Installing the NetApp® NFS Plug-in 1.1.0 for VMware® VAAI

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

Before you begin

- NFSv3 must be enabled on the storage system.

- VMware vSphere 6.0 must be available.

For more information about enabling NFS and using VMware vSphere, see the manuals listed in Step 10.

About this task

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

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

- Installing the NFS plug-in is a disruptive activity that requires rebooting the ESXi host before the installation is complete. To ensure 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 clustered Data ONTAP systems.

Steps

1. Enable VMware vStorage for NFS by using one of the following methods:

If you use...	Then...
Clustered Data ONTAP CLI	Enable VMware vStorage for NFS on the SVM by using the following command: **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 by using the following command: **options nfs.vstorage.enable on**
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 by using the following command: **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...	Then...

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

vSphere Client	**a.** Using the vSphere Client, 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 ensure 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. Scroll down and go to **NetApp NFS Plug-in for VMware VAAI** in the Products section.

c. Select the appropriate ESXi host from the <Select Platform> drop-down 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.

To...	Then...

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. Enter the following command to list the contents of the offline bundle and verify the plug-in version:
	
	~ # esxcli software sources vib list –d file:/// **_path_offline_bundle_.zip**
	
	In the following output examples, the version and release date of the plug-in are for illustration purposes. The most recent version and release date of the plug-in might be different from what is shown. _path_offline_bundle_ is the file name and full path of the offline bundle, and _plugin_name_ is the name of the NFS plug-in.
	
	The following output is displayed when you enter this command:
	
	<pre>~ # esxcli software sources vib list -d file:///
	NetAppNasPlugin.zip
	
	Name Version Vendor Creation Date Acceptance
	Level
	--------------- ------- ------ ---------- ----------------
	
	NetAppNasPlugin 1.1.0-0 NetApp 2014-10-22 VMwareAccepted</pre>
	c. Enter the following command to 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 when you enter this command:
	
	<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_1.1.0-0
	   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, VSC allows you to change that directory.
	c. Ensure 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 select vCenter Server on which you want to install the plug-in. This option is available for both single and multi vCenter environment.
	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.

However, the storage system does not need to be rebooted.

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

`~ # esxcli software vib list | more`

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

The following output is displayed when you enter this command:

```
Name               Version  Vendor  Acceptance Level    Install Date
---------------    -------- ------  -----------------   ------------
NetAppNasPlugin    1.1.0-0  NetApp  VMwareAccepted      2015-03-13
~ # esxcli software vib get|more

NetApp_bootbank_NetAppNasPlugin_1.1.0-0
   Name: NetAppNasPlugin
   Version: 1.1.0-0
   Type: bootbank
   Vendor: NetApp
   Acceptance Level: VMwareAccepted
   Summary: NAS VAAI NetApp Plugin
   Description: NetApp NAS VAAI Module for ESX Server
   ReferenceURLs:
   Creation Date: 2014-10-22
   Depends:
   Conflicts:
   Replaces:
   Provides:
   Maintenance Mode Required: False
   Hardware Platforms Required:
```

```
    Live Install Allowed: False
    Live Remove Allowed: False
    Stateless Ready: True
    Overlay: False
    Tags:
    Payloads: NetAppNasPlugin
~ #
```

7. If you are installing the plug-in on a new system or on clustered Data 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.

Configuring export policies for clustered Data ONTAP to allow VAAI over NFS on page 8

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.

If you use...	Then...
Clustered Data ONTAP CLI	Enter the following command to set `nfs` as the access protocol for each export policy rule for ESXi servers that use VAAI: **vserver export-policy rule modify -vserver *vserver_name* -policyname *policy* -ruleindex *index* -protocol nfs** 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. <pre>cluster1::> vserver export-policy rule modify -vserver vs1 -policyname mypolicy -ruleindex 1 -protocol nfs</pre>
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, use the `exportfs` command for exporting volume paths.

Skip this step if you are using clustered Data 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 NFS datastore on the ESXi host by performing the following steps:

   a. Enter the following command:

   ```
   ~ # esxcfg-nas -a mount_point_name -o 192.168.42.80 -s /volume_path
   ```

   Example

   The following example shows the command to be run on clustered Data 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. Enter the following command:

   ```
   ~ # 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	Enter the following command:
	
	`~ # vmkfstools -Ph /vmfs/volumes/onc_src/`
	
	The following output is displayed:
	
	<pre>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
	~ #</pre>

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 *Clustered Data ONTAP File Access Management Guide for NFS* or *Data ONTAP File Access and Protocols Management Guide for 7-Mode*.

For details about configuring volumes and space in the volumes, see the *Clustered Data ONTAP Logical Storage Management Guide* or *Data ONTAP 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 *Virtual Storage Console for VMware vSphere Installation and Administration Guide*.

For more information about working with NFS datastores and performing cloning operations, see the *VMware vSphere Storage* guide at *pubs.vmware.com/vsphere-60/topic/com.vmware.ICbase/PDF/vsphere-esxi-vcenter-server-60-storage-guide.pdf*.

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

For clustered Data ONTAP, run the following command to view the efficiency details for a volume:

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

If the command output does not display any volumes with storage efficiency enabled, then run the following command to 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 *Clustered Data ONTAP Logical Storage Management Guide* or *Data ONTAP Storage 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 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 clustered Data ONTAP to allow VAAI over NFS

You must configure export policies to ensure compliance between VMware vStorage APIs for Array Integration (VAAI) storage features over the NFS server and NetApp storage. In clustered Data 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 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.

Choices

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

    vserver export-policy rule modify -vserver -policyname default -ruleindex -protocol

- 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 volume with all the relevant access permissions.

    ◦ You must have set the value of RW, RO, and Superuser to **SYS** or **ANY** for the client match.

    ◦ You must have allowed the NFSv3 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** (to include both NFSv3 (for the datastore access) and NFSv4 (for the VAAI-specific calls)).

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 the volumes using the relevant policy and is not restricted to the NFS datastore volumes.

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

   ◦ You must have configured all 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 more number of 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 of the cases, the root volume uses a policy with the Policy Name set to default.

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

• Enable the vStorage feature and view the status.

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

Example

```
cm3240c-rtp::> nfs modify -vserver vmware -vstorage enabled

To display it, run the following command:

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

Example

The following commands set and display the export policy:

```
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 show (vserver export-policy show)
Virtual Server    Policy Name
---------------   -------------------
vs1               default

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::>
```