Installing the NetApp® NFS Plug-in 1.1.2 for VMware® VAAI

Installing the NFS Plug-in involves enabling VMware vStorage for NFS on the NetApp storage system, verifying that VAAI ((VMware vStorage APIs for Array Integration) is enabled on the VMware host, downloading and installing the plug-in on the VMware ESXi host, and verifying that the installation is successful.

Before you begin

- NFSv3 or NFSv4.1 must have been enabled on the storage system.

  Note: NFSv4.1 is available only on ONTAP 9.0 systems and NFSv3 is available on both 7-Mode and Cluster-Mode systems.

- VMware vSphere 6.0 must be available.

For additional information about enabling NFS and using VMware vSphere, see the manuals listed in *Step 10* on page 6.

About this task

- If you are using the VMware ESXi CLI to install the plug-in, start with *Step 1* on page 1.

- If you are using Virtual Storage Console for VMware vSphere (VSC) to install the plug-in, start with *Step 3* on page 2. VSC enables VMware vStorage for NFS on the storage controller and enables VAAI on the ESXi host, which are steps *1* on page 1 through *2* on page 2 of this procedure.

- Installing the NFS plug-in is a disruptive activity that requires rebooting the ESXi host before the installation is complete. For consistent access to the virtual machines residing on the ESXi host on which you are installing the NFS plug-in, you should consider virtual machine migrations, or install the NFS plug-in during planned maintenance windows.

  IP address conventions used:

  - IP addresses of the form 192.168.42.2xx refer to ESXi server VMkernel ports.

  - IP addresses of the form 192.168.42.6x refer to systems running Data ONTAP operating in 7-Mode.

  - IP addresses of the form 192.168.42.8x refer to Storage Virtual Machines (SVMs, formerly known as Vservers) on ONTAP systems.

Steps

1. Enable VMware vStorage for NFS:

If you use the...	Then...
ONTAP CLI	Enable VMware vStorage for NFS on the SVM: **vserver nfs modify –vserver *vserver_name* -vstorage enabled** *vserver_name* is the name of the SVM.
7-Mode CLI	Enable VMware vStorage for NFS on the storage system: **options nfs.vstorage.enable on**

If you use the...	Then...
7-Mode CLI for vFiler units	Enable the installation of NetApp NFS plug-in vStorage for NFS on the MultiStore vFiler unit hosting VMware NFS datastores: **`vfiler run vfiler_name options nfs.vstorage.enable on`**

2. Verify that VAAI is enabled on each ESXi host.

   In VMware vSphere 5.0 and later, VAAI is enabled by default.

If you use the...	Then...

VMware ESXi CLI	**a.** Verify that VAAI is enabled:
	
	`esxcfg-advcfg -g /DataMover/HardwareAcceleratedMove`
	
	`esxcfg-advcfg -g /DataMover/HardwareAcceleratedInit`
	
	If VAAI is enabled, these commands display the following output:
	
	<pre>~ # esxcfg-advcfg -g /DataMover/HardwareAcceleratedMove
	Value of HardwareAcceleratedMove is 1
	~ # esxcfg-advcfg -g /DataMover/HardwareAcceleratedInit
	Value of HardwareAcceleratedInit is 1</pre>
	b. If VAAI is not enabled, enable VAAI:
	
	`esxcfg-advcfg -s 1 /DataMover/HardwareAcceleratedInit`
	
	`esxcfg-advcfg -s 1 /DataMover/HardwareAcceleratedMove`
	
	These commands display the following output:
	
	<pre>~ # esxcfg-advcfg -s 1 /DataMover/HardwareAcceleratedInit
	Value of HardwareAcceleratedInit is 1
	~ # esxcfg-advcfg -s 1 /DataMover/HardwareAcceleratedMove
	Value of HardwareAcceleratedMove is 1</pre>

vSphere Client	**a.** Log in to the vCenter Server. **b.** For each ESXi server, click the server name. **c.** In the Software section of the Configuration tab, click **Advanced Settings**. **d.** Select **DataMover**, and then verify that the `DataMover.HardwareAcceleratedMove` and `DataMover.HardwareAcceleratedInit` parameters are set to **1**.

3. Download the NetApp NFS Plug-in for VMware VAAI:

   a. Go to the **Software Download** page at *mysupport.netapp.com/NOW/cgi-bin/software*.

   b. Select **NetApp NFS Plug-in for VMware VAAI** in the **Products** section.

   c. Select the appropriate ESXi host from the **Select Platform** menu.

   d. Download either the offline bundle (`.zip`) or online bundle (`.vib`) of the most recent plug-in.

4. Install the plug-in on the ESXi host by using one of the following three methods:

To...	Then...
Install the online bundle using the ESXi CLI	Enter the following command: **`esxcli software vib install -v `**`http_path` `http_path` is the path to the online bundle (`.vib`), which must be available online.

Install the offline bundle using the ESXi CLI	**a.** Copy the offline bundle to the ESXi host, or to a common datastore accessible by all ESXi hosts.
	
	b. List the contents of the offline bundle and verify the plug-in version:
	
	`~ # esxcli software sources vib list -d file:///``path_offline_bundle`**`.zip`**
	
	c. Install the plug-in from the offline bundle:
	
	`esxcli software vib install -n ``plugin_name`**` -d file:///`**`path_offline_bundle`**`.zip`**
	The following output is displayed:
	
	<pre>~ # esxcli software vib install -n NetAppNasPlugin -d file:///NetAppNasPlugin.zip
	
	Message: The update completed successfully, but the system needs to be rebooted for the changes to be effective.
	
	  Reboot Required: true
	  VIBs Installed:
	  NetApp_bootbank_NetAppNasPlugin_1.1.2-3
	  VIBs Removed:
	  VIBs Skipped:
	~ #</pre>

To...	Then...
Use VSC to install the plug-in	**a.** Extract the offline bundle in `.zip` format.
	b. Copy the plug-in `.vib` file, `NetAppNasPlugin.vib`, to the VSC installation directory. The path name is `VSC_installation_directory\etc\vsc\web`, where `VSC_installation_directory` is the directory where you installed VSC. The default directory path is `C:\Program Files\NetApp\Virtual Storage Console\`. For example, if you are using the default installation directory, the path to the `NetAppNasPlugin.vib` file is `C:\Program Files\Virtual Storage Console\etc\vsc\web\NetAppNasPlugin.vib`. However, you can change that directory.
	c. Verify that the file name of the `.vib` file that you downloaded matches the predefined name that VSC uses: `NetAppNasPlugin.vib` If the file name does not match the predefined name, rename the `.vib` file. You do not need to restart the VSC client or the NetApp vSphere Plug-in Framework (NVPF) service.
	d. Go to the NFS Plug-in for VMware VAAI section of the Tools panel of Monitoring and Host Configuration, and then select vCenter Server on which you want to install the plug-in. This option is available for both single and multi vCenter environments.
	e. Click **Install to Host**.
	f. In the dialog box, specify the ESXi hosts on which you want to install the plug-in.
	g. Click **OK**. The Monitoring and Host Configuration capability automatically installs the plug-in on the hosts that you specified.

5. Reboot the ESXi host to complete the installation.

You do not need to reboot the storage system.

6. Verify that the plug-in was successfully installed on the host at the VMware ESXi command line:

`esxcli software vib list | more`

The plug-in works automatically following the installation and reboot.

7. If you are installing the plug-in on a new system or on ONTAP, either create or modify export policy rules for the root volumes and for each NFS datastore volume on the ESXi servers that use VAAI.

Skip this step if you are using Data ONTAP operating in 7-Mode.

You can use export policies to restrict access to volumes to specific clients. NFSv4 is required in the export policy for VAAI copy offloading to work, so you might need to modify the export policy rules for datastore volumes on SVMs. If you are using protocols other than NFS on a datastore, verify that setting NFS in the export rule does not remove those other protocols.

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If you use...	Then...
ONTAP CLI	Set `nfs` as the access protocol for each export policy rule for ESXi servers that use VAAI: **`vserver export-policy rule modify -vserver vs1 -policyname mypolicy -ruleindex 1 -protocol nfs -rwrule krb5|krb5i|any -rorule krb5|krb5i|any`** In the following example: • **`vs1`** is the name of the SVM. • **`mypolicy`** is the name of the export policy. • **`1`** is the index number of the rule. • **`nfs`** includes the NFSv3 and NFSv4 protocols. • The security style for RO (read-only) and RW (read-write) is either krb5, krb5i, or any. <code>cluster1::> vserver export-policy rule modify -vserver vs1 -policyname mypolicy -ruleindex 1 -protocol nfs -rwrule krb5|krb5i|any - rorule krb5|krb5i|any</code>
OnCommand System Manager	a. From the Home tab, double-click the appropriate cluster. b. Expand the Storage Virtual Machines (SVMs) hierarchy in the left navigation pane. **Note:** If you are using a version of System Manager prior to 3.1, the term *Vservers* is used instead of *Storage Virtual Machines* in the hierarchy. c. In the navigation pane, select the Storage Virtual Machine (SVM) with VAAI-enabled datastores, and then click **Policies > Export Policies**. d. In the Export Policies window, expand the export policy, and then select the rule index. The user interface does not specify that the datastore is VAAI enabled. e. Click **Modify Rule** to display the Modify Export Rule dialog box. f. Under **Access Protocols**, select **NFS** to enable all versions of NFS. g. Click **OK**.

8. If you are using Data ONTAP operating in 7-Mode, execute the `exportfs` command for exporting volume paths.

   Skip this step if you are using ONTAP.

   For more information about the `exportfs` command, see the *Data ONTAP File Access and Protocols Management Guide for 7-Mode* or the man pages.

   Example

   When exporting the volume, you can specify a host name or IP address, a subnet, or a netgroup. You can specify IP address, subnet, or hosts for both the `rw` and `root` options. For example:

   ```
   sys1> exportfs -p root=192.168.42.227 /vol/VAAI
   ```

   You also can have a list, separated by colons. For example:

   ```
   sys1> exportfs -p root=192.168.42.227:192.168.42.228 /vol/VAAI
   ```

   If you export the volume with the actual flag, the export path should have a single component for copy offload to work properly. For example:

```
sys1> exportfs -p actual=/vol/VAAI,root=192.168.42.227 /VAAI-ALIAS
```

Note: Copy offload does not work for multicomponent export paths.

9. Mount the NFSv3 or NFSv4.1 datastore on the ESXi host:

   a. To mount the NFSv3 datastore, execute the following command:

   esxcli storage nfs add -H 192.168.42.80 -s share_name -v volume_name
   To mount the NFSv4.1 datastore, execute the following command:

   **esxcli storage nfs41 add -H 192.168.42.80 -s share_name -v volume_name -a AUTH_SYS/
   SEC_KRB5/SEC_KRB5I**

   Example

   The following example shows the command to be run on ONTAP for mounting the datastore and the resulting output:

   ```
   ~ # esxcfg-nas -a onc_src -o 192.168.42.80 -s /onc_src
   Connecting to NAS volume: onc_src
   /onc_src created and connected.
   ```

   For systems running Data ONTAP operating in 7-Mode, the /vol prefix precedes the NFS volume name. The following example shows the 7-Mode command for mounting the datastore and the resulting output:

   ```
   ~ # esxcfg-nas -a vms_7m -o 192.168.42.69 -s /vol/vms_7m
   Connecting to NAS volume: /vol/vms_7m
   /vol/vms_7m created and connected.
   ```

   b. To manage NAS mounts:

   esxcfg-nas -l

   The following output is displayed:

   ```
   VMS_vol103 is /VMS_vol103 from 192.168.42.81 mounted available
   VMS_vol104 is VMS_vol104 from 192.168.42.82 mounted available
   dbench1 is /dbench1 from 192.168.42.83 mounted available
   dbench2 is /dbench2 from 192.168.42.84 mounted available
   onc_src is /onc_src from 192.168.42.80 mounted available
   ```

   Upon completion, the volume is mounted and available in the /vmfs/volumes directory.

10. Verify that the mounted datastore supports VAAI by using one of the following methods:

If you use...	Then...
ESXi CLI	**vmkfstools -Ph /vmfs/volumes/onc_src/** The following output is displayed: ``` NFS-1.00 file system spanning 1 partitions. File system label (if any): onc_src Mode: public Capacity 760 MB, 36.0 MB available, file block size 4 KB UUID: fb9cccc8-320a99a6-0000-000000000000 Partitions spanned (on "notDCS"): nfs:onc_src NAS VAAI Supported: YES Is Native Snapshot Capable: YES ~ # ```

If you use...	Then...
vSphere Client	a. Click **ESXi Server > Configuration > Storage**. b. View the Hardware Acceleration column for an NFS datastore with VAAI enabled.

For more information about VMware vStorage over NFS, see the following guides:

ONTAP 9 NFS Reference

Data ONTAP 8.2 File Access and Protocols Management Guide for 7-Mode

For details about configuring volumes and space in the volumes, see the following guides:

ONTAP 9 Logical Storage Management Guide

Data ONTAP 8.2 Storage Management Guide For 7-Mode

For information about using VSC to provision NFS datastores and create clones of virtual machines in the VMware environment, see the following guide:

Virtual Storage Console 6.0 for VMware vSphere Installation and Administration Guide

For more information about working with NFS datastores and performing cloning operations, see the following guide:

VMware vSphere Storage

11. If you are using Data ONTAP operating in 7-Mode, execute the `sis on` command to enable the datastore volume for copy offloading and deduplication.

   For ONTAP, view the efficiency details for a volume:

   volume efficiency show -vserver *vserver_name* -volume *volume_name*

   > **Note:** For All Flash FAS (AFF) systems, volume efficiency is enabled by default.

   If the command output does not display any volumes with storage efficiency enabled, then enable efficiency:

   volume efficiency on -vserver *vserver_name* -volume *volume_name*

   Skip this step if you are using VSC to set up the volumes because volume efficiency is enabled on the datastores by default.

   ```
   sys1> volume efficiency show
   This table is currently empty.

   sys1> volume efficiency on –volume  testvol1
   Efficiency for volume "testvol1" of Vserver "vs1" is enabled.

   sys1> volume efficiency show
   Vserver     Volume           State    Status       Progress          Policy
   ----------  ---------------- -------- ------------  ----------------- ----------
   vs1         testvol1         Enabled  Idle          Idle for 00:00:06  –
   ```

   For details about enabling deduplication on the datastore volumes, see the following guides.

   ONTAP 9 Logical Storage Management Guide

   Data ONTAP 8.2 File Access and Protocols Management Guide for 7-Mode

After you finish

Use the NFS plug-in space reservation and copy offload features to make routine tasks more efficient:

• Create virtual machines in the thick virtual machine disk (VMDK) format on NetApp traditional volumes or FlexVol volumes, and reserve space for the file when you create it.

- Clone existing virtual machines within or across NetApp volumes:

  ◦ Datastores that are volumes on the same SVM on the same node.

  ◦ Datastores that are volumes on the same SVM on different nodes.

  ◦ Datastores that are volumes on the same 7-Mode system or vFiler unit.

- Perform cloning operations that finish faster than non-VAAI clone operations because they do not need to go through the ESXi host.

Configuring export policies for ONTAP to allow VAAI over NFS

You must configure export policies to provide compliance between VMware vStorage APIs for Array Integration (VAAI) storage features over the NFS server and NetApp storage. In ONTAP, volume exports are restricted by export policies that are applied on Storage Virtual Machines (SVMs, formerly known as Vservers).

Before you begin

- NFSv4 calls must be allowed by the relevant NFS volumes.

- The root user must be retained as the primary user.

- NFSv4 must be allowed on all of the interconnected parent volumes.

- The option for VAAI support must be set on the relevant NFS server.

About this task

You can configure different export policies for multiple conditions and protocols.

Steps

1. If an export policy is not created, then create an export policy for the SVM in the root volume of the VMware ESXi host that contains the SVM name, policy name, default rule index, protocol, and so on:

   `vserver export-policy rule modify -vserver` *vserver name* `-policyname default -ruleindex` *rule index* `-protocol NFSv3|NFSv4`

2. Modify the export policy to allow both NFSv3 and NFSv4 protocols with the following conditions:

   - You must have configured the export policy rule for the respective ESX server and the volume with all of the relevant access permissions.

   - You must have set the values of RW, RO, and Superuser to `SYS` or `ANY` for the client match.

   - You must have allowed the NFSv3 and NFSv4 protocol.
     The Access Protocol in the export policy is set as follows:

     ◦ Access Protocol = `nfs` (to include all versions of NFS)

     ◦ Access Protocol = `nfsv3, nfsv4` (NFSv3 for NFSv3 datastore access) and NFSv4 (NFSv4 for NFSv4.1 datastore access)).

   Example

   The following commands display the SVM details and set the export policy:

```
cm3240c-rtp::> vol show -vserver vmware -volume vmware_VAAI -fields policy (volume
show)
vserver volume       policy          junction-path
------- ------       -------         -------------
vmware  vmware_VAAI  vmware_access   /VAAI
```

```
cm3240c-rtp::> export-policy rule show -vserver vmware -policyname vmware_access
-ruleindex 2(vserver export-policy rule show)

Vserver: vmware
Policy Name: vmware_access
Rule Index: 1
Access Protocol: nfs3,nfs4 (can also be nfs for NFSv3)
Client Match Spec: 192.168.1.6
RO Access Rule: sys
RW Access Rule: sys
User ID To Which Anonymous Users Are Mapped: 65534
Superuser Security Flavors: sys
Honor SetUID Bits In SETATTR: true
Allow Creation of Devices: true
```

Any policy change is applied to all of the volumes using the relevant policy and is not restricted to the NFS datastore volumes.

3. Modify the export policy to set the Superuser as **sys** with the following conditions:

   • You must have configured all of the parent volumes in the junction path with read access permission to the root volume, NFSv4 access, and VAAI access to the junction volume.
     The Superuser of the root volume for the SVM is set to **sys** for the relevant client.

   • You must have denied write access permission for the SVM root volume.

Example

The following commands display the SVM details and set the export policy:

```
cm3240c-rtp::> vol show -vserver vmware -volume vmware_root -fields policy,
junction-path (volume show)
vserver volume policy   junction-path
------- ------ -------  -------------
vmware  vmware_root  root_policy /
```

```
cm3240c-rtp::> export-policy rule show -vserver vmware -policyname root_policy
-ruleindex 1 (vserver export-policy rule show)

Vserver: vmware
Policy Name: root_policy
Rule Index: 1
Access Protocol: nfs  <--- as in scenario 1, set to nfs or nfs3,nfs4
Client Match Spec: 192.168.1.5
RO Access Rule: sys
RW Access Rule: never  <--- this can be never for security reasons
User ID To Which Anonymous Users Are Mapped: 65534
Superuser Security Flavors: sys    <--- this is required for VAAI to be set, even
in the parent volumes like vsroot
Honor SetUID Bits In SETATTR: true
Allow Creation of Devices: true
```

The root user is retained because the Superuser is set to **SYS**. Therefore, the root user can access the volume that has the junction path /VAAI.

If additional volumes exist in the junctions between the root volume and the vmware_VAAI volume, then those volumes should have a policy rule for the respective client, where the Superuser is set to **SYS** or **ANY**.

In most cases, the root volume uses a policy with the Policy Name set to default.

Any policy change is applied to all of the volumes using the relevant policy and is not restricted to the root volume.

4. Enable the vStorage feature:

nfs modify -vserver *vserver_name* vmware -vstorage enabled

The NFS service on the SVM requires enabling the vStorage feature.

5. Verify that the vStorage feature is enabled:

nfs show -fields vstorage

Example

The output should display enabled:

```
cm3240c-rtp::> nfs show -fields vstorage
vserver vstorage
------- --------
vmware  enabled
```

6. Create the export policy:

vserver export-policy rule create

Example

The following commands create the export policy rule:

```
User1-vserver2::> protocol export-policy rule create -vserver vs1
-policyname default -clientmatch 0.0.0.0/0 -rorule any -rwrule any -superuser
any -anon 0

User1-vserver2::> export-policy rule show vserver export-policy rule show)
Virtual      Policy          Rule    Access   Client                RO
Server       Name            Index   Protocol Match                 Rule
------------ --------------- ------  -------- -------------------- ---------
vs1          default         1       any      0.0.0.0/0             any

User1-vserver2::>
```

7. Display the export policy:

vserver export-policy show

Example

The following commands display the export policy:

```
User1-vserver2::> export-policy show (vserver export-policy show)
Virtual Server   Policy Name
---------------  -------------------
vs1              default
```