

Oracle FS Path Manager 4

Linux Installation Guide



FLASH STORAGE
SYSTEMS

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Preface

Oracle Resources

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">• Oracle Technology Network Documentation: (http://docs.oracle.com)• From the Oracle FS System Manager (GUI): Help > Documentation• From Oracle FS System HTTP access: (http://system-name-ip/documentation.php where system-name-ip 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>	<p>Within normal text, words in italics indicate one of the following items:</p> <ul style="list-style-type: none"> • Hypertext, as in a URL • A reference to a book title • New terms and emphasized words • Command variables
monospace	<p>Indicates one of the following, depending on the context:</p> <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
monospace (bold)	<i>Input</i> provided by an administrator on the command line.
>	Indicates a menu item or a navigation path in the 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.
monospace	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 Overview

The information in this document is for system administrators who want to use the Oracle FS Path Manager (FSPM) software on a SAN host running an operating system based on Linux. FSPM supports SAN multipathing to the Oracle FS System and to the Pillar Axiom system. The FSPM software replaces the Axiom Path Manager (APM) software.

FSPM automates the task of configuring information about the host in the Oracle FS System Manager. Oracle recommends that you install FSPM as part of initially connecting the host in the SAN to the Oracle FS System. This document describes the sequence of steps for doing this.

This document describes how to install and configure FSPM.

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.

If you are updating your Pillar Axiom software or Oracle Flash Storage System software, complete that update before installing the FSPM software on the SAN host.

This release supports both Fibre Channel (FC) and iSCSI Controller and Slammer ports. You can connect your host to Fibre Channel or iSCSI ports on Controller or Slammer.

You can also connect your host through iSCSI-to-FC routers to FC ports on Controller or Slammer.

FSPM Requirements

For updated information on which product versions are supported, review 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.

Oracle FS Path Manager (FSPM) for Linux supports a range of Linux-based server operating systems and specialized platforms including:

- CentOS
- Oracle Linux
- Oracle VM Server for x86
- Red Hat Enterprise Linux
- SUSE Linux Enterprise Server

Note: For details on which versions of the operating systems and specialized platforms are supported, review the *Oracle FS Path Manager Release Notes*.

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

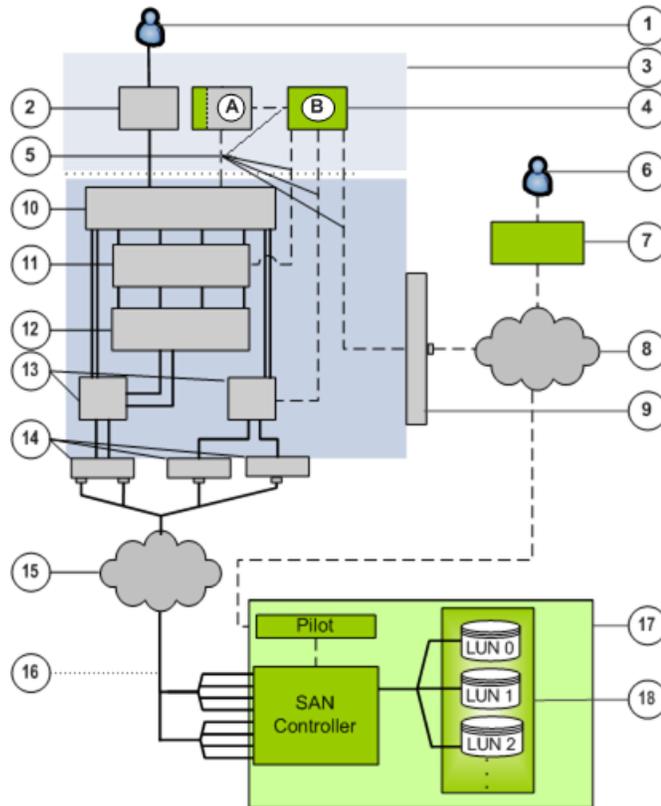
Oracle FS Path Manager (FSPM) manages the Linux multipath framework and communicates with Oracle FS System systems on a control path, which is separate from the data path. The Linux multipath framework manages the LUN data access paths.

The following figure illustrates how the FSPM software installed on a SAN host interacts with a Oracle FS System system. 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
	Oracle FS System hardware and software
	Other hardware and software
	SAN host kernel space
	SAN host user space

Figure 1: FSPM interaction with an Oracle FS System



Legend	1 User	10 Linux multipath framework
	2 User application	11 iSCSI software initiator (iSCSI)
	3 SAN host	12 TCP/IP driver (iSCSI)
	4 A Linux Multipath daemon with FSPM plug-ins and 4B FSPM daemon	13 HBA driver (FC, FCoE, or CNA) or NIC driver (iSCSI)
	5 Control path (all dashed lines)	14 HBA (FC) or NIC (iSCSI)
	6 Oracle FS System administrator	15 SCSI over FC (FC) or iSCSI over IP (iSCSI)
	7 Oracle FS System CLI or 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

Related Links

[Control Path](#)

[Data Path](#)

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 FC and iSCSI port information from the HBA and CNA drivers and iSCSI initiator
- Configure the Linux multipath framework
- 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 and, if iSCSI is configured, the iSCSI initiator name.

The Oracle FS System Manager (GUI) and Oracle FS CLI list the World Wide Names (WWNs) of the FC ports 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 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.

Related Links

[Data Path](#)

[FSPM Architecture](#)

Data Path

Oracle FS Path Manager (FSPM) uses the Linux multipath framework (`device-mapper` and `multipath-tools`) to provide paths for reading and writing data to LUNs on the Oracle FS System. FSPM includes plug-in modules for the Linux `multipath-tools`. These plug-ins provide increased multipath functions when managing Oracle FS System LUNs.

The Linux multipath framework:

- 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

[Control Path](#)

[FSPM Architecture](#)

Multipathing and Device Mapper Automation Overview

Oracle FS Path Manager (FSPM) uses the Linux `device-mapper` to provide multipathing services.

FSPM installs extensions to the Linux Multipath daemon that monitor the state of the Oracle FS System LUNs and determine the appropriate priority of each path. The Multipath daemon presents the Oracle FS System LUNs as virtual block devices in the Linux `device-mapper` framework. FSPM also provides the FSPM daemon, which monitors the state of the `device-mapper` and communicates with the Oracle FS System software.

Note: You can use these `device-mapper` and `multipath-tools` for many purposes other than managing multipathing for Oracle FS System systems.

FSPM provides installation and start up scripts that automate several of the manual integration and configuration tasks that `device-mapper` usually requires.

Multipathing and FSPM Plug-In Libraries Descriptions

The Oracle FS Path Manager (FSPM) provides plug-in libraries for the Multipath Daemon that automatically adjust to differences between different versions of Multipath Tools to ensure that FSPM works with the version of the Multipath Daemon provided by the operating system.

As the FSPM plug-in is loaded, information from the Multipath Tools is compared with information in a FSPM parameter file and if the information matches, then all functions provided by FSPM are used.

If the information does not match, LUN management is passed through to the most suitable libraries provided by the operating system. This means that the FSPM functions of static load balancing support and path preference by protocol are not available. The operating system Multipath Tools continue to report that

the Multipath Tools are using the FSPM plug-in as the LUN management pass-through is not visible to Multipath Tools.

When FSPM is using the native operating system plugins in this way, it appends the word native to the FSPM version string displayed in the Oracle FS System Manager (GUI). For example, the FSPM version might be displayed under SAN Hosts Oracle FS Path Manager Version as 4.0.x native (where x is the release number such as 4.0.2). If you see FSPM version listed as native, contact Oracle Customer Support for a FSPM update to provide full support for your version of Multipath Tools.

As FSPM is installed, FSPM integrates into the Multipath Tools configuration on the system. FSPM copies libraries and programs into the appropriate directories and creates or modifies the Multipath Tools configuration file which is named as `/etc/multipath.conf`. If a different version of Multipath Tools is subsequently installed, these integrations could be overridden. FSPM uses the RPM 'trigger' mechanism to automatically set up or refresh the FSPM integration into Multipath Tools whenever any of the following events happen:

- FSPM is installed or upgraded
- The OS Multipath Tools package is upgraded
- The FSPM parameter file is upgraded
- The OS Multipath Tools Libraries are upgraded

An example of this process is where an administrator uses the `yum` update tool to apply operating system patches that install a different version of Multipath Tools which does not match the information in the FSPM parameter file, the FSPM installation immediately and automatically reintegrates into the new Multipath Tools, and starts using the native ALUA prioritizer instead of the FSPM prioritizer.

When a new version of the FSPM parameter file is installed that supports the version of the Multipath Tools, installing the FSPM parameter file causes a reintegration of FSPM. The reintegration enables full FSPM support and static load balancing and path preference is restored.

An advantage of using the parameter file is that as Multipath tools are updated and released, the FSPM parameter file is updated and can be installed into the existing FSPM installation. When you install the parameter file, FSPM is reconfigured to match the Multipath tools and all functions are restored as described earlier. This avoids installing a new version of FSPM.

Note: The FSPM parameter file is included in the FSPM software package and can be installed separately. The process is described in this document.

Whenever FSPM modifies `/etc/multipath.conf`, FSPM saves a copy first. If FSPM is integrating itself into the Multipath Tools, the saved file is named as follows: `/etc/multipath.conf.fspm.in.YYYY-MM-DDThh:mm:ss`. In this example, `YYYY-MM-DDThh:mm:ss` represents the date and time as shown here as: `/etc/multipath.conf.fspm.in.2014-03-27T16:57:37`. If FSPM is being

installed, the saved file is named as follows: `/etc/multipath.conf.fspm.out.YYYY-MM-DDThh:mm:ss`. You can use these saved files to check any changes which FSPM has made if necessary.

FSPM Features

FSPM works with the Linux Multipath Tools and Device Mapper 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. An example is 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 5: FSPM for Linux features

Feature	Benefit
Automatic data path failover	Automatically switches to the most suitable paths available after a path failure or fail back.
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 WWNs for each host FC port, iSCSI Initiator Names associated with the hosts, and the version of FSPM running on the host.

Table 5: FSPM for Linux 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 information collected from each FSPM host includes</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	Makes connections to clustered systems operating in a SAN.
Support for virtualization	FSPM supports any Xen or KVM hypervisor included in the operating system.
Support for Boot from SAN	FSPM can be on a host which is booted from an Oracle FS System or Pillar Axiom LUN. FSPM is not part of the boot process; if the Linux version supports booting from a multipath LUN managed by Multipath Tools, then FSPM may be used with the system.
FCoE CNAs	FC over Ethernet (FCoE) Converged Network Adapters (CNAs) are supported on the host.
Support for load balancing	Both static and round-robin load balancing options are supported.
Oracle Virtual Networking	Oracle Fabric Interconnect and Oracle Virtual Networking host software provide Ethernet and FC emulation over Infiniband.

FSPM and Clustering Overview

Oracle FS Path Manager (FSPM) can be used in a cluster environment. Refer to the operating system for information on cluster requirements and support. Additional information to support FSPM in a cluster environment is presented here.

For all operating systems, FSPM must be installed before you set up clustering. Once FSPM is installed, then set up clustering to avoid configuration errors.

For Red Hat, the Cluster Logical Volume Manager (CLVM) associated with the shared storage unit and the Red Hat Global File System are both required to prevent failed nodes from accessing shared devices.

For more information on how to set up clustering in your environment using Red Hat, refer to the RHEL [documentation](http://docs.redhat.com/docs/en-US/Red_Hat_Enterprise_Linux/5/html/Cluster_Suite_Overview/index.html) (http://docs.redhat.com/docs/en-US/Red_Hat_Enterprise_Linux/5/html/Cluster_Suite_Overview/index.html) or [documentation](http://docs.redhat.com/docs/en-US/Red_Hat_Enterprise_Linux/6/html/Cluster_Administration/index.html) (http://docs.redhat.com/docs/en-US/Red_Hat_Enterprise_Linux/6/html/Cluster_Administration/index.html)

Note: For Red hat, the Red Hat Cluster Suite installs and enables the `scsi_reserve` service by default. This service should be disabled if the `scsi_fence` option is not used as a fencing mechanism. To disable the `scsi_reserve` service, run the following command:

```
# chkconfig scsi_reserve off
```

For Oracle Linux, to obtain additional information on how to set up clustering in your environment, refer to the [Oracle Real Application Clusters \(RAC\) documentation](http://www.oracle.com/technetwork/database/clustering/overview/index-086583.html) (http://www.oracle.com/technetwork/database/clustering/overview/index-086583.html).

For Oracle Linux, the Oracle Clusterware associated with the shared storage unit and the Oracle Clustering File System (OCFS) are both required to prevent failed nodes from accessing shared devices.

For SLES 11, refer to the [SUSE Linux Enterprise High Availability Extension Guide](https://www.suse.com/documentation/sle_ha/singlehtml/book_sleha/book_sleha.html) (https://www.suse.com/documentation/sle_ha/singlehtml/book_sleha/book_sleha.html) for instructions.

Related Links

[FSPM Features](#)

Supported SAN Protocols

Provides information about supported FC and iSCSI protocols supported by Oracle FS Path Manager (FSPM).

FSPM supports FC and iSCSI connections to the Oracle FS System.

Supported FC Topologies

Description of supported and unsupported of FC topologies.

Oracle FS Path Manager (FSPM) supports the Point-to-Point (FC-P2P) and Switched Fabric (FC-SW) topologies and Fiber Channel over Ethernet (FCoE) connections from the host through a Switched Fabric. FSPM does not support Arbitrated Loop (FC-AL).

Supported Hardware

Oracle FS Path Manager (FSPM) supports a variety of FC HBAs, converged network adapters (CNAs), and SAN routers and switches.

FSPM supports all FC adapters which are fully supported for the operating system distribution used. FC adapters should be selected with care to ensure that the adapter is suitable for use in a multipath environment with large I/O loads. For example, some low-end adapters have a low limit on the number of simultaneous connections which can be made from each port. This can cause those adapters to be unsuitable for use in an environment where the adapters need to connect to several Controller ports.

Information is provided in this document about supported hardware including recommended configurations settings. Review the *Oracle FS Path Manager Release Notes* for additional information.

Supported Emulex FC Adapters and Drivers

Oracle FS Path Manager (FSPM) supports Emulex FC adapters and drivers.

FSPM supports all FC adapters which are fully supported for the operating system distribution used. FC adapters should be selected with care to ensure that the adapter is suitable for use in a multipath environment with large I/O loads. For example, some low-end adapters have a low limit on the number of simultaneous connections which can be made from each port. This can cause those adapters to be unsuitable for use in an environment where the adapters need to connect to several Controller ports.

Recommended Settings for Emulex FC Adapters

Oracle recommends the following settings for Emulex HBAs and converged network adapters (CNAs):

Table 6: Emulex adapter settings

Adapter setting	Recommended value
lpfc_lun_queue_depth	64
lpfc_devloss_tmo	60
lpfc_cr_count	60

Note: The installation instructions tell you how to set these parameters by editing the `/etc/modprobe.conf` file and rebooting the host. It is also possible to set

these parameters using utilities supplied by Emulex. Refer to the Emulex website for details.

Install Emulex FC Adapters and Drivers

To ensure compatibility between Oracle FS Path Manager (FSPM) and your Emulex HBAs or converged network adapters (CNAs), be sure to follow the instructions in this section for installing the supported Emulex adapters and drivers.

- 1 Install Emulex HBAs and CNAs according to the instructions at the [Emulex support download page](http://www.emulex.com/downloads) (currently <http://www.emulex.com/downloads>).
- 2 Install the Emulex HBA and CNA drivers that come with the Linux distribution.
- 3 Edit the `/etc/modprobe.conf` file to set the options for the `lpfc` driver. If an `options` line already exists for this driver, modify it to include the recommended settings. If an `options` line does not exist, add one in the following format:

```
options lpfc lpfc_devloss_tmo=60 lpfc_lun_queue_depth=64
```

- 4 Rebuild the kernel to ensure that any changes to the driver are picked up. Use the following command:

```
# /sbin/new-kernel-pkg --mkinitrd --depmod --install  
`uname -r`
```

- 5 Reboot the host.

Note: Emulex provides utilities that can be used to set the driver options without rebooting the host. Refer to the [Emulex website](http://www.emulex.com/downloads/emulex.html) (<http://www.emulex.com/downloads/emulex.html>) for details. If you use the Emulex utilities, you should still follow the steps above to update the configuration file and build a new kernel so that the options are in effect after the next reboot.

Supported QLogic FC Adapters and Drivers

The Oracle FS Path Manager (FSPM) supports QLogic FC adapters and drivers.

Information is provided in this document about supported hardware including recommended configurations settings. Review the *Oracle FS Path Manager Release Notes* for changes or additional recommendations.

Recommended Settings for QLogic FC Adapters

Oracle recommends the following settings for QLogic QL series HBAs and converged network adapters (CNAs):

Table 7: QLogic adapter settings

Adapter setting	Recommended value
ql2xloginretrycount	30
ql2xlogintimeout	60
qlport_down_retry	45
ql2xmaxqdepth	64

Note: The installation instructions tell you how to set these parameters by editing the `/etc/modprobe.conf` file and rebooting the host. It is also possible to set these parameters using utilities supplied by QLogic. Refer to the [QLogic website](http://www.qlogic.com/Products/adapters/Pages/FibreChannelAdapters.aspx) (<http://www.qlogic.com/Products/adapters/Pages/FibreChannelAdapters.aspx>) for details.

Install QLogic FC Adapters and Drivers

To ensure compatibility between Oracle FS Path Manager (FSPM) and your QLogic HBAs or converged network adapters (CNAs), be sure to follow the instructions in this section for installing the supported QLogic adapters and drivers.

- 1 Install QLogic HBAs and CNAs according to the instructions at the [QLogic support download page](http://driverdownloads.qlogic.com/QLogicDriverDownloads_UI/) (currently http://driverdownloads.qlogic.com/QLogicDriverDownloads_UI/).
- 2 Install the QLogic HBA and CNA drivers that come with the Linux distribution.
- 3 Edit the file `/etc/modprobe.conf` to set the options for the `qla2xxx` driver.

If an `options` line already exists for this driver, modify it to include the recommended settings. If an `options` line does not exist, add one in the following format:

```
options qla2xxx ql2xloginretrycount=30 ql2xlogintimeout=60
qlport_down_retry=45 ql2xmaxqdepth=64
```

- 4 Rebuild the kernel to ensure that any changes to the driver are included. Use the following command:

```
# /sbin/new-kernel-pkg --mkinitrd --depmod --install
`uname -r`
```

- 5 Reboot the host.

Note: QLogic provides utilities that can be used to set the driver options without rebooting the host. Refer to the [QLogic website](http://www.qlogic.com/Products/adapters/Pages/FibreChannelAdapters.aspx) (<http://www.qlogic.com/Products/adapters/Pages/FibreChannelAdapters.aspx>)

for details. If you use the QLogic utilities, you should still follow the steps above to update the configuration file and build a new kernel so that the options are in effect after the next reboot.

Supported QLogic BR Series FC Adapters and Drivers

Oracle FS Path Manager (FSPM) supports QLogic BR Series FC adapters and drivers.

Information is provided in this document about supported hardware including recommended configurations settings. Review the *Oracle FS Path Manager Release Notes* for changes or additional recommendations.

Recommended Setting for QLogic BR Series FC Adapters

Oracle recommends the following setting for QLogic BR Series HBAs and converged network adapters (CNAs):

Table 8: QLogic BR Series adapter setting

Adapter setting	Recommended value
pathtov (path time out value)	60

Install QLogic BR Series Adapters and Drivers

To ensure compatibility between Oracle FS Path Manager (FSPM) and your QLogic BR Series HBAs or converged network adapters (CNAs), be sure to follow the instructions in this section for installing the supported QLogic BR Series adapters and drivers.

- 1 Install QLogic BR Series HBAs and CNAs according to the instructions available from [QLogic Downloads and Documentation](http://driverdownloads.qlogic.com/QLogicDriverDownloads_UI/DefaultNewSearch.aspx) (currently [//http://driverdownloads.qlogic.com/QLogicDriverDownloads_UI/DefaultNewSearch.aspx](http://driverdownloads.qlogic.com/QLogicDriverDownloads_UI/DefaultNewSearch.aspx)).
- 2 Download version 3.1.0 or later of the driver and utilities package from the [QLogic Downloads and Documentation](http://driverdownloads.qlogic.com/QLogicDriverDownloads_UI/DefaultNewSearch.aspx) (currently [//http://driverdownloads.qlogic.com/QLogicDriverDownloads_UI/DefaultNewSearch.aspx](http://driverdownloads.qlogic.com/QLogicDriverDownloads_UI/DefaultNewSearch.aspx)).
- 3 Follow the QLogic BR Series instructions to install the driver and utilities. Be sure to update the adapter firmware if required.
- 4 Use one of the QLogic BR Series utilities to set the path time out value (`pathtov`) for each QLogic BR Series FC and FC over Ethernet (FCoE) port. The path time out value should be set to 60. Refer to the QLogic BR Series documentation for details of how to set the value.

Supported FC and FCoE Switches

For a list of supported FC and FC over Ethernet (FCoE) switches:

- Refer to the *Oracle FS System Support and Interoperability Guide*, which can be found on the [Oracle Technology Network Documentation](http://www.oracle.com/technetwork/documentation/oracle-unified-ss-193371.html) website (<http://www.oracle.com/technetwork/documentation/oracle-unified-ss-193371.html>).

Note: Refer to the switch vendor's website for the most recent installation instructions, patches, and firmware.

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) (<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) (http://docs.oracle.com/cd/E38500_01/index.html) for instructions on setting up and configuring the Oracle Fabric Interconnect and associated components which 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.

Review the *Oracle FS Path Manager Release Notes* for information on required Oracle Virtual Networking host drivers.

Supported iSCSI Software and Hardware

Lists supported iSCSI software and hardware.

Oracle FS Path Manager (FSPM) supports the following iSCSI software and hardware:

- iSCSI HBAs and other support hardware-assist mechanisms that are fully supported by the operating system
- The iSCSI software initiator included in the operating system distribution
- iSCSI-to-FC routing features of the Cisco MDS 9000 family of routers and switches

Network Configuration for iSCSI Multipathing Overview

You can reduce the impact of failures in your iSCSI network by ensuring that iSCSI connections are made through several NICs on the host or through network switching.

Oracle recommends using the normal IP configuration facilities to route connections to different ports on the Controller through different host NICs. For example, if the host has two NICs available for iSCSI connections to a Controller, you can set up routing to send all traffic to one port on each Controller through one NIC, and traffic to the other port on each Controller through the other NIC.

The best way to ensure that your iSCSI paths use different physical connections depends on factors such as the number of available NICs in the host and the existing configuration of your IP network. Oracle recommends using normal IP routing configuration techniques such as subnet configuration and explicit route configuration to distribute connections over multiple NICs. You can also use NIC bonding to provide redundancy on Ethernet connections between the host and the switch.

Subnet Configuration Overview

Groups of host NICs and Controller ports can be configured into different subnets. Whenever the iSCSI initiator opens a connection to a Controller port, that connection will automatically be routed through the host NIC in the same subnet as the Controller port. For example, if a host has two NIC ports on the iSCSI network, one of the host NIC ports connected to one of the Controller control unit (CU) ports could be placed in one subnet, and another host NIC port connected to the other Controller CU port could be placed in a different subnet.

NIC Bonding Description

Network interface card (NIC) bonding is another way to add redundancy to Ethernet networks.

With *NIC bonding*, also known as *channel bonding*, two or more NICs and their physical connections to the switches are logically bonded together and presented to the IP as a single virtual NIC. If one of the physical connections fails, the traffic is transferred to another NIC without the IP layer or the layers above it knowing about the transfer.

This approach protects against low-level Ethernet failures, such as a faulty NIC or cable, between the host and its local IP switch. Because the redundancy is at a very low level in the protocol stack, the higher layers such as TCP/IP, iSCSI, and `device-mapper` are not aware that a transfer to a different NIC has taken place. To the IP protocol, the virtual bonded NIC appears as a single physical connection. To iSCSI, it appears as a single connection to each target port.

In short, the iSCSI, `device-mapper`, and Oracle FS Path Manager (FSPM) layers are not aware of the physical path redundancy provided at the NIC bonding level and do not treat this redundancy as providing multiple paths to the Controller storage controller. Multiple paths created by NIC bonding will not be

reported as multiple paths by `device-mapper` or in the Oracle FS System Manager.

Configure the iSCSI Initiator

To support iSCSI connections, Oracle FS Path Manager (FSPM) requires the iSCSI initiator that is included in your operating system distribution be configured to startup automatically.

For complete installation and configuration instructions, refer to: `/usr/share/doc/iscsi-initiator-utils-*/README`. The steps below are an overview of the instructions in the `README` file.

Important: You must ensure that each iSCSI initiator on the iSCSI SAN has a unique name, and set this host's initiator name in the `/etc/iscsi/initiatorname.iscsi` file.

- 1 Set up IP addresses and network parameters on Controller iSCSI ports.

This might include setting up Challenge Handshake Authentication Protocol (CHAP) on your system.

- 2 Configure iSCSI accordingly.
If you are using CHAP to communicate with the Controller iSCSI ports, you may need to modify the `/etc/iscsi/iscsid.conf` file accordingly.
- 3 Start the iSCSI initiator.

- a) Run the following command for operating systems that use the `open-iscsi` service:

```
# service open-iscsi start
```

- b) Run the following command for operating systems that use the `iscsi` service:

```
# service iscsi start
```

- 4 Discover the iSCSI target ports.

Two methods are shown below to discover an iSCSI target port where `172.20.191.11` is the IP address and `3260` is the default port number of either a Controller iSCSI port or an iSCSI-to-FC router port:

```
# iscsiadm -m discovery -t sendtargets -p 172.20.191.11:3260
```

```
# iscsi_discovery 172.20.191.11:3260
```

- 5 Log in to the iSCSI target ports.

Example:

```
# iscsiadm -m node --loginall=all
```

- 6 (Optional) Discover the other ports, depending on the desired design.
- 7 Restart the `iscsi` or `open-iscsi` service to log in to the discovered target ports.

- a) Run the following command for operating systems that use the `open-iscsi` service:


```
# service open-iscsi start
```
 - b) Run the following command for operating systems that use the `iscsi` service:


```
# service iscsi start
```
- 8 Use `chkconfig` to configure the `iscsi` or `open-iscsi` service to start up automatically.

Start the iSCSI Initiator Service

After you have configured the iSCSI initiator, set the iSCSI initiator to start at startup time and confirm that your iSCSI devices are visible.

- 1 Start the iSCSI initiator.
 - a) Run the following command for operating systems that use the `open-iscsi` service:


```
# service open-iscsi start
```
 - b) Run the following command for operating systems that use the `iscsi` service:


```
# service iscsi start
```
- 2 Configure the `iscsi` or `open-iscsi` service to start at boot time.

Run the following commands depending upon your iSCSI service. The first command checks that the scripts necessary to start and stop the service are available. The second command sets the service to start at the appropriate run levels.

 - a)

```
# chkconfig --add iscsi
```
 - b)

```
# chkconfig iscsi on
```

or

 - c)

```
# chkconfig --add open-iscsi
```
 - d)

```
# chkconfig open-iscsi on
```
- 3 Verify that the `iscsi` or `open-iscsi` service is configured to start at boot time.

Run the following commands depending upon your iSCSI service:

 - a)

```
# chkconfig --list iscsi
```
 - b)

```
# chkconfig --list open-iscsi
```

The following is a sample of the output of this command when the service is *not* configured to start at boot time:

```
0:off 1:off 2:off 3:off 4:off 5:off 6:off
```

The following is a sample of the output of this command when the service is configured to start at boot time:

```
0:off 1:off 2:on 3:on 4:on 5:on 6:off
```

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 multilayer 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) (www.cisco.com) website and search on the product family, Cisco MDS 9000.

Supported iSCSI Switches

For a list of supported iSCSI switches,

- Refer to the *Oracle FS System Support and Interoperability Guide*, which can be found on the [Oracle Technology Network Documentation](http://www.oracle.com/technetwork/documentation/oracle-unified-ss-193371.html) website (http://www.oracle.com/technetwork/documentation/oracle-unified-ss-193371.html).

Note: Refer to the vendor's website for the most recent installation instructions, patches, and firmware.

Configure the iSCSI-to-FC Router

The iSCSI-to-FC routing features of the Cisco MDS 9000 family of multi-layer directors and fabric switches require configuration to work with the Oracle FS Path Manager (FSPM) and the Pillar Axiom system.

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) (http://www.cisco.com/en/US/products/ps10495/products_installation_and_configuration_guides_list.html).

- 1 Present the ports on the Controller storage controller as iSCSI targets. Choose Dynamic Mapping or Static Mapping. However, we recommend that you use dynamic mapping because the main Cisco features for static mapping requirements are supplied by FSPM and the Oracle FS System Manager.
- 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 systems in exactly the same way as when both hosts and Controllers use the same SAN protocol.

Operating Limits

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 this document.

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

The Linux `device-mapper` and other parts of the Linux system limit the total number of devices and paths that can be used. The operating system administrator can change some of these limits. Please refer to the operating system administrator's guide to change these values.

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 initially connecting a host or hosts to the Oracle FS System through the SAN and assigning storage to the host. The sequence of steps in this document assumes that there are no configuration entries in the Oracle FS System Manager 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 Read 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. Review 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 installed according to the manufacturer's instructions.
- 4 If you are using iSCSI connections, verify that your iSCSI configurations are supported by the FSPM and installed according to the manufacturer's instructions.
- 5 Follow the installation process in order as described in this section. It is important to follow the process as you cannot perform these tasks out of order. For example, before installing FSPM, it is important to verify port access, pre-configure SAN host for Oracle FS System, and verify installation of the device mapper and multipath tools. Installing FSPM first and then performing these other tasks out of sequence will cause installation problems.

Delete SAN Host Before FSPM Installation

Before you install the FSPM software, you need to delete any SAN host that was manually created.

During installation, FSPM automatically creates a host entry for the host in the Oracle FS System Services and associates the host's initiators with the entry. If you manually associated any of the host's initiators with a host entry and mapped LUNs to the host, you must delete that host entry before installing FSPM on the host. If you do not follow this process to delete the host entry, the LUN mappings are deleted and you need to recreate the LUN mappings after installing FSPM.

Note: In this section, all references to GUI screens refer to the layout of the Oracle FS System Manager (GUI) version 6.0. Other GUI versions are organized differently, but all versions offer equivalent functionality. Review the *Administrator's Guide* for details on how to access the features in older versions of the GUI.

- 1 From the GUI, navigate to the SAN > Storage > Hosts page.
- 2 Select the host you want to delete.
- 3 Select SAN > Storage > Hosts > Actions > Delete Host
The Delete SAN Host dialog is displayed.
- 4 On the Delete SAN Host dialog, make sure Delete mappings and initiators? is not checked, which is the default value. If the box is checked, uncheck the box. This saves the associated LUN mappings to the host which FSPM restores as part of the FSPM installation process.

Figure 2: Delete SAN Host



- 5 Select OK to delete the SAN host.

You can also delete the SAN Host using the Oracle FS CLI. Review the *Oracle FS CLI Reference Guide* for further information.

Verify Management Network Requirements

FSPM communicates with the Pilot using secure encrypted messages. The SAN host where the FSPM is installed requires a TCP/IP connection for

communication with Oracle FS System Manager (GUI) or Pillar Axiom Storage Services Manager (GUI).

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

Network firewalls may 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.

Here is an example of the command for the Pillar Axiom storage system port:

```
telnet axiom_ip_or_dns_name 26004
```

Here is an example of the command for the Oracle FS System port:

```
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.

Related Links

[FSPM Requirements](#)

[Operating Limits](#)

[Supported Hardware](#)

[Prepare to Install the FSPM Software](#)

[Configure SAN Host Connections](#)

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 Oracle FS System meets the following requirements:

- Available FC or iSCSI ports on an Oracle FS System Controller or Pillar Axiom Slammer.
- Supported HBA and converged network adapter (CNA) drivers.
- Ethernet connections to the management ports on the Pilot.
- A network configuration 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 6.0. Other GUI versions are organized differently, but all versions offer equivalent functionality. Review 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 as described in this document.
- 2 Set up the SAN (physical connectivity and any required switch zoning) so there is at least one path through the SAN the 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 the SAN > Storage > Hosts page.
- 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. This is shown in the following illustration:

Figure 3: Example of Host Ports grouped under Unassociated Host Name

Host Name	Controller-Initiator Connect...	Number of LUNs Mapped	Oracle FS Path Manager			HBA
			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.11.85.54	Connected					
10.00.00.90:FA.11.85.55	Connected					
21.00.00.E0.88.84.14.9C	Connected					

Verify Installation of Device Mapper and Multipath Tools

The Linux `device-mapper`, among other uses, maps a logical block device on the SAN host to a LUN. The Linux Multipath Tools use Device Mapper to present the multiple paths to a LUN as a single device. The Oracle FS Path Manager (FSPM) daemon monitors the Multipath Tools and integrates with the Multipath Tools to provide multipathing.

FSPM requires the `device-mapper` and `multipath-tools` version that comes with the Linux distribution.

- 1 Verify that `device-mapper` package is installed.

Run the following commands:

```
# rpm -qa | grep device-mapper | grep -v multipath
```

The output displays all versions of all installed packages that include `device-mapper` in their names.

- 2 If the `device-mapper` packages are not installed, install them. You can install the packages from your Linux installation media or the operating system vendor website.
- 3 Verify that the Multipath Tools packages are installed.

Run the following command:

```
# rpm -qa | grep multipath
```

The output displays all installed packages that include `multipath` in the package names. The name of the Multipath Tools package differs between distributions but is usually `multipath-tools` or `device-mapper-multipath`. Some distributions also require a second package which is usually named `device-mapper-multipath-libs`.

- 4 If the Multipath Tools packages are not installed, install the packages and any dependencies. You can install the packages from your Linux installation CDs or the operating system vendor website.

FSPM Download and Installation Overview

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

[Configure SAN Host Access to LUNs](#)

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).

Prerequisite: Join the [Oracle Technology Network](#) to gain access to software and documentation downloads:

<http://www.oracle.com/technetwork/community/join/why-join/index.html>

Follow these steps to access and download the software:

- 1 On the Oracle Technology Network, open the [Oracle Flash Storage System Downloads](#) page (<http://www.oracle.com/technetwork/server-storage/san-storage/downloads/index.html>) in a web browser.
- 2 From Oracle FS System Downloads, select Accept License Agreement.
- 3 Locate and select the name of the software package to download for your operating system version.
- 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 or Update the FSPM Software

Install the software that you extracted to your SAN host so you can use Oracle FS Path Manager (FSPM).

Prerequisite: Before you install the FSPM software, verify that your system meets all hardware and software prerequisites mentioned earlier in this document.

You can install the full FSPM installation package or just the parameter file. You would install the full package if you are initially installing FSPM or you want to

reinstall FSPM. If your Linux Multipathing tools have changed, then you might need to install a new parameter file.

- 1 Install the FSPM package and parameter file.

To install the product package and the parameter file at the same time, enter one of the following commands depending upon the software package you downloaded.

Note: In the command, *version* is the name of the software package release you downloaded. For example, `oracle-fspm-4.0.0-1.i486.rpm` or `oracle-fspm-4.0.0-1.x86_64.rpm`.

```
# rpm -Uvh oracle-fspm-version.i486.rpm oracle-fspm-params-  
version.noarch.rpm
```

```
# rpm -Uvh oracle-fspm-version.x86_64.rpm oracle-fspm-params-  
version.noarch.rpm
```

FSPM files and scripts are installed in the `/opt/oracle` directory.

- 2 To replace or update the parameter file, enter the following:

In the command, *version* is the name of the software product release you downloaded.

For example, `oracle-fspm-params-4.0.0-1.noarch.rpm`

```
# rpm -Uvh oracle-fspm-params-version.noarch.rpm
```

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

To use the 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 below:

Figure 4: Example of Host Ports grouped under Unassociated Host Name before FSPM installation

Host Name	Controller-Initiator Connect...	Number of LUNs Mapped	Oracle FS Path Manager			HBA
			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.E0.88.84.14.9C	Connected					

Figure 5: Example of Host Ports grouped under Host Name after FSPM installation

Host Name	Controller-Initiator C...	Number of LUNs Mapped	Oracle FS Path Manager			HBA
			Status	Version	Host IP Address	HBA Alias Name
co-fs01-01						
10.00.00.90:FA.11.B5.54	Not Connected		5 Communicating	4.0.1	10.79.186.179	
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					
iqn.1986-03.com:snm:01:00:10e0203b36:5212e476	Not Connected					

Note: The following Oracle FS Path Manager Status, Controller-Initiator Connectivity and Version 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 Connected: The host SAN connection is logged in to a Controller on the Oracle FS System.

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

Version If the FSPM Status is Not Registered or Not Communicating, the Version field will be empty.

If the FSPM Status is Communicating, the Version string will have one of these forms as shown.

Note: The version numbers are for example only; the actual version depends upon which version of FSPM is installed.

4.0.1/ 4.0.2 native The first value is the version of the main FSPM package, the second value is the version of the parameter file, and native indicates that FSPM has detected a version of Multipath Tools which it does not fully support. FSPM is running in a limited mode which supports basic multipathing by passing control through to support libraries provided by Multipath Tools, instead of using the enhanced versions provided by FSPM.

Contact Oracle Customer Support to request a new version of the FSPM parameter file to support your version of Multipath Tools.

4.0.1/ 4.0.2 The first value is the version of the main FSPM package, the second value is the version of the parameter file. This indicates that FSPM is operating normally.

4.0.2 This is the version of both FSPM packages. This indicates that FSPM is operating normally.

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 the FSPM version you installed. Select the name of the new host and the select Actions > View Host > Oracle FS Path Manager to view the version information. The operating system and FSPM versions shown in the illustration can differ from your configuration.
- 5 Review the LUN names on the Oracle FS System under the LUN Name column.

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 its name and other information to the GUI. You may 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.

- 6 Review the load balancing algorithm being used for each LUN to determine if you need to change the current load balancing setting.
- 7 Review the numbers of optimized and non-optimized paths currently reported by FSPM under the Optimized Paths and Non-Optimized Paths.
- 8 Select the 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:

- The LUN numbers used to make the LUN visible to the host
- An indication whether or not each SAN port on the host has a connection to at least one port on the Controller

Configure Oracle Clustering Timeout Settings

If you experience reboot or hang problems with Oracle Cluster File System (OFCS), Oracle recommends setting O2CB service parameters to values that are higher than the usual suggested minimums.

Prerequisite: Review the *Oracle FS Path Manager Release Notes* notes for any changes to the recommended timeout settings for Oracle Clustering.

Use the O2CB services configuration file to automatically start up the O2CB driver for the OFCS.

- 1 Run the following command to generate the `/etc/sysconfig/o2cb` configuration file:

```
/etc/init.d/o2cb configure
```

- 2 Use a text editor to make the following modifications to the generated `o2cb` file:

```
O2CB_HEARTBEAT_THRESHOLD = 181
O2CB_IDLE_TIMEOUT_MS = 9000000
O2CB_KEEPAALIVE_DELAY_MS = 90000
O2CB_RECONNECT_DELAY_MS = 20000
```

- 3 Add the following new line to the `/etc/fstab` file.

Note: In this example, the OCFS is mounted at `/dev/mapper/2000b08008e001305`.

```
/dev/mapper/2000b08008e001305/u02/oradata/orcl ocfs
_netdev 0 0
```

This line configures the OCFS filesystems to mount automatically at startup.

Note: The `_netdev` option prevents the OCFS filesystem from being mounted until the network has first been enabled on the system, which provides access to the storage device (see `mount(8)`).

Partition and Format the LUN Disk (Optional)

Follow these instructions if you plan to use the Linux `fdisk` or `parted` utilities to partition and format the disk on which a LUN resides.

The `fdisk` utility cannot be used with devices listed in the `/dev/mapper` directory. Instead, use `fdisk` on one of the underlying paths, and then run the scripts to restart the `multipath-tools` and FSPM daemons to notify `device-mapper` that a `/dev/mapper` device has a new partition.

- 1 Identify one of the highest priority paths to the LUN using the output of the `multipath -ll` command as shown: `multipath -ll /dev/mapper/2000b08008e00135`

In the output below, you could identify either the `/dev/sdd` path or the `/dev/sdt` path such as `4:0:1:1 sdd...` or `5:0:1:1 sdt....`

```
2000b08008e001305 dm-0 Oracle,FS1-2
size=50G features='1 queue_if_no_path' hwhandler='0' wp=rw
|-- policy='round-robin 0' prio=4000000 status=active
|  |-- 4:0:1:1 sdd 8:48 active ready running
|  |-- 5:0:1:1 sdt 65:48 active ready running
|-- policy='round-robin 0' prio=3000000 status=enabled
|  |-- 8:0:0:1 sdj 8:144 active ready running
|  |-- 6:0:0:1 sdk 8:160 active ready running
|-- policy='round-robin 0' prio=2000000 status=enabled
|  |-- 4:0:0:1 sdb 8:16 active ready running
|  |-- 5:0:0:1 sdf 8:80 active ready running
|-- policy='round-robin 0' prio=1000000 status=enabled
|  |-- 9:0:0:1 sdl 8:176 active ready running
|  |-- 7:0:0:1 sdp 8:240 active ready running
```

Note: The output displayed depends upon the SAN configuration and the version of Multipath tools. Choose a path from the group which has the largest `prio` value. In the above example, the highest `prio` value is `prio=4000000` which Oracle recommends you choose.

- 2 Use `fdisk` to partition one of the highest priority paths identified in Step 1.
- 3 Create the device files and links to access the new partitions. The best way to do this depends on the operating system, see the operating system's multipath disk administration documentation. On some operating system, this is completed by triggering the `udev` mechanism to inform it that partitions have been added.

For example: `# echo add > /sys/block/dm-0/uevent` with `dm-0` replaced by the `dm` name listed in the first step. `Udev` is used to create set of rules to create any necessary files. On other operating systems, you may need to use the `kpartx` command manually as shown here:

```
# kpartx -a /dev/mapper/2000b08008e001305.
```

- 4 Run one of the the following commands to restart the Multipath Daemon:

```
# service multipathd restart
```

or

```
# /etc/init.d/multipathd restart
```

- 5 Verify that devices were created for the new partitions .Partition device files in `/dev/mapper` consist of the disk name followed by a delimiter followed by the partition number. The delimiter is usually `p'` or `part`, so partition devices are usually named

For Linux versions:

```
/dev/mapper/LUNpx
```

```
/dev/mapper/LUN_partx
```

In the example above, if only partition 1 were created with `fdisk`, it could appear as follows:

```
localhost$ ls -l /dev/mapper/2000b08008e001305*
brw-rw---- 1 root disk 253,  2 Jul  7 12:02 2000b08008e001305
brw-rw---- 1 root disk 253,  3 Jul  7 15:12 2000b08008e001305p1
```

6 Format the new partition.

To format the partition created in the example above, you might run the following command:

```
# mke2fs -j /dev/mapper/2000b08008e001305p1
```

7 Mount the filesystem.

For detailed information, refer to your Linux documentation.

Load Balancing Configurations

FSPM can be configured for static or round-robin load balancing. You can also configure load balancing separately for each LUN.

In static load balancing, the software selects the best available path and all commands are sent over that path until the path is no longer operational or a better path becomes available. Then, a failover to another appropriate path is initiated.

In round-robin load balancing, commands are sent by turn over the best available paths. This ensures that LUN commands are evenly distributed over any path that is available to access the LUNs. Round-robin load balancing is the default method to manage data paths.

Note: Round robin is the preferred method as round robin balances I/O across all available optimized paths.

Load balancing allows the paths to share the load in different ways:

- Balances access to a LUN across all optimized Oracle FS System Controller ports available for that LUN
- Balances access from a host across the host HBA channels

To configure round-robin or static load balancing through Oracle FS System Manager (GUI), refer to the *Oracle Flash Storage System Administrator's Guide* for additional information.

Related Links

[Configure SAN Host Access to LUNs](#)

Path Selection Overview

Oracle FS Path Manager (FSPM) selects the best paths to access Oracle FS System LUNs.

Path selection is based on three factors:

- Path optimization state
- Path performance
- Path availability

A path's 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. Generally, FC paths perform better than iSCSI paths, so FC paths are preferred over iSCSI paths.

Note: In this discussion, FC includes FC HBA as well as FCoE CNAs.

Path availability is determined by the ability of the path to transfer I/O traffic. An available path is fully functional but 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.

FSPM groups the paths in the following order of preference:

- First, FC optimized
- Next, iSCSI optimized
- Next, FC non-optimized
- Finally, 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 failing 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 FSPM Software

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 nor 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 as diagnostic information can 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 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, or start services.
- 2 To verify the status (running or stopped) of the FSPM service on the host, perform the following:

- From the command line, run the following command:

```
service oracle-fspmd status
```

or

```
/etc/init.d/oracle-fspmd status
```

If the FSPM service is stopped, you need to start the service. Follow the steps in this document.

- 3 To restart the FSPM service, perform the following:

- From the command line, run the following command:

```
service oracle-fspmd restart
```

or

```
/etc/init.d/oracle-fspmd restart
```

After restarting the FSPM service, verify the service status is running by following the steps in this document.

4 To stop the FSPM service, use the following command:

- From the command line, run the following command:

```
service oracle-fspmd stop
```

or

```
/etc/init.d/oracle-fspmd stop
```

After stopping the FSPM service, verify the service status is stopped by following the steps in this document.

5 To start the FSPM service, use the following command:

- From the command line, run the following command:

```
service oracle-fspmd start
```

or

```
/etc/init.d/oracle-fspmd start
```

After starting the FSPM service, verify the service status is running by following the steps in this document.

Host Reconfiguration Overview

Once you have installed Oracle FS Path Manager (FSPM) and the host is using LUNs from a Oracle FS System, you may 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 Fibre Channel 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, effect 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 Choose one of:
 - 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. To restart the FSPM , review the information on starting and stopping the FSPM software as described in this document.

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 FSPM Software](#)

iSCSI HBAs or IP Addresses Change

Changes to an iSCSI HBA do not require any further actions if the iSCSI initiator name or IP addresses are not changed.

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 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 the new host name change is updated in the Oracle FS System configuration information.

FSPM installs a service which 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, it sends the hostname which FSPM discovered from the host to the Oracle FS System. That hostname is used as the name of the host entry in the Oracle FS System Services. If you want to change the hostname 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, select SAN > Storage > Hosts.
 - b) Under the Host Name locate the host to be renamed.
 - c) Under the Controller-Initiator Connectivity verify that Connected is displayed for one of the connections.
- 2 Stop the FSPM service. Follow information provided in this document.
- 3 Review the existing LUN mappings for the host you are renaming before deleting the host. From the GUI, select SAN > Storage > Host-LUN Mapping to review the LUN mappings to the host you are deleting.
- 4 From the GUI, select SAN > Storage > Hosts to select the host you want to delete.
- 5 From the GUI select SAN > Storage > Hosts > Actions > Delete Host and delete the host to be renamed. The Delete SAN Host dialog is displayed.
 - a) When the Delete SAN Host dialog is displayed, make sure the Delete mappings and initiators is not checked. This preserves the associated LUN mappings to the host. Select OK to delete the SAN Host.
 - b) You can also delete a SAN Host using the Oracle FS CLI. Review 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) following the instructions in this document.

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, select SAN > Storage > Host-LUN Mapping to verify 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 APM or FSPM, perform the following steps to ensure a successful installation.

Review 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.

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

You do not need to uninstall a previous version of APM or FSPM before installing a new version of FSPM.

Remove the FSPM Software (Optional)

Removing the FSPM is optional and is not recommended. If you want to install a newer version or an updated parameter file, follow the steps in this document. If you want to completely remove FSPM, then follow the steps listed in this section.

Prerequisite: Before you uninstall FSPM, if you do not want to access Oracle FS System LUNs, we recommend that you disconnect the SAN host from the Oracle FS System.

Enter the following command to remove FSPM including the product release and the parameter file:

```
rpm -e oracle-fspm oracle-fspm-params
```

After the FSPM software has been removed, the host appears not to be communicating in the Oracle FS System Manager. The system configuration is left with a configuration that uses the most efficient settings of the native Multipath Tools to manage LUNs which were previously managed by FSPM.

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