



Provision SAN storage

System Manager Classic

NetApp
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Provision SAN storage

FC configuration for ESXi using VSC

FC configuration for ESXi using VSC overview

This content describes how to quickly set up the FC service on a storage virtual machine (SVM), provision a LUN, and make the LUN available as a datastore using an FC HBA on an ESX host computer.

This content is based on the following assumptions:

- You want to use best practices, not explore every available option.
- You do not want to read a lot of conceptual background.
- You want to use System Manager, not the ONTAP command-line interface or an automated scripting tool.
- You want to use the *Classic* System Manager UI for ONTAP 9.7 and earlier releases, not the ONTAP System Manager UI for ONTAP 9.7 and later.

[ONTAP System Manager documentation](#)

- You are using a supported version of Virtual Storage Console for VMware vSphere to configure storage settings for your ESX host and to provision the datastores.
- Your network uses IPv4 addressing.
- You are using traditional FC HBAs on ESXi 5.x and traditional FC switches.

This content does not cover FCoE.

- You have at least two FC target ports available on each node in the cluster.

Onboard FC and UTA2 (also called “CNA”) ports, as well as some adapters are configurable. Configuring those ports is done in the ONTAP CLI and is not covered in this content.

- You are not configuring FC SAN boot.
- You are creating datastores on the host.

This content does not cover raw device mapping (RDM) disks or using N-port ID virtualization (NPIV) to provide FC directly to VMs.

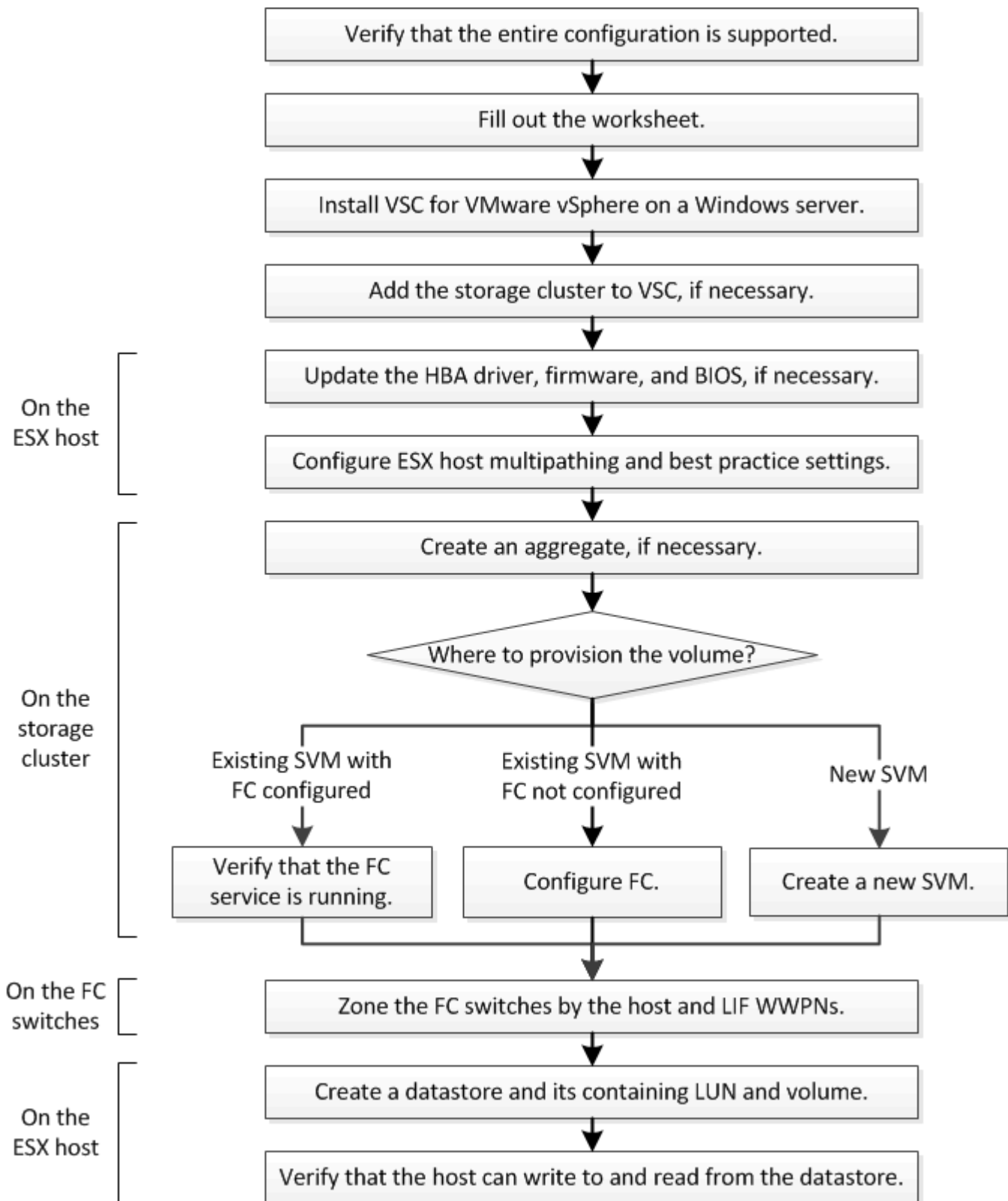
If these assumptions are not correct for your situation, you should see the following resources:

- [ONTAP 9 SAN Administration](#)
- [ONTAP 9 SAN Configuration](#)
- [Appliance administration](#)
- *VMware vSphere Storage* for your version of ESXi 5 (available from VMware).

[VMware](#)

FC configuration workflow

When you make storage available to a host using FC, you provision a volume and LUN on the storage virtual machine (SVM), and then connect to the LUN from the host.



Verify that the FC configuration is supported

For reliable operation, you must verify that the entire FC configuration is supported.

Steps

1. Go to the Interoperability Matrix to verify that you have a supported combination of the following components:
 - ONTAP software
 - Host computer CPU architecture (for standard rack servers)
 - Specific processor blade model (for blade servers)
 - FC host bus adapter (HBA) model and driver, firmware, and BIOS versions
 - Storage protocol (FC)
 - ESXi operating system version
 - Guest operating system type and version
 - Virtual Storage Console (VSC) for VMware vSphere software
 - Windows Server version to run VSC
2. Click the configuration name for the selected configuration.

Details for that configuration are displayed in the Configuration Details window.

3. Review the information in the following tabs:

- Notes

Lists important alerts and information that are specific to your configuration.

- Policies and Guidelines

Provides general guidelines for all SAN configurations.

Complete the FC configuration worksheet

You require FC initiator and target WWPNs and storage configuration information to perform FC configuration tasks.

FC host WWPNs

Port	WWPN
Initiator (host) port connected to FC switch 1	
Initiator (host) port connected to FC switch 2	

FC target WWPNs

You require two FC data LIFs for each node in the cluster. The WWPNs are assigned by ONTAP when you create the LIFs as part of creating the storage virtual machine (SVM).

LIF	WWPN
Node 1 LIF with port connected to FC switch 1	
Node 2 LIF with port connected to FC switch 1	
Node 3 LIF with port connected to FC switch 1	
Node 4 LIF with port connected to FC switch 1	
Node 1 LIF with port connected to FC switch 2	
Node 2 LIF with port connected to FC switch 2	
Node 3 LIF with port connected to FC switch 2	
Node 4 LIF with port connected to FC switch 2	

Storage configuration

If the aggregate and SVM are already created, record their names here; otherwise, you can create them as required:

Node to own LUN
Aggregate name
SVM name

LUN information

LUN size
LUN name (optional)
LUN description (optional)

SVM information

If you are not using an existing SVM, you require the following information to create a new one:

SVM name
SVM IPspace

SVM name
Aggregate for SVM root volume
SVM user name (optional)
SVM password (optional)
SVM management LIF (optional)
Subnet:
IP address:
Network mask:
Gateway:
Home node:
Home port:

Install Virtual Storage Console

Virtual Storage Console for VMware vSphere automates many of the configuration and provisioning tasks required to use NetApp FC storage with an ESXi host. Virtual Storage Console is a plug-in to vCenter Server.

Before you begin

You must have administrator credentials on the vCenter Server used to manage the ESXi host.

About this task

- Virtual Storage Console is installed as a virtual appliance that includes Virtual Storage Console, vStorage APIs for Storage Awareness (VASA) Provider, and Storage Replication Adapter (SRA) for VMware vSphere capabilities.

Steps

1. Download the version of Virtual Storage Console that is supported for your configuration, as shown in the Interoperability Matrix tool.

[NetApp Support](#)

2. Deploy the virtual appliance and configure it following the steps in the *Deployment and Setup Guide*.

Add the storage cluster or SVM to VSC for VMware vSphere

Before you can provision the first datastore to an ESXi host in your Datacenter, you must

add the cluster or a specific storage virtual machine (SVM) to Virtual Storage Console for VMware vSphere. Adding the cluster enables you to provision storage on any SVM in the cluster.

Before you begin

You must have administrator credentials for the storage cluster or the SVM that is being added.

About this task

Depending on your configuration, the cluster might have been discovered automatically, or might have already been added.

Steps

1. Log in to the vSphere Web Client.
2. Select **Virtual Storage Console**.
3. Select **Storage Systems** and then click the **Add** icon.
4. In the **Add Storage System** dialog box, enter the host name and administrator credentials for the storage cluster or SVM and then click **OK**.

Update the HBA driver, firmware, and BIOS

If the FC host bus adapters (HBAs) in the ESX host are not running supported driver, firmware, and BIOS versions, you must update them.

Before you begin

You must have identified the supported driver, firmware, and BIOS versions for your configuration from the [NetApp Interoperability Matrix Tool](#).

About this task

Drivers, firmware, BIOS, and HBA utilities are provided by the HBA vendors.

Steps

1. List the installed HBA driver, firmware, and BIOS versions using the ESXi host console commands for your version of ESXi.
2. Download and install the new driver, firmware, and BIOS as needed from the HBA vendor's support site.

Installation instructions and any required installation utilities are available with the download.

Related information

[VMware KB article 1002413: Identifying the firmware of a Qlogic or Emulex FC HBA](#)

Configure the ESXi host best practice settings

You must ensure that the host multipathing and best practice settings are correct so that the ESXi host can correctly manage the loss of an FC path or a storage failover event.

Steps

1. From the VMware vSphere Web Client **Home** page, click **vCenter > Hosts**.
2. Right-click the host, and then select **Actions > NetApp VSC > Set Recommended Values**.

3. In the **NetApp Recommended Settings** dialog box, ensure that all of the options are selected, and then click **OK**.

The vCenter Web Client displays the task progress.

Create an aggregate

If you do not want to use an existing aggregate, you can create a new aggregate to provide physical storage to the volume which you are provisioning.

Steps

1. Enter the URL `https://IP-address-of-cluster-management-LIF` in a web browser and log in to System Manager using your cluster administrator credential.
2. Navigate to the **Aggregates** window.
3. Click **Create**.
4. Follow the instructions on the screen to create the aggregate using the default RAID-DP configuration, and then click **Create**.

The screenshot shows the 'Create Aggregate' dialog box. At the top, it says 'Create Aggregate'. Below that, a instruction reads: 'To create an aggregate, select a disk type then specify the number of disks.' The form contains the following fields and options:

- Name:** A text input field containing 'aggr2'.
- Disk Type:** A dropdown menu with a question mark icon, currently set to 'SAS'. To its right is a 'Browse' button.
- Number of Disks:** A spinner box set to '8'. To its right is the text: 'Max: 8 (excluding 1 hot spare), min: 5 for RAID-DP'.
- RAID Configuration:** A text field showing 'RAID-DP; RAID group size of 16 disks' with a 'Change' link to its right.
- New Usable Capacity:** A text field showing '4.968 TB (Estimated)'.

Results

The aggregate is created with the specified configuration and added to the list of aggregates in the Aggregates window.

Decide where to provision the volume

Before you provision a volume to contain your LUNs, you need to decide whether to add the volume to an existing storage virtual machine (SVM) or to create a new SVM for the volume. You might also need to configure FC on an existing SVM.

About this task

If an existing SVM is already configured with the needed protocols and has LIFs that can be accessed from the host, it is easier to use the existing SVM.

You can create a new SVM to separate data or administration from other users of the storage cluster. There is no advantage to using separate SVMs just to separate different protocols.

Procedure

- If you want to provision volumes on an SVM that is already configured for FC, you must verify that the FC service is running.

Verifying that the FC service is running on an existing SVM

- If you want to provision volumes on an existing SVM that has FC enabled but not configured, configure iSCSI on the existing SVM.

Configuring FC on an existing SVM

This is the case when you did not follow the procedure in this content to create the SVM while configuring a different protocol.

- If you want to provision volumes on a new SVM, create the SVM.

Creating a new SVM

Verify that the FC service is running on an existing SVM

If you choose to use an existing storage virtual machine (SVM), you must verify that the FC service is running on the SVM by using ONTAP System Manager. You must also verify that FC logical interfaces (LIFs) are already created.

Before you begin

You must have selected an existing SVM on which you plan to create a new LUN.

Steps

1. Navigate to the **SVMs** window.
2. Select the required SVM.
3. Click the **SVM Settings** tab.
4. In the **Protocols** pane, click **FC/FCoE**.
5. Verify that the FC service is running.

The screenshot shows the ONTAP System Manager interface for the FC/FCoE service. At the top, there are buttons for Edit, Start, Stop, and Refresh. Below these, the status is indicated as 'FC/FCoE service is running' with a green checkmark icon. The WWNN is listed as '20:05:00:a0:98:29:18:76'. Under the 'FC/FCoE Interfaces' section, there is a table with four columns: Network Interface, WWPN, Current Port, and Status.

Network Interface	WWPN	Current Port	Status
FC_1_1	20:10:00:a0:98:29:18:76	innovate-01:0b	Enabled
FC_2_1	20:11:00:a0:98:29:18:76	innovate-02:0b	Enabled
FC_1_2	20:04:00:a0:98:29:18:76	innovate-02:0a	Enabled
FC_2_2	20:03:00:a0:98:29:18:76	innovate-01:0a	Enabled

If the FC service is not running, start the FC service or create a new SVM.

6. Verify that there are at least two FC LIFs listed for each node.

If there are fewer than two FC LIFs per node, update the FC configuration on the SVM or create a new SVM for FC.

Configure FC on an existing SVM

You can configure FC on an existing storage virtual machine (SVM). The FC protocol must already be enabled but not configured on the SVM. This information is intended for SVMs for which you are configuring multiple protocols, but have not yet configured FC.

Before you begin

Your FC fabric must be configured and the desired physical ports must be connected to the fabric.

Steps

1. Navigate to the **SVMs** window.
2. Select the SVM that you want to configure.
3. In the **SVMDetails** pane, verify that **FC/FCoE** is displayed with a gray background, which indicates that the protocol is enabled but not fully configured.

If **FC/FCoE** is displayed with a green background, the SVM is already configured.



4. Click the **FC/FCoE** protocol link with the gray background.

The Configure FC/FCoE Protocol window is displayed.

5. Configure the FC service and LIFs from the **Configure FC/FCoE protocol** page:
 - a. Select the **Configure Data LIFs for FC** check box.
 - b. Enter 2 in the **LIFs per node** field.

Two LIFs are required for each node, to ensure availability and data mobility.

- c. Ignore the optional **Provision a LUN for FCP storage** area, because the LUN is provisioned by Virtual Storage Console for VMware vSphere in a later step.
 - d. Click **Submit & Close**.
6. Review the **Summary** page, record the LIF information, and then click **OK**.

Create a new SVM

The storage virtual machine (SVM) provides the FC target through which a host accesses LUNs. When you create the SVM, you also create logical interfaces (LIFs) that provide paths to the LUN. You can create an SVM to separate the data and administration functions of a user from those of the other users in a cluster.

Before you begin

- Your FC fabric must be configured and the desired physical ports must be connected to the fabric.

Steps

1. Navigate to the **SVMs** window.

2. Click **Create**.

3. In the **Storage Virtual Machine (SVM) Setup** window, create the SVM:

a. Specify a unique name for the SVM.

The name must either be a fully qualified domain name (FQDN) or follow another convention that ensures unique names across a cluster.

b. Select the IPspace that the SVM will belong to.

If the cluster does not use multiple IPspaces, the “Default” IPspace is used.

c. Keep the default volume type selection.

Only FlexVol volumes are supported with SAN protocols.

d. Select all of the protocols that you have licenses for and that you might use on the SVM, even if you do not want to configure all of the protocols immediately.

Selecting both NFS and CIFS when you create the SVM enables these two protocols to share the same LIFs. Adding these protocols later does not allow them to share LIFs.

If CIFS is one of the protocols you selected, then the security style is set to NTFS. Otherwise, the security style is set to UNIX.

e. Keep the default language setting C.UTF-8.

f. Select the desired root aggregate to contain the SVM root volume.

The aggregate for the data volume is selected separately in a later step.

g. Click **Submit & Continue**.

The SVM is created, but protocols are not yet configured.

4. If the **Configure CIFS/NFS protocol** page appears because you enabled CIFS or NFS, click **Skip** and then configure CIFS or NFS later.

5. If the **Configure iSCSI protocol** page appears because you enabled iSCSI, click **Skip** and then configure iSCSI later.

6. Configure the FC service and LIFs from the **Configure FC/FCoE protocol** page:

a. Select the **Configure Data LIFs for FC** check box.

b. Enter 2 in the **LIFs per node** field.

Two LIFs are required for each node to ensure availability and data mobility.

c. Skip the optional **Provision a LUN for FCP storage** area because the LUN is provisioned by Virtual Storage Console for VMware vSphere in a later step.

d. Click **Submit & Continue**.

7. When the **SVM Administration** appears, configure or defer configuring a separate administrator for this SVM:
 - Click **Skip** and configure an administrator later if desired.
 - Enter the requested information, and then click **Submit & Continue**.
8. Review the **Summary** page, record the LIF information, and then click **OK**.

Zone the FC switches by the host and LIF WWPNs

Zoning the FC switches enables the hosts to connect to the storage and limits the number of paths. You zone the switches using the management interface of the switches.

Before you begin

- You must have administrator credentials for the switches.
- You must know the WWPN of each host initiator port and of each FC LIF for the storage virtual machine (SVM) in which you created the LUN.

About this task

For details about zoning your switches, see the switch vendor's documentation.

You must zone by WWPN, not by physical port. Each initiator port must be in a separate zone with all of its corresponding target ports.

LUNs are mapped to a subset of the initiators in the igroup to limit the number of paths from the host to the LUN.

- By default, ONTAP uses Selective LUN Map to make the LUN accessible only through paths on the node owning the LUN and its HA partner.
- You still must zone all of the FC LIFs on every node for LUN mobility in case the LUN is moved to another node in the cluster.
- When moving a volume or a LUN, you must modify the Selective LUN Map reporting-nodes list before moving.

The following illustration shows a host connected to a four-node cluster. There are two zones, one zone indicated by the solid lines and one zone indicated by the dashed lines. Each zone contains one initiator from the host and a LIF from each storage node.

You must use the WWPNs of the target LIFs, not the WWPNs of the physical FC ports on the storage nodes. The LIF WWPNs are all in the range `2x:xx:00:a0:98:xx:xx:xx`, where `x` is any hexadecimal digit. The physical port WWPNs are all in the range `50:0a:09:8x:xx:xx:xx:xx`.

Steps

1. Log in to the FC switch administration program, and then select the zoning configuration option.
2. Create a new zone that includes the first initiator and all of the FC LIFs that connect to the same FC switch as the initiator.
3. Create additional zones for each FC initiator in the host.
4. Save the zones, and then activate the new zoning configuration.

Provision a datastore and create its containing LUN and volume

A datastore contains virtual machines and their VMDKs on the ESXi host. The datastore on the ESXi host is provisioned on a LUN on the storage cluster.

Before you begin

Virtual Storage Console for VMware vSphere (VSC) must be installed and registered with the vCenter Server that manages the ESXi host.

VSC must have sufficient cluster or storage virtual machine (SVM) credentials to create the LUN and volume.

About this task

VSC automates the datastore provisioning, including creating a LUN and volume on the specified SVM.

Steps

1. From the vSphere Web Client **Home** page, click **Hosts and Clusters**.
2. In the navigation pane, expand the datacenter where you want to provision the datastore.
3. Right-click the ESXi host, and then select **NetApp VSC > Provision Datastore**.

Alternatively, you can right-click the cluster when provisioning to make the datastore available to all hosts in the cluster.

4. Provide the required information in the wizard:

The image shows a screenshot of the 'NetApp Datastore Provisioning Wizard' window. The window has a title bar with the NetApp logo and the text 'NetApp Datastore Provisioning Wizard'. On the left side, there is a navigation pane with four steps: '1 Name and type' (selected with a green checkmark), '2 Storage system', '3 Details', and '4 Ready to complete'. The main area of the wizard is titled 'Specify the name and type of datastore you want to provision.' and includes a sub-note: 'You will be able to select the storage system for your datastore in the next page of this wizard.' The 'Name' field is a text box containing 'ESX_1_DS2'. The 'Type' section has two radio buttons: 'NFS' (unselected) and 'VMFS' (selected). The 'VMFS Protocol' section has two radio buttons: 'FC/FCoE' (selected) and 'iSCSI' (unselected). Below this, there is a section titled 'Select the storage capability profile you want to use to provision a new datastore.' with a 'Storage Capability Profile' dropdown menu set to 'None'. At the bottom of the wizard, there are four buttons: 'Back', 'Next', 'Finish', and 'Cancel'.

- Select **VMFS** as the datastore type.
- Select **FC/FCoE** as the VMFS protocol.
- Select **None** as the Storage Capability Profile.
- Select the box for **Thin provision**.
- Select the **Create new volume** check box.

Verify that the host can write to and read from the LUN

Before using the LUN, you should verify that the host can write data to the LUN and read

it back.

About this task

If the cluster node on which the LUN is created can be failed over to its partner node, you should verify reading the data while the node is failed over. This test might not be possible if the cluster is in production use.

Steps

1. On the vSphere Web Client **Home** page, click **Hosts and Clusters**.
2. In the navigation pane, click the **Storage** tab.
3. Expand the datacenter, and then select the new datastore.
4. In the center pane, click **Manage > Files**.

The contents of the datastore are displayed.

5. Create a new folder in the datastore and upload a file to the new folder.

You might need to install the Client Integration Plug-in.

6. Verify that you can access the file you just wrote.
7. Fail over the cluster node containing the LUN and verify that you can still write and read a file.

If any of the tests fail, verify that the FC service is running on the storage cluster and check the FC paths to the LUN and FC switch zoning.

8. If you failed over the cluster node, be sure to give back the node and return all LIFs to their home ports.
9. For an ESXi cluster, view the datastore from each ESXi host in the cluster and verify that the file you uploaded is displayed.

Related information

[ONTAP 9 High-Availability Configuration](#)

Where to find additional information

There are additional documents to help you learn more about FC configuration.

All of the following documentation is available:

- [ONTAP 9 SAN Configuration](#)

Describes supported FC, iSCSI, and FCoE topologies for connecting host computers to storage controllers in clusters.

- [ONTAP 9 SAN Administration](#)

Describes how to configure and manage the iSCSI, FCoE, and FC protocols for clustered SAN environments, including configuration of LUNs, igroups, and targets.

VMware documentation

Documentation about iSCSI for ESXi servers is available directly from VMware.

- *vSphere Storage*

This VMware content describes FC and iSCSI configuration for ESXi 5.x.

- *Multipathing Configuration for Software iSCSI Using Port Binding*

Technical White Paper describes MPIO setup for ESXi servers.

FC configuration for Red Hat Enterprise Linux

FC configuration for Red Hat Enterprise Linux overview

This content describes how to quickly set up the FC service on a storage virtual machine (SVM), provision a LUN, and make the LUN available using an FC host bus adapter (HBA) on a Red Hat Enterprise Linux server.

This content is based on the following assumptions:

- You want to use best practices, not explore every available option.
- You do not want to read a lot of conceptual background.
- You want to use the *Classic* System Manager UI for ONTAP 9.7 and earlier releases, not the ONTAP System Manager UI for ONTAP 9.7 and later.

[ONTAP System Manager documentation](#)

- The host is running a supported version of Red Hat Enterprise Linux 6.4 or later.
- You are using traditional FC HBAs and switches.

This content does not cover Fibre Channel over Ethernet (FCoE).

- You have at least two FC target ports available on each node in the cluster.

Onboard FC and UTA2 (also called “CNA”) ports, as well as some adapters, are configurable. Configuring those ports is done in the ONTAP command-line interface (CLI) and is not covered in this content.

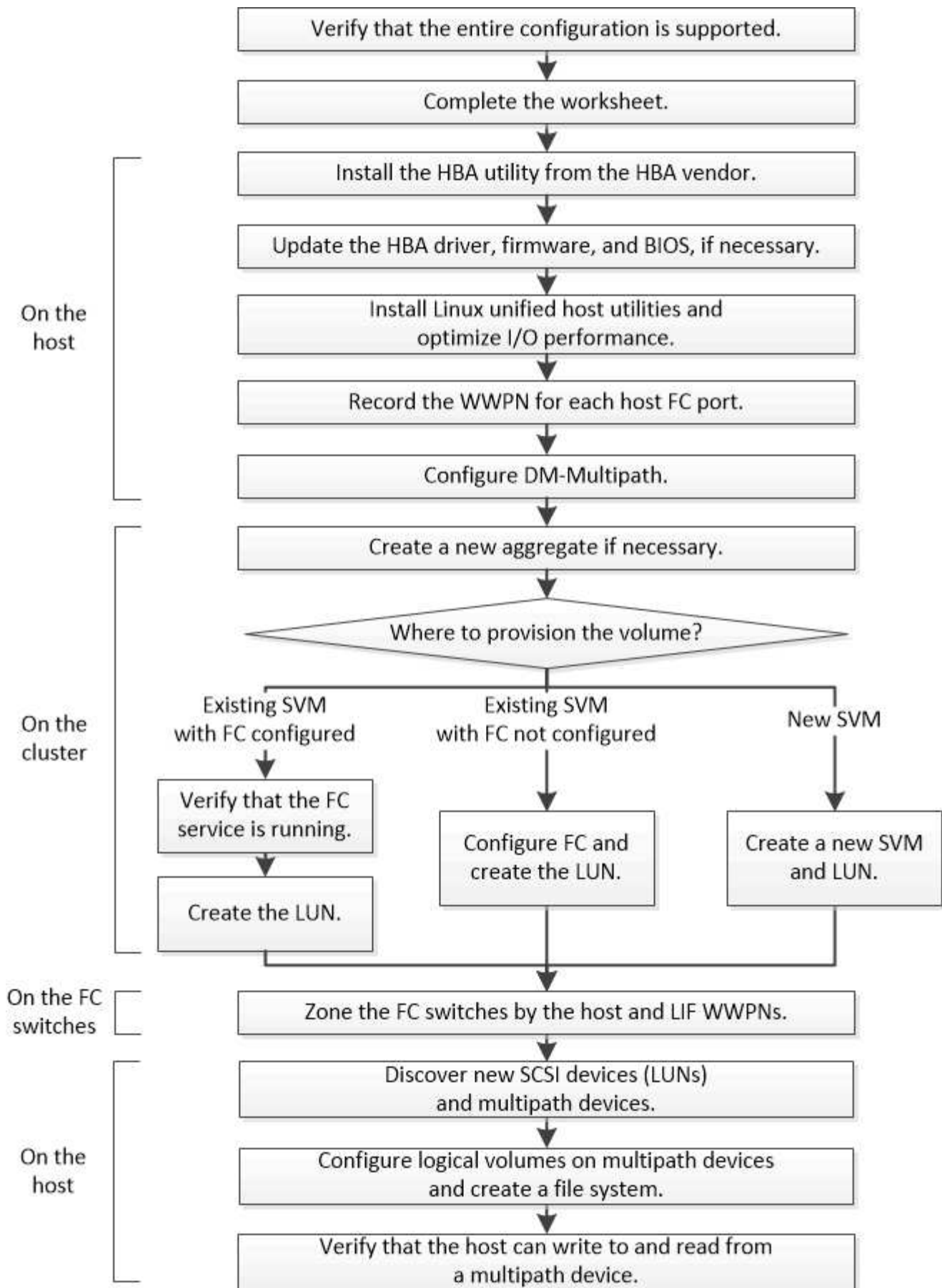
- You are not configuring FC SAN boot.

If these assumptions are not correct for your situation, you should see the following resources:

- [SAN administration](#)
- [SAN configuration](#)
- [Linux Unified Host Utilities 7.1 Installation](#)

FC configuration and provisioning workflow

When you make storage available to a host using FC, you provision a volume and LUN on the storage virtual machine (SVM), and then connect to the LUN from the host.



Verify that the FC configuration is supported

For reliable operation, you must verify that the entire FC configuration is supported.

Steps

1. Go to the Interoperability Matrix to verify that you have a supported combination of the following components:
 - ONTAP software
 - Host computer CPU architecture (for standard rack servers)
 - Specific processor blade model (for blade servers)
 - FC host bus adapter (HBA) model and driver, firmware, and BIOS versions
 - Storage protocol (FC)
 - Linux operating system version
 - DM-Multipath package
 - Linux Unified Host Utilities
2. Select the configuration name for the selected configuration.

Details for that configuration are displayed in the Configuration Details window.

3. Review the information in the following tabs:

- Notes

Lists important alerts and information that are specific to your configuration.

Review the alerts to identify the packages that are required for your operating system.

- Policies and Guidelines

Provides general guidelines for all SAN configurations.

Complete the FC configuration worksheet

You require FC initiator and target WWPNs and storage configuration information to perform FC configuration tasks.

FC host WWPNs

Port	WWPN
Initiator (host) port connected to FC switch 1	
Initiator (host) port connected to FC switch 2	

FC target WWPNs

You require two FC data LIFs for each node in the cluster. The WWPNs are assigned by ONTAP when you create the LIFs as part of creating the storage virtual machine (SVM).

LIF	WWPN
Node 1 LIF with port connected to FC switch 1	
Node 2 LIF with port connected to FC switch 1	
Node 3 LIF with port connected to FC switch 1	
Node 4 LIF with port connected to FC switch 1	
Node 1 LIF with port connected to FC switch 2	
Node 2 LIF with port connected to FC switch 2	
Node 3 LIF with port connected to FC switch 2	
Node 4 LIF with port connected to FC switch 2	

Storage configuration

If the aggregate and SVM are already created, record their names here; otherwise, you can create them as required:

Node to own LUN
Aggregate name
SVM name

LUN information

LUN size
LUN name (optional)
LUN description (optional)

SVM information

If you are not using an existing SVM, you require the following information to create a new one:

SVM name
SVM IPspace

SVM name
Aggregate for SVM root volume
SVM user name (optional)
SVM password (optional)
SVM management LIF (optional)
Subnet:
IP address:
Network mask:
Gateway:
Home node:
Home port:

Install the HBA utility from the HBA vendor

The HBA utility enables you to view the worldwide port name (WWPN) of each FC port. The utility is also useful for troubleshooting FC issues.

About this task

Each HBA vendor offers an HBA utility for their FC HBAs. You must download the correct version for your host operating system and CPU.

The following is a partial list of HBA utilities:

- Emulex HBA Manager, formerly known as OneCommand Manager, for Emulex HBAs
- QLogic QConvergeConsole for QLogic HBAs

Steps

1. Download the appropriate utility from your HBA vendor's web site.
2. Run the installation program and follow the prompts to complete the installation.

Related information

[Broadcom \(Emulex\) Support Documents and Downloads](#)

[Emulex HBA Manager](#)

[QLogic: NetApp Downloads](#)

Update the HBA driver, firmware, and BIOS

If the FC host bus adapters (HBAs) in the Linux host are not running supported driver, firmware, and BIOS versions, you must update them.

Before you begin

You must have identified the supported driver, firmware, and BIOS versions for your configuration from the Interoperability Matrix tool.

[NetApp Interoperability Matrix Tool](#)

About this task

Drivers, firmware, BIOS, and HBA utilities are provided by the HBA vendors.

Steps

1. List the installed HBA driver, firmware, and BIOS versions by using the HBA utility from your HBA vendor.
2. Download and install the new driver, firmware, and BIOS as needed from the HBA vendor's support site.

Installation instructions and any required installation utilities are available with the download.

Install Linux Unified Host Utilities and optimize I/O performance

Linux Unified Host Utilities software includes the `sanlun` utility, a NetApp LUN reporting tool that you can use to display information about storage cluster nodes and Host Bus Adapters (HBAs) that are on the Linux host. You must also enable the correct server profile on the Linux host to optimize NetApp storage performance.

Before you begin

You must have identified the supported Linux Unified Host Utilities version for your configuration by using the Interoperability Matrix. You must also have the `tuned` package, which is part of your Linux OS distribution and contains the `tuned-adm` command, which you use to set the server profile on the host.

Steps

1. Download the supported Linux Unified Host Utilities version from the NetApp Support Site.

[NetApp Downloads: Software](#)

2. Install Linux Unified Host Utilities software by following the instructions in the installation documentation.
3. If the `tuned` package is not installed, enter the following command:
`yum install tuned`
4. For a physical host, ensure that you have set the `enterprise-storage` profile:
`tuned-adm profile enterprise-storage`
5. For a virtual host, ensure that you have set the `virtual-guest` profile:
`tuned-adm profile virtual-guest`

[Linux Unified Host Utilities 7.1 Installation](#)

Record the WWPN for each host FC port

The worldwide port name (WWPN) is required to zone the FC switches and to create the

igroups that allow the host to access its LUN.

Before you begin

You must have installed the vendor's HBA utility for the HBAs in your host and verified HBAs are running supported driver, firmware, and BIOS versions for your configuration.

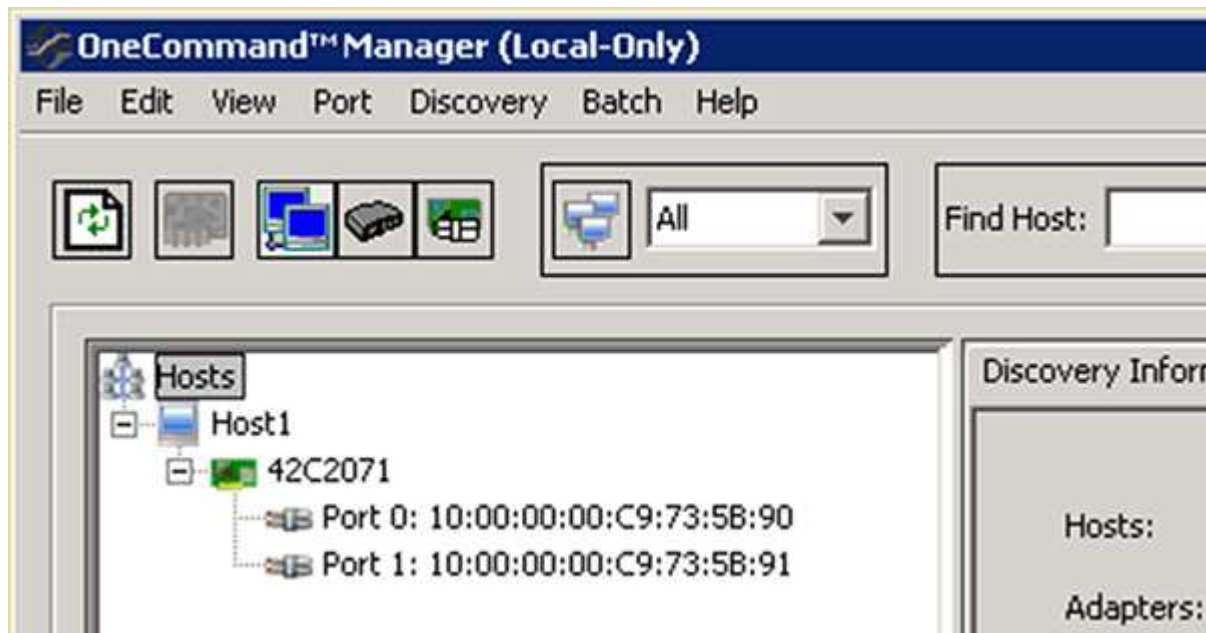
About this task

The WWPN is used for all configuration. You do not have to record the worldwide node name (WWNN).

Steps

1. Run the HBA utility for your FC HBA type.
2. Select the HBA.
3. Record the WWPN of each port.

The following example shows Emulex HBA Manager, formerly known as OneCommand Manager.



Other utilities, such as QLogic QConvergeConsole, provide the equivalent information.

4. Repeat the previous step for each FC HBA in the host.

In Linux, you can also obtain the WWPN by running the `sanlun` utility.

The following example shows output from the `sanlun` command.

```
# sanlun fcp show adapter -v

adapter name:      host0
**WWPN:           10000000c9813a14**
WWNN:             20000000c9813a14
driver name:       lpfc
model:            LPe12002-M8
model description: Emulex LPe12002-M8 8Gb 2-port PCIe Fibre Channel
Adapter
serial number:     VM84364896
hardware version:  31004549
driver version:    8.3.7.34.3p; HBAAPI(I) v2.3.b, 07-12-10
firmware version:  2.01A12 (U3D2.01A12)
Number of ports:   1
port type:         Fabric
port state:        Operational
supported speed:   2 GBit/sec, 4 GBit/sec, 8 GBit/sec
negotiated speed:  8 GBit/sec
OS device name:    /sys/class/scsi_host/host0

adapter name:      host5
**WWPN:           10000000c9813a15**
WWNN:             20000000c9813a15
driver name:       lpfc
model:            LPe12002-M8
model description: Emulex LPe12002-M8 8Gb 2-port PCIe Fibre Channel
Adapter
serial number:     VM84364896
hardware version:  31004549
driver version:    8.3.7.34.3p; HBAAPI(I) v2.3.b, 07-12-10
firmware version:  2.01A12 (U3D2.01A12)
Number of ports:   1
port type:         Fabric
port state:        Operational
supported speed:   2 GBit/sec, 4 GBit/sec, 8 GBit/sec
negotiated speed:  8 GBit/sec
OS device name:    /sys/class/scsi_host/host5
```

Configure DM-Multipath

DM-Multipath manages multiple paths between the Linux host and the storage cluster. Configuring DM-Multipath on a LUN, which appears to the Linux host as a SCSI device, enables your Linux host to access its LUN on the storage cluster if a path or component fails.

Before you begin

You must have identified the required version of DM-Multipath from the Interoperability Matrix tool.

NetApp Interoperability Matrix Tool



The recommended approach is that you configure two paths per node into each fabric or Ethernet network. This allows a path to fail without the node switching over to its partner. Using link aggregation (LAG) for the physical ports is not recommended with a Windows-based operating system.

Steps

1. Edit the `/etc/multipath.conf` file as follows:

a. Determine whether there are non-NetApp SCSI devices to exclude (blacklist).

These are devices that are not displayed when you enter the `sanlun lun show` command.

- If there are non-NetApp SCSI devices to exclude, enter the worldwide identifier (WWID) for the devices in the blacklist section of the `multipath.conf` file.

To display the WWID of a non-NetApp SCSI device, enter the following command on the device that you want to exclude, where `SCSI_device_name` is a device that you specify: `/lib/udev/scsi_id -gud /dev/SCSI_device_name`

For example, if `/dev/sda` is the non-NetApp SCSI device that you want to exclude, you would enter the following: `/lib/udev/scsi_id -gud /dev/sda`

This displays the WWID of the device, which you can copy and paste in the `multipath.conf` file.

In the following example showing the blacklist section of the `multipath.conf` file, the non-NetApp SCSI device with WWID `3600508e000000000753250f933cc4606` is excluded:

```
blacklist {
    **wwid          3600508e000000000753250f933cc4606**
    devnode         "^(ram|raw|loop|fd|md|dm-|sr|scd|st)[0-9]*"
    devnode         "^hd[a-z]"
    devnode         "^cciss.*"
}
```

- If there are no devices to exclude, remove the `wwid` line from the `multipath.conf` file.

b. Enable NetApp recommended DM-Multipath settings by appending the following string to the end of the kernel line in the boot loader: `rdloaddriver=scsi_dh_alua`

2. Start the DM-Multipath daemon: `/etc/init.d/multipathd start`

3. Add the multipath service to the boot sequence so that the multipath daemon always starts during system boot: `chkconfig multipathd on`

4. Reboot the Linux host.

5. Verify that the `rdloaddriver` setting appears in the output when you run `cat /proc/cmdline`.

The `rdloaddriver` setting appears as one of several boot options that are passed to the kernel:

```
# cat /proc/cmdline
ro root=/dev/mapper/vg_ibmx3650210104-lv_root rd_NO_LUKS LANG=en_US.UTF-
8 rd_NO_MD rd_LVM_LV=vg_ibmx3650210104/lv_root SYSFONT=latarcyrheb-sun16
rd_LVM_LV=vg_ibmx3650210104/lv_swap crashkernel=129M@0M KEYBOARDTYPE=pc
KEYTABLE=us rd_NO_DM rhgb quiet **rdloaddriver=scsi_dh_alua**
```

Create an aggregate

If you do not want to use an existing aggregate, you can create a new aggregate to provide physical storage to the volume which you are provisioning.

Steps

1. Enter the URL `https://IP-address-of-cluster-management-LIF` in a web browser and log in to System Manager using your cluster administrator credential.
2. Navigate to the **Aggregates** window.
3. Select **Create**.
4. Follow the instructions on the screen to create the aggregate using the default RAID-DP configuration, and then select **Create**.

Create Aggregate

To create an aggregate, select a disk type then specify the number of disks.

Name:

Disk Type:

Number of Disks: Max: 8 (excluding 1 hot spare), min: 5 for RAID-DP

RAID Configuration: RAID-DP; RAID group size of 16 disks [Change](#)

New Usable Capacity: 4.968 TB (Estimated)

Results

The aggregate is created with the specified configuration and added to the list of aggregates in the Aggregates window.

Decide where to provision the volume

Before you provision a volume to contain your LUNs, you need to decide whether to add the volume to an existing storage virtual machine (SVM) or to create a new SVM for the volume. You might also need to configure FC on an existing SVM.

About this task

If an existing SVM is already configured with the needed protocols and has LIFs that can be accessed from the

host, it is easier to use the existing SVM.

You can create a new SVM to separate data or administration from other users of the storage cluster. There is no advantage to using separate SVMs just to separate different protocols.

Procedure

- If you want to provision volumes on an SVM that is already configured for FC, you must verify that the FC service is running and then create a LUN on the SVM.

Verifying that the FC service is running on an existing SVM

Creating a LUN

- If you want to provision volumes on an existing SVM that has FC enabled but not configured, configure iSCSI on the existing SVM.

Configuring FC on an existing SVM

This is the case when you did not follow the procedure in this content to create the SVM while configuring a different protocol.

- If you want to provision volumes on a new SVM, create the SVM.

Creating a new SVM

Verify that the FC service is running on an existing SVM

If you choose to use an existing storage virtual machine (SVM), you must verify that the FC service is running on the SVM by using ONTAP System Manager. You must also verify that FC logical interfaces (LIFs) are already created.

Before you begin

You must have selected an existing SVM on which you plan to create a new LUN.

Steps

1. Navigate to the **SVMs** window.
2. Select the required SVM.
3. Select the **SVM Settings** tab.
4. In the **Protocols** pane, select **FC/FCoE**.
5. Verify that the FC service is running.

Edit

Start

Stop

Refresh

Status:

FC/FCoE service is running

WWNN:
20:05:00:a0:98:29:18:76

FC/FCoE Interfaces:

Network Interface	WWPN	Current Port	Status
FC_1_1	20:10:00:a0:98:29:18:76	innovate-01:0b	Enabled
FC_2_1	20:11:00:a0:98:29:18:76	innovate-02:0b	Enabled
FC_1_2	20:04:00:a0:98:29:18:76	innovate-02:0a	Enabled
FC_2_2	20:03:00:a0:98:29:18:76	innovate-01:0a	Enabled

If the FC service is not running, start the FC service or create a new SVM.

6. Verify that there are at least two FC LIFs listed for each node.

If there are fewer than two FC LIFs per node, update the FC configuration on the SVM or create a new SVM for FC.

Create a LUN

You use the Create LUN wizard to create a LUN. The wizard also creates the igroup and maps the LUN to the igroup, which enables the specified host to access the LUN.

Before you begin

- There must be an aggregate with enough free space to contain the LUN.
- There must be a storage virtual machine (SVM) with the FC protocol enabled and the appropriate logical interfaces (LIFs) created.
- You must have recorded the worldwide port names (WWPNs) of the host FC ports.

About this task

If your organization has a naming convention, you should use names for the LUN, volume, and so on that fit your convention. Otherwise, you should accept the default names.

Steps

1. Navigate to the **LUNs** window.
2. Select **Create**.
3. Browse and select an SVM in which you want to create the LUNs.

The Create LUN Wizard is displayed.

4. On the **General Properties** page, select the LUN type **Linux** for LUNs used directly by the Linux host.

Leave the **Thin Provisioned** check box unselected.

You can specify the size of the LUN. Storage will be optimized according to the type selected.

Type:

Size:

☐ Thin Provisioned

- On the **LUN Container** page, select an existing FlexVol volume.

You must ensure that there is enough space in the volume. If sufficient space is not available in the existing volumes, you can create a new volume.

- On the **Initiators Mapping** page, select **Add Initiator Group**, enter the required information on the **General** tab, and then on the **Initiators** tab, enter all the WWPNs of the host FC ports that you recorded.
- Confirm the details, and then select **Finish** to complete the wizard.

Related information

System administration

Configure FC on an existing SVM

You can configure FC on an existing storage virtual machine (SVM) and create a LUN and its containing volume with a single wizard. The FC protocol must already be enabled but not configured on the SVM. This information is intended for SVMs for which you are configuring multiple protocols, but have not yet configured FC.

Before you begin

Your FC fabric must be configured and the desired physical ports must be connected to the fabric.

Steps

- Navigate to the **SVMs** window.
- Select the SVM that you want to configure.
- In the **SVM Details** pane, verify that **FC/FCoE** is displayed with a gray background, which indicates that the protocol is enabled but not fully configured.

If **FC/FCoE** is displayed with a green background, the SVM is already configured.

Details

Protocols: [NFS](#) [CIFS](#) [FC/FCoE](#) [iSCSI](#)

- Select the **FC/FCoE** protocol link with the gray background.

The Configure FC/FCoE Protocol window is displayed.


- Configure the FC service and LIFs from the **Configure FC/FCoE protocol** page:
 - Select the **Configure Data LIFs for FC** check box.

- b. Enter 2 in the **LIFs per node** field.

Two LIFs are required for each node, to ensure availability and data mobility.

- c. Select **Submit & Close**.

Configure FC/FCoE protocol

 Configure LIFs to access the data using FC/FCoE protocol


Data Interface (LIF) Configuration


Both FC and FCoE enabled hardware found. Click on the appropriate checkbox to configure the FC and/or FCoE LIFs.

☒ Configure Data LIFs for FC

LIFs per node:
(Minimum: 1, Maximum: 2)

Provision a Lun for FCP storage (Optional)

Lun Size: GB 

LUN OS Type: 

Host Initiator:

☐ Review or Edit the Interface Association

☐ Configure Data LIFs for FCoE

6. Review the **Summary** page, record the LIF information, and then select **OK**.

Create a new SVM

The storage virtual machine (SVM) provides the FC target through which a host accesses LUNs. When you create the SVM, you also create logical interfaces (LIFs) and the LUN and its containing volume. You can create an SVM to separate the data and administration functions of a user from those of the other users in a cluster.

Before you begin

- Your FC fabric must be configured and the desired physical ports must be connected to the fabric.

Steps

1. Navigate to the **SVMs** window.
2. Select **Create**.
3. In the **Storage Virtual Machine (SVM) Setup** window, create the SVM:

Storage Virtual Machine (SVM) Setup



SVM Details

? Specify a unique name and the data protocols for the SVM

SVM Name:

? IPspace: ▼

? Data Protocols: ☒ CIFS ☒ NFS ☒ iSCSI ☒ FC/FCoE ☐ NVMe

? Default Language: ▼

The language of the SVM specifies the default language encoding setting for the SVM and its volumes. Using a setting that incorporates UTF-8 character encoding is recommended.

? Security Style: ▼

Root Aggregate: ▼

a. Specify a unique name for the SVM.

The name must either be a fully qualified domain name (FQDN) or follow another convention that ensures unique names across a cluster.

b. Select the IPspace that the SVM will belong to.

If the cluster does not use multiple IPspaces, the “Default” IPspace is used.

c. Keep the default volume type selection.

Only FlexVol volumes are supported with SAN protocols.

d. Select all of the protocols that you have licenses for and that you might use on the SVM, even if you do not want to configure all of the protocols immediately.

Selecting both NFS and CIFS when you create the SVM enables these two protocols to share the same LIFs. Adding these protocols later does not allow them to share LIFs.

If CIFS is one of the protocols you selected, then the security style is set to NTFS. Otherwise, the security style is set to UNIX.

e. Keep the default language setting C.UTF-8.

f. Select the desired root aggregate to contain the SVM root volume.

The aggregate for the data volume is selected separately in a later step.

g. Select **Submit & Continue**.

The SVM is created, but protocols are not yet configured.

4. If the **Configure CIFS/NFS protocol** page appears because you enabled CIFS or NFS, select **Skip** and

then configure CIFS or NFS later.

5. If the **Configure iSCSI protocol** page appears because you enabled iSCSI, select **Skip** and then configure iSCSI later.
6. Configure the FC service and create LIFs, and the LUN and its containing volume from the **Configure FC/FCoE protocol** page:
 - a. Select the **Configure Data LIFs for FC** check box.
 - b. Enter 2 in the **LIFs per node** field.

Two LIFs are required for each node to ensure availability and data mobility.

- c. In the **Provision a LUN for FCP storage** area, enter the desired LUN size, host type, and WWPNs of the host initiators.
- d. Select **Submit & Continue**.

Configure FC/FCoE protocol

? Configure LIFs to access the data using FC/FCoE protocol

Data Interface (LIF) Configuration

Both FC and FCoE enabled hardware found. Click on the appropriate checkbox to configure the FC and/or FCoE LIFs.

☒ Configure Data LIFs for FC

☐ Configure Data LIFs for FCoE

LIFs per node: (Minimum: 1, Maximum: 2)

Provision a Lun for FCP storage (Optional)

Lun Size: GB

LUN OS Type:

Host Initiator:

7. When the **SVM Administration** appears, configure or defer configuring a separate administrator for this SVM:
 - Select **Skip** and configure an administrator later if desired.
 - Enter the requested information, and then select **Submit & Continue**.
8. Review the **Summary** page, record the LIF information, and then select **OK**.

Zone the FC switches by the host and LIF WWPNs

Zoning the FC switches enables the hosts to connect to the storage and limits the number of paths. You zone the switches using the management interface of the switches.

Before you begin

- You must have administrator credentials for the switches.
- You must know the WWPN of each host initiator port and of each FC LIF for the storage virtual machine (SVM) in which you created the LUN.

About this task

For details about zoning your switches, see the switch vendor's documentation.

You must zone by WWPN, not by physical port. Each initiator port must be in a separate zone with all of its corresponding target ports.

LUNs are mapped to a subset of the initiators in the igroup to limit the number of paths from the host to the LUN.

- By default, ONTAP uses Selective LUN Map to make the LUN accessible only through paths on the node owning the LUN and its HA partner.
- You still must zone all of the FC LIFs on every node for LUN mobility in case the LUN is moved to another node in the cluster.
- When moving a volume or a LUN, you must modify the Selective LUN Map reporting-nodes list before moving.

The following illustration shows a host connected to a four-node cluster. There are two zones, one zone indicated by the solid lines and one zone indicated by the dashed lines. Each zone contains one initiator from the host and a LIF from each storage node.

You must use the WWPNs of the target LIFs, not the WWPNs of the physical FC ports on the storage nodes. The LIF WWPNs are all in the range `2x:xx:00:a0:98:xx:xx:xx`, where `x` is any hexadecimal digit. The physical port WWPNs are all in the range `50:0a:09:8x:xx:xx:xx:xx`.

Steps

1. Log in to the FC switch administration program, and then select the zoning configuration option.
2. Create a new zone that includes the first initiator and all of the FC LIFs that connect to the same FC switch as the initiator.
3. Create additional zones for each FC initiator in the host.
4. Save the zones, and then activate the new zoning configuration.

Discover new SCSI devices (LUNs) and multipath devices

LUNs on the storage cluster appear to the Linux host as SCSI devices, which are I/O paths that DM-Multipath aggregates into a new device, called a multipath device. The host does not automatically discover new SCSI devices (LUNs) that you add to your system. You must manually rescan them to discover them.

Before you begin

You must have a copy of the `rescan` script, which is in the `sg3_utils` package that is part of your Linux OS distribution.

Steps

1. Discover new SCSI devices (LUNs) and create the corresponding multipath devices for the LUNs:
`/usr/bin/rescan-scsi-bus.sh`
2. Verify DM-Multipath configuration:`multipath -ll`

This displays the following type of output, listing the recommended settings for each NetApp LUN:


```

3600a0980324666546e2b443251655177 dm-2 NETAPP,LUN C-Mode
size=10G features='4 queue_if_no_path pg_init_retries 50
retain_attached_hw_handle' hwhandler='1 alua' wp=rw
|+- policy='round-robin 0' prio=50 status=active
| |- 0:0:1:0 sdb 8:16 active ready running
| |- 0:0:0:0 sda 8:0 active ready running
| |- 1:0:0:0 sde 8:64 active ready running
| `-- 1:0:1:0 sdf 8:80 active ready running
`+- policy='round-robin 0' prio=10 status=enabled
  |- 0:0:3:0 sdd 8:48 active ready running
  |- 1:0:3:0 sdh 8:112 active ready running
  |- 0:0:2:0 sdc 8:32 active ready running
  `-- 1:0:2:0 sdg 8:96 active ready running

```

Configure logical volumes on multipath devices and creating a file system

When the Linux host first accesses a new SCSI device (LUN), there is no partition or file system. If you want to use a partitioned multipath device, you must first partition the underlying SCSI devices. You might also want to create logical volumes on multipath devices, and optionally create a file system.

Before you begin

SCSI devices and corresponding multipath devices must have been discovered by the Linux host.

About this task

At a minimum DM-Multipath should be configured on the SCSI devices. Any configuration beyond DM-Multipath is optional. The following steps are general guidelines if you wish to perform additional configuration, such as partitioning, configuring logical volumes on multipath devices, and creating a file system. For details on Linux commands, refer to Red Hat Enterprise Linux documentation and man pages.

Steps

1. To use a partitioned multipath device, first partition the underlying SCSI devices using the `fdisk` or `parted` utility.
2. Create corresponding multipath partitions using the `kpartx` utility.
3. Create logical volumes on corresponding multipath devices using Logical Volume Manager (LVM) commands.
4. Create a file system, such as Ext4 or XFS, on logical volumes or multipath devices using the `mkfs` utility.

Verify that the host can write to and read from a multipath device

Before using a multipath device, you should verify that the host can write data to the multipath device and read it back.

Before you begin

DM-Multipath must be configured on the Linux host for the storage cluster nodes you are accessing.

About this task

If the storage cluster node that the multipath device corresponds to can be failed over to its partner node, you should verify reading the data while the node is failed over. This verification might not be possible if the storage cluster is in production use.

Steps

1. Run some I/O on the specified multipath device: `dd if=/dev/zero of=<multipath_device_name>`
2. Verify that I/O is running on the multipath device, specifying the number of seconds to refresh statistics (for example, every two seconds, as shown): `iostat 2`

When I/O is running on the multipath device, you can see the various I/O counters output change dynamically, indicating that I/O is running successfully on the multipath device.

```
avg-cpu:  %user   %nice %system %iowait  %steal   %idle
           0.00    0.00    0.01    0.00    0.00   99.98

Device:            tps    Blk_read/s    Blk_wrtn/s    Blk_read    Blk_wrtn
sda                 0.18         1.34         2.29      832606     1428026
dm-0                 0.37         1.29         2.29      801530     1427984
dm-1                 0.00         0.00         0.00       2576         0
dm-2                 0.00         0.00         0.00       1770         24
sdd                 0.17         1.18        17.87     734688    11128584
sde                 0.17         1.18        18.01     734560    11219016
sdf                 0.00         0.00         0.00       1344         0
sdg                 0.00         0.00         0.00       1344         0
dm-3                 0.68         4.71        71.96    2932496    44816008
sdh                 0.17         1.18        18.22     734360    11343920
sdi                 0.17         1.18        17.86     734272    11124488
sdj                 0.00         0.00         0.00       1344         0
sdk                 0.00         0.00         0.00       1344         0
.....
```

3. If possible, run the `takeover` command on the storage cluster node: `storage failover takeover -ofnode <node_name>`
4. Verify that I/O is still running on the multipath device by re-running the `iostat` command.
5. Run the `giveback` command on the storage cluster node: `storage failover giveback -ofnode <node_name>`
6. Check `iostat` output to verify that I/O is still running.

What to do next

If any of the tests fail, verify that the FC service is running and re-check the DM-Multipath configuration and the FC paths to the multipath device.

Where to find additional information

After you have successfully tested FC, you can perform advanced FC configuration or add SAN or NAS protocols. There is comprehensive content, and technical reports to help you achieve these goals.

SAN configuration

All of the following documentation is available:

- [SAN configuration](#)

Describes supported FC, iSCSI, and FCoE topologies for connecting host computers to storage controllers in clusters.

- [SAN administration](#)

Describes how to configure and manage the iSCSI, FCoE, and FC protocols for clustered SAN environments, including configuration of LUNs, igroups, and targets.

- [Linux Unified Host Utilities 7.1](#)

Describes how to install Linux Unified Host Utilities software and configure DM-Multipath.

- [NetApp Technical Report 4159: Red Hat Enterprise Virtualization 3.1 and NetApp Clustered Data ONTAP Storage Best Practices](#)

Describes the current best practices for Red Hat virtualized environments.

- Red Hat Enterprise Linux 6 documentation and man pages

Provides instructions for managing storage devices, file systems, and Linux commands.

FC configuration for Windows

FC configuration for Windows overview

This content describes how to quickly set up the FC service on a storage virtual machine (SVM), provision a LUN, and make the LUN available using an FC HBA on a Windows host computer.

This content is based on the following assumptions:

- You want to use best practices, not explore every available option.
- You do not want to read a lot of conceptual background.
- You want to use the *Classic* System Manager UI for ONTAP 9.7 and earlier releases, not the ONTAP System Manager UI for ONTAP 9.7 and later.

[ONTAP System Manager documentation](#)

- You are using traditional FC HBAs and switches.

This content does not cover FCoE.

- You have at least two FC target ports available on each node in the cluster.

Onboard FC and UTA2 (also called CNA) ports, as well as some adapters are configurable. Configuring those ports is done in the ONTAP CLI and is not covered in this content.

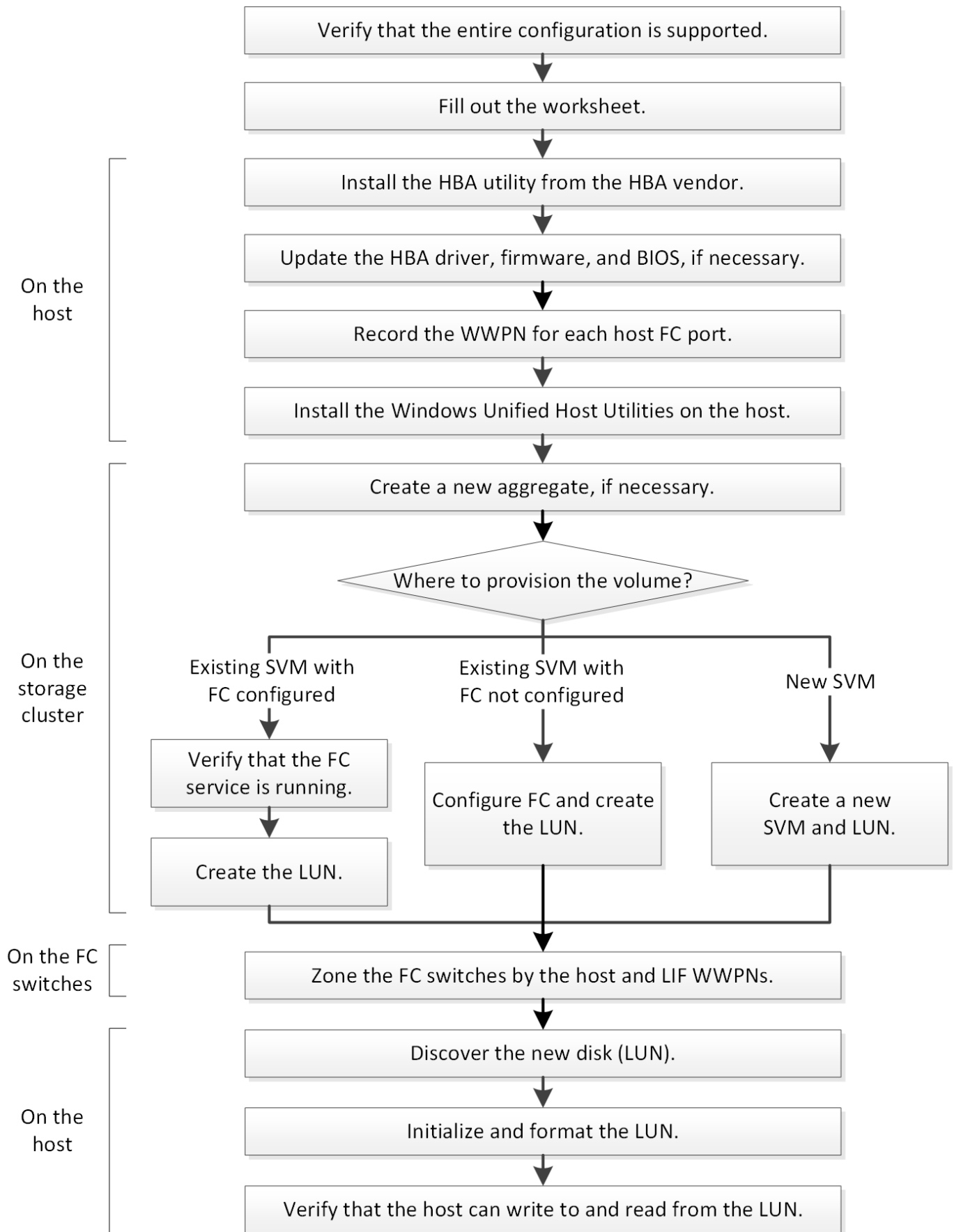
- You are not configuring FC SAN boot.
- You are not using virtual Fibre Channel (VFC) with Hyper-V or ESX guests.

If these assumptions are not correct for your situation, you should see the following resources:

- [SAN administration](#)
- [SAN configuration](#)
- [NetApp Documentation: Host Utilities](#)

FC configuration workflow

When you make storage available to a host using FC, you provision a volume and LUN on the storage virtual machine (SVM), and then connect to the LUN from the host.



Verify that the FC configuration is supported

For reliable operation, you must verify that the entire FC configuration is supported.

Steps

1. Go to the Interoperability Matrix to verify that you have a supported combination of the following components:
 - ONTAP software
 - Host computer CPU architecture (for standard rack servers)
 - Specific processor blade model (for blade servers)
 - FC host bus adapter (HBA) model and driver, firmware, and BIOS versions
 - Storage protocol (FC)
 - Windows operating system version
 - Windows Unified Host Utilities
2. Click the configuration name for the selected configuration.

Details for that configuration are displayed in the Configuration Details window.

3. Review the information in the following tabs:

- Notes

Lists important alerts and information that are specific to your configuration.

Review the alerts to identify the hotfixes that are required for your operating system.

- Policies and Guidelines

Provides general guidelines for all SAN configurations.

Complete the FC configuration worksheet

You require FC initiator and target WWPNs and storage configuration information to perform FC configuration tasks.

FC host WWPNs

Port	WWPN
Initiator (host) port connected to FC switch 1	
Initiator (host) port connected to FC switch 2	

FC target WWPNs

You require two FC data LIFs for each node in the cluster. The WWPNs are assigned by ONTAP when you create the LIFs as part of creating the storage virtual machine (SVM).

LIF	WWPN
Node 1 LIF with port connected to FC switch 1	
Node 2 LIF with port connected to FC switch 1	
Node 3 LIF with port connected to FC switch 1	
Node 4 LIF with port connected to FC switch 1	
Node 1 LIF with port connected to FC switch 2	
Node 2 LIF with port connected to FC switch 2	
Node 3 LIF with port connected to FC switch 2	
Node 4 LIF with port connected to FC switch 2	

Storage configuration

If the aggregate and SVM are already created, record their names here; otherwise, you can create them as required:

Node to own LUN
Aggregate name
SVM name

LUN information

LUN size
Host operating system
LUN name (optional)
LUN description (optional)

SVM information

If you are not using an existing SVM, you require the following information to create a new one:

SVM name

SVM name
SVM IPspace
Aggregate for SVM root volume
SVM user name (optional)
SVM password (optional)
SVM management LIF (optional)
Subnet:
IP address:
Network mask:
Gateway:
Home node:
Home port:

Install the HBA utility from the HBA vendor

The HBA utility enables you to view the worldwide port name (WWPN) of each FC port. The utility is also useful for troubleshooting FC issues.

About this task

Each HBA vendor offers an HBA utility for their FC HBAs. You must download the correct version for your host operating system and CPU.

The following is a partial list of HBA utilities:

- Emulex HBA Manager, formerly known as OneCommand Manager, for Emulex HBAs
- QLogic QConvergeConsole for QLogic HBAs

Steps

1. Download the appropriate utility from your HBA vendor's web site.
2. Run the installation program and follow the prompts to complete the installation.

Related information

[Broadcom \(Emulex\) Support Documents and Downloads](#)

Update the HBA driver, firmware, and BIOS

If the FC host bus adapters (HBAs) in the Windows host are not running supported driver, firmware, and BIOS versions, you must update them.

Before you begin

You must have identified the supported driver, firmware, and BIOS versions for your configuration from the Interoperability Matrix tool.

[NetApp Interoperability Matrix Tool](#)

About this task

Drivers, firmware, BIOS, and HBA utilities are provided by the HBA vendors.

Steps

1. List the installed HBA driver, firmware, and BIOS versions by using the HBA utility from your HBA vendor.
2. Download and install the new driver, firmware, and BIOS as needed from the HBA vendor's support site.

Installation instructions and any required installation utilities are available with the download.

Record the WWPN for each host FC port

The worldwide port name (WWPN) is required to zone the FC switches and to create the igroups that allow the host to access its LUN.

Before you begin

You must have installed the vendor's HBA utility for the HBAs in your host and verified HBAs are running supported driver, firmware, and BIOS versions for your configuration.

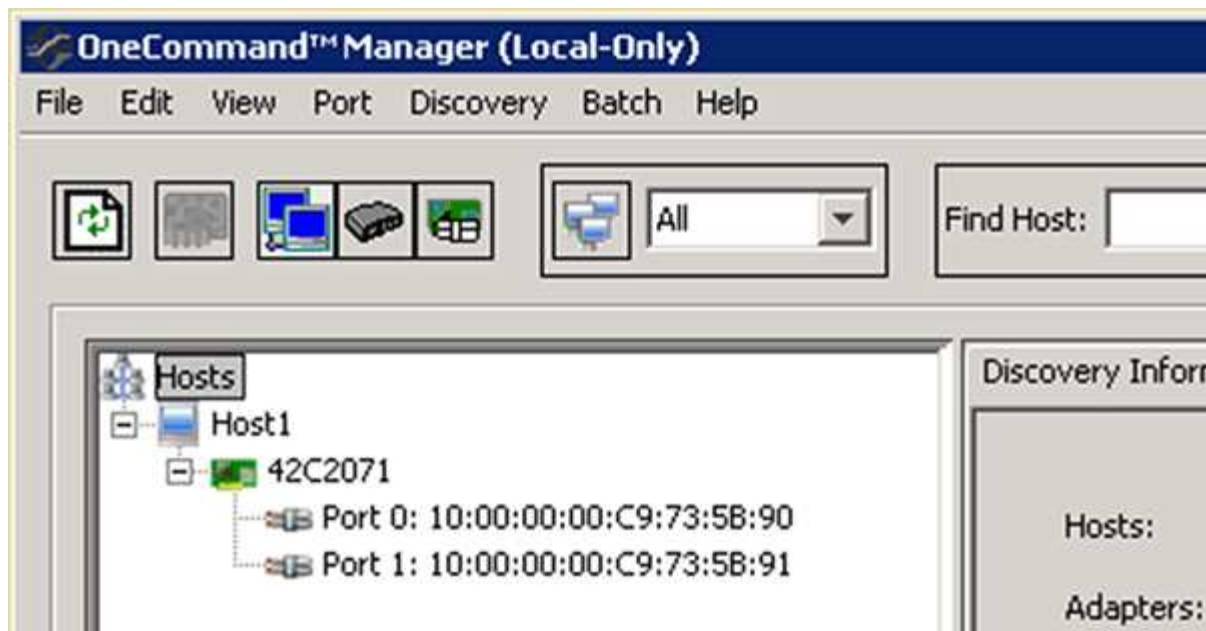
About this task

The WWPN is used for all configuration. You do not have to record the worldwide node name (WWNN).

Steps

1. Run the HBA utility for your FC HBA type.
2. Select the HBA.
3. Record the WWPN of each port.

The following example shows Emulex HBA Manager, formerly known as OneCommand Manager.



Other utilities, such as QLogic QConvergeConsole, provide the equivalent information.

4. Repeat the previous step for each FC HBA in the host.

Install Windows Unified Host Utilities

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.

Before you begin

You must have completed the following tasks:

- Check the supported configuration in the Interoperability Matrix
[NetApp Interoperability Matrix Tool](#)
- Identified any required Windows hotfixes from the Interoperability Matrix
[NetApp Interoperability Matrix Tool](#)
- Add the FCP license and start the target service
- Verify your cabling

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

About this task

You must specify whether to include multipathing support when you install the Windows Unified Host Utilities software package. 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.

Detailed installation information is available in [Windows Unified Host Installation](#).

NetApp Support

Steps

1. Download the appropriate version of the Windows Unified Host Utilities from the NetApp Support Site.

NetApp Support

2. Run the executable file and follow the instructions on the screen.
3. Reboot the Windows host when prompted.

Create an aggregate

If you do not want to use an existing aggregate, you can create a new aggregate to provide physical storage to the volume which you are provisioning.

Steps

1. Enter the URL `https://IP-address-of-cluster-management-LIF` in a web browser and log in to System Manager using your cluster administrator credential.
2. Navigate to the **Aggregates** window.
3. Click **Create**.
4. Follow the instructions on the screen to create the aggregate using the default RAID-DP configuration, and then click **Create**.

Create Aggregate

To create an aggregate, select a disk type then specify the number of disks.

Name:

Disk Type:

Number of Disks: Max: 8 (excluding 1 hot spare), min: 5 for RAID-DP

RAID Configuration: RAID-DP; RAID group size of 16 disks [Change](#)

New Usable Capacity: 4.968 TB (Estimated)

Results

The aggregate is created with the specified configuration and added to the list of aggregates in the Aggregates window.

Decide where to provision the volume

Before you provision a volume to contain your LUNs, you need to decide whether to add the volume to an existing storage virtual machine (SVM) or to create a new SVM for the volume. You might also need to configure FC on an existing SVM.

About this task

If an existing SVM is already configured with the needed protocols and has LIFs that can be accessed from the host, it is easier to use the existing SVM.

You can create a new SVM to separate data or administration from other users of the storage cluster. There is no advantage to using separate SVMs just to separate different protocols.

Procedure

- If you want to provision volumes on an SVM that is already configured for FC, you must verify that the FC service is running and then create a LUN on the SVM.

Verifying that the FC service is running on an existing SVM

Creating a LUN

- If you want to provision volumes on an existing SVM that has FC enabled but not configured, configure iSCSI on the existing SVM.

Configuring FC on an existing SVM

This is the case when you did not follow the procedure in this content to create the SVM while configuring a different protocol.

- If you want to provision volumes on a new SVM, create the SVM.

Creating a new SVM

Verify that the FC service is running on an existing SVM

If you choose to use an existing storage virtual machine (SVM), you must verify that the FC service is running on the SVM by using ONTAP System Manager. You must also verify that FC logical interfaces (LIFs) are already created.

Before you begin

You must have selected an existing SVM on which you plan to create a new LUN.

Steps

1. Navigate to the **SVMs** window.
2. Select the required SVM.
3. Click the **SVM Settings** tab.
4. In the **Protocols** pane, click **FC/FCoE**.
5. Verify that the FC service is running.

Edit
 Start
 Stop
 Refresh

Status: FC/FCoE service is running

WWNN: 20:05:00:a0:98:29:18:76

FC/FCoE Interfaces:

Network Interface	WWPN	Current Port	Status
FC_1_1	20:10:00:a0:98:29:18:76	innovate-01:0b	Enabled
FC_2_1	20:11:00:a0:98:29:18:76	innovate-02:0b	Enabled
FC_1_2	20:04:00:a0:98:29:18:76	innovate-02:0a	Enabled
FC_2_2	20:03:00:a0:98:29:18:76	innovate-01:0a	Enabled

If the FC service is not running, start the FC service or create a new SVM.

6. Verify that there are at least two FC LIFs listed for each node.

If there are fewer than two FC LIFs per node, update the FC configuration on the SVM or create a new SVM for FC.

Create a LUN

You use the Create LUN wizard to create a LUN. The wizard also creates the igroup and maps the LUN to the igroup, which enables the specified host to access the LUN.

Before you begin

- There must be an aggregate with enough free space to contain the LUN.
- There must be a storage virtual machine (SVM) with the FC protocol enabled and the appropriate logical interfaces (LIFs) created.
- You must have recorded the worldwide port names (WWPNs) of the host FC ports.

About this task

If your organization has a naming convention, you should use names for the LUN, volume, and so on that fit your convention. Otherwise, you should accept the default names.

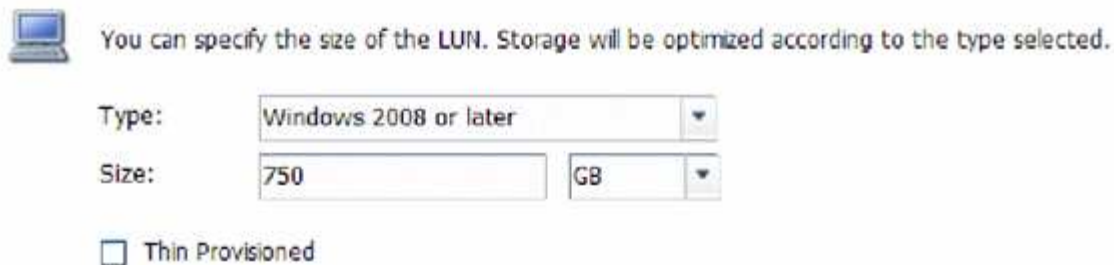
Steps

1. Navigate to the **LUNs** window.
2. Click **Create**.
3. Browse and select an SVM in which you want to create the LUNs.

The Create LUN Wizard is displayed.

4. On the **General Properties** page, select the LUN type **Windows 2008 or later** for LUNs used directly by the Windows host, or select **Hyper-V** for LUNs containing virtual hard disks (VHDs) for Hyper-V virtual machines.

Leave the **Thin Provisioned** check box unselected.



You can specify the size of the LUN. Storage will be optimized according to the type selected.

Type: Windows 2008 or later

Size: 750 GB

☐ Thin Provisioned

5. On the **LUN Container** page, select an existing FlexVol volume.

You must ensure that there is enough space in the volume. If sufficient space is not available in the existing volumes, you can create a new volume.

6. On the **Initiators Mapping** page, click **Add Initiator Group**, enter the required information on the **General** tab, and then on the **Initiators** tab, enter all the WWPNs of the host FC ports that you recorded.
7. Confirm the details, and then click **Finish** to complete the wizard.

Related information

System administration

Configure FC on an existing SVM

You can configure FC on an existing storage virtual machine (SVM) and create a LUN and its containing volume with a single wizard. The FC protocol must already be enabled but not configured on the SVM. This information is intended for SVMs for which you are configuring multiple protocols, but have not yet configured FC.

Before you begin

Your FC fabric must be configured and the desired physical ports must be connected to the fabric.

Steps

1. Navigate to the **SVMs** window.
2. Select the SVM that you want to configure.
3. In the **SVM Details** pane, verify that **FC/FCoE** is displayed with a gray background, which indicates that the protocol is enabled but not fully configured.

If **FC/FCoE** is displayed with a green background, the SVM is already configured.



4. Click the **FC/FCoE** protocol link with the gray background.

The Configure FC/FCoE Protocol window is displayed.

5. Configure the FC service and LIFs from the **Configure FC/FCoE protocol** page:
 - a. Select the **Configure Data LIFs for FC** check box.

- b. Enter 2 in the **LIFs per node** field.

Two LIFs are required for each node, to ensure availability and data mobility.

- c. In the **Provision a LUN for FCP storage** area, enter the desired LUN size, host type, and WWPNs of the host initiators.
- d. Click **Submit & Close**.

Configure FC/FCoE protocol

? Configure LIFs to access the data using FC/FCoE protocol

Data Interface (LIF) Configuration

Both FC and FCoE enabled hardware found. Click on the appropriate checkbox to configure the FC and/or FCoE LIFs.

☒ Configure Data LIFs for FC

LIFs per node: (Minimum: 1, Maximum: 2)

Provision a LUN for FCP storage (Optional)

Lun Size: ▼

LUN OS Type: ▼

Host Initiator:

6. Review the **Summary** page, record the LIF information, and then click **OK**.

Create a new SVM

The storage virtual machine (SVM) provides the FC target through which a host accesses LUNs. When you create the SVM, you also create logical interfaces (LIFs) and the LUN and its containing volume. You can create an SVM to separate the data and administration functions of a user from those of the other users in a cluster.

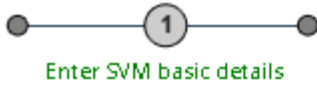
Before you begin

- Your FC fabric must be configured and the desired physical ports must be connected to the fabric.

Steps

1. Navigate to the **SVMs** window.
2. Click **Create**.
3. In the **Storage Virtual Machine (SVM) Setup** window, create the SVM:

Storage Virtual Machine (SVM) Setup



SVM Details

? Specify a unique name and the data protocols for the SVM

SVM Name:

? IPspace: ▼

? Data Protocols: ☒ CIFS ☒ NFS ☒ iSCSI ☒ FC/FCoE ☐ NVMe

? Default Language: ▼

The language of the SVM specifies the default language encoding setting for the SVM and its volumes. Using a setting that incorporates UTF-8 character encoding is recommended.

? Security Style: ▼

Root Aggregate: ▼

a. Specify a unique name for the SVM.

The name must either be a fully qualified domain name (FQDN) or follow another convention that ensures unique names across a cluster.

b. Select the IPspace that the SVM will belong to.

If the cluster does not use multiple IPspaces, the “Default” IPspace is used.

c. Keep the default volume type selection.

Only FlexVol volumes are supported with SAN protocols.

d. Select all of the protocols that you have licenses for and that you might use on the SVM, even if you do not want to configure all of the protocols immediately.

Selecting both NFS and CIFS when you create the SVM enables these two protocols to share the same LIFs. Adding these protocols later does not allow them to share LIFs.

If CIFS is one of the protocols you selected, then the security style is set to NTFS. Otherwise, the security style is set to UNIX.

e. Keep the default language setting C.UTF-8.

f. Select the desired root aggregate to contain the SVM root volume.

The aggregate for the data volume is selected separately in a later step.

g. Click **Submit & Continue**.

The SVM is created, but protocols are not yet configured.

4. If the **Configure CIFS/NFS protocol** page appears because you enabled CIFS or NFS, click **Skip** and

then configure CIFS or NFS later.

5. If the **Configure iSCSI protocol** page appears because you enabled iSCSI, click **Skip** and then configure iSCSI later.
6. Configure the FC service and create LIFs, and the LUN and its containing volume from the **Configure FC/FCoE protocol** page:
 - a. Select the **Configure Data LIFs for FC** check box.
 - b. Enter 2 in the **LIFs per node** field.

Two LIFs are required for each node to ensure availability and data mobility.

- c. In the **Provision a LUN for FCP storage** area, enter the desired LUN size, host type, and WWPNs of the host initiators.
- d. Click **Submit & Continue**.

Configure FC/FCoE protocol

? Configure LIFs to access the data using FC/FCoE protocol

Data Interface (LIF) Configuration

Both FC and FCoE enabled hardware found. Click on the appropriate checkbox to configure the FC and/or FCoE LIFs.

☒ Configure Data LIFs for FC

LIFs per node: (Minimum: 1, Maximum: 2)

Provision a Lun for FCP storage (Optional)

Lun Size: GB

LUN OS Type:

Host Initiator:

☐ Review or Edit the Interface Association

☐ Configure Data LIFs for FCoE

7. When the **SVM Administration** appears, configure or defer configuring a separate administrator for this SVM:
 - Click **Skip** and configure an administrator later if desired.
 - Enter the requested information, and then click **Submit & Continue**.
8. Review the **Summary** page, record the LIF information, and then click **OK**.

Zone the FC switches by the host and LIF WWPNS

Zoning the FC switches enables the hosts to connect to the storage and limits the number of paths. You zone the switches using the management interface of the switches.

Before you begin

- You must have administrator credentials for the switches.
- You must know the WWPNS of each host initiator port and of each FC LIF for the storage virtual machine (SVM) in which you created the LUN.

About this task

For details about zoning your switches, see the switch vendor's documentation.

You must zone by WWPN, not by physical port. Each initiator port must be in a separate zone with all of its corresponding target ports.

LUNs are mapped to a subset of the initiators in the igroup to limit the number of paths from the host to the LUN.

- By default, ONTAP uses Selective LUN Map to make the LUN accessible only through paths on the node owning the LUN and its HA partner.
- You still must zone all of the FC LIFs on every node for LUN mobility in case the LUN is moved to another node in the cluster.
- When moving a volume or a LUN, you must modify the Selective LUN Map reporting-nodes list before moving.

The following illustration shows a host connected to a four-node cluster. There are two zones, one zone indicated by the solid lines and one zone indicated by the dashed lines. Each zone contains one initiator from the host and a LIF from each storage node.

You must use the WWPNs of the target LIFs, not the WWPNs of the physical FC ports on the storage nodes. The LIF WWPNs are all in the range `2x:xx:00:a0:98:xx:xx:xx`, where `x` is any hexadecimal digit. The physical port WWPNs are all in the range `50:0a:09:8x:xx:xx:xx:xx`.

Steps

1. Log in to the FC switch administration program, and then select the zoning configuration option.
2. Create a new zone that includes the first initiator and all of the FC LIFs that connect to the same FC switch as the initiator.
3. Create additional zones for each FC initiator in the host.
4. Save the zones, and then activate the new zoning configuration.

Discover new disks

LUNs on your storage virtual machine (SVM) appear as disks to the Windows host. Any new disks for LUNs you add to your system are not automatically discovered by the host. You must manually rescan disks to discover them.

Steps

1. Open the Windows Computer Management utility:

If you are using...	Navigate to...
Windows Server 2012	Tools > Computer Management
Windows Server 2008	Start > Administrative Tools > Computer Management
Windows Server 2016	Start > Administrative Tools > Computer Management

2. Expand the **Storage** node in the navigation tree.
3. Click **Disk Management**.
4. Click **Action > Rescan Disks**.

Initialize and format the LUN

When a new LUN is first accessed by the Windows host, it has no partition or file system. You must initialize the LUN, and optionally format it with a file system.

Before you begin

The LUN must have been discovered by the Windows host.

About this task

LUNs appear in Windows Disk Management as disks.

You can initialize the disk as a basic disk with a GPT or MBR partition table.

You typically format the LUN with a file system such as NTFS, but some applications use raw disks instead.

Steps

1. Start Windows Disk Management.
2. Right-click the LUN, and then select the required disk or partition type.
3. Follow the instructions in the wizard.

If you choose to format the LUN as NTFS, you must select the **Perform a quick format** check box.

Verify that the host can write to and read from the LUN

Before using the LUN, you should verify that the host can write data to the LUN and read it back.

Before you begin

The LUN must be initialized and formatted with a file system.

About this task

If the storage cluster node on which the LUN is created can be failed over to its partner node, you should verify reading the data while the node is failed over. This test might not be possible if the storage cluster is in production use.

If any of the tests fail, you should verify that the FC service is running and check the FC paths to the LUN.

Steps

1. On the host, copy one or more files to the LUN.
2. Copy the files back to a different folder on the original disk.
3. Compare the copied files to the original.

You can use the `comp` command at the Windows command prompt to compare two files.

4. Fail over the storage cluster node containing the LUN and verify that you can still access the files on the

LUN.

5. Use the native DSM to view the paths to the LUN and verify that you have the expected number of paths.

You should see two paths to the storage cluster node on which the LUN is created, and two paths to the partner node.

Where to find additional information

There are additional documents to help you learn more about FC configuration.

All of the following documentation is available:

- [SAN configuration](#)

Describes supported FC, iSCSI, and FCoE topologies for connecting host computers to storage controllers in clusters.

- [SAN administration](#)

Describes how to configure and manage the iSCSI, FCoE, and FC protocols for clustered SAN environments, including configuration of LUNs, igroups, and targets.

iSCSI configuration for ESXi using VSC

iSCSI configuration for ESXi using VSC overview

This content describes how to quickly set up the iSCSI service on a storage virtual machine (SVM), provision a LUN, and make the LUN available using an iSCSI initiator on an ESXi host computer.

This content is based on the following assumptions:

- You want to use best practices, not explore every available option.
- You do not want to read a lot of conceptual background.
- You want to use System Manager, not the ONTAP command-line interface or an automated scripting tool.
- You want to use the *Classic* System Manager UI for ONTAP 9.7 and earlier releases, not the ONTAP System Manager UI for ONTAP 9.7 and later.

[ONTAP System Manager documentation](#)

- You are using the native ESXi iSCSI software initiator on ESXi 5.x.
- You are not using CHAP authentication for iSCSI.
- You are using a supported version of Virtual Storage Console for VMware vSphere to configure storage settings for your ESX host.
- Your network uses IPv4 addressing.
- You want to assign addresses to logical interfaces using any of the following methods:
 - Automatically from a subnet you define

- Manually, using an address selected from an existing subnet
- Manually, using an address that will be added to an existing subnet
- You have at least two high-speed Ethernet ports (1 GbE minimum, 10 GbE recommended) available on each node in the cluster.

Onboard UTA2 (also called CNA) ports are configurable. You configure those ports in the ONTAP CLI; that process is not covered in this content.

You should see [ONTAP 9 Network Management](#) for using the CLI to configure Ethernet port flow control.

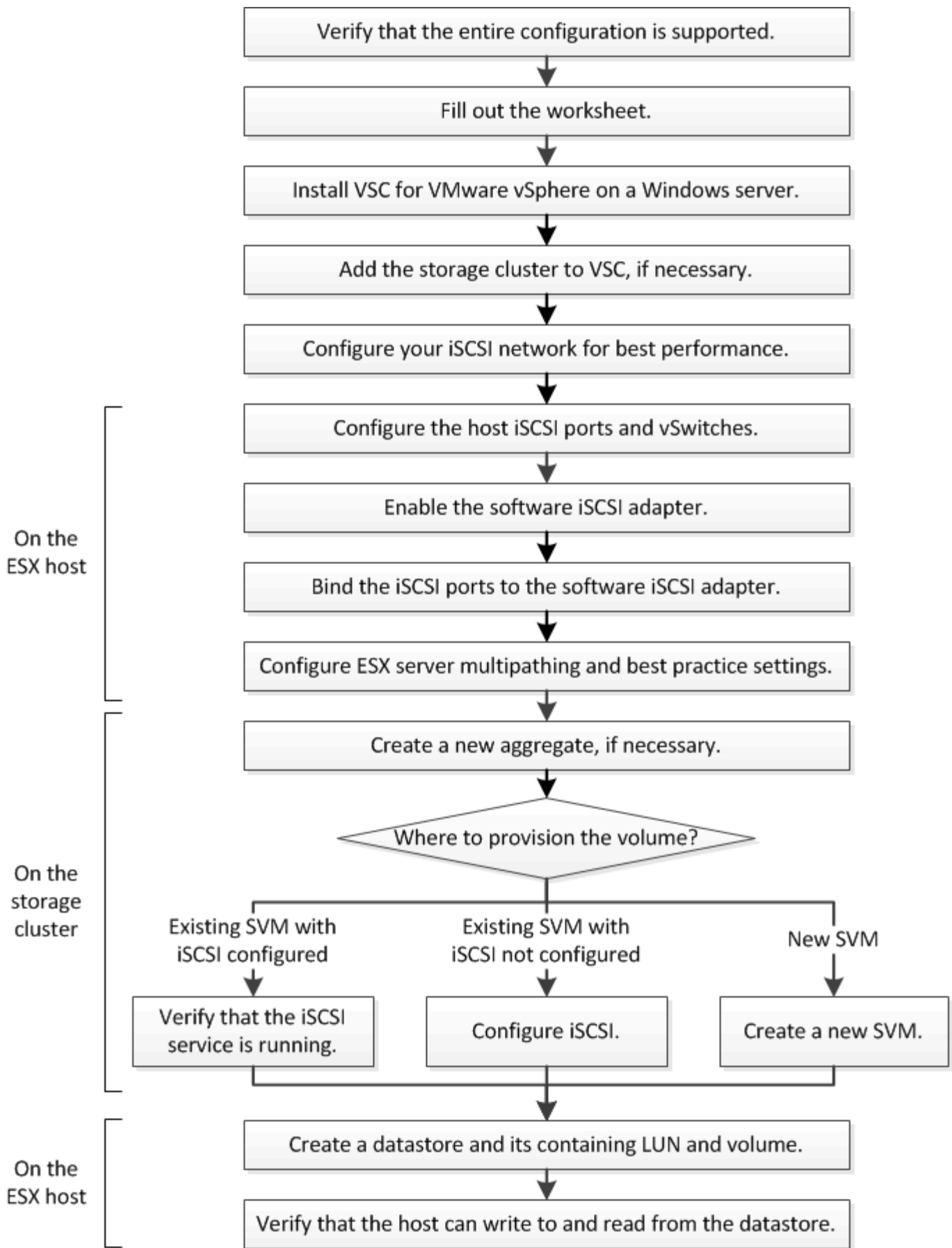
- You are not configuring iSCSI SAN boot.
- You are providing storage to VMs through the ESXi hypervisor and not running an iSCSI initiator within the VM.

If these assumptions are not correct for your situation, you should see the following resources:

- [ONTAP 9 SAN Administration](#)
- [ONTAP 9 SAN Configuration](#)
- [Appliance administration](#)
- *VMware vSphere Storage* for your version of ESXi 5 (available from [VMware](#))

iSCSI configuration workflow

When you make storage available to an ESXi host using iSCSI, you provision a volume and LUN on the storage virtual machine (SVM) using Virtual Storage Console for VMware vSphere, and then connect to the LUN from the host.



Verify that the iSCSI configuration is supported

For reliable operation, you must verify that the entire iSCSI configuration is supported.

Steps

1. Go to the Interoperability Matrix to verify that you have a supported combination of the following components:
 - ONTAP software
 - Host computer CPU architecture (for standard rack servers)
 - Specific processor blade model (for blade servers)
 - Storage protocol (iSCSI)
 - ESXi operating system version
 - Guest operating system type and version
 - Virtual Storage Console (VSC) for VMware vSphere software
 - Windows Server version to run VSC
2. Click the configuration name for the selected configuration.

Details for that configuration are displayed in the Configuration Details window.

3. Review the information in the following tabs:

- Notes

Lists important alerts and information that are specific to your configuration.

- Policies and Guidelines

Provides general guidelines for all SAN configurations.

Completing the iSCSI configuration worksheet

You require network addresses and storage configuration information to perform iSCSI configuration tasks.

Target network addresses

The storage virtual machine (SVM) is the iSCSI target.

You require a subnet with two IP addresses for iSCSI data LIFs for each node in the cluster. There should be two separate networks for high availability. The specific IP addresses are assigned by ONTAP when you create the LIFs as part of creating the SVM.

If possible, separate iSCSI traffic on separate physical networks or on VLANs.

Subnet for LIFs:

Node or LIF with port to switch	IP address	Network mask	Gateway	VLAN ID	Home port
Node 1 / LIF to switch 1					
Node 2 / LIF to switch 1					
Node 3 / LIF to switch 1					
Node 4 / LIF to switch 1					
Node 1 / LIF to switch 2					
Node 2 / LIF to switch 2					
Node 3 / LIF to switch 2					
Node 4 / LIF to switch 2					

Storage configuration

If the aggregate and SVM are already created, record their names here; otherwise, you can create them as required:

Node to own LUN
Aggregate name
SVM name

LUN information

LUN size
LUN name (optional)
LUN description (optional)

LUN size

SVM information

If you are not using an existing SVM, you require the following information to create a new one:

SVM name
SVM IPspace
Aggregate for SVM root volume
SVM user name (optional)
SVM password (optional)
SVM management LIF (optional)
Subnet:
IP address:
Network mask:
Gateway:
Home node:
Home port:

Install Virtual Storage Console

Virtual Storage Console for VMware vSphere automates many of the configuration and provisioning tasks required to use NetApp iSCSI storage with an ESXi host. Virtual Storage Console is a plug-in to vCenter Server.

Before you begin

You must have administrator credentials on the vCenter Server used to manage the ESXi host.

About this task

- Virtual Storage Console is installed as a virtual appliance that includes Virtual Storage Console, vStorage APIs for Storage Awareness (VASA) Provider, and Storage Replication Adapter (SRA) for VMware vSphere capabilities.

Steps

1. Download the version of Virtual Storage Console that is supported for your configuration, as shown in the Interoperability Matrix tool.

[NetApp Support](#)

2. Deploy the virtual appliance and configure it following the steps in the *Deployment and Setup Guide*.

Add the storage cluster or SVM to VSC for VMware vSphere

Before you can provision the first datastore to an ESXi host in your Datacenter, you must add the cluster or a specific storage virtual machine (SVM) to Virtual Storage Console for VMware vSphere. Adding the cluster enables you to provision storage on any SVM in the cluster.

Before you begin

You must have administrator credentials for the storage cluster or the SVM that is being added.

About this task

Depending on your configuration, the cluster might have been discovered automatically, or might have already been added.

Steps

1. Log in to the vSphere Web Client.
2. Select **Virtual Storage Console**.
3. Select **Storage Systems** and then click the **Add** icon.
4. In the **Add Storage System** dialog box, enter the host name and administrator credentials for the storage cluster or SVM and then click **OK**.

Configure your network for best performance

Ethernet networks vary greatly in performance. You can maximize the performance of the network used for iSCSI by selecting specific configuration values.

Steps

1. Connect the host and storage ports to the same network.

It is best to connect to the same switches. Routing should never be used.

2. Select the highest speed ports available, and dedicate them to iSCSI.

10 GbE ports are best. 1 GbE ports are the minimum.

3. Disable Ethernet flow control for all ports.

You should see [ONTAP 9 Network Management](#) for using the CLI to configure Ethernet port flow control.

4. Enable jumbo frames (typically MTU of 9000).

All devices in the data path, including initiators, targets, and switches, must support jumbo frames. Otherwise, enabling jumbo frames actually reduces network performance substantially.

Configure host iSCSI ports and vSwitches

The ESXi host requires network ports for the iSCSI connections to the storage cluster.

About this task

It is recommended that you use IP Hash as the NIC teaming policy, which requires a single VMkernel port on a single vSwitch.

The host ports and storage cluster ports used for iSCSI must have IP addresses in the same subnet.

This task lists the high-level steps for configuring the ESXi host. If you require more detailed instructions, see the VMware publication *VMware vSphere Storage* for your version of ESXi.

VMware

Steps

1. Log in to the vSphere Client, and then select the ESXi host from the inventory pane.
2. On the **Manage** tab, click **Networking**.
3. Click **Add Networking**, and then select **VMkernel** and **Create a vSphere standard switch** to create the VMkernel port and vSwitch.
4. Configure jumbo frames for the vSwitch (MTU size of 9000, if used).
5. Repeat the previous step to create a second VMkernel port and vSwitch.

Enable the iSCSI software adapter

The iSCSI software adapter creates the iSCSI connection on the ESXi host. It is built into the operating system, but must be enabled before it can be used.

Before you begin

You must have a VMware vSphere Client installed on your workstation or you must have access to a vSphere Web Client.

Steps

1. Log in to the vSphere Client.
2. Select the ESX host from the inventory pane.
3. Click **Configuration > Storage Adapters**.
4. Select the iSCSI software adapter and click **Properties > Configure**.
5. Select **Enabled** and then click **OK**.

Bind iSCSI ports to the iSCSI software adapter

The ports you created for iSCSI must be associated with the iSCSI software adapter to support multipathing.

Before you begin

- The iSCSI VMkernel ports must be created.
- The iSCSI software adapter must be enabled on the ESXi host.

About this task

You can bind the iSCSI ports using the vSphere Client.

For detailed instructions, see *VMware vSphere Storage* for your version of ESXi 5 from VMware.

VMware

Steps

1. Bind the first iSCSI port to the iSCSI software adapter by using the **Network Port Binding** tab of the iSCSI software adapter **Adapter Details** dialog box in the vSphere Client.
2. Bind the second iSCSI port to the iSCSI software adapter.

Configure the ESXi host best practice settings

You must ensure that the host multipathing and best practice settings are correct so that the ESXi host can correctly manage the loss of an iSCSI connection or a storage failover event.

Steps

1. From the VMware vSphere Web Client **Home** page, click **vCenter > Hosts**.
2. Right-click the host, and then select **Actions > NetApp VSC > Set Recommended Values**.
3. In the **NetApp Recommended Settings** dialog box, ensure that all of the options are selected, and then click **OK**.

The vCenter Web Client displays the task progress.

Create an aggregate

If you do not want to use an existing aggregate, you can create a new aggregate to provide physical storage to the volume which you are provisioning.

Steps

1. Enter the URL `https://IP-address-of-cluster-management-LIF` in a web browser and log in to System Manager using your cluster administrator credential.
2. Navigate to the **Aggregates** window.
3. Click **Create**.
4. Follow the instructions on the screen to create the aggregate using the default RAID-DP configuration, and then click **Create**.

Create Aggregate

To create an aggregate, select a disk type then specify the number of disks.

Name:

? Disk Type:

Number of Disks:
Max: 8 (excluding 1 hot spare), min: 5 for RAID-DP

RAID Configuration: RAID-DP; RAID group size of 16 disks

New Usable Capacity: 4.968 TB (Estimated)

Results

The aggregate is created with the specified configuration and added to the list of aggregates in the Aggregates window.

Decide where to provision the volume

Before you provision a volume to contain your LUNs, you need to decide whether to add the volume to an existing storage virtual machine (SVM) or to create a new SVM for the volume. You might also need to configure iSCSI on an existing SVM.

About this task

If an existing SVM is already configured with the needed protocols and has LIFs that can be accessed from the host, it is easier to use the existing SVM.

You can create a new SVM to separate data or administration from other users of the storage cluster. There is no advantage to using separate SVMs just to separate different protocols.

Procedure

- If you want to provision volumes on an SVM that is already configured for iSCSI, you must verify that the iSCSI service is running.

Verifying that the iSCSI service is running on an existing SVM

- If you want to provision volumes on an existing SVM that has iSCSI enabled but not configured, configure iSCSI on the existing SVM.

Configuring iSCSI on an existing SVM

This is the case when you did not follow the procedure in this content to create the SVM while configuring a different protocol.

- If you want to provision volumes on a new SVM, [create a new SVM](#).

Verify that the iSCSI service is running on an existing SVM

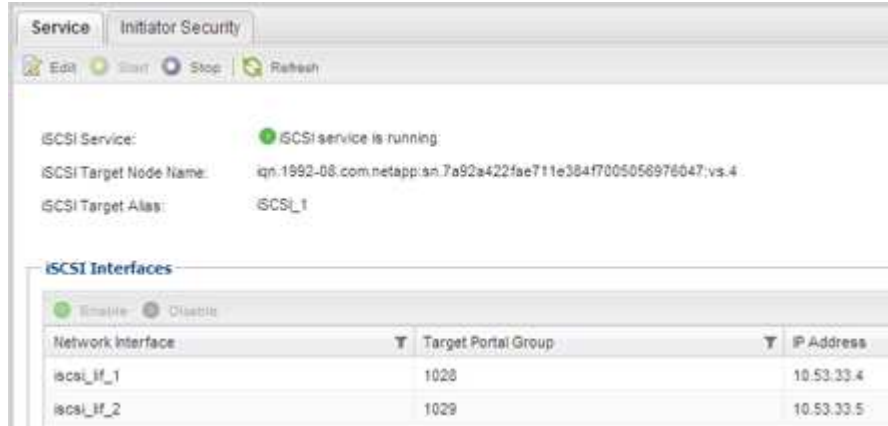
If you choose to use an existing storage virtual machine (SVM), you must verify that the iSCSI service is running on the SVM.

Before you begin

You must have selected an existing SVM on which you plan to create a new LUN.

Steps

1. Navigate to the **SVMs** window.
2. Click the **SVM Settings** tab.
3. In the **Protocols** pane, click **iSCSI**.
4. Verify that the iSCSI service is running.



5. Record the iSCSI interfaces listed for the SVM.

What to do next

If the iSCSI service is not running, start the iSCSI service or create a new SVM.

If there are fewer than two iSCSI interfaces per node, update the iSCSI configuration on the SVM or create a new SVM for iSCSI.

Configure iSCSI on an existing SVM

You can configure iSCSI on an existing storage virtual machine (SVM). The iSCSI protocol must already be enabled but not configured on the SVM. This information is intended for SVMs for which you are configuring multiple protocols, but have not yet configured iSCSI.

Before you begin

You must have enough network addresses available to create two LIFs for each node.

Steps

1. Navigate to the **SVMs** window.
2. Select the SVM that you want to configure.
3. In the **SVMDetails** pane, verify that **iSCSI** is displayed with a gray background, which indicates that the protocol is enabled but not fully configured.

If **iSCSI** is displayed with a green background, the SVM is already configured.

Details

Protocols:

NFS CIFS FC/FCoE **iSCSI**

4. Click the **iSCSI** protocol link with the gray background.

The Configure iSCSI Protocol window is displayed.

5. Configure the iSCSI service and LIFs from the **Configure iSCSI protocol** page:

- a. Enter a target alias name.
- b. Enter 2 in the **LIFs per node** field.

Two LIFs are required for each node to ensure availability and data mobility.

- c. Assign IP addresses for the LIFs either with a subnet or without a subnet.
- d. Ignore the optional **Provision a LUN for iSCSI storage** area, because the LUN is provisioned by Virtual Storage Console for VMware vSphere in a later step.
- e. Click **Submit & Close**.

6. Review the **Summary** page, record the LIF information, and then click **OK**.

Create a new SVM

The storage virtual machine (SVM) provides the iSCSI target through which a host accesses LUNs. When you create the SVM, you also create logical interfaces (LIFs) that provide paths to the LUN. You can create an SVM to separate the data and administration functions of a user from those of the other users in a cluster.

Before you begin

- You must have enough network addresses available to create two LIFs for each node.

Steps

1. Navigate to the **SVMs** window.
2. Click **Create**.
3. In the **Storage Virtual Machine (SVM) Setup** window, create the SVM:

- a. Specify a unique name for the SVM.

The name must either be a fully qualified domain name (FQDN) or follow another convention that ensures unique names across a cluster.

- b. Select the IPspace that the SVM will belong to.

If the cluster does not use multiple IPspaces, the “Default” IPspace is used.

- c. Keep the default volume type selection.

Only FlexVol volumes are supported with SAN protocols.

- d. Select all of the protocols that you have licenses for and that you might use on the SVM, even if you do not want to configure all of the protocols immediately.

Selecting both NFS and CIFS when you create the SVM enables these two protocols to share the same LIFs. Adding these protocols later does not allow them to share LIFs.

If CIFS is one of the protocols you selected, then the security style is set to NTFS. Otherwise, the security style is set to UNIX.

- e. Keep the default language setting C.UTF-8.
- f. Select the desired root aggregate to contain the SVM root volume.

The aggregate for the data volume is selected separately in a later step.

- g. Click **Submit & Continue**.

The SVM is created, but protocols are not yet configured.

- 4. If the **Configure CIFS/NFS protocol** page appears because you enabled CIFS or NFS, click **Skip** and then configure CIFS or NFS later.
- 5. Configure the iSCSI service and create LIFs from the **Configure iSCSI protocol** page:
 - a. Enter a target alias name.
 - b. Assign IP address for the LIFs either by using a subnet or without a subnet.
 - c. Enter 2 in the **LIFs per node** field.

Two LIFs are required for each node to ensure availability and data mobility.

- d. Skip the optional **Provision a LUN for iSCSI storage** area because the LUN is provisioned by Virtual Storage Console for VMware vSphere in a later step.
 - e. Click **Submit & Continue**.
- 6. If the **Configure FC/FCoE protocol** page appears because you enabled FC, click **Skip** and then configure FC later.
- 7. When the **SVM Administration** appears, configure or defer configuring a separate administrator for this SVM:
 - Click **Skip** and configure an administrator later if desired.
 - Enter the requested information, and then click **Submit & Continue**.
- 8. Review the **Summary** page, record the LIF information, and then click **OK**.

Test iSCSI paths from the host to the storage cluster

To ensure successful storage failover and data mobility, you need to ensure that you have two paths from the host to every node in the storage cluster. Because the number of paths advertised by the iSCSI target is limited, you need to ping the storage cluster ports from the host.

Before you begin

You must know the IP address or host name of all of the logical interfaces (LIFs) to be used for iSCSI paths.

About this task

LUNs are mapped to a subset of the initiators in the igroup to limit the number of paths from the host to the LUN.

- By default, only paths from the host to the node containing the storage virtual machine (SVM) where the LUN was created, and paths to the HA partner of that node, are visible to the host.
- You still must create and test paths from the host to every node in the cluster, but the host can access only those paths on the owning node and its HA partner.
- You should use the default LUN mapping behavior.

Only add nodes in other HA pairs to the LUN map in preparation for moving the LUN to a different node.

Steps

1. From the ESXi host, use the `ping` command to verify the path to the first LIF.

The `ping` command is available from the ESXi service console.

2. Repeat the `ping` command to verify connectivity to each iSCSI LIF on each node in the cluster.

Related information

[VMware KB article 1003486: Testing network connectivity with the ping command](#)

Provision a datastore and creating its containing LUN and volume

A datastore contains virtual machines and their VMDKs on the ESXi host. The datastore on the ESXi host is provisioned on a LUN on the storage cluster.

Before you begin

Virtual Storage Console for VMware vSphere (VSC) must be installed and registered with the vCenter Server that manages the ESXi host.

VSC must have sufficient cluster or storage virtual machine (SVM) credentials to create the LUN and volume.

About this task

VSC automates the datastore provisioning, including creating a LUN and volume on the specified SVM.

Steps

1. From the vSphere Web Client **Home** page, click **Hosts and Clusters**.
2. In the navigation pane, expand the datacenter where you want to provision the datastore.
3. Right-click the ESXi host, and then select **NetApp VSC > Provision Datastore**.

Alternatively, you can right-click the cluster when provisioning to make the datastore available to all hosts in the cluster.

4. Provide the required information in the wizard:



The screenshot shows the 'NetApp Datastore Provisioning Wizard' window. On the left, a sidebar lists four steps: '1 Name and type' (selected with a green checkmark), '2 Storage system', '3 Details', and '4 Ready to complete'. The main area contains the following fields and instructions:

- Name :** A text box containing 'ESX_1_DS2'.
- Type :** Radio buttons for 'NFS' and 'VMFS'. 'VMFS' is selected.
- VMFS Protocol :** Radio buttons for 'FC/FCoE' and 'iSCSI'. 'iSCSI' is selected.
- Storage Capability Profile :** A dropdown menu showing 'None'.

Instructions in the main area include: 'Specify the name and type of datastore you want to provision.', 'You will be able to select the storage system for your datastore in the next page of this wizard.', and 'Select the storage capability profile you want to use to provision a new datastore.' At the bottom right are buttons for 'Back', 'Next', 'Finish', and 'Cancel'.

- Select **VMFS** as the datastore type.
- Select **iSCSI** as the VMFS protocol.
- Select **None** as the Storage Capability Profile.
- Select the box for **Thin provision**.
- Select the **Create new volume** check box.

Verify that the host can write to and read from the LUN

Before using the LUN, you should verify that the host can write data to the LUN and read it back.

About this task

If the cluster node on which the LUN is created can be failed over to its partner node, you should verify reading the data while the node is failed over. This test might not be possible if the cluster is in production use.

Steps

1. On the vSphere Web Client **Home** page, click **Hosts and Clusters**.
2. In the navigation pane, click the **Storage** tab.
3. Expand the datacenter, and then select the new datastore.
4. In the center pane, click **Manage > Files**.

The contents of the datastore are displayed.

5. Create a new folder in the datastore and upload a file to the new folder.

You might need to install the Client Integration Plug-in.

6. Verify that you can access the file you just wrote.
7. Fail over the cluster node containing the LUN and verify that you can still write and read a file.

If any of the tests fail, verify that the iSCSI service is running on the storage cluster and check the iSCSI paths to the LUN.

8. If you failed over the cluster node, be sure to give back the node and return all LIFs to their home ports.
9. For an ESXi cluster, view the datastore from each ESXi host in the cluster and verify that the file you uploaded is displayed.

Related information

[High availability management](#)

Where to find additional information

There are additional documents to help you learn more about iSCSI configuration.

All of the following documentation is available:

- [SAN configuration](#)

Describes supported FC, iSCSI, and FCoE topologies for connecting host computers to storage controllers in clusters.

- [SAN administration](#)

Describes how to configure and manage the iSCSI, FCoE, and FC protocols for clustered SAN environments, including configuration of LUNs, igroups, and targets.

VMware documentation

Documentation about iSCSI for ESXi servers is available directly from VMware.

[VMware](#)

- *vSphere Storage*

This VMware guide describes FC and iSCSI configuration for ESXi 5.x.

- *Multipathing Configuration for Software iSCSI Using Port Binding*

Technical White Paper describes MPIO setup for ESXi servers.

iSCSI configuration for Red Hat Enterprise Linux

iSCSI configuration for Red Hat Enterprise Linux overview

This content describes how to quickly set up the iSCSI service on a storage virtual machine (SVM), provision a LUN, and make the LUN available using an iSCSI initiator on a Red Hat Enterprise Linux server.

This content is based on the following assumptions:

- You want to use best practices, not explore every available option.
- You do not want to read a lot of conceptual background.
- You want to use the *Classic* System Manager UI for ONTAP 9.7 and earlier releases, not the ONTAP

System Manager UI for ONTAP 9.7 and later.

[ONTAP System Manager documentation](#)

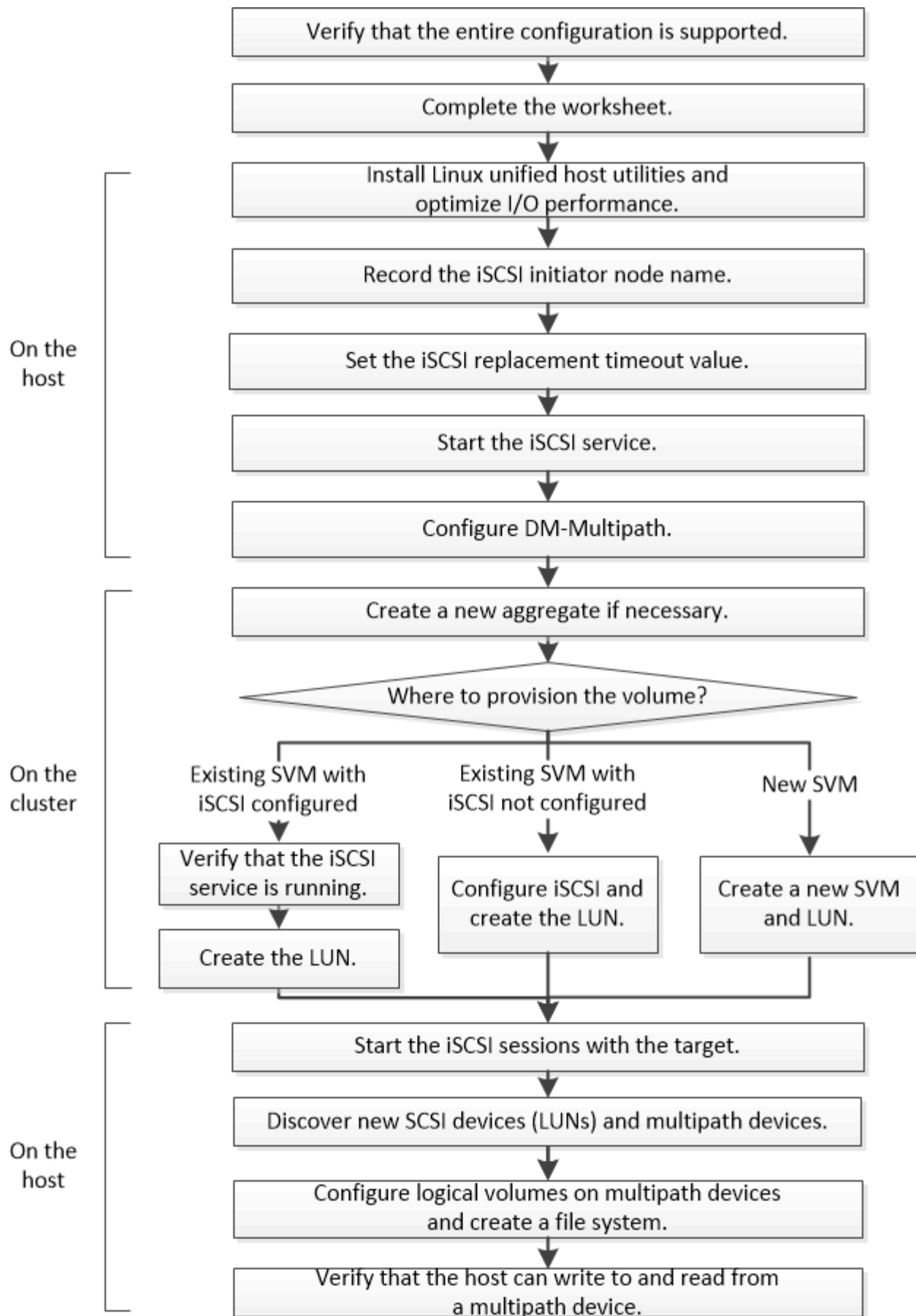
- You are using the iSCSI software initiator on a Red Hat Enterprise Linux host running a supported version of RHEL Series 6.4 or higher.
- Your network uses IPv4 addressing.
- You want to assign addresses to logical interfaces using any of the following methods:
 - Automatically, from a subnet you define
 - Manually, using an address selected from an existing subnet
 - Manually, using an address that will be added to an existing subnet
- You are not configuring iSCSI SAN boot.

If these assumptions are not correct for your situation, you should see the following resources:

- [SAN administration](#)
- [SAN configuration](#)
- [Linux Unified Host Utilities 7.1 Installation](#)

iSCSI configuration and provisioning workflow

When you make storage available to a host using iSCSI, you provision a volume and LUN on the storage virtual machine (SVM), and then connect to the LUN from the host.



Verify that the iSCSI configuration is supported

For reliable operation, you must verify that the entire iSCSI configuration is supported.

Steps

1. Go to the Interoperability Matrix to verify that you have a supported combination of the following components:
 - ONTAP software
 - Host computer CPU architecture (for standard rack servers)
 - Specific processor blade model (for blade servers)
 - Storage protocol (iSCSI)
 - Linux operating system version
 - DM-Multipath package
 - Linux Unified Host Utilities
2. Click the configuration name for the selected configuration.

Details for that configuration are displayed in the Configuration Details window.

3. Review the information in the following tabs:

- Notes

Lists important alerts and information that are specific to your configuration.

Review the alerts to identify the packages that are required for your operating system.

- Policies and Guidelines

Provides general guidelines for all SAN configurations.

Related information

[NetApp Interoperability Matrix Tool](#)

Complete the iSCSI configuration worksheet

You require iSCSI identifiers, network addresses, and storage configuration information to perform iSCSI configuration tasks.

iSCSI identifiers

Initiator (host) iSCSI node name (IQN)
Target alias (optional)

Target network addresses

The storage virtual machine (SVM) is the iSCSI target.

You require a subnet with two IP addresses for iSCSI data LIFs for each node in the cluster. There should be two separate networks for high availability. The specific IP addresses are assigned by ONTAP when you create the LIFs as part of creating the SVM.

If possible, separate iSCSI traffic on separate physical networks or on VLANs.

Subnet for LIFs: **_

Node or LIF with port to switch	IP address	Network mask	Gateway	VLAN ID	Home port
Node 1 / LIF to switch 1					
Node 2 / LIF to switch 1					
Node 3 / LIF to switch 1					
Node 4 / LIF to switch 1					
Node 1 / LIF to switch 2					
Node 2 / LIF to switch 2					
Node 3 / LIF to switch 2					
Node 4 / LIF to switch 2					

Storage configuration

If the aggregate and SVM are already created, record their names here; otherwise, you can create them as required:

Node to own LUN
Aggregate name
SVM name

LUN information

LUN size
LUN name (optional)
LUN description (optional)

SVM information

If you are not using an existing SVM, you require the following information to create a new one:

SVM name
SVM IPspace
Aggregate for SVM root volume
SVM user name (optional)
SVM password (optional)
SVM management LIF (optional)
Subnet:
IP address:
Network mask:
Gateway:
Home node:
Home port:

Install Linux Unified Host Utilities and optimizing I/O performance

Linux Unified Host Utilities software includes the `sanlun` utility, a NetApp LUN reporting tool that you can use to display information about storage cluster nodes. You must also enable the correct server profile on the Linux host to optimize NetApp storage performance.

Before you begin

You must have identified the supported Linux Unified Host Utilities version for your configuration by using the Interoperability Matrix. You must also have the `tuned` package, which is part of your Linux OS distribution and contains the `tuned-adm` command, which you use to set the server profile on the host.

Steps

1. Download the supported Linux Unified Host Utilities version from the NetApp Support Site.

[NetApp Downloads: Software](#)

2. Install Linux Unified Host Utilities software by following the instructions in the installation documentation.
3. If the `tuned` package is not installed, enter the following command:
`yum install tuned`
4. For a physical host, ensure that you have set the `enterprise-storage` profile: `tuned-adm profile enterprise-storage`
5. For a virtual host, ensure that you have set the `virtual-guest` profile: `tuned-adm profile virtual-guest`

[Linux Unified Host Utilities 7.1 Installation](#)

Record the iSCSI node name

You must record the iSCSI initiator node name on the Linux host so that you have it when you configure the storage system.

Steps

1. Use a text editor to open the `/etc/iscsi/initiatorname.iscsi` file containing the node names.
2. Write down the node name or copy it to a text file.

The iSCSI initiator node name looks something like this:

```
iqn.1994-05.com.redhat:127
```

Set the iSCSI replacement timeout value

To support multipathing, you must modify the replacement timeout value in the iSCSI configuration file.

Steps

1. Change the replacement timeout value in the `/etc/iscsi/iscsid.conf` file from the default of 120 to 5.

The replacement timeout value looks like the following in `iscsid.conf`:


```
node.session.timeo.replacement_timeout = 5
```

Start the iSCSI service

After you edit the iSCSI configuration file, you must start the iSCSI service so that the host can discover the targets and access LUNs. If the iSCSI service is running, you must restart it.

Steps

1. Start the iSCSI service at the Linux host command prompt:

If you are using...	Enter...
Red Hat Enterprise Linux 7 series and SUSE Linux Enterprise 12 series	<code>systemctl start iscsid</code>
Red Hat Enterprise Linux 6 series  You must execute this command the first time you start the iSCSI service on a host running Red Hat Enterprise Linux 6 series and Oracle Linux 6 series. If you execute <code>/etc/init.d/iscsi start</code> without previously executing <code>service iscsid force-start</code> , you get an error message.	<code>service iscsid force-start</code>
Red Hat Enterprise Linux 5 or 4 series and Oracle Linux 5 series, Red Hat Enterprise Virtualization, Oracle Linux, and Oracle VM	<code>/etc/init.d/iscsi start</code>
SUSE Linux Enterprise Server 10 or 11 series	<code>/etc/init.d/open-iscsi start</code>

Citrix discourages the use of the `iscsiadm` tool. The native XAPI stack accomplishes the tasks of starting and stopping the `iscsi` service, automatic login on boot, and other iSCSI operations.

Configure DM-Multipath

DM-Multipath manages multiple paths between the Linux host and the storage cluster. Configuring DM-Multipath on a LUN, which appears to the Linux host as a SCSI device, enables your Linux host to access its LUN on the storage cluster if a path or component fails.

Before you begin

You must have identified the required version of DM-Multipath from the Interoperability Matrix tool.

[NetApp Interoperability Matrix Tool](#)



The recommended approach is that you configure two paths per node into each fabric or Ethernet network. This allows a path to fail without the node switching over to its partner. Using link aggregation (LAG) for the physical ports is not recommended with a Windows-based operating system.

Steps

1. Edit the `/etc/multipath.conf` file as follows:

a. Determine whether there are non-NetApp SCSI devices to exclude (blacklist).

These are devices that are not displayed when you enter the `sanlun lun show` command.

- If there are non-NetApp SCSI devices to exclude, enter the worldwide identifier (WWID) for the devices in the blacklist section of the `multipath.conf` file.

To display the WWID of a non-NetApp SCSI device, enter the following command on the device that you want to exclude, where `SCSI_device_name` is a device that you specify:

```
/lib/udev/scsi_id -gud /dev/SCSI_device_name
```

For example, if `/dev/sda` is the non-NetApp SCSI device that you want to exclude, you would enter the following: `/lib/udev/scsi_id -gud /dev/sda`

+ This displays the WWID of the device, which you can copy and paste in the `multipath.conf` file.

+ In the following example showing the blacklist section of the `multipath.conf` file, the non-NetApp SCSI device with WWID `3600508e000000000753250f933cc4606` is excluded:

+

```
blacklist {
    **wwid          3600508e000000000753250f933cc4606**
    devnode         "(ram|raw|loop|fd|md|dm-|sr|scd|st)[0-9]*"
    devnode         "^hd[a-z]"
    devnode         "^cciss.*"
}
```

◦ If there are no devices to exclude, remove the `wwid` line from the `multipath.conf` file.

a. Enable NetApp recommended DM-Multipath settings by appending the following string to the end of the kernel line in the boot loader: `rdloaddriver=scsi_dh_alua`

2. Start the DM-Multipath daemon: `/etc/init.d/multipathd start`

3. Add the multipath service to the boot sequence so that the multipath daemon always starts during system boot: `chkconfig multipathd on`

4. Reboot the Linux host.

5. Verify that the `rdloaddriver` setting appears in the output when you run `cat /proc/cmdline`.

The `rdloaddriver` setting appears as one of several boot options that are passed to the kernel:

```
# cat /proc/cmdline
ro root=/dev/mapper/vg_ibmx3650210104-lv_root rd_NO_LUKS LANG=en_US.UTF-
8 rd_NO_MD rd_LVM_LV=vg_ibmx3650210104/lv_root SYSFONT=latarcyrheb-sun16
rd_LVM_LV=vg_ibmx3650210104/lv_swap crashkernel=129M@0M KEYBOARDTYPE=pc
KEYTABLE=us rd_NO_DM rhgb quiet **rdloaddriver=scsi_dh_alua**
```

Create an aggregate

If you do not want to use an existing aggregate, you can create a new aggregate to provide physical storage to the volume which you are provisioning.

Steps

1. Enter the URL `https://IP-address-of-cluster-management-LIF` in a web browser and log in to System Manager using your cluster administrator credential.
2. Navigate to the **Aggregates** window.
3. Click **Create**.
4. Follow the instructions on the screen to create the aggregate using the default RAID-DP configuration, and then click **Create**.

Create Aggregate

To create an aggregate, select a disk type then specify the number of disks.

Name:

Disk Type:

Number of Disks: Max: 8 (excluding 1 hot spare), min: 5 for RAID-DP

RAID Configuration: RAID-DP; RAID group size of 16 disks [Change](#)

New Usable Capacity: 4.968 TB (Estimated)

Results

The aggregate is created with the specified configuration and added to the list of aggregates in the Aggregates window.

Decide where to provision the volume

Before you provision a volume to contain your LUNs, you need to decide whether to add the volume to an existing storage virtual machine (SVM) or to create a new SVM for the volume. You might also need to configure iSCSI on an existing SVM.

About this task

If an existing SVM is already configured with the needed protocols and has LIFs that can be accessed from the host, it is easier to use the existing SVM.

You can create a new SVM to separate data or administration from other users of the storage cluster. There is no advantage to using separate SVMs just to separate different protocols.

Procedure

- If you want to provision volumes on an SVM that is already configured for iSCSI, you must verify that the iSCSI service is running and then create a LUN on the SVM.

[Verifying that the iSCSI service is running on an existing SVM](#)

[Creating a LUN](#)

- If you want to provision volumes on an existing SVM that has iSCSI enabled but not configured, configure iSCSI on the existing SVM.

[Configuring iSCSI on an existing SVM](#)

This is the case when you did not follow the procedure in this content to create the SVM while configuring a different protocol.

- If you want to provision volumes on a new SVM, create the SVM.

[Creating a new SVM](#)

Verify that the iSCSI service is running on an existing SVM

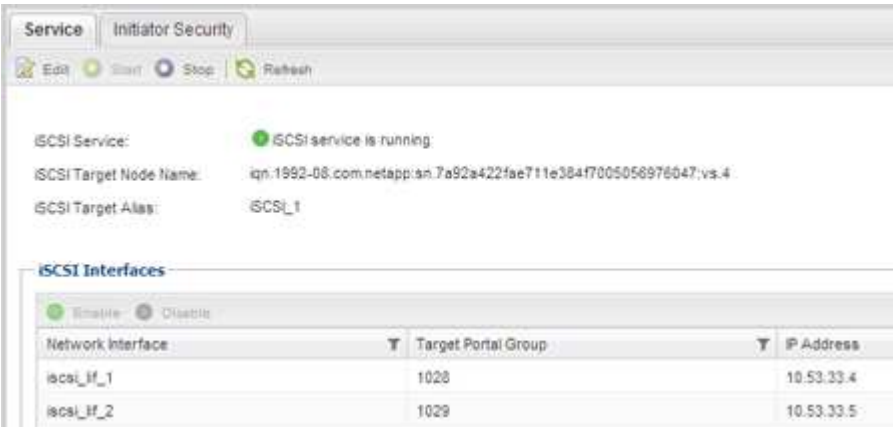
If you choose to use an existing storage virtual machine (SVM), you must verify that the iSCSI service is running on the SVM.

Before you begin

You must have selected an existing SVM on which you plan to create a new LUN.

Steps

1. Navigate to the **SVMs** window.
2. Click the **SVM Settings** tab.
3. In the **Protocols** pane, click **iSCSI**.
4. Verify that the iSCSI service is running.



5. Record the iSCSI interfaces listed for the SVM.

What to do next

If the iSCSI service is not running, start the iSCSI service or create a new SVM.

If there are fewer than two iSCSI interfaces per node, update the iSCSI configuration on the SVM or create a new SVM for iSCSI.

Create a LUN

You use the Create LUN wizard to create a LUN. The wizard also creates the igroup and maps the LUN to the igroup, which enables the specified host to access the LUN.

Before you begin

- There must be an aggregate with enough free space to contain the LUN.
- There must be a storage virtual machine (SVM) with the iSCSI protocol enabled and the appropriate logical interfaces (LIFs) created.
- You must have recorded the iSCSI initiator node name of the host.

LUNs are mapped to a subset of the initiators in the igroup to limit the number of paths from the host to the LUN.

- By default, ONTAP uses Selective LUN Map (SLM) to make the LUN accessible only through paths on the node owning the LUN and its high-availability (HA) partner.
- You still must configure all of the iSCSI LIFs on every node for LUN mobility in case the LUN is moved to another node in the cluster.
- When moving a volume or a LUN, you must modify the SLM reporting-nodes list before moving.

About this task

If your organization has a naming convention, you should use names for the LUN, volume, and so on that fit your convention. Otherwise, you should accept the default names.

Steps

1. Navigate to the **LUNs** window.
2. Click **Create**.
3. Browse and select an SVM in which you want to create the LUNs.

The Create LUN Wizard is displayed.

4. On the **General Properties** page, select the LUN type **Linux** for LUNs used directly by the Linux host.

Leave the **Thin Provisioned** check box unselected.



You can specify the size of the LUN. Storage will be optimized according to the type selected.

Type:

Size:

☐ Thin Provisioned

5. On the **LUN Container** page, select an existing FlexVol volume.

You must ensure that there is enough space in the volume. If sufficient space is not available in the existing volumes, you can create a new volume.

6. On the **Initiators Mapping** page, click **Add Initiator Group**, enter the required information on the **General** tab, and then on the **Initiators** tab, enter the iSCSI initiator node name of the host that you recorded.
7. Confirm the details, and then click **Finish** to complete the wizard.

Related information

[System administration](#)

Configure iSCSI on an existing SVM

You can configure iSCSI on an existing storage virtual machine (SVM) and create a LUN and its containing volume with a single wizard. The iSCSI protocol must already be enabled but not configured on the SVM. This information is intended for SVMs for which you are configuring multiple protocols, but have not yet configured iSCSI.

Before you begin

You must have enough network addresses available to create two LIFs for each node.

About this task

LUNs are mapped to a subset of the initiators in the igroup to limit the number of paths from the host to the LUN.

- ONTAP uses Selective LUN Map (SLM) to make the LUN accessible only through paths on the node owning the LUN and its HA partner.
- You still must configure all of the iSCSI LIFs on every node for LUN mobility in case the LUN is moved to another node in the cluster.
- You must modify the SLM reporting-nodes list before moving a volume or a LUN.

Steps

1. Navigate to the **SVMs** window.
2. Select the SVM that you want to configure.
3. In the SVM **Details** pane, verify that **iSCSI** is displayed with a gray background, which indicates that the protocol is enabled but not fully configured.

If **iSCSI** is displayed with a green background, the SVM is already configured.



4. Click the **iSCSI** protocol link with the gray background.

The Configure iSCSI Protocol window is displayed.

5. Configure the iSCSI service and LIFs from the **Configure iSCSI protocol** page:

- a. Enter a target alias name.
- b. Enter 2 in the **LIFs per node** field.

Two LIFs are required for each node to ensure availability and data mobility.

- c. Assign IP addresses for the LIFs either with a subnet or without a subnet.
- d. In the **Provision a LUN for iSCSI storage** area, enter the desired LUN size, host type, and iSCSI initiator name of the host.
- e. Click **Submit & Close**.

Configure New Protocol for Storage Virtual Machine (SVM)

Configure iSCSI protocol

?
Configure LIFs to access the data using iSCSI protocol

Data Interface (LIF) Configuration

Target Alias:	vs1_alias	Provision a LUN for iSCSI storage (Optional):	
LIFs Per Node:	2 <small>(Minimum: 1, Maximum: 6)</small>	LUN Size:	50 GB
Assign IP Address:	Without a subnet	LUN OS Type:	Linux
	IP Address: 10.10.10.10 Change	Host Initiator:	iqn.2001-04.com.example:ab
Broadcast Domain:	Default		
Adapter Type:	NIC		
<input type="checkbox"/> Review or modify LIF configuration (Advanced Settings)			

6. Review the **Summary** page, record the LIF information, and then click **OK**.

Create a new SVM

The storage virtual machine (SVM) provides the iSCSI target through which a host accesses LUNs. When you create the SVM, you also create logical interfaces (LIFs) and the LUN and its containing volume. You can create an SVM to separate the data and administration functions of a user from those of the other users in a cluster.

Before you begin

- You must have enough network addresses available to create two LIFs for each node.

About this task

LUNs are mapped to a subset of the initiators in the igroup to limit the number of paths from the host to the LUN.

- By default, ONTAP uses Selective LUN Map (SLM) to make the LUN accessible only through paths on the node owning the LUN and its HA partner.
- You still must configure all of the iSCSI LIFs on every node for LUN mobility in case the LUN is moved to

another node in the cluster.

- When moving a volume or a LUN, you must modify the SLM-reporting-nodes list before moving.

Steps

1. Navigate to the **SVMs** window.
2. Click **Create**.
3. In the **Storage Virtual Machine (SVM) Setup** window, create the SVM:

Storage Virtual Machine (SVM) Setup

●

1

●

Enter SVM basic details

SVM Details

?

Specify a unique name and the data protocols for the SVM

SVM Name:

?

IPspace:

?

Data Protocols: ☒ CIFS ☒ NFS ☒ iSCSI ☒ FC/FCoE ☐ NVMe

?

Default Language:

The language of the SVM specifies the default language encoding setting for the SVM and its volumes. Using a setting that incorporates UTF-8 character encoding is recommended.

?

Security Style:

Root Aggregate:

- a. Specify a unique name for the SVM.

The name must either be a fully qualified domain name (FQDN) or follow another convention that ensures unique names across a cluster.

- b. Select the IPspace that the SVM will belong to.

If the cluster does not use multiple IPspaces, the “Default” IPspace is used.

- c. Keep the default volume type selection.

Only FlexVol volumes are supported with SAN protocols.

- d. Select all of the protocols that you have licenses for and that you might use on the SVM, even if you do not want to configure all of the protocols immediately.

Selecting both NFS and CIFS when you create the SVM enables these two protocols to share the same LIFs. Adding these protocols later does not allow them to share LIFs.

If CIFS is one of the protocols you selected, then the security style is set to NTFS. Otherwise, the security style is set to UNIX.

- e. Keep the default language setting C.UTF-8.
- f. Select the desired root aggregate to contain the SVM root volume.

The aggregate for the data volume is selected separately in a later step.

- g. Click **Submit & Continue**.

The SVM is created, but protocols are not yet configured.

4. If the **Configure CIFS/NFS protocol** page appears because you enabled CIFS or NFS, click **Skip** and then configure CIFS or NFS later.
5. Configure the iSCSI service and create LIFs, and the LUN and its containing volume from the **Configure iSCSI protocol** page:
 - a. Enter a target alias name.
 - b. Assign IP address for the LIFs either by using a subnet or without a subnet.
 - c. Enter 2 in the **LIFs per node** field.

Two LIFs are required for each node to ensure availability and data mobility.

- d. In the **Provision a LUN for iSCSI storage** area, enter the desired LUN size, host type, and iSCSI initiator name of the host.
- e. Click **Submit & Continue**.

Configure New Protocol for Storage Virtual Machine (SVM)

Configure iSCSI protocol

Configure LIFs to access the data using iSCSI protocol

Data Interface (LIF) Configuration

<div style="margin-bottom: 10px;"> Target Alias: <input style="width: 150px;" type="text" value="vs1_alias"/> </div> <div style="margin-bottom: 10px;"> LIFs Per Node: <input style="width: 50px;" type="text" value="2"/> <small>(Minimum: 1, Maximum: 6)</small> </div> <div style="margin-bottom: 10px;"> Assign IP Address: Without a subnet </div> <div style="margin-bottom: 10px;"> Broadcast Domain: Default </div> <div style="margin-bottom: 10px;"> Adapter Type: NIC </div> <div style="margin-top: 10px;"> <input type="checkbox"/> Review or modify LIF configuration (Advanced Settings) </div>	<div style="margin-bottom: 10px;"> Provision a LUN for iSCSI storage (Optional): </div> <div style="margin-bottom: 10px;"> LUN Size: <input style="width: 50px;" type="text" value="50"/> GB </div> <div style="margin-bottom: 10px;"> LUN OS Type: Linux </div> <div style="margin-bottom: 10px;"> Host Initiator: <input style="width: 150px;" type="text" value="iqn.2001-04.com.example:ab"/> </div>
---	---

6. If the **Configure FC/FCoE protocol** page appears because you enabled FC, click **Skip** and then configure FC later.
7. When the **SVM Administration** appears, configure or defer configuring a separate administrator for this SVM:
 - Click **Skip** and configure an administrator later if desired.

- Enter the requested information, and then click **Submit & Continue**.

8. Review the **Summary** page, record the LIF information, and then click **OK**.

Start the iSCSI sessions with the target

The Linux host must have an iSCSI connection with each node (target) in the storage cluster. You establish the sessions from the host.

About this task

In ONTAP, the iSCSI host must have paths to each node in the cluster. DM-Multipath selects the best paths to use. If paths fail, DM-Multipath selects alternate paths.

Steps

1. Start the iSCSI service from the Linux host command prompt: `service iscsid force-start`
2. Discover the iSCSI target: `iscsiadm --mode discovery --op update --type sendtargets --portal targetIP`

The IP address of each discovered target displays on a separate line.

3. Establish iSCSI sessions by logging in to each target: `iscsiadm --mode node -l all`
4. You can view a list of the active iSCSI sessions: `iscsiadm --mode session`

Discover new SCSI devices (LUNs) and multipath devices

LUNs on the storage cluster appear to the Linux host as SCSI devices, which are I/O paths that DM-Multipath aggregates into a new device, called a multipath device. The host does not automatically discover new SCSI devices (LUNs) that you add to your system. You must manually rescan them to discover them.

Before you begin

You must have a copy of the `rescan` script, which is in the `sg3_utils` package that is part of your Linux OS distribution.

Steps

1. Discover new SCSI devices (LUNs) and create the corresponding multipath devices for the LUNs:
`/usr/bin/rescan-scsi-bus.sh`
2. Verify DM-Multipath configuration: `multipath -ll`

This displays the following type of output, listing the recommended settings for each NetApp LUN:

```

3600a0980324666546e2b443251655177 dm-2 NETAPP,LUN C-Mode
size=10G features='4 queue_if_no_path pg_init_retries 50
retain_attached_hw_handle' hwhandler='1 alua' wp=rw
|+- policy='round-robin 0' prio=50 status=active
| |- 0:0:1:0 sdb 8:16 active ready running
| |- 0:0:0:0 sda 8:0 active ready running
| |- 1:0:0:0 sde 8:64 active ready running
| `-- 1:0:1:0 sdf 8:80 active ready running
`+- policy='round-robin 0' prio=10 status=enabled
  |- 0:0:3:0 sdd 8:48 active ready running
  |- 1:0:3:0 sdh 8:112 active ready running
  |- 0:0:2:0 sdc 8:32 active ready running
  `-- 1:0:2:0 sdg 8:96 active ready running

```

Configure logical volumes on multipath devices and creating a file system

When the Linux host first accesses a new SCSI device (LUN), there is no partition or file system. If you want to use a partitioned multipath device, you must first partition the underlying SCSI devices. You might also want to create logical volumes on multipath devices, and optionally create a file system.

Before you begin

SCSI devices and corresponding multipath devices must have been discovered by the Linux host.

About this task

At a minimum DM-Multipath should be configured on the SCSI devices. Any configuration beyond DM-Multipath is optional. The following steps are general guidelines if you wish to perform additional configuration, such as partitioning, configuring logical volumes on multipath devices, and creating a file system. For details on Linux commands, refer to Red Hat Enterprise Linux documentation and man pages.

Steps

1. To use a partitioned multipath device, first partition the underlying SCSI devices using the `fdisk` or `parted` utility.
2. Create corresponding multipath partitions using the `kpartx` utility.
3. Create logical volumes on corresponding multipath devices using Logical Volume Manager (LVM) commands.
4. Create a file system, such as Ext4 or XFS, on logical volumes or multipath devices using the `mkfs` utility.

Verify that the host can write to and read from a multipath device

Before using a multipath device, you should verify that the host can write data to the multipath device and read it back.

Before you begin

DM-Multipath must be configured on the Linux host for the storage cluster nodes you are accessing.

About this task

If the storage cluster node that the multipath device corresponds to can be failed over to its partner node, you should verify reading the data while the node is failed over. This verification might not be possible if the storage cluster is in production use.

Steps

1. Run some I/O on the specified multipath device: `dd if=/dev/zero of=<multipath_device_name>`
2. Verify that I/O is running on the multipath device, specifying the number of seconds to refresh statistics (for example, every two seconds, as shown): `iostat 2`

When I/O is running on the multipath device, you can see the various I/O counters output change dynamically, indicating that I/O is running successfully on the multipath device.

```
avg-cpu:  %user   %nice %system %iowait  %steal   %idle
           0.00    0.00    0.01    0.00    0.00   99.98

Device:            tps    Blk_read/s    Blk_wrtn/s    Blk_read    Blk_wrtn
sda                 0.18         1.34         2.29      832606     1428026
dm-0                 0.37         1.29         2.29      801530     1427984
dm-1                 0.00         0.00         0.00       2576         0
dm-2                 0.00         0.00         0.00       1770         24
sdd                 0.17         1.18        17.87     734688    11128584
sde                 0.17         1.18        18.01     734560    11219016
sdf                 0.00         0.00         0.00       1344         0
sdg                 0.00         0.00         0.00       1344         0
dm-3                 0.68         4.71        71.96    2932496    44816008
sdh                 0.17         1.18        18.22     734360    11343920
sdi                 0.17         1.18        17.86     734272    11124488
sdj                 0.00         0.00         0.00       1344         0
sdk                 0.00         0.00         0.00       1344         0
.....
```

3. If possible, run the `takeover` command on the storage cluster node: `storage failover takeover -ofnode <node_name>`
4. Verify that I/O is still running on the multipath device by re-running the `iostat` command.
5. Run the `giveback` command on the storage cluster node: `storage failover giveback -ofnode <node_name>`
6. Check `iostat` output to verify that I/O is still running.

What to do next

If any of the tests fail, verify that the iSCSI service is running and re-check the DM-Multipath configuration and the iSCSI paths to the multipath device.

Where to find additional information

After you have successfully tested iSCSI , you can perform advanced iSCSI configuration or add SAN or NAS protocols. There is comprehensive content and technical reports to help you achieve these goals.

SAN configuration

All of the following documentation is available:

- [SAN configuration](#)

Describes supported FC, iSCSI, and FCoE topologies for connecting host computers to storage controllers in clusters.

- [SAN administration](#)

Describes how to configure and manage the iSCSI, FCoE, and FC protocols for clustered SAN environments, including configuration of LUNs, igroups, and targets.

- [Linux Unified Host Utilities 7.1](#)

Describes how to install Linux Unified Host Utilities software and configure DM-Multipath.

- [NetApp Technical Report 4159: Red Hat Enterprise Virtualization 3.1 and NetApp Clustered Data ONTAP Storage Best Practices](#)

Describes the current best practices for Red Hat virtualized environments.

- Red Hat Enterprise Linux 6 documentation and man pages

Provides instructions for managing storage devices, file systems, and Linux commands.

iSCSI configuration for Windows

iSCSI configuration for Windows overview

This content describes how to quickly set up the iSCSI service on a storage virtual machine (SVM), provision a LUN, and make the LUN available using an iSCSI initiator on a Windows host computer.

This content is based on the following assumptions:

- You want to use best practices, not explore every available option.
- You do not want to read a lot of conceptual background.
- You want to use the *Classic* System Manager UI for ONTAP 9.7 and earlier releases, not the ONTAP System Manager UI for ONTAP 9.7 and later.

[ONTAP System Manager documentation](#)

- You are using the Microsoft iSCSI software initiator on Windows Server 2008 or Windows Server 2012.

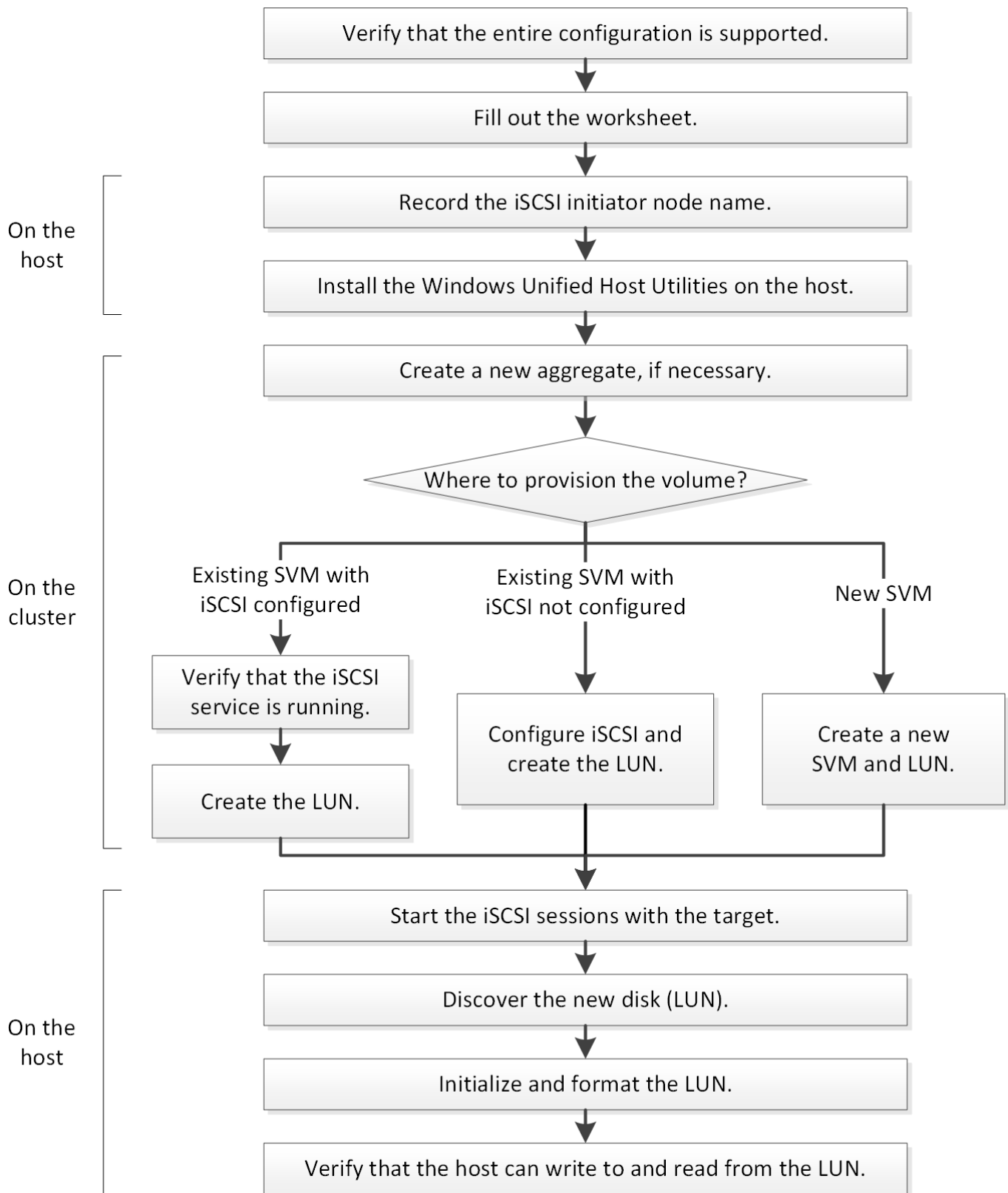
- Your network uses IPv4 addressing.
- You want to assign addresses to logical interfaces using any of the following methods:
 - Automatically, from a subnet you define
 - Manually, using an address selected from an existing subnet
 - Manually, using an address that will be added to an existing subnet
- You are not configuring iSCSI SAN boot.

If these assumptions are not correct for your situation, you should see the following resources:

- [SAN administration](#)
- [SAN configuration](#)
- [Windows Unified Host Utilities 7.1](#)

iSCSI configuration and provisioning workflow

When you make storage available to a host using iSCSI, you provision a volume and LUN on the storage virtual machine (SVM), and then connect to the LUN from the host.



Verify that the iSCSI configuration is supported

For reliable operation, you must verify that the entire iSCSI configuration is supported.

Steps

1. Go to the Interoperability Matrix to verify that you have a supported combination of the following

components:

- ONTAP software
- Host computer CPU architecture (for standard rack servers)
- Specific processor blade model (for blade servers)
- Storage protocol (iSCSI)
- Windows operating system version
- Windows Unified Host Utilities

2. Click the configuration name for the selected configuration.

Details for that configuration are displayed in the Configuration Details window.

3. Review the information in the following tabs:

- Notes

Lists important alerts and information that are specific to your configuration.

Review the alerts to identify the hotfixes that are required for your operating system.

- Policies and Guidelines

Provides general guidelines for all SAN configurations.

Complete the iSCSI configuration worksheet

You require iSCSI identifiers, network addresses, and storage configuration information to perform iSCSI configuration tasks.

iSCSI identifiers

Initiator (host) iSCSI node name (IQN)
Target alias (optional)

Target network addresses

The storage virtual machine (SVM) is the iSCSI target.

You require a subnet with two IP addresses for iSCSI data LIFs for each node in the cluster. There should be two separate networks for high availability. The specific IP addresses are assigned by ONTAP when you create the LIFs as part of creating the SVM.

If possible, separate iSCSI traffic on separate physical networks or on VLANs.

Subnet for LIFs: **_

Node or LIF with port to switch	IP address	Network mask	Gateway	VLAN ID	Home port
Node 1 / LIF to switch 1					
Node 2 / LIF to switch 1					
Node 3 / LIF to switch 1					
Node 4 / LIF to switch 1					
Node 1 / LIF to switch 2					
Node 2 / LIF to switch 2					
Node 3 / LIF to switch 2					
Node 4 / LIF to switch 2					

Storage configuration

If the aggregate and SVM are already created, record their names here; otherwise, you can create them as required:

Node to own LUN
Aggregate name
SVM name

LUN information

LUN size
Host operating system
LUN name (optional)

LUN size
LUN description (optional)

SVM information

If you are not using an existing SVM, you require the following information to create a new one:

SVM name
SVM IPspace
Aggregate for SVM root volume
SVM user name (optional)
SVM password (optional)
SVM management LIF (optional)
Subnet:
IP address:
Network mask:
Gateway:
Home node:
Home port:

Record 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

If you are using...	Navigate to...
Windows Server 2008, Windows Server 2008 R2	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 should look like the following example:

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

Install Windows Unified Host Utilities

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.

Before you begin

You must have completed the following tasks:

- Check the supported configuration in the Interoperability Matrix

[NetApp Interoperability Matrix Tool](#)

- Identified any required Windows hotfixes from the Interoperability Matrix

[NetApp Interoperability Matrix Tool](#)

- Add the FCP license and start the target service
- Verify your cabling

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

About this task

You must specify whether to include multipathing support when you install the Windows Unified Host Utilities software package. 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.

See [Windows Unified Host Installation](#) for detailed information.

Steps

1. Download the appropriate version of the Windows Unified Host Utilities from the NetApp Support Site.

2. Run the executable file and follow the instructions on the screen.
3. Reboot the Windows host when prompted.

Create an aggregate

If you do not want to use an existing aggregate, you can create a new aggregate to provide physical storage to the volume which you are provisioning.

Steps

1. Enter the URL `https://IP-address-of-cluster-management-LIF` in a web browser and log in to System Manager using your cluster administrator credential.
2. Navigate to the **Aggregates** window.
3. Click **Create**.
4. Follow the instructions on the screen to create the aggregate using the default RAID-DP configuration, and then click **Create**.

Create Aggregate

To create an aggregate, select a disk type then specify the number of disks.

Name:

Disk Type:

Number of Disks: Max: 8 (excluding 1 hot spare), min: 5 for RAID-DP

RAID Configuration: RAID-DP; RAID group size of 16 disks

New Usable Capacity: 4.968 TB (Estimated)

Results

The aggregate is created with the specified configuration and added to the list of aggregates in the Aggregates window.

Decide where to provision the volume

Before you provision a volume to contain your LUNs, you need to decide whether to add the volume to an existing storage virtual machine (SVM) or to create a new SVM for the volume. You might also need to configure iSCSI on an existing SVM.

About this task

If an existing SVM is already configured with the needed protocols and has LIFs that can be accessed from the host, it is easier to use the existing SVM.

You can create a new SVM to separate data or administration from other users of the storage cluster. There is no advantage to using separate SVMs just to separate different protocols.

Procedure

- If you want to provision volumes on an SVM that is already configured for iSCSI, you must verify that the iSCSI service is running and then create a LUN on the SVM.

Verifying that the iSCSI service is running on an existing SVM

Creating a LUN

- If you want to provision volumes on an existing SVM that has iSCSI enabled but not configured, configure iSCSI on the existing SVM.

Configuring iSCSI on an existing SVM

This is the case when you did not follow the procedure in this content to create the SVM while configuring a different protocol.

- If you want to provision volumes on a new SVM, create the SVM.

Creating a new SVM

Verify that the iSCSI service is running on an existing SVM

If you choose to use an existing storage virtual machine (SVM), you must verify that the iSCSI service is running on the SVM.

Before you begin

You must have selected an existing SVM on which you plan to create a new LUN.

Steps

1. Navigate to the **SVMs** window.
2. Click the **SVM Settings** tab.
3. In the **Protocols** pane, click **iSCSI**.
4. Verify that the iSCSI service is running.



5. Record the iSCSI interfaces listed for the SVM.

What to do next

If the iSCSI service is not running, start the iSCSI service or create a new SVM.

If there are fewer than two iSCSI interfaces per node, update the iSCSI configuration on the SVM or create a new SVM for iSCSI.

Create a LUN

You use the Create LUN wizard to create a LUN. The wizard also creates the igroup and maps the LUN to the igroup, which enables the specified host to access the LUN.

Before you begin

- There must be an aggregate with enough free space to contain the LUN.
- There must be a storage virtual machine (SVM) with the iSCSI protocol enabled and the appropriate logical interfaces (LIFs) created.
- You must have recorded the iSCSI initiator node name of the host.

LUNs are mapped to a subset of the initiators in the igroup to limit the number of paths from the host to the LUN.

- By default, ONTAP uses Selective LUN Map (SLM) to make the LUN accessible only through paths on the node owning the LUN and its high-availability (HA) partner.
- You still must configure all of the iSCSI LIFs on every node for LUN mobility in case the LUN is moved to another node in the cluster.
- When moving a volume or a LUN, you must modify the SLM reporting-nodes list before moving.

About this task

If your organization has a naming convention, you should use names for the LUN, volume, and so on that fit your convention. Otherwise, you should accept the default names.

Steps

1. Navigate to the **LUNs** window.
2. Click **Create**.
3. Browse and select an SVM in which you want to create the LUNs.

The Create LUN Wizard is displayed.

4. On the **General Properties** page, select the LUN type **Windows 2008 or later** for LUNs used directly by the Windows host, or select **Hyper-V** for LUNs containing virtual hard disks (VHDs) for Hyper-V virtual machines.

Leave the **Thin Provisioned** check box unselected.



You can specify the size of the LUN. Storage will be optimized according to the type selected.

Type:

Size:

☐ Thin Provisioned

5. On the **LUN Container** page, select an existing FlexVol volume.

You must ensure that there is enough space in the volume. If sufficient space is not available in the existing volumes, you can create a new volume.

6. On the **Initiators Mapping** page, click **Add Initiator Group**, enter the required information on the **General** tab, and then on the **Initiators** tab, enter the iSCSI initiator node name of the host that you recorded.
7. Confirm the details, and then click **Finish** to complete the wizard.

Related information

[System administration](#)

Configure iSCSI on an existing SVM

You can configure iSCSI on an existing storage virtual machine (SVM) and create a LUN and its containing volume with a single wizard. The iSCSI protocol must already be enabled but not configured on the SVM. This information is intended for SVMs for which you are configuring multiple protocols, but have not yet configured iSCSI.

Before you begin

You must have enough network addresses available to create two LIFs for each node.

About this task

LUNs are mapped to a subset of the initiators in the igroup to limit the number of paths from the host to the LUN.

- ONTAP uses Selective LUN Map (SLM) to make the LUN accessible only through paths on the node owning the LUN and its HA partner.
- You still must configure all of the iSCSI LIFs on every node for LUN mobility in case the LUN is moved to another node in the cluster.
- You must modify the SLM reporting-nodes list before moving a volume or a LUN.

Steps

1. Navigate to the **SVMs** window.
2. Select the SVM that you want to configure.
3. In the **SVMDetails** pane, verify that **iSCSI** is displayed with a gray background, which indicates that the protocol is enabled but not fully configured.

If **iSCSI** is displayed with a green background, the SVM is already configured.

Details

Protocols:

[NFS](#) [CIFS](#) [FC/FCoE](#) [iSCSI](#)

- Click the **iSCSI** protocol link with the gray background.

The Configure iSCSI Protocol window is displayed.

- Configure the iSCSI service and LIFs from the **Configure iSCSI protocol** page:

- Enter a target alias name.
- Enter 2 in the **LIFs per node** field.

Two LIFs are required for each node to ensure availability and data mobility.

- Assign IP addresses for the LIFs either with a subnet or without a subnet.
- In the **Provision a LUN for iSCSI storage** area, enter the desired LUN size, host type, and iSCSI initiator name of the host.
- Click **Submit & Close**.

Configure New Protocol for Storage Virtual Machine (SVM)

Configure iSCSI protocol

? Configure LIFs to access the data using iSCSI protocol

Data Interface (LIF) Configuration

Target Alias:	<input type="text" value="vs1_alias"/>
LIFs Per Node:	<input type="text" value="2"/> <small>(Minimum: 1, Maximum: 6)</small>
Assign IP Address:	<input type="text" value="Without a subnet"/>
	IP Address: 10.10.10.10 Change
Broadcast Domain:	<input type="text" value="Default"/>
Adapter Type:	<input type="text" value="NIC"/>

Provision a LUN for iSCSI storage (Optional):

LUN Size:	<input type="text" value="50"/>	<input type="text" value="GB"/>
LUN OS Type:	<input type="text" value="Windows 2008 or later"/>	
Host Initiator:	<input type="text" value="iqn.2001-04.com.example:ab"/>	

☐ Review or modify LIF configuration (Advanced Settings)

- Review the **Summary** page, record the LIF information, and then click **OK**.

Create a new SVM

The storage virtual machine (SVM) provides the iSCSI target through which a host accesses LUNs. When you create the SVM, you also create logical interfaces (LIFs) and the LUN and its containing volume. You can create an SVM to separate the data and administration functions of a user from those of the other users in a cluster.

Before you begin

- You must have enough network addresses available to create two LIFs for each node.

About this task


LUNs are mapped to a subset of the initiators in the igroup to limit the number of paths from the host to the LUN.

- By default, ONTAP uses Selective LUN Map (SLM) to make the LUN accessible only through paths on the node owning the LUN and its HA partner.
- You still must configure all of the iSCSI LIFs on every node for LUN mobility in case the LUN is moved to another node in the cluster.
- When moving a volume or a LUN, you must modify the SLM-reporting-nodes list before moving.

Steps

1. Navigate to the **SVMs** window.
2. Click **Create**.
3. In the **Storage Virtual Machine (SVM) Setup** window, create the SVM:

Storage Virtual Machine (SVM) Setup



Enter SVM basic details

SVM Details

? Specify a unique name and the data protocols for the SVM

SVM Name:

? IPspace: ▼

? Data Protocols: ☒ CIFS ☒ NFS ☒ iSCSI ☒ FC/FCoE ☐ NVMe

? Default Language: ▼

The language of the SVM specifies the default language encoding setting for the SVM and its volumes. Using a setting that incorporates UTF-8 character encoding is recommended.

? Security Style: ▼

Root Aggregate: ▼

- a. Specify a unique name for the SVM.

The name must either be a fully qualified domain name (FQDN) or follow another convention that ensures unique names across a cluster.

- b. Select the IPspace that the SVM will belong to.

If the cluster does not use multiple IPspaces, the “Default” IPspace is used.

- c. Keep the default volume type selection.

Only FlexVol volumes are supported with SAN protocols.

- d. Select all of the protocols that you have licenses for and that you might use on the SVM, even if you do not want to configure all of the protocols immediately.

Selecting both NFS and CIFS when you create the SVM enables these two protocols to share the same LIFs. Adding these protocols later does not allow them to share LIFs.

If CIFS is one of the protocols you selected, then the security style is set to NTFS. Otherwise, the security style is set to UNIX.

- e. Keep the default language setting C.UTF-8.
- f. Select the desired root aggregate to contain the SVM root volume.

The aggregate for the data volume is selected separately in a later step.

- g. Click **Submit & Continue**.


The SVM is created, but protocols are not yet configured.

4. If the **Configure CIFS/NFS protocol** page appears because you enabled CIFS or NFS, click **Skip** and then configure CIFS or NFS later.
5. Configure the iSCSI service and create LIFs, and the LUN and its containing volume from the **Configure iSCSI protocol** page:
 - a. Enter a target alias name.
 - b. Assign IP address for the LIFs either by using a subnet or without a subnet.
 - c. Enter 2 in the **LIFs per node** field.

Two LIFs are required for each node to ensure availability and data mobility.

- d. In the **Provision a LUN for iSCSI storage** area, enter the desired LUN size, host type, and iSCSI initiator name of the host.
- e. Click **Submit & Continue**.

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LIFs Per Node:	<input type="text" value="2"/> <small>(Minimum: 1, Maximum: 6)</small>
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	IP Address: 10.10.10.10 Change
Broadcast Domain:	<input type="text" value="Default"/> ▼
Adapter Type:	<input type="text" value="NIC"/> ▼

Provision a LUN for iSCSI storage (Optional):

LUN Size:	<input type="text" value="50"/>	<input type="text" value="GB"/>	▼
LUN OS Type:	<input type="text" value="Windows 2008 or later"/> ▼		
Host Initiator:	<input type="text" value="iqn.2001-04.com.example:ab"/>		

☐ Review or modify LIF configuration (Advanced Settings)

6. If the **Configure FC/FCoE protocol** page appears because you enabled FC, click **Skip** and then configure FC later.
7. When the **SVM Administration** appears, configure or defer configuring a separate administrator for this SVM:
 - Click **Skip** and configure an administrator later if desired.
 - Enter the requested information, and then click **Submit & Continue**.
8. Review the **Summary** page, record the LIF information, and then click **OK**.

Start iSCSI sessions with the target

The Windows host must have an iSCSI connection to each node in the cluster. You establish the sessions from the host by using the iSCSI Initiator Properties dialog box on the host.

Before you begin

You must know the IP address of an iSCSI data LIF on the storage virtual machine (SVM) that contains the LUN you are accessing.

About this task

In ONTAP, the iSCSI host must have paths to each node in the cluster. The native DSM selects the best paths to use. If paths fail, the native DSM selects alternate paths.

The buttons and labels in the iSCSI Initiator Properties dialog box vary between versions of Windows. Some of the steps in the task include more than one button or label name; you should pick the name that matches the version of Windows you are using.

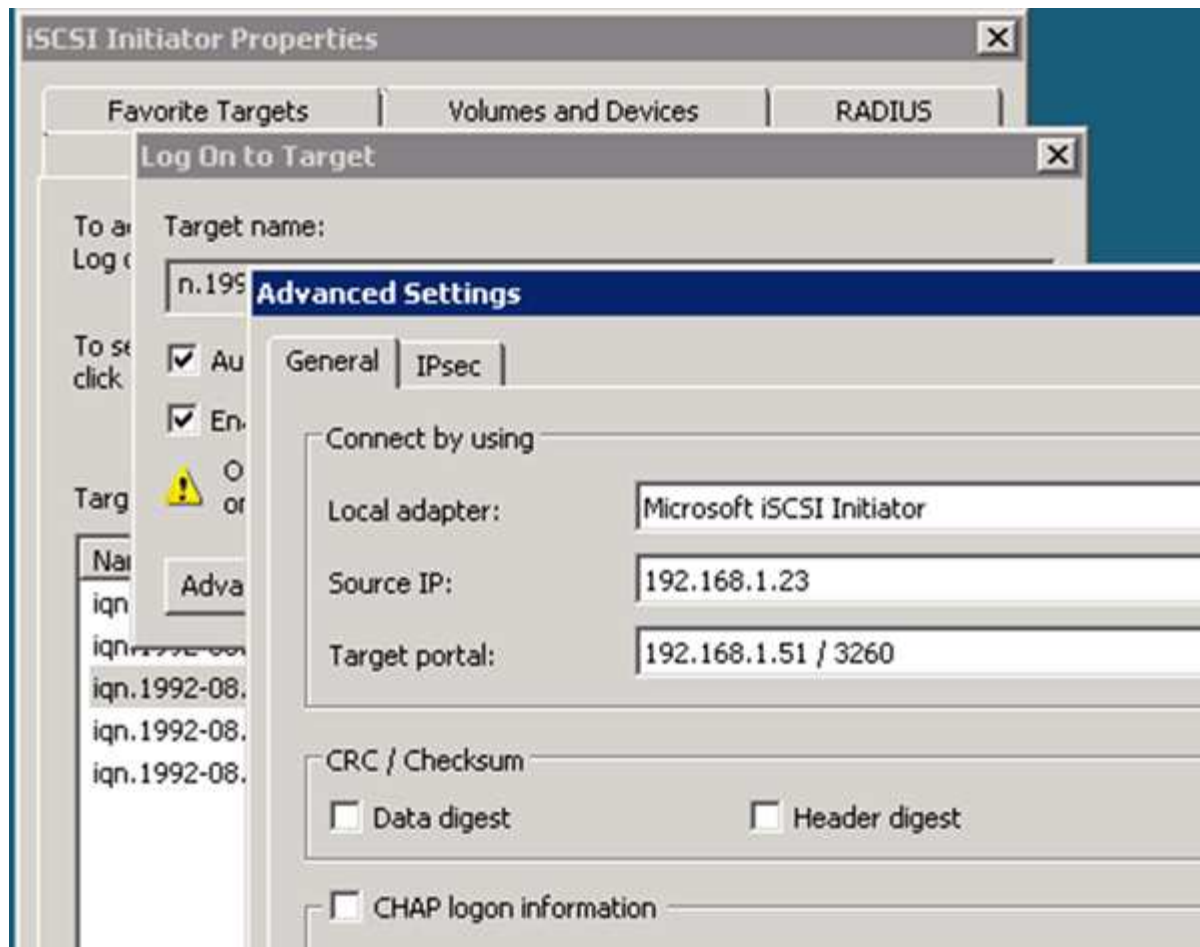
Steps

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

For...	Click...
Windows Server 2012	Server Manager > Dashboard > Tools > iSCSI Initiator
Windows Server 2008	Start > Administrative Tools > iSCSI Initiator

2. On the **Discovery** tab, click **Discover Portal** or **Add Portal**, and then enter the IP address of the iSCSI target port.
3. On the **Targets** tab, select the target you discovered, and then click **Log on** or **Connect**.
4. Select **Enable multi-path**, select **Automatically restore this connection when the computer starts** or **Add this connection to the list of Favorite Targets**, and then click **Advanced**.
5. For **Local adapter**, select **Microsoft iSCSI Initiator**.

The following example is from Windows Server 2008:



6. For **Source IP** or **Initiator IP**, select the IP address of a port on the same subnet or VLAN as one of the iSCSI target LIFs.
7. Retain the default values for the remaining check boxes, and then click **OK**.
8. On the **Targets** tab, select the same target again, and then click **Log on** or **Connect**.
9. Select **Enable multi-path**, select **Automatically restore this connection when the computer starts** or **Add this connection to the list of Favorite Targets**, and then click **Advanced**.
10. For **Source IP** or **Initiator IP**, select the IP address of a different port on the subnet or VLAN of a different iSCSI target LIF.
11. For **Target portal**, select the IP address of the iSCSI target LIF that corresponds to the port you just selected for **Source IP**.
12. Retain the default values for the remaining check boxes, and then click **OK**.
13. Repeat steps 8 through 12 to connect to each target LIF that is available.

Discover new disks

LUNs on your storage virtual machine (SVM) appear as disks to the Windows host. Any new disks for LUNs you add to your system are not automatically discovered by the host. You must manually rescan disks to discover them.

Steps

1. Open the Windows Computer Management utility:

If you are using...	Navigate to...
Windows Server 2012	Tools > Computer Management
Windows Server 2008	Start > Administrative Tools > Computer Management
Windows Server 2016	Start > Administrative Tools > Computer Management

2. Expand the **Storage** node in the navigation tree.
3. Click **Disk Management**.
4. Click **Action > Rescan Disks**.

Initialize and format the LUN

When a new LUN is first accessed by the Windows host, it has no partition or file system. You must initialize the LUN, and optionally format it with a file system.

Before you begin

The LUN must have been discovered by the Windows host.

About this task

LUNs appear in Windows Disk Management as disks.

You can initialize the disk as a basic disk with a GPT or MBR partition table.

You typically format the LUN with a file system such as NTFS, but some applications use raw disks instead.

Steps

1. Start Windows Disk Management.
2. Right-click the LUN, and then select the required disk or partition type.
3. Follow the instructions in the wizard.

If you choose to format the LUN as NTFS, you must select the **Perform a quick format** check box.

Verify that the host can write to and read from the LUN

Before using the LUN, you should verify that the host can write data to the LUN and read it back.

Before you begin

The LUN must be initialized and formatted with a file system.

About this task

If the storage cluster node on which the LUN is created can be failed over to its partner node, you should verify reading the data while the node is failed over. This test might not be possible if the storage cluster is in production use.

If any of the tests fail, you should verify that the iSCSI service is running and check the iSCSI paths to the LUN.

Steps

1. On the host, copy one or more files to the LUN.
2. Copy the files back to a different folder on the original disk.
3. Compare the copied files to the original.

You can use the `comp` command at the Windows command prompt to compare two files.

4. Fail over the storage cluster node containing the LUN and verify that you can still access the files on the LUN.
5. Use the native DSM to view the paths to the LUN and verify that you have the expected number of paths.

You should see two paths to the storage cluster node on which the LUN is created, and two paths to the partner node.

Where to find additional information

There are additional documents to help you learn more about iSCSI configuration.

All of the following documentation is available:

- [SAN configuration](#)

Describes supported FC, iSCSI, and FCoE topologies for connecting host computers to storage controllers in clusters.

- [SAN administration](#)

Describes how to configure and manage the iSCSI, FCoE, and FC protocols for clustered SAN environments, including configuration of LUNs, igroups, and targets.

Microsoft documentation

Documentation about the Microsoft iSCSI software initiator is available directly from Microsoft.

- *Microsoft iSCSI Software Initiator Version 2.X Users Guide*

Describes the Microsoft iSCSI software initiator for Windows Server 2008. It is included with the iSCSI software initiator download files.

- *Microsoft iSCSI Initiator Overview*

Online Help for the Windows Server 2012 iSCSI initiator (available from within the initiator). Describes the software initiator and includes links to the Microsoft web site for further information.

Related information

[Microsoft](#)

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