Pillar Axiom Path Manager 3.3

Installation Guide and Release Notes

for Windows

ORACLE

PILLAR AXIOM

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Preface

Audience

This document is intended for individuals who install and maintain Oracle's Pillar Axiom Path Manager (APM) software.

Expected experience includes:

- Experience installing software packages on a Windows system.
- Understanding of logical networks and disk storage systems.

  Note: An understanding of Fibre Channel or iSCSI technology is required for administering storage area network (SAN) systems.
- Practical knowledge of Pillar Axiom storage systems.

Before You Read This Document

Being familiar with certain other Pillar Axiom technical documentation helps you succeed in the use of this guide.

Familiarize yourself with the following related documentation:

- *Pillar Axiom Customer Release Notes*: Includes late-breaking important information about the installation and operation of the Pillar Axiom system.
- *Pillar Axiom Administrator's Guide*: Provides detailed information on creating and managing storage resources.
- *Pillar Axiom CLI Reference Guide* (for Pillar Axiom CLI) or *CLI Reference Guide* (for pdscli): Provides detailed information about functions available in the Pillar Axiom command line interfaces (CLIs).

Access Documentation

Technical documentation (including installation, service, cabling, integration, and administration guides) for Oracle's Pillar Axiom 600 storage system is available from several sources.

Pillar Axiom GUI	After logging in to the Pillar Axiom Storage Services Manager on the Pilot, navigate to **Support > Technical Documentation** and click on the document of interest.
Web sites	Technical documents (http://www.pillardata.com/techdocs) Customer support portal (https://support.pillardata.com/login.do) After logging in to the web site, click on **Documents** in the left navigation pane, and then click the appropriate category in the expanded list. Click on the document of interest.
Product CD-ROM	Insert the Technical Documentation CD-ROM that came with your Pillar Axiom storage system into the CD player in a computer. Open the DocMenu PDF and click on the document of interest. **Tip:** To search all technical documents on the CD-ROM, click the **Search all PDFs** icon in the top right corner. In the Search dialog, enter the word or phrase for which you would like to search.

Typographical Conventions

Table 1 Typography to mark certain content

Convention	Meaning
italics	Within normal text, words in italics indicate: • A reference to a book title. • New terms and emphasized words. • Command variables.
`monospace`	Indicates one of the following, depending on the context: • The name of a file or the path to the file.

Table 1 Typography to mark certain content (continued)

Convention	Meaning
	• *Output* displayed by the system on the command line.
monospace (bold)	*Input* provided by an administrator on the command line.
>	Indicates a menu item or a navigation path in a graphical user interface (GUI). For example, "Click **Storage** > **Clone LUNs**" means to click the **Clone LUNs** link on the **Storage** page in the graphical user interface (GUI).

Oracle Contacts

Table 2 Oracle resources

For help with...	Contact...
Support	https://support.oracle.com
Training	https://education.oracle.com
Documentation	• Oracle Technical Network: http://www.oracle.com/pls/topic/lookup?ctx=pillardocs • From the Pillar Axiom Storage Services Manager (GUI): **Support** > **Documentation** • From Pillar Axiom 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
Contact Oracle	http://www.oracle.com/us/corporate/contact/index.html

CHAPTER 1

Introduction to Pillar Axiom Path Manager

About Pillar Axiom Path Manager for Windows

The information in this document is for system administrators who want to use the Pillar Axiom Path Manager (APM) 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 APM for Windows software.

This APM release requires release 3.3.15 or higher of the Pillar Axiom software.

Note: If you are updating your Pillar Axiom software, complete that update before installing the APM software on the SAN host.

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

Related tasks

- *Download the Pillar Axiom Path Manager Software*
- *Install the Pillar Axiom Path Manager Software*
- *Complete the LUN Configuration*
- *Update the Pillar Axiom Path Manager Software on Windows Server 2003*
- *Remove the Pillar Axiom Path Manager Software (Optional)*

Supported Windows Platforms

Pillar Axiom Path Manager (APM) 3.3 for Windows supports the following Windows editions on 32-bit, x64, and Itanium processor platforms.

Note: Some of the editions of Windows Server 2008 R2 and Windows Server 2008 listed here include the Hyper-V option, and others do not. APM 3.3 supports the editions that include Hyper-V, regardless of whether Hyper-V is enabled and in use.

For more information on the different editions of Windows Server, refer to:

- Microsoft's Windows Server 2008 Web site

  (http://www.microsoft.com/windowsserver2008)

- Microsoft's Windows Server 2003 Web site

  (http://technet.microsoft.com/en-us/windowsserver/bb512919.aspx)

For additional information regarding software use and lists of current and resolved product issues, see the Release Notes at the end of this document.

Related concepts

- *Microsoft Service Pack and Hotfix Requirements*

Related references

- *Supported Windows Server 2008 R2 Editions*
- *Supported Windows Server 2008 Editions*
- *Supported Windows Server 2003 R2 Editions*
- *Supported Windows Server 2003 Editions*

Supported Windows Server 2008 R2 Editions

- Windows Server 2008 R2 Standard
- Windows Server 2008 R2 Enterprise
- Windows Server 2008 R2 Datacenter
- Windows Web Server 2008 R2
- Windows Server 2008 R2 for Itanium-Based Systems

Supported Windows Server 2008 Editions

- Windows Server 2008 Standard
- Windows Server 2008 Enterprise
- Windows Server 2008 Datacenter
- Windows Server 2008 Standard without Hyper-V
- Windows Server 2008 Enterprise without Hyper-V
- Windows Server 2008 Datacenter without Hyper-V
- Windows Server 2008 for Itanium-Based Systems

Note: APM 3.3 supports Windows Server 2008 with or without SP2.

Supported Windows Server 2003 R2 Editions

APM 3.3 requires SP2 with Windows Server 2003 R2.

- Windows Server 2003 R2 Standard Edition with SP2
- Windows Server 2003 R2 Enterprise Edition with SP2
- Windows Server 2003 R2 Standard x64 Edition with SP2
- Windows Server 2003 R2 Enterprise x64 Edition with SP2
- Windows Server 2003 R2 Enterprise Edition with SP2 for Itanium-based Systems

Note: Microsoft Storport Hotfix 932755 must be installed *after* SP2.

Supported Windows Server 2003 Editions

APM 3.3 requires SP2 with Windows Server 2003.

- Windows Server 2003 Standard Edition with SP2

- Windows Server 2003 Enterprise Edition with SP2
- Windows Server 2003 Web Edition with SP2
- Windows Server 2003 Standard x64 Edition with SP2
- Windows Server 2003 Enterprise x64 Edition with SP2
- Windows Server 2003 Enterprise Edition with SP2 for Itanium-based Systems

Note: Microsoft Storport Hotfix 932755 must be installed *after* SP2.

About the Pillar Axiom Path Manager Software

The Pillar Axiom Path Manager (APM) software runs on the host system. Usually, multiple paths are presented as multiple drives. With this software, every configured multi-pathed Pillar Axiom LUN is presented as a single drive to the operating system.

The APM 3.3 for Windows software integrates with the Microsoft Windows Multipath I/O (MPIO) component. APM consists of a configuration service and an MPIO Device Specific Module (DSM) for the Pillar Axiom system. This combination, along with the Microsoft MPIO component, allows Windows to detect and configure Pillar Axiom storage devices, and to manage the I/O paths to those devices.

On Windows Server 2003 and Windows Server 2003 R2, APM 3.3 installs version 1.23 of the Microsoft MPIO component. On Windows Server 2008 and Windows Server 2008 R2, APM uses the version of MPIO that has been installed as part of Windows.

Note: One host can access a maximum of 255 LUNs on each Pillar Axiom system, up to a maximum of eight Pillar Axiom systems. The LUNs should be numbered from 0 to 254 because Windows does not recognize LUN number 255.

Pillar Axiom Path Manager Architecture

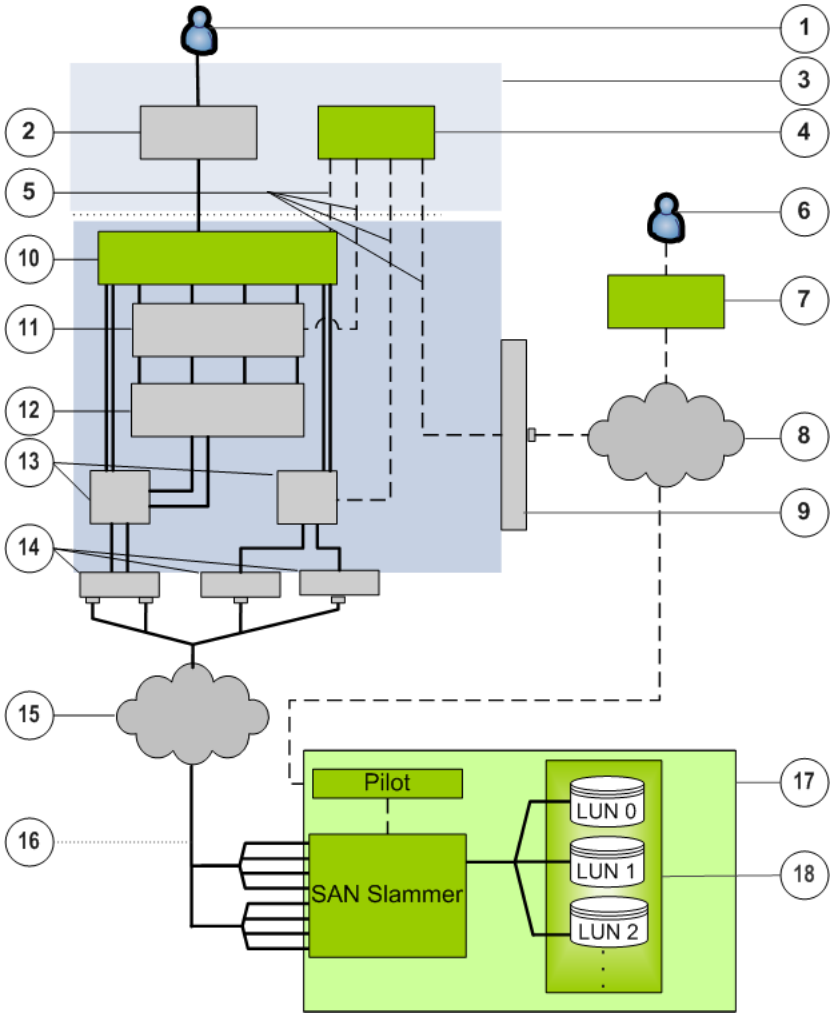
Pillar Axiom Path Manager (APM) manages multipathing and communicates with the Pillar Axiom servers on a control path, which is separate from the data path. LUN access is managed along the data path.

Figure 1: APM interaction with a Pillar Axiom server illustrates how the APM software installed on a SAN host interacts with a Pillar Axiom system. Refer to the table below to determine the significance of the lines and colors in the figure.

Table 3 Line and color key

Graphic element	Description
———	Data path
- - - - -	Control path
	Pillar-supplied hardware and software
	Non-Pillar hardware and software
	SAN host system space
	SAN host user space

Figure 1 APM interaction with a Pillar Axiom server



Legend

1 User	10 APM Device-Specific Module (DSM)
2 User application	11 iSCSI software initiator (iSCSI only)
3 SAN host	12 TCP/IP driver (iSCSI only)
4 APM service	13 HBA driver (FC or iSCSI) or NIC driver (iSCSI)
5 Control path	14 HBA (FC or iSCSI) or NIC (iSCSI)
6 Pillar Axiom administrator	15 SCSI over FC or iSCSI over IP
7 Pillar Axiom command line interface (CLI) or graphical user interface (GUI)	16 Data path
8 Encrypted XML over TCP/IP	17 Pillar Axiom server
9 Network card	18 Brick storage pool

Related concepts

- *About the Pillar Axiom Path Manager Control Path*
- *About the Pillar Axiom Path Manager Data Path*

About the Pillar Axiom Path Manager Control Path

The Pillar Axiom Path Manager (APM) service assists with driver configuration and uses the control path to:

- Get information (for example, the load balancing algorithm) from the Pilot.
- Send information (for example, host attributes and statistics) to the Pilot.
- Get Fibre Channel (FC) and iSCSI path information from the HBA drivers and iSCSI Software Initiator.
- Configure the APM Device-Specific Module (DSM).
- Collect logs from the SAN host on request.

The APM service sends a description of the host to the Pilots on connected Pillar Axiom systems. This description creates a definition for the host in the Pillar Axiom Storage Services Manager. The definition includes any FC ports in the host and the name of the host iSCSI initiator, if iSCSI is configured. The Pillar Axiom Storage Services Manager or command line interface (CLI) lists the WWNs of the FC ports in the host, as well as the IP addresses that are used to make iSCSI connections to the Pillar Axiom system.

If you use iSCSI on the host to connect to a FC Slammer through an iSCSI-to-FC router, the APM service describes these connections as FC. The connections will appear to originate from the FC ports that are assigned on the switch to the host iSCSI initiator. The WWNs of these ports are listed as FC HBA ports in the host. The HBA model associated with these ports is reported as iSCSI-FC-router.

You can configure the software for static or round-robin load balancing through the Pillar Axiom Storage Services Manager.

Note: A control path connection to the Pilots on connected Pillar Axiom systems is recommended but optional. Functionality available through the control path will not be available if there is no control path connection.

Related concepts

- *About Path Selection*
- *About Load Balancing Configurations*

About the Pillar Axiom Path Manager Data Path

The Pillar Axiom Path Manager (APM) Device Specific Module (DSM), an MPIO module for the Pillar Axiom system, manages I/O to storage devices over the data path.

The DSM manages the data path to:

- Support failover across redundant paths.
- Control and manage all data paths to Pillar Axiom LUNs.
- Group multiple paths to a Pillar Axiom LUN and present this group to the operating system as a single LUN or drive.
- Identify and use optimized paths when possible.
- Determine which path to use to implement load balancing.
- Handle path failover and failback.
- Manage data path errors.
- Handle reserve and release commands for clustering.

Pillar Axiom Path Manager for Windows Features

Pillar Axiom Path Manager (APM) is defined as:

> Optional software installed on a storage area network (SAN) host to manage multiple paths to the Pillar Axiom system.

APM performs the following primary functions:

- Routes I/O to Pillar Axiom LUNs using only the best available data paths.
- Shares traffic among the available paths and ensures that access to the LUNs is not interrupted if some paths fail.
- Automatically configures the host into the Pillar Axiom Storage Services Manager and updates the configuration if the host information changes.

The function described in the last bullet enables the Pillar Axiom Storage Services Manager to report information about APM 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 Pillar Axiom Pilot.

Each APM release provides different features, and the features provided for each platform may vary. Refer to the following table for descriptions of the specific features implemented in this release.

Table 4 APM 3.3 for Windows features

Feature	Benefit
Automatic data path failover	Automatically switches to the highest priority optimized path available after a path failure or fail back.
Automatic recognition of storage attached network (SAN) hosts by the Pillar Axiom Storage Services Manager	Sends a description of the host to each Pilot management controller on connected Pillar Axiom systems, allowing the Pillar Axiom Storage Services Manager and command line interface (CLI) tools to create a definition for the host. This definition includes such information as the World Wide Names (WWNs) for each of the host's Fibre Channel (FC) ports, and the version of APM running on the host. **Note:** This feature is only available if the host has a control path connection to the Pillar Axiom Pilot.

Table 4 APM 3.3 for Windows features (continued)

Feature	Benefit
Call-Home log collection	When a Pillar Axiom administrator uses the Pillar Axiom Storage Services Manager to collect system information (refer to the *Pillar Axiom Administrator's Guide* for details), the Pillar Axiom system sends a request to each connected APM host. The APM hosts collect useful diagnostic information and send it to the Pillar Axiom system, where it is bundled with any other requested information. The Pillar Axiom system can then transmit this information to Oracle Pillar Customer Support. The information collected from each APM host includes: • Logs from the APM components. • Configuration and status information from the operating system. • System and error logs from the operating system. **Note:** No customer data is transmitted. **Note:** This feature is only available if the host has a control path connection to the Pillar Axiom Pilot.
Support for upgrades	Upgrades from earlier versions of APM are supported.
LUN access	Access to Pillar Axiom LUNs using both iSCSI and FC is supported.
Fibre Channel HBAs	All FC HBAs that meet the following HBA driver requirements are supported: • Storport miniport driver • Digitally signed by the Microsoft Windows Hardware Compatibility Publisher (WHQL signed or WHQL certified) • Dated after January 1, 2008 The HBA must be officially supported by the driver and meet all requirements specified for use with the driver. FC HBAs with speeds ranging between 1, 2, 4, and 8 Gb/s are supported.
iSCSI hardware and software	QLogic iSCSI HBAs and the Microsoft iSCSI Software Initiator are supported.

Table 4 APM 3.3 for Windows features (continued)

Feature	Benefit
Configuration at the host	Enhanced ability to configure APM at the host in the absence of a control path connection to the Pillar Axiom system is supported.
Fibre Channel over Ethernet (FCoE) Converged Network Adapters (CNAs)	FCoE CNAs on the host are supported.
Xsigo Fibre Channel and Ethernet emulation over InfiniBand	The proprietary FC emulation over InfiniBand provided by Xsigo's I/O Director and associated host software are supported.
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. • On Windows Server 2003 and 2003 R2, access to LUNs used as Microsoft cluster disk resources will only be in static mode, regardless of how load balancing is configured. • Windows Server 2008 and 2008 R2 cluster disk resources support both static and round-robin load balancing.

Related concepts

- *About Boot from SAN*
- *About Configuration at the Host*
- *About Xsigo I/O Director Support*
- *About Pillar Axiom Path Manager and Hyper-V*
- *About Pillar Axiom Path Manager and Clustering*

About Configuration at the Host

Configuration at the host without a control path connection 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.

Previous releases of Pillar Axiom Path Manager (APM) for Windows required a control path connection to the Pillar Axiom system Pilot to perform configuration tasks. Enhancements in support for the WMI interfaces, and persistence of the most recent load balancing setting at the host, make it possible to configure APM at the host without a control path connection.

APM 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) for details. APM does not use or support all aspects of these classes. For example, APM implements two load balancing algorithms, while the WMI classes define more.

Windows Server 2008 R2 uses these classes to implement extensions to various management applets. For example, the Device Properties applet associated with Pillar Axiom LUNs has an MPIO tab that displays information from the WMI classes and allows modification of some fields. APM allows only certain fields to be modified. The optimization state of paths, for example, is controlled entirely by the Pillar Axiom system. Attempts to modify fields which APM does not support will not fail, but the setting will not be changed.

The APM distribution includes a simple VBscript script (`Scripts\lbset.vbs` in the installation directory) as an example of a way 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 Pillar Axiom 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.

Note: The load balancing setting for LUNs is normally configured at the Pillar Axiom system using the Pillar Axiom Storage Services Manager GUI or CLI.

When APM is running in its recommended configuration, with a control path connection to the Pilot, it may update the load balancing configuration from time to time to that stored at the Pillar Axiom system. When load balancing is configured using WMI, only the current setting at the host is changed.

If APM has a control path connection to the Pillar Axiom system, the setting may subsequently be updated at any time to match that configured at the Pillar Axiom system. Therefore, the ability to configure the load balancing configuration through WMI is mainly of use if you choose to use APM without a control path connection to the Pillar Axiom system.

APM remembers the latest load balancing configuration at the host. When the host is rebooted, LUNs will come online using the load balancing configuration most recently set through one of the following means:

- WMI
- APM, from the configuration at the Pillar Axiom system
- The default setting when the LUN was first discovered (which is now round-robin)

In previous APM releases, LUNs would start with a default setting of static in the expectation of being immediately updated to the configuration received over the control path from the Pillar Axiom system. This change is therefore of most use to customers who choose to use APM without a control path connection to the Pillar Axiom system, but it is also helpful in situations where the control path is temporarily unavailable when the host boots.

Note: There are three consequences to running APM without a control path connection:

- Host logs initiated at the Pillar Axiom system will not be collected.
- You will need to manually add the host name, along with all associated host Fibre Channel port WWNs and iSCSI initiator names, at the **Storage > SAN > Hosts** page in the Pillar Axiom graphical user interface (GUI).
- Load balancing configuration from the Pillar Axiom GUI or CLI will be ignored.

Related concepts

- *About Path Selection*
- *About Load Balancing Configurations*

Related tasks

- *Complete the LUN Configuration*

About Boot from SAN

The Pillar Axiom Path Manager (APM) software supports booting the host using a LUN on a Pillar Axiom system accessed over iSCSI or Fibre Channel (FC) as the system drive.

You can use the LUN as a system drive, but we recommend that you use another storage device 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 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, so you will need to 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 APM, first contact your host hardware vendor, and then contact Oracle Pillar 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)
- Windows Boot from Fibre Channel SAN (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)

Related references

- *Boot-from-SAN Tips*

About Pillar Axiom Path Manager and Hyper-V

Pillar Axiom Path Manager (APM) supports Hyper-V on Windows Server platforms.

You can install APM on a Windows Server host configured as a Hyper-V parent. Multi-pathed Pillar Axiom LUNs that are mapped to the Hyper-V parent host can be accessed by the guest operating systems in the same way as other disks. For

example, they can be used to hold Virtual Hard Disk (VHD) files, which can then be exposed to the guests, or the guests can access them as pass-through disks.

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

Refer to the Microsoft Hyper-V documentation for more information on using disks with Hyper-V.

About Pillar Axiom Path Manager and Clustering

The Pillar Axiom Path Manager (APM) for Windows can be used in a clustered environment.

The clustered environment must be set up and working before you install the APM software.

For information on setting up a cluster environment on Windows Server 2003 and Windows Server 2003 R2, see one of the following:

- Windows Server 2003 R2 Enterprise Edition – Cluster Server Resource Center

  (http://www.microsoft.com/windowsserver2003/technologies/clustering/resources.mspx)

- Microsoft Knowledge Base article KB 301647

  (http://support.microsoft.com/kb/301647)

- Microsoft Support for Server Clusters with Third-Party System Components

  (http://support.microsoft.com/kb/814607/en-us)

For information on setting up a cluster environment on Windows Server 2008 and Windows Server 2008 R2, see the Microsoft Failover Clustering documentation (http://www.microsoft.com/Windowsserver2008/en/us/failover-clustering-main.aspx).

Note: Pillar Data Systems supports the type of clustering Microsoft refers to as failover clustering.

Operating Limits

Pillar Axiom Path Manager (APM) provides access over multiple data paths to LUNs defined on a Pillar Axiom system. APM, the Microsoft MPIO, Windows, and the Pillar Axiom software limit the following aspects of this access.

Table 5 APM operating limits

APM capabilities	Maximum value
Target Pillar Axiom systems	Eight for each SAN host
Connect to SAN Slammer storage controllers	Four for each Pillar Axiom system
Connect to LUNs	255 for each Pillar Axiom system
Handle data paths	32 to each LUN
Handle FC HBA ports	32 for each SAN host

Important! Not all combinations of the limits shown have been tested. Use care when operating a system that has been configured to run at or near these limits. The system may exhibit anomalies when all limits are exercised concurrently.

About Fibre Channel SAN Component Support

The Pillar Axiom Path Manager (APM) software can be used on SAN hosts that use Fibre Channel (FC) connections to SAN Slammers.

Note: If you are using Windows Server 2003 or Windows Server 2003 R2, you must update the Microsoft Storport driver. Refer to Microsoft Knowledge Base article KB 932755 (http://support.microsoft.com/kb/ 932755).

Related concepts

- *About Xsigo I/O Director Support*
- *HBA Driver and Software Requirements*

Related references

- *Supported Fibre Channel HBAs*
- *Supported Fibre Channel HBA Settings*
- *Supported Fibre Channel Switches*
- *Supported Fibre Channel Over Ethernet CNA Settings*

Related tasks

- *Configure a Fibre Channel SAN*

Supported Fibre Channel HBAs

This release supports all Fibre Channel (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 or WHQL certified.
- The HBA driver is dated after January 1, 2008. In general, 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, such as hardware version, firmware version, and bus slot capability.

Important! FC HBAs should be selected with care to ensure that they are suitable for use in a multipath environment with particular I/O loads. For example, some low-end HBAs have a low limit on the number of simultaneous connections that can be made from each port. This may make them unsuitable for use in an environment where they need to connect to several 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). 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 Fibre Channel HBA Settings

Most Fibre Channel host bus adapter (HBA) drivers have parameters that can be configured by utilities built into the HBA firmware, by utilities supplied by the HBA manufacturer, or through configuration files. Refer to your HBA vendor documentation to determine which parameters can be configured and how they are configured.

HBA settings control many aspects of HBA driver behavior, which can affect how Pillar Axiom Path Manager (APM) and Microsoft Multipath I/O (MPIO) deal with transient errors and other events in the SAN and in the Pillar Axiom system. We recommend configuring the following aspects of HBA behavior for your HBAs to work well with APM:

- 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.

We recommend the settings in the following tables:

Table 6 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 7 Recommended Emulex HBA settings

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

We recommend setting any other configurable parameters according to the HBA manufacturer's recommendations, or to their default values, unless you have a particular requirement to set them to other values.

Supported Fibre Channel Switches

For a list of supported Fibre Channel switches, you can:

- Call Technical Support.
- Refer to the *Pillar Axiom Support and Interoperability Guide*, which can be found on the Oracle Pillar Customer Support website: (http://support.pillardata.com/).

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

Related references

- *Oracle Contacts*

About Xsigo I/O Director Support

Xsigo I/O Director and associated host software provide proprietary Fibre Channel (FC) emulation over InfiniBand.

The FC ports on the Xsigo I/O Director must connect to the FC fabric through an N_Port ID Virtualization (NPIV)-aware FC switch. Direct connection of the Xsigo I/O Director to the Pillar Axiom system is not supported.

In addition to FC emulation, Pillar Axiom Path Manager also supports the Ethernet emulation provided by the Xsigo solution. The Xsigo virtual Ethernet network interface controllers (NICs) are supported in the same ways as other Ethernet NICs.

Refer to the Xsigo documentation for instructions on setting up and configuring the Xsigo I/O Director and associated components. The InfiniBand host channel adapters (HCAs) and other equipment required for this solution are specified in the Xsigo documentation.

Related references

- *Supported Xsigo Software and Firmware*

Supported Xsigo Software and Firmware

Pillar Axiom Path Manager supports the following Xsigo software, firmware, and drivers:

Table 8 Xsigo software, firmware, and driver versions

Xsigo software and firmware	Version
XgOS	2.7.1.1
XMS	2.7.1
HCA firmware	2.7.9
Drivers	2.6.0.6

About iSCSI Software and Hardware Support

The Pillar Axiom Path Manager (APM) software can be used on SAN hosts that use Internet small computer systems interface (iSCSI) connections to SAN Slammers.

Related concepts

- *Supported iSCSI Software*
- *HBA Driver and Software Requirements*

Related references

- *Supported iSCSI HBAs*
- *Supported iSCSI-to-Fibre Channel Routers*
- *Supported iSCSI Switches*

Related tasks

- *Configure an iSCSI SAN*

Supported iSCSI Software

If you intend to use iSCSI, you must enable and configure the Microsoft iSCSI Software Initiator.

For Windows Server 2003 and Windows Server 2003 R2:

- Download and install version 2.08 or later of the Microsoft iSCSI Software Initiator from Microsoft.
- If you plan to boot from a NIC using the iSCSI Boot Firmware Table (iBFT), ensure that you have the boot version of the Microsoft iSCSI Software Initiator.

For more information on the Microsoft iSCSI Software Initiator and links to download packages, refer to the Microsoft Storage Technologies - iSCSI page (http://www.microsoft.com/windowsserver2003/technologies/storage/iscsi/default.mspx).

For Windows Server 2008 and Windows Server 2008 R2:

- The iSCSI Software Initiator is a standard part of the OS.
- Use Windows Update to ensure that you have the latest version.

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

Related tasks

- *Configure iSCSI Connections*

Supported iSCSI HBAs

The following table lists supported and tested QLogic HBAs and drivers, and the versions of software and firmware required to use these HBAs with Pillar Axiom Path Manager.

Table 9 Supported QLogic iSCSI HBAs

HBA models	Required versions
QLA4050 QLA4050C QLA4052C QLE4060C QLE4062C	BIOS: 1.15 iSCSI Firmware: 3.0.1.53 Storport driver: 2.1.4.26

Supported iSCSI-to-Fibre Channel Routers

iSCSI-to-Fibre Channel (FC) routing features enable a host to use Internet Small Computer System Interface (iSCSI) to access LUNs on Pillar Axiom FC Slammers.

Pillar Axiom Path Manager (APM) 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, refer to the Cisco documentation (http://www.cisco.com/).

See Configure the iSCSI-to-Fibre Channel Router for the steps required to use the Cisco MDS switch as an iSCSI-to-FC router with APM and the Pillar Axiom system.

Related tasks

- *Configure the iSCSI-to-Fibre Channel Router*

Supported iSCSI Switches

For a list of supported iSCSI switches, you can:

- Call Technical Support at the number listed in Oracle Contacts.
- Refer to the *Pillar Axiom Support and Interoperability Guide*, which can be found on the Oracle Pillar Customer Support website (http://support.pillardata.com/).

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

About Fibre Channel Over Ethernet Support

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

APM treats FCoE connections the same as FC connections.

Related references

- *Supported Fibre Channel Over Ethernet CNA Settings*
- *Supported Fibre Channel Over Ethernet Switches*

Supported Fibre Channel Over Ethernet CNA Settings

We recommend the following settings for the supported Fibre Channel over Ethernet (FCoE) converged network adapters (CNAs):

Table 10 Supported Emulex and Brocade FCoE CNA Settings

CNA models	Required versions
Emulex OCe10102–F	• Firmware and boot code: 2.102.200.28 • Ethernet NDIS miniport driver: 2.102.200.13 • FCoE Storport miniport driver: 2.32.002
Brocade 1010 and 1020	• Boot code, from multi-boot image: 2.2.0.0 • Drivers, from driver package:2.2.0.0

Note: These FCoE CNAs can also be used concurrently as Ethernet network interface controllers (NICs).

Supported Fibre Channel Over Ethernet 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.

CHAPTER 2

Install Pillar Axiom Path Manager

Pillar Axiom Path Manager Preinstallation Requirements

Before you install the Pillar Axiom Path Manager (APM) software, ensure that your network and Pillar Axiom system meet the installation requirements.

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

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

Management Network Requirements

The Pillar Axiom Path Manager (APM) software communicates with the Pilot over secure, encrypted XML. The SAN host on which the APM software is installed requires a TCP/IP connection for communication with the Pillar Axiom Storage Services Manager.

The network configuration must allow the SAN host to connect to TCP port 26004 on the Pilot's management Ethernet interfaces to connect the control path. Connecting to the control path is optional if you are using the APM configuration from the host feature. This connection is used to implement the control path, so it is optional but recommended.

Tip: To check your network connectivity, issue a simple `pdscli` or `axiomcli` request from the host to the Pillar Axiom system. Both `pdscli` and `axiomcli` use the same port and protocols as those used by APM.

Related concepts

- *About Configuration at the Host*

HBA Driver and Software Requirements

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

Perform the following actions:

- Install or update the Microsoft iSCSI Software Initiator if you plan to use iSCSI.
- Install any FC or iSCSI HBAs, or Fibre Channel over Ethernet (FCoE) Converged Network Adapters (CNAs), that you plan to use.
- If the supported driver versions for your HBAs or CNAs are not already installed, install them.
- If necessary, update the firmware and BIOS on iSCSI HBAs or FCoE CNAs to the supported versions.
- Verify that your 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 APM software.

For both Windows Server 2003 and Windows Server 2003 R2, install Service Pack 2. In addition, install Microsoft's Storport Hotfix from Microsoft Support (http://support.microsoft.com/kb/932755/en-us).

Note: Install Hotfix 932755 *after* you install Service Pack 2 on Windows Server 2003 or Windows Server 2003 R2.

APM 3.3 supports Windows Server 2008 with or without Service Pack 2.

Configure a Fibre Channel SAN

1. Verify that HBAs, HBA drivers, and required HBA vendor software is installed on the host according to the vendor's instructions.
2. Set up the SAN (physical connectivity and any required switch zoning) so there is at least one path through the SAN between an HBA port on the host and a Slammer port on each Pillar Axiom system.

   This enables the APM Service to discover the Pillar Axiom systems and automatically create host entries in the Pillar Axiom Storage Services Manager.
3. From the Pillar Axiom Storage Services Manager, check the connection in the **Storage > SAN > Hosts** page for the following:
   - The host port should appear as an entry with the **Host Name** shown as **Hostname Unknown**.

     Note: The host page will display the host name after you install APM.
   - The **Host Port** name should be shown as its port WWN.

Configure the iSCSI-to-Fibre Channel Router

This release 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 Pillar Axiom Path Manager (APM) and the Pillar Axiom system.

For more information on these features, refer to the Cisco documentation (http://www.cisco.com/univercd/cc/td/doc/product/sn5000/mds9000/3_0/fmcfg/index.htm).

1. Present the Pillar Axiom Slammer storage controller 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 APM and the Pillar Axiom Storage Services Manager.

2. Present the iSCSI hosts as virtual Fibre Channel 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, APM on the iSCSI hosts interacts with the Pillar Axiom systems in exactly the same way as when both hosts and Slammers use the same SAN protocol.

Configure an iSCSI SAN

1. Verify that the Microsoft iSCSI Software 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 functionality and set up the FC SAN between the FC ports on the router and the FC ports on the Slammers.
3. Set up the IP SAN between the host and the iSCSI ports on the Slammer or the iSCSI-to-FC router.

Configure iSCSI Connections

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

1. Launch the iSCSI Software 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 Slammer port on each Slammer.
   - An iSCSI port on the iSCSI-to-FC router that represents the Slammer ports.

   Result:
   An entry for each Pillar Axiom system should be listed on the **Targets** tab.
3. On the **Targets** tab, select a Pillar Axiom system or the representation of a Pillar Axiom 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 represent the ends of the connection you are creating.

   Note: Each connection forms a path to the Pillar Axiom systems. You will need to repeat these steps for each possible combination of these fields.

8 Click **OK** to close the Advanced Settings dialog box.

9 Click **OK** to close the Log On to Target (or Connect to Target) dialog box.

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 Slammer.

11 Repeat Steps 3 through 10 for each target that represents a Pillar Axiom system.

Download and Install the Pillar Axiom Path Manager Software

To install the Pillar Axiom Path Manager (APM) software, download the APM for Windows package, install the package, and configure your Pillar Axiom system to work with APM.

Prerequisites:

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

1. Download the APM software.
2. Install the APM software if you are installing APM for the first time.
3. Complete the installation by configuring access from the SAN host to Pillar Axiom LUNs.

- If you are updating an existing APM installation, see the instructions for updating the APM software.
- To remove the software from your SAN host, see the instructions for removing the APM software.

Related concepts

- *Pillar Axiom Path Manager Preinstallation Requirements*

Related tasks

- *Download the Pillar Axiom Path Manager Software*
- *Install the Pillar Axiom Path Manager Software*
- *Complete the LUN Configuration*
- *Update the Pillar Axiom Path Manager Software on Windows Server 2003*
- *Remove the Pillar Axiom Path Manager Software (Optional)*

Download the Pillar Axiom Path Manager Software

Download the Pillar Axiom Path Manager (APM) software from Pillar Support.

1. Navigate to the Pillar Support website (http://supportportal.pillardata.com/csportal/login.seam).
2. Click **Log In**.
3. Enter your Username and Password, and click **Log In**.

4 Click **Software Downloads** and **Pillar Axiom Path Manager** in the left-hand navigation pane.

5 Navigate to the name of the installation package for your hardware platform in the right-hand content pane.

6 Click the green arrow in the **Software Download Details** pane below, and follow the download prompts.

The software package downloads to your system.

Tip: Save the package to a local drive on your system. The package will not install if copied to a network drive.

Install the Pillar Axiom Path Manager Software

Follow these instructions to install the Pillar Axiom Path Manager (APM) software on the host, if another version of APM is not already installed.

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

1 Verify that you have administrator privileges to install the software.

2 Close all applications and management applets.

3 On Windows Server 2003 and Windows Server 2003 R2 hosts with mirrored disks, stop the `dmadmin` service.

4 To install the software, choose one of:

- From Windows Explorer, double-click the name of the APM package you downloaded.
- From the command line, run the following command:

  ```
  msiexec /i package_name
  ```

Result:
Either option installs the following components:

- Microsoft Mutipath I/O (MPIO).

  On Windows Server 2003 and Windows Server 2003 R2, the Microsoft MPIO 1.23 framework is installed.

  On Windows Server 2008 and Windows Server 2008 R2, the Multipath I/O feature, which is part of the operating system, is installed, if it is not already installed.

- The Pillar Device-Specific Module (DSM).
- The APM service.
- The sample WMI script.

5 Restart the system if you are prompted to do so.

6 On Windows Server 2003 and Windows Server 2003 R2 hosts with mirrored disks, restart the `dmadmin` service.

Complete the LUN Configuration

The LUN configuration procedure provides the SAN host with access to Pillar Axiom LUNs.

Perform the following steps for both iSCSI and Fibre Channel.

1 Open the **Storage > SAN > Hosts** page in the Pillar Axiom Storage Services Manager.

2 Verify that the individual entries for the host ports have been replaced with a single entry under the host name.

Example:

Figure 2 Example host ports before APM installation

Host Name	Host Port	Type	AxiomONE Path Manager	Number of LUNs	Host Port Status
Hostname Unknown	10:00:00:00:c9:36:84:6e	FC	Not Registered	0	Connected
Hostname Unknown	10:00:00:00:c9:36:84:6f	FC	Not Registered	0	Connected
Hostname Unknown	10:00:00:00:c9:36:85:20	FC	Not Registered	6	Connected
Hostname Unknown	10:00:00:00:c9:41:32:c3	FC	Not Registered	0	Connected
Hostname Unknown	10:00:00:00:c9:41:32:c4	FC	Not Registered	0	Connected
iqn.1987-05.com.cisco:01.eca9a9b8d555	192.168.2.93	iSCSI	Not Registered	0	Connected
	192.168.2.94	iSCSI			Connected

Figure 3 Example host ports after APM installation

Host Name	Host Port	Type	AxiomONE Path Manager	Number of LUNs	Host Port Status
happy	10:00:00:00:c9:36:84:6e	FC	Communicating	0	Connected
	10:00:00:00:c9:36:84:6f	FC			Connected
	192.168.2.93	iSCSI			Connected
	192.168.2.94	iSCSI			Connected
Hostname Unknown	10:00:00:00:c9:36:85:20	FC	Not Registered	6	Connected
Hostname Unknown	10:00:00:00:c9:41:32:c3	FC	Not Registered	0	Connected
Hostname Unknown	10:00:00:00:c9:41:32:c4	FC	Not Registered	0	Connected

Note: The Hosts page may display differently in your version of Pillar Axiom Storage Services Manager.

The automatic configuration of a host entry occurs when APM discovers the Pillar Axiom system on the Storage Attached Network (SAN) and then makes a control path connection to the Pilot. If you are using APM without a control path connection, you will need to manually create a host entry in the Pillar AxiomGUI and associate all host FC port WWNs and iSCSI Initiator names with that entry.

You will see one or more of the following **Pillar Axiom Path Manager Status** and **Host Port Status** messages on the Hosts page:

APM Status	**Communicating**: The host control path is currently logged into the Pilot. **Note: Communicating** status is required for the APM control path to report path status, configure load balancing, and use the Pillar Axiom system to collect APM diagnostic logs. However, the configuration at the host feature makes it possible to configure load balancing locally when the status is other than **Communicating**. **Not Registered**: A control path from an APM host with this name has never logged into the Pilot. **Not Communicating**: The APM host control path has previously logged into the Pilot, but it is not currently logged in.
Host Port Status	**Connected**: The host SAN connection is logged in to the SAN Slammer. **Not connected**: The host SAN connection is not logged in to the SAN Slammer.

See the Pillar Axiom Storage Services Manager Help for information about the remaining fields on the Hosts page.

3 Connect and enable any additional paths through the SAN between the host and the Slammers.

4 Create any new LUNs on the Pillar Axiom system for this host, and set up any mappings of LUNs to the new host entry.

Note: Windows does not recognize LUN number 255. If you configure a LUN for the host at LUN number 255, it will not be seen by Windows.

5 The LUNs should appear automatically on the host. If they do not appear, select **Rescan Disks** in the Windows Disk Manager.

Result:
The LUNs should become available as drives on the host. If the drives do not appear, restart the host.

6 Go to the **Storage > SAN > Hosts** page in the Pillar Axiom Storage Services Manager, and select the entry for the new host.

7 Select the **View** or **Modify** action for the new host entry, and select the LUN Connections tab.

It make take some time for the names to appear in the LUN Name on Host column on the Hosts page.

Tip: If the names are not visible within two or three minutes, you may need to refresh the screen to see them.

Result:
The LUNs that are mapped to the host, and the connection state between the host ports and the Slammer ports, are displayed. If the APM control path is communicating, each LUN name as allocated by Windows on the host, along with the numbers of optimized and non-optimized paths currently being controlled by APM, are also displayed.

8 Format and set up the drives for use in Windows.

Note: On Windows Server 2003 and Windows Server 2003 R2, the Microsoft iSCSI Software Initiator supports formatting iSCSI LUNs as basic (not dynamic) drives only.

9 Click the **Settings** tab to change the load balancing algorithm used on this host for each LUN, if the control path is communicating. (Optional)

Related concepts

- *About Configuration at the Host*

Boot-from-SAN Tips

The following information provides tips to ensure that the Pillar Axiom Path Manager (APM) 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 concepts

- *About Boot from SAN*
- *About Boot LUNs*
- *About Boot Device Failover*
- *About Boot Device Paths*

Related tasks

- *Clone a Boot LUN*

About Boot LUNs

When you create a LUN and install Windows on it 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 may exhibit sluggish performance when the Pillar Axiom 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.

About Boot Device Paths

Note the following regarding boot device paths:

- Verify that the boot device path is set up correctly; otherwise, the system may not start up.
- When the Pillar Axiom Path Manager (APM) software is not used, there must be only a single path through the SAN between the host and the boot LUN. Without APM, if more than one path is visible to Windows, the host may fail to boot, and the boot LUN may 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 Fibre Channel ports in the path may be 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 may cause details of the path to change include moving cables to different ports, reconfiguring zones, or changing port masking for a LUN.

About Boot Device Failover

The APM drivers must load before the boot device can fail over. These drivers usually load before the CTRL+ALT+DELETE login prompt displays.

Important! Losing the boot path before this point will cause 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 made.

1. Shut down the host.
2. Use the Pillar Axiom Storage Services Manager Clone LUN feature to create a clone of the LUN.

   See the *Pillar Axiom Administrator's Guide*.
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.

About Load Balancing Configurations

Pillar Axiom Path Manager (APM) can be configured for static or round-robin load balancing. You can configure load balancing separately for each LUN.

Note: On Windows Server 2003 and Windows 2003 R2, LUNs used as Microsoft cluster disk resources use static load balancing regardless of how they are configured. Windows Server 2008 and Windows 2008 R2 cluster disk resources support both static and round-robin load balancing.

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. 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.

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

- Balances access to a LUN across all optimized Slammer ports available for that LUN
- Balances access from a host across the host's HBA channels

To configure round-robin or static load balancing through the Pillar Axiom Storage Services Manager, see the *Pillar Axiom Administrator's Guide*.

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

You can use the Pillar AxiomGUI or CLI to change these load balancing settings from the Pillar Axiom system, or you can change them from the host using Windows applets or WMI calls. If you change load balancing settings from the host and leave the APM control path connection communicating with the Pilot, however, the Pillar Axiom system may override your changes. Running APM without a control path connection ensures that the Pillar Axiom system cannot override your changes, but other control path functions will not be available.

Related concepts

- *About Path Selection*

About Path Selection

Pillar Axiom Path Manager (APM) supports access to LUNs using Internet Small Computer System Interface (iSCSI) and Fibre Channel (FC) protocol at the same time, as well as individually.

Paths to a LUN may have different performance characteristics. Paths to the Slammer control unit where the LUN resides are considered *optimized paths*; other paths to the LUN are considered *non-optimized paths*. When both FC and iSCSI access to a LUN are available, FC access generally performs better.

APM divides the paths to each LUN into four groups with different performance characteristics, in this order of precedence:

- First, FC optimized
- Next, iSCSI optimized
- Next, FC non-optimized
- Finally, iSCSI non-optimized

At any given time, APM only uses paths from the most preferred group that has paths available.

Note: When an active path fails, and I/O traffic is transferred to a different path, I/O performance will be reduced for a short time while the operating system recognizes the failure and makes the path transfer. If the failing path was optimized and the new path is non-optimized, I/O performance may remain lower than before since it is now using a lower-performance path. Within a few minutes of traffic being transferred to a non-optimized path, the Pillar Axiom system will reconfigure the LUNs to use an optimized path, if possible. I/O performance will improve.

About Updating the Pillar Axiom Path Manager Software

In this release, directly updating the Pillar Axiom Path Manager (APM) software is not supported for all configurations of Windows Server. The update path you need to follow depends on your Windows Server configuration:

- **Windows Server in a clustered environment:** The cluster node being updated should be Passive. This should allow I/O to the cluster to continue without interruption. Changing the roles of the nodes from Active to Passive will allow all nodes to be updated.

  Note: The act of changing the nodes from Active to Passive will introduce a disruption.

- **Any Windows Server 2008 or Windows Server 2008 R2 configuration:** You can update the APM software directly. Follow the installation instructions in this guide for installing APM when it is not already installed. This installation will automatically replace the existing version with the new one.

- **Windows Server 2003 and Windows Server 2003 R2 configurations in which the host is booted from a Pillar Axiom LUN:**

  - First remove the previous version of APM by following the instructions in the appropriate *Pillar Axiom Path Manager Installation Guide and Release Notes*.

  - Then install APM following the installation instructions in this guide.

- **Other Windows Server 2003 and Windows Server 2003 R2 configurations** (in which the host is *not* booted from a Pillar Axiom LUN): Follow the update instructions for Windows Server 2003 in this guide.

Related tasks

- *Download the Pillar Axiom Path Manager Software*
- *Install the Pillar Axiom Path Manager Software*
- *Complete the LUN Configuration*
- *Update the Pillar Axiom Path Manager Software on Windows Server 2003*
- *Remove the Pillar Axiom Path Manager Software (Optional)*

Update the Pillar Axiom Path Manager Software on Windows Server 2003

Follow this procedure to update the Pillar Axiom Path Manager (APM) software on a Windows Server 2003 or Windows Server 2003 R2 configuration in which the host is *not* booted from a Pillar Axiom LUN.

1. Disconnect all Fibre Channel (FC) and iSCSI paths from the host to the Pillar Axiom system.
2. Reboot the host.
3. Install the new version of APM by following the instructions in this guide for installing APM if another version of APM is not installed.
4. Reboot the host at the end of the installation.
5. Log in to the host.
6. Reconnect the FC and iSCSI paths to the Pillar Axiom system.

Related tasks

- *Install the Pillar Axiom Path Manager Software*

Remove the Pillar Axiom Path Manager Software (Optional)

When you remove the Pillar Axiom Path Manager (APM) software, support for multiple paths to Pillar Axiom LUNs is removed.

Important! Before you remove the software, you must disconnect the host from all Pillar Axiom systems if you do not want to access Pillar Axiom LUNs. 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 made 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 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 vital that you wait until Windows has recognized that these changes have been made and completed updating its configuration before you proceed to remove APM.

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

   Wait until Device Manager shows that all Pillar Axiom LUNs have been removed (or that all 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 APM.

2. Use one of the following to remove APM:

   - Windows Server 2003 or 2003 R2 **Add or Remove Programs** Control Panel.
   - Windows Server 2008 or 2008 R2 **Programs and Features** Control Panel.
   - Enter the following at a command line prompt:

     ```
     wmic product where name="Pillar Axiom Path Manager"
     call uninstall
     ```

     This command may prompt you for a response.

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

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

3 In Windows Server 2008 or 2008 R2, you may choose to remove the Multipath I/O feature after removing APM, if nothing else is using it. (Optional)

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**.

There are situations in which you might be tempted 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.

Caution Do not use anything but **Add or Remove Programs** (Windows Server 2003 or 2003 R2), **Programs and Features** (Windows Server 2008 or 2008 R2), or the wmic command described above to change your installation because other tools may leave the system in an inconsistent state, possibly preventing subsequent system startups. These commands ensure that all components are left in a consistent state. If any of these command fails to remove APM, contact Oracle Pillar Customer Support.

Important! Uninstalling MPIO from a Windows Server 2003 or 2003 R2 host that is booted from a multipathed iSCSI LUN may cause problems. Refer to Microsoft Knowledge Base Article 952775 before uninstalling APM from a host that is booted over iSCSI from a Pillar Axiom LUN.

CHAPTER 3

Pillar Axiom Path Manager Release Notes

New in This Release

Pillar Axiom Path Manager 3.3 for Windows supports:

- Configuration at the host.
- Xsigo Fibre Channel and Ethernet emulation over InfiniBand.
- Fibre Channel over Ethernet (FCoE) Converged Network Adapters (CNAs).

Known APM Issues

The following Pillar Axiom Path Manager (APM) issues are known in this release.

Table 11 Known issues

Issue	Workaround or planned fix
Windows sometimes halts unexpectedly with a blue screen at the end of an APM installation or during reboot after an APM installation. This blue screen may occur during APM installation on a Windows Server instance running in a virtual machine.	Restart the system. If APM is not fully installed after the reboot, install it again.

Known Pillar Axiom Issues

The following issues might be associated with the version of the Pillar Axiom software you are using.

Table 12 Known Pillar Axiom issues

Issue	Workaround or planned fix
When a Fibre Channel HBA is removed from a host running APM, it remains associated with that host. If the HBA is moved to a host that is either not running APM or on which APM is shown as not communicating with the Pillar Axiom Pilot, any LUNs mapped to the host will continue to be accessible through the HBA ports. The Pillar Axiom GUI and CLI will continue to report the HBA as being present in the original host. If the HBA is moved to a host where APM is running and communicating with the Pilot, its association and mappings for the old host will be removed, and the mappings for the new host will be applied.	This issue is fixed in release 4.0 of the Pillar Axiom software.
If you use the Pillar Axiom GUI or CLI to change the default configured Slammer control unit (CU) of a LUN to the other CU on the Slammer, the Slammer port mask for the LUN will be reversed. For example, if CU0 Port 0 is enabled and Port 1 is excluded, and the LUN is moved to CU1, then CU1 Port 0 will become excluded and CU1 Port 1 will become enabled.	After you change the default configured Slammer CU for a LUN, be sure to update the LUN port mask to the required value. This issue is fixed in release 4.0.0 of the Pillar Axiom software.
If an Pillar Axiom Path Manager (APM) host uses iSCSI to connect to a Pillar Axiom system, and it uses an iSCSI initiator name that is the same as its host name, then the entry for that host in the Pillar Axiom Storage Services	Ensure that the iSCSI initiator names configured on hosts that use iSCSI to connect to a Pillar Axiom system are different from all host names used by APM hosts, including virtual machine hosts, connected to that Pillar Axiom

Table 12 Known Pillar Axiom issues (continued)

Issue	Workaround or planned fix
Manager will be continually deleted and recreated, causing the host entry to disappear and reappear intermittently.	system. The iSCSI standards require that iSCSI names follow particular formats, as specified in RFC 3720: (http://tools.ietf.org/html/rfc3720#section-3.2.6). If hosts are configured to use iSCSI initiator names that conform to these requirements, it is extremely unlikely that they will be the same as any host name. This issue is fixed in release 4.1 of the Pillar Axiom software.
If all paths to a LUN's configured Slammer control unit (CU) fail, APM will re-route all traffic through the non-optimized paths to the LUN's alternate CU. In response, the Pillar Axiom system will initially log events indicating non-optimized access, then when this traffic continues it will temporarily move the LUN to the alternate CU. This process leaves the host using optimized paths to the LUN, but the LUN is resident on a CU other than its configured home. Normally, the system will attempt to move the LUN back to its configured CU from time to time, and if the paths to the other CU have recovered the traffic will transfer back and the system returns to its normal configured state. However, if the Pilot software is restarted while a LUN is in this temporary state, as might happen during a software update that includes the option to update the Pilot software, two problems occur: 1 The graphical user interface (GUI) and command line interface (CLI) wrongly report that the LUN's current CU is its configured CU.	This issue is fixed in release 4.0 of the Pillar Axiom software.

Table 12 Known Pillar Axiom issues (continued)

Issue	Workaround or planned fix
2 Non-optimized access events are no longer logged for the LUN, and the system does not attempt to move the LUN back to its configured CU. If subsequent path failures and recoveries cause traffic to be sent to the CU on which the LUN is not resident, the system will not move the LUN to the CU receiving the traffic. This means that all traffic to the LUN would have non-optimized access, which decreases performance, and this non-optimized access would not be logged.	
When a LUN is created on a Pillar Axiom system, its load balancing attribute is set to round-robin by default. If the LUN is then mapped to a host running APM, the load balancing attribute setting can change to static when APM on the host first communicates with the Pillar Axiom system after detecting the LUN. Instead, this attribute should be set to round-robin when the LUN is first created, and should change only if an administrator changes it using the Pillar Axiom graphical user interface (GUI) or command line interface (CLI).	This issue is fixed in Pillar Axiom software release 4.0. If the Pillar Axiom system is running a release earlier than 4.0, check that the load balancing attribute for the LUN is still set to the desired value after APM on the host has detected the LUN and its **LUN name on Host** has been reported in the Pillar Axiom GUI. If the setting has changed, change it back to the desired value, which can then be correctly saved.
If an iSCSI initiator is added to a SAN host that has authentication enabled, authentication will not be enabled for that initiator. Also, if an iSCSI initiator with authentication enabled on a previous SAN host is moved to another host with or without authentication enabled, the initiator will retain its original configuration.	This issue is fixed in Pillar Axiom software release 4.0. If the Pillar Axiom system is running a release earlier than 4.0, disable then re-enable authentication for the host after iSCSI initiators are added to or moved between SAN hosts.
The Pillar Axiom GUI and CLI may show incorrect link speeds for SAN hosts with 8 Gb/s HBAs.	This issue is fixed in release 4.1 of the Pillar Axiom software.

Table 12 Known Pillar Axiom issues (continued)

Issue	Workaround or planned fix
After recovery from a Slammer control unit (CU) failure, the Pillar Axiom system may become incapable of automatically moving LUNs between the CUs on that Slammer. When the system attempts to move the LUNs automatically in response to non-optimized access from a host, the attempts fail, and non-optimized access persists.	Use the Pillar Axiom GUI or CLI to re-assign the LUNs to the CUs through which access is currently taking place. Alternatively, restart the Pillar Axiom system to restore optimized access. This issue is fixed in release 4.1 of the Pillar Axiom software.
When an iSCSI initiator name is changed or removed on an APM host, the Pillar Axiom GUI and CLI may continue to associate the old name with the host.	1 Stop the APM service on the host. 2 When the Pillar Axiom system reports the host as **Not Connected**, delete the host. This will preserve LUN mappings to the initiators. 3 Restart the APM service. This issue is fixed in release 4.2 of the Pillar Axiom software.
When a Pilot restart occurs on a Pillar Axiom system running release 4.0 (4.0.4 or later) or release 4.1 (4.1.0 or later) of the Pillar Axiom software, all LUNs on the system move from their current Slammer control unit (CU) to the other Slammer CU. As a result, the optimization of all paths to the LUNs changes. **Note:** A non-disruptive upgrade to release 4.0 (4.0.4 or later) or release 4.1 (4.1.0 or later) of the Pillar Axiom software will cause a Pilot restart, which will trigger this problem.	If all relevant SAN hosts have paths to both CUs on the Slammers, and those paths are managed by an ALUA-aware path management system such as Pillar Axiom Path Manager, it should not be necessary to take any action. The LUNs will remain balanced across the CUs, and the path management software will ensure that only optimized paths to the LUNs are used. Be aware that traffic may be moved to alternate paths when a Pilot restart occurs. Other hosts may need their path configuration to be changed to ensure that they access each LUN through its new current home CU. Alternatively, all LUNs can be moved back to their default configured CU by restarting the Pillar Axiom system.

Table 12 Known Pillar Axiom issues (continued)

Issue	Workaround or planned fix
	This issue is fixed in release 4.1.4 of the Pillar Axiom software.
The load balancing configuration displayed in the Pillar Axiom graphical user interface (GUI) or command line interface (CLI) can be different from the load balancing setting that the Pillar Axiom system sends to APM on the SAN host. This happens because, occasionally in the course of updating its configuration records to describe the new host, the Pillar Axiom system creates duplicate internal records.	Contact Oracle Pillar Customer Support for assistance.

Known Operating System Issues

APM Installation Hangs

Occasionally, installation of MPIO-based components (such as APM) may hang if any I/O is happening at the time to any disk subsystems controlled by MPIO.

Messages such as `Restarting all SCSI adapters` may be displayed while installation is suspended.

If this happens, restart the host and try the install or upgrade process again. Microsoft specifies that I/O to MPIO-managed disk subsystems should be low or quiescent during the install.

Multiple iSCSI Initiator Names

The Microsoft iSCSI Software Initiator may sometimes use an iSCSI initiator name other than the one set in its configuration.

For example, if the configured initiator name ends with the fully qualified domain name of the host, when making iSCSI connections, the iSCSI Software Initiator may use a name ending with only the node name of the host. In this case, the Pillar Axiom Storage Services Manager and command line interface (CLI) will report that the host is using two iSCSI initiator names, both the configured name and the name it is actually using.

This is normal behavior of the Microsoft iSCSI Software Initiator. In this case, the iSCSI Software Initiator effectively has two names associated with it, and APM is reporting both of these names.

Warmstart Suspends I/O to LUNs

If a Pillar Axiom system experiences a temporary outage on one Slammer control unit (CU) while attached to a Windows host running Pillar Axiom Path Manager (APM), the LUNs on the non-failing CU may experience a suspension of I/O for a period longer than the normal recovery process. All I/O should resume without failure, however, after this brief delay.

Hyper-V Delays Switching to Alternate iSCSI Path

Windows Server with Hyper-V enabled can take an exceptionally long time to report iSCSI path failures to Pillar Axiom Path Manager (APM), resulting in long delays before APM moves I/O to an alternate path.

For example, I/O may pause for five minutes or more before it is transferred from one Slammer control unit (CU) to its alternate CU. This issue can occur on the Hyper-V host or on operating system instances running in guest partitions.

There is no known workaround for this issue.

Added iSCSI Paths Not Detected

iSCSI paths added to a formerly Fibre Channel-only host might not be detected by APM.

When LUNs on a Pillar Axiom system are mapped to the SAN host through Fibre Channel, and iSCSI paths are subsequently enabled, APM might not detect the iSCSI paths. When the iSCSI Software Initiator is configured on the host, it will successfully connect to the Pillar Axiom system through iSCSI, but APM will not detect the iSCSI paths.

Reboot the host to correct the problem.

Microsoft Knowledge Base MPIO Articles

Pillar Axiom Path Manager (APM) uses the Windows Multipath I/O (MPIO) feature. Unless your system already has some other MPIO-based multipathing solution installed, the installation of APM will install and enable MPIO. It is therefore possible that issues caused by this Microsoft multipathing feature may become apparent on your system after installing APM. The following table lists current entries in the Microsoft Windows Knowledge Base describing issues that may apply when Microsoft MPIO is implemented on your system.

Table 13 Microsoft MPIO Knowledge Base Articles

Article ID	Summary
940393	Event ID 271 is logged in the System log after you install Microsoft MPIO Multipathing Support for iSCSI on a computer that is running Microsoft Windows Server 2003 or Microsoft Windows 2000 Server.
947788	The System Recovery Tool in System Center Data Protection Manager 2007 cannot create recovery points when the protected server is a passive node of a cluster or when the protected server has multipath I/O disks.
951434	The Windows Server 2008 cluster validation process may fail when disjoint iSCSI networks use the same subnet.
951590	Multipath I/O disks may disappear after you use the Hot Add Processor feature to add a new CPU to a Windows Server 2008-based computer.
952775	Error message after you uninstall MPIO on a Windows Server 2003-based computer that has the iSCSI boot sequence enabled: "STOP: 0x0000007B".
952779	A Windows Server 2008-based computer that has a single-processor stops responding if an MPIO-connected device is repeatedly connected and then disconnected.
953531	A "0x0000007E" Stop error occurs in Windows Server 2008 after you unmount and delete a persistent VSS snapshot.
953652	A physical disk resource may unexpectedly fail or go offline when the IsAlive function is executed on a Windows Server 2008 cluster node.
957509	Stop error when you use a Microsoft Device Specific Module in Windows Server 2008: "0x000000C2".
957522	The Windows Server 2008 system may stop responding when an error occurs on one of the logical units of a storage array that is connected over a single MPIO path.
958912	A Windows Server 2008-based computer may stop responding when you use a Device Specific Module that plugs into MPIO.
961570	The system becomes unresponsive after the primary MPIO path is disconnected on a Windows Server 2008-based computer.

Table 13 Microsoft MPIO Knowledge Base Articles (continued)

Article ID	Summary
961891	Error message when you try to restart or shut down a Windows Server 2008-based computer that is connected to an MPIO-controlled storage device: "Stop 0x0000009F".
963702	A Windows Server 2008 Failover Cluster that has a MPIO solution may encounter stop code 0x0000007E or 0x000000D5 during a path failover.
967349	Access to an MPIO-controlled storage device fails on a Windows Server 2008-based computer after you disconnect and then reconnect all data cables.
967724	A Windows Server 2008-based computer that has the MPIO solution installed and that has many LUNs attached stops responding during the startup process after you install hotfix 963702.
967999	A Stop 0x0000007E error may occur when you start a Windows Server 2008-based computer from an iSCSI boot device that is connected over MPIO paths.
968287	The MPIO failover process does not complete on a Windows Server 2008-based computer that uses Microsoft Device Specific Module for MPIO.
969255	A D1 Stop error may occur when you use Microsoft Multipath I/O (MPIO) together with multiple host bus adapters on a Windows Server 2003-based computer.
970525	Cluster resources fail over before the time expires in the PDORemovePeriod parameter in Windows Server 2008.
972324	Support for an adjustable PathRecoveryInterval in Windows Server 2008.
973607	When MPIO disks are enumerated under stress, ports may be missing from Device Manager **Location** field.
973663	After you generate an MPIO configuration report on a computer that is running Windows Server 2008 R2, some the text in the report is not readable.

Table 13 Microsoft MPIO Knowledge Base Articles (continued)

Article ID	Summary
974878	PhysicalDisk counters contain invalid and duplicate entries when you use MPIO to control one or more storage devices.
977506	The iSCSI Software Initiator Setup program does not select the default options as expected.
977567	An upgrade from Windows Server 2008 SP1 to Windows Server 2008 R2 rolls back if the default SAN policy is set to offline shared.
978562	The Validate Multiple Arbitration test on a Windows Server 2008 R2-based failover cluster may incorrectly fail.

Resolved APM Issues

The issues listed in the following table have been resolved in the current release of Pillar Axiom Path Manager (APM).

Table 14 Resolved issues

Issue
SAN hosts with 8 Gb HBAs show incorrect link speed in the Pillar Axiom GUI and CLI.
iSCSI Initiator can cause hosts to appear as Not Communicating in the Pillar Axiom GUI.
APM switches to unreliable paths when equivalent and more reliable paths are available, causing Windows Server 2003 cluster failovers and consequent disruption to data access.

Additional Notes

Faulty SAN Component

Faulty SAN hardware components can cause unreliable data transfer, resulting in a variety of different symptoms in Windows.

For example, some tests were performed using an iSCSI SAN running over Ethernet with Jumbo Frames enabled. The Ethernet chipset on the host did not correctly support Jumbo Frames (the details of its behavior are not known). The symptoms included:

- A LUN appeared to be accessible and usable until a `chkdsk` command was run. Part way through execution of the command, all paths failed in sequence and the LUN was taken off-line.
- `iscsicli` commands and the iSCSI management applet sometimes hang.
- Small LUNs worked correctly but large GPT LUNs had access errors.
- Cluster nodes would fail over after apparently random access errors.

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