

Oracle Flash Storage System

Oracle FS Path Manager 4 for Windows 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 4 for Windows 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 the Windows Server operating systems on 32-bit, x64, and Itanium-based systems.

This document describes how to install and configure the FSPM for Windows software.

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.

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.

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

Related Links

[Download the FSPM Software](#)

[Install the FSPM Software](#)

[Configure SAN Host Access to LUNs](#)

[Update the FSPM Software](#)

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

FSPM Software Description

The Oracle FS Path Manager (FSPM) software runs on the host system. For this operating system, multiple LUN paths are presented as multiple drives. With

FSPM, every configured multi-pathed FSPM LUN is presented as a single drive to the operating system.

FSPM software integrates with the Microsoft Windows Multipath I/O (MPIO) component. FSPM consists of a configuration service and an MPIO Device Specific Module (DSM) for Oracle FS System. This combination, along with the Microsoft MPIO component, allows Windows to detect and configure Oracle FS System storage devices and to manage the I/O paths to those devices.

Note: One host can access a maximum of 255 LUNs on each Oracle FS System. (The Oracle FS System supports more than 255 LUNs but Windows Servers do not support more than 255 LUNs.) The LUNs must be numbered from 0 to 254 because Windows does not recognize LUN number 255.

Note: One host can access up to eight systems in any combination of Oracle FS System or Pillar Axiom systems.

FSPM Architecture

Oracle FS Path Manager (FSPM) manages multipathing and communicates with the Oracle FS System on a control path, which is separate from the data path. LUN access is managed along the data path.

The following figure illustrates how the FSPM software installed on a SAN host interacts with an Oracle FS System. The following table describes meanings of the lines and colors used in the figure.

Table 4: Line and color key





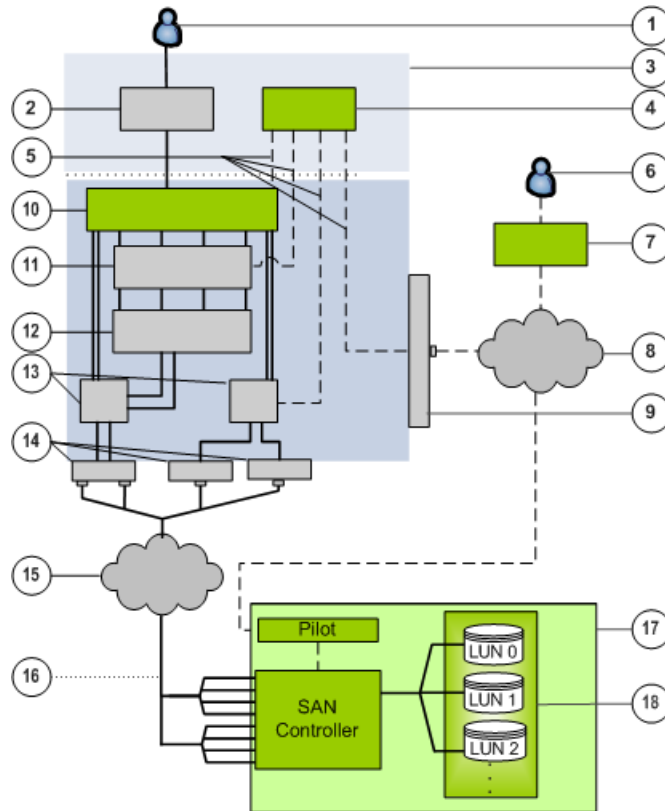
Graphic element	Description
————	Data path
-----	Control path
	Oracle FS System hardware and software
	Non-Oracle FS System hardware and software
	SAN host system space
	SAN host user space

Figure 1: FSPM interaction with an Oracle FS System



Legend 1 User	10 FSPM Device-Specific Module (DSM)
2 User application	11 iSCSI software initiator (iSCSI only)
3 SAN host	12 TCP/IP driver (iSCSI only)
4 FSPM service, <code>fspm</code>	13 HBA driver (FC or iSCSI) or NIC driver (iSCSI)
5 Control path (all dashed lines)	14 HBA (FC or iSCSI) or NIC (iSCSI)
6 Oracle FS System administrator	15 SCSI over FC or iSCSI over IP
7 Oracle FS 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

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.

The Oracle FS Path Manager (FSPM) service assists with driver configuration and uses the control path to:

- Get information from the Pilot management controller
- Get FC and iSCSI port information from the HBA and CNA drivers and iSCSI initiator
- Configure the FSPM Device-Specific Module (DSM)
- Send information such as host attributes and statistics to the Pilot management controller and, if requested, collect logs from the host

The FSPM service sends a description of the host to the Pilot on each connected Oracle FS System. In the Oracle FS System Manager (GUI), 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.

You can configure the software for static or round-robin load balancing through the Oracle FS System Manager (GUI).

Note: A control path connection to the Pilot on an Oracle FS System is recommended but optional. If there is no control path connection, functionality provided by the control path is not available.

Data Path

The FSPM, Device Specific Module (DSM) is a Multipath I/O (MPIO) module on Windows Servers that supports Oracle FS System to manage I/O to storage devices over the data path.

The DSM provides the following features:

- Supports failover across redundant paths
- 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 the best path to use to implement load balancing
- Identifies and uses optimized data paths when possible
- Handles data path failover and failback
- Manages data path errors
- Handles reserve and release commands for clustering

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

FSPM for Windows Features

Oracle FS Path Manager (FSPM) is defined as optional software installed on a storage area network (SAN) host to manage multiple paths to the Oracle FS System.

FSPM performs the following primary functions:

- Routes I/O to the Oracle FS System or Pillar Axiom LUNs using the best available data paths.
- Shares traffic among the available paths if some paths fail to ensure that access to the LUNs is not interrupted.
- Automatically configures host information changes and updates the configuration in Oracle FS System Manager (GUI). This enables the GUI to report information about FSPM running on the host, such as the number of working paths, and, in some environments, to configure features such as load balancing. This function is only available if the host has a control path connection to the Pilot.

Each FSPM release provides different features, and the features provided for each platform can vary. The following table describes the specific features of this product.

Table 5: FSPM for Windows features

Feature	Benefit
Automatic data path failover	Automatically switches to the best available path 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 Windows 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 upgrades	Upgrades from earlier versions of FSPM are supported.
LUN access	Access to the Oracle FS System or Pillar Axiom system LUNs using both iSCSI and FC is supported.
FC HBAs	<p>All FC HBAs that meet the following HBA driver requirements are supported:</p> <ul style="list-style-type: none"> • Storport miniport driver. • Digitally signed by the Microsoft Windows Hardware Compatibility Publisher; these drivers can be referred to as "WHQL signed" or "WHQL certified" or "Windows certified". • Dated after January 1, 2008. <p>FC HBAs with speeds ranging between 2 - 16 Gb/s are supported.</p>
iSCSI hardware and software	iSCSI adapters and Microsoft iSCSI Initiator are supported.
Configuration at the host	Ability to configure FSPM at the host system is supported.
Fibre Channel over Ethernet (FCoE) Converged Network Adapters (CNAs)	FCoE CNAs on the host are supported and managed as an FC connection.

Table 5: FSPM for Windows features (continued)

Feature	Benefit
Oracle Fabric Interconnect	Oracle Fabric Interconnect and associated Oracle Virtual Networking host software provide Ethernet and FC emulation over InfiniBand.
Boot from SAN	Boot from SAN is supported for both iSCSI and FC.
Clustering	Both FC and iSCSI clusters are supported.
Load balancing	I/O can be balanced across the best available paths. Both static and round-robin load balancing are supported. Round-robin is the default value.
Hyper-V	Supported by FSPM running in the hardware operating system or with iSCSI software Initiators or Oracle Virtual Networking in guest VMs. Hyper-V Virtual Fibre Channel is not supported

Related Links[Configuration at the Host](#)[Oracle Virtual Networking Overview](#)[FSPM and Hyper-V](#)[FSPM and Clustering](#)**Configuration at the Host**

Configuration at the host is supported through use of standard Microsoft Multipath I/O (MPIO) Windows Management Instrumentation (WMI) interfaces and persistence of the most recent load balancing setting at the host.

FSPM works with Microsoft MPIO to implement the MPIO WMI Classes. Refer to [MPIO WMI Classes](http://msdn.microsoft.com/en-us/library/ff562468(VS.85).aspx) ([http://msdn.microsoft.com/en-us/library/ff562468\(VS.85\).aspx](http://msdn.microsoft.com/en-us/library/ff562468(VS.85).aspx)) for details. FSPM does not use or support all aspects of these classes. FSPM implements two load balancing algorithms, while the WMI classes define more.

Windows Server 2008 R2 and later versions of Windows use these classes to implement extensions to various management applets. For example, the `Device Properties` applet associated with Oracle FS System LUNs displays an MPIO tab. The MPIO tab shows information from the WMI classes and enables modification of some fields. .

FSPM only allows certain fields to be modified. The Oracle FS System controls the optimization state of paths so path optimization state cannot be set from the host. Attempts to modify fields that FSPM does not control but which can be modified from the `Device Properties` applet do not fail. But settings not controlled by FSPM and modified with the `Device Properties` applet, are not changed within FSPM

The FSPM distribution includes a simple VBscript script (`Scripts\lbset.vbs` in the installation directory) as an example to access the WMI classes from scripts.

To use this script, open a command prompt, change to the Scripts directory, and run `cscript lbset.vbs`. This script lists the current load balancing setting for all Oracle FS System and Pillar Axiom storage system LUNs accessible by the host, and then updates their settings to round-robin.

You may find this particular functionality useful, but the main purpose of this script is to illustrate how to access the WMI functionality from a script. You may copy and modify this script to implement whatever functionality you choose.

When a LUN is first discovered, the default setting is round-robin. The load balancing setting for LUNs can be configured at the Oracle FS System using the Oracle FS System Manager (GUI) or Oracle FS System CLI.

FSPM remembers the latest load balancing configuration at the host. When the host is rebooted, LUNs come online using the load balancing configuration most recently set.

Note: When running FSPM without a control path connection, the following occur:

- The host name, along with all associated host FC port WWNs and iSCSI initiator names, must be entered at the SAN > Storage > Hosts page in the GUI.
- Load balancing configuration from the GUI or CLI is ignored.
- FSPM logs created on the host cannot be collected nor managed by the GUI.

Related Links

[Configure SAN Host Access to the Pillar Axiom LUNs](#)

Boot from SAN

The Oracle FS Path Manager (FSPM) software supports booting the host using a LUN on an Oracle FS System accessed over iSCSI or FC as the system drive.

You can use the LUN as a system drive, but we recommend that you use a storage device directly attached to the host as the paging file.

To use this feature, your system and configuration must support booting from a SAN-attached drive. Verify with your system and CNA, HBA, or NIC manufacturers that boot from SAN is supported.

Setting up a SAN with network boot technology has many hardware dependencies and deployment scenarios that are beyond the scope of this document. Configuration of boot-from-SAN depends on your system, refer to your system and hardware vendor documentation.

Note: Booting from SAN with the Extensible Firmware Interface (EFI) on Itanium-based systems has not been tested in this release. If you want to set up an Itanium-based system for boot from SAN with FSPM, first contact your host hardware vendor, and then contact the Oracle Customer Support.

Boot-from-iSCSI-SAN can use any of three mechanisms:

- iSCSI HBAs
- iSCSI-boot-enabled Ethernet NICs (for example, using Intel PRO/1000 PT Server Adapters with iSCSI boot firmware)
- Preboot Execution Environment (PXE) boot of secondary bootstrap (for example, using Vision Solutions' Double-Take Flex)

For information on how to set up a Windows system to boot from a SAN-attached drive, refer to the following Microsoft articles:

- [Support for booting from a Storage Area Network \(SAN\)](http://support.microsoft.com/kb/305547) (<http://support.microsoft.com/kb/305547>)
- [Windows Boot from Fibre Channel SAN](http://www.microsoft.com/downloads/details.aspx?FamilyID=f4095fae-553d-4700-aafa-1cce38b5618f) (<http://www.microsoft.com/downloads/details.aspx?FamilyID=f4095fae-553d-4700-aafa-1cce38b5618f>)
- [Microsoft iSCSI Boot Guide](http://technet.microsoft.com/en-us/library/ee619733(WS.10).aspx) ([http://technet.microsoft.com/en-us/library/ee619733\(WS.10\).aspx](http://technet.microsoft.com/en-us/library/ee619733(WS.10).aspx))

Related Links

[Boot-from-SAN Tips](#)

FSPM and Hyper-V

Oracle FS Path Manager (FSPM) supports Hyper-V on Windows Server platforms.

You can install FSPM on a Windows Server host configured as a Hyper-V parent that is multi-pathed to Oracle FS System. LUNs that are mapped to the Hyper-V parent host are accessed by the guest operating systems in the same way as other disks. For example, the LUNs can hold Virtual Hard Disk (VHD) files, which can be exposed to the guests, or the guests can access these LUNs as pass-through disks.

Guest operating systems can also use iSCSI software initiators to connect to Oracle FS System and access LUNs. In this example, FSPM maps the LUNs directly to the guest operating system. If the guest operating system has a version of FSPM that supports iSCSI, this version of FSPM can be installed on the guest and used to manage multiple iSCSI paths to the Oracle FS System LUNs in the same way as FSPM would be used on a physical host.

Note: FSPM does not support the use of Hyper-V Virtual Fibre Channel in guest operating systems.

Refer to [Microsoft Hyper-V](http://www.microsoft.com/en-us/server-cloud/virtualization/default.aspx) (<http://www.microsoft.com/en-us/server-cloud/virtualization/default.aspx>) documentation for more information on using disks with Hyper-V.

FSPM and Clustering

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.

FSPM can be used in a cluster environment with Microsoft supported configurations. FC, FCoE, iSCSI, and Oracle Fabric Interconnect are supported for use with FSPM and clustering if the components are both: certified by Microsoft for use with clustering and supported by FSPM as described in this manual.

The cluster environment must be set up and working before you install the FSPM for Windows software.

For information on setting up a cluster environment on Windows Server 2008 and Windows Server 2008 R2, refer to the [Microsoft Failover Clusters](http://technet.microsoft.com/en-us/library/cc732488(v=ws.10).aspx) ([http://technet.microsoft.com/en-us/library/cc732488\(v=ws.10\).aspx](http://technet.microsoft.com/en-us/library/cc732488(v=ws.10).aspx)).

Note: FSPM supports the type of clustering Microsoft refers to as failover clustering.

For information on setting up a cluster environment on Windows Server 2012 and Windows Server 2012 R2, refer to the [Microsoft Failover Clustering Overview](http://technet.microsoft.com/en-us/library/hh831579.aspx) (<http://technet.microsoft.com/en-us/library/hh831579.aspx>).

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 6: 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 255 LUNs are supported from each Oracle FS System. The Oracle FS System supports more than 255 LUNs but Windows Server is limited to 255 LUNs.
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.

FC SAN Component Support Overview

The Oracle FS Path Manager (FSPM) software that can be used with SAN hosts that use Fibre Channel (FC) connections to Controllers.

Review information on supported Host Bus Adapters, including Fibre Channel over Ethernet, (FCoE), and FC switches provided in this document.

Related Links

[Supported FC HBAs](#)

[Supported FC HBA Settings](#)

[Supported Fibre Channel Switches](#)

[Supported FCoE Adapter Requirements](#)

[Supported FCoE Switches](#)

[Configure a FC SAN](#)

Supported FC HBAs

This release supports all FC host bus adapters (HBAs) that meet the following requirements:

- The HBA has a Storport miniport driver. Other types of drivers, such as SCSIport miniport and monolithic drivers, are not supported.
- The HBA driver is digitally signed by the Microsoft Windows Hardware Compatibility Publisher for use on your version of Windows. These drivers are often described as Windows Hardware Quality Labs (WHQL) signed WHQL certified, or Windows certified.
- The HBA driver is dated after January 1, 2008. We recommend the most recent available driver that meets all of these conditions.
- The HBA is officially supported by the driver and meets all requirements specified for use with the driver. These requirements include hardware version, firmware version, and bus slot capability.

Important: Select FC HBAs carefully to ensure that the HBAs are suitable for use in a multipath environment with particular I/O loads. For example, some low-end HBAs support a limited number of simultaneous connections that can be made from each port. These HBAs can be unsuitable for use in an environment where the HBA needs to connect to several Oracle FS System Controller or Pillar Axiom Slammer ports.

Install and configure the HBA and HBA driver according to the vendor documentation.

Suitable HBAs and drivers can be found in the Storage section of the [Windows Server Catalog](http://www.windowsservercatalog.com) (<http://www.windowsservercatalog.com>). In addition, the HBA vendor driver download page, or driver release notes, will usually specify that a driver is WHQL certified. After a driver is installed in the system, you can use the Windows Device Manager to check that it is appropriately signed.

Supported FC HBA Settings

Most FC host bus adapter (HBA) drivers have parameters that can be configured using utilities built into the HBA firmware, by utilities supplied by the HBA manufacturer, or through configuration files. To determine which parameters can be configured and how to configure the parameters, refer to your HBA vendor documentation.

HBA settings control many aspects of HBA driver behavior, which affect how Oracle FS Path Manager (FSPM) and Microsoft Multipath I/O (MPIO) manage transient errors and other events in the SAN and in the Oracle FS System.

We recommend defining the following HBA characteristics to work well with FSPM:

- Allow a maximum of 64 commands to be outstanding on each target port.
- Wait at least 100 seconds after detecting a loss of link before reporting to the operating system that the link is down.
- Wait at least 30 seconds to retry access to a target port before assuming that the port or target has failed.
- Allow access to up to 256 LUNs per target.

Here are recommended settings:

Table 7: Recommended QLogic HBA settings

Parameter	Value
Execution Throttle	64 maximum
Link Down Timeout	100 minimum
Port Down Retry Count	30 minimum
LUNs per Target	256

Table 8: Recommended Emulex HBA settings

Parameter	Value
QueueDepth	64 maximum
LinkTimeOut	100 minimum
NodeTimeOut	30 minimum
QueueTarget	1

Unless you have a particular requirement to set other configuration parameters to custom values, we recommend using the HBA manufacturer's recommendations or default values.

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

For additional information on HBAs not listed in this document, go to the [Oracle Technology Network](http://www.oracle.com/technetwork/index.html) (<http://www.oracle.com/technetwork/index.html>).

Supported Fibre Channel Switches

Supported Fibre Channel (FC) switches work with Oracle FS Path Manager (FSPM) software.

For a list of supported FC switches, review the *Oracle FS System Oracle Flash Storage System Support and Interoperability Guide*, which can be found on the [Oracle Technology Network](http://www.oracle.com/technetwork/documentation/oracle-unified-ss-193371.html) (<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.

FCoE Support Overview

The Oracle FS Path Manager (FSPM) software can be used on SAN hosts that use Fibre Channel over Ethernet (FCoE) connections from Converged Network Adapters (CNAs) through a switch to an FC SAN.

FSPM manages FCoE connections the same as FC connections.

Related Links

[Supported FCoE Adapter Requirements](#)

[Supported FCoE Switches](#)

Supported FCoE Adapter Requirements

All FCoE adapters that meet the FC HBA requirements are supported. The following are minimum driver and firmware requirements for certain Fibre

Channel over Ethernet (FCoE) converged network adapters (CNAs) to work with Oracle FS Path Manager.

Table 9: FCoE Adapter requirements

CNA models	Required versions
Emulex OCe10102-F	<ul style="list-style-type: none"> Firmware and boot code: 2.102.200.28 or higher Ethernet NDIS miniport driver: 2.102.200.13 or higher FCoE Storport miniport driver: 2.32.002 or higher
Brocade 1010 and 1020	<ul style="list-style-type: none"> Boot code, from multi-boot image: 2.2.0.0 or higher Drivers, from driver package: 2.2.0.0 or higher
QLogic QLE8150 and QLE8152,	<ul style="list-style-type: none"> Boot code, from multi-boot image: 1.01.54 or higher Ethernet NDIS miniport driver: 1.0.1.0 or higher FCoE Storport miniport driver: 9.1.8.26 or higher iSCSI Storpoint miniport driver: 2.1.5.37 or higher

Note: For all FCoE adapters, Oracle recommends the latest firmware and driver versions available from the vendor be installed.

Note: Many FCoE adapters can be used concurrently as Ethernet controllers (NICs) and sometimes as iSCSI HBAs.

Supported FCoE Switches

The supported Fibre Channel over Ethernet (FCoE) converged network adapters (CNAs) were tested in conjunction with the Brocade 8000 switch.

For best results, the Brocade 8000 switch must be running Fabric OS version 6.4.0a or higher.

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 Drivers

Oracle FS Path Manager (FSPM) supports the Oracle Virtual Networking solution.

Review the *Oracle FS Path Manager Release Notes* for the latest information on Oracle Virtual Networking drivers and software versions required for FSPM.

Hosts using the Oracle Virtual Networking hardware must use the following firmware and software at a minimum. Oracle recommends the latest versions available from Oracle be used:

- XgOS: version 2.7.1.1 or higher
- XMS: version 2.7.1 or higher
- HCA firmware: version 2.7.9 or higher
- Drivers: version 2.6.0.6 or higher

For access to the Oracle Virtual Networking drivers, refer to the Oracle Technology Network at [Xsigo Downloads](http://www.oracle.com/technetwork/server-storage/xsigo-1870185.html) (<http://www.oracle.com/technetwork/server-storage/xsigo-1870185.html>).

For product information on Oracle Virtual Networking, refer to the [Oracle Technology Network Documentation](http://www.oracle.com/technetwork/documentation/oracle-net-sec-hw-190016.html) (<http://www.oracle.com/technetwork/documentation/oracle-net-sec-hw-190016.html>).

iSCSI Software and Hardware Support Overview

The Oracle FS Path Manager (FSPM) software can be used on SAN hosts that use iSCSI connections to Controllers and Slammers.

Review the information on supported Host Bus Adapters, iSCSI routers, and switches in this document.

Related Links

[Supported iSCSI HBAs](#)

[Supported iSCSI-to-FC Routers](#)

[Supported iSCSI Switches](#)

Supported iSCSI Software

If you use iSCSI, enable and configure the Microsoft iSCSI Initiator following instructions in this document.

For additional information, refer to the [Microsoft iSCSI Initiator Step-by-Step Guide](http://technet.microsoft.com/en-us/library/ee338476(WS.10).aspx) ([http://technet.microsoft.com/en-us/library/ee338476\(WS.10\).aspx](http://technet.microsoft.com/en-us/library/ee338476(WS.10).aspx)).

Related Links

[Configure iSCSI Connections for SAN](#)

Supported iSCSI HBAs

All iSCSI HBAs that meet FC HBA requirements are supported. The following information lists required software or firmware for iSCSI HBAs needed to support Oracle FS Path Manager.

Below are the required minimums software or firmware versions for the QLogic QLA405x and QLA4060x HBAs.

- BIOS: 1.15 or higher
- iSCSI firmware: 3.0.1.53 or higher
- Storport Driver: 2.1.5.37 or higher

For updated information on software or firmware requirements, review the *Oracle FS Path Manager Release Notes*.

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.

Related Links

[Configure the iSCSI-to-FC Router](#)

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.

Install FSPM

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

FSPM Software Installation Overview

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

The FSPM installation requires that you download the FSPM software installation package from the Oracle Technology Network (OTN) and install the software on your system.

After you install FSPM, configure access from the SAN host to Oracle FS System LUNs.

Updating an existing FSPM or APM installation is a separate task.

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.

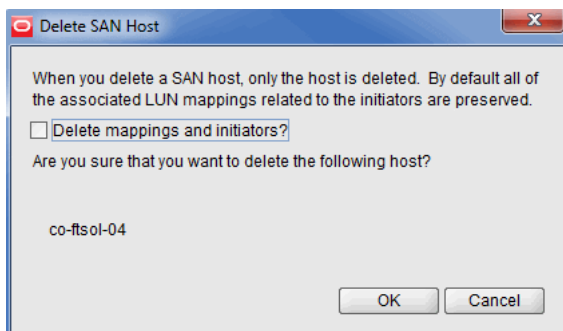
Delete SAN Host Before FSPM Installation

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.

FSPM Preinstallation Requirements

Before you install the Oracle FS Path Manager (FSPM) software, ensure that your network and Oracle FS System or Pillar Axiom system meet the installation requirements.

To function fully and correctly, FSPM requires a network connection to the Pilot management controller and installation of one or more of the following:

- Fibre Channel host bus adapter (HBA) or Converged Network Adapter (CNA) cards and drivers.
- For a hardware iSCSI installation, iSCSI HBAs, and the Microsoft iSCSI Initiator.
- For a software iSCSI installation, network interface cards (NICs), and the Microsoft iSCSI Initiator.

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. Connecting to the control path is optional if you are using FSPM configuration from the host feature. This network connection is used to implement the control path and while optional, is highly recommended.

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

[Configuration at the Host](#)

HBA Driver and Software Requirements

You must set up the Microsoft iSCSI Initiator or FC host bus adapters (HBAs) and their required software before you can access LUNs on an Oracle FS System or Pillar Axiom system and use the Oracle FS Path Manager software.

Perform the following actions:

- If you plan to use any FC or iSCSI HBAs, or Fibre Channel over Ethernet (FCoE) Converged Network Adapters (CNAs), install the devices.
- If the supported driver versions for your HBAs or CNAs are not already installed, install the driver.
- If necessary, update the firmware and BIOS on iSCSI HBAs or FCoE CNAs to the supported versions.
- After installing any HBA, verify that the HBA configurations meet the specified requirements.

Microsoft Service Pack and Hotfix Requirements

Install the applicable Microsoft service packs and hotfixes for your operating system before you install the Oracle FS Path Manager (FSPM) software.

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

			Oracle FS Path Manager			HBA
Host Name	Controller-Initiator Connect...	Number of LUNs Mapped	Status	Version	Host IP Address	HBA Alias Name
Unassociated						
10.00.00.00:C8.76.63.F4	Connected		Connected			
10.00.00.00:C8.76.63.F5	Connected		Connected			
10.00.00.90:FA.11.85.54	Connected		Connected			
10.00.00.90:FA.11.85.55	Connected		Connected			
21.00.00.EB.88.84.14.9C	Connected		Connected			

Configure the iSCSI-to-FC Router

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 the Oracle FS Path Manager (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) (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. 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 (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.

Configure an iSCSI SAN

- 1 Verify that the Microsoft iSCSI Initiator and TCP/IP networking are installed and configured on the host.
- 2 If you are using an iSCSI-to-FC router, configure the router as described in *Configure the iSCSI-to-FC Router* and enable the FC SAN communication between the FC ports on the router and the FC ports on the Oracle FS System Controller or Pillar Axiom Slammer.
- 3 Set up the TCP network between the host and the iSCSI ports on the Oracle FS System Controller or Pillar Axiom Slammer or the iSCSI-to-FC router.
- 4 After completing the above steps, configure iSCSI connections as described in this manual.

Configure iSCSI Connections for SAN

Follow this procedure to use the Microsoft iSCSI initiator to make iSCSI connections using NICs or HBAs.

- 1 Launch the iSCSI initiator.
- 2 On the Discovery tab, click the button to add or discover a target portal, and add the IP address of one of the following:
 - A Controller port on each Controller.
 - An iSCSI port on the iSCSI-to-FC router that represents the Controller ports.

An entry for each Oracle FS System should be listed on the Targets tab.

- 3 On the Targets tab, select an Oracle FS System or the representation of an Oracle FS System on an iSCSI-to-FC router.
- 4 Click Log On (or Connect).
- 5 Select Automatically Restore this Connection (or Add this connection to the list of Favorite Targets) and Enable Multi-path.
- 6 Click Advanced.
- 7 In the Advanced Settings dialog box, select a Local Adapter, Source IP (or Initiator IP), and Target Portal that represents the ends of the connection you are creating.

Note: Each connection forms a path to the Oracle FS System or Pillar Axiom storage system. You will need to repeat these steps for each possible combination of these fields.

- 8 Click OK to close the **Advanced Settings** dialog.
- 9 Click OK to close the Log On to Target (or Connect to Target) dialog.

- 10 Repeat Steps 4 through 9 for each available combination of Local Adapter, Source IP (or Initiator IP), and Target Portal, up to a maximum of 32 combinations for each Controller or Slammer.
- 11 Repeat Steps 3 through 10 for each target that represents an Oracle FS System.

Download and Install the FSPM Software

To install the Oracle FS Path Manager (FSPM) software, download the FSPM for Windows package, install the package, and configure your Oracle FS System to work with FSPM.

Prerequisites:

- Install any applicable Microsoft service packs and hotfixes.
- Configure the SAN. Follow the instructions listed in this document.
- Verify that your system meets the pre-installation requirements.

Perform these steps to download and install the FSPM software.

- 1 Download the FSPM software.
 - 2 Install the FSPM software if you are installing FSPM for the first time.
 - 3 Complete the installation by configuring access from the SAN host to Oracle FS System LUNs.
- If you are updating an existing FSPM installation, see the instructions for updating the FSPM software.
 - To remove the software from your SAN host, see the instructions for removing the FSPM software.

Related Links

[FSPM Preinstallation Requirements](#)

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 the FSPM Software

Follow these instructions to install the Oracle FS Path Manager (FSPM) software on the host, if another version of FSPM is not already installed.

If you are updating from a previous version of the software, see the instructions for updating the FSPM software.

- 1 Verify that you have administrator privileges to install the software.
- 2 Close all applications and management applets.
- 3 To install the software, choose one of the following options:
 - From Windows Explorer, double-click the name of the FSPM package you downloaded.
 - From the command line, run the following command where *package_name* is the name of the package that you downloaded:

```
msiexec /i package_name
```

Either option enables or installs the following components:

- Microsoft Mutipath I/O (MPIO) is an optional feature of the operating system which may or may not be enabled. The FSPM installer enables this feature if it is not already enabled.
 - The Oracle FS System Device-Specific Module (DSM).
 - The FSPM service.
 - The sample WMI script.
- 4 If prompted to do so by Windows Server, restart the system. If not, then the installation process is complete.

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					
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					
			5 Communicating	4.0.1	10.79.166.179	
						co-fs01-01.us.oracle.com

Note: The following Oracle FS Path Manager Status, 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.

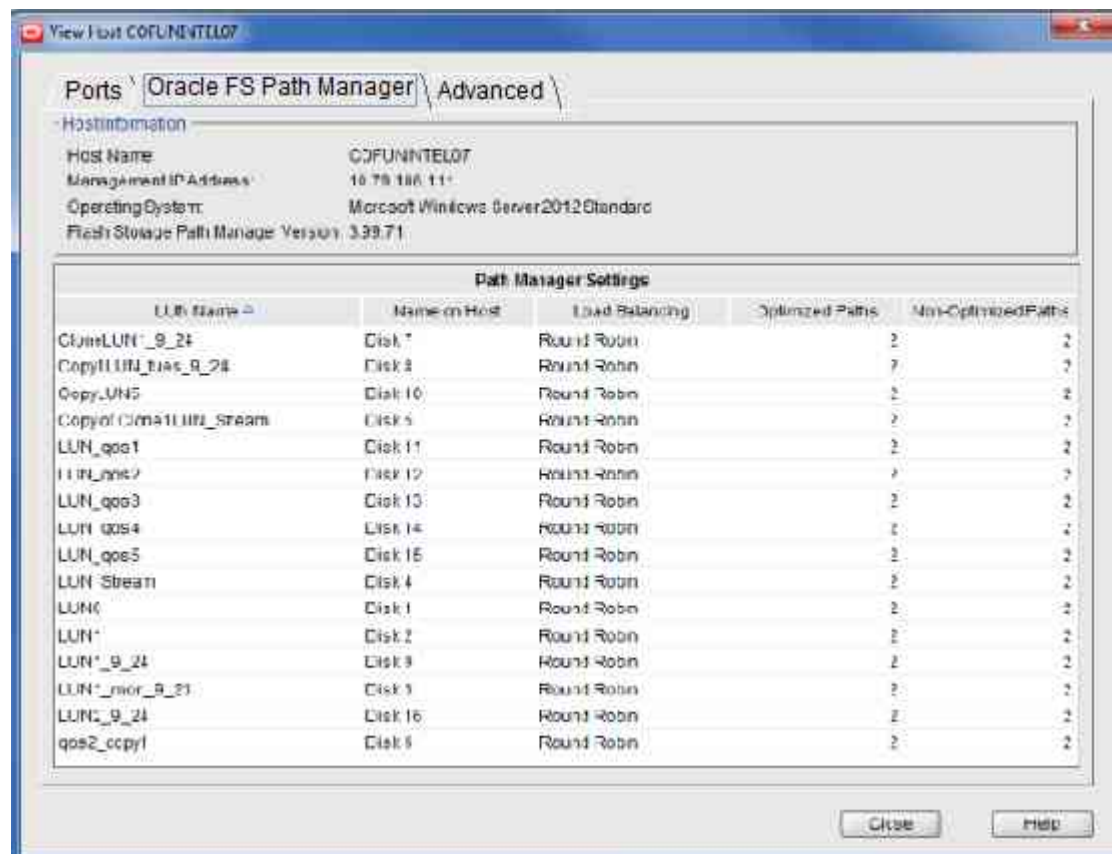
See the Oracle FS Manager Online Help for information about the remaining fields on the Hosts page.

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

Note: Windows does not recognize any LUN number over 254. If you configure a LUN for the host using a number greater than LUN 254, the LUN is not be seen by Windows.

- 4 Verify that the LUNs appear on the host. If the LUNs do not appear, select Rescan Disks in the Windows Disk Manager. The LUNs should become available as drives on the host. If the drives do not appear, restart the host.
- 5 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.

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 Windows 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 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.

- 7 Review the load balancing algorithm being used for each LUN to determine if you need to change the current load balancing setting.
 - a) To change load balancing, complete these steps. From SAN > Storage > Hosts select the host that is mapped to the LUN
 - b) Select Modify Host and change the load balancing setting. You can also change the load balancing from Windows. Regardless of where you change the load balancing setting, both Windows and Oracle FS System use the same setting.
- 8 Review the numbers of optimized and non-optimized paths currently reported by FSPM under the Optimized Paths and Non-Optimized Paths.

Figure 7: Host-LUN Mapping view

HBA Port / Device	Controller-Initiator Connectivity	Map via LUN Number	LUN Name on Host
cofunintel05 21:00:00:E0:BB:84:14:9C	Connected	1	Disk 1
	Connected	2	Disk 2
21:01:00:E0:BB:A4:14:9C	Connected	1	Disk 1
	Connected	2	Disk 2

- 9 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:
 - Each LUN name as allocated by Windows on the host.
 - 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
- 10 Format and set up the drives for use in Windows.

Boot-from-SAN Tips

The following information provides tips to ensure that the Oracle FS Path Manager functions properly in a boot-from-SAN environment.

Important: Setting up a SAN with network boot technology has many hardware dependencies and deployment scenarios that are beyond the scope of this document. Refer to your Microsoft Windows and hardware vendors' documentation for details.

Note: Fibre Channel Arbitrated Loop (FCAL) is not supported for boot-from-SAN.

Related Links

[Boot LUNs](#)

[Boot Device Failover](#)

[Boot Device Paths](#)

[Clone a Boot LUN](#)

Boot LUNs

When you create a LUN and install Windows on the LUN to use as the boot LUN for the host, we recommend that you set the boot LUN to high priority. If you do not choose high priority, the host can exhibit sluggish performance when the Oracle FS System is under heavy load.

Note: Microsoft recommends putting the pagefile on local storage to ensure that access to the pagefile cannot be affected by events on the SAN.

Boot Device Paths

Review the following information on boot device paths:

- Verify that the boot device path is set up correctly; otherwise, the system may not start up.
- When the Oracle FS Path Manager (FSPM) software is not used, there must be only a single path through the SAN between the host and the boot LUN. Without FSPM, if more than one path is visible to Windows, the host can fail to boot, and the boot LUN can become corrupted.

Important: Losing all paths to the boot device will cause system failure.

- The exact mechanism used by the host to identify boot and pagefile paths varies with host boot system and HBA design.

For example, details of the various FC ports in the path are stored as part of the path definition. If you later change your SAN configuration so that details of the path are changed, the host may not be able to access the LUN using the path definition it stored earlier, even if access is still possible through other similar paths.

Actions that cause details of the path to change include moving cables to different ports, reconfiguring zones, or changing port masking for a LUN.

Boot Device Failover

The Oracle FS Path Manager drivers must load before the boot device can fail over. These drivers usually load before the login prompt displays.

Important: Losing the boot path before this point causes system failure.

Clone a Boot LUN

You can create a clone of a Windows boot LUN as a safety archive or to set up a number of similar boot-from-SAN hosts. The host must not be booted from the LUN when a clone is created.

- 1 Shut down the host.
- 2 Use the Clone LUN feature in the Oracle FS System Manager (GUI) to create a clone of the LUN.
Refer to the *Oracle FS System Administrator's Guide* for additional details.
- 3 Remove the host mappings from the original LUN.
- 4 Change the original LUN number to some other LUN number.
- 5 Assign the original LUN number to the clone.
- 6 Map the clone to the host.
- 7 Restart the host.

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.

Note: Various Windows configuration tools report the load balancing settings for multi-pathed LUNs and provide options to modify the settings. Static load balancing is reported as *Fail Over Only* and round-robin load balancing as *Round Robin With Subset*.

Note: You can use the GUI or CLI to change these load balancing settings from the Oracle FS System or you can change them from the host using Windows applets or WMI processes.

For Pillar Axiom storage system, if you change load balancing settings from the host and leave the FSPM control path connection communicating with the Pilot, the Pillar Axiom can override your changes at the host at any time. Running FSPM without a control path connection ensures that the Pillar Axiom cannot override your changes at the host, but other control path functions are not available

For Oracle FS System, you can change the load balancing settings on the Oracle FS System or on the host and regardless of where the settings are changed, the settings are updated on both the Oracle FS System and the host.

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:

```
sc query fspmd
```

Another method for Windows is to open the Windows Services applet and verify the Oracle FS Path Manager Service status is Running.

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:

```
net stop fspmd & net start fspmd
```

Another method for Windows is to open the Windows Services applet, locate the Oracle FS Path Manager Service and select Restart Service.

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:

```
net stop fspmd
```

Another method for Windows is to open the Windows Services applet and locate the Oracle FS Path Manager Service and select Stop Service.

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:

```
net start fspmd
```

Another method for Windows is to open the Windows Services applet and locate the Oracle FS Path Manager Service and select Start Service.

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

Related Links

[Rename the FSPM Host](#)

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.

Update the FSPM Software

You can update directly from Pillar Axiom Path Manager (APM) or from an earlier version of Oracle FS Path Manager (FSPM) to latest version of FSPM. You do not need to uninstall the previous version of APM or FSPM.

If you are updating FSPM on a host in a clustered environment, that host cluster node must be a passive node. This enables I/O to the cluster to continue without interruption. Changing the roles of the node from active to passive enables all nodes to be updated.

Note: Changing the nodes from active to passive causes a disruption during the changeover from active to passive node.

To update FSPM, follow the installation instructions in this guide for installing FSPM when it is not already installed. This installation automatically replaces the existing version, whether APM or FSPM to the version of FSPM you chose to install.

Related Links

[Download the FSPM Software](#)

[Install the FSPM Software](#)

[Configure SAN Host Access to LUNs](#)

[Update the FSPM Software](#)

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

Remove the FSPM Software (Optional)

When you remove the Oracle FS Path Manager (FSPM) software, support for multiple paths to Oracle FS System LUNs is removed.

Important: Before you remove the FSPM software, you must disconnect the host from the Oracle FS System if you do not want to access the Oracle FS System LUNs.

Note: Microsoft requires that, before removing MPIO support for a device, there must be a maximum of one path connected to the device and, if a path is left connected, that I/O to the device should be stopped or reduced as low as possible.

If you want to continue LUN access, reconfigure the SAN so that there is only a single Fibre Channel path or iSCSI connection from the host to each Oracle FS System Controller pair or Pillar Axiom Slammer.

- 1 Verify that all applications and management applications are closed.

Important: It may take several minutes for Windows to recognize that paths or LUNs have been disconnected from the host. It is important that you wait until Windows recognizes these changes have been made and completes updating its configuration before you remove FSPM.

Use Windows Device Manager to check the paths and LUNs that Windows currently has in its configuration. Selecting Scan for hardware changes in Device Manager can help Windows recognize the changes more quickly.

Wait until Device Manager shows that all Oracle FS System or Pillar Axiom LUNs have been removed (or that all Oracle FS System or Pillar Axiom LUNs have a maximum of one path remaining if you have chosen to leave the LUNs connected) before closing Device Manager and removing FSPM.

- 2 Use one of the following options listed below to remove FSPM.

Please note, if you want to install a newer version, you do not need to remove the previous version. If you want to remove the product, follow these steps:

- From the GUI, in Control Panel go to Programs and Features and select the program the eversion you want to remove.
- From the command line, enter the following command at a command line prompt:

```
wmic product where name="Oracle FS Path Manager" call  
uninstall
```

This command may prompt you for a response.

Note: If Windows requires a reboot after uninstalling using this command, Windows reboots immediately without warning or asking for confirmation.

Tip: Sometimes the uninstall process may take longer than expected on the host and the process can appear to be hang. Allow the process to run for at least an hour before attempting to restart it.

- 3 (Optional). You can choose to remove the Multipath I/O feature after removing FSPM, if nothing else is using it.
- 4 If you are prompted to do so, restart the system.

Note: If access to a LUN is lost, you can use the Disk Administrator to reactivate the drive on one of the paths that is showing. If the path that the Disk Administrator can see is missing, restore the path and then choose Reactivate Disk.

CAUTION: There are situations in which you might want to remove or update the `pillardsm.sys` driver or a component of Microsoft's MPIO multi-path disk framework using the device and driver property pages in the Windows Device Manager. Use only the Programs and Features or the `wmic` command described above to change your installation. Other tools can leave the system in an inconsistent state and possibly prevent subsequent system startups.

Note: The options listed above to remove FSPM ensure that all components are left in a consistent state. If the above options fail to remove FSPM, contact Oracle Customer Support.

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