



VCF with NetApp AFF Arrays

NetApp Solutions

NetApp
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VMware Cloud Foundation with NetApp AFF Arrays

VMware Cloud Foundation (VCF) is an integrated software defined data center (SDDC) platform that provides a complete stack of software-defined infrastructure for running enterprise applications in a hybrid cloud environment. It combines compute, storage, networking, and management capabilities into a unified platform, offering a consistent operational experience across private and public clouds.

This document provides information on storage options available for VMware Cloud Foundation using the NetApp All-Flash AFF storage system. Supported storage options are covered with specific instruction for creating workload domains with NFS and vVol datastores as principal storage as well as a range of supplemental storage options.

Use Cases

Use cases covered in this documentation:

- Storage options for customers seeking uniform environments across both private and public clouds.
- Automated solution for deploying virtual infrastructure for workload domains.
- Scalable storage solution tailored to meet evolving needs, even when not aligned directly with compute resource requirements.
- Deploy VCF VI Workload Domains using ONTAP as principal storage.
- Deploy supplemental storage to VI Workload Domains using ONTAP Tools for VMware vSphere.

Audience

This solution is intended for the following people:

- Solution architects looking for more flexible storage options for VMware environments that are designed to maximize TCO.
- Solution architects looking for VCF storage options that provide data protection and disaster recovery options with the major cloud providers.
- Storage administrators wanting to understand how to configure VCF with principal and supplemental storage.

Technology Overview

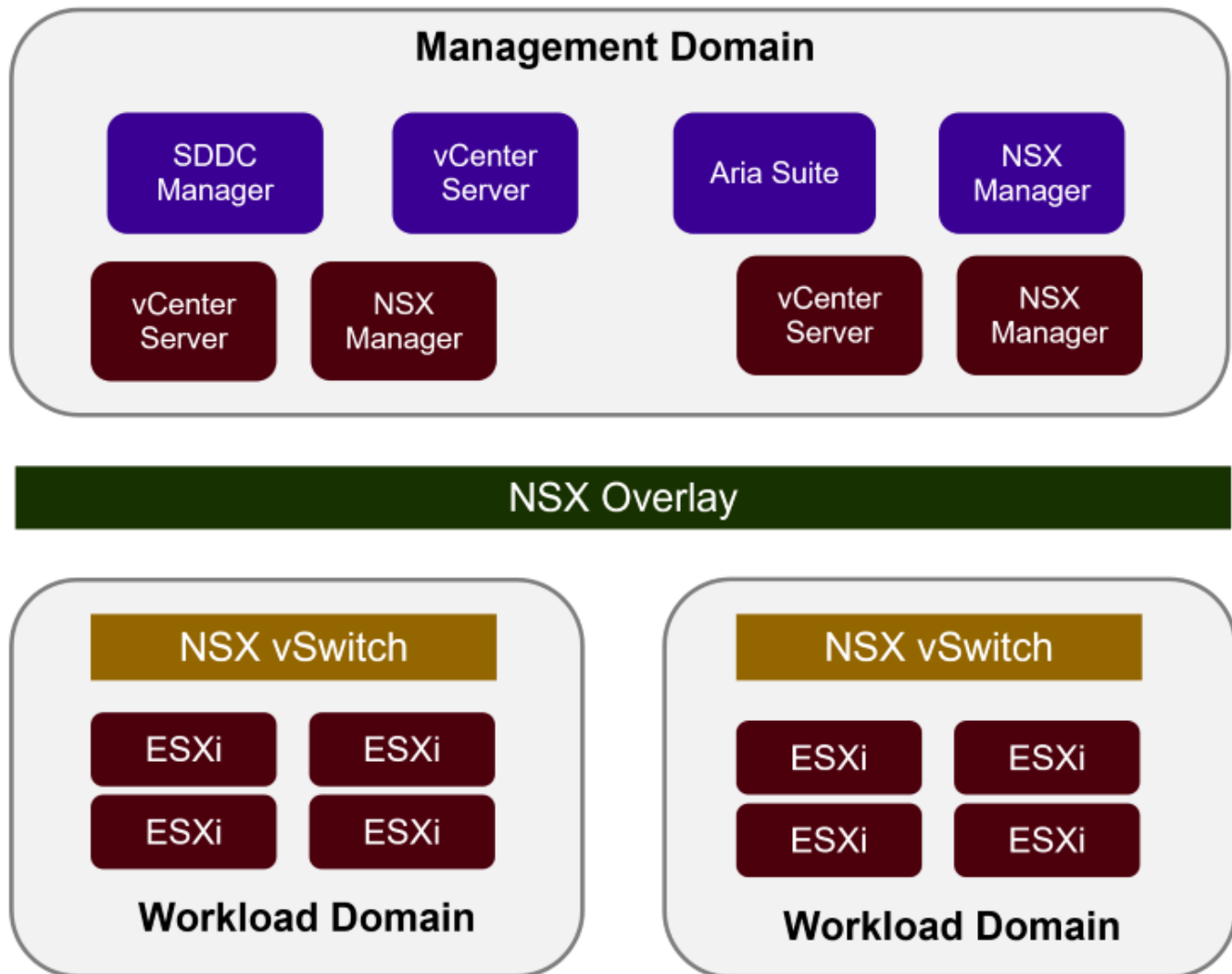
The VCF with NetApp AFF solution is comprised of the following major components:

VMware Cloud Foundation

VMware Cloud Foundation extends VMware's vSphere hypervisor offerings by combining key components such as SDDC Manager, vSphere, vSAN, NSX, and VMware Aria Suite to create a virtualized datacenter.

The VCF solution supports both native Kubernetes and virtual machine-based workloads. Key services such as VMware vSphere, VMware vSAN, VMware NSX-T Data Center, and VMware vRealize Cloud Management are integral components of the VCF package. When combined, these services establish a software-defined infrastructure capable of efficiently managing compute, storage, networking, security, and cloud management.

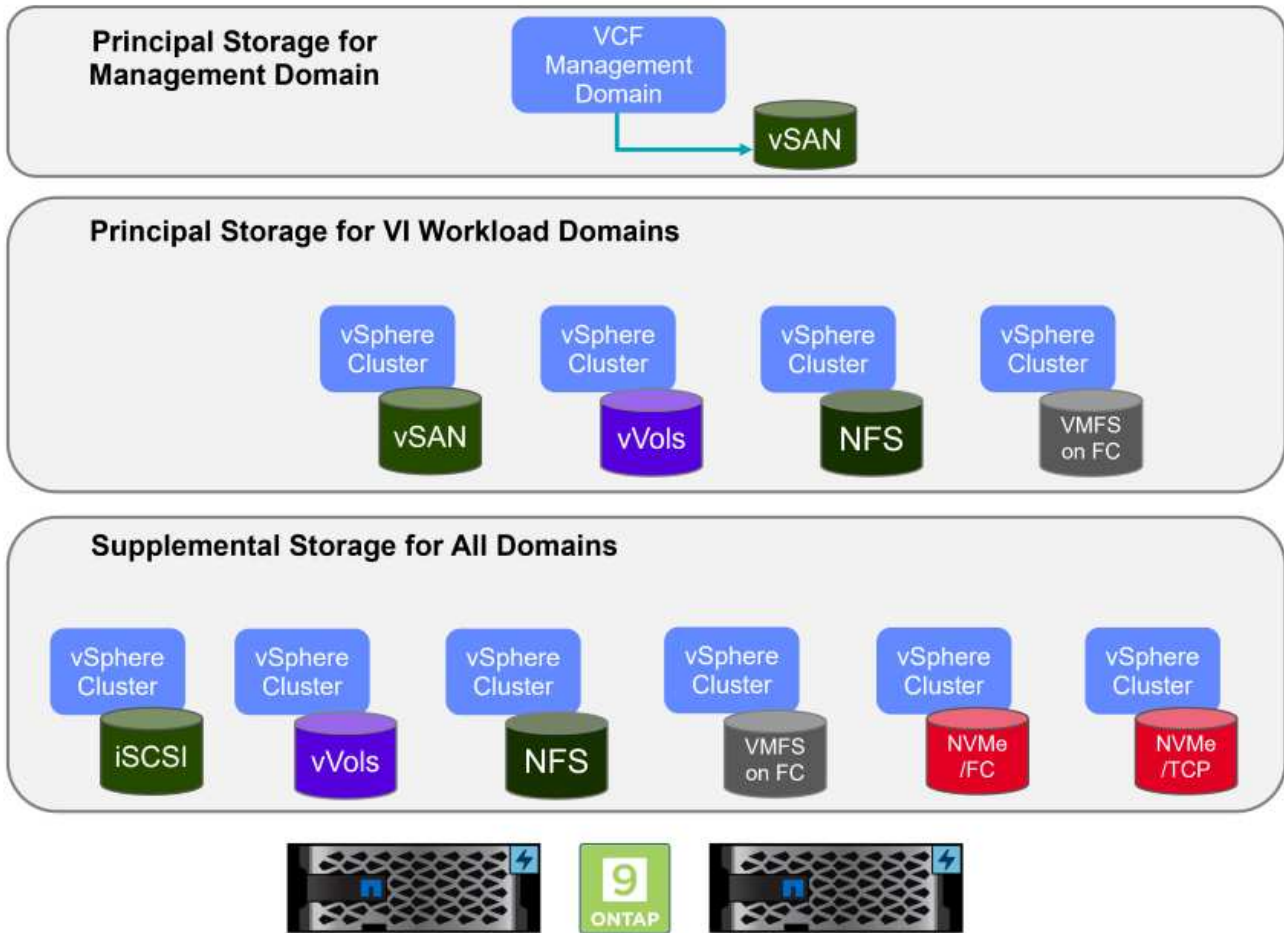
VCF is comprised of a single management domain and up to 24 VI Workload Domains that each represent a unit of application-ready infrastructure. A workload domain is comprised of one or more vSphere clusters managed by a single vCenter instance.



For more information on VCF architecture and planning, refer to [Architecture Models and Workload Domain Types in VMware Cloud Foundation](#).

VCF Storage Options

VMware divides storage options for VCF into **principal** and **supplemental** storage. The VCF Management Domain must use vSAN as its principal storage. However, there are many supplemental storage options for the Management Domain and both principal and supplemental storage options available for VI Workload Domains.



Principal Storage for Workload Domains

Principal Storage refers to any type of storage that can be directly connected to a VI Workload Domain during the setup process within SDDC Manager. Principal storage is the first datastore configured for a Workload Domain and includes vSAN, vVols (VMFS), NFS and VMFS on Fibre Channel.

Supplemental Storage for Management and Workload Domains

Supplemental storage is the storage type that can be added to the management or workload domains at any time after the cluster has been created. Supplemental storage represents the widest range of supported storage options, all of which are supported on NetApp AFF arrays.

Additional documentation resources for VMware Cloud Foundation:

- * [VMware Cloud Foundation Documentation](#)
- * [Supported Storage Types for VMware Cloud Foundation](#)
- * [Managing Storage in VMware Cloud Foundation](#)

NetApp All-Flash Storage Arrays

NetApp AFF (All Flash FAS) arrays are high-performance storage solutions designed to leverage the speed and efficiency of flash technology. AFF arrays incorporate integrated data management features such as snapshot-based backups, replication, thin provisioning, and data protection capabilities.

NetApp AFF arrays utilize the ONTAP storage operating system, offering comprehensive storage protocol support for all storage options compatible with VCF, all within a unified architecture.

NetApp AFF storage arrays are available in the highest performing A-Series and a QLC flash-based C-Series. Both series use NVMe flash drives.

For more information on NetApp AFF A-Series storage arrays see the [NetApp AFF A-Series](#) landing page.

For more information on NetApp C-Series storage arrays see the [NetApp AFF C-Series](#) landing page.

NetApp ONTAP Tools for VMware vSphere

ONTAP Tools for VMware vSphere (OTV) allows administrators to manage NetApp storage directly from within the vSphere Client. ONTAP Tools allows you to deploy and manage datastores, as well as provision vVol datastores.

ONTAP Tools allows mapping of datastores to storage capability profiles which determine a set of storage system attributes. This allows the creation of datastores with specific attributes such as storage performance and QoS.

ONTAP Tools also includes a **VMware vSphere APIs for Storage Awareness (VASA) Provider** for ONTAP storage systems which enables the provisioning of VMware Virtual Volumes (vVols) datastores, creation and use of storage capability profiles, compliance verification, and performance monitoring.

For more information on NetApp ONTAP tools see the [ONTAP tools for VMware vSphere Documentation](#) page.

Solution Overview

In the scenarios presented in this documentation we will demonstrate how to use ONTAP storage systems as principal storage for VCF VI Workload Domain deployments. In addition, we will install and use ONTAP Tools for VMware vSphere to configure supplemental datastores for VI Workload Domains.

Scenarios covered in this documentation:

- **Configure and use an NFS datastore as principal storage during VI Workload Domain deployment.** Click [here](#) for deployment steps.
- **Install and demonstrate the use of ONTAP Tools to configure and mount NFS datastores as supplemental storage in VI Workload Domains.** Click [here](#) for deployment steps.

Author: Josh Powell, Ravi BCB

NFS as principal storage for VI Workload Domains

Scenario Overview

In this scenario we will demonstrate how to configure an NFS datastore as principal storage for the deployment of a VI Workload Domain in VCF. Where appropriate we will refer to external documentation for the steps that must be performed in VCF's SDDC Manager, and cover those steps that are specific to the storage configuration portion.

This scenario covers the following high level steps:

- Verify networking for the ONTAP storage virtual machine (SVM) and that a logical interface (LIF) is present to carry NFS traffic.

- Create an export policy to allow the ESXi hosts access to the NFS volume.
- Create an NFS volume on the ONTAP storage system.
- Create a Network Pool for NFS and vMotion traffic in SDDC Manager.
- Commission hosts in VCF for use in a VI Workload Domain.
- Deploy a VI Workload Domain in VCF using an NFS datastore as principal storage.
- Install NetApp NFS Plug-in for VMware VAAI

Prerequisites

This scenario requires the following components and configurations:

- NetApp AFF storage system with a storage virtual machine (SVM) configured to allow NFS traffic.
- Logical interface (LIF) has been created on the IP network that is to carry NFS traffic and is associated with the SVM.
- VCF management domain deployment is complete and the SDDC Manager interface is accessible.
- 4 x ESXi hosts configured for communication on the VCF management network.
- IP addresses reserved for vMotion and NFS storage traffic on the VLAN or network segment established for this purpose.



When deploying a VI Workload Domain, VCF validates connectivity to the NFS Server. This is done using the management adapter on the ESXi hosts before any additional vmkernel adapter is added with the NFS IP address. Therefore, it is necessary to ensure that either 1) the management network is routable to the NFS Server, or 2) a LIF for the management network has been added to the SVM hosting the NFS datastore volume, to ensure that the validation can proceed.

For information on configuring ONTAP storage systems refer to the [ONTAP 9 Documentation](#) center.

For information on configuring VCF refer to [VMware Cloud Foundation Documentation](#).

Deployment Steps

To deploy a VI Workload Domain with an NFS datastore as principal storage, complete the following steps:

Verify networking for ONTAP SVM

Verify that the required logical interfaces have been established for the network that will carry NFS traffic between the ONTAP storage cluster and VI Workload Domain.

1. From ONTAP System Manager navigate to **Storage VMs** in the left-hand menu and click on the SVM to be used for NFS traffic. On the **Overview** tab, under **NETWORK IP INTERFACES**, click on the numeric to the right of **NFS**. In the list verify that the required LIF IP addresses are listed.

The screenshot shows the ONTAP System Manager interface. The left-hand menu is expanded to 'STORAGE', and 'Storage VMs' is selected. The main area displays a list of Storage VMs, with 'EHC_NFS' selected. The right-hand pane shows the 'Overview' tab for 'EHC_NFS'. Under the 'NETWORK IP INTERFACES' section, the 'NFS' interface is highlighted, and a dropdown menu is open showing a list of IP addresses. The IP addresses 172.21.118.163 and 172.21.118.164 are highlighted with blue boxes.

Name
EHC_ISCSI
<input checked="" type="checkbox"/> EHC_NFS
HMC_187
HMC_3510
HMC_ISCSI_3510
infra_svm_a300
JS_EHC_ISCSI
OTVtest
svm0
Temp_3510_N1
zoneb

NETWORK IP INTERFACES	
NFS	7
S	
S	172.21.253.117
M	172.21.253.118
N	172.21.253.116
SP	172.21.253.112
d	172.21.253.113
N	172.21.118.163
N	172.21.118.164
LE	

Alternately, verify the LIFs associated with an SVM from the ONTAP CLI with the following command:

```
network interface show -vserver <SVM_NAME>
```

1. Verify that the ESXi hosts can communicate to the ONTAP NFS Server. Log into the ESXi host via SSH and ping the SVM LIF:

```
vmkping <IP Address>
```

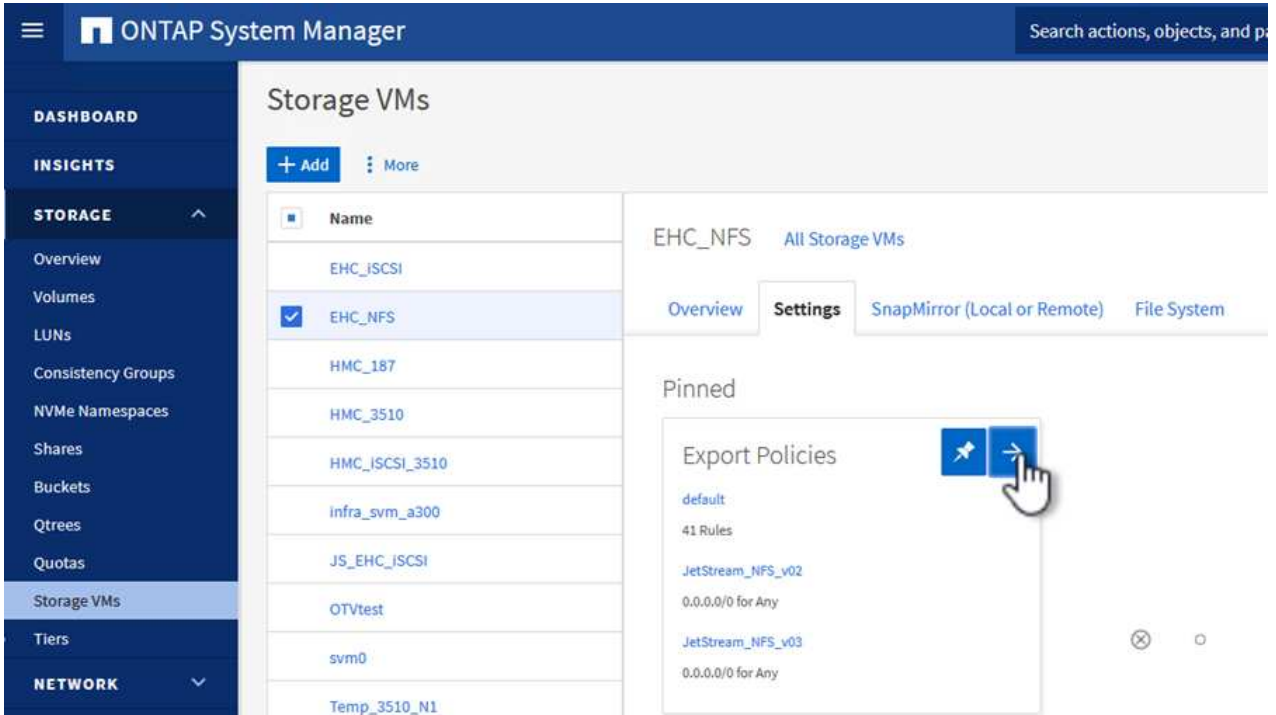



When deploying a VI Workload Domain, VCF validates connectivity to the NFS Server. This is done using the management adapter on the ESXi hosts before any additional vmkernel adapter is added with the NFS IP address. Therefore, it is necessary to ensure that either 1) the management network is routable to the NFS Server, or 2) a LIF for the management network has been added to the SVM hosting the NFS datastore volume, to ensure that the validation can proceed.

Create Export Policy for sharing NFS volume

Create an export policy in ONTAP System Manager to define access control for NFS volumes.

1. In ONTAP System Manager click on **Storage VMs** in the left-hand menu and select an SVM from the list.
2. On the **Settings** tab locate **Export Policies** and click on the arrow to access.



The screenshot shows the ONTAP System Manager interface. The left-hand menu is expanded to 'STORAGE', and 'Storage VMs' is selected. The main panel displays a list of Storage VMs with 'EHC_NFS' selected. The 'Settings' tab is active, and the 'Export Policies' section is visible, showing a list of policies including 'default' and 'JetStream_NFS_v02'. A hand cursor is pointing to the right arrow icon in the 'Export Policies' section.

3. In the **New export policy** window add a name for the policy, click on the **Add new rules** button and then on the **+Add** button to begin adding a new rule.

New export policy

NAME

WKLD_DM01

Copy rules from existing policy

STORAGE VM

svm0

EXPORT POLICY

default

RULES

No data

+ Add



Add New Rules

Save

Cancel

4. Fill in the IP Addresses, IP address range, or network that you wish to include in the rule. Uncheck the **SMB/Cifs** and **FlexCache** boxes and make selections for the access details below. Selecting the UNIX boxes is sufficient for ESXi host access.

New Rule




CLIENT SPECIFICATION

ACCESS PROTOCOLS

 SMB/CIFS FlexCache NFS NFSv3 NFSv4

ACCESS DETAILS

Type	Read-only Access	Read/Write Access	Superuser Access
All	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
All (As anonymous user) 	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
UNIX	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Kerberos 5	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Kerberos 5i	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Kerberos 5p	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
NTLM	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Cancel

Save 



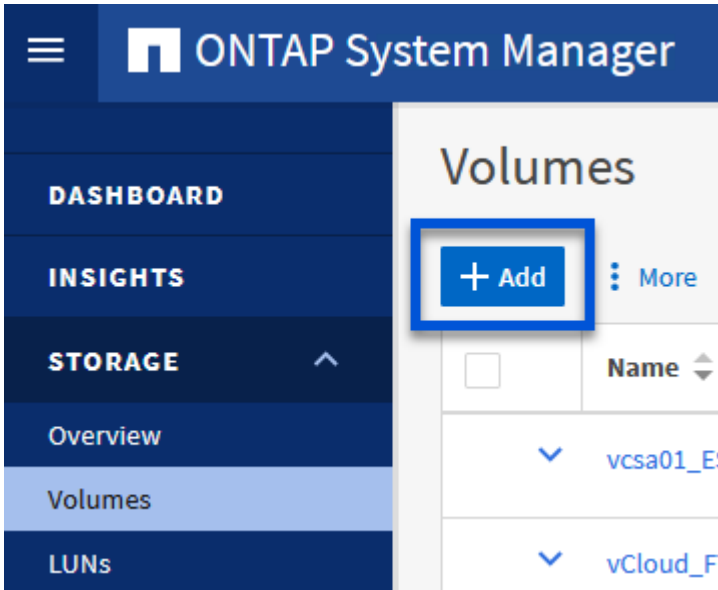
When deploying a VI Workload Domain, VCF validates connectivity to the NFS Server. This is done using the management adapter on the ESXi hosts before any additional vmkernel adapter is added with the NFS IP address. Therefore, it is necessary to ensure that the export policy includes the VCF management network in order to allow the validation to proceed.

- Once all rules have been entered click on the **Save** button to save the new Export Policy.
- Alternately, you can create export policies and rules in the ONTAP CLI. Refer to the steps for creating an export policy and adding rules in the ONTAP documentation.
 - Use the ONTAP CLI to [Create an export policy](#).
 - Use the ONTAP CLI to [Add a rule to an export policy](#).

Create NFS volume

Create an NFS volume on the ONTAP storage system to be used as a datastore in the Workload Domain deployment.

1. From ONTAP System Manager navigate to **Storage > Volumes** in the left-hand menu and click on **+Add** to create a new volume.



2. Add a name for the volume, fill out the desired capacity and selection the storage VM that will host the volume. Click on **More Options** to continue.

Add Volume



NAME

VCF_WKLD_01

CAPACITY

5



TiB



STORAGE VM

EHC_NFS



Export via NFS

[More Options](#)

Cancel


Save

3. Under Access Permissions, select the Export Policy which includes the VCF management network or IP address and NFS network IP addresses that will be used for both validation of the NFS Server and NFS traffic.

Access Permissions

Export via NFS

GRANT ACCESS TO HOST

default 

JetStream_NFS_v04
Clients : 0.0.0.0/0 | Access protocols : Any

NFSmountTest01
3 rules

NFSmountTestReno01
Clients : 0.0.0.0/0 | Access protocols : Any

PerfTestVols
Clients : 172.21.253.0/24 | Access protocols : NFSv3, NFSv4, NFS

TestEnv_VPN
Clients : 172.21.254.0/24 | Access protocols : Any

VCF_WKLD
2 rules

WKLD_DM01
2 rules

Wkld01_NFS
Clients : 172.21.252.205, 172.21.252.206, 172.21.252.207, 172.21.2

+



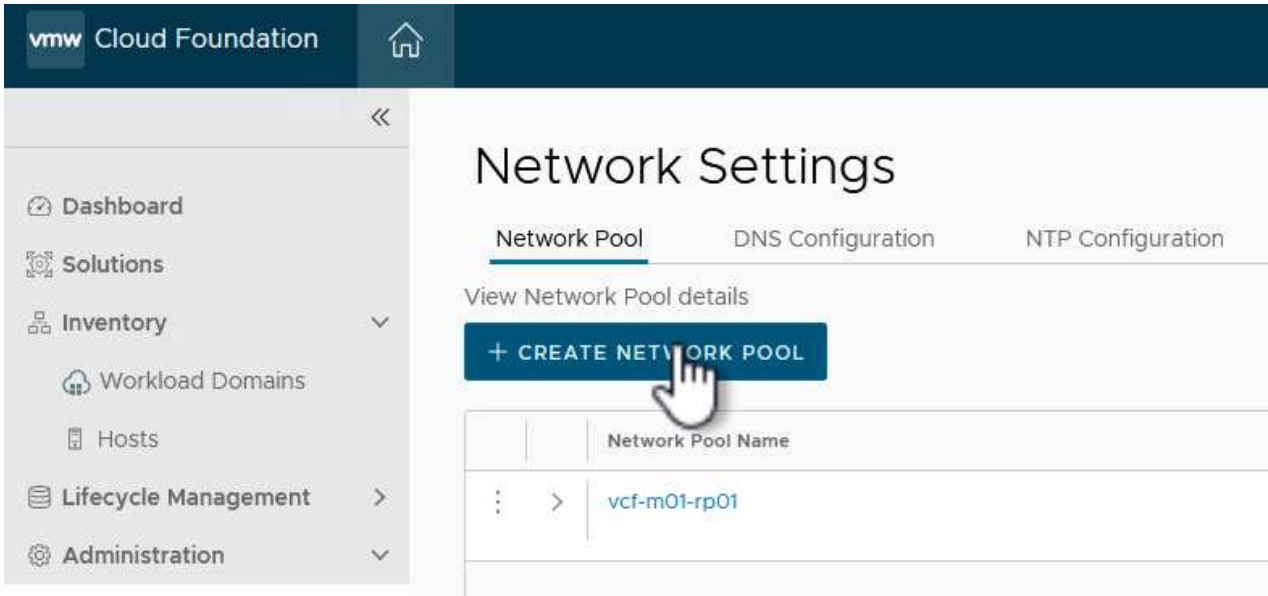
When deploying a VI Workload Domain, VCF validates connectivity to the NFS Server. This is done using the management adapter on the ESXi hosts before any additional vmkernel adapter is added with the NFS IP address. Therefore, it is necessary to ensure that either 1) the management network is routable to the NFS Server, or 2) a LIF for the management network has been added to the SVM hosting the NFS datastore volume, to ensure that the validation can proceed.

4. Alternately, ONTAP Volumes can be created in the ONTAP CLI. For more information refer to the [lun create](#) command in the ONTAP commands documentation.

Create Network Pool in SDDC Manager

A Network Pool must be created in SDDC Manager before commissioning the ESXi hosts, as preparation for deploying them in a VI Workload Domain. The Network Pool must include the network information and IP address range(s) for VMkernel adapters to be used for communication with the NFS server.

1. From the SDDC Manager web interface navigate to **Network Settings** in the left-hand menu and click on the **+ Create Network Pool** button.



2. Fill out a name for the Network Pool, select the check box for NFS and fill out all networking details. Repeat this for the vMotion network information.

The screenshot shows the VMware Cloud Foundation interface for creating a Network Pool. The page is titled "Network Settings" and "Create Network Pool". The "Network Pool Name" is "NFS_NPOOL". The "Network Type" is "NFS".

NFS Network Information

VLAN ID	3374
MTU	9000
Network	172.21.118.0
Subnet Mask	255.255.255.0
Default Gateway	172.21.118.1

Included IP Address Ranges

Once a network pool has been created, you are not able to edit or remove IP ranges from that pool.

172.21.118.145	To	172.21.118.148	REMOVE
xxx.xxx.xxx.xxx	To	xxx.xxx.xxx.xxx	ADD

vMotion Network Information

VLAN ID	3423
MTU	9000
Network	172.21.167.0
Subnet Mask	255.255.255.0
Default Gateway	172.21.167.1

Included IP Address Ranges

Once a network pool has been created, you are not able to edit or remove IP ranges from that pool.

172.21.167.121	To	172.21.167.124	REMOVE
xxx.xxx.xxx.xxx	To	xxx.xxx.xxx.xxx	ADD

At the bottom of the form, there are "CANCEL" and "SAVE" buttons.

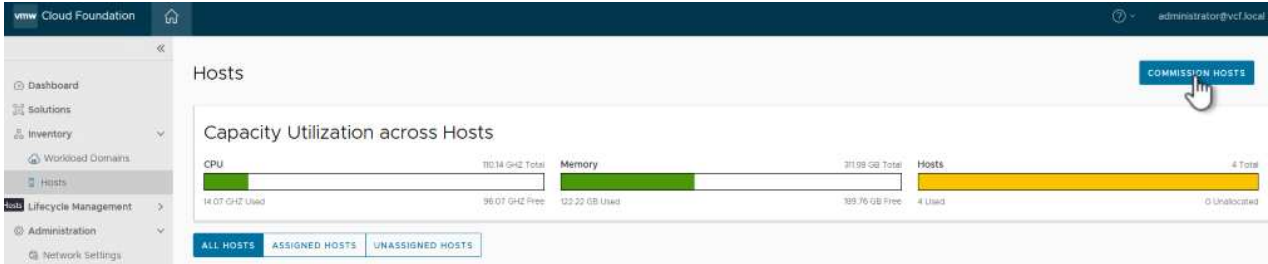
3. Click the **Save** button to complete creating the Network Pool.

Commission Hosts

Before ESXi hosts can be deployed as a workload domain they must be added to the SDDC Manager inventory. This involves providing the required information, passing validation and starting the commissioning process.

For more information see [Commission Hosts](#) in the VCF Administration Guide.

1. From the SDDC Manager interface navigate to **Hosts** in the left-hand menu and click on the **Commission Hosts** button.



2. The first page is a prerequisite checklist. Double-check all prerequisites and select all checkboxes to proceed.

Checklist

Commissioning a host adds it to the VMware Cloud Foundation inventory. The host you want to commission must meet the checklist criterion below.

- Select All**
- Host for vSAN/vSAN ESA workload domain should be vSAN/vSAN ESA compliant and certified per the VMware Hardware Compatibility Guide. BIOS, HBA, SSD, HDD, etc. must match the VMware Hardware Compatibility Guide.
- Host has a standard switch with two NIC ports with a minimum 10 Gbps speed.
- Host has the drivers and firmware versions specified in the VMware Compatibility Guide.
- Host has ESXi installed on it. The host must be preinstalled with supported versions (8.0.2-22380479)
- Host is configured with DNS server for forward and reverse lookup and FQDN.
- Hostname should be same as the FQDN.
- Management IP is configured to first NIC port.
- Ensure that the host has a standard switch and the default uplinks with 10Gb speed are configured starting with traditional numbering (e.g., vmnic0) and increasing sequentially.
- Host hardware health status is healthy without any errors.
- All disk partitions on HDD / SSD are deleted.
- Ensure required network pool is created and available before host commissioning.
- Ensure hosts to be used for VSAN workload domain are associated with VSAN enabled network pool.
- Ensure hosts to be used for NFS workload domain are associated with NFS enabled network pool.
- Ensure hosts to be used for VMFS on FC workload domain are associated with NFS or VMOTION only enabled network pool.
- Ensure hosts to be used for vVol FC workload domain are associated with NFS or VMOTION only enabled network pool.
- Ensure hosts to be used for vVol NFS workload domain are associated with NFS and VMOTION only enabled network pool.
- Ensure hosts to be used for vVol iSCSI workload domain are associated with iSCSI and VMOTION only enabled network pool.
- For hosts with a DPU device, enable SR-IOV in the BIOS and in the vSphere Client (if required by your DPU vendor).

CANCEL

PROCEED

3. In the **Host Addition and Validation** window fill out the **Host FQDN**, **Storage Type**, The **Network Pool** name that includes the vMotion and NFS storage IP addresses to be used for the workload domain, and the credentials to access the ESXi host. Click on **Add** to add the host to the group of hosts to be validated.

Host Addition and Validation

▼ Add Hosts

You can either choose to add host one at a time or download [JSON](#) template and perform bulk commission.

Add new Import

Host FQDN

Storage Type vSAN NFS VMFS on FC vVol

Network Pool Name ⓘ

User Name

Password ⓘ

ADD

Hosts Added

✓ Hosts added successfully. Add more or confirm fingerprint and validate host

REMOVE

Confirm all Finger Prints ⓘ

VALIDATE ALL

<input checked="" type="checkbox"/>	FQDN	Network Pool	IP Address	Confirm FingerPrint	Validation Status
<input checked="" type="checkbox"/>	vcf-wkld-esx01.sddc.netapp.com	NFS_NP01 ⓘ	172.21.166.135	✗ SHA256:CKbsinf EOG+Hz/ lpFUoFDI2tLuY FZ47WicVdp6v EGM	⊖ Not Validated

1 hosts

CANCEL

NEXT

- Once all hosts to be validated have been added, click on the **Validate All** button to continue.
- Assuming all hosts are validated, click on **Next** to continue.

Hosts Added

✔ Host Validated Successfully. ✕

REMOVE Confirm all Finger Prints (i) VALIDATE ALL

<input checked="" type="checkbox"/>	FGDN	Network Pool	IP Address	Confirm FingerPrint	Validation Status
<input checked="" type="checkbox"/>	vcf-wkld-esx04.sddc.netapp.com	NFS_NP01 (i)	172.21.166.138	✔ SHA256:9Kg+9nQaE4SQkOMsQPON/k5gZB9zyKN+6CBPmXsvLBc	✔ Valid
<input checked="" type="checkbox"/>	vcf-wkld-esx03.sddc.netapp.com	NFS_NP01 (i)	172.21.166.137	✔ SHA256:nPX4/mei/2zmLJHfmPwbk6zhapoUxV2IOWZDPFH+z0	✔ Valid
<input checked="" type="checkbox"/>	vcf-wkld-esx02.sddc.netapp.com	NFS_NP01 (i)	172.21.166.136	✔ SHA256:AMhyR60OpTQ1YYq0DJhqVbj/M/GvrQaqUy7Ce+M4IWY	✔ Valid
<input checked="" type="checkbox"/>	vcf-wkld-esx01.sddc.netapp.com	NFS_NP01 (i)	172.21.166.135	✔ SHA256:CKbsinfEOG+!+z/lpFUoFDI2tLuYFZ47WicVDp6vEQM	✔ Valid

CANCEL NEXT

- Review the list of hosts to be commissioned and click on the **Commission** button to start the process. Monitor the commissioning process from the Task pane in SDDC manager.

Commission Hosts

1 Host Addition and Validation

2 **Review**

Review

Skip failed hosts during commissioning  On

Validated Host(s)	
vcf-wkld-esx04.sddc.netapp.com	Network Pool Name: NFS_NP01 IP Address: 172.21.166.138 Storage Type: NFS
vcf-wkld-esx03.sddc.netapp.com	Network Pool Name: NFS_NP01 IP Address: 172.21.166.137 Storage Type: NFS
vcf-wkld-esx02.sddc.netapp.com	Network Pool Name: NFS_NP01 IP Address: 172.21.166.136 Storage Type: NFS
vcf-wkld-esx01.sddc.netapp.com	Network Pool Name: NFS_NP01 IP Address: 172.21.166.135 Storage Type: NFS

CANCEL

BACK

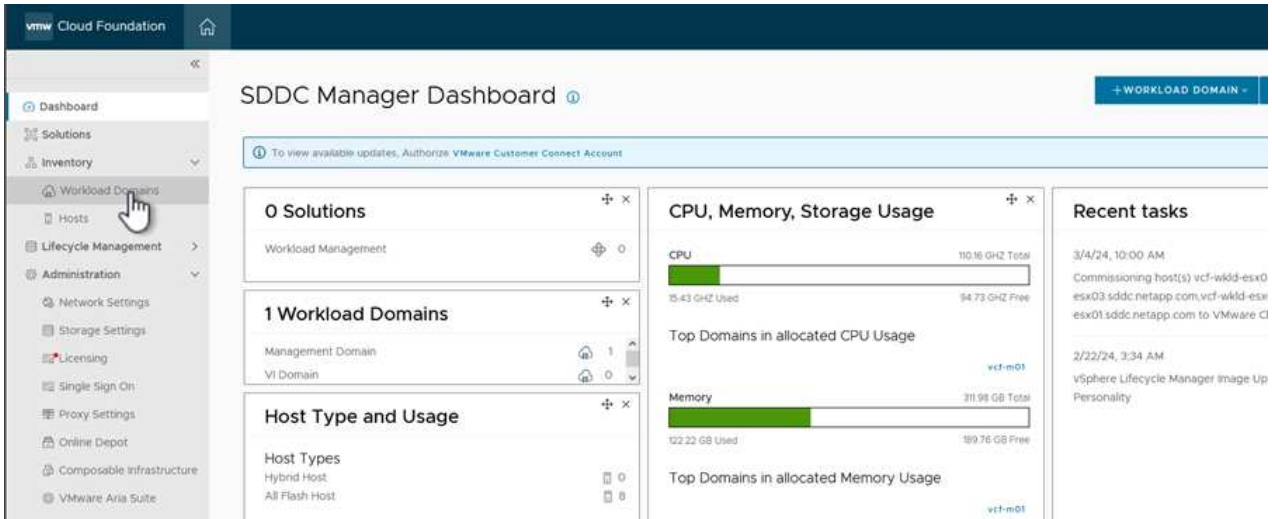
COMMISSION

Deploy VI Workload Domain

Deploying VI workload domains is accomplished using the VCF Cloud Manager interface. Only the steps related to the storage configuration will be presented here.

For step-by-step instructions on deploying a VI workload domain refer to [Deploy a VI Workload Domain Using the SDDC Manager UI](#).

1. From the SDDC Manager Dashboard click on **+ Workload Domain** in the upper right hand corner to create a new Workload Domain.



2. In the VI Configuration wizard fill out the sections for **General Info**, **Cluster**, **Compute**, **Networking**, and **Host Selection** as required.

For information on filling out the information required in the VI Configuration wizard refer to [Deploy a VI Workload Domain Using the SDDC Manager UI](#).

+

VI Configuration

1 General Info

2 Cluster

3 Compute

4 Networking

5 Host Selection

6 NFS Storage

7 Switch Configuration

8 License

9 Review

1. In the NFS Storage section fill out the Datastore Name, the folder mount point of the NFS volume and the IP address of the ONTAP NFS storage VM LIF.

VI Configuration

- 1 General Info
- 2 Cluster
- 3 Compute
- 4 Networking
- 5 Host Selection
- 6 NFS Storage

NFS Storage

NFS Share Details

Datastore Name ⓘ	VCF_WKLD_01
Folder ⓘ	/VCF_WKLD_01
NFS Server IP Address ⓘ	172.21.118.163

2. In the VI Configuration wizard complete the Switch Configuration and License steps, and then click on **Finish** to start the Workload Domain creation process.

VI Configuration

- 1 General Info
- 2 Cluster
- 3 Compute
- 4 Networking
- 5 Host Selection
- 6 NFS Storage
- 7 Switch Configuration
- 8 License
- 9 Review**

Review

General	
Virtual Infrastructure Name	vcf-wkld-01
Organization Name	it-inf
SSO Domain Option	Joining Management SSO Domain
Cluster	
Cluster Name	IT-INF-WKLD-01
Compute	
vCenter IP Address	172.21.166.143
vCenter DNS Name	vcf-wkld-vc01.sddc.netapp.com
vCenter Subnet Mask	255.255.255.0
vCenter Default Gateway	172.21.166.1
Networking	
NSX Manager Instance Option	Creating new NSX instance
NSX Manager Cluster IP	172.21.166.147
NSX Manager Cluster FQDN	vcf-w01-nsxc101.sddc.netapp.com
NSX Manager IP Addresses	172.21.166.144, 172.21.166.145, 172.21.166.146

CANCEL BACK **FINISH**

3. Monitor the process and resolve any validation issues that arise during the process.

Install NetApp NFS Plug-in for VMware VAAI

The NetApp NFS Plug-in for VMware VAAI integrates the VMware Virtual Disk Libraries installed on the ESXi host and provides higher performance cloning operations that finish faster. This is a recommended procedure when using ONTAP storage systems with VMware vSphere.

For step-by-step instructions on deploying the NetApp NFS Plug-in for VMware VAAI following the instructions at [Install NetApp NFS Plug-in for VMware VAAI](#).

Author: Josh Powell, Ravi BCB

Use ONTAP Tools to configure supplemental storage (NFS and vVols) for VCF Workload Domains

Scenario Overview

In this scenario we will demonstrate how to deploy and use ONTAP Tools for VMware vSphere (OTV) to configure both an **NFS datastore**, and a **vVols datastore** for a VCF workload domain.

NFS is used as the storage protocol for the vVols datastore.

This scenario covers the following high level steps:

- Create a storage virtual machine (SVM) with logical interfaces (LIFs) for NFS traffic.
- Create a distributed port group for the NFS network on the VI workload domain.
- Create a vmkernel adapter for NFS on the ESXi hosts for the VI workload domain.
- Deploy ONTAP Tools on the VI workload domain.
- Create a new NFS datastore on the VI workload domain.
- Create a new vVols datastore on the VI workload domain.

Prerequisites

This scenario requires the following components and configurations:

- An ONTAP AFF storage system with physical data ports on ethernet switches dedicated to storage traffic.
- VCF management domain deployment is complete and the vSphere client is accessible.
- A VI workload domain has been previously deployed.

NetApp recommends a redundant network designs for NFS, providing fault tolerance for storage systems, switches, networks adapters and host systems. It is common to deploy NFS with a single subnet or multiple subnets depending on the architectural requirements.

Refer to [Best Practices For Running NFS with VMware vSphere](#) for detailed information specific to VMware vSphere.

For network guidance on using ONTAP with VMware vSphere refer to the [Network configuration - NFS](#) section of the NetApp enterprise applications documentation.

This documentation demonstrates the process of creating a new SVM and specifying the IP address information to create multiple LIFs for NFS traffic. To add new LIFs to an existing SVM refer to [Create a LIF \(network interface\)](#).

Deployment Steps

To deploy ONTAP Tools and use it to create a vVols and NFS datastore on the VCF management domain, complete the following steps:

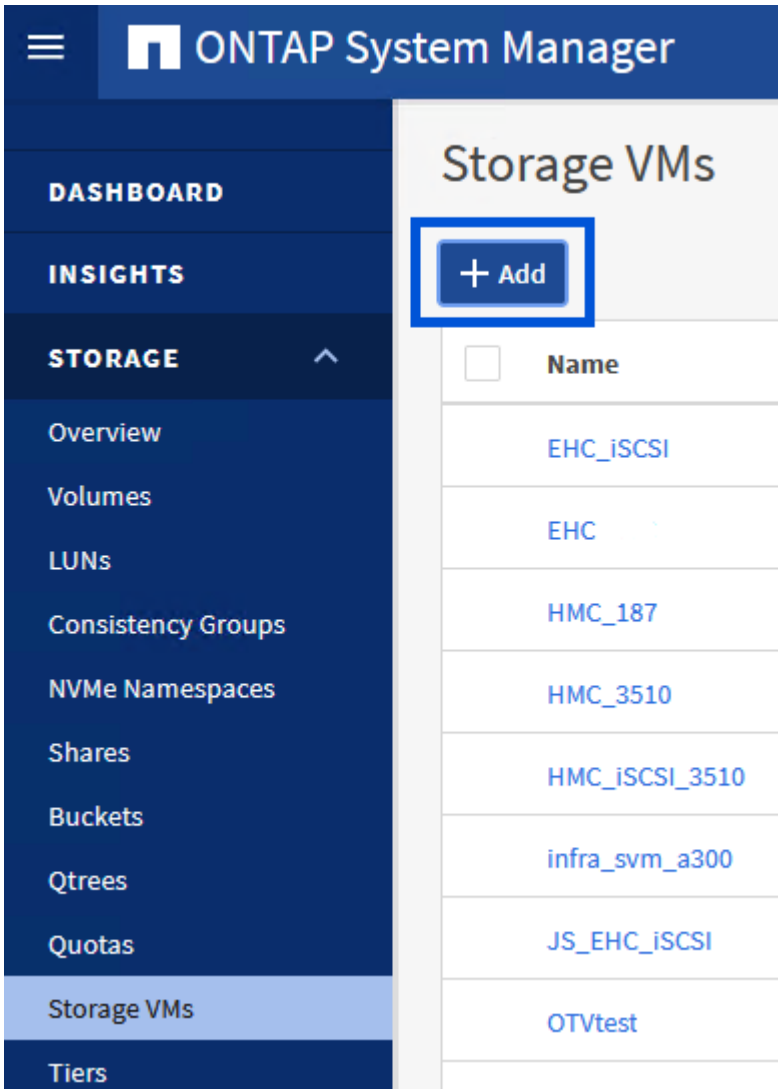
Create SVM and LIFs on ONTAP storage system

The following step is performed in ONTAP System Manager.

Create the storage VM and LIFs

Complete the following steps to create an SVM together with multiple LIFs for NFS traffic.

1. From ONTAP System Manager navigate to **Storage VMs** in the left-hand menu and click on **+ Add** to start.



2. In the **Add Storage VM** wizard provide a **Name** for the SVM, select the **IP Space** and then, under **Access Protocol**, click on the **SMB/CIFS, NFS, S3** tab and check the box to **Enable NFS**.

Add Storage VM



STORAGE VM NAME

VCF_NFS

IPSPACE

Default

Access Protocol

SMB/CIFS, NFS, S3 [iSCSI](#) [FC](#) [NVMe](#)

Enable SMB/CIFS

Enable NFS

Allow NFS client access

Add at least one rule to allow NFS clients to access volumes in this storage VM. [?](#)

EXPORT POLICY

Default

Enable S3

DEFAULT LANGUAGE [?](#)

c.utf_8



It is not necessary to check the **Allow NFS client access** button here as Ontap Tools for VMware vSphere will be used to automate the datastore deployment process. This includes providing client access for the ESXi hosts.

3. In the **Network Interface** section fill in the **IP address**, **Subnet Mask**, and **Broadcast Domain and Port** for the first LIF. For subsequent LIFs the checkbox may be enabled to use common settings across all remaining LIFs or use separate settings.

NETWORK INTERFACE

Use multiple network interfaces when client traffic is high.

ntaphci-a300-01

SUBNET

Without a subnet

IP ADDRESS

172.21.118.119

SUBNET MASK

24

GATEWAY

[Add optional gateway](#)

BROADCAST DOMAIN AND PORT

NFS_iSCSI

Use the same subnet mask, gateway, and broadcast domain for all of the following interfaces

ntaphci-a300-02

SUBNET

Without a subnet

IP ADDRESS

172.21.118.120

PORT

a0a-3374

4. Choose whether to enable the Storage VM Administration account (for multi-tenancy environments) and click on **Save** to create the SVM.

Storage VM Administration

Manage administrator account

Save

Cancel

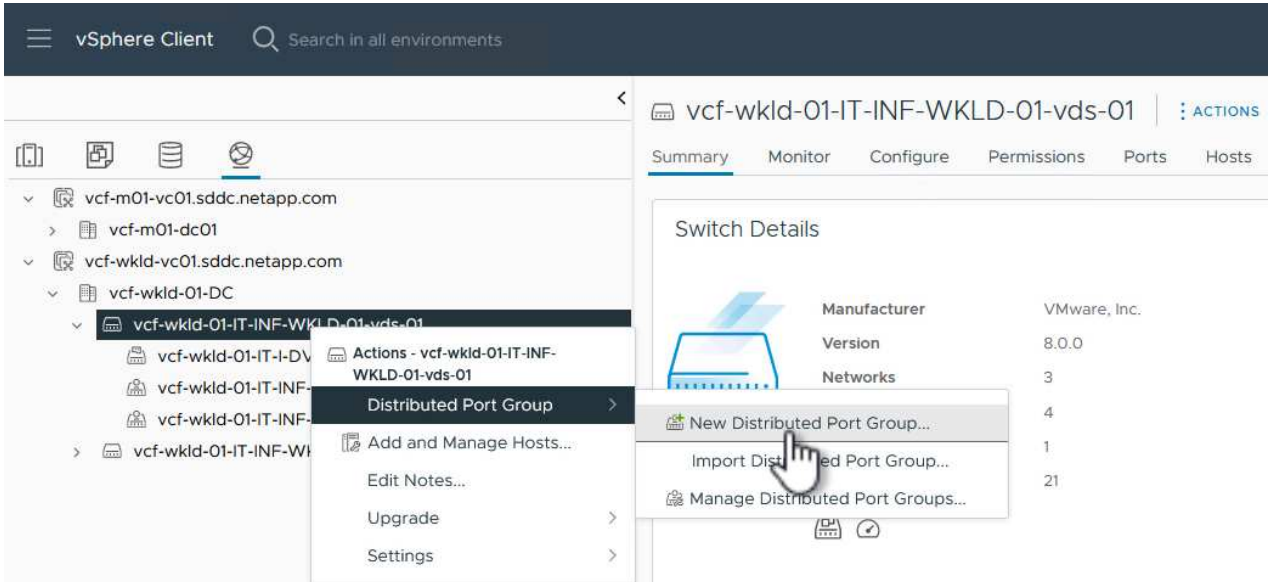
Set up networking for NFS on ESXi hosts

The following steps are performed on the VI Workload Domain cluster using the vSphere client. In this case vCenter Single Sign-On is being used so the vSphere client is common across the management and workload domains.

Create a Distributed Port Group for NFS traffic

Complete the following to create a new distributed port group for the network to carry NFS traffic:

1. From the vSphere client , navigate to **Inventory > Networking** for the workload domain. Navigate to the existing Distributed Switch and choose the action to create **New Distributed Port Group....**



2. In the **New Distributed Port Group** wizard fill in a name for the new port group and click on **Next** to continue.
3. On the **Configure settings** page fill out all settings. If VLANs are being used be sure to provide the correct VLAN ID. Click on **Next** to continue.

New Distributed Port Group

1 Name and location

2 **Configure settings**

3 Ready to complete

Configure settings

Set general properties of the new port group.

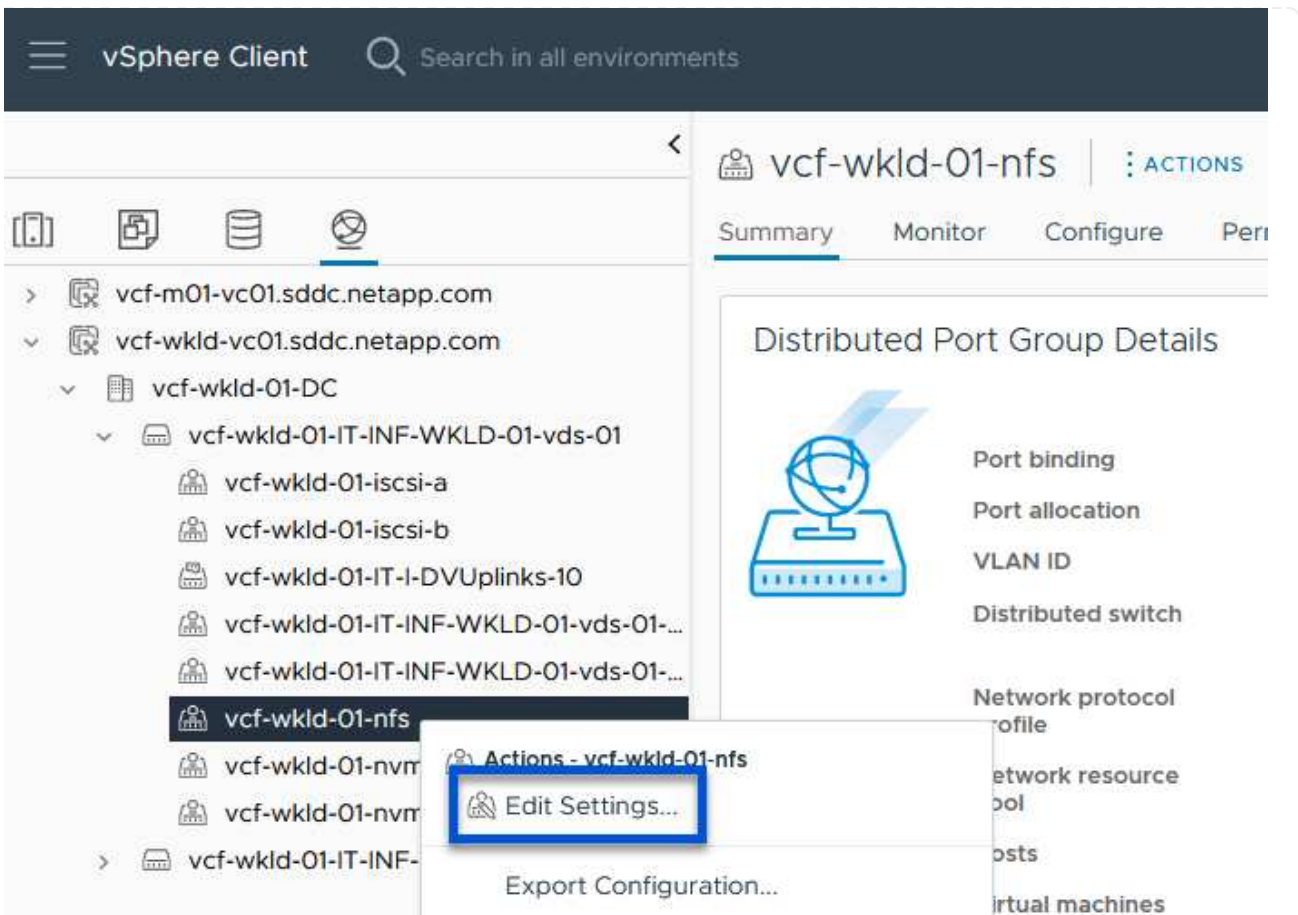
Port binding	Static binding
Port allocation	Elastic ?
Number of ports	8
Network resource pool	(default)
VLAN	
VLAN type	VLAN
VLAN ID	3374
Advanced	
<input type="checkbox"/> Customize default policies configuration	

CANCEL

BACK

NEXT

4. On the **Ready to complete** page, review the changes and click on **Finish** to create the new distributed port group.
5. Once the port group has been created, navigate to the port group and select the action to **Edit settings**....



6. On **Distributed Port Group - Edit Settings** page, navigate to **Teaming and failover** in the left-hand menu. Enable teaming for the Uplinks to be used for NFS traffic by ensuring they are together in the **Active uplinks** area. Move any unused uplinks down to **Unused uplinks**.

Distributed Port Group - Edit Settings | vcf-wkld-01-nfs

General

Advanced

VLAN

Security

Traffic shaping

Teaming and failover

Monitoring

Miscellaneous

Load balancing

Route based on originating virtual port

Network failure detection

Link status only

Notify switches

Yes

Failback

Yes

Failover order 

MOVE UP MOVE DOWN

Active uplinks

uplink2

uplink1

Standby uplinks

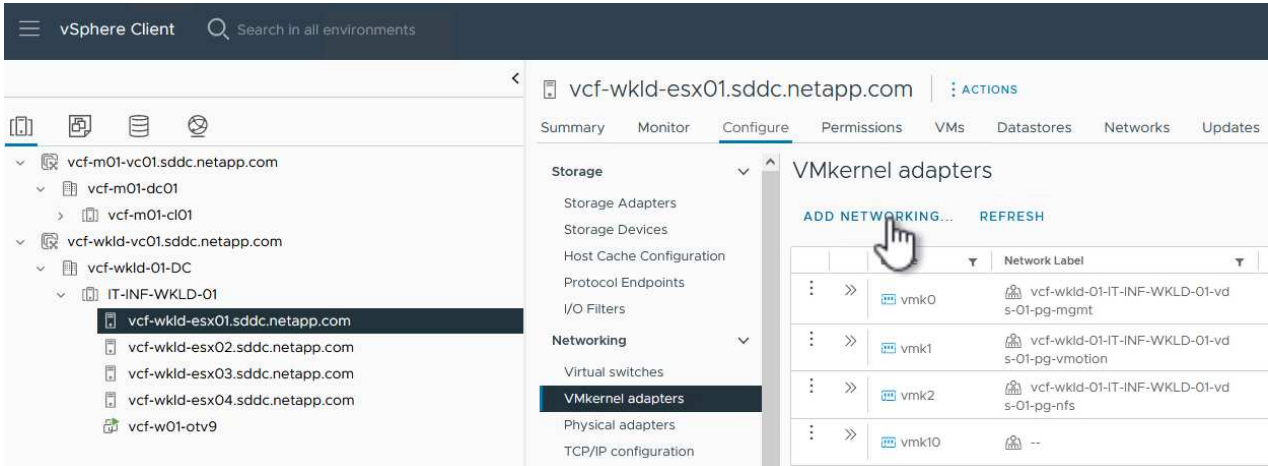
Unused uplinks

7. Repeat this process for each ESXi host in the cluster.

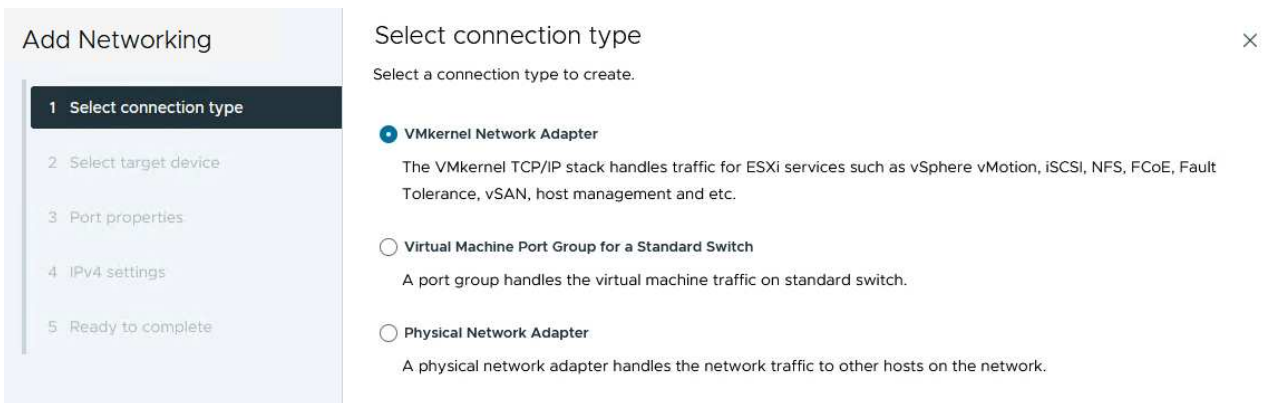
Create a VMkernel adapter on each ESXi host

Repeat this process on each ESXi host in the workload domain.

1. From the vSphere client navigate to one of the ESXi hosts in the workload domain inventory. From the **Configure** tab select **VMkernel adapters** and click on **Add Networking...** to start.



2. On the **Select connection type** window choose **VMkernel Network Adapter** and click on **Next** to continue.



3. On the **Select target device** page, choose one of the distributed port groups for NFS that was created previously.

Add Networking

1 Select connection type

2 Select target device

3 Port properties

4 IPv4 settings

5 Ready to complete

Select target device

Select a target device for the new connection.

- Select an existing network
- Select an existing standard switch
- New standard switch

Quick Filter

Enter value

	Name	NSX Port Group ID	Distributed Switch
<input type="radio"/>	vcf-wkld-01-iscsi-a	--	vcf-wkld-01-IT-INF-WKLD-01-vds-01
<input type="radio"/>	vcf-wkld-01-iscsi-b	--	vcf-wkld-01-IT-INF-WKLD-01-vds-01
<input type="radio"/>	vcf-wkld-01-IT-INF-WKLD-01-vds-01-pg-mgmt	--	vcf-wkld-01-IT-INF-WKLD-01-vds-01
<input type="radio"/>	vcf-wkld-01-IT-INF-WKLD-01-vds-01-pg-nfs	--	vcf-wkld-01-IT-INF-WKLD-01-vds-02
<input type="radio"/>	vcf-wkld-01-IT-INF-WKLD-01-vds-01-pg-vmotion	--	vcf-wkld-01-IT-INF-WKLD-01-vds-01
<input checked="" type="radio"/>	vcf-wkld-01-nfs	--	vcf-wkld-01-IT-INF-WKLD-01-vds-01
<input type="radio"/>	vcf-wkld-01-nvme-a	--	vcf-wkld-01-IT-INF-WKLD-01-vds-01
<input type="radio"/>	vcf-wkld-01-nvme-b	--	vcf-wkld-01-IT-INF-WKLD-01-vds-01

Manage Columns 8 items

CANCEL

BACK

NEXT

4. On the **Port properties** page keep the defaults (no enabled services) and click on **Next** to continue.

5. On the **IPv4 settings** page fill in the **IP address**, **Subnet mask**, and provide a new Gateway IP address (only if required). Click on **Next** to continue.

Add Networking

1 Select connection type

2 Select target device

3 Port properties

4 IPv4 settings

5 Ready to complete

IPv4 settings

Specify VMkernel IPv4 settings.

- Obtain IPv4 settings automatically
- Use static IPv4 settings

IPv4 address 172.21.118.145

Subnet mask 255.255.255.0

Default gateway Override default gateway for this adapter

172.21.166.1

DNS server addresses 10.61.185.231

CANCEL

BACK

NEXT

6. Review the your selections on the **Ready to complete** page and click on **Finish** to create the

VMkernel adapter.

Add Networking

- 1 Select connection type
- 2 Select target device
- 3 Port properties
- 4 IPv4 settings
- 5 Ready to complete**

Ready to complete ✕

Review your selections before finishing the wizard

▼ **Select target device**

Distributed port group	vcf-wkld-01-nfs
Distributed switch	vcf-wkld-01-IT-INF-WKLD-01-vds-01

▼ **Port properties**

New port group	vcf-wkld-01-nfs (vcf-wkld-01-IT-INF-WKLD-01-vds-01)
MTU	9000
vMotion	Disabled
Provisioning	Disabled
Fault Tolerance logging	Disabled
Management	Disabled
vSphere Replication	Disabled
vSphere Replication NFC	Disabled
vSAN	Disabled
vSAN Witness	Disabled
vSphere Backup NFC	Disabled
NVMe over TCP	Disabled

CANCEL **BACK** **FINISH**

Deploy and use ONTAP Tools to configure storage

The following steps are performed on the VCF management domain cluster using the vSphere client and involve deploying OTV, creating a vVols NFS datastore, and migrating management VM's to the new datastore.

For VI workload domains, OTV is installed to the VCF Management Cluster but registered with the vCenter associated with the VI workload domain.

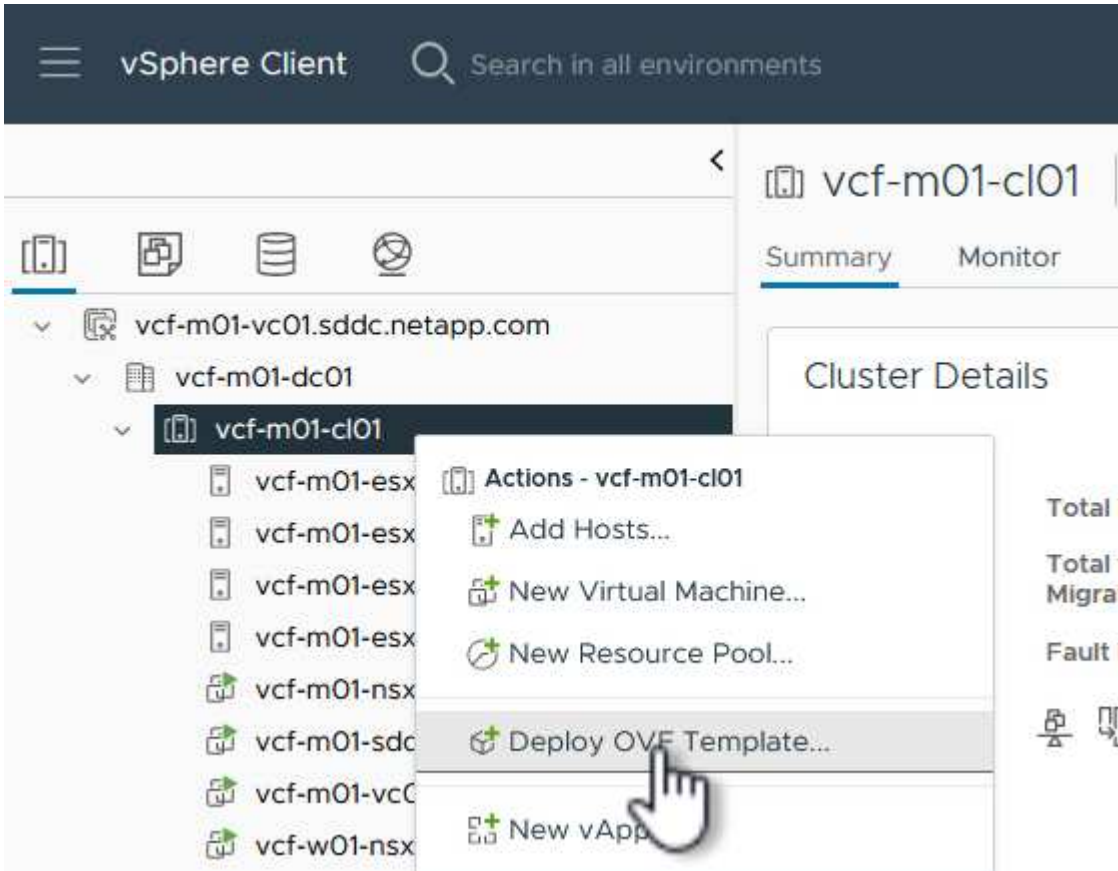
For additional information on deploying and using ONTAP Tools in a multiple vCenter environment refer to [Requirements for registering ONTAP tools in multiple vCenter Servers environment](#).

Deploy ONTAP tools for VMware vSphere

ONTAP tools for VMware vSphere (OTV) is deployed as a VM appliance and provides an integrated vCenter UI for managing ONTAP storage.

Complete the following to Deploy ONTAP tools for VMware vSphere:

1. Obtain the ONTAP tools OVA image from the [NetApp Support site](#) and download to a local folder.
2. Log into the vCenter appliance for the VCF management domain.
3. From the vCenter appliance interface right-click on the management cluster and select **Deploy OVF Template...**



4. In the **Deploy OVF Template** wizard click the **Local file** radio button and select the ONTAP tools OVA file downloaded in the previous step.

Deploy OVF Template

1 Select an OVF template

- 2 Select a name and folder
- 3 Select a compute resource
- 4 Review details
- 5 Select storage
- 6 Ready to complete

Select an OVF template

Select an OVF template from remote URL or local file system

Enter a URL to download and install the OVF package from the Internet, or browse to a location accessible from your computer, such as a local hard drive, a network share, or a CD/DVD drive.

URL

Local file

netapp-ontap-tools-for-vmware-vsphere-9.13-9554.ova

5. For steps 2 through 5 of the wizard select a name and folder for the VM, select the compute resource, review the details, and accept the license agreement.
6. For the storage location of the configuration and disk files, select the vSAN datastore of the VCF management domain cluster.

Deploy OVF Template

- 1 Select an OVF template
- 2 Select a name and folder
- 3 Select a compute resource
- 4 Review details
- 5 License agreements
- 6 Select storage**
- 7 Select networks
- 8 Customize template
- 9 Ready to complete

Select storage

Select the storage for the configuration and disk files

Encrypt this virtual machine [?](#)

Select virtual disk format As defined in the VM storage policy

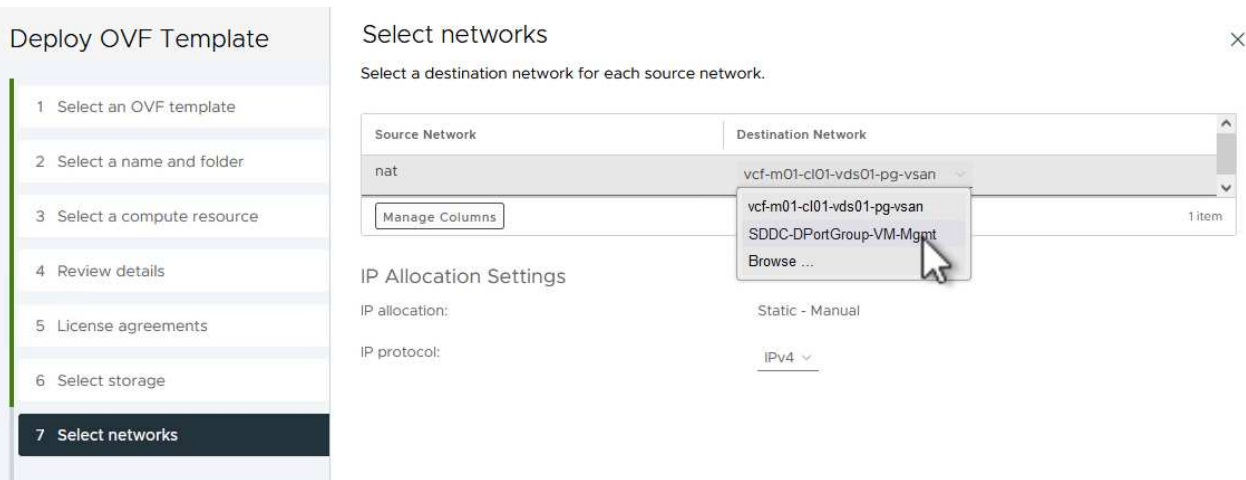
VM Storage Policy Datastore Default

Disable Storage DRS for this virtual machine

	Name	Storage Compatibility	Capacity	Provisioned	Free	T
<input checked="" type="radio"/>	vcf-m01-c01-ds-vsan01	--	999.97 GB	7.17 TB	225.72 GB	v
<input type="radio"/>	vcf-m01-esx01-esx-install-datastore	--	25.75 GB	4.56 GB	21.19 GB	v
<input type="radio"/>	vcf-m01-esx02-esx-install-datastore	--	25.75 GB	4.56 GB	21.19 GB	v
<input type="radio"/>	vcf-m01-esx03-esx-install-datastore	--	25.75 GB	4.56 GB	21.19 GB	v
<input type="radio"/>	vcf-m01-esx04-esx-install-datastore	--	25.75 GB	4.56 GB	21.19 GB	v

Manage Columns Items per page 10 5 items

7. On the Select network page select the network used for management traffic.



8. On the Customize template page fill out all required information:

- Password to be used for administrative access to OTV.
- NTP server IP address.
- OTV maintenance account password.
- OTV Derby DB password.
- Do not check the box to **Enable VMware Cloud Foundation (VCF)**. VCF mode is not required for deploying supplemental storage.
- FQDN or IP address of the vCenter appliance for the **VI Workload Domain**
- Credentials for the vCenter appliance of the **VI Workload Domain**
- Provide the required network properties fields.

Click on **Next** to continue.

Deploy OVF Template

- 1 Select an OVF template
- 2 Select a name and folder
- 3 Select a compute resource
- 4 Review details
- 5 License agreements
- 6 Select storage
- 7 Select networks
- 8 Customize template**
- 9 Ready to complete

Customize template

Customize the deployment properties of this software solution.

2 properties have invalid values ✕

System Configuration 4 settings

Application User Password (*) Password to assign to the administrator account. For security reasons, it is recommended to use a password that is of eight to thirty characters and contains a minimum of one upper, one lower, one digit, and one special character.

Password

Confirm Password

NTP Servers A comma-separated list of hostnames or IP addresses of NTP Servers. If left blank, VMware tools based time synchronization will be used.

Maintenance User Password (*) Password to assign to maint user account.

Password

Confirm Password

Deploy OVF Template

- 1 Select an OVF template
- 2 Select a name and folder
- 3 Select a compute resource
- 4 Review details
- 5 License agreements
- 6 Select storage
- 7 Select networks
- 8 Customize template**
- 9 Ready to complete

Customize template

Configure vCenter or Enable vCenter 3 settings

Enable VMware Cloud Foundation (VCF) vCenter server and user details are ignored when VCF is enabled.

vCenter Server Address (*) Specify the IP address/hostname of an existing vCenter to register to.

Port (*) Specify the HTTPS port of an existing vCenter to register to.

Username (*) Specify the username of an existing vCenter to register to.

Password (*) Specify the password of an existing vCenter to register to.

Password

Confirm Password

Network Properties 8 settings

Host Name Specify the hostname for the appliance. (Leave blank if DHCP is desired)

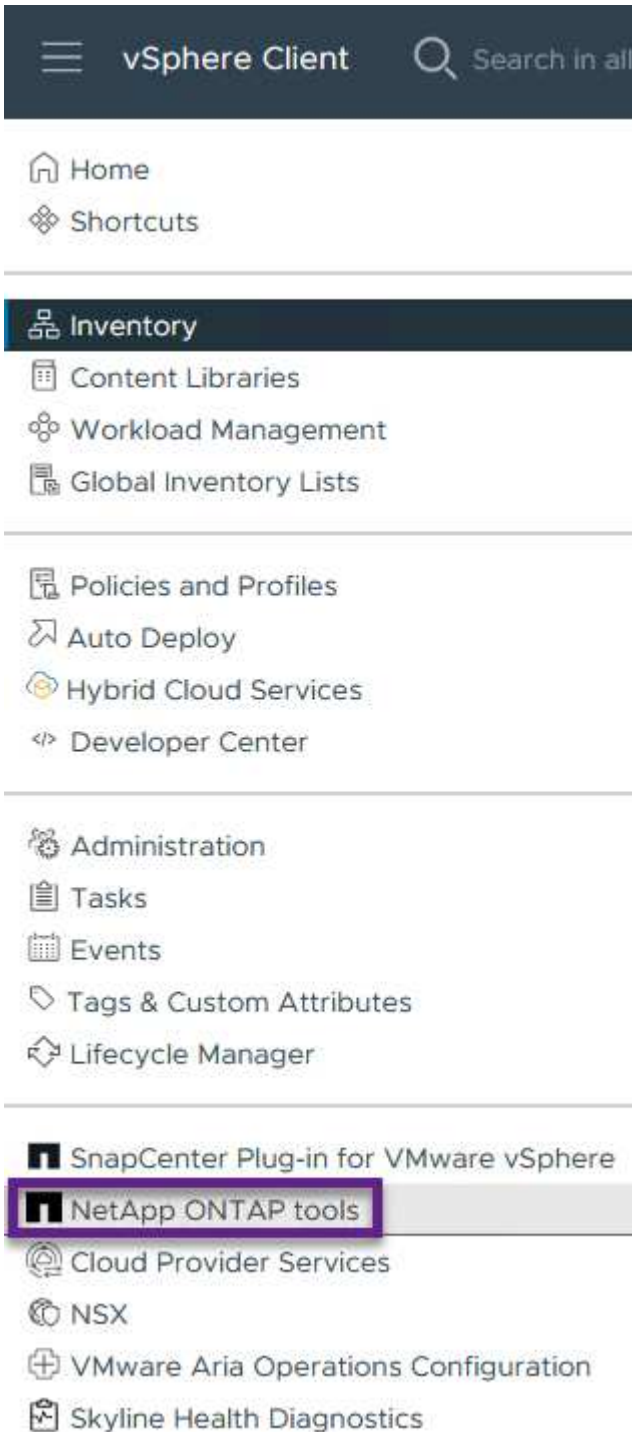
IP Address Specify the IP address for the appliance. (Leave blank if DHCP is desired)

CANCEL BACK NEXT

9. Review all information on the Ready to complete page and the click Finish to begin deploying the OTV appliance.

Add a storage system to ONTAP Tools.

1. Access NetApp ONTAP Tools by selecting it from the main menu in the vSphere client.




2. From the **INSTANCE** drop down menu in the ONTAP Tool interface, select the OTV instance associated with the workload domain to be managed.

vSphere Client Search in all environments

NetApp ONTAP tools INSTANCE 172.21.166.139:8443

	Plugin Instance	Version	vCenter Server
Overview			
Storage Systems	172.21.166.139:8443	9.13.0.36905	vcf-m01-vc01.sddc.netapp.com
Storage capability profile	172.21.166.149:8443	9.13.0.36905	vcf-wkld-vc01.sddc.netapp.com
Storage Mapping			
Settings			

provide



3. In ONTAP Tools select **Storage Systems** from the left hand menu and then press **Add**.

vSphere Client Search in all environments

NetApp ONTAP tools INSTANCE 172.21.166.149:8443

Overview


Storage Systems

Storage Systems **ADD** REDISCOVER ALL

Storage capability profile

4. Fill out the IP Address, credentials of the storage system and the port number. Click on **Add** to start the discovery process.

Add Storage System

 Any communication between ONTAP tools plug-in and the storage system should be mutually authenticated.

vCenter server	<input type="text" value="vcf-m01-vc01.sddc.netapp.com"/> ▾
Name or IP address:	<input type="text" value="172.16.9.25"/>
Username:	<input type="text" value="admin"/>
Password:	<input type="password" value="••••••••"/>
Port:	<input type="text" value="443"/>

Advanced options 

ONTAP Cluster Certificate: Automatically fetch Manually upload

CANCEL

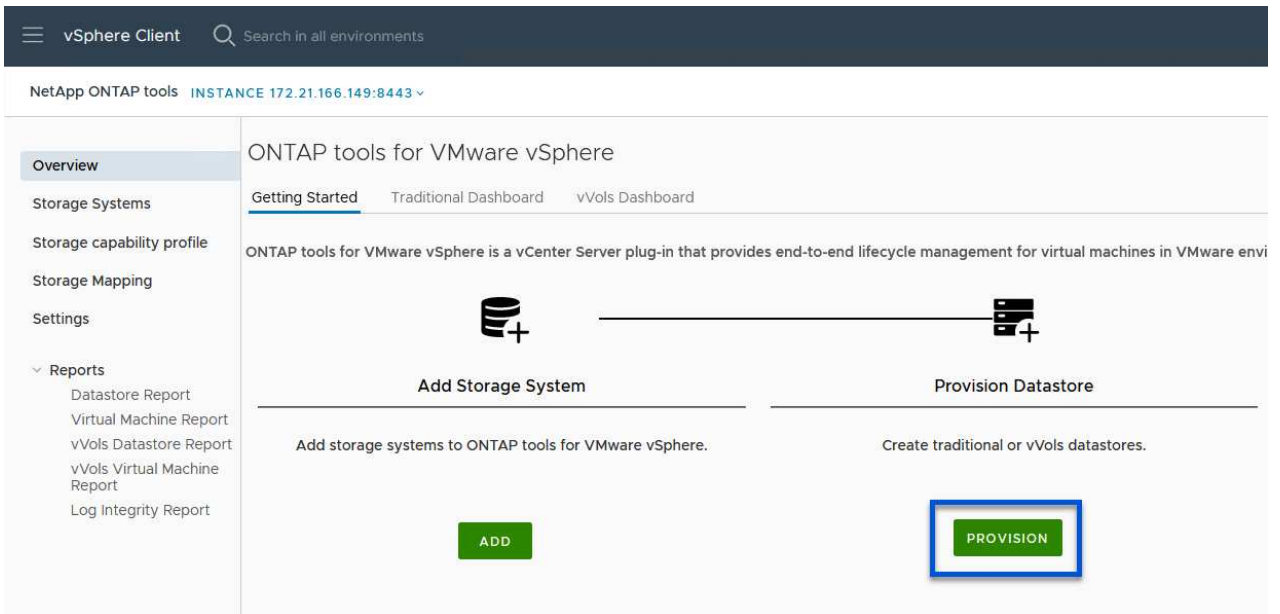
SAVE & ADD MORE

ADD

Create an NFS datastore in ONTAP Tools

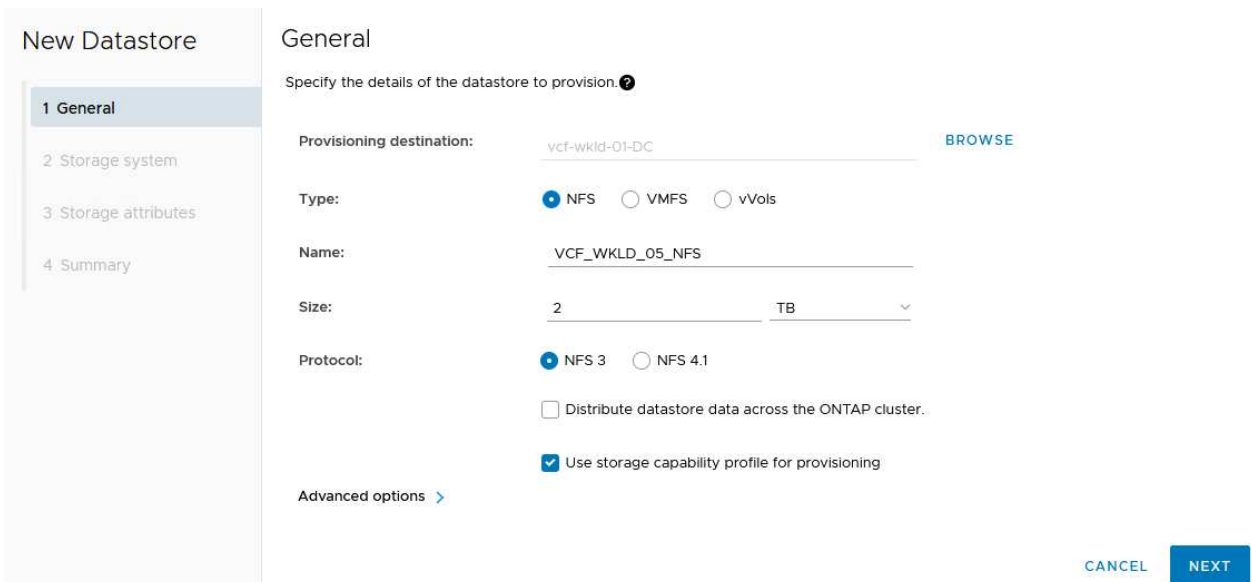
Complete the following steps to deploy an ONTAP datastore, running on NFS, using ONTAP Tools.

1. In ONTAP Tools select **Overview** and from the **Getting Started** tab click on **Provision** to start the wizard.



2. On the **General** page of the New Datastore wizard select the vSphere datacenter or cluster destination. Select **NFS** as the datastore type, fill out a name for the datastore, and select the protocol. Choose whether to use FlexGroup volumes and whether to use a storage capability file for provisioning. Click on **Next** to continue.

Note: Selecting to **Distribute datastore data across the cluster** will create the underlying volume as a FlexGroup volume which precludes the use of Storage Capability Profiles. Refer to [Supported and unsupported configurations for FlexGroup volumes](#) for more information on using FlexGroup Volumes.



- On the **Storage system** page select the select a storage capability profile, the storage system and SVM. Click on **Next** to continue.

New Datastore

- 1 General
- 2 Storage system
- 3 Storage attributes
- 4 Summary

Storage system

Specify the storage capability profiles and the storage system you want to use.

Storage capability profile:	Platinum_AFF_A	▼
Storage system:	ntaphci-a300e9u25 (172.16.9.25)	▼
Storage VM:	VCF_NFS	▼

- On the **Storage attributes** page select the aggregate to use and then click on **Next** to continue.

New Datastore

- 1 General
- 2 Storage system
- 3 Storage attributes
- 4 Summary

Storage attributes

Specify the storage details for provisioning the datastore.

Aggregate:	EHCAagr02 - (25350.17 GB Free)	▼
Volumes:	Automatically creates a new volume.	
Advanced options	>	

- Finally, review the **Summary** and click on Finish to begin creating the NFS datastore.

New Datastore

- 1 General
- 2 Storage system
- 3 Storage attributes
- 4 Summary

Summary

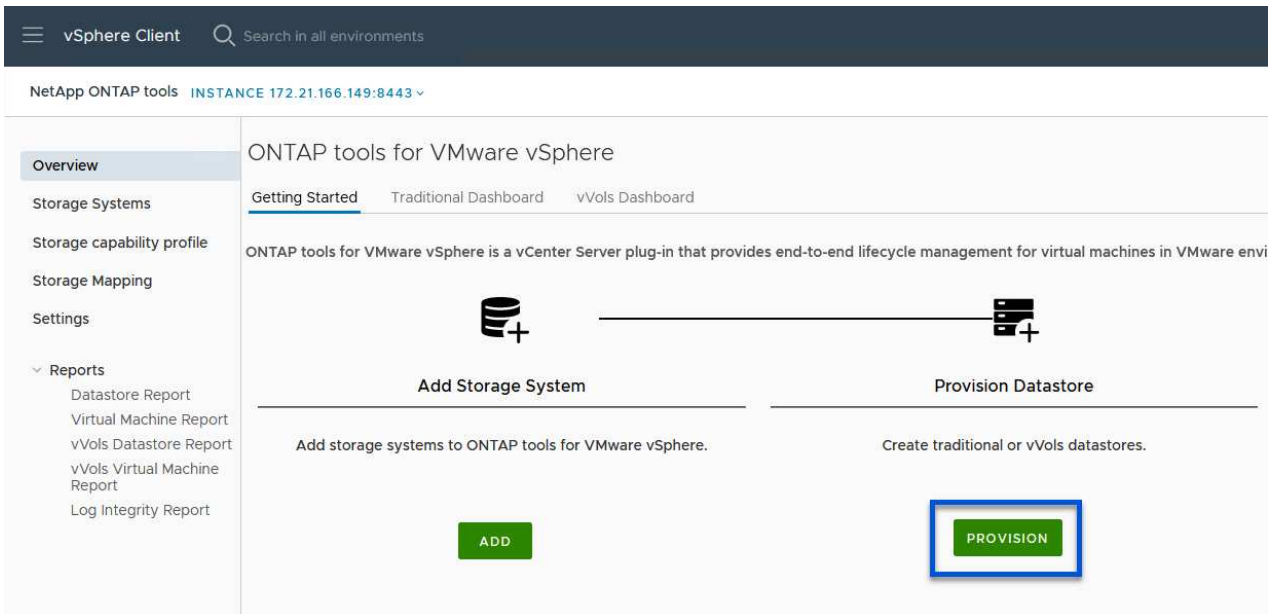
General	
vCenter server:	vcf-wkld-vc01.sddc.netapp.com
Provisioning destination:	vcf-wkld-01-DC
Datastore name:	VCF_WKLD_05_NFS
Datastore size:	2 TB
Datastore type:	NFS
Protocol:	NFS 3
Datastore cluster:	None
Storage capability profile:	Platinum_AFF_A
Storage system details	
Storage system:	ntaphci-a300e9u25
SVM:	VCF_NFS
Storage attributes	
Aggregate:	EHCAagr02

CANCEL
BACK
FINISH

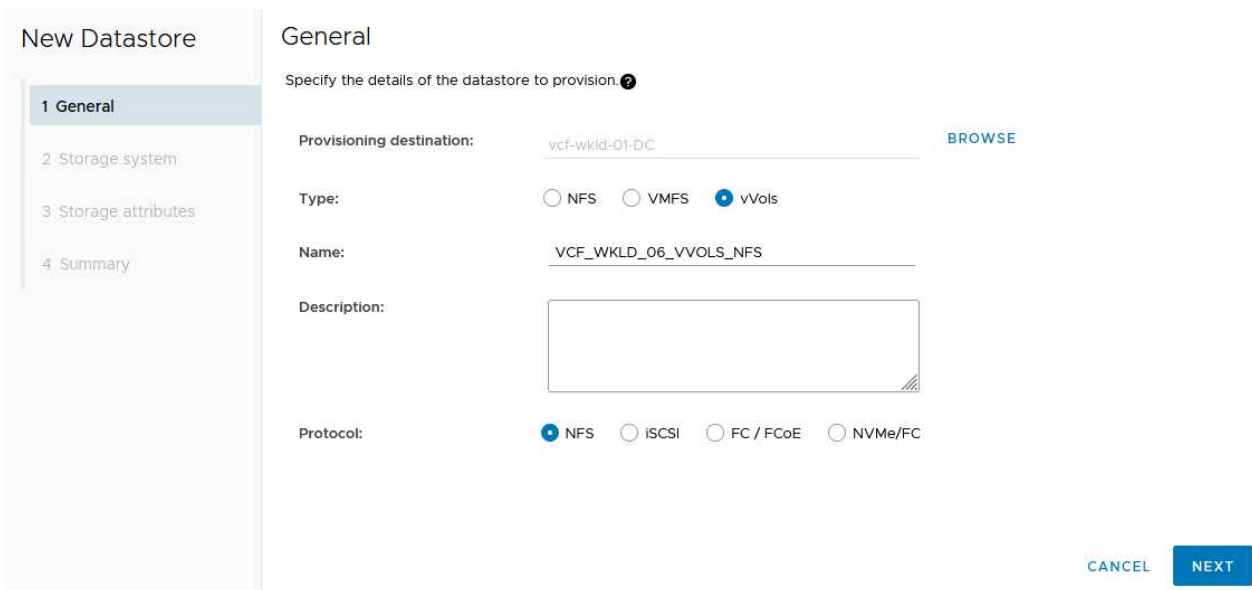
Create a vVols datastore in ONTAP Tools

To create a vVols datastore in ONTAP Tools complete the following steps:

1. In ONTAP Tools select **Overview** and from the **Getting Started** tab click on **Provision** to start the wizard.



2. On the **General** page of the New Datastore wizard select the vSphere datacenter or cluster destination. Select **vVols** as the datastore type, fill out a name for the datastore, and select **NFS** as the protocol. Click on **Next** to continue.



3. On the **Storage system** page select the select a storage capability profile, the storage system and SVM. Click on **Next** to continue.

New Datastore

1 General

2 Storage system

3 Storage attributes

4 Summary

Storage system

Specify the storage capability profiles and the storage system you want to use.

Storage capability profile:	Platinum_AFF_A	▼
Storage system:	ntaphci-a300e9u25 (172.16.9.25)	▼
Storage VM:	VCF_NFS	▼

4. On the **Storage attributes** page select to create a new volume for the datastore and fill out the storage attributes of the volume to be created. Click on **Add** to create the volume and then **Next** to continue.

Name	Size(GB) ⓘ	Storage capability profile	Aggregates	Space reserve
vcf_wkld_06_vvr	2000	Platinum_AFF_A ▼	EHCaggr02 - (25404 GB I ▼	Thin

ADD

New Datastore

1 General

2 Storage system

3 Storage attributes

4 Summary

Storage attributes

Specify the storage details for provisioning the datastore.

Volumes: Create new volumes Select volumes

Create new volumes

Name	Size	Storage Capability Profile	Aggregate
vcf_wkld_06_vvols	2000 GB	Platinum_AFF_A	EHCaggr02

1 - 1 of 1 item

Name	Size(GB) ⓘ	Storage capability profile	Aggregates	Space reserve
		Platinum_AFF_A ▼	EHCaggr02 - (25407.15 G ▼	Thin

ADD

Default storage capability profile: Platinum_AFF_A ▼

CANCEL

BACK

NEXT

5. Finally, review the **Summary** and click on **Finish** to start the vVol datastore creation process.

New Datastore

- 1 General
- 2 Storage system
- 3 Storage attributes
- 4 Summary

Summary

General

vCenter server: vcf-wkld-vc01.sddc.netapp.com

Provisioning destination: vcf-wkld-01-DC

Datastore name: VCF_WKLD_06_VVOLS_NFS

Datastore type: vVols

Protocol: NFS

Storage capability profile: Platinum_AFF_A

Storage system details

Storage system: ntaphci-a300e9u25

SVM: EHC_NFS

Storage attributes

New FlexVol Name	New FlexVol Size	Aggregate	Storage Capability Profile
------------------	------------------	-----------	----------------------------

CANCEL
BACK
FINISH

Additional information

For information on configuring ONTAP storage systems refer to the [ONTAP 9 Documentation](#) center.

For information on configuring VCF refer to [VMware Cloud Foundation Documentation](#).

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