the Oracle FS System Services. If you want to change the host name of a SAN host that is running FSPM, use the following sequence of steps to create an FSPM host entry in the Oracle FS System Services with the new name and the same LUN mappings as the old FSPM host entry.

Note: If you rename a host without going through this process, the LUN mappings to the host are lost. You will not be able to access the Oracle FS System LUNs from the host until the LUN mappings are recreated. This process preserves the LUN mappings from the original host name to the renamed host name.

The following information describes how to rename a host where FSPM is installed.

- 1 From the Oracle FS System Manager (GUI), ensure that one of the host initiators is connected to the Oracle FS System. Follow these steps:
 - a) From the GUI, navigate to **SAN > Storage > Hosts**.

- b) Under Host Name, locate the host to be renamed.
 - c) Under Controller-Initiator Connectivity, verify that **Connected** is displayed for one of the host initiators.
- 2 Stop the FSPM service.
 - 3 From the GUI, navigate to **SAN > Storage > Host-LUN Mapping** to review the LUN mappings to the host you are deleting.
 - 4 From the GUI, navigate to **SAN > Storage > Hosts** to select the host you want to delete.
 - 5 From the GUI navigate to **Actions > Delete Host** and delete the host entry with the old host name. The **Delete SAN Host** dialog is displayed.
 - a) When the Delete SAN Host dialog is displayed, make sure that the **Delete mappings and initiators** is not checked, and then click **OK** to delete the SAN host.
The associated LUN mappings to the host are preserved.
 - b) You can also delete a SAN Host using the Oracle FS CLI. Refer to the *Oracle Flash Storage System CLI Reference* for further information.
 - 6 From the host operating system, rename the host.
 - 7 Start the FSPM service (also referred to as the daemon).
- Once the FSPM is started, FSPM logs into the Pilots and sends a message that includes the new host name. The Oracle FS System creates an FSPM host entry with the new host name, and transfers the initiators and LUN mappings associated to the host. (These values were preserved when the host was deleted.)
- 8 From the GUI, navigate to **SAN > Storage > Host-LUN Mapping** to verify that the LUN mappings are restored to the renamed host.

Upgrade From Earlier Versions of APM or FSPM

If you are upgrading to Oracle FS Path Manager (FSPM) from an earlier version of Axiom Path Manager (APM) or FSPM, perform the following steps to ensure a successful installation.

Refer to the *Oracle FS Path Manager Release Notes* to determine if you need to update the operating system software before installing a new version of FSPM.

If you determine the need to upgrade from earlier versions of APM or FSPM, complete the following steps.

- 1 To uninstall a previous version of APM, enter the following command:
`pkgrm axiompm`
- 2 To uninstall a previous version of FSPM, enter the following command:
`pkgrm ORCLfspm`

- 3 Upgrade the operating system to the required software level. Follow the operating system instructions for installing any required upgrades or patches.
- 4 Install FSPM software following the information provided in this document.

Related Links

[*FSPM Download and Installation*](#)

[*FSPM Requirements*](#)

Remove the FSPM Software on Solaris (Optional)

Follow these instructions to remove the FSPM software. If you are upgrading FSPM, you must remove the installed version before installing a newer version.

When you remove FSPM, the ability to manage multiple paths to Oracle FS System LUNs through FSPM is no longer available. Support for multiple paths is still available through the operating system multipathing features.

- 1 Log in as `root`.
- 2 To remove the FSPM software, run the following commands:
`pkgrm ORCLfspm`

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