

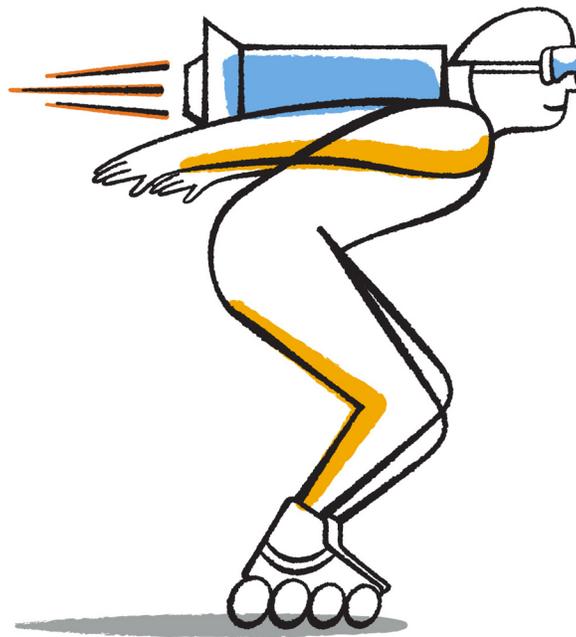


**NetApp®**

Updated for 8.3.1

## Clustered Data ONTAP® 8.3

### NFS Client Configuration for ESX Express Guide



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## Deciding whether to use this guide

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This guide describes how to quickly set up NFS access for ESXi hosts to files contained in new volumes in clustered Data ONTAP 8.3.

You should use this guide if you want to configure NFS access for ESXi hosts to a volume in the following way:

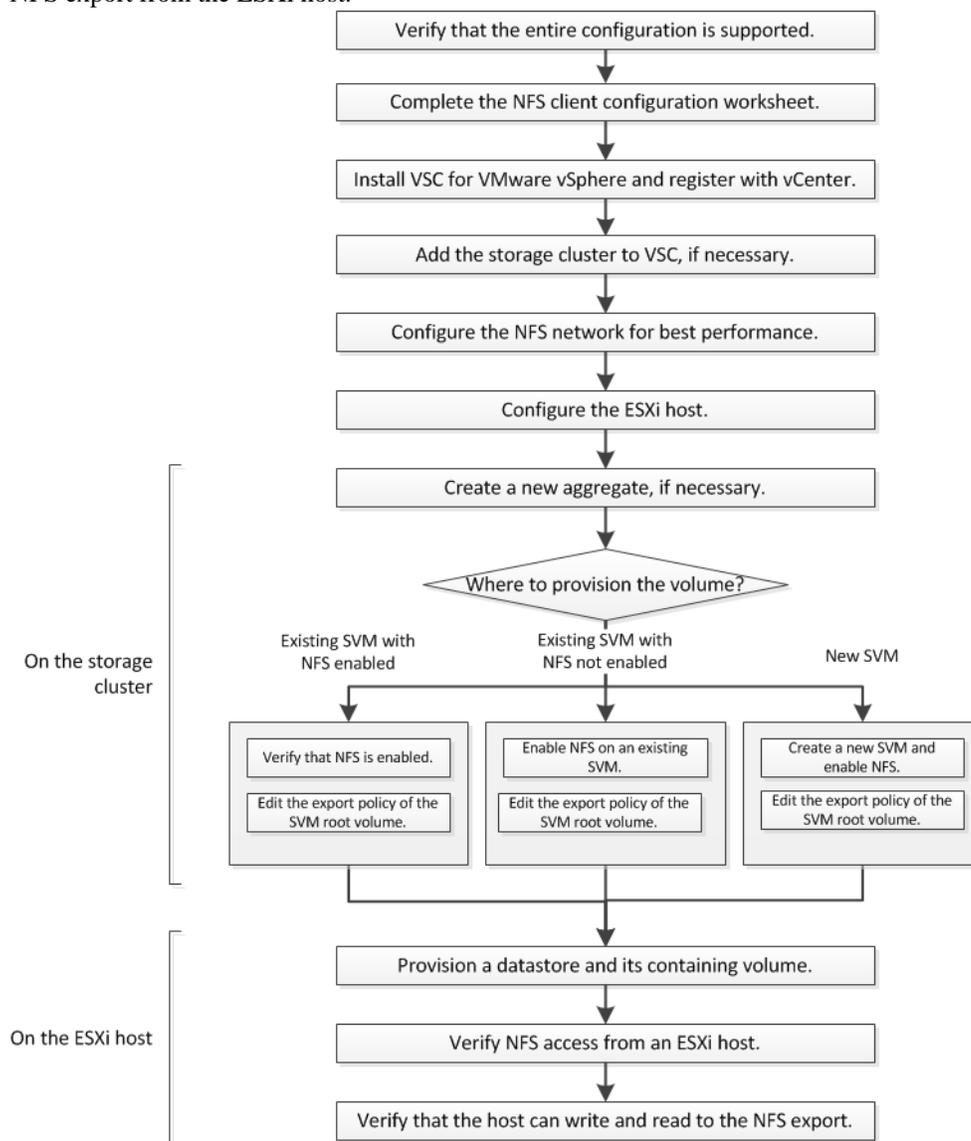
- NFS access will be via NFSv3, not NFSv4 or NFSv4.1.
- You want to use best practices, not explore every available option.
- You do not want to read a lot of conceptual background.
- You want to use OnCommand System Manager, not the Data ONTAP command-line interface or an automated scripting tool.
- You want to create FlexVol volumes, not Infinite Volumes.
- You want to use Virtual Storage Console to provision a datastore and create a volume.
- You do not want to use the NetApp Plug-In for VMware VAAI.

If this guide is not suitable for your situation, you should see the following documentation instead:

- [\*NetApp Technical Report 4068: VMware vSphere 5 on NetApp Clustered Data ONTAP 8.1\*](#)
- [\*NetApp Technical Report 4333: VMware vSphere 5 on NetApp Clustered Data ONTAP Best Practices Using vSphere Web Client\*](#)
- [\*Clustered Data ONTAP 8.3 File Access Management Guide for NFS\*](#)
- [\*NetApp Technical Report 4067: Clustered Data ONTAP Best Practice and NFS Implementation Guide\*](#)
- [\*NetApp Technical Report 4379: Name Services Best Practice Guide Clustered Data ONTAP\*](#)

## NFS Client Configuration for ESX workflow

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



### Verifying that the configuration is supported

To ensure reliable operation, you must verify that the entire configuration is supported. The Interoperability Matrix lists the supported configurations for NFS and for Virtual Storage Console.

#### Steps

1. Go to the [NetApp Interoperability Matrix Tool](#) to verify that you have a supported combination of the following components:
  - Clustered Data ONTAP software

- Host computer CPU architecture (for standard rack servers)
  - Specific processor blade model (for blade servers)
  - NFS storage protocol
  - ESXi operating system version
  - Guest operating system type and version
  - Virtual Storage Console for VMware vSphere (VSC) 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 NAS configurations.

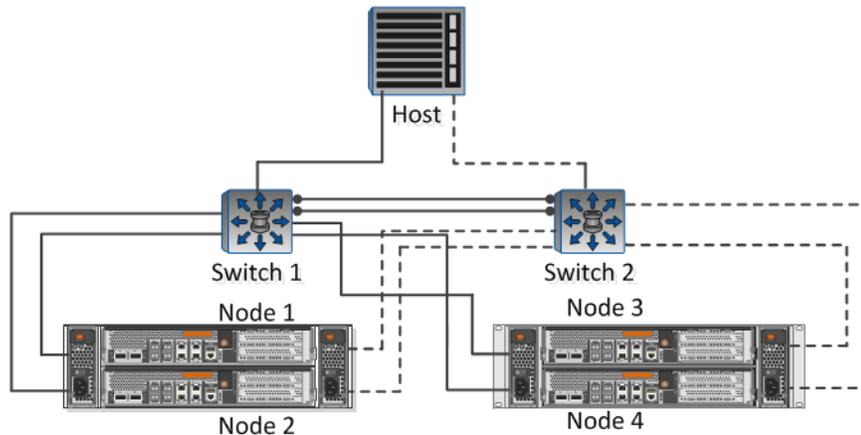
## Completing the NFS client configuration worksheet

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

### Target network addresses

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

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



Subnet for LIFs: \_\_\_\_\_

<b>Node or LIF with port to switch</b>	<b>IP address</b>	<b>Network mask</b>	<b>Gateway</b>	<b>VLAN ID</b>	<b>Home port</b>
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 NFS export	
Aggregate name	
SVM name	

### NFS export information

Export size	
Export name (optional)	
Export 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:

## Installing VSC

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

### Before you begin

- You must have administrator credentials on the Windows server.
- You must have administrator credentials on the vCenter Server used to manage the ESXi host.
- The Windows server on which you install VSC must have network connectivity to the ESXi host, to the vCenter Server, and to the storage cluster.

### About this task

- You can install VSC on the same Windows server that runs the vCenter Server.
- You cannot install VSC on vCenter Server Appliance (vCSA).  
You can install VSC on a separate Windows server or VM and register it with vCSA.
- VSC is not supported on a Windows server with IPv6 enabled.
- You do not need the VSC backup feature license for any tasks in this guide.

### Steps

1. Download the version of VSC that is supported for your configuration from [NetApp Support](#).
2. Run the installation wizard on the Windows server.
3. After the wizard finishes, complete the web page that is displayed to register VSC with the vCenter Server that manages your ESXi host.

## Adding 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**.

## Configuring your network for best performance

Ethernet networks vary greatly in performance. You can maximize the performance of the network 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.
2. Select the highest speed ports available.  
10 GbE ports are best. 1 GbE ports are the minimum.
3. Disable Ethernet flow control for all ports.
4. Enable jumbo frames.  
Jumbo frames should have an MTU of 9000 for ESXi hosts and storage systems and 9216 for most switches.  
All devices in the data path, including ESXi NICs, storage NICs, and switches, must support jumbo frames. Enabling jumbo frames improves network performance substantially.

## Configuring the ESXi host

Configuring the ESXi host involves configuring ports and vSwitches, and using ESXi host best practice settings. After verifying that these settings are correct, you can then create an aggregate and decide where to provision the new volume.

### Configuring host ports and vSwitches

The ESXi host requires network ports for the NFS 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 NFS must have IP addresses in the same network.

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

**Configuring the ESXi host best practice settings**

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

**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**.

MPIO Settings do not apply to NFS. However, if you use other protocols, you should ensure that all options are selected.

The vCenter Web Client displays the task progress.

**Creating 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 you are provisioning.

**About this task**

If you have an existing aggregate that you want to use for the new volume, you can skip this procedure.

**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. In the navigation pane, expand the **Cluster** hierarchy and click **Storage > Aggregates**.
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)

### Result

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

## Deciding where to provision the new volume

Before you create a new NFS volume, you must decide whether to place it in an existing Storage Virtual Machine (SVM) and, if so, how much configuration the SVM requires. This decision determines your workflow.

### Choices

- If you want a new SVM, see [Creating a new NFS-enabled SVM](#) on page 11. You must choose this option if NFS is not enabled on an existing SVM.
- If you want to provision a volume on an existing SVM that has NFS enabled but not configured, see [Configuring NFS access to an existing SVM](#) on page 15. You should choose this option if you created the SVM for SAN access by using the relevant Express Guide.
- If you want to provision a volume on an existing SVM that is fully configured for NFS access, see [Verifying settings on an existing SVM](#) on page 17.

## Creating a new NFS-enabled SVM

Setting up a new SVM involves creating the new SVM, enabling NFS, and editing the default export policy of the SVM root volume. You can then configure NFS access on the ESXi host and verify that NFS is enabled by using Virtual Storage Console.

### Creating a new SVM

You can use a wizard that guides you through the process of creating the SVM, configuring DNS, creating a data LIF, and enabling NFS.

#### Before you begin

- Your network must be configured and the relevant physical ports must be connected to the network.
- You must know which of the following networking components the SVM will use:
  - IPspace, if the network has more than one IPspace  
You cannot change the IPspace after the SVM is created.

- Node and the specific port on that node where the data logical interface (LIF) will be created
- The subnet from which the data LIF's IP address will be provisioned, and optionally the specific IP address you want to assign to the data LIF
- Any external firewalls must be appropriately configured to allow access to network services.

## Steps

1. Expand the **Storage Virtual Machines** hierarchy in the left navigation pane, and then click **Create**.
2. 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 to which the SVM will belong.  
If the cluster does not use multiple IPspaces, you should select the **Default** IPspace.
  - c. Select **NFS** for the data protocol.  
If you plan to use additional protocols on the same SVM, you should select them even if you do not want to configure them immediately.
  - d. Keep the default language setting, C.UTF-8.  
This language is inherited by the volume that you create later, and a volume's language cannot be changed.
  - e. Optional: If you enabled the CIFS protocol, change the security style to **UNIX**.  
Selecting the CIFS protocol sets the security style to NTFS by default.
  - f. Optional: Select the root aggregate to contain the SVM root volume.  
The aggregate that you select for the root volume does not determine the location of the data volume.

The screenshot shows the 'Storage Virtual Machine (SVM) Setup' window. At the top, there is a progress indicator with a circle containing the number '1' and the text 'Enter SVM basic details'. Below this is the 'SVM Details' section, which contains several configuration fields:

- SVM Name:** A text input field containing 'vs0.example.com'.
- IPspace:** A dropdown menu set to 'Default'.
- Volume Type:** Radio buttons for 'FlexVol volumes' (selected) and 'Infinite Volume'.
- Data Protocols:** Checkboxes for 'CIFS', 'NFS' (checked), 'iSCSI', and 'FC/CoE'.
- Default Language:** A dropdown menu set to 'C.UTF-8 [ c.utf\_8 ]'.
- Security Style:** A dropdown menu set to 'UNIX'.
- Root Aggregate:** A dropdown menu set to 'aggr3'.

Help icons (question marks) are present next to the SVM Name, IPspace, Volume Type, Data Protocols, Default Language, and Security Style fields. A note below the Volume Type section states: 'An SVM can contain either multiple FlexVol volumes or a single Infinite Volume. You cannot change the volume type of the SVM after you set it.'

- g. Optional: In the **DNS Configuration** area, ensure that the default DNS search domain and name servers are the ones that you want to use for this SVM.

**DNS Configuration**

Specify the DNS domain and name servers. DNS details are required to configure CIFS protocol.

Search Domains:

Name Servers:

- h. Click **Submit & Continue**.

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

3. In the **Data LIF Configuration** section of the **Configure CIFS/NFS protocol** page, specify the details of the first data LIF of the first datastore.
  - a. Assign an IP address to the LIF automatically from a subnet you specify or manually enter the address.
  - b. Click **Browse** and select a node and port that will be associated with the LIF.

**Data LIF Configuration**

Retain the CIFS data LIF's configuration for NFS clients.

Data interface details for CIFS

Subnet:

Auto-select the IP address from this subnet  
 Use a specific IP address:

Port:

4. Do not enter any information to provision a volume.  
You can provision datastores later using Virtual Storage Console.
5. Click **Submit & Continue**.  
The following objects are created:
  - A data LIF named after the SVM with the suffix “\_nfs\_lif1”
  - An NFS server
6. For all other protocol configuration pages that are displayed, click **Skip**, and then configure the protocol later.
7. When the **SVM Administration** page is displayed, configure or defer configuring a separate administrator for this SVM:
  - Click **Skip**, and then configure an administrator later if required.
  - Enter the requested information, and then click **Submit & Continue**.
8. Review the **Summary** page, record any information that you might require later, and then click **OK**.

NFS clients need to know the IP address of the data LIF.

## Result

A new SVM is created with NFS enabled.

## Editing the export policy of the SVM root volume

You must add a rule to the default export policy to allow ESXi host access through NFSv3. Without such a rule, all NFS clients are denied access to the Storage Virtual Machine (SVM) and its volumes.

### About this task

You should open all NFS access in the default export policy, and later restrict access to individual volumes using by creating custom export policies for individual volumes.

You should open all NFS access in the default export policy, and later restrict access to individual volumes using the export policies managed by Virtual Storage Console.

### Steps

1. In the navigation pane, select the SVM and click **Policies > Export Policies**.
2. Select the export policy named **default**, which is applied to the SVM root volume.
3. In the lower pane, click **Add**.
4. In the **Create Export Rule** dialog box, create a rule that opens access to all clients for NFS clients.
  - a. In the **Client Specification** field, enter **0.0.0.0/0** so that the rule applies to all clients.
  - b. Retain the default value as **1** for the rule index.
  - c. Select **NFSv3**.
  - d. Clear all the check boxes except the **UNIX** check box under **Read-Only**.
  - e. Click **OK**.

The screenshot shows the 'Create Export Rule' dialog box with the following configuration:

- Client Specification:** 0.0.0.0/0
- Rule Index:** 1
- Access Protocols:**
  - CIFS
  - NFS
  - NFSv3
  - NFSv4
  - Flexcache
- Information:** If you do not select any protocol, access is provided through any of the above protocols (CIFS, NFS, or FlexCache) configured on the Storage Virtual Machine (SVM).
- Access Details:**
  - Read-Only
  - Read/Write
- Authentication:**
  - UNIX
  - Kerberos 5
  - Kerberos 5i
  - NTLM
- Permissions:**
  - Allow Superuser Access

## Result

ESXi hosts can now access any volumes created on the SVM.

## Configuring NFS access to an existing SVM

Adding NFS access to an existing SVM involves configuring NFS on the SVM and editing the export policy of the SVM root volume. You can then configure NFS access on the ESXi host and verify that NFS is enabled using Virtual Storage Console.

### Steps

1. [Adding NFS access to an existing SVM](#) on page 15
2. [Editing the export policy of the SVM root volume](#) on page 16

## Adding NFS access to an existing SVM

To add NFS access to an existing SVM, you must create a data LIF and configure the export policy on the SVM root volume.

### Before you begin

- You must know which of the following networking components the SVM will use:
  - Node and the specific port on that node where the data logical interface (LIF) will be created
  - The subnet from which the data LIF's IP address will be provisioned, and optionally the specific IP address you want to assign to the data LIF
- Any external firewalls must be appropriately configured to allow access to network services.
- The NFS protocol must be allowed on the SVM.  
This is the case if you created the SVM while following another Express Guide to configure a SAN protocol.

### Steps

1. Navigate to the area where you can configure the protocols of the SVM:
  - a. In the navigation pane, expand the **Storage Virtual Machines** hierarchy, and then select the cluster.
  - b. In the list of SVMs, select the SVM that you want to configure.
  - c. In the **Details** pane, next to **Protocols**, click **NFS**.

Protocols:  NFS  FCiFCoE

2. In the **Configure NFS protocol** dialog box, create a data LIF:
  - a. Assign an IP address to the LIF automatically from a subnet you specify or manually enter the address.
  - b. Click **Browse** and select a node and port that will be associated with the LIF.

3. Do not enter any information to provision a volume.  
You can provision datastores later using Virtual Storage Console.
4. Click **Submit & Close**, and then click **OK**.

## Editing the export policy of the SVM root volume

You must add a rule to the default export policy to allow ESXi host access through NFSv3. Without such a rule, all NFS clients are denied access to the Storage Virtual Machine (SVM) and its volumes.

### About this task

You should open all NFS access in the default export policy, and later restrict access to individual volumes using by creating custom export policies for individual volumes.

You should open all NFS access in the default export policy, and later restrict access to individual volumes using the export policies managed by Virtual Storage Console.

### Steps

1. In the navigation pane, select the SVM and click **Policies > Export Policies**.
2. Select the export policy named **default**, which is applied to the SVM root volume.
3. In the lower pane, click **Add**.
4. In the **Create Export Rule** dialog box, create a rule that opens access to all clients for NFS clients.
  - a. In the **Client Specification** field, enter **0.0.0.0/0** so that the rule applies to all clients.
  - b. Retain the default value as **1** for the rule index.
  - c. Select **NFSv3**.
  - d. Clear all the check boxes except the **UNIX** check box under **Read-Only**.
  - e. Click **OK**.

**Create Export Rule**

Client Specification: 0.0.0.0/0

Rule Index: 1

Access Protocols:

- CIFS
- NFS  NFSv3  NFSv4
- Flexcache

*! If you do not select any protocol, access is provided through any of the above protocols (CIFS, NFS, or FlexCache) configured on the Storage Virtual Machine (SVM).*

Access Details:

- Read-Only  Read/Write

---

UNIX

Kerberos 5

Kerberos 5i

NTLM

Allow Superuser Access  
*Superuser access is set to all*

## Result

ESXi hosts can now access any volumes created on the SVM.

## Verifying settings on an existing SVM

Verifying the settings on an existing SVM involves verifying that NFS is enabled on the SVM and opening the export policy of the SVM root volume. You can then configure NFS access and verify that NFS is enabled by using Virtual Storage Console.

### Verifying that NFS is enabled on an existing SVM

If you choose to use an existing SVM, you must verify that NFS is enabled.

#### Steps

1. Navigate to the area where you can configure the protocols of the SVM:
  - a. In the list of SVMs, select the SVM that you want to configure.
  - b. In the **Details** pane, next to **Protocols**, click **NFS**:

Protocols: NFS FC/FCoE

2. In the left navigation pane, expand the **Storage Virtual Machines** hierarchy.
3. Select the SVM and click **Configuration > Protocols > NFS**.
4. Verify that NFS displays as enabled.

#### After you finish

If NFS is not enabled, you must enable it or create a new SVM.

## Editing the export policy of the SVM root volume

You must add a rule to the default export policy to allow ESXi host access through NFSv3. Without such a rule, all NFS clients are denied access to the Storage Virtual Machine (SVM) and its volumes.

### About this task

You should open all NFS access in the default export policy, and later restrict access to individual volumes using by creating custom export policies for individual volumes.

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### Steps

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  - a. In the **Client Specification** field, enter **0.0.0.0/0** so that the rule applies to all clients.
  - b. Retain the default value as **1** for the rule index.
  - c. Select **NFSv3**.
  - d. Clear all the check boxes except the **UNIX** check box under **Read-Only**.
  - e. Click **OK**.

The screenshot shows the 'Create Export Rule' dialog box with the following configuration:

- Client Specification:** 0.0.0.0/0
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- Authentication:**
  - UNIX
  - Kerberos 5
  - Kerberos 5i
  - NTLM
- Permissions:**
  - Allow Superuser Access

### Result

ESXi hosts can now access any volumes created on the SVM.

## Provisioning a datastore and creating its containing volume

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

### About this task

VSC automates the datastore provisioning, including creating a 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**.
4. Provide the required information in the wizard:

### After you finish

Set storage timeouts for guest operating systems using the Guest OS Tools in VSC.

For an ESXi cluster, make the datastore available to all the hosts in the cluster.

## Verifying NFS access from an ESXi host

After you have provisioned a datastore, you can verify that the ESXi host has NFS access by creating a virtual machine on the datastore and powering it on.

### Steps

1. From the vSphere Web Client **Home** page, click **Hosts and Clusters**.
2. In the navigation pane, expand the datacenter to locate the datastore you previously created.
3. Click **Create a new virtual machine** and provide the required information in the wizard.  
To verify NFS access, you should select the datacenter, ESXi host, and datastore that you previously created.  
The virtual machine appears in the vSphere Web Client inventory.

4. Power on the virtual machine.

## Verifying that the host can write to and read from the NFS share

Before using the NFS export, you should verify that the host can write data read from the NFS export.

### About this task

If the cluster node on which the NFS export 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.

For detailed instructions on node failover and giveback, see the *Clustered Data ONTAP 8.3 High-Availability Configuration Guide*.

### 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 NFS export and verify that you can still write and read a file.  
If any of the tests fail, verify that the NFS service is running on the storage cluster and check the paths to the export.
8. Optional: 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

[Clustered Data ONTAP 8.3 High-Availability Configuration Guide](#)

## Where to find additional information

After you have successfully tested NFS client access, you can perform advanced NFS configuration or add SAN access. When protocol access is complete, you should protect the root volume of the

SVM. There are express guides, comprehensive guides, and technical reports to help you achieve these goals.

### **NFS configuration**

You can further configure NFS access using the following comprehensive guides and technical reports:

- [\*Clustered Data ONTAP 8.3 File Access Management Guide for NFS\*](#)  
Describes how to configure and manage file access using the NFS protocol.
- [\*NetApp Technical Report 4068: VMware vSphere 5 on NetApp Clustered Data ONTAP 8.1\*](#)  
Describes the best practices that should be followed when using clustered Data ONTAP and VMware vSphere server virtualization environments.
- [\*NetApp Technical Report 4379: Name Services Best Practice Guide Clustered Data ONTAP\*](#)  
Explains how to configure LDAP, NIS, DNS, and local file configuration for authentication purposes.
- [\*NetApp Technical Report 4067: Clustered Data ONTAP Best Practice and NFS Implementation Guide\*](#)  
Serves as an NFSv3 and NFSv4 operational guide and provides an overview of Data ONTAP operating system with a focus on NFSv4.
- [\*NetApp Technical Report 4333: VMware vSphere 5 on NetApp Clustered Data ONTAP Best Practices Using vSphere Web Client\*](#)  
Describes the best practices that should be followed when using VMware vSphere 5.x with clustered Data ONTAP and the VMware vSphere Web Client.

### **Root volume protection**

After configuring protocols on the SVM, you should ensure that its root volume is protected by using the following express guide:

- [\*Clustered Data ONTAP 8.3 SVM Root Volume Protection Express Guide\*](#)  
Describes how to quickly create load-sharing mirrors on every node of a Data ONTAP 8.3 cluster to protect the SVM root volume, which is a NetApp best practice for NAS-enabled SVMs. Also describes how to quickly recover from volume failures or losses by promoting the SVM root volume from a load-sharing mirror.

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