Windows® Unified Host Utilities 7.0

Installation Guide

n NetApp®

Contents

Introduction to Host Utilities

This section introduces the Host Utilities and what they contain.

What the Host Utilities are

The Host Utilities are a set of software programs and documentation that enable you to connect host computers to virtual disks (LUNs) on NetApp storage systems.

The Host Utilities include the following components:

• An installation program that sets required parameters on the host computer and on certain host bus adapters (HBAs).

• This documentation, which describes how to install the Host Utilities and troubleshoot common problems.

What Windows Unified Host Utilities is

Windows Unified Host Utilities includes an installation program that sets the required Windows registry and HBA parameters so that the Windows host correctly handles the storage system behaviors for NetApp ONTAP and E-Series platforms.

Tasks required for installing the Host Utilities

Installing the Host Utilities involves performing a number of tasks on the host to enable the installation to complete successfully.

The required tasks are as follows:

1. Install the Host Utilities and other required and optional software.

2. Record the FC and iSCSI initiator identifiers.

3. Create LUNs and make them available as virtual disks on the host computer.
   For more information about setting up LUNs, see the *Using Windows Hosts with Data ONTAP Storage* for Data ONTAP storage systems.

Optionally, depending on your configuration, you can configure SAN booting of the host.

Related concepts

Host configuration settings on page 27

Related tasks

Installing and Configuring Host Utilities on page 11

What the Host Utilities contain

The Host Utilities include an installation program. When you install the Host Utilities software, the installer sets required Windows registry and HBA parameters.

The following programs and files are installed on the Windows host computer. The default directory is `C:\Program Files\NetApp\Windows Host Utilities`.

Program	Purpose
emulexhba.reg	Troubleshooting program; run this program only if instructed to do so by technical support personnel.
\NetAppQCLI\fcconfig.exe	Used by the installation program to set HBA parameters. Not installed if Data ONTAP DSM for Windows MPIO is detected on the host.
\NetAppQCLI\fcconfig.ini	Used by the installation program to set HBA parameters. Not installed if Data ONTAP DSM for Windows MPIO is detected on the host.
\NetAppQCLI*.*	Used by the installation program to set QLogic Fibre Channel HBA parameters.
san_version.exe	Displays the version of the Host Utilities and Fibre Channel HBAs.

Windows configurations supported by the Host Utilities

The Host Utilities support a number of different Windows host configurations.

Depending on your specific environment, the Host Utilities support the following Windows host configurations:

- iSCSI paths to the storage system

- Fibre Channel paths to the storage system

- Multiple paths to the storage system when a multipathing solution is installed

- Virtual machines using Hyper-V (Windows Server 2008, Windows Server 2008 R2, Windows Server 2012, Windows Server 2012 R2, Windows Server 2016)

- SAN booting

You should use the Interoperability Matrix to find a supported combination of host and storage system components and software and firmware versions.

Related information

NetApp Interoperability Matrix Tool

Protocols supported by the Host Utilities

The Host Utilities provide support for Fibre Channel, Fibre Channel over Ethernet (FCoE), iSCSI, and SAS connections to the storage system.

For more information about SAN protocols and supported configurations, see the *SAN Configuration Guide* for your version of Data ONTAP or the *SANtricity Storage Manager 11.20 Configuration and Provisioning for Windows Express Guide* that is appropriate for your protocol.

Related information

[*NetApp Documentation*](#)

Dynamic disk support

Windows dynamic disks are supported with specific configuration requirements.

When using the native Windows storage stack, all LUNs composing the dynamic volume must be located on the same storage system controller.

When using Veritas Storage Foundation for Windows, the LUNs composing the dynamic volume can span storage controllers in active/active configurations.

Multipathing options supported by the Host Utilities

You can use the Host Utilities to support multiple paths, including a combination of protocols. Configuring multiple paths can provide a highly available connection between the Windows host and storage system.

Multipath I/O (MPIO) software is required any time a Windows host has more than one path to the storage system. The MPIO software presents a single disk to the operating system for all paths, and a device-specific module (DSM) manages path failover. Without MPIO software, the operating system might see each path as a separate disk, which can lead to data corruption.

On a Windows system, there are two main components to any MPIO configuration: the Windows MPIO components and a DSM. MPIO is supported for Windows Server 2008, Windows Server 2008 R2, Windows Server 2012, Windows Server 2012 R2, and Windows Server 2016 systems. MPIO is not supported on any version of Windows running in a Hyper-V virtual machine.

When you select MPIO support during Host Utilities installation, the Host Utilities installer enables the included MPIO feature on all supported Windows versions.

See the Interoperability Matrix for the DSM software currently supported.

The Microsoft Windows multipathing software uses a DSM to communicate with storage devices, such as NetApp storage systems. You must use only one DSM for a given storage vendor. More precisely, you can have only one DSM that claims the LUNs for a given vendor ID and product ID (VID/PID) pair. If you are using Windows Server 2008, Windows Server 2008 R2, Windows Server 2012, Windows Server 2012 R2, or Windows Server 2016, the Host Utilities enable the Windows multipathing feature. See the installation documentation for the DSM version you are using.

A supported DSM is required for multipathing. The following DSMs are available for Windows hosts:

Data ONTAP DSM for Windows MPIO

Data ONTAP DSM for Windows MPIO is for use with Data ONTAP storage systems only. This multipathing software supports active/active and active/passive policies on

Windows Server hosts. ALUA must be disabled on the storage system igroup when using Data ONTAP DSM 3.3.1 and earlier.

DSM for SANtricity Storage Manager

DSM for SANtricity Storage Manager is for use with E-Series storage systems only. For more information, see the *SANtricity Storage Manager 11.20 Multipath Drivers Guide.*

Windows Multipath DSM

This is the native DSM provided with Microsoft Windows Server 2008, Windows Server 2008 R2, Windows Server 2012, Windows Server 2012 R2, and Windows Server 2016. It offers active/active and active/passive load balance policies for both the FC and iSCSI protocols. ALUA must be enabled on the storage system igroup for FC. See the Interoperability Matrix to verify that you have a version of Data ONTAP or SANtricity Storage Manager software that is supported with this DSM.

Related information

[*NetApp Interoperability Matrix Tool*](#)

What Hyper-V is

Hyper-V is a Windows technology that enables you to create multiple virtual machines on a single physical x64 computer running certain versions of Microsoft Windows Server.

Hyper-V is a "role" available in the following versions of Microsoft Windows Server.

- Windows Server 2008

- Windows Server 2008 R2

- Windows Server 2012

- Windows Server 2012 R2

- Windows Server 2016

Each virtual machine runs its own operating system and applications. For a list of currently-supported operating systems on Hyper-V virtual machines, see the Windows Host Utilities Release Notes.

Methods for using storage with Hyper-V

Hyper-V enables you to provision storage using a virtual hard disk, an unformatted (raw) LUN, or an iSCSI LUN.

Virtual machines use storage on a storage system in the following ways:

- A virtual hard disk (IDE or SCSI) formatted as NTFS
  The virtual hard disk is stored on a LUN mapped to the Hyper-V parent system. The guest OS must boot from an IDE virtual hard disk.

- An unformatted (raw) LUN mapped to the Hyper-V parent system and provided to the virtual machine as a physical disk mapped through either the SCSI or IDE virtual adapter

  Note: You must not enable multipathing in Windows Host Utilities installed on a guest OS if you are using raw (pass-through) disks. The raw disks do not show up in the guest OS if multipathing is enabled.

- An iSCSI LUN accessed by an iSCSI initiator running on the guest OS:

  ◦ For Windows Vista, you must use the built-in iSCSI initiator; multipathing is not supported.

◦ For Windows XP, you must use Microsoft iSCSI initiator 2.07; multipathing is not supported.

◦ For Windows Server 2008, Windows Server 2008 R2, Windows Server 2012, Windows Server 2012 R2, and Windows Server 2016, you must use an iSCSI initiator and multipathing solution that is supported by NetApp for use on a standard host platform.
The guest OS supports the same iSCSI configurations as if it was not running on a virtual machine.

◦ For SUSE Linux Enterprise Server, you must use a supported iSCSI initiator and multipathing solution.
The guest OS supports the same iSCSI configurations as if it was not running on a virtual machine.

The parent Hyper-V system can connect to storage system LUNs just like any other host for Windows Server 2008, Windows Server 2008 R2, Windows Server 2012, Windows Server 2012 R2, and Windows Server 2016.

Methods for clustering Windows hosts with Hyper-V

Hyper-V provides two ways to let you cluster Windows hosts.

• You can cluster the parent Hyper-V system with other parent systems using Windows failover clustering.

• You can cluster guest systems running in virtual machines with other guest systems using the clustering solution supported on the operating system. You must use an iSCSI software initiator on the guest system to access the quorum and shared disks.

About SAN booting

SAN booting is the general term for booting a Windows host from a storage system LUN instead of an internal hard disk. The host might or might not have any hard drives installed.

SAN booting offers many advantages. Because the system (C:\) drive is located on the storage system, all of the reliability and backup features of the storage system are available to the system drive. You can also clone system drives to simplify deploying many Windows hosts and to reduce the total storage needed. SAN booting is especially useful for blade servers.

The downside of SAN booting is that loss of connectivity between the host and storage system can prevent the host from booting. Be sure to use a reliable connection to the storage system.

There are two options for SAN booting a Windows host:

Fibre Channel HBA

Requires one or more supported adapters. These same adapters can also be used for data LUNs. The Windows Host Utilities installer automatically configures required HBA settings.

iSCSI software boot

Requires a supported network interface card (NIC) and a special version of the Microsoft iSCSI software initiator.

For information on iSCSI software boot, see the vendor (Intel or IBM) documentation for the iSCSI boot solution you choose. Also, see NetApp Technical Report 3644.

Related information

NetApp Technical Report 3644: iSCSI Software Boot for Windows with NetApp Storage

Support for non-English operating system versions

Windows Host Utilities are supported on all Language Editions of Windows Server. All product interfaces and messages are displayed in English. However, all variables accept Unicode characters as input.

Where to find more information

For additional information about host and storage system requirements, supported configurations, your operating system, and troubleshooting, you should refer to the appropriate documentation.

If you need more information about...	Go to...
Known issues, system requirements, and last-minute updates	• The latest Host Utilities *Release Notes*
The latest supported configurations	• The Interoperability Matrix • Hardware Universe
Configuring the storage system	• The *Software Setup Guide* for your version of Data ONTAP • The *SAN Administration Guide* for your version of Data ONTAP • *SANtricity Storage Manager 11.20 Configuration and Provisioning for Windows Express Guide* that is appropriate for your protocol
Supported SAN topologies	The *SAN Configuration Guide* for your version of Data ONTAP
Installing and configuring the HBA in your host	Your HBA vendor documentation
Installing and configuring MPIO using the Data ONTAP DSM	The *Installation and Administration Guide* for that version of Data ONTAP DSM for Windows MPIO
Installing and configuring MPIO using the DSM for SANtricity Storage Manager	The *SANtricity Storage Manager 11.20 Multipath Drivers Guide*
Installing and configuring a supported version of SnapDrive for Windows software	The *Installation and Administration Guide* for that version of SnapDrive for Windows
Managing SAN storage on the storage system	• The *SAN Administration Guide* for your version of Data ONTAP • Data ONTAP man pages or the *Data ONTAP Commands: Manual Page Reference* for your version of Data ONTAP

Related information

[NetApp Interoperability Matrix Tool](#)
[NetApp Documentation](#)

Installing and Configuring Host Utilities

This section describes how to install and configure the Host Utilities and how to perform related tasks.

Steps

Installing and configuring the Host Utilities (high level)

The following steps provide a high-level overview of what is involved in installing the Host Utilities and configuring your system to work with that software.

About this task

This section is for people familiar with this operating system and storage systems. If you need more information, see the detailed instructions for the steps.

Note: If you are upgrading a host running the Data ONTAP DSM from Windows Server 2008 to Server 2008 R2, you must upgrade to Data ONTAP DSM 3.3.1 before installing Server 2008 R2. You must also upgrade to Windows Host Utilities 5.2 before upgrading to Windows Server 2008 R2.

Steps

1. Verify your host and storage system configuration.

2. Confirm that your storage system is set up.

3. Configure FC HBAs and switches.

4. Check the media type setting of FC target ports.

5. For Data ONTAP, install an iSCSI software initiator or HBA.

   For E-Series, see the *SANtricity Storage Manager 11.20 Configuration and Provisioning for Windows Express Guide* that is appropriate for your protocol.

6. For Data ONTAP, configure iSCSI options and security.

7. Configure a multipathing solution.

8. Install the Host Utilities.

After you finish

If you add a Windows Server 2008 R2 or Windows Server 2012 host to a failover cluster after installing the Host Utilities, run the Repair option of the Host Utilities installation program to set the required ClusSvcHangTimeout parameter.

Verifying your host and storage system configuration

Before you install the Host Utilities, you must verify that the Host Utilities version supports your host and storage system configuration to ensure the software installs correctly.

About this task

The Interoperability Matrix lists all supported configurations. Individual computer models are not listed; Windows hosts are qualified based on their CPU chips. The following configuration items must be verified:

- Windows host CPU architecture

- Guest operating systems

- Windows operating system version, service pack level, and required hotfixes

    Note: If you are upgrading a host running the Data ONTAP DSM from Windows Server 2008 to Server 2008 R2, you must upgrade to Data ONTAP DSM 3.3.1 or later before installing Server 2008 R2. You must also upgrade to Windows Host Utilities 5.2 or later before upgrading to Windows Server 2008 R2.

    If you upgrade to Data ONTAP DSM 3.5 or later, Windows Unified Host Utilities is not required. All of the components and functions of the Host Utilities are included in the DSM package.

- HBA model and firmware version

- Multipathing software

- Storage firmware version and cfmode setting

- Optional software such as SnapDrive for Windows

Step

1. Verify that your entire configuration is listed in the matrix.

Related information

[NetApp Interoperability Matrix Tool](#)

Installing Windows hotfixes

Obtain and install the required Windows hotfixes for your version of Windows.

Before you begin

Some of the hotfixes require a reboot of your Windows host. You can wait to reboot the host until after you install or upgrade the Host Utilities.

When you run the installer for the Windows Host Utilities, it lists any missing required hotfixes. You must add the required hotfixes before the installer will complete the installation process.

Note: Some hotfixes for Windows Server 2008 are not recognized unless the affected feature is enabled. If you are prompted to install a hotfix that is already installed, try enabling the affected Windows feature and then restarting the Host Utilities installation program.

Note: Some Server 2012 R2 hotfixes require a rollup package update. The section *List of required hotfixes for Windows Server* provides more information.

List of required hotfixes for Windows Server on page 13

Steps

1. Determine which hotfixes are required for your version of Windows.

2. Download hotfixes from the Microsoft support site.

    Note: Some hotfixes must be requested from Microsoft support personnel. They are not available for direct download.

3. Follow the instructions provided by Microsoft to install the hotfixes.

Related information

Microsoft Support
NetApp Interoperability Matrix Tool

List of required hotfixes for Windows Server

Specific Windows Server hotfixes are required before you install or upgrade the Windows Unified Host Utilities, or the installation or the upgrade does not succeed.

The hotfixes that are listed in this section are the minimum requirement. The following tables specify the name and version of the file that is included in each required hotfix for Windows Unified Host Utilities. The specified file version is the minimum requirement.

The Interoperability Matrix lists updates to hotfix requirements when new hotfixes supersede older hotfixes.

Note: The product installer does not check for the hotfixes that are required for Windows Failover Clustering configurations. The installer checks for all other hotfixes.

Windows Server 2016

The following table lists the minimum required hotfixes for Windows Server 2016:

Hotfix	When required	File name
3197954	Always	Cumulative update

Windows Server 2012 R2

Hotfix	When recommended	File name
2990170	Always	`mpio.sys`

Note: Hotfix package 2990170 for Windows Server 2012 R2 may require a Windows update download. For more information, see the Microsoft Support site.

The following hotfix is not required for Windows Server 2012 R2, but it is recommended:

Hotfix	When recommended	File name
2908783	Always	Msiscsi.sys

Windows Server 2012

The following table lists the minimum required hotfixes for Windows Server 2012:

Hotfix	When required	File name
2908783	Always	Msiscsi.sys
2990170	Always	mpio.sys

The following hotfix is not required for Windows Server 2012, but is recommended.

Hotfix	When recommended	File name
2796995	Always	Csvfs.sys

Windows Server 2003 SP2 and Windows Server 2003 R2 SP2

The following table lists the minimum required hotfixes for Windows Server 2003 SP2 and Windows Server 2003 R2 SP2:

Hotfix	When required	File name
945119	Always	Storport.sys
982109	Always	Mpio.sys

Windows Server 2008 SP2

The following table lists the minimum required hotfixes for Windows Server 2008 SP2:

Hotfix	When required	File name
968675	Always	Storport.sys
2754704	Always	Mpio.sys
2684681	Always	Msiscsi.sys

Windows Server 2008 R2

The following table lists the minimum required hotfixes for Windows Server 2008 R2:

Hotfix	When required	File name
2718576	Always	Mpio.sys
2528357	Always	Storport.sys
979711	Always	Msiscsi.sys
981379	Always	Msdsm.sys
2684681	Always	Iscsilog.dll

The following hotfixes are not required for Windows Server 2008 R2, but they are recommended:

Hotfix	When recommended	File name
2754704	Always	Mpio.sys
2520235	Always	Clusres.dll

Windows Server 2008 R2 SP1

The following table lists the minimum required hotfixes for Windows Server 2008 R2 SP1:

Hotfix	When required	Filename
2908783	Always	Msiscsi.sys
2990170	Always	Mpio.sys

The following hotfixes are not required for Windows Server 2008 R2 SP1, but they are recommended.

Hotfix	When recommended	File name
2754704	Always	Mpio.sys
2531907	Always	Includes the following collection of files: • Failoverclusters.agent.interop.dll • Failoverclusters.validation.bestpracticetests.dll • Failoverclusters.validation.common.dll • Failoverclusters.validation.generaltests.dll • Failoverclusters.validation.storagetests.dll • Failoverclusters.validation.wizard.dll
2520235	Always	Clusres.dll

Windows Server 2008

Service Pack 2 (SP2) is required with Windows Server 2008.

Related information

Microsoft Support
NetApp Interoperability Matrix Tool

Confirming your storage system configuration

You must make sure that your storage system is properly cabled, that the protocol services are licensed, if required, and that the services are started. Proper configuration ensures that the storage system is accessible to host systems.

Steps

1. Add the iSCSI or FCP license and start the target service.

   The Fibre Channel and iSCSI protocols are licensed features of Data ONTAP software. If you need to purchase a license, you should contact your NetApp or sales partner representative. The Fibre Channel and iSCSI protocols do not require licenses on E-Series storage systems using SANtricity Storage Manager.

2. Verify your cabling.

   See the *SAN Configuration Guide* for your version of Data ONTAP or the *Hardware Cabling Guide* for your E-Series storage system for detailed cabling and configuration information.

Related information

[*NetApp Documentation*](#)

Configuring FC HBAs and switches

Install and configure one or more supported Fibre Channel host bus adapters (HBAs) for Fibre Channel connections to the storage system.

About this task

The Windows Host Utilities installer sets the required Fibre Channel HBA settings.

   Note: Do not change HBA settings manually.

Steps

1. Install one or more supported Fibre Channel host bus adapters (HBAs) according to the instructions provided by the HBA vendor.

2. Obtain the supported HBA drivers and management utilities and install them according to the instructions provided by the HBA vendor.

   The supported HBA drivers and utilities are available from the following locations:

   Emulex HBAs

   Emulex support page for NetApp.

   QLogic HBAs

   QLogic support page for NetApp.

3. Connect the HBAs to your Fibre Channel switches or directly to the storage system.

4. Create zones on the Fibre Channel switch according to your Fibre Channel switch documentation.

   For clustered Data ONTAP, zone the switch by WWPN. Be sure to use the WWPN of the logical interfaces (LIFs) and not of the physical ports on the storage controllers.

Related information

> [Emulex: NetApp Qualified Downloads and Documentation](#)
> [QLogic: NetApp Downloads](#)

Configuring iSCSI initiators

See the Interoperability Matrix for initiators supported with iSCSI configurations.

An iSCSI software initiator uses the Windows host CPU for most processing and Ethernet network interface cards (NICs) or TCP/IP offload engine (TOE) cards for network connectivity. An iSCSI HBA offloads most iSCSI processing to the HBA card, which also provides network connectivity.

Note: You configure iSCSI paths differently for ONTAP. You need to create one or more iSCSI paths to each storage controller that can access a given LUN. Unlike earlier versions of ONTAP software, the iSCSI ports on a partner node do not assume the IP addresses of the failed partner. Instead, the MPIO software on the host is responsible for selecting the new paths. This behavior is very similar to Fibre Channel path failover.

Related information

> [NetApp Interoperability Matrix Tool](#)

iSCSI software initiator options

You should select the appropriate iSCSI software initiator for your host configuration.

The following is a list of operating systems and their iSCSI software initiator options.

Windows Server 2008

> The iSCSI initiator is built into the operating system. The iSCSI Initiator Properties dialog box can be accessed from the Administrative Tools.

Windows Server 2008 R2

> The iSCSI initiator is built into the operating system. The iSCSI Initiator Properties dialog box is available from the Administrative Tools.

Windows Server 2012

> The iSCSI initiator is built into the operating system. The iSCSI Initiator Properties dialog box is available from **Server Manager > Dashboard > Tools > iSCSI Initiator**.

Windows Server 2012 R2

> The iSCSI initiator is built into the operating system. The iSCSI Initiator Properties dialog box is available from **Server Manager > Dashboard > Tools > iSCSI Initiator**.

Windows Server 2016

> The iSCSI initiator is built into the operating system. The iSCSI Initiator Properties dialog box is available from the Administrative Tools.

Windows Vista guest systems on Hyper-V

> For Windows Vista guest systems on Hyper-V virtual machines that access storage directly (not as a virtual hard disk mapped to the parent system), the iSCSI initiator is built into the operating system. The iSCSI Initiator Properties dialog box is available from Administrative Tools.
>
> > **Note:** A Windows Vista iSCSI connection to NetApp storage is supported only on Hyper-V virtual machines.

Linux guest systems on Hyper-V

For Linux guest systems on Hyper-V virtual machines that access storage directly (not as a virtual hard disk mapped to the parent system), you must use an iSCSI initiator solution on a Hyper-V guest that is supported for stand-alone hardware. A supported version of Linux Host Utilities is required.

Installing the iSCSI initiator software

On the Windows host, complete the following steps to install the iSCSI initiator.

Before you begin

You must have downloaded the appropriate iSCSI initiator installer to the Windows host.

Steps

1. Open the local directory to which you downloaded the iSCSI initiator software.

2. Run the installation program by double-clicking its icon.

3. When prompted to select installation options, select **Initiator Service** and **Software Initiator**.

4. For all multipathing solutions, select the **Microsoft MPIO Multipathing Support for iSCSI** check box, regardless of whether you are using MPIO or not.

   Multipathing is not available for Windows XP and Windows Vista.

5. Follow the prompts to complete the installation.

Installing the iSCSI HBA

If your configuration uses an iSCSI HBA, you must make sure that the HBA is installed and configured correctly.

About this task

You can optionally boot your Windows host from a storage system LUN using a supported HBA.

Steps

1. Install one or more supported iSCSI host bus adapters according to the instructions provided by the HBA vendor.

2. Obtain the supported HBA drivers and management utilities, and install them according to the instructions provided by the HBA vendor.

3. Manually set the required QLogic iSCSI HBA settings.

   a. Start the QConvergeConsole program on the Windows host and select the iSCSI HBA. See the QConvergeConsole online Help for more information.

   b. Specify an IP address for each HBA port.

   c. Set the Connection KeepAliveTO value to 180.

   d. Enable ARP Redirect.

   e. Set the iSCSI node name of all iSCSI HBA ports to the same name as shown in the iSCSI initiator GUI on the Windows host.

   f. Save the HBA settings and reboot the Windows host.

4. Connect the iSCSI HBA to your Ethernet switches or directly to the storage system. Avoid routing if possible.

5. Using the iSCSI initiator GUI, configure the iSCSI target addresses of your storage system. If you are using more than one path, select the initiator and target for each path when you log on.

After you finish

If you are SAN booting from an iSCSI HBA, you must also manually set the boot BIOS on the HBA.

Related information

> QLogic: NetApp Downloads

Options for iSCSI sessions and error recovery levels

By default, Data ONTAP operating in 7-Mode enables four TCP/IP connections per iSCSI session and an error recovery level of 0.

In a 7-Mode environment only, you can optionally enable more than four connections per session and error recovery level 1 or 2 by setting Data ONTAP option values. For more information, see the information about managing the iSCSI network in the *SAN Administration Guide* for your version of Data ONTAP.

The iSCSI initiator does not automatically create multiple sessions. You must explicitly create each session using the iSCSI initiator GUI.

By default, clustered Data ONTAP enables a single connection per iSCSI session, and for E-Series storage systems, SANtricity Storage Manager enables a single connection per iSCSI session.

Options for using CHAP with iSCSI initiators

You can use one-way or mutual (bidirectional) authentication with the challenge handshake authentication protocol (CHAP).

For one-way CHAP, the target authenticates only the initiator. For mutual CHAP, the initiator authenticates the target also.

The iSCSI initiator sets strict limits on the length of both the initiator's and the target's CHAP passwords.

- For Windows Server 2008 or Windows Server 2008 R2, see the "Manage iSCSI Security" topic in Help.

- For Windows Server 2012, Windows Server 2012 R2, or Windows Server 2016 see the "Configuration Properties" topic in Help.

There are two types of CHAP user names and passwords. These types indicate the direction of authentication, relative to the storage system.

Inbound

> The storage system authenticates the iSCSI initiator. Inbound settings are required if you are using CHAP authentication.

Outbound

> The iSCSI initiator authenticates the storage system using CHAP. Outbound values are used only with mutual CHAP.

You can specify the iSCSI initiator CHAP settings by using the iSCSI Initiator Properties dialog box on the host.

For Windows Server 2012, Windows Server 2012 R2, and Windows Server 2016, you must click **Server Manager > Dashboard > Tools > iSCSI Initiator > Targets > Discovery > Advanced** to

specify the inbound values for each storage system when you add a target portal. You must click **Configuration > CHAP** in the iSCSI Initiator Properties dialog box to specify the outbound value (mutual CHAP only).

By default, the iSCSI initiator uses its iSCSI node name as its CHAP user name.

You must always use ASCII text passwords; you must not use hexadecimal passwords. For mutual (bidirectional) CHAP, the inbound and outbound passwords cannot be the same.

Using RADIUS for iSCSI authentication

You can optionally use a RADIUS (Remote Authentication Dial-in User Service) server to centrally manage passwords for iSCSI authentication. Using RADIUS simplifies password management, increases security, and offloads authentication processing from Data ONTAP storage systems only.

Support for RADIUS is available starting with Data ONTAP 8.0 for the iSCSI target and the following versions of Windows Server, which include a RADIUS server.

- Windows Server 2008

- Windows Server 2008 R2

- Windows Server 2012

- Windows Server 2012 R2

- Windows Server 2016

You can configure either one-way authentication (the target authenticates the initiator), or mutual authentication (the initiator also authenticates the target).

There are three parts to enabling RADIUS authentication for iSCSI initiators:

- Set up a RADIUS server.

- Configure the storage system to use RADIUS.

- Configure iSCSI initiators to use RADIUS.

For information about configuring this RADIUS server, see the Windows online Help.

For information about configuring the storage system to use RADIUS, see the *SAN Administration Guide* for your version of Data ONTAP.

Installing multipath I/O software

You must install MPIO software and have multipathing set up if your Windows host has more than one path to the storage system. Without MPIO software, the operating system might see each path as a separate disk, which can lead to data corruption.

The MPIO software presents a single disk to the operating system for all paths, and a device-specific module (DSM) manages path failover.

On a Windows system, there are two main components to any MPIO solution: a DSM and the Windows MPIO components.

Install a supported DSM after you install the Windows Unified Host Utilities. Choices include the Data ONTAP DSM for Windows MPIO and the DSM for SANtricity Storage Manager. The Microsoft msdsm is included with Windows Server 2008, Windows Server 2008 R2, Windows Server 2012, and Windows Server 2012 R2 and is available by default when the MPIO feature is enabled. If you use the Data ONTAP DSM, installation of the Host Utilities is optional.

MPIO is not supported for Windows XP and Windows Vista running in a Hyper- V virtual machine.

When you select MPIO support, the Windows Unified Host Utilities enables the included MPIO feature of Windows Server 2008, Windows Server 2008 R2, Windows Server 2012, Windows Server 2012 R2.

How to install a DSM multipath solution

If your environment uses DSM as its multipathing solution, see the appropriate DSM documentation for instructions to install a DSM multipath solution.

The various procedures to install a DSM multipath solution are as follows:

- You can install Data ONTAP DSM for Windows MPIO by following the instructions that are provided in the Installation and Administration Guide for your version of DSM.

- You can install DSM for SANtricity Storage Manager by following the instructions that are provided in the Configuration and Installation documentation for your version of SANtricity Storage Manager.

- You can install Microsoft iSCSI DSM by selecting the **Microsoft MPIO Multipathing Support for iSCSI** option when you install the iSCSI initiator on Windows Server 2003.

The Microsoft Device Specific Module (MSDSM) is included with Windows Server 2008, Windows Server 2008 R2, Windows Server 2012, Windows Server 2012 R2, and Windows Server 2016. No additional installation is required if you selected MPIO support when you installed Windows Host Utilities. If you did not originally select MPIO support, you should run the **Repair** option of the Windows Unified Host Utilities installer, and select `MPIO` support.

Configuring Hyper-V systems

Hyper-V systems require special configuration steps for some virtual machines.

Adding virtual machines to a failover cluster

Hyper-V virtual machines stored on the same LUN can be added to a cluster only if all of the virtual machine resources are in the same storage resource group.

About this task

When you have more than one virtual machine (configuration files and boot .vhd file) stored on the same LUN, and you are adding the virtual machines to a failover cluster, you must put all of the virtual machine resources in the same storage resource group. Otherwise, adding virtual machines to the cluster fails.

Steps

1. Move the available storage resource group to the node on which you are creating and adding virtual machines. (The available storage resource group in a Windows Server 2008, 2008 R2, 2012, 2012 R2 or 2016 the Windows failover cluster is hidden.)

   - For Windows Server 2008, enter the following command at a Windows command prompt on the cluster node:

     `c:\cluster group "Available Storage" /move:`*node_name*

     node_name is the host name of the cluster node from which you are adding virtual machines.

   - For Windows Server 2008 R2, 2012, 2012 R2 or 2016 enter the following command at a Windows command prompt on the cluster node:

     `c:\PS>Move-ClusterGroup "Available Storage" -Node `*node_name*

     node_name is the host name of the cluster node from which you are adding virtual machines.

2. Move all of the virtual machine resources to the same failover cluster resource group.

3. Create the virtual machines and then add them to the failover cluster. Be sure that the resources for all virtual machines are configured as dependent on the disk mapped to the LUN. For Windows Server 2012 and later, virtual machines should be created using Cluster Manager.

Hyper-V VHD requires alignment for best performance

On Windows Server 2008 R2 or later versions or a Linux virtual machine, a Hyper-V virtual hard drive (VHD) partitioned with a master boot record (MBR) must be aligned with the underlying LUN for best performance. You must use the Data ONTAP PowerShell Toolkit to check and correct MBR partition alignment on VHDs.

If the data block boundaries of a disk partition do not align with the block boundaries of the underlying LUN, the storage system often has to complete two block reads or writes for every operating system block read or write. The additional block reads and writes that are caused by the misalignment can cause serious performance problems.

Misalignment is caused by the location of the starting sector for each partition defined by the master boot record. Partitions created by Windows Server 2008 R2 and Linux are usually not aligned with underlying NetApp LUNs. Partitions created by Windows Server 2008, 2008 R2, 2012, 2012 R2, and 2016 should be aligned by default.

You must use the Get-NaVirtualDiskAlignment cmdlet in the Data ONTAP PowerShell Toolkit to check whether partitions are aligned with underlying LUNs. If the partitions are incorrectly aligned, you must use the Repair-NaVirtualDiskAlignment cmdlet to create a new VHD file with the correct alignment. This cmdlet copies all of the partitions to the new file. The original VHD file is not modified or deleted. The virtual machine must be shut down while the data is copied.

You can download the Data ONTAP PowerShell Toolkit at NetApp Communities. You must unzip the `DataONTAP.zip` file into the location specified by the environment variable %PSModulePath% (or use the Install.ps1 script to do it for you). Once you have completed the installation, you can use the Show-NaHelp cmdlet to get help for the cmdlets.

> **Note:** The PowerShell Toolkit supports only fixed-size VHD files with MBR-type partitions. VHDs using Windows dynamic disks or GPT partitions are not supported.

> The PowerShell Toolkit requires a minimum partition size of 4 GB. Smaller partitions cannot be correctly aligned.

> For Linux virtual machines using the GRUB boot loader on a VHD, you must update the boot configuration after running the PowerShell Toolkit.

Related information

[NetApp Communities](#)

Reinstalling GRUB for Linux guests after correcting MBR alignment with PowerShell Toolkit

After running `mbralign` on disks for correcting MBR alignment with PowerShell Toolkit on Linux guest operating systems using the GRUB boot loader, you must reinstall GRUB to ensure that the guest operating system boots correctly.

Before you begin

The PowerShell Toolkit cmdlet has completed on the VHD file for the virtual machine.

About this task

This topic applies only to Linux guest operating systems using the GRUB boot loader and SystemRescueCd.

Steps

1. Mount the ISO image of Disk 1 of the installation CDs for the correct version of Linux for the virtual machine.

2. Open the console for the virtual machine in Hyper-V Manager.

3. If the VM is running and hung at the GRUB screen, click in the display area to make sure it is active, then click the Ctrl-Alt-Delete toolbar icon to reboot the VM. If the VM is not running, start it, and then immediately click in the display area to make sure it is active.

4. As soon as you see the VMware BIOS splash screen, press the Esc key once.

   The boot menu is displayed.

5. At the boot menu, select CD-ROM.

6. At the Linux boot screen, enter:

   `linux rescue`

7. Take the defaults for Anaconda (the blue/red configuration screens). Networking is optional.

8. Launch GRUB by entering:

   `grub`

9. If there is only one virtual disk in this VM, or if there are multiple disks, but the first is the boot disk, run the following GRUB commands:

   `root (hd0,0)`

   `setup (hd0)`

   `quit`

   If you have multiple virtual disks in the VM, and the boot disk is not the first disk, or you are fixing GRUB by booting from the misaligned backup VHD, enter the following command to identify the boot disk:

   `find /boot/grub/stage1`

   Then run the following commands:

   `root (`*`boot_disk`*`,0)`

   `setup (`*`boot_disk`*`)`

   `quit`

   `boot_disk` is the disk identifier of the boot disk.

10. Press Ctrl-D to log out.

    Linux rescue shuts down and then reboots.

Running the Host Utilities installation program

The installation program installs the Host Utilities package and sets the Windows registry and HBA settings.

You must specify whether to include multipathing support when you install the Windows Unified Host Utilities software package. The installer prompts you for the following choice. You can also run a quiet (unattended) installation from a Windows command prompt.

Multipathing support

Choose MPIO if you have more than one path from the Windows host or virtual machine to the storage system. Choose no MPIO only if you are using a single path to the storage system.

The MPIO selection is not available for Windows XP and Windows Vista systems; multipath I/O is not supported on these guest operating systems.

For Hyper-V guests, raw (pass-through) disks do not appear in the guest OS if you choose multipathing support. You can either use raw disks, or you can use MPIO, but you cannot use both in the guest OS.

Installing the Host Utilities interactively

To install the Host Utilities software package interactively, you must run the Host Utilities installation program and follow the prompts.

Steps

1. Change to the directory to which you downloaded the executable file.

2. Run the executable file and follow the instructions on the screen.

   Note: The Windows Host Utilities installer checks for required Windows hotfixes. If it detects a missing hotfix, it displays an error. Download and install any requested hotfixes, and then restart the installer.

3. Reboot the Windows host when prompted.

Related tasks

Installing the Host Utilities from a command line

You can perform a quiet (unattended) installation of the Host Utilities by entering the appropriate commands at a Windows command prompt.

Before you begin

The Host Utilities installation package must be in a path that is accessible by the Windows host. Follow the instructions for installing the Host Utilities interactively to obtain the installation package.

About this task

The system automatically reboots when the installation is complete.

If a required Windows hotfix is missing, the installation fails with a message in the event log saying the installation failed, but not why. Problems with hotfixes are logged to the msiexec log file. It is recommended that you enable logging in the `msiexec` command to record the cause of this and other possible installation failures.

Step

1. Enter the following command at a Windows command prompt:

   `msiexec /i installer.msi /quiet`

   `MULTIPATHING={0 | 1}`

   `[INSTALLDIR=inst_path]`

   where `installer` is the name of the `.msi` file for your CPU architecture;

MULTIPATHING specifies whether MPIO support is installed. Allowed values are `0` for no, `1` for yes

`inst_path` is the path where the Host Utilities files are installed. The default path is `C:\Program Files\NetApp\Windows Host Utilities\`.

> **Note:** To see the standard Microsoft Installer (MSI) options for logging and other functions, enter `msiexec /help` at a Windows command prompt. For example, enter:
>
> `msiexec /i install.msi /quiet /l*v <install.log> LOGVERBOSE=1`

After you finish

If you add a Windows Server 2008 R2 or Windows Server 2012 host to a failover cluster after installing the Host Utilities, run the Repair option of the Host Utilities installation program to set the required ClusSvcHangTimeout parameter.

Related tasks

Repairing and removing Windows Host Utilities

You can use the Repair option of the Host Utilities installation program to update HBA and Windows registry settings. You can remove the Host Utilities entirely, either interactively or from the Windows command line.

> **Note:** Removing the Host Utilities affects installed DSMs.

Repairing or removing Windows Host Utilities interactively

The Repair option updates the Windows registry and Fibre Channel HBAs with the required settings. You can also remove the Host Utilities entirely.

Steps

1. Open Windows **Add or Remove Programs** (Windows Server 2003) or **Programs and Features** (Windows Server 2008, Windows Server 2008 R2, Windows Server 2012, Windows Server 2012 R2, or Windows Server 2016).

2. Select **Windows Host Utilities**.

3. Click **Change**.

4. Click **Repair** or **Remove**, as needed.

5. Follow the instructions on the screen.

Repairing or removing Windows Host Utilities from a command line

The Repair option updates the Windows registry and Fibre Channel HBAs with the required settings. You can also remove the Host Utilities entirely from a Windows command line.

Step

1. Enter the following command on the Windows command line to repair Windows Host Utilities:

   `msiexec {/uninstall | /f]installer.msi [/quiet]`

   `/uninstall` removes the Host Utilities entirely

`/f` repairs the installation

`installer`.msi is the name of the Windows Host Utilities installation program on your system

`/quiet` suppresses all feedback and reboots the system automatically without prompting when the command completes

Removing Windows Host Utilities can affect DSM

Removing Windows Unified Host Utilities can remove the registry settings needed by DSMs.

The registry settings for Windows Unified Host Utilities affect device-specific modules (DSMs) that claim NetApp LUNs. This includes the Data ONTAP DSM for Windows MPIO and the DSM for SANtricity Storage Manager. Removing Windows Unified Host Utilities removes the registry settings needed by these DSMs to claim the LUNs.

If you remove Windows Unified Host Utilities, you can restore the DSM registry settings by running the Repair option of the DSM installation program.

Note: Windows Unified Host Utilities is currently required for all supported configurations of Windows hosts that use NetApp LUNs except if the host is running the Data ONTAP DSM 3.5 for Windows MPIO or later.

Host configuration settings

You need to collect some host configuration settings as part of the installation process. The Host Utilities installer modifies other host settings based on your installation choices.

What FC and iSCSI identifiers are

The storage system identifies hosts that are allowed to access LUNs based on the FC worldwide port names (WWPNs) or iSCSI initiator node name on the host.

Each Fibre Channel port has its own WWPN. A host has a single iSCSI node name for all iSCSI ports. You need these identifiers when manually creating initiator groups (igroups) on the storage system.

> **Note:** If you use SnapDrive for Windows software on the host, it automatically collects the FC and iSCSI identifiers it needs to create igroups on the storage system. You do not need to collect these identifiers manually.

The storage system also has WWPNs and an iSCSI node name, but you do not need them for configuring the host.

Recording the WWPN

Record the worldwide port names (sometimes styled "World Wide Port Names") of all FC ports that connect to the storage system.

About this task

Each HBA port has its own WWPN. For a dual-port HBA, you need to record two values; for a quad-port HBA, you record four values.

The WWPN looks like this:

```
WWPN: 10:00:00:00:c9:73:5b:90
```

Steps

1. Display the WWPNs.

For	Use
Windows Server 2012 or Windows Server 2012 R2 or Windows Server 2016	The HBA manufacturer's management software, such as OneCommand Manager for Emulex HBAs or QConvergeConsole for QLogic HBAs.
Windows Server 2008 or Windows Server 2008 R2	The Storage Explorer application or the HBA manufacturer's management software, such as OneCommand Manager for Emulex HBAs or QConvergeConsole for QLogic HBAs.

   OneCommand Manager is the successor to HBAnyware. QConvergeConsole is the successor to SANsurfer

2. If the system is SAN booted and not yet running an operating system or the HBA management software is not available, obtain the WWPNs using the boot BIOS.

Obtaining the WWPN using Storage Explorer

For hosts running Windows Server 2008 or Windows Server 2008 R2, you can obtain the Fibre Channel Worldwide Port Name (WWPN) using the Storage Explorer application.

Steps

1. In Windows Server 2008 or Windows Server 2008 R2, select **Start > Administrative Tools > Storage Explorer**.

2. Expand the **Servers** node of the Storage Explorer console tree and locate the HBAs.

3. Record the value of the **Port WWN** field for each HBA port.

Obtaining the WWPN using Microsoft fcinfo.exe

If your host OS supports `fcinfo.exe`, then you can obtain the Fibre Channel Worldwide Port Name (WWPN) using the `Microsoft fcinfo.exe`.

Steps

1. If it is not already installed, download and install the fcinfo.exe program from the Microsoft Download Center. Search the Download Center for "Fibre Channel Information Tool (fcinfo)".

   A reboot is not required.

2. Open a command prompt and enter the following command: `fcinfo /ports /details`

   For more options, run the `fcinfo /??` command.

3. Record the value of the **Port WWN** field for each HBA port.

Related information

[Microsoft Download Center](#)

Obtaining the WWPN using Emulex BootBIOS

For SAN-booted systems with Emulex HBAs that do not yet have an operating system, you can get the WWPNs from the boot BIOS.

Steps

1. Restart the host.

2. During startup, press **Alt-E** to access BootBIOS.

3. Select the menu entry for the Emulex HBA.

   BootBIOS displays the configuration information for the HBA, including the WWPN.

4. Record the WWPN for each HBA port.

Obtaining the WWPN using QLogic BootBIOS

For SAN-booted systems with QLogic HBAs that do not yet have an operating system, you can get the WWPNs from the boot BIOS.

Steps

1. Restart the host.

2. During startup, press **Ctrl-Q** to access BootBIOS.

3. Select the appropriate HBA and press **Enter**.

   The Fast!UTIL options are displayed.

4. Select **Configuration Settings** and press **Enter**.

5. Select **Adapter Settings** and press **Enter**.

6. Record the WWPN for each HBA port from the **Adapter Port Name** field.

Recording the iSCSI initiator node name

You must record the iSCSI initiator node name from the iSCSI initiator program on the Windows host.

Steps

1. Open the **iSCSI Initiator Properties** dialog box:

If you are using...	Navigate to...
Windows Server 2012 or Windows Server 2012 R2 or Windows Server 2016	**Server Manager > Dashboard > Tools > iSCSI Initiator > Configuration**
Windows Server 2008, Windows Server 2008 R2, or Windows Vista	**Start > Administrative Tools > iSCSI Initiator**

2. Copy the **Initiator Name** or **Initiator Node Name** value to a text file or write it down.

   The exact label in the dialog box differs depending on the Windows version. The iSCSI initiator node name looks like this:

   ```
   iqn.1991-05.com.microsoft:server3
   ```

Overview of settings used by the Host Utilities

The Host Utilities require certain registry and parameter settings to ensure the Windows host correctly handles the storage system behavior.

Windows Host Utilities sets the parameters that affect how the Windows host responds to a delay or loss of data. The particular values have been selected to ensure that the Windows host correctly handles events such as the failover of one controller in the storage system to its partner controller. Not all the values apply for the DSM for SANtricity Storage Manager; however, any overlap of values set by the Host Utilities and those set by the DSM for SANtricity Storage Manager do not result in conflicts.

Fibre Channel and iSCSI host bus adapters (HBAs) also have parameters that must be set to ensure the best performance and to successfully handle storage system events.

The installation program supplied with Windows Unified Host Utilities sets the Windows and Fibre Channel HBA parameters to the supported values. You must manually set iSCSI HBA parameters.

Note: Starting with Windows Host Utilities 5.3, the installation program skips most settings if it detects the Data ONTAP DSM for Windows MPIO software on the host. It instead relies on the values set by the DSM installation program.

The installer sets different values depending on whether you specify multipath I/O (MPIO) support when running the installation program, whether you enable the Microsoft DSM on Windows Server 2008, Windows Server 2008 R2, Windows Server 2012, or Windows Server 2012 R2, and which

protocols you select (iSCSI, Fibre Channel, both, or none). You should not change these values unless technical support directs you to do so.

Registry values set by Windows Unified Host Utilities

The Windows Host Utilities installer automatically sets registry values that are based on the choices that you make during installation. You should be aware of these registry values, the operating system version, and whether Data ONTAP DSM for Windows multipath I/O (MPIO) is installed.

The following values are set by the Windows Unified Host Utilities installer. All values are decimal unless otherwise noted. *HKLM* is the abbreviation for HKEY_LOCAL_MACHINE.

Registry key	Value	When set
HKLM\SYSTEM\CurrentControlSet\Services\msdsm \Parameters **DsmMaximumRetryTimeDuringStateTransition**	120	When MPIO support is specified and your server is Windows Server 2008, Windows Server 2008 R2, Windows Server 2012, Windows Server 2012 R2, or Windows Server 2016, except if Data ONTAP DSM is detected
HKLM\SYSTEM\CurrentControlSet\Services\msdsm \Parameters\ **DsmMaximumStateTransitionTime**	120	When MPIO support is specified and your server is Windows Server 2008, Windows Server 2008 R2, Windows Server 2012, Windows Server 2012 R2, or Windows Server 2016, except if Data ONTAP DSM is detected
HKLM\SYSTEM\CurrentControlSet\Services\msdsm \Parameters**DsmSupportedDeviceList**	"NETAPP LUN"	When MPIO support is specified
	"NETAPP LUN", "NETAPP LUN C-Mode"	When MPIO support is specified, except if Data ONTAP DSM is detected
HKLM\SYSTEM\CurrentControlSet\Control\Class\ {*iSCSI_driver_GUID*}\ *instance_ID*\Parameters **IPSecConfigTimeout**	60	Always, except when Data ONTAP DSM is detected
HKLM\SYSTEM\CurrentControlSet\Control\Class\ {*iSCSI_driver_GUID*}\ *instance_ID*\Parameters **LinkDownTime**	10	Always
HKLM\SYSTEM\CurrentControlSet\Services\ClusDisk \Parameters**ManageDisksOnSystemBuses**	1	Always, except when Data ONTAP DSM is detected

Registry key	Value	When set
HKLM\SYSTEM\CurrentControlSet\Control\Class\ {*iSCSI_driver_GUID*}\ *instance_ID*\Parameters **MaxRequestHoldTime**	120	When no MPIO support is selected
	30	Always, except when Data ONTAP DSM is detected
HKLM\SYSTEM\CurrentControlSet\Control\MPDEV **MPIOSupportedDeviceList**	"NETAPP LUN"	When MPIO support is specified
	"NETAPP LUN", "NETAPP LUN C-Mode"	When MPIO is support specified, except if Data ONTAP DSM is detected
HKLM\SYSTEM\CurrentControlSet\Services\mpio \Parameters**PathRecoveryInterval**	40	When your server is Windows Server 2008, Windows Server 2008 R2, Windows Server 2012, Windows Server 2012 R2, or Windows Server 2016 only
HKLM\SYSTEM\CurrentControlSet\Services\mpio \Parameters**PathVerifyEnabled**	0	When MPIO support is specified, except if Data ONTAP DSM is detected
HKLM\SYSTEM\CurrentControlSet\Services\msdsm \Parameters**PathVerifyEnabled**	0	When MPIO support is specified and your server is Windows Server 2008, Windows Server 2008 R2, Windows Server 2012, Windows Server 2012 R2, or Windows Server 2016, except if Data ONTAP DSM is detected
HKLM\SYSTEM\CurrentControlSet\Services\msiscdsm \Parameters**PathVerifyEnabled**	0	When MPIO support is specified and your server is Windows Server 2003, except if Data ONTAP DSM is detected
HKLM\SYSTEM\CurrentControlSet\Services\vnetapp \Parameters**PathVerifyEnabled**	0	When MPIO support is specified, except if Data ONTAP DSM is detected
HKLM\SYSTEM\CurrentControlSet\Services\mpio \Parameters**PDORemovePeriod**	130	When MPIO support is specified, except if Data ONTAP DSM is detected

Registry key	Value	When set
HKLM\SYSTEM\CurrentControlSet\Services\msdsm \Parameters**PDORemovePeriod**	130	When MPIO support is specified and your server is Windows Server 2008, Windows Server 2008 R2, Windows Server 2012, Windows Server 2012 R2, or Windows Server 2016, except if Data ONTAP DSM is detected
HKLM\SYSTEM\CurrentControlSet\Services\msiscdsm \Parameters**PDORemovePeriod**	130	When MPIO support is specified and your server is Windows Server 2003, except if Data ONTAP DSM is detected
HKLM\SYSTEM\CurrentControlSet\Services\vnetapp \Parameters**PDORemovePeriod**	130	When MPIO support is specified, except if Data ONTAP DSM is detected
HKLM\SYSTEM\CurrentControlSet\Services\ontapdsm \Parameters**ReservationTimeout**	30	When MPIO support is specified and Data ONTAP DSM is detected
HKLM\SYSTEM\CurrentControlSet\Services\mpio \Parameters**RetryCount**	6	When MPIO support is specified, except if Data ONTAP DSM is detected
HKLM\SYSTEM\CurrentControlSet\Services\msdsm \Parameters**RetryCount**	6	When MPIO support is specified and your server is Windows Server 2008, Windows Server 2008 R2, Windows Server 2012, Windows Server 2012 R2, or Windows Server 2016, except if Data ONTAP DSM is detected
HKLM\SYSTEM\CurrentControlSet\Services\msiscdsm \Parameters**RetryCount**	6	When MPIO support is specified and your server is Windows Server 2003, except if Data ONTAP DSM is detected
HKLM\SYSTEM\CurrentControlSet\Services\vnetapp \Parameters**RetryCount**	6	When MPIO support is specified, except if Data ONTAP DSM is detected

Registry key	Value	When set
HKLM\SYSTEM\CurrentControlSet\Services\mpio \Parameters**RetryInterval**	1	When MPIO support is specified, except if Data ONTAP DSM is detected
HKLM\SYSTEM\CurrentControlSet\Services\msdsm \Parameters**RetryInterval**	1	When MPIO support is specified and your server is Windows Server 2008, Windows Server 2008 R2, Windows Server 2012, Windows Server 2012 R2, or Windows Server 2016, except if Data ONTAP DSM is detected
HKLM\SYSTEM\CurrentControlSet\Services\msiscdsm \Parameters**RetryInterval**	1	When MPIO support is specified and your server is Windows Server 2003, except if Data ONTAP DSM is detected
HKLM\SYSTEM\CurrentControlSet\Services\vnetapp \Parameters**RetryInterval**	1	When MPIO support is specified, except if Data ONTAP DSM is detected
HKLM\SYSTEM\CurrentControlSet\Services\disk **TimeOutValue**	120	When no MPIO support is selected, except if Data ONTAP DSM is detected
	60	When MPIO support is specified, except if Data ONTAP DSM is detected
HKLM\SYSTEM\CurrentControlSet\Services\mpio \Parameters**UseCustomPathRecoveryInterval**	1	When your server is Windows Server 2008, Windows Server 2008 R2, Windows Server 2012, Windows Server 2012 R2, or Windows Server 2016 only

Hotfix 2718576 requires a registry change to enable the fix functionality. The 6.0.2 Windows Host Utilities installer makes the following registry changes to support this fix.

Registry key	Type	Value
HKLM\System \CurrentControlSet\Services \mpio\Parameters\ **DiskPathCheckEnabled**	DWORD	1

Registry key	Type	Value
HKLM\System \CurrentControlSet\Services \mpio\Parameters **DiskPathCheckInterval**	DWORD	20

Note: If you configure a Windows cluster after installing Windows Host Utilities, you must run the Repair option of the Host Utilities installation program to set ClusSvcHangTimeout. If Data ONTAP DSM for Windows MPIO is installed, you must use the Repair option of the DSM installation program instead.

DsmMaximumStateTransitionTime and DsmMaximumRetryTimeDuringStateTransition settings

The DsmMaximumStateTransitionTime and the DsmMaximumRetryTimeDuringStateTransition settings specify the time that the Windows Server 2008, Windows Server 2008 R2, or Windows Server 2012 msdsm waits for an ALUA path transition before returning an I/O error to the layer above it in the stack.

The DsmMaximumStateTransitionTime and DsmMaximumRetryTimeDuringStateTransition settings allow time for a path state transition to complete after a storage system failover or other event. These settings are used for MPIO configurations on Windows Server 2008, Windows Server 2008 R2, and Windows Server 2012.

DsmSupportedDeviceList setting

The DsmSupportedDeviceList setting specifies that a DSM should claim storage devices with the specified vendor identifier and product identifier (VID/PID).

This setting is set for the msdsm included in Windows Server 2008, Windows Server 2008 R2, and Windows Server 2012. The msdsm always gives priority to other DSMs. If another DSM is installed and configured to claim all LUNs with a specified VID/PID, that other DSM would handle the specified LUNs, even though the msdsm has this parameter set.

IPSecConfigTimeout setting

The IPSecConfigTimeout parameter specifies how long the iSCSI initiator waits for the discovery service to configure or release ipsec for an iSCSI connection.

The supported value enables the initiator service to start correctly on slow-booting systems that use CHAP.

LinkDownTime setting

For iSCSI only, the LinkDownTime setting specifies the maximum time in seconds that requests are held in the device queue and retried if the connection to the target is lost.

If MPIO is installed, this value is used. If MPIO is not installed, MaxRequestHoldTime is used instead.

ManageDisksOnSystemBuses setting

The ManageDisksOnSystemBuses parameter is used by SAN-booted systems to ensure that the startup disk, pagefile disks, and cluster disks are all on the same SAN fabric.

For detailed information about the ManageDisksOnSystemBuses parameter, see Microsoft Support article 886569.

Related information

MaxRequestHoldTime setting

The MaxRequestHoldTime setting specifies the maximum time in seconds that requests are queued if connection to the target is lost and the connection is being retried.

After this hold period, requests are failed with "error no device" and the disk is removed from the system. The supported setting enables the connection to survive the maximum expected storage failover time.

MPIOSupportedDeviceList

The MPIOSupportedDeviceList setting specifies that the Windows MPIO component should claim storage devices with the specified vendor identifier and product identifier (VID/PID).

This parameter does not determine which DSM handles the claimed devices; the DsmSupportedDeviceList setting specifies the DSM to use.

PathRecoveryInterval setting

The PathRecoveryInterval setting specifies how long in seconds the MPIO component waits before retrying a lost path.

The PathRecoveryInterval setting causes the MPIO component to try to recover a lost path that had a transient error before it decides the disk device is no longer available.

Note that this parameter affects all DSMs on the system.

PathVerifyEnabled setting

The PathVerifyEnabled parameter specifies whether the Windows MPIO driver periodically requests that the DSM check its paths.

Note that this parameter affects all DSMs on the system.

PDORemovePeriod setting

This parameter specifies the amount of time that the multipath pseudo-LUN stays in system memory after all paths to the device are lost.

RetryCount setting

The RetryCount parameter specifies the number of times the current path to a LUN is retried before failing over to an alternate path.

The RetryCount setting enables recovery from a transient path problem. If the path is not recovered after the specified number of retries, it is probably a more serious network problem.

RetryInterval setting

The RetryInterval parameter specifies the amount of time to wait between retries of a failed path.

This setting gives the path a chance to recover from a transient problem before trying again.

TimeOutValue setting

The disk TimeOutValue parameter specifies how long an I/O request is held at the SCSI layer before timing out and passing a timeout error to the application above.

UseCustomPathRecoveryInterval setting

The UseCustomPathRecoveryInterval setting enables or disables use of the PathRecoveryInterval setting.

Note that this parameter affects all DSMs on the system.

FC HBA values set by Windows Host Utilities

On systems using FC, the Host Utilities installer sets the required timeout values for Emulex and QLogic FC HBAs. If Data ONTAP DSM for Windows MPIO is detected on the host, the Host Utilities installer does not set any HBA values.

For Emulex Fibre Channel HBAs, the installer sets the following parameters when MPIO is selected, unless the Data ONTAP DSM for Windows MPIO is detected.

Property Type	Property Value
LinkTimeOut	1
NodeTimeOut	10

For Emulex Fibre Channel HBAs, the installer sets the following parameters when no MPIO is selected:

Property Type	Property Value
LinkTimeOut	30
NodeTimeOut	120

For QLogic Fibre Channel HBAs, the installer sets the following parameters when MPIO is selected, unless the Data ONTAP DSM for Windows MPIO is detected.

Property Type	Property Value
LinkDownTimeOut	1
PortDownRetryCount	10

For QLogic Fibre Channel HBAs, the installer sets the following parameters when no MPIO is selected:

Property Type	Property Value
LinkDownTimeOut	30
PortDownRetryCount	120

Note: The names of the parameters may vary slightly depending on the program. For example, in the QLogic SANsurfer program, the parameter is displayed as Link Down Timeout. The Host Utilities fcconfig.ini file displays this parameter as either LinkDownTimeOut or MpioLinkDownTimeOut depending on whether MPIO is specified. However, all of these names refer to the same HBA parameter.

Emulex HBA LinkTimeOut setting

The LinkTimeOut parameter specifies the interval after which a link that is down stops issuing a BUSY status for requests and starts issuing SELECTION_TIMEOUT error status. This LinkTimeOut includes port login and discovery time.

This LinkTimeOut includes port login and discovery time.

Emulex HBA NodeTimeOut setting

The NodeTimeOut parameter specifies the interval after which a formerly logged-in node issues SELECTION_TIMEOUT error status to an I/O request.

This setting causes the system to wait for a node that might reenter the configuration soon before reporting a failure. The timer starts after port discovery is completed and the node is no longer present.

QLogic HBA LinkDownTimeOut setting

The LinkDownTimeOut parameter specifies the interval after which a link that is down stops issuing a BUSY status for requests and starts issuing SELECTION_TIMEOUT error status.

This LinkDownTimeOut includes port login and discovery time.

QLogic HBA PortDownRetryCount setting

The PortDownRetryCount parameter specifies the number of times the I/O request is re-sent to a port that is not responding in one second intervals.

Troubleshooting

This section describes general troubleshooting techniques for Windows Host Utilities.

Be sure to check the latest *Release Notes* for known problems and solutions.

Different areas to identify the possible interoperability problems

To identify potential interoperability problems, you must confirm that the Host Utilities support your combination of host operating system software, host hardware, Data ONTAP software, and storage system hardware.

- You must check the Interoperability Matrix.

- You must verify that you have the correct iSCSI configuration.
  If iSCSI LUNs are not available after a reboot, you must verify that the target is listed as persistent on the **Persistent Targets** tab of the Microsoft iSCSI initiator GUI.
  If applications using the LUNs display errors on startup, you must verify that the applications are configured to depend on the iSCSI service.

- For Fibre Channel paths to storage controllers running ONTAP, you must verify that the FC switches are zoned using the WWPNs of the target logical interfaces (LIFs), not the WWPNs of the physical ports on the node.

- You must review the *Release Notes* for Windows Host Utilities to check for known problems.
  The *Release Notes* include a list of known problems and limitations.

- You must review the troubleshooting information in the *SAN Administration Guide* for your version of Data ONTAP.

- You must search Bugs Online for recently discovered problems.
  In the **Bug Types** field under **Advanced Search**, you should select ISCSI - Windows and then click **Go**. You should repeat the search for Bug Type FCP -Windows.

- You must collect information about your system:

  - Record any error messages that are displayed on the host or storage system console.

  - Collect the host and storage system log files.

  - Record the symptoms of the problem and any changes made to the host or storage system just before the problem appeared.

- If you are unable to resolve the problem, then you can contact NetApp technical support.

Related concepts

About the diagnostic programs on page 45

Related information

NetApp Interoperability Matrix Tool
NetApp Documentation
NetApp Bugs Online
Contacting NetApp Global Services

Displaying Host Utilities and HBA version information

Use the `san_version.exe` command to display the Windows Host Utilities version and the firmware and driver versions of HBAs installed in the host.

About this task

HBA information is displayed only for Emulex and QLogic FC and FCoE adapters detected in the host. Version information for other supported adapters is not displayed.

Step

1. Enter the following command at a Windows command prompt:

   san_version

   ```
   C:\>san_version
   Windows(R) Host Utilities *10420_1405

   HBA com.qlogic-QLE8152-0:
           Manufacturer: QLogic Corporation
           Model: QLE8152
           Model Description: QLogic QLE8152 Fibre Channel Adapter
           Firmware: 5.01.03
           Driver (qlfcoe.sys): 9.1.8.25
           Hardware version:
           SerialNumber: RFC0922L02901
   ```

After you finish

Verify the reported versions are supported, and update the driver and firmware versions if needed.

Updating the HBA software driver

Check the version of the HBA software driver and determine whether it needs to be upgraded.

Before you begin

Current driver requirements are in the Interoperability Matrix.

About this task

To see if you have the latest driver, complete the following steps.

Steps

1. Open the Computer Management window.

For	Click
Windows Server 2012 and Windows Server 2012 R2	**Server Manager > Dashboard > Tools > Computer Management**
Windows Server 2008, Windows Server 2008 R2, and Windows Server 2016	**My Computer** on your desktop, then right-click and select **Manage**

2. Double-click **Device Manager**.

   A list of installed devices displays. Previously installed drivers are listed under SCSI and RAID controller. One installed driver appears for each port on the HBA.

   > **Note:** If you uninstalled a device driver, a FC controller (HBA) appears under Other devices.

3. Expand **Storage controllers** and double-click the appropriate HBA.

   The **Properties** dialog box for the HBA is displayed.

4. Click **Driver**.

   - If the driver version is correct, then you do not need to do anything else and can stop now.

   - If the version is not correct, proceed to the next step.

5. Obtain the latest supported version from the Emulex or QLogic website.

Related information

> *NetApp Interoperability Matrix Tool*
> *Emulex: NetApp Qualified Downloads and Documentation*
> *QLogic: NetApp Downloads*

Understanding the Host Utilities changes to FC HBA driver settings

During the installation of the required Emulex or QLogic HBA drivers on an FC system, several parameters are checked and, in some cases, modified.

The Host Utilities set values for the following parameters if Data ONTAP DSM for Windows MPIO is not detected:

- LinkTimeOut – defines the length of time in seconds that the host port waits before resuming I/O after a physical link is down.

- NodeTimeOut – defines the length of time in seconds before the host port recognizes that a connection to the target device is down.

When troubleshooting HBA issues, check to make sure these settings have the correct values. The correct values depend on two factors:

- The HBA vendor

- Whether you are using multipathing software (MPIO)

You can correct the HBA settings by running the Repair option of the Windows Host Utilities installer.

Verifying the Emulex HBA driver settings on FC systems

On FC systems, verify the Emulex HBA driver settings. These settings must exist for each port on the HBA.

Steps

1. Open OneCommand Manager.

   OneCommand Manager is the successor to HBAnyware.

2. Select the appropriate HBA from the list and click the **Driver Parameters** tab.

The driver parameters appear.

3. If you are using MPIO software, ensure that you have the following driver settings:

   - LinkTimeOut - 1

   - NodeTimeOut - 10

   If Data ONTAP DSM for Windows MPIO is installed on the host, the DSM installation program sets the HBA values. Check the DSM documentation for the values set by the version of DSM installed on your host.

4. If you are not using MPIO software, ensure that you have the following driver settings:

   - LinkTimeOut - 30

   - NodeTimeOut - 120

Related references

FC HBA values set by Windows Host Utilities on page 36

Verifying the QLogic HBA driver settings on FC systems

On FC systems, verify the QLogic HBA driver settings. These settings must exist for each port on the HBA.

Steps

1. Open SANsurfer and click **Connect** on the toolbar.

   The **Connect to Host** dialog box appears.

2. Select the appropriate host from the list and click **Connect**.

   A list of HBAs appears in the FC HBA pane.

3. Select the appropriate HBA port from the list and click the **Settings** tab.

4. Select **Advanced HBA Port Settings** from the **Select Settings** section.

5. If you are using MPIO software, ensure you have the following driver settings:

   - Link Down Timeout (linkdwnto) - 1

   - Port Down Retry Count (portdwnrc) - 10

   If Data ONTAP DSM for Windows MPIO is installed on the host, the DSM installation program sets the HBA values. Check the DSM documentation for the values set by the version of DSM installed on your host.

6. If you are not using MPIO software, ensure you have the following driver settings:

   - Link Down Timeout (linkdwnto) - 30

   - Port Down Retry Count (portdwnrc) - 120

Related references

FC HBA values set by Windows Host Utilities on page 36

Enabling logging on the Emulex HBA

In some unusual circumstances, your technical support engineer might request that you enable error logging on the Emulex HBA miniport driver.

Steps

1. Open OneCommand Manager.

   OneCommand Manager is the successor to HBAnyware.

2. In OneCommand Manager, select the appropriate HBA from the list and click the **Driver Parameters** tab.

3. Select the **LogErrors** parameter and change its value to the desired severity level.

4. Click **Apply**.

Enabling logging on the QLogic HBA

In some unusual circumstances, your technical support engineer might request that you enable error logging on the QLogic HBA miniport driver.

Steps

1. Open QConvergeConsole.

2. Open the **Settings** menu and select **Options**.

3. Ensure **Log Informational Events**, **Warning Events**, and **Enable Warning display** are selected.

4. Click **OK**.

FCoE troubleshooting overview

Fibre Channel over Ethernet (FCoE) troubleshooting is similar to traditional Fibre Channel (FC) troubleshooting, with a few specific changes for this new protocol.

FCoE encapsulates FC frames within Ethernet packets. Unlike iSCSI, FCoE does not use TCP/IP.

Troubleshooting FCoE problems should be divided into several distinct areas:

• Initiator to FCoE switch connection

• FCoE switch

• Switch to target connection

In the SAN context, the initiator is always in the Windows host, and the target is always a component of the NetApp storage system.

Troubleshooting the FCoE initiator to switch connection

To troubleshoot the FCoE initiator to FCoE switch connection, check the link lights, cabling, firmware versions, and switch port configuration.

Before you begin

You should have the manufacturer's documentation for your FCoE initiator (converged network adapter or CNA) and for your FCoE switch.

Steps

1. Verify that your CNA model is listed in the Interoperability Matrix as supported for your configuration. Note the required FCoE firmware and host operating system versions.

2. Check the link lights on the card.

   See the manufacturer's documentation for the location and meaning of each light.

   a. If the lights indicate that there is no Ethernet link, check the cables and optical module and that the card is correctly installed.

      For copper cables, be sure to use copper cables supplied by the FCoE switch manufacturer. For optical cables, be sure to use an optical modules supplied by the CNA manufacturer in the CNA and an optical module supplied by the switch manufacturer in the switch. These items are *NOT* interchangeable between different switch and CNA brands. An FCoE component disables its port if it does not recognize the cable or optical module.

   b. Verify the CNA is cabled directly to a port on a supported FCoE switch.

   c. Verify the firmware version for the NIC function of the CNA.

      The NIC firmware version can be found in Windows **Device Manager** under **Network adapter** in the properties for the CNA. Note that a CNA has two firmware versions, one for its FCoE function and one for its NIC function. Check the CNA manufacturer's support site to see if updated NIC firmware is available; if so, download and install it.

   d. If the lights indicate that there is an Ethernet link but no FCoE connection, verify the firmware version of the CNA installed on the Windows host computer.

      The FCoE firmware version can be found in Windows **Device Manager** under **Storage controllers** in the properties for the CNA. Note that a CNA has two firmware versions, one for its FCoE function and one for its NIC function. If needed, download and install a supported FCoE firmware version.

Related information

[NetApp Interoperability Matrix Tool](#)

Troubleshooting the FCoE switch

You should use the manufacturer's documentation for FCoE switch troubleshooting. However, a few high-level troubleshooting steps are listed here for your convenience.

Steps

1. Verify that the switch model and its firmware version are listed on the Interoperability Matrix.

   Note that an FCoE switch, with an integrated FC name server is required. A standard data center bridging (DCB) Ethernet switch is not sufficient.

2. Verify the switch zoning. Each initiator should be in a separate zone with one or more target ports.

3. If you are also using the CNA port as a NIC for other Ethernet traffic (iSCSI, NFS, CIFS), be sure the switch port is configured for trunking.

    FCoE and other Ethernet traffic should be separated onto different VLANs.

Related information

[NetApp Interoperability Matrix Tool](#)

Troubleshooting the FCoE switch to target connection

To troubleshoot the FCoE switch to target connection, you should check the link lights, ONTAP software version, and storage system configuration.

Steps

1. Check the Interoperability Matrix Tool to verify that you have a supported version of ONTAP software and a supported FC or FCoE target adapter.

    Data ONTAP 7.3.2 was required for an FCoE target adapter when this document was written. If you are using an FC target adapter, ONTAP 7.2.6.1 or later was required when this document was written.

2. Verify that the Fibre Channel protocol is licensed on the storage system.

3. On the console of a storage controller running Data ONTAP operating in 7-Mode, execute the following command:

    ```
    fcp show adapter -v
    ```
    On the console of a storage controller running ONTAP, execute the following command:

    ```
    network fcp adapter show -instance
    ```

    The target adapter is listed and is brought online.

4. On the console of a storage controller running Data ONTAP operating in 7-Mode, execute the following command:

    ```
    fcp show initiator -v
    ```
    On the console of a storage controller running ONTAP, execute the following command:

    ```
    vserver fcp initiator show
    ```

    The FCoE initiator is listed.

5. If the FCoE initiator is not listed, check the initiator group (igroup) on the storage controller, and verify that the initiator's world wide port name (WWPN) is configured correctly.

    You can view the WWPN of the initiator on the Windows host by running the `hba_info.exe` command from Windows Host Utilities.

Related information

[NetApp Interoperability Matrix Tool](#)

Troubleshooting FCoE failover problems

FCoE connections in a high availability configuration should fail over to paths during an outage. Verify CNA and host timeout settings if failover is not working correctly.

Steps

1. Verify you have a supported version of Windows Host Utilities installed. If you installed the CNA after installing Windows Host Utilities, run the Windows Host Utilities **Repair** option from Windows **Programs and Features**.

2. Verify you have supported multipathing software installed and that two or more paths are shown from the host to each LUN.

About the diagnostic programs

The diagnostic programs provided with earlier versions of Windows Host Utilities have been replaced by the nSANity Diagnostic and Configuration Data Collector program starting with Windows Host Utilities 5.3.

The following diagnostic programs are no longer included in Windows Host Utilities. The data that was collected by these programs is now collected by the nSANity Diagnostic and Configuration Data Collector program.

* `controller_info`

* `hba_info`

* `windows_info`

* `brocade_info`, `cisco_info`, `mcdata_info`, and `qlogic_info`

* `msiscsi_info`

* `vm_info`

The following program is still included with Windows Host Utilities:

* `san_version`. The `san_version` program displays the version number of the Host Utilities programs installed on the host. It also displays the model and firmware version of FC HBAs installed on the host.

Installing the nSANity data collection program

Download and install the `nSANity Diagnostic and Configuration Data Collector` program when instructed to do so by your technical support representative.

About this task

The nSANity program replaces the diagnostic programs included in previous versions of the Host Utilities. The nSANity program runs on a Windows or Linux system with network connectivity to the component from which you want to collect data.

Steps

1. Log in to the NetApp Support Site and search for "nSANity".

2. Follow the instructions to download the Windows zip or Linux tgz version of the nSANity program, depending on the workstation or server you want to run it on.

3. Change to the directory to which you downloaded the zip or tgz file.

4. Extract all of the files and follow the instructions in the `README.txt` file. Also be sure to review the `RELEASE_NOTES.txt` file for any warnings and notices.

After you finish

Run the specific nSANity commands specified by your technical support representative.

Collecting diagnostic data using nSANity

Run the nSANity Diagnostic and Configuration Data Collector program when instructed by technical support to collect diagnostic data about your host, storage system, and Fibre Channel switches.

Before you begin

Download and install the latest version of nSANity on a Windows or Linux host. Be sure you have the user IDs and passwords of the components for which you need to collect data. In general, you need Administrator or root credentials to collect diagnostic data.

Steps

1. Open the Windows or Linux command prompt and change to the directory where you installed the nSANity program.

2. Enter the following command to display the nSANity command options:

   `nsanity --help`

3. Enter the commands specified by your technical support representative.

After you finish

Send the file or files generated by the nSANity program to your technical support representative.

Related tasks

Installing the nSANity data collection program on page 45

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