



NetApp Storage in Hyperscaler Clouds

NetApp Solutions

NetApp
June 09, 2023

This PDF was generated from <https://docs.netapp.com/us-en/netapp-solutions/ehc/aws/aws-native-overview.html> on June 09, 2023. Always check docs.netapp.com for the latest.

Table of Contents

- NetApp Storage options for Public Cloud Providers 1
 - TR-4938: Mount Amazon FSx for ONTAP as a NFS datastore with VMware Cloud on AWS 1
 - NetApp Guest Connected Storage Options for AWS 3
 - Overview of ANF Datastore Solutions 31
 - NetApp Guest Connected Storage Options for Azure 33
 - Google Cloud VMware Engine Supplemental NFS Datastore with NetApp Cloud Volume Service 50
 - NetApp Storage Options for GCP 53
 - Region Availability for Supplemental NFS datastores on AWS, Azure, and GCP 79

NetApp Storage options for Public Cloud Providers

Explore the options for NetApp as storage in the three major hyperscalers.

AWS / VMC

AWS supports NetApp storage in the following configurations:

- FSx ONTAP as guest connected storage
- Cloud Volumes ONTAP (CVO) as guest connected storage
- FSx ONTAP as a supplemental NFS datastore

View the detailed [guest connect storage options for VMC](#).

View the detailed [supplemental NFS datastore options for VMC](#).

Azure / AVS

Azure supports NetApp storage in the following configurations:

- Azure NetApp Files (ANF) as guest connected storage
- Cloud Volumes ONTAP (CVO) as guest connected storage
- Azure NetApp Files (ANF) as a supplemental NFS datastore

View the detailed [guest connect storage options for AVS](#).

View the detailed [supplemental NFS datastore options for AVS](#).

GCP / GCVE

Google Cloud supports NetApp storage in the following configurations:

- Cloud Volumes ONTAP (CVO) as guest connected storage
- Cloud Volumes Service (CVS) as guest connected storage
- Cloud Volumes Service (CVS) as a supplemental NFS datastore

View the detailed [guest connect storage options for GCVE](#).

Read more about [NetApp Cloud Volumes Service datastore support for Google Cloud VMware Engine \(NetApp blog\)](#) or [How to use NetApp CVS as datastores for Google Cloud VMware Engine \(Google blog\)](#)

TR-4938: Mount Amazon FSx for ONTAP as a NFS datastore with VMware Cloud on AWS

Niyaz Mohamed, NetApp

Introduction

Every successful organization is on a path of transformation and modernization. As part of this process, companies typically use their existing VMware investments to leverage cloud benefits and exploring how to

migrate, burst, extend, and provide disaster recovery for processes as seamlessly as possible. Customers migrating to the cloud must evaluate the use cases for elasticity and burst, data-center exit, data-center consolidation, end-of-life scenarios, mergers, acquisitions, and so on.

Although VMware Cloud on AWS is the preferred option for the majority of the customers because it delivers unique hybrid capabilities to a customer, limited native storage options have restricted its usefulness for organizations with storage-heavy workloads. Because storage is directly tied to hosts, the only way to scale storage is to add more hosts, which can increase costs by 35-40% or more for storage intensive workloads. These workloads need additional storage and segregated performance, not additional horsepower, but that means paying for additional hosts. This is where the [recent integration](#) of FSx for ONTAP comes in handy for storage and performance intensive workloads with VMware Cloud on AWS.

Let's consider the following scenario: a customer requires eight hosts for horsepower (vCPU/vMem), but they also have a substantial requirement for storage. Based on their assessment, they require 16 hosts to meet storage requirements. This increases the overall TCO because they must buy all that additional horsepower when all they really need is more storage. This is applicable for any use case, including migration, disaster recovery, bursting, dev/test, and so on.

This document walks you through the steps necessary to provision and attach FSx for ONTAP as a NFS datastore for VMware Cloud on AWS.



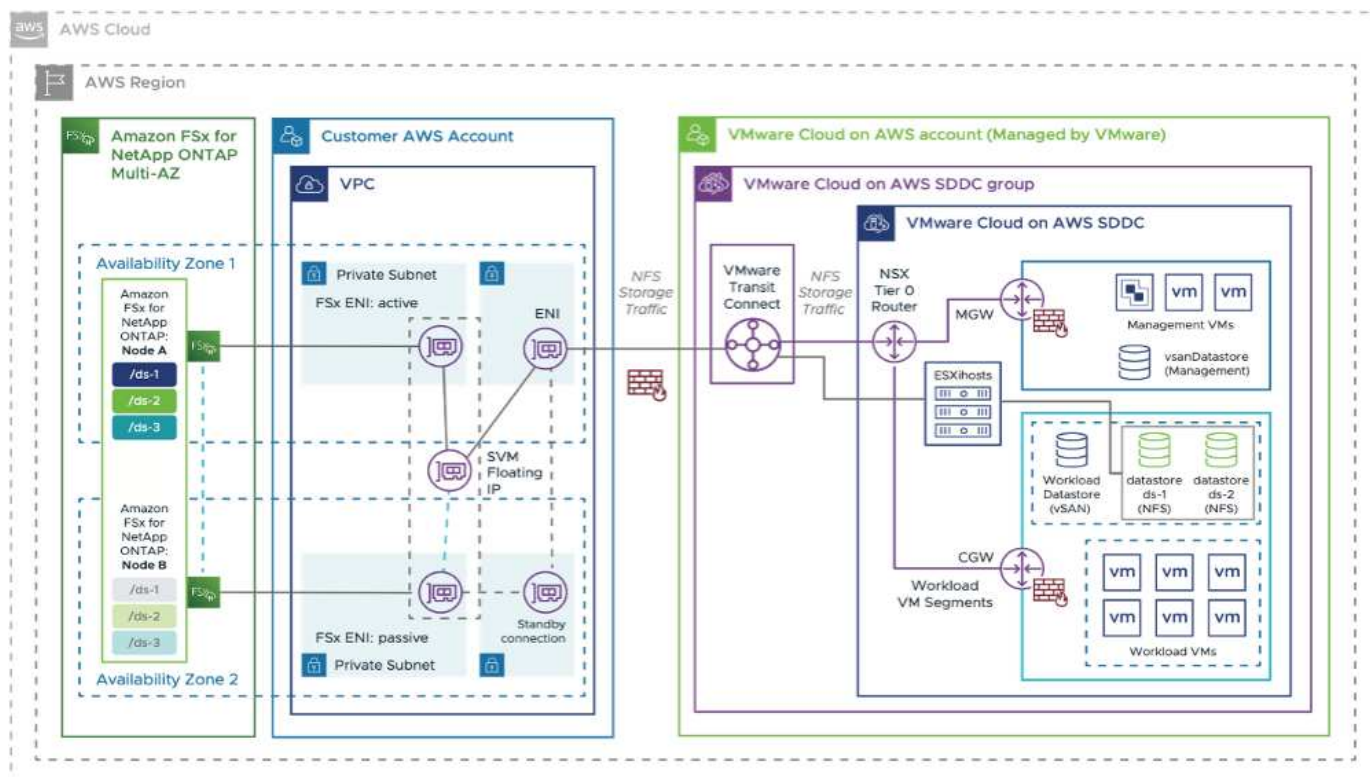
This solution is also available from VMware. Please visit the [VMware Cloud Tech Zone](#) for more information.

Connectivity options



VMware Cloud on AWS supports both multi-AZ and single-AZ deployments of FSx for ONTAP.

This section describes the high-level connectivity architecture along with the steps needed to implement the solution to expand the storage in a SDDC cluster without the need for adding additional hosts.



The high-level deployment steps are as follows:

1. Create Amazon FSx for ONTAP in a new designated VPC.
2. Create an SDDC group.
3. Create VMware Transit Connect and a TGW attachment.
4. Configure routing (AWS VPC and SDDC) and security groups.
5. Attach an NFS volume as a datastore to the SDDC cluster.

Before you provision and attach FSx for ONTAP as a NFS datastore, you must first set up a VMware on Cloud SDDC environment or get an existing SDDC upgraded to v1.20 or above. For more information, see the [Getting Started With VMware Cloud on AWS](#).



FSx for ONTAP is not currently supported with stretched clusters.

Conclusion

This document covers the steps necessary to configure Amazon FSx for ONTAP with VMware cloud on AWS. Amazon FSx for ONTAP provides excellent options to deploy and manage application workloads along with file services while reducing the TCO by making data requirements seamless to the application layer. Whatever the use case, choose VMware Cloud on AWS along with Amazon FSx for ONTAP for rapid realization of cloud benefits, consistent infrastructure, and operations from on-premises to AWS, bidirectional portability of workloads, and enterprise-grade capacity and performance. It is the same familiar process and procedures used to connect storage. Remember, it is just the position of the data that changed along with new names; the tools and processes all remain the same, and Amazon FSx for ONTAP helps to optimize the overall deployment.

To learn more about this process, feel free to follow the detailed walkthrough video.

[Mount Amazon FSx for ONTAP Volumes on VMC SDDC](#)

NetApp Guest Connected Storage Options for AWS

AWS supports guest connected NetApp storage with the native FSx service (FSx ONTAP) or with Cloud Volumes ONTAP (CVO).

FSx ONTAP

Amazon FSx for NetApp ONTAP is a fully managed service that provides highly reliable, scalable, high-performing, and feature-rich file storage built on NetApp's popular ONTAP file system. FSx for ONTAP combines the familiar features, performance, capabilities, and API operations of NetApp file systems with the agility, scalability, and simplicity of a fully managed AWS service.

FSx for ONTAP provides feature-rich, fast, and flexible shared file storage that's broadly accessible from Linux, Windows, and macOS compute instances running in AWS or on premises. FSx for ONTAP offers high-performance solid state drive (SSD) storage with submillisecond latencies. With FSx for ONTAP, you can achieve SSD levels of performance for your workload while paying for SSD storage for only a small fraction of your data.

Managing your data with FSx for ONTAP is easier because you can snapshot, clone, and replicate your files with the click of a button. In addition, FSx for ONTAP automatically tiers your data to lower-cost, elastic storage, lessening the need for you to provision or manage capacity.

FSx for ONTAP also provides highly available and durable storage with fully managed backups and support for cross-Region disaster recovery. To make it easier to protect and secure your data, FSx for ONTAP supports popular data security and antivirus applications.

FSx ONTAP as guest connected storage

Configure Amazon FSx for NetApp ONTAP with VMware Cloud on AWS

Amazon FSx for NetApp ONTAP files shares and LUNs can be mounted from VMs that are created within the VMware SDDC environment at VMware Cloud at AWS. The volumes can also be mounted on the Linux client and mapped on the Windows client using the NFS or SMB protocol, and LUNS can be accessed on Linux or Windows clients as block devices when mounted over iSCSI. Amazon FSx for the NetApp ONTAP file system can be set up quickly with the following steps.



Amazon FSx for NetApp ONTAP and VMware Cloud on AWS must be in the same availability zone to achieve better performance and avoid data transfer charges between availability zones.

Create and mount Amazon FSx for ONTAP volumes

To create and mount Amazon FSx for NetApp ONTAP file system, complete the following steps:

1. Open the [Amazon FSx console](#) and choose Create file system to start the file system creation wizard.
2. On the Select File System Type page, choose Amazon FSx for NetApp ONTAP, and then choose Next. The Create File System page appears.



3. In the Networking section, for Virtual Private Cloud (VPC), choose the appropriate VPC and preferred subnets along with the route table. In this case, vmcfsx2.vpc is selected from the dropdown.

Create file system

Creation method

☐ Quick create
Use recommended best-practice configurations. Most configuration options can be changed after the file system is created.

☒ Standard create
You set all of the configuration options, including specifying performance, networking, security, backups, and maintenance.

4. For the creation method, choose Standard Create. You can also choose Quick Create, but this document uses the Standard create option.

File system details

File system name - optional [Info](#)

vmcfsxval2

Maximum of 256 Unicode letters, whitespace, and numbers, plus + - = . _ : /

SSD storage capacity [Info](#)

1024

Minimum 1024 GB; Maximum 192 TB.

Provisioned SSD IOPS

Amazon FSx provides 3 IOPS per GB of storage capacity. You can also provision additional SSD IOPS as needed.

☒ Automatic (3 IOPS per GB of SSD storage)

☐ User-provisioned

Throughput capacity [Info](#)

The sustained speed at which the file server hosting your file system can serve data. The file server can also burst to higher speeds for periods of time.

512 MB/s (Recommended)

5. In the Networking section, for Virtual Private Cloud (VPC), choose the appropriate VPC and preferred subnets along with the route table. In this case, vmcfsx2.vpc is selected from the dropdown.

Network & security

Virtual Private Cloud (VPC) [Info](#)

Specify the VPC from which your file system is accessible.

vmcfsx2.vpc | vpc-0d1c764bcc495e805

VPC Security Groups [Info](#)

Specify VPC Security Groups to associate with your file system's network interface.

Choose VPC security group(s)

sg-018896ea218164ccb (default) X

Preferred subnet [Info](#)

Specify the preferred subnet for your file system.

subnet02.sn | subnet-013675849a5b99b3c (us-west-2b)

Standby subnet

subnet01.sn | subnet-0ef956cebf539f970 (us-west-2a)

VPC route tables

Specify the VPC route tables associated with your file system.

☒ VPC's default route table

☐ Select one or more VPC route tables

Endpoint IP address range

Specify the IP address range in which the endpoints to access your file system will be created.

☒ No preference

☐ Select an IP address range



In the Networking section, for Virtual Private Cloud (VPC), choose the appropriate VPC and preferred subnets along with the route table. In this case, vmcsx2.vpc is selected from the dropdown.

6. In the Security & Encryption section, for the Encryption Key, choose the AWS Key Management Service (AWS KMS) encryption key that protects the file system's data at rest. For the File System Administrative Password, enter a secure password for the fsxadmin user.

Security & encryption

Encryption key [Info](#)

AWS Key Management Service (KMS) encryption key that protects your file system data at rest.

aws/fsx (default) ▼

Description	Account	KMS key ID
Default master key that protects my FSx resources when no other key is defined	139763910815	72745367-7bb0-499c-acc0-4f2c0a80e7c5

File system administrative password

Password for this file system's "fsxadmin" user, which you can use to access the ONTAP CLI or REST API.

☐ Don't specify a password

☒ Specify a password

Password

••••••••

Confirm password

••••••••

7. In virtual machine and specify the password to use with vsadmin for administering ONTAP using REST APIs or the CLI. If no password is specified, a fsxadmin user can be used for administering the SVM. In the Active Directory section, make sure to join Active Directory to the SVM for provisioning SMB shares. In the Default Storage Virtual Machine Configuration section, provide a name for the storage in this validation, SMB shares are provisioned using a self-managed Active Directory domain.

Default storage virtual machine configuration

Storage virtual machine name

vmcfsxval2svm

SVM administrative password

Password for this SVM's "vsadmin" user, which you can use to access the ONTAP CLI or REST API.

- ☐ Don't specify a password
☒ Specify a password

Password

••••••••

Confirm password

••••••••

Active Directory

Joining an Active Directory enables access from Windows and MacOS clients over the SMB protocol.

- ☒ Do not join an Active Directory
☐ Join an Active Directory

8. In the Default Volume Configuration section, specify the volume name and size. This is an NFS volume. For Storage Efficiency, choose Enabled to turn on the ONTAP storage efficiency features (compression, deduplication, and compaction) or Disabled to turn them off.

Default volume configuration

Volume name

vol1

Maximum of 203 alphanumeric characters, plus _ .

Junction path

/vol1

The location within your file system where your volume will be mounted.

Volume size

1024

Minimum 20 MiB; Maximum 104857600 MiB

Storage efficiency

Select whether you would like to enable ONTAP storage efficiencies on your volume: deduplication, compression, and compaction.

- ☐ Enabled (recommended)
☒ Disabled

Capacity pool tiering policy

You can optionally enable automatic tiering of your data to lower-cost capacity pool storage.

Auto

9. Review the file system configuration shown on the Create File System page.
10. Click Create File System.

aws Services Search for services, features, marketplace products, and docs [Alt+S] nimo @ cloudbrokers Oregon Support

Amazon FSx

File systems (3)

File system name	File system ID	File system type	Status	Deployment type	Storage type	Size
fsxntapcifs	fs-014c28399be9c1f9f	ONTAP	Available	Multi-AZ	SSD	1,024 GiB
vmcfsxval2	fs-040eacc5d0ac31017	ONTAP	Available	Multi-AZ	SSD	1,024 GiB
fsxntapsql	fs-0ab4b447ebd6082aa	ONTAP	Available	Multi-AZ	SSD	2,048 GiB

Network & security Administration **Storage virtual machines** Volumes Backups Tags

Storage virtual machines (SVMs) (2)

SVM name	SVM ID	Status	Creation time	Active Directory
fsxsmbtesting01	svm-075dcfbe2cfa2ece9	Created	2021-10-19 15:17:08 UTC +01:00	FSXTESTING.LOCAL
vmcfsxval2svm	svm-095db076341561212	Created	2021-10-15 15:16:54 UTC +01:00	-

FSx > Storage virtual machines > svm-075dcfbe2cfa2ece9

fsxsmbtesting01 (svm-075dcfbe2cfa2ece9)

Delete Update

Summary

SVM ID svm-075dcfbe2cfa2ece9	Creation time 2021-10-19T15:17:08+01:00	Active Directory FSXTESTING.LOCAL
SVM name fsxsmbtesting01	Lifecycle state Created	Net BIOS name FSXSMBTESTING01
UUID 4a50e659-30e7-11ec-ac4f-f3ad92a6a735	Subtype DEFAULT	Fully qualified domain name FSXTESTING.LOCAL
File system ID fs-040eacc5d0ac31017		Service account username administrator
		Organizational unit distinguished name CN=Computers

For more detailed information, see [Getting started with Amazon FSx for NetApp ONTAP](#).

After the file system is created as above, create the volume with the required size and protocol.

1. Open the [Amazon FSx console](#).
2. In the left navigation pane, choose File systems, and then choose the ONTAP file system that you

want to create a volume for.

3. Select the Volumes tab.
4. Select the Create Volume tab.
5. The Create Volume dialog box appears.

For demo purposes, an NFS volume is created in this section that can be easily mounted on VMs running on VMware cloud on AWS. nfsdemo01 is created as depicted below:

Create volume [X]

File system
fs-040eacc5d0ac31017 | vmcfsxval2

Storage virtual machine
svm-095db076341561212 | vmcfsxval2svm

Volume name
nfsdemo01
Maximum of 205 alphanumeric characters, plus _ .

Junction path
/nfsdemo01
The location within your file system where your volume will be mounted.

Volume size
1024
Minimum 20 MiB; Maximum 104857600 MiB

Storage efficiency
Select whether you would like to enable ONTAP storage efficiencies on your volume: deduplication, compression, and compaction.
☐ Enabled (recommended)
☒ Disabled

Capacity pool tiering policy
You can optionally enable automatic tiering of your data to lower-cost capacity pool storage.
Auto

Cancel Confirm

Mount FSx ONTAP volume on Linux client

To mount the FSx ONTAP volume created in the previous step. from the Linux VMs within VMC on AWS SDDC, complete the following steps:

1. Connect to the designated Linux instance.
2. Open a terminal on the instance using Secure Shell (SSH) and log in with the appropriate credentials.
3. Make a directory for the volume's mount point with the following command:

```
$ sudo mkdir /fsx/nfsdemovol01
```

4. Mount the Amazon FSx for NetApp ONTAP NFS volume to the directory that is created in the previous step.

```
sudo mount -t nfs nfsvers=4.1,198.19.254.239:/nfsdemovol01  
/fsx/nfsdemovol01
```

```
root@ubuntu01:/fsx/nfsdemovol01# mount -t nfs 198.19.254.239:/nfsdemovol01 /fsx/nfsdemovol01
```

5. Once executed, run the df command to validate the mount.



```
root@ubuntu01:/fsx/nfsdemovol01# df
Filesystem            1K-blocks    Used Available Use% Mounted on
tmpfs                  814396      1176    813220   1% /run
/dev/mapper/ubuntu--vg-ubuntu--lv 15412168 3666428 10943132 25% /
tmpfs                  4071960         0    4071960   0% /dev/shm
tmpfs                   5120         0     5120   0% /run/lock
tmpfs                  4096         0     4096   0% /sys/fs/cgroup
/dev/sda2              999320 254996  675512 26% /boot
tmpfs                  814392         4    814388   1% /run/user/1000
172.16.0.2:/nfsdemo01 9961472 4241792 5719680 43% /fsxcvotest1ng01/nfsdemovol01
198.19.254.239:/nfsdemovol01 996160    512    995648   1% /fsx/nfsdemovol01
root@ubuntu01:/fsx/nfsdemovol01# cd /fsx/nfsdemovol01/
root@ubuntu01:/fsx/nfsdemovol01# ls
nfsdemo11.txt
root@ubuntu01:/fsx/nfsdemovol01#
```

[Watch a video walkthrough of this process.](#)

Attach FSx ONTAP volumes to Microsoft Windows clients

To manage and map file shares on an Amazon FSx file system, the Shared Folders GUI must be used.

1. Open the Start menu and run fsmgmt.msc using Run As Administrator. Doing this opens the Shared Folders GUI tool.
2. Click Action > All tasks and choose Connect to Another Computer.
3. For Another Computer, enter the DNS name for the storage virtual machine (SVM). For example, FSXSMBTESTING01.FSXTESTING.LOCAL is used in this example.



To find the SVM's DNS name on the Amazon FSx console, choose Storage Virtual Machines, choose SVM, and then scroll down to Endpoints to find the SMB DNS name. Click OK. The Amazon FSx file system appears in the list for the Shared Folders.

Endpoints

Management DNS name

svm-075dcfbe2cfa2ece9.fs-040eacc5d0ac31017.fsx.us-west-2.amazonaws.com

NFS DNS name

svm-075dcfbe2cfa2ece9.fs-040eacc5d0ac31017.fsx.us-west-2.amazonaws.com

SMB DNS name

FSXSMBTESTING01.FSXTESTING.LOCAL



iSCSI DNS name

iscsi.svm-075dcfbe2cfa2ece9.fs-040eacc5d0ac31017.fsx.us-west-2.amazonaws.com

Management IP address

198.19.254.9

NFS IP address

198.19.254.9

SMB IP address

198.19.254.9

iSCSI IP addresses

10.222.2.224, 10.222.1.94

4. In the Shared Folders tool, choose Shares in the left pane to see the active shares for the Amazon FSx file system.



5. Now choose a new share and complete the Create a Shared Folder wizard.

Create A Shared Folder Wizard

Name, Description, and Settings

Specify how people see and use this share over the network.

Type information about the share for users. To modify how people use the content while offline, click Change.

Share name:

nimtestsmb01

Share path:

\\FSXSMBTESTING01.FSXTESTING.LOCAL\nimtestsmb01

Description:

Offline setting:

Selected files and programs available offline

Change...

< Back

Next >

Cancel

Create A Shared Folder Wizard

Sharing was Successful

Status:

You have successfully completed the Share a Folder Wizard.

Summary:

You have selected the following share settings on \\FSXSMBTESTING01.FSXTESTING.LOCAL:
Folder path: C:\nimtestsmb01
Share name: nimtestsmb01
Share path: \\FSXSMBTESTING01.FSXTESTING.LOCAL\nimtestsmb01

☐ When I click Finish, run the wizard again to share another folder

To close this wizard, click Finish.

Finish

Cancel

To learn more about creating and managing SMB shares on an Amazon FSx file system, see [Creating SMB Shares](#).

6. After connectivity is in place, the SMB share can be attached and used for application data. To accomplish this, Copy the share path and use the Map Network Drive option to mount the volume on the VM running on VMware Cloud on the AWS SDDC.



Connect a FSx for NetApp ONTAP LUN to a host using iSCSI

[Watch a video walkthrough of this step.](#)

iSCSI traffic for FSx traverses the VMware Transit Connect/AWS Transit Gateway via the routes provided in the previous section. To configure a LUN in Amazon FSx for NetApp ONTAP, follow the documentation found [here](#).

On Linux clients, make sure that the iSCSI daemon is running. After the LUNs are provisioned, refer to the detailed guidance on iSCSI configuration with Ubuntu (as an example) [here](#).

In this paper, connecting the iSCSI LUN to a Windows host is depicted:

Provision a LUN in FSx for NetApp ONTAP:

1. Access the NetApp ONTAP CLI using the management port of the FSx for the ONTAP file system.
2. Create the LUNs with the required size as indicated by the sizing output.

```
FsxId040eacc5d0ac31017::> lun create -vserver vmcfssxval2svm -volume  
nimfssxscsivol -lun nimofssxlun01 -size 5gb -ostype windows -space  
-reserve enabled
```

In this example, we created a LUN of size 5g (5368709120).

3. Create the necessary igroups to control which hosts have access to specific LUNs.

```
FsxId040eacc5d0ac31017::> igroup create -vserver vmcfssxval2svm  
-igroup winIG -protocol iscsi -ostype windows -initiator iqn.1991-  
05.com.microsoft:vmcdc01.fsxtesting.local
```

```
FsxId040eacc5d0ac31017::> igroup show
```

Vserver	Igroup	Protocol	OS	Type	Initiators

vmcfssxval2svm					
	ubuntu01	iscsi	linux		iqn.2021- 10.com.ubuntu:01:initiator01
vmcfssxval2svm					
	winIG	iscsi	windows		iqn.1991- 05.com.microsoft:vmcdc01.fsxtesting.local

Two entries were displayed.

4. Map the LUNs to igroups using the following command:

```
FsxId040eacc5d0ac31017::> lun map -vserver vmcfsxval2svm -path  
/vol/nimfsxscsivol/nimofsxlun01 -igroup winIG
```

```
FsxId040eacc5d0ac31017::> lun show
```

Vserver	Path	State	Mapped	Type
Size				

vmcfsxval2svm				
	/vol/blocktest01/lun01	online	mapped	linux
5GB				
vmcfsxval2svm				
	/vol/nimfsxscsivol/nimofsxlun01	online	mapped	windows
5GB				

Two entries were displayed.

5. Connect the newly provisioned LUN to a Windows VM:

To connect the new LUN for a Windows host residing on VMware cloud on AWS SDDC, complete the following steps:

- RDP to the Windows VM hosted on the VMware Cloud on AWS SDDC.
- Navigate to Server Manager > Dashboard > Tools > iSCSI Initiator to open the iSCSI Initiator Properties dialog box.
- From the Discovery tab, click Discover Portal or Add Portal and then enter the IP address of the iSCSI target port.
- From the Targets tab, select the target discovered and then click Log On or Connect.
- Select Enable Multipath, and then select "Automatically Restore This Connection When the Computer Starts" or "Add This Connection to the List of Favorite Targets". Click Advanced.



The Windows host must have an iSCSI connection to each node in the cluster. The native DSM selects the best paths to use.



LUNs on the storage virtual machine (SVM) appear as disks to the Windows host. Any new disks that are added are not automatically discovered by the host. Trigger a manual rescan to discover the disks by completing the following steps:

1. Open the Windows Computer Management utility: Start > Administrative Tools > Computer Management.
2. Expand the Storage node in the navigation tree.
3. Click Disk Management.
4. Click Action > Rescan Disks.



When a new LUN is first accessed by the Windows host, it has no partition or file system. Initialize the LUN and, optionally, format the LUN with a file system by completing the following steps:

1. Start Windows Disk Management.
2. Right-click the LUN, and then select the required disk or partition type.
3. Follow the instructions in the wizard. In this example, drive F: is mounted.



Cloud Volumes ONTAP (CVO)

Cloud volumes ONTAP, or CVO, is the industry-leading cloud data management solution built on NetApp's ONTAP storage software, available natively on Amazon Web Services (AWS), Microsoft Azure and Google Cloud Platform (GCP).

It is a software-defined version of ONTAP that consumes cloud-native storage, allowing you to have the same storage software in the cloud and on-premises, reducing the need to retrain you IT staff in all-new methods to manage your data.

CVO gives customers the ability to seamlessly move data from the edge, to the data center, to the cloud and back, bringing your hybrid cloud together — all managed with a single-pane management console, NetApp Cloud Manager.

By design, CVO delivers extreme performance and advanced data management capabilities to satisfy even your most demanding applications in the cloud

Cloud Volumes ONTAP (CVO) as guest connected storage

Deploy new Cloud Volumes ONTAP instance in AWS (do it yourself)

Cloud Volumes ONTAP shares and LUNs can be mounted from VMs that are created in the VMware Cloud on AWS SDDC environment. The volumes can also be mounted on native AWS VM Linux Windows clients, and LUNS can be accessed on Linux or Windows clients as block devices when mounted over iSCSI because Cloud Volumes ONTAP supports iSCSI, SMB, and NFS protocols. Cloud Volumes ONTAP volumes can be set up in a few simple steps.

To replicate volumes from an on-premises environment to the cloud for disaster recovery or migration purposes, establish network connectivity to AWS, either using a site-to-site VPN or DirectConnect. Replicating data from on-premises to Cloud Volumes ONTAP is outside the scope of this document. To replicate data between on-premises and Cloud Volumes ONTAP systems, see [Setting up data replication between systems](#).



Use the [Cloud Volumes ONTAP sizer](#) to accurately size the Cloud Volumes ONTAP instances. Also, monitor on-premises performance to use as inputs in the Cloud Volumes ONTAP sizer.

1. Log into NetApp Cloud Central; the Fabric View screen is displayed. Locate the Cloud Volumes ONTAP tab and select Go to Cloud Manager. After you are logged in, the Canvas screen is displayed.



2. On the Cloud Manager home page, click Add a Working Environment and then select AWS as the cloud and the type of the system configuration.



3. Provide the details of the environment to be created including the environment name and admin credentials. Click Continue.

↑ Previous Step	Instance Profile Credential Name	139763910815 Account ID	netapp.com-cloud-volumes-... Marketplace Subscription	Edit Credentials
-----------------	-------------------------------------	----------------------------	--	----------------------------------

Details

Working Environment Name (Cluster Name)
fsxcvotesting01

[+ Add Tags](#) Optional Field | Up to four tags

Credentials

User Name
admin

Password

Confirm Password

Continue

4. Select the add-on services for Cloud Volumes ONTAP deployment, including Cloud Data Sense, Cloud Backup, and Cloud Insights. Click Continue.

 Data Sense & Compliance

☒ 

 Backup to Cloud

☒ 

 Monitoring

☒ 

Continue

5. On the HA Deployment Models page, choose the Multiple Availability Zones configuration.

↑ Previous Step

Multiple Availability Zones

 Provides maximum protection against AZ failures.

 Enables selection of 3 availability zones.

 An HA node serves data if its partner goes offline.

 Extended Info

Single Availability Zone

 Protects against failures within a single AZ.

 Single availability zone. HA nodes are in a placement group, spread across distinct underlying hardware.

 An HA node serves data if its partner goes offline.

 Extended Info

6. On the Region & VPC page, enter the network information and then click Continue.

[↑ Previous Step](#)

AWS Region

US West | Oregon

VPC

vpc-0d1c764bcc495e805 -
10.222.0.0/16

Security group

Use a generated security group

 Node 1:

Availability Zone

us-west-2a

Subnet

10.222.1.0/24

 Node 2:

Availability Zone

us-west-2b

Subnet

10.222.2.0/24

 Mediator:

Availability Zone

us-west-2c

Subnet

10.222.3.0/24

Continue

7. On the Connectivity and SSH Authentication page, choose connection methods for the HA pair and the mediator.

[↑ Previous Step](#) Nodes

SSH Authentication Method

Password

 Mediator

Security Group

Use a generated security group

Key Pair Name

nimokey

Internet Connection Method

Public IP address

Continue

8. Specify the floating IP addresses and then click Continue.

[↑ Previous Step](#)

Floating IP addresses are required for cluster and SVM access and for NFS and CIFS data access. These floating IPs can migrate between HA nodes if failures occur. To access the data from outside the VPC, [you can set up an AWS transit gateway](#).

You must specify IP addresses that are outside of the CIDR blocks for all VPCs in the selected AWS region.

Floating IP address for cluster management

Floating IP address 1 for NFS and CIFS data

Floating IP address 2 for NFS and CIFS data

Floating IP address for SVM management (Optional)

[Continue](#)

9. Select the appropriate route tables to include routes to the floating IP addresses and then click Continue.

[↑ Previous Step](#)

Select the route tables that should include routes to the floating IP addresses. This enables client access to the Cloud Volumes ONTAP HA pair. If you leave a route table unselected, clients that are associated with the route table cannot access the HA pair.

Additional information ⓘ

Name	Main	ID	Associate with Subnet	Tags
<input checked="" type="checkbox"/>	Yes	rtb-00b2d30c3f68fdbdd	0 Subnets	1 Tags

1 Route Tables | The main route table is the default for the VPC

[Continue](#)

10. On the Data Encryption page, choose AWS-managed encryption.

[↑ Previous Step](#)


AWS Managed Encryption

AWS is responsible for data encryption and decryption operations. Key management is handled by AWS key management services.

Default Master Key: **aws/ebs**

[Change Key](#)
[Continue](#)

11. Select the license option: Pay-As-You-Go or BYOL for using an existing license. In this example, the Pay-As-You-Go option is used.

Create a New Working Environment Cloud Volumes ONTAP Charging Methods & NSS Account

Cloud Volumes ONTAP Charging Methods

[Learn more about our charging methods](#)

☒ Pay-As-You-Go by the hour

☐ Bring your own license

NetApp Support Site Account (Optional)

[Learn more about NetApp Support Site \(NSS\) accounts](#)

To register this Cloud Volumes ONTAP to support, you should add NetApp Support Site Account.

Don't have a NetApp Support Site account? Select go to finish deploying this system. After it's created, use the Support Registration option to create an NSS account.

[Continue](#)

12. Select between several preconfigured packages available based on the type of workload to be deployed on the VMs running on the VMware cloud on AWS SDDC.



Select a preconfigured Cloud Volumes ONTAP system that best matches your needs, or create your own configuration. Preconfigured settings can be modified at a later time.

[Change Configuration](#)


POC and small workloads
Up to 500GB of storage



Database and application data
production workloads



Cost effective DR
Up to 500GB of storage



Highest performance production
workloads

[Continue](#)

13. On the Review & Approve page, review and confirm the selections. To create the Cloud Volumes ONTAP instance, click Go.

[Previous Step](#)

fsxcvotesting

AWS | us-west-2 | HA

[Show API request](#)

This Cloud Volumes ONTAP instance will be registered with NetApp support under the NSS Account **mchad**.

☐ I understand that Cloud Manager will allocate the appropriate AWS resources to comply with my above requirements. [More information >](#)

Overview

Networking

Storage

Storage System:	Cloud Volumes ONTAP HA	HA Deployment Model:	Multiple Availability Zones
License Type:	Cloud Volumes ONTAP Explore	Encryption:	AWS Managed
Capacity Limit:	2TB	Customer Master Key:	aws/ebs

Go

14. After Cloud Volumes ONTAP is provisioned, it is listed in the working environments on the Canvas page.

The screenshot shows the Canvas page with a navigation bar at the top containing: Canvas, Replication, Backup & Restore, K8s, Data Sense, File Cache, Compute, Sync, and All Services (+8) v. Below the navigation bar, the main area is titled 'Canvas' and includes an 'Add Working Environment' button. Three cloud icons represent working environments: 'vmc/saval2' (fsxcvotesting01, 9 Volumes, 26.49 GiB Capacity), 'fsxcvotesting01' (Cloud Volumes ONTAP, 46 GiB Capacity), and 'Amazon S3' (4 Buckets, 2 Regions). On the right, a sidebar for 'fsxcvotesting01' shows 'On' status and details: Cloud Volumes ONTAP | AWS | HA. The 'SERVICES' section lists 'Replication' (Off, Enable button) and 'Backup & Restore' (Loading...).

Additional configurations for SMB volumes

1. After the working environment is ready, make sure the CIFS server is configured with the appropriate DNS and Active Directory configuration parameters. This step is required before you can create the SMB volume.

The screenshot shows the AWS Management Console interface for the instance **fsxcvotesting01** (Multiple AZs). The top navigation bar includes tabs for Volumes, HA Status, Cost, and Replications. The main content area is titled **Create a CIFS server** with a **+ Advanced** link. The configuration form includes the following fields:

- DNS Primary IP Address:** 192.168.1.3
- DNS Secondary IP Address (Optional):** Example: 127.0.0.1
- Active Directory Domain to join:** fsxcvotesting.local
- Credentials authorized to join the domain:** Username and Password fields.

At the bottom of the form are **Save** and **Cancel** buttons.

2. Select the CVO instance to create the volume and click the Create Volume option. Choose the appropriate size and cloud manager chooses the containing aggregate or use advanced allocation mechanism to place on a specific aggregate. For this demo, SMB is selected as the protocol.

The screenshot shows the **Create new volume in fsxcvotesting01** configuration page. The page is divided into two main sections: **Details & Protection** and **Protocol**.

Details & Protection:

- Volume Name:** smbdemovol01
- Size (GB):** 100
- Snapshot Policy:** default (with a dropdown arrow)
- Default Policy:** (indicated by an information icon)

Protocol:

- NFS**, **CIFS** (selected), **iSCSI**
- Share name:** smbdemovol01_share
- Permissions:** Full Control (with a dropdown arrow)
- Users / Groups:** Everyone; (with a text input field)
- Valid users and groups separated by a semicolon

At the bottom of the form is a **Continue** button.

3. After the volume is provisioned, it is available under the Volumes pane. Because a CIFS share is provisioned, you should give your users or groups permission to the files and folders and verify that those users can access the share and create a file.

INFO

Disk Type	GP2
Tiering Policy	None
Backup	OFF

CAPACITY



1.67 MB
EBS Used

- After the volume is created, use the mount command to connect to the share from the VM running on the VMware Cloud in AWS SDDC hosts.
- Copy the following path and use the Map Network Drive option to mount the volume on the VM running on the VMware Cloud in AWS SDDC.

Mount Volume smbdemovo101



Access from inside the VPC using Floating IP

Auto failover between nodes

The IP address automatically migrates between nodes if failures occur

Go to your machine and enter this command

```
\\172.16.0.2\smbdemovo101_share
```



Access from outside the VPC using AWS Private IP

No auto failover between nodes

The IP address does not migrate between nodes if failures occur

To avoid traffic between nodes, mount the volume by using the primary node's IP address:

```
\\10.222.1.100\smbdemovo101_share
```



If the primary node goes offline, mount the volume by using the HA partner's IP address:



Connect the LUN to a host

To connect the Cloud Volumes ONTAP LUN to a host, complete the following steps:

1. On the Cloud Manager Canvas page, double-click the Cloud Volumes ONTAP working environment to create and manage volumes.
2. Click Add Volume > New Volume, select iSCSI, and click Create Initiator Group. Click Continue.



3. After the volume is provisioned, select the volume, and then click Target IQN. To copy the iSCSI Qualified Name (IQN), click Copy. Set up an iSCSI connection from the host to the LUN.

To accomplish the same for the host residing on the VMware Cloud on AWS SDDC, complete the following steps:

- a. RDP to the VM hosted on VMware cloud on AWS.
- b. Open the iSCSI Initiator Properties dialog box: Server Manager > Dashboard > Tools > iSCSI Initiator.

- c. From the Discovery tab, click Discover Portal or Add Portal and then enter the IP address of the iSCSI target port.
- d. From the Targets tab, select the target discovered and then click Log On or Connect.
- e. Select Enable Multipath, and then select Automatically Restore This Connection When the Computer Starts or Add This Connection to the List of Favorite Targets. Click Advanced.



The Windows host must have an iSCSI connection to each node in the cluster. The native DSM selects the best paths to use.



LUNs from the SVM appear as disks to the Windows host. Any new disks that are added are not automatically discovered by the host. Trigger a manual rescan to discover the disks by completing the following steps:

1. Open the Windows Computer Management utility: Start > Administrative Tools > Computer Management.
2. Expand the Storage node in the navigation tree.
3. Click Disk Management.
4. Click Action > Rescan Disks.



When a new LUN is first accessed by the Windows host, it has no partition or file system. Initialize the LUN; and optionally, format the LUN with a file system by completing the following steps:

1. Start Windows Disk Management.
2. Right-click the LUN, and then select the required disk or partition type.
3. Follow the instructions in the wizard. In this example, drive F: is mounted.



On the Linux clients, ensure the iSCSI daemon is running. After the LUNs are provisioned, refer to the detailed guidance on iSCSI configuration for your Linux distribution. For example, Ubuntu iSCSI configuration can be found [here](#). To verify, run `lsblk` cmd from the shell.

Mount Cloud Volumes ONTAP NFS volume on Linux client

To mount the Cloud Volumes ONTAP (DIY) file system from VMs within VMC on AWS SDDC, complete the following steps:

1. Connect to the designated Linux instance.
2. Open a terminal on the instance using secure shell (SSH) and log in with the appropriate credentials.
3. Make a directory for the volume's mount point with the following command.

```
$ sudo mkdir /fsxcvotesting01/nfsdemovol01
```

4. Mount the Amazon FSx for NetApp ONTAP NFS volume to the directory that is created in the previous step.

```
sudo mount -t nfs nfsvers=4.1,172.16.0.2:/nfsdemovol01  
/fsxcvotesting01/nfsdemovol01
```



The screenshot shows a terminal window titled 'ubuntu01' with the following commands and output:

```
root@ubuntu01:/fsx# mount -t nfs 172.16.0.2:/nfsdemovol01 /fsxcvotesting01/nfsdemovol01_
root@ubuntu01:/fsx/nfsdemovol01# df
```

Filesystem	1k-blocks	Used	Available	Use%	Mounted on
tmpfs	814396	1176	813220	1%	/run
/dev/mapper/ubuntu--vg-ubuntu--lv	15412168	3666428	10943132	26%	/
tmpfs	4071960	0	4071960	0%	/dev/shm
tmpfs	5120	0	5120	0%	/run/lock
tmpfs	4096	0	4096	0%	/sys/fs/cgroup
/dev/sda2	999320	254996	675512	28%	/boot
tmpfs	814392	4	814388	1%	/run/user/1000
172.16.0.2:/nfsdemovol01	9961472	4241752	5719680	43%	/fsxcvotesting01/nfsdemovol01
198.19.254.239:/nfsdemovol01	996160	512	995648	1%	/fsx/nfsdemovol01

Subsequent commands and output:

```
root@ubuntu01:/fsx/nfsdemovol01# cd /fsx/nfsdemovol01/
root@ubuntu01:/fsx/nfsdemovol01# ls
nfsnow11.txt
root@ubuntu01:/fsx/nfsdemovol01#
```

Overview of ANF Datastore Solutions

Every successful organization is on a path of transformation and modernization. As part of this process, companies typically use their existing VMware investments while leveraging cloud benefits and exploring how to make migration, burst, extend, and disaster recovery processes as seamless as possible. Customers migrating to the cloud must evaluate the issues of elasticity and burst, data center exit, data center consolidation, end- of- life scenarios, mergers, acquisitions, and so on. The approach adopted by each organization can vary based on their respective business priorities. When choosing cloud-based operations, selecting a low- cost model with appropriate performance and minimal hindrance is a critical goal. Along with choosing the right platform, storage and workflow orchestration is particularly important to unleash the power of cloud deployment and elasticity.

Use Cases

Although the Azure VMware solution delivers unique hybrid capabilities to a customer, limited native storage options have restricted its usefulness for organizations with storage-heavy workloads. Because storage is directly tied to hosts, the only way to scale storage is to add more hosts, which can increase costs by 35-40% or more for storage intensive workloads. These workloads need additional storage, not additional horsepower, but that means paying for additional hosts.

Let's consider the following scenario; a customer requires six hosts for horsepower (vCPU/vMem), but they also have a substantial requirement for storage. Based on their assessment, they require 12 hosts to meet storage requirements. This increases the overall TCO because they must buy all that additional horsepower when all they really need is more storage. This is applicable for any use case, including migration, disaster recovery, bursting, dev/test, and so on.

Another common use case for Azure VMware Solution is disaster recovery (DR). Most organizations do not have a fool-proof DR strategy, or they might struggle to justify running a ghost datacenter just for DR. Administrators might explore zero-footprint DR options with a pilot-light cluster or an on-demand cluster. They could then scale the storage without adding additional hosts, potentially an attractive option.

So, to summarize, the use cases can be classified in two ways:

- Scaling storage capacity using ANF datastores
- Using ANF datastores as a disaster recovery target for a cost-optimized recovery workflow from on-premises or within Azure regions between the software-defined datacenters (SDDCs). This guide provides insight into using Azure NetApp Files to provide optimized storage for datastores (currently in public preview) along with best-in-class data protection and DR capabilities in an Azure VMware solution, which enables you to offload storage capacity from vSAN storage.



Contact NetApp or Microsoft solution architects in your region for additional information on using ANF datastores.

VMware Cloud options in Azure

Azure VMware Solution

The Azure VMware Solution (AVS) is a hybrid cloud service that provides fully functioning VMware SDDCs within a Microsoft Azure public cloud. AVS is a first-party solution fully managed and supported by Microsoft and verified by VMware that uses Azure infrastructure. Therefore, customers get VMware ESXi for compute virtualization, vSAN for hyper-converged storage, and NSX for networking and security, all while taking advantage of Microsoft Azure's global presence, class-leading data center facilities, and proximity to the rich ecosystem of native Azure services and solutions. A combination of Azure VMware Solution SDDC and Azure NetApp Files provides the best performance with minimal network latency.

Regardless of the cloud used, when a VMware SDDC is deployed, the initial cluster includes the following components:

- VMware ESXi hosts for compute virtualization with a vCenter server appliance for management.
- VMware vSAN hyper-converged storage incorporating the physical storage assets of each ESXi host.
- VMware NSX for virtual networking and security with an NSX Manager cluster for management.

Conclusion

Whether you are targeting all-cloud or hybrid cloud, Azure NetApp files provide excellent options to deploy and manage the application workloads along with file services while reducing the TCO by making the data requirements seamless to the application layer. Whatever the use case, choose Azure VMware Solution along with Azure NetApp Files for rapid realization of cloud benefits, consistent infrastructure, and operations across on-premises and multiple clouds, bi-directional portability of workloads, and enterprise-grade capacity and performance. It is the same familiar process and procedures used to connect the storage. Remember, it is just the position of the data that changed along with new names; the tools and processes all remain the same, and Azure NetApp Files helps in optimizing the overall deployment.

Takeaways

The key points of this document include:

- You can now use Azure NetApp Files as a datastore on AVS SDDC.
- Boost the application response times and deliver higher availability to provide access workload data when and where it is needed.
- Simplify the overall complexity of the vSAN storage with simple and instant resizing capabilities.
- Guaranteed performance for mission-critical workloads using dynamic reshaping capabilities.
- If Azure VMware Solution Cloud is the destination, Azure NetApp Files is the right storage solution for optimized deployment.

Where to find additional information

To learn more about the information described in this document, refer to the following website links:

- Azure VMware Solution documentation

<https://docs.microsoft.com/en-us/azure/azure-vmware/>

- Azure NetApp Files documentation

<https://docs.microsoft.com/en-us/azure/azure-netapp-files/>

- Attach Azure NetApp Files datastores to Azure VMware Solution hosts (Preview)

<https://docs.microsoft.com/en-us/azure/azure-vmware/attach-azure-netapp-files-to-azure-vmware-solution-hosts?tabs=azure-portal/>

NetApp Guest Connected Storage Options for Azure

Azure supports guest connected NetApp storage with the native Azure NetApp Files (ANF) service or with Cloud Volumes ONTAP (CVO).

Azure NetApp Files (ANF)

Azure netApp Files brings enterprise-grade data management and storage to Azure so you can manage your workloads and applications with ease. Migrate your workloads to the cloud and run them without sacrificing performance.

Azure NetApp Files removes obstacles, so you can move all of your file-based applications to the cloud. For the first time, you do not have to re-architect your applications, and you get persistent storage for your applications without complexity.

Because the service is delivered through the Microsoft Azure Portal, users experience a fully managed service as part of their Microsoft enterprise Agreement. World-class support, managed by Microsoft, gives you complete peace of mind. This single solution enables you to quickly and easily add multiprotocol workloads. you can build and deploy both Windows and Linux file-based applications, even for legacy environments.

Azure NetApp Files (ANF) as guest connected storage

Configure Azure NetApp Files with Azure VMware Solution (AVS)

Azure NetApp Files shares can be mounted from VMs that are created in the Azure VMware Solution SDDC environment. The volumes can also be mounted on the Linux client and mapped on the Windows client because Azure NetApp Files supports SMB and NFS protocols. Azure NetApp Files volumes can be set up in five simple steps.

Azure NetApp Files and Azure VMware Solution must be in the same Azure region.

Create and mount Azure NetApp Files volumes

To create and mount Azure NetApp Files volumes, complete the following steps:

1. Log in to the Azure Portal and access Azure NetApp Files. Verify access to the Azure NetApp Files service and register the Azure NetApp Files Resource Provider by using the `az provider register --namespace Microsoft.NetApp --wait` command. After registration is complete, create a NetApp account.

For detailed steps, see [Azure NetApp Files shares](#). This page will guide you through the step-by-step process.



The screenshot shows the 'New NetApp account' page in the Azure Portal. The left sidebar contains the 'Azure NetApp Files' header, a 'Create' button, a 'Manage view' dropdown, and a filter bar. Below the filter bar is a list of NetApp accounts, currently showing 0. The main content area is titled 'New NetApp account' and contains a form with the following fields: 'Name' (text input with 'nimoAVSANFdemo'), 'Subscription' (dropdown menu with 'SaaS Backup Production'), 'Resource group' (dropdown menu with 'NimoAVSDemo' and a 'Create new' link), and 'Location' (dropdown menu with 'East US 2'). At the bottom of the form are 'Create' and 'Download a template for automation' buttons.

2. After the NetApp account is created, set up the capacity pools with the required service level and size.

For more information, see [Set up a capacity pool](#).



3. Configure the delegated subnet for Azure NetApp Files and specify this subnet while creating the volumes. For detailed steps to create delegated subnet, see [Delegate a subnet to Azure NetApp Files](#).



4. Add an SMB volume by using the Volumes blade under the Capacity Pools blade. Make sure the Active Directory connector is configured prior to creating the SMB volume.



5. Click Review + Create to create the SMB volume.

If the application is SQL Server, then enable the SMB continuous availability.





To learn more about Azure NetApp Files volume performance by size or quota, see [Performance considerations for Azure NetApp Files](#).

- After the connectivity is in place, the volume can be mounted and used for application data.

To accomplish this, from the Azure portal, click the Volumes blade, and then select the volume to mount and access the mount instructions. Copy the path and use the Map Network Drive option to mount the volume on the VM running on Azure VMware Solution SDDC.





7. To mount NFS volumes on Linux VMs running on Azure VMware Solution SDDC, use this same process. Use volume reshaping or dynamic service level capability to meet the workload demands.

```
nimoadmin@nimoadmin-virtual-machine:~$ sudo mount -t nfs -o rw,hard,tcp 172.24.3.4:/nimodemonfsv1 /home/nimoadmin/nimodem011
nimoadmin@nimoadmin-virtual-machine:~$ df
Filesystem            1K-blocks    Used Available Use% Mounted on
udev                  8168112         0   8168112   0% /dev
tmpfs                 1639548     1488   1638060   1% /run
/dev/sda5             50824704 7902752 40310496  17% /
tmpfs                 8197728         0   8197728   0% /dev/shm
tmpfs                  5120         0      5120   0% /run/lock
tmpfs                 8197728         0   8197728   0% /sys/fs/cgroup
/dev/loop0            56832     56832         0 100% /snap/core18/2128
/dev/loop2            66688     66688         0 100% /snap/gtk-common-themes/1515
/dev/loop1            224256    224256         0 100% /snap/gnome-3-34-1804/72
/dev/loop3            52224     52224         0 100% /snap/snap-store/547
/dev/loop4            33152     33152         0 100% /snap/snapd/12704
/dev/sda1             523248         4   523244   1% /boot/efi
tmpfs                 1639544         52  1639492   1% /run/user/1000
/dev/sr0              54738     54738         0 100% /media/nimoadmin/VMware Tools
172.24.3.4:/nimodemonfsv1 104857600         0 104857600   0% /home/nimoadmin/nimodem011
nimoadmin@nimoadmin-virtual-machine:~$
```

For more information, see [Dynamically change the service level of a volume](#).

Cloud Volumes ONTAP (CVO)

Cloud volumes ONTAP, or CVO, is the industry-leading cloud data management solution built on NetApp's ONTAP storage software, available natively on Amazon Web Services (AWS), Microsoft Azure and Google

Cloud Platform (GCP).

It is a software-defined version of ONTAP that consumes cloud-native storage, allowing you to have the same storage software in the cloud and on-premises, reducing the need to retrain you IT staff in all-new methods to manage your data.

CVO gives customers the ability to seamlessly move data from the edge, to the data center, to the cloud and back, bringing your hybrid cloud together — all managed with a single-pane management console, NetApp Cloud Manager.

By design, CVO delivers extreme performance and advanced data management capabilities to satisfy even your most demanding applications in the cloud

Cloud Volumes ONTAP (CVO) as guest connected storage

Deploy new Cloud Volumes ONTAP in Azure

Cloud Volumes ONTAP shares and LUNs can be mounted from VMs that are created in the Azure VMware Solution SDDC environment. The volumes can also be mounted on the Linux client and on Windows client because Cloud Volumes ONTAP supports iSCSI, SMB, and NFS protocols. Cloud Volumes ONTAP volumes can be set up in a few simple steps.

To replicate volumes from an on-premises environment to the cloud for disaster recovery or migration purposes, establish network connectivity to Azure, either using a site-to-site VPN or ExpressRoute. Replicating data from on-premises to Cloud Volumes ONTAP is outside the scope of this document. To replicate data between on-premises and Cloud Volumes ONTAP systems, see [Setting up data replication between systems](#).



Use [Cloud Volumes ONTAP sizer](#) to accurately size the Cloud Volumes ONTAP instances. Also monitor on-premises performance to use as inputs in the Cloud Volumes ONTAP sizer.

1. Log in to NetApp Cloud Central—the Fabric View screen is displayed. Locate the Cloud Volumes ONTAP tab and select Go to Cloud Manager. After you are logged in, the Canvas screen is displayed.



2. On the Cloud Manager home page, click Add a Working Environment and then select Microsoft Azure as the cloud and the type of the system configuration.



3. When creating the first Cloud Volumes ONTAP working environment, Cloud Manager prompts you to deploy a Connector.



4. After the connector is created, update the Details and Credentials fields.

Managed Service Ide...	SaaS Backup Prod...	CMCVOSub	Edit Credentials
Credential Name	Azure Subscription	Marketplace Subscription	

Details

Working Environment Name (Cluster Name)

nimavsCVO

Credentials

User Name

admin

Password

Continue

5. Provide the details of the environment to be created including the environment name and admin credentials. Add resource group tags for the Azure environment as an optional parameter. After you are done, click Continue.

Details	Credentials
Working Environment Name (Cluster Name)	User Name
nimavsCVO	admin
+ Add Resource Group Tags Optional Field	Password

	Confirm Password

Continue

6. Select the add-on services for Cloud Volumes ONTAP deployment, including Cloud Data Sense, Cloud Backup, and Cloud Insights. Select the services and then click Continue.

 Data Sense & Compliance	<input checked="" type="checkbox"/> 
 Backup to Cloud	<input checked="" type="checkbox"/> 
 Monitoring	<input checked="" type="checkbox"/> 

Continue

7. Configure the Azure location and connectivity. Select the Azure Region, resource group, VNet, and subnet to be used.

Azure Region <input type="text" value="East US 2"/>	Resource Group <input checked="" type="radio"/> Create a new group <input type="radio"/> Use an existing group
Availability Zone (Optional) <input type="text" value="Select an Availability Zone"/>	Resource Group Name <input type="text" value="nimassCVO-rg"/>
VNet <input type="text" value="nimovspriv-vnet NimioAVSDemo"/>	Security Group <input checked="" type="radio"/> Generated security group <input type="radio"/> Use existing security group
Subnet <input type="text" value="172.24.2.0/24"/>	<input checked="" type="checkbox"/> I have verified network connectivity between the Cloud Manager server and the selected VNet.

[Continue](#)

8. Select the license option: Pay-As-You-Go or BYOL for using existing license. In this example, Pay-As-You-Go option is used.

Cloud Volumes ONTAP Charging Methods Learn more about our charging methods	NetApp Support Site Account (Optional) Learn more about NetApp Support Site (NSS) accounts
<input checked="" type="radio"/> Pay-As-You-Go by the hour	To register this Cloud Volumes ONTAP to support, you should add NetApp Support Site Account.
<input type="radio"/> Bring your own license	Don't have a NetApp Support Site account? Select go to finish deploying this system. After it's created, use the Support Registration option to create an NSS account.

[Continue](#)

9. Select between several preconfigured packages available for the various types of workloads.

Create a New Working Environment
Preconfigured Packages
✕

Select a preconfigured Cloud Volumes ONTAP system that best matches your needs, or create your own configuration. Preconfigured settings can be modified at a later time.
 Change Configuration



POC and small workloads
Up to 500GB of storage



Database and application data production workloads



Cost effective DR
Up to 500GB of storage



Highest performance production workloads

[Continue](#)

10. Accept the two agreements regarding activating support and allocation of Azure resources. To create the Cloud Volumes ONTAP instance, click Go.

nimavsCVO

Azure | East US 2

- ☒ I understand that in order to activate support, I must first register Cloud Volumes ONTAP with NetApp. [More information >](#)
- ☒ I understand that Cloud Manager will allocate the appropriate Azure resources to comply with my above requirements. [More information >](#)

Overview

Networking

Storage

Go

11. After Cloud Volumes ONTAP is provisioned, it is listed in the working environments on the Canvas page.

Canvas | Replication | Backup & Restore | K8s | Data Sense | File Cache | Compute | Sync | All Services (+8) v

Canvas Go to Tabular View

Add Working Environment

SINGLE
nimavsCVO
Cloud Volumes ONTAP
Freemium

nimavsCVO On

DETAILS

Cloud Volumes ONTAP | Azure | Single

SERVICES

Replication

Enter Working Environment

Additional configurations for SMB volumes

1. After the working environment is ready, make sure the CIFS server is configured with the appropriate DNS and Active Directory configuration parameters. This step is required before you can create the SMB volume.

The screenshot shows the 'Create a CIFS server' configuration page in the nimavsCVO interface. The page has a header with the 'nimavsCVO' logo and 'Azure Managed Encryption' status. Below the header, there are tabs for 'Volumes' and 'Replications'. The main configuration area includes fields for 'DNS Primary IP Address' (172.24.1.5), 'Active Directory Domain to join' (nimodemo.com), 'DNS Secondary IP Address (Optional)' (Example: 127.0.0.1), and 'Credentials authorized to join the domain' (nimoadmin). A password field is also present, indicated by a blue box with dots. A '+ Advanced' link is visible on the right side of the configuration area.

2. Creating the SMB volume is an easy process. Select the CVO instance to create the volume and click the Create Volume option. Choose the appropriate size and cloud manager chooses the containing aggregate or use advanced allocation mechanism to place on a specific aggregate. For this demo, SMB is selected as the protocol.

The screenshot shows the 'Volume Details, Protection & Protocol' configuration page. It is divided into two main sections: 'Details & Protection' and 'Protocol'. In the 'Details & Protection' section, there are fields for 'Volume Name' (nimavssmbvol1), 'Size (GB)' (50), 'Snapshot Policy' (default), and a 'Default Policy' link. In the 'Protocol' section, there are tabs for 'NFS', 'CIFS' (selected), and 'iSCSI'. Below the tabs, there are fields for 'Share name' (nimavssmbvol1_share), 'Permissions' (Full Control), and 'Users / Groups' (Everyone). A blue 'Continue' button is located at the bottom of the page.

3. After the volume is provisioned, it will be available under the Volumes pane. Because a CIFS share is provisioned, give your users or groups permission to the files and folders and verify that those users can access the share and create a file. This step is not required if the volume is replicated from an on-premises environment because the file and folder permissions are all retained as part of SnapMirror replication.

Volumes

1 Volume | 50 GB Allocated | 1.74 MB Total Used (1.74 MB in Disk, 0 KB in Blob)


nimavssmbvol1
ONLINE

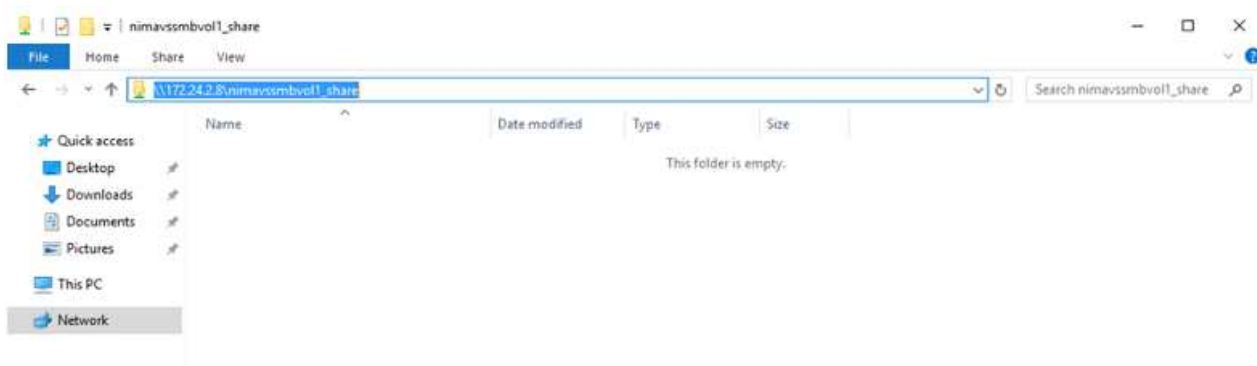
INFO		CAPACITY	
Disk Type	PREMIUM_LRS		1.74 MB Disk Used
Tiering Policy	Auto		0 GB Blob Used
Backup	OFF		

- After the volume is created, use the mount command to connect to the share from the VM running on the Azure VMware Solution SDDC hosts.
- Copy the following path and use the Map Network Drive option to mount the volume on the VM running on Azure VMware Solution SDDC.

Mount Volume nimavssmbvol1

Go to your machine and enter this command

```
\\172.24.2.8\nimavssmbvol1_share
```



Connect the LUN to a host

To connect the LUN to a host, complete the following steps:

1. On the Canvas page, double-click the Cloud Volumes ONTAP working environment to create and manage volumes.
2. Click Add Volume > New Volume and select iSCSI and click Create Initiator Group. Click Continue.

The screenshot shows two side-by-side configuration panels. The left panel, titled 'Details & Protection', contains a 'Volume Name' field with the value 'nimavsscsi1', a 'Size (GB)' field with the value '500', and a 'Snapshot Policy' dropdown menu set to 'default'. Below the dropdown is a link for 'Default Policy'. The right panel, titled 'Protocol', has three tabs: 'NFS', 'CIFS', and 'iSCSI' (which is selected and highlighted in blue). Below the tabs is a link that says 'What about LUNs?'. Underneath is an 'Initiator Group' section with two radio buttons: 'Map Existing Initiator Groups' (unselected) and 'Create Initiator Group' (selected). Below the radio buttons is a text field for the 'Initiator Group' name, which contains the value 'avsvmIG'. At the bottom center of the two panels is a blue 'Continue' button.

3. After the volume is provisioned, select the volume, and then click Target IQN. To copy the iSCSI Qualified Name (IQN), click Copy. Set up an iSCSI connection from the host to the LUN.

To accomplish the same for the host residing on Azure VMware Solution SDDC:

- a. RDP to the VM hosted on Azure VMware Solution SDDC.
- b. Open the iSCSI Initiator Properties dialog box: Server Manager > Dashboard > Tools > iSCSI Initiator.
- c. From the Discovery tab, click Discover Portal or Add Portal and then enter the IP address of the iSCSI target port.
- d. From the Targets tab, select the target discovered and then click Log on or Connect.
- e. Select Enable multipath, and then select Automatically Restore This Connection When the Computer Starts or Add This Connection to the List of Favorite Targets. Click Advanced.

Note: The Windows host must have an iSCSI connection to each node in the cluster. The native DSM selects the best paths to use.



LUNs on storage virtual machine (SVM) appear as disks to the Windows host. Any new disks that are added are not automatically discovered by the host. Trigger a manual rescan to discover the disks by completing the following steps:

1. Open the Windows Computer Management utility: Start > Administrative Tools > Computer Management.
2. Expand the Storage node in the navigation tree.
3. Click Disk Management.
4. Click Action > Rescan Disks.



When a new LUN is first accessed by the Windows host, it has no partition or file system. Initialize the LUN; and optionally, format the LUN with a file system by completing the following steps:

1. Start Windows Disk Management.
2. Right-click the LUN, and then select the required disk or partition type.
3. Follow the instructions in the wizard. In this example, drive E: is mounted

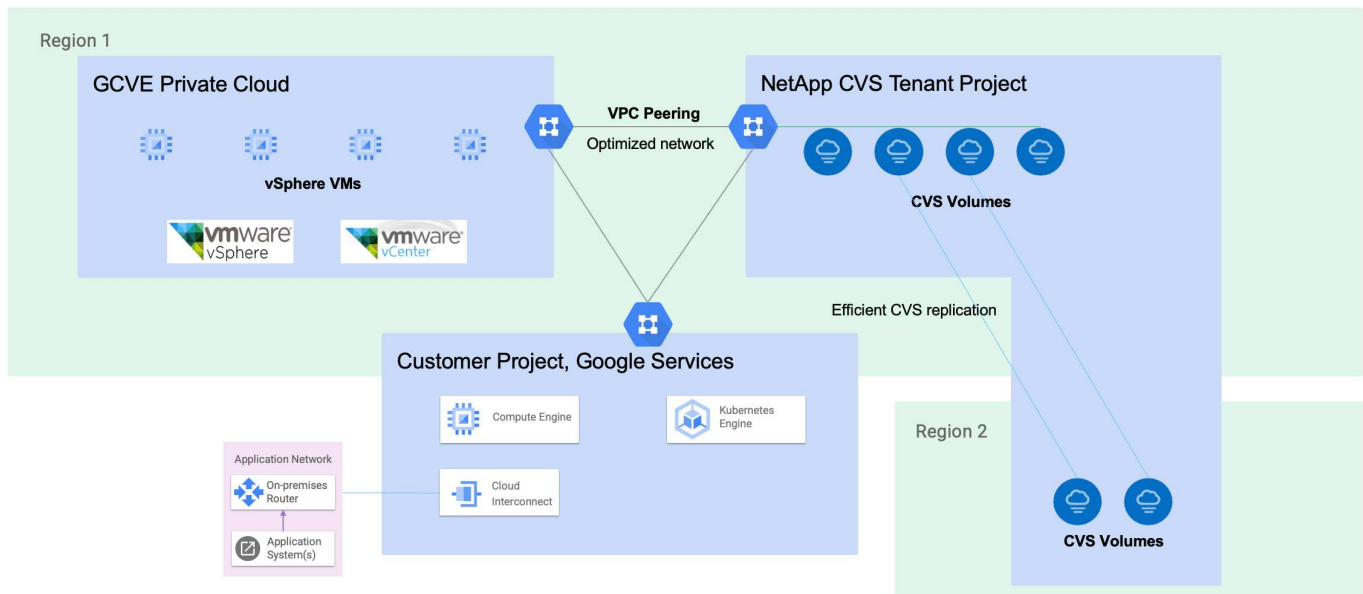


Google Cloud VMware Engine Supplemental NFS Datastore with NetApp Cloud Volume Service

Overview

Authors: Suresh Thoppay, NetApp

Customers that requires additional storage capacity on their Google Cloud VMware Engine (GCVE) environment can utilize Netapp Cloud Volume Service to mount as supplemental NFS datastore. Storing data on NetApp Cloud Volume Service allows customers to replicate between regions to protect from diaster.



Deployment steps to mount NFS datastore from NetApp CVS on GCVE

Provision CVS-Performance Volume

The NetApp Cloud Volume Service volume can be either provisioned by
[Using Google Cloud Console](#)
[Using NetApp BlueXP portal or API](#)

Mark that CVS volume as non-deletable

To avoid accidental deletion of volume while VM is running, ensure the volume is marked as non-deletable as shown in screenshot below.

The screenshot shows the NetApp Cloud Volumes console. On the left is a sidebar with navigation options: Cloud Volumes, Storage Pools, Volumes (selected), Backups, Snapshots, Active Directories, Volume Replication, and Project Settings. The main panel is titled 'Edit File System' and shows details for a volume named 'Extreme'. The 'Allocated Capacity' is set to 1024 GiB. The 'Protocol Type' is set to NFSv3. A red box highlights the checkbox 'Block volume from deletion when clients are connected', which is checked. Below this is the 'Export Policy' section.

Cloud Volumes

- Storage Pools
- Volumes**
- Backups
- Snapshots
- Active Directories
- Volume Replication
- Project Settings

Edit File System

Up to 64 MiB/s per TiB
Extreme
Up to 128 MiB/s per TiB

Volume Details

Allocated Capacity * 1024 GiB
Allocated size must be between 1 TiB (1024 GiB) and 100 TiB (102400 GiB)

Managing your volumes for growth. [Learn more](#)

Protocol Type
NFSv3

Active Directory must be setup to provision an SMB or dual-protocol volume. The Allow local NFS users with LDAP option in Active Directory connections enables local NFS client users not present on the Windows LDAP server to access a dual-protocol volume that has LDAP with extended groups enabled. [Learn more](#)

- ☐ Make snapshot directory (.snapshot) visible
Makes .snapshot directory visible to clients. For NFSv4.1 volumes (CVS-Performance only), the directory itself will not be listed but can be accessed to list contents, etc.
- ☐ Enable LDAP
Enables user look up from AD LDAP server for your NFS volumes
- ☒ **Block volume from deletion when clients are connected**
Required for volumes used as GCVE datastores

Export Policy

For more info, please refer [Creating NFS Volume](#) documentation.

Ensure Private Connection on GCVE exists for NetApp CVS Tenant VPC.

To mount NFS Datastore, there should be a private connection exists between GCVE and NetApp CVS project.

For more info, please refer [How to setup Private Service Access](#)

Mount NFS datastore

For instructions on how to mount NFS datastore on GCVE, please refer [How to create NFS datastore with NetApp CVS](#)



As vSphere hosts are managed by Google, you don't have access to install NFS vSphere API for Array Integration (VAAI) vSphere Installation Bundle (VIB).

If you need support for Virtual Volumes (vVol), please let us know.

If you like to use Jumbo Frames, please refer [Maximum supported MTU sizes on GCP](#)

Savings with NetApp Cloud Volume Service

To learn more about your potential saving with NetApp Cloud Volume Service for your storage demands on GCVE, please check [NetApp ROI Calculator](#)

Reference Links

- [Google Blog - How to use NetApp CVS as datastores for Google Cloud VMware Engine](#)
- [NetApp Blog - A better way to migrate your storage-rich apps to Google Cloud](#)

NetApp Storage Options for GCP

GCP supports guest connected NetApp storage with Cloud Volumes ONTAP (CVO) or Cloud Volumes Service (CVS).

Cloud Volumes ONTAP (CVO)

Cloud volumes ONTAP, or CVO, is the industry-leading cloud data management solution built on NetApp's ONTAP storage software, available natively on Amazon Web Services (AWS), Microsoft Azure and Google Cloud Platform (GCP).

It is a software-defined version of ONTAP that consumes cloud-native storage, allowing you to have the same storage software in the cloud and on-premises, reducing the need to retrain you IT staff in all-new methods to manage your data.

CVO gives customers the ability to seamlessly move data from the edge, to the data center, to the cloud and back, bringing your hybrid cloud together — all managed with a single-pane management console, NetApp Cloud Manager.

By design, CVO delivers extreme performance and advanced data management capabilities to satisfy even your most demanding applications in the cloud

Cloud Volumes ONTAP (CVO) as guest connected storage

Deploy Cloud Volumes ONTAP in Google Cloud (Do It Yourself)

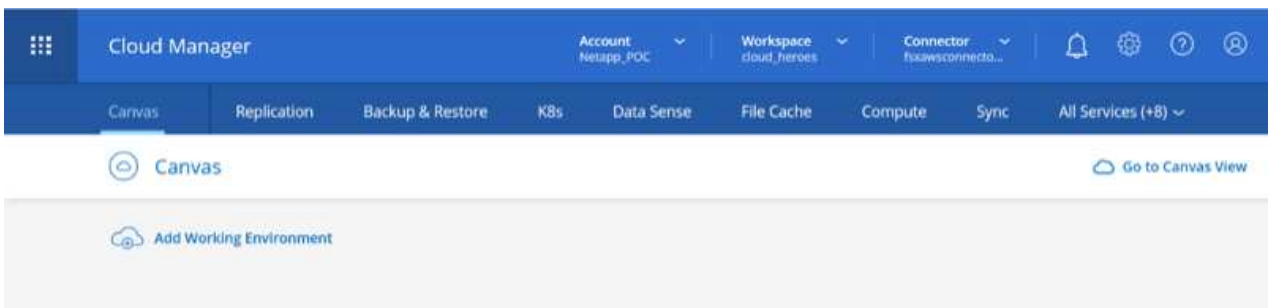
Cloud Volumes ONTAP shares and LUNs can be mounted from VMs that are created in the GCVE private cloud environment. The volumes can also be mounted on the Linux client and on Windows client and LUNS can be accessed on Linux or Windows clients as block devices when mounted over iSCSI because Cloud Volumes ONTAP supports iSCSI, SMB, and NFS protocols. Cloud Volumes ONTAP volumes can be set up in a few simple steps.

To replicate volumes from an on-premises environment to the cloud for disaster recovery or migration purposes, establish network connectivity to Google Cloud, either using a site-to-site VPN or Cloud Interconnect. Replicating data from on-premises to Cloud Volumes ONTAP is outside the scope of this document. To replicate data between on-premises and Cloud Volumes ONTAP systems, see [xref:./ehc/gcp/Setting up data replication between systems](#).

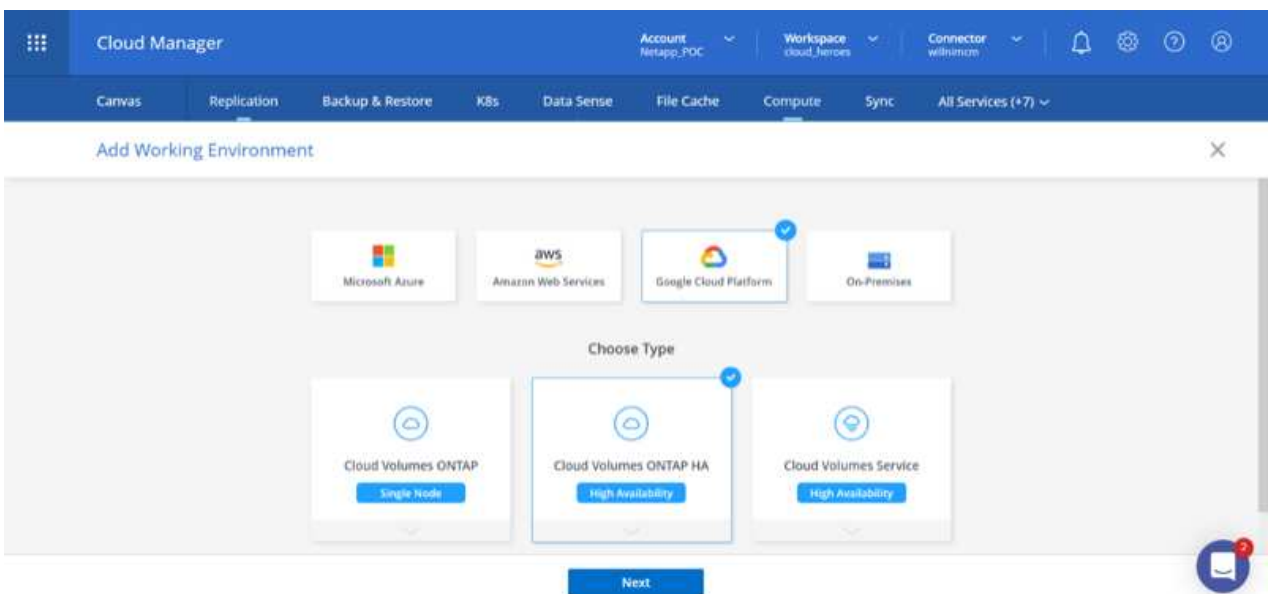


Use [Cloud Volumes ONTAP sizer](#) to accurately size the Cloud Volumes ONTAP instances. Also monitor on-premises performance to use as inputs in the Cloud Volumes ONTAP sizer.

1. Log in to NetApp Cloud Central—the Fabric View screen is displayed. Locate the Cloud Volumes ONTAP tab and select Go to Cloud Manager. After you are logged in, the Canvas screen is displayed.



2. On the Cloud Manager Canvas tab, click Add a Working Environment and then select Google Cloud Platform as the cloud and the type of the system configuration. Then, click Next.



3. Provide the details of the environment to be created including the environment name and admin

credentials. After you are done, click Continue.

Create a New Working Environment

Details and Credentials

↑ Previous Step

CV-Performance-Testing
Google Cloud Project

HCLMainBillingAccountSubs...
Marketplace Subscription

Edit Project

Details

Credentials

Working Environment Name (Cluster Name)
cvogcveval

Service Account ☐

ⓘ

Notice: A Google Cloud service account is required to use two features: backing up data using Backup

User Name
admin

Password

Confirm Password

Continue


4. Select or deselect the add-on services for Cloud Volumes ONTAP deployment, including Data Sense & Compliance or Backup to Cloud. Then, click Continue.


HINT: A verification pop-up message will be displayed when deactivating add-on services. Add-on services can be added/removed after CVO deployment, consider to deselect them if not needed from the beginning to avoid costs.

Create a New Working Environment

Services

↑ Previous Step

 Data Sense & Compliance ☒

 Backup to Cloud ☐

⚠ WARNING:By turning off Backup to Cloud, future data recovery will not be possible in case of data corruption or loss

Continue

5. Select a location, choose a firewall policy, and select the checkbox to confirm network connectivity to Google Cloud storage.

[↑ Previous Step](#) Location

Connectivity

GCP Region

europe-west3

VPC

cloud-volumes-vpc

GCP Zone

europe-west3-c

Subnet

10.0.6.0/24

☒ I have verified connectivity between the target VPC and Google Cloud storage.

Firewall Policy

☒ Generated firewall policy ☐ Use existing firewall policy

Continue

6. Select the license option: Pay-As-You-Go or BYOL for using existing license. In this example, Freemium option is used. Then, click on Continue.

[↑ Previous Step](#) Cloud Volumes ONTAP Charging Methods[Learn more about our charging methods](#)☐ Pay-As-You-Go by the hour☐ Bring your own license☒ Freemium (Up to 500GB)

NetApp Support Site Account

[Learn more about NetApp Support Site \(NSS\) accounts](#)

NetApp Support Site Account

mchad

To add a new NetApp Support Site account, go to the Support - NSS Management tab.

Continue

7. Select between several preconfigured packages available based on the type of workload that will be deployed on the VMs running on VMware cloud on AWS SDDC.

HINT: Hover your mouse over the tiles for details or customize CVO components and ONTAP version by clicking on Change Configuration.

Select a preconfigured Cloud Volumes ONTAP system that best matches your needs, or create your own configuration.
Preconfigured settings can be modified at a later time.

[Change Configuration](#)


POC and small workloads
Up to 500GB of storage



**Database and application data
production workloads**



Cost effective DR
Up to 500GB of storage



**Highest performance production
workloads**

[Continue](#)

8. On the Review & Approve page, review and confirm the selections. To create the Cloud Volumes ONTAP instance, click Go.

[Previous Step](#)

cvogcveval
GCP | europe-west3

[Show API request](#)

This Cloud Volumes ONTAP instance will be registered with NetApp support under the NS5 Account **mchad**.

☒ I understand that Cloud Manager will allocate the appropriate GCP resources to comply with my above requirements. [More information >](#)

[Overview](#)
[Networking](#)
[Storage](#)

Storage System: Cloud Volumes ONTAP

Cloud Volumes ONTAP runs on: n2-standard-4

License Type: Cloud Volumes ONTAP Freemium

Encryption: Google Cloud Managed

Capacity Limit: 500GB

Write Speed: Normal

[Go](#)

9. After Cloud Volumes ONTAP is provisioned, it is listed in the working environments on the Canvas page.

The screenshot shows the Cloud Manager interface. The top navigation bar includes 'Cloud Manager', 'Account: NetApp_POC', 'Workspace: cloud_heroes', and 'Connector: winnemo'. Below this is a secondary navigation bar with tabs: 'Canvas', 'Replication', 'Backup & Restore', 'K8s', 'Data Sense', 'File Cache', 'Compute', 'Sync', and 'All Services (+7)'. The 'Canvas' tab is active, showing a 'Canvas' section with an 'Add Working Environment' button. Below this, there are two cloud icons representing working environments. The first is labeled 'cvogcve01 Cloud Volumes ONTAP Freemium'. The second is labeled 'DatacenterDude Azure NetApp Files' with '31 Volumes' and '9.71 TiB Capacity'. On the right side, there is a 'Working Environments' list showing three items: '1 Cloud Volumes ONTAP 43.05 GiB Provisioned Capacity', '1 FSx for ONTAP (High-Availability) 0B Provisioned Capacity', and '1 Azure NetApp Files 9.71 TiB Provisioned Capacity'.

Additional configurations for SMB volumes

1. After the working environment is ready, make sure the CIFS server is configured with the appropriate DNS and Active Directory configuration parameters. This step is required before you can create the SMB volume.

HINT: Click on the Menu Icon (°), select Advanced to display more options and select CIFS setup.

The screenshot shows the 'Create a CIFS server' configuration page. At the top, there's a header with the Canvas logo 'cvogcve01' and 'GCP Managed Encryption' status. Below the header, there are tabs for 'Volumes' and 'Replications'. The main content area has a 'Create a CIFS server' button and a '+ Advanced' link. The configuration fields are:

- DNS Primary IP Address: 192.168.0.16
- Active Directory Domain to join: nimgcveval.com
- DNS Secondary IP Address (Optional): Example: 127.0.0.1
- Credentials authorized to join the domain: administrator

At the bottom, there are 'Save' and 'Cancel' buttons.

2. Creating the SMB volume is an easy process. At Canvas, double-click the Cloud Volumes ONTAP working environment to create and manage volumes and click on the Create Volume option. Choose the appropriate size and cloud manager chooses the containing aggregate or use advanced allocation mechanism to place on a specific aggregate. For this demo, CIFS/SMB is selected as the protocol.

The screenshot shows the 'Volume Details, Protection & Protocol' configuration page. It has two main sections: 'Details & Protection' and 'Protocol'.

Details & Protection:

- Volume Name: cvogcvesmbvol01
- Size (GB): 10
- Snapshot Policy: default
- Default Policy: Default Policy

Protocol:

- Protocol: CIFS (selected)
- Share name: cvogcvesmbvol01_share
- Permissions: Full Control
- Users / Groups: Everyone
- Valid users and groups separated by a semicolon

At the bottom, there is a 'Continue' button.

3. After the volume is provisioned, it will be available under the Volumes pane. Because a CIFS share is provisioned, give your users or groups permission to the files and folders and verify that those users can access the share and create a file. This step is not required if the volume is replicated from an on-premises environment because the file and folder permissions are all retained as part of SnapMirror replication.

HINT: Click on the volume menu (°) to display its options.


cvogcvesmbvol01
ONLINE

INFO

Disk Type	PD-SSD
Tiering Policy	None

CAPACITY

10 GB
Allocated

1.84 MB
Disk Used

- After the volume is created, use the mount command to display the volume connection instructions, then connect to the share from the VMs on Google Cloud VMware Engine.


cvogcve01

Volumes
Replications


Mount Volume cvogcvesmbvol01

Go to your machine and enter this command

```
\\10.0.6.251\cvogcvesmbvol01_share
```

Copy

- Copy the following path and use the Map Network Drive option to mount the volume on the VM running on the Google Cloud VMware Engine.

Specify the drive letter for the connection and the folder that you want to connect to:

Drive:
Y:

Folder:
\\10.0.6.251\cvogcvesmbvol01_share
Browse...

Example: \\server\share

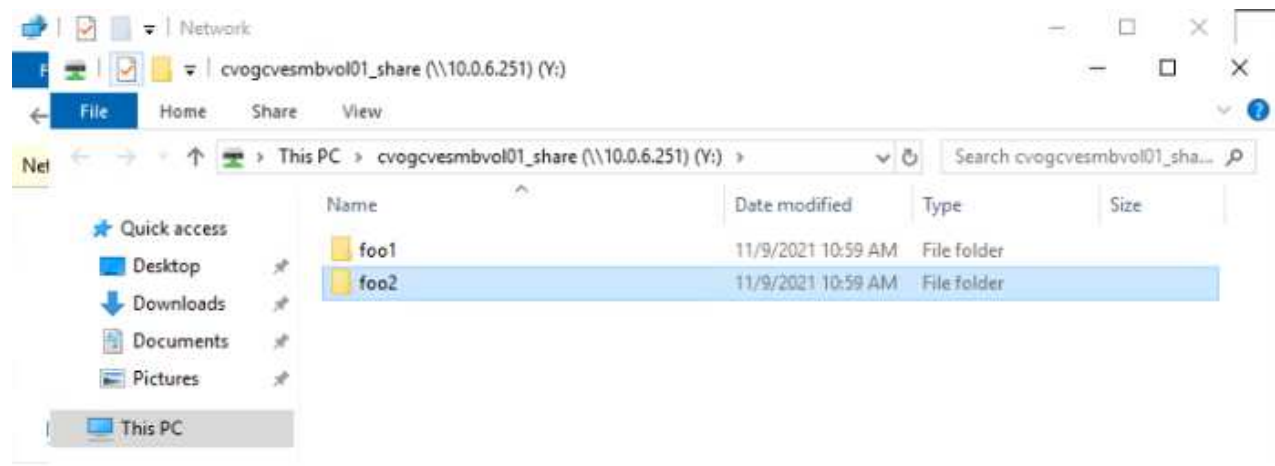
☒ Reconnect at sign-in

☐ Connect using different credentials

[Connect to a Web site that you can use to store your documents and pictures.](#)

Finish
Cancel

Once mapped, it can be easily accessed, and the NTFS permissions can be set accordingly.



To connect the cloud volumes ONTAP LUN to a host, complete the following steps:

1. On the Canvas page, double-click the Cloud Volumes ONTAP working environment to create and manage volumes.
2. Click Add Volume > New Volume and select iSCSI and click Create Initiator Group. Click Continue.

Create new volume in cvogcve01

Volume Details, Protection & Protocol

Details & Protection

Volume Name: cvogcvescilun01 Size (GB): 10

Snapshot Policy: default

Default Policy

Protocol

NFS CIFS **iSCSI**

What about LUNs?

Initiator Group

Map Existing Initiator Groups Create Initiator Group

Initiator Group WinIG

Operating System Type Windows

Continue

VMware Cloud - ntap-fsx-demo X vSphere - vmcdc01 - Summary X vmcdc01 NetApp Cloud Manager X +

https://vcenter.sddc-52-37-127-104.vmwarevmc.com/ui/webconsole.html?vmid=vm-1005&vmName=vmcdc01 80%

Getting Started EC2 Management Con... New Tab

Other Bookmarks

vmcdc01

Enforce US Keyboard Layout View Fullscreen Send Ctrl+Alt+Delete

Server Manager • Dashboard

QUICK LINKS

WELCOME TO SERVER MANAGER

File Explorer

Storage

ambdemon01_share [\\172.16.0.2] (Z)

This PC ambdemon01_share [\\172.16.0.2] (Z)

Drive Tools

Name Date modified Type Size

Folder01 19/10/2021 7:12 AM File Folder

ambdemon01 19/10/2021 2:11 AM File Folder

ambdemon01 19/10/2021 2:11 AM File Folder

ambdemon01 19/10/2021 2:11 AM File Folder

DVD Drive (D:) VLS_W

Network

ROLES AND SERVER GROUPS

Active Directory

AD DS

Manageability

Events

Services

Performance

BRA results

2:29 AM 10/20/2021

3. After the volume is provisioned, select the volume menu (°), and then click Target IQN. To copy the iSCSI Qualified Name (iqn), click Copy. Set up an iSCSI connection from the host to the LUN.

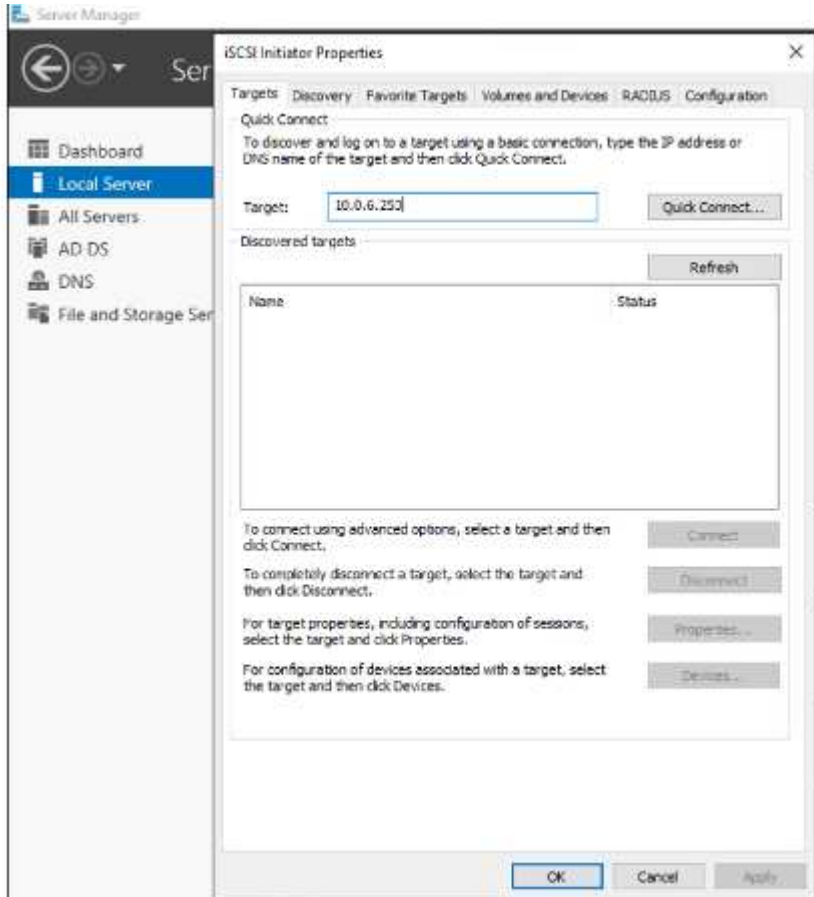
To accomplish the same for the host residing on Google Cloud VMware Engine:

- a. RDP to the VM hosted on Google Cloud VMware Engine.
- b. Open the iSCSI Initiator Properties dialog box: Server Manager > Dashboard > Tools > iSCSI Initiator.
- c. From the Discovery tab, click Discover Portal or Add Portal and then enter the IP address of the iSCSI target port.

- d. From the Targets tab, select the target discovered and then click Log on or Connect.
- e. Select Enable multipath, and then select Automatically Restore This Connection When the Computer Starts or Add This Connection to the List of Favorite Targets. Click Advanced.

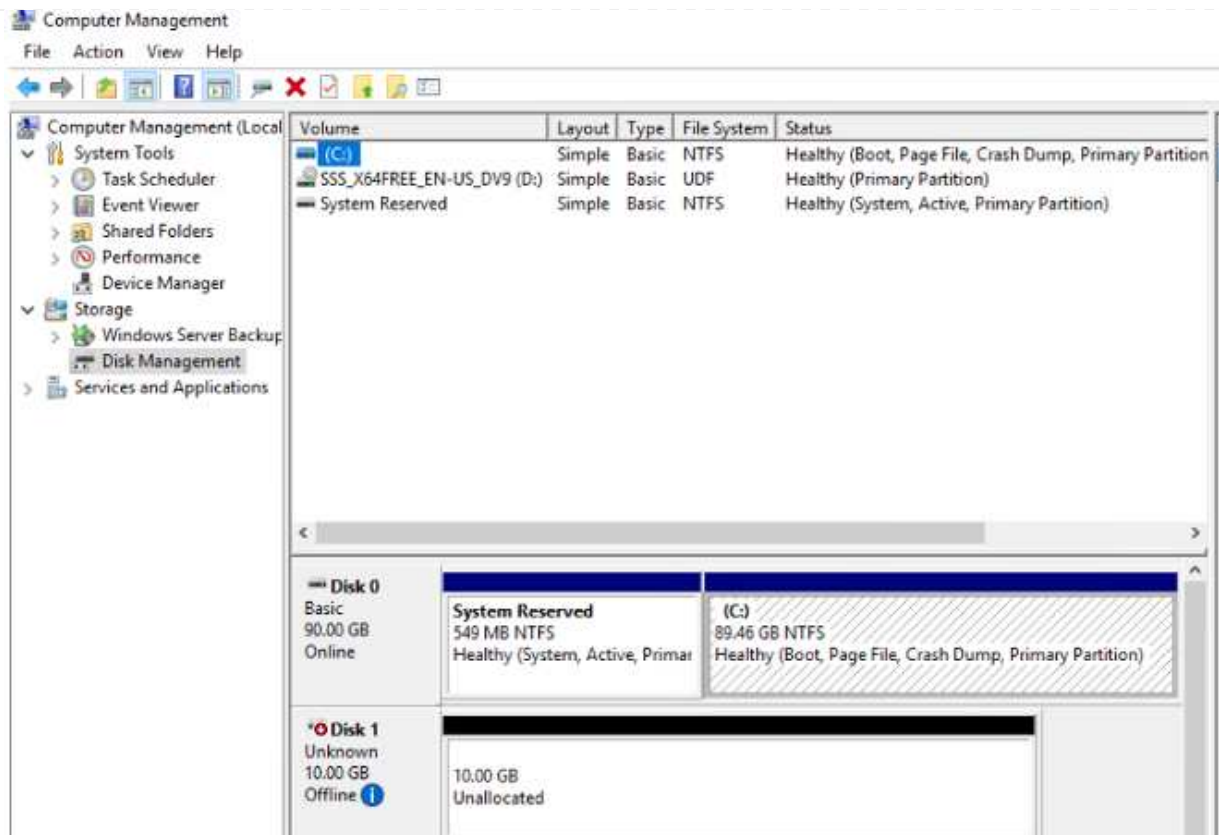


The Windows host must have an iSCSI connection to each node in the cluster. The native DSM selects the best paths to use.



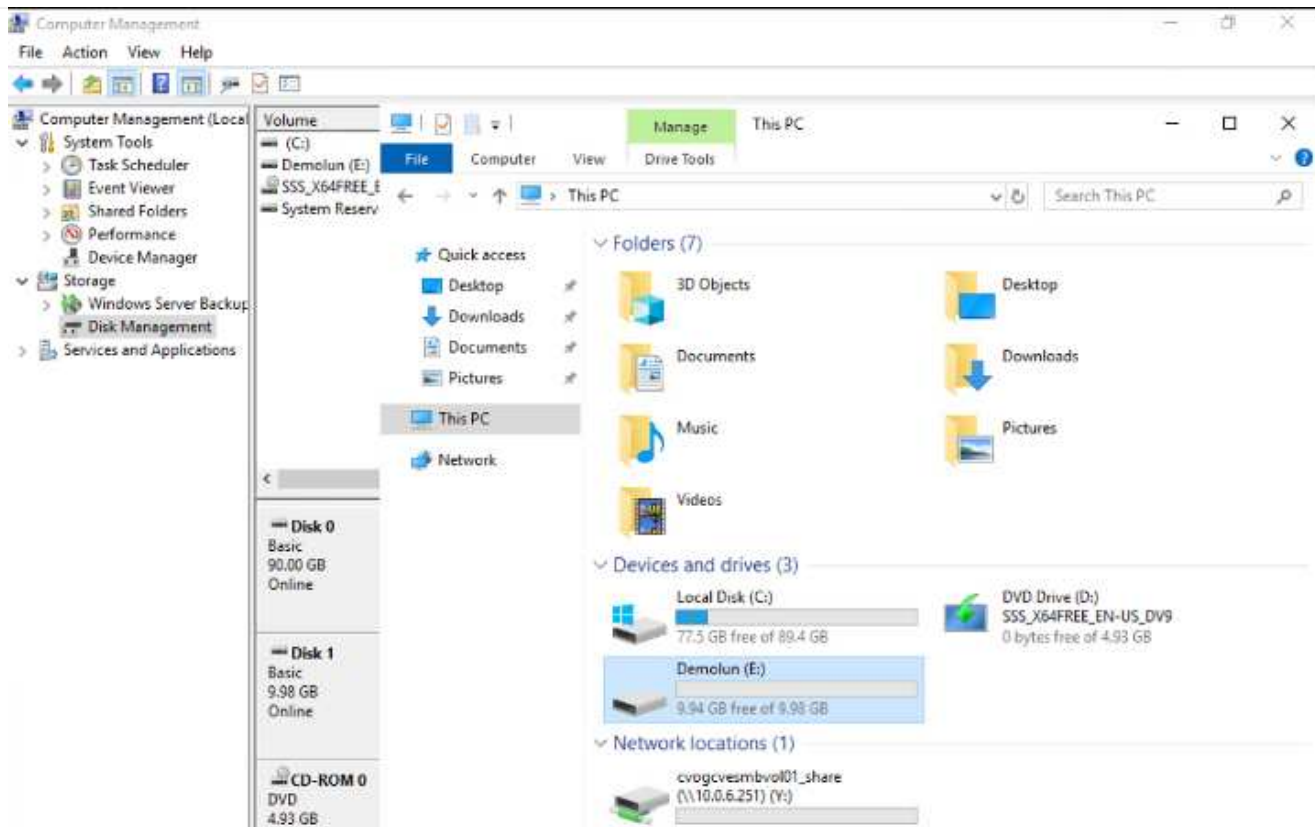
LUNs on storage virtual machine (SVM) appear as disks to the Windows host. Any new disks that are added are not automatically discovered by the host. Trigger a manual rescan to discover the disks by completing the following steps:

1. Open the Windows Computer Management utility: Start > Administrative Tools > Computer Management.
2. Expand the Storage node in the navigation tree.
3. Click Disk Management.
4. Click Action > Rescan Disks.



When a new LUN is first accessed by the Windows host, it has no partition or file system. Initialize the LUN; and optionally, format the LUN with a file system by completing the following steps:

5. Start Windows Disk Management.
6. Right-click the LUN, and then select the required disk or partition type.
7. Follow the instructions in the wizard. In this example, drive F: is mounted.



On the Linux clients, ensure the iSCSI daemon is running. Once the LUNs are provisioned, refer to the detailed guidance on iSCSI configuration with Ubuntu as an example here. To verify, run `lsblk` cmd from the shell.

```
niyaz@nimubu01:~$ lsblk
NAME        MAJ:MIN RM  SIZE RO TYPE MOUNTPOINT
loop0       7:0      0  55.4M 1 loop /snap/core18/2128
loop1       7:1      0   219M 1 loop /snap/gnome-3-34-1804/72
loop2       7:2      0   65.1M 1 loop /snap/gtk-common-themes/1515
loop3       7:3      0    51M 1 loop /snap/snap-store/547
loop4       7:4      0   32.3M 1 loop /snap/snapd/12704
loop5       7:5      0   32.5M 1 loop /snap/snapd/13640
loop6       7:6      0   55.5M 1 loop /snap/core18/2246
loop7       7:7      0     4K 1 loop /snap/bare/5
loop8       7:8      0   65.2M 1 loop /snap/gtk-common-themes/1519
sda         8:0      0    16G 0 disk
├─sda1      8:1      0   512M 0 part /boot/efi
├─sda2      8:2      0     1K 0 part
└─sda5      8:5      0   15.5G 0 part /
sdb         8:16     0     1G 0 disk
```

```

niyaz@nimubu01:~$ df -h
Filesystem      Size  Used Avail Use% Mounted on
udev            1.9G   0    1.9G   0% /dev
tmpfs           394M  1.5M  392M   1% /run
/dev/sda5       16G   7.6G   6.9G  53% /
tmpfs           2.0G   0    2.0G   0% /dev/shm
tmpfs           5.0M   0    5.0M   0% /run/lock
tmpfs           2.0G   0    2.0G   0% /sys/fs/cgroup
/dev/loop1      219M  219M    0 100% /snap/gnome-3-34-1804/72
/dev/loop2       66M   66M    0 100% /snap/gtk-common-themes/1515
/dev/loop3       51M   51M    0 100% /snap/snap-store/547
/dev/loop0       56M   56M    0 100% /snap/core18/2128
/dev/loop4       33M   33M    0 100% /snap/snapd/12704
/dev/sda1       511M   4.0K  511M   1% /boot/efi
tmpfs           394M   64K  394M   1% /run/user/1000
/dev/loop5       33M   33M    0 100% /snap/snapd/13640
/dev/loop6       56M   56M    0 100% /snap/core18/2246
/dev/loop7      128K  128K    0 100% /snap/bare/5
/dev/loop8       66M   66M    0 100% /snap/gtk-common-themes/1519
/dev/sdb        976M   2.6M  907M   1% /mnt

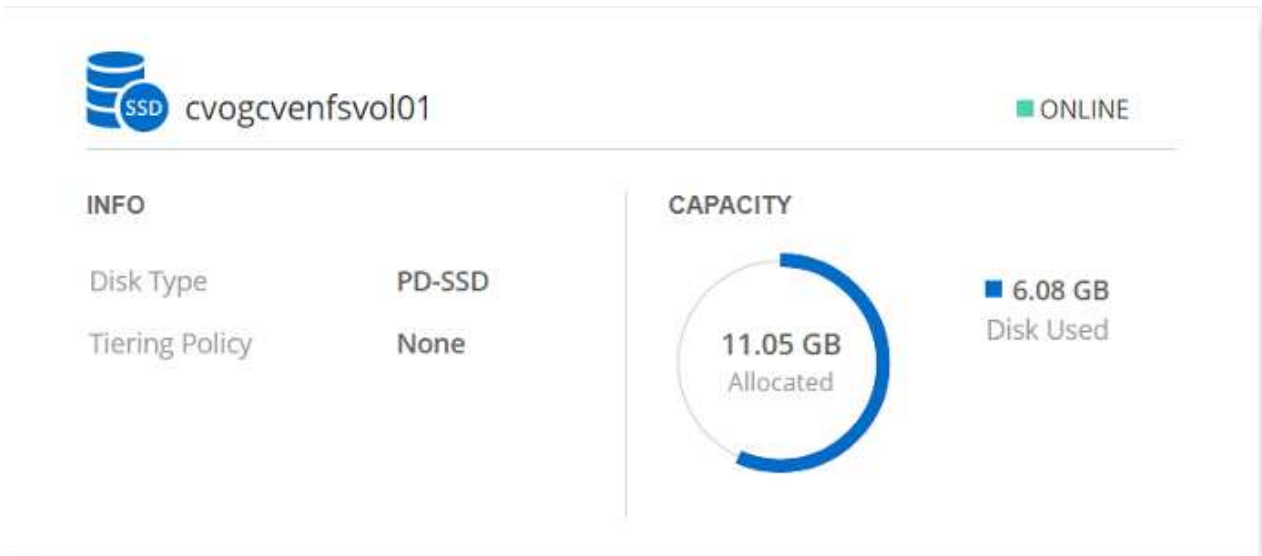
```

Mount Cloud Volumes ONTAP NFS volume on Linux client

To mount the Cloud Volumes ONTAP (DIY) file system from VMs within Google Cloud VMware Engine, follow the below steps:

Provision the volume following the below steps

1. In the Volumes tab, click Create New Volume.
2. On the Create New Volume page, select a volume type:



3. In the Volumes tab, place your mouse cursor over the volume, select the menu icon (°), and then click Mount Command.



Go to your Linux machine and enter this mount command

```
mount 10.0.6.251:/cvogcvenfsvol01 <dest_dir>
```



4. Click Copy.
5. Connect to the designated Linux instance.
6. Open a terminal on the instance using secure shell (SSH) and log in with the appropriate credentials.
7. Make a directory for the volume's mount point with the following command.

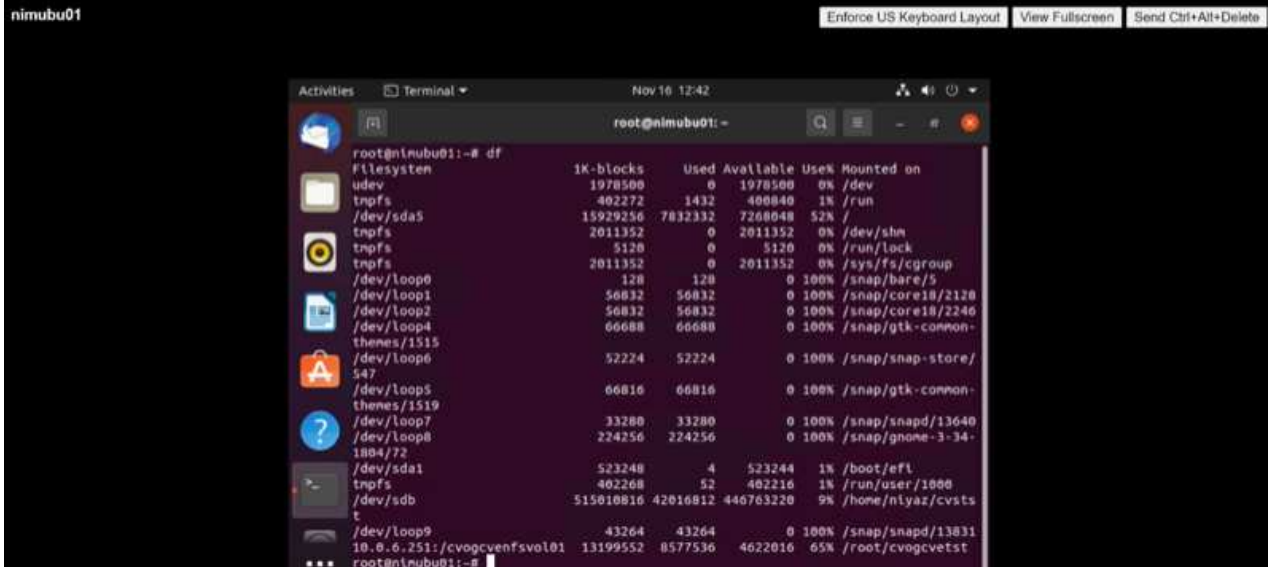
```
$ sudo mkdir /cvogcvetst
```

```
root@nimubu01:~# sudo mkdir cvogcvetst
```

8. Mount the Cloud Volumes ONTAP NFS volume to the directory that is created in the previous step.

```
sudo mount 10.0.6.251:/cvogcvenfsvol01 /cvogcvetst
```

```
root@nimubu01:~# sudo mount -t nfs 10.0.6.251:/cvogcvenfsvol01 cvogcvetst
```



Cloud Volumes Service (CVS)

Cloud Volumes Services (CVS) is a complete portfolio of data services to deliver advanced cloud solutions. Cloud Volumes Services supports multiple file access protocols for major cloud providers (NFS and SMB support).

Other benefits and features include: data protection and restore with Snapshot; special features to replicate, sync and migrate data destinations on-prem or in the cloud; and consistent high performance at the level of a dedicated flash storage system.

Cloud Volumes Service (CVS) as guest connected storage

Configure Cloud Volumes Service with VMware Engine

Cloud Volumes Service shares can be mounted from VMs that are created in the VMware Engine environment. The volumes can also be mounted on the Linux client and mapped on the Windows client because Cloud Volumes Service supports SMB and NFS protocols. Cloud Volumes Service volumes can be set up in simple steps.

Cloud Volume Service and Google Cloud VMware Engine private cloud must be in the same region.

To purchase, enable and configure NetApp Cloud Volumes Service for Google Cloud from the Google Cloud Marketplace, follow this detailed [guide](#).

Create a CVS NFS volume to GCVE private cloud

To create and mount NFS volumes, complete the following steps:

1. Access Cloud Volumes from Partner Solutions within the Google cloud console.



2. In the Cloud Volumes Console, go to the Volumes page and click Create.




3. On the Create File System page, specify the volume name and billing labels as required for chargeback mechanisms.

Cloud Volumes	← Create File System
<ul style="list-style-type: none"> Volumes Backups Snapshots Active Directories Volume Replication 	<p>Volume Name</p> <p>Name *</p> <input type="text" value="nimCVNFSvol01"/> <p>A human readable name used for display purposes.</p> <p>Billing Labels</p> <p>Label your volumes for billing reports, queries. Supported with CVS-Performance service type; can be set with CVS service type but not available for billing at this time.</p> <p>+ ADD LABEL</p>


- Select the appropriate service. For GCVE, choose CVS-Performance and desired service level for improved latency and higher performance based on the application workload requirements.

Cloud Volumes	← Create File System
<ul style="list-style-type: none"> Volumes Backups Snapshots Active Directories Volume Replication 	<p>Service Type</p> <p>Cloud Volumes Service is offered as two service types: CVS and CVS-Performance. Select the service type that matches your workload needs. Region availability varies by service type. Learn more</p> <p> <input type="radio"/> CVS Offers volumes created with zonal high availability. </p> <p> <input checked="" type="radio"/> CVS-Performance Offers 3 performance levels and improved latency to address higher performance application requirements. </p> <p>Volume Replication</p> <p> <input type="checkbox"/> Secondary Select to create volume as a destination target for volume replication. Applicable only to CVS-performance volumes. </p>


- Specify the Google Cloud region for the volume and volume path (The volume path must be unique across all of cloud volumes in the project)

 Cloud Volumes	Create File System
<ul style="list-style-type: none"> Volumes Backups Snapshots Active Directories Volume Replication 	<p>Region</p> <p>Region availability varies by service type.</p> <p>Region * <input type="text" value="europe-west3"/> ?</p> <p>Volume will be provisioned in the region you select.</p> <p>Volume Path * <input type="text" value="nimCVSNFSol01"/> ↻</p> <p>Must be unique to the project.</p>

6. Select the level of performance for the volume.

 Cloud Volumes	Create File System
<ul style="list-style-type: none"> Volumes Backups Snapshots Active Directories Volume Replication 	<p>Service Level</p> <p>Select the performance level required for your workload.</p> <p><input checked="" type="radio"/> Standard Up to 16 MiB/s per TiB</p> <p><input type="radio"/> Premium Up to 64 MiB/s per TiB</p> <p><input type="radio"/> Extreme Up to 128 MiB/s per TiB</p> <p>Snapshot <input type="text"/></p> <p>The snapshot to create the volume from.</p>

7. Specify the size of the volume and the protocol type. In this testing, NFSv3 is used.

 Cloud Volumes	Create File System
<ul style="list-style-type: none"> Volumes Backups Snapshots Active Directories Volume Replication 	<p>Volume Details</p> <p>Allocated Capacity * <input type="text" value="1024"/> GiB</p> <p>Allocated size must be between 1 TiB (1024 GiB) and 100 TiB (102400 GiB)</p> <p>Protocol Type * <input type="text" value="NFSv3"/></p> <p><input type="checkbox"/> Make snapshot directory (.snapshot) visible Makes .snapshot directory visible to clients. For NFSv4.1 volumes (CVS-Performance only), the directory itself will not be listed but can be accessed to list contents, etc.</p> <p><input type="checkbox"/> Enable LDAP Enables user look up from AD LDAP server for your NFS volumes</p>

8. In this step, select the VPC Network from which the volume will be accessible. Ensure VPC peering is in place.

HINT: If VPC peering has not been done, a pop-up button will be displayed to guide you through the peering commands. Open a Cloud Shell session and execute the appropriate commands to peer your VPC with Cloud Volumes Service producer. In case you decide to prepare VPC peering in beforehand, refer to these instructions.

Cloud Volumes

Volumes

Backups

Snapshots

Active Directories

Volume Replication

Create File System

Network Details

☐ Shared VPC configuration
 Provide the host project name when deploying in a shared VPC service project.

VPC Network Name *

cloud-volumes-vpc

Select the VPC Network from which the volume will be accessible. This cannot be changed later.

☐ Use Custom Address Range

Reserved Address range

netapp-addresses

9. Manage the Export policy rules by adding the appropriate rules and Select the checkbox for the corresponding NFS version.

Note: Access to NFS volumes won't be possible unless an export policy is added.

Cloud Volumes

Volumes

Backups

Snapshots

Active Directories

Volume Replication

Create File System

Export Policy

Rules

Item 1

Allowed Clients 1 *

0.0.0.0/0

Access

☒ Read & Write
☐ Read Only

Root Access

☒ On
☐ Off

Protocol Type (Select at least 1 of the below options)

Must select for Protocol type NFSv3. Optional for Protocol Type Both. Do not select for NFSv4.1
☒ Allows Matching Clients for NFSv3

10. Click Save to create the volume.

<input type="checkbox"/>		4b6ed9a9-bc6d-f3d5-5a0f-7da26aed3ed0	nimmfsdemos02	europa-west3	Available for use	CVS-Performance	Primary	Extreme	NFSv3 : 10.53.0.4/nimmfsdemos02
--------------------------	--	--------------------------------------	---------------	--------------	-------------------	-----------------	---------	---------	---------------------------------

72

Mounting NFS exports to VMs running on VMware Engine

Before preparing to mount the NFS volume, ensure the peering status of private connection is listed as Active. Once status is Active, use the mount command.

To mount an NFS volume, do the following:

1. In the Cloud Console, go to Cloud Volumes > Volumes.
2. Go to the Volumes page
3. Click the NFS volume for which you want to mount NFS exports.
4. Scroll to the right, under Show More, click Mount Instructions.

To perform the mounting process from within the guest OS of the VMware VM, follow the below steps:

1. Use SSH client and SSH to the virtual machine.
2. Install the nfs client on the instance.
 - a. On Red Hat Enterprise Linux or SuSE Linux instance:

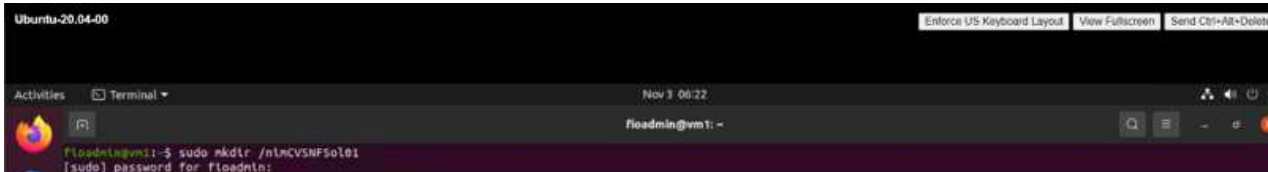
```
sudo yum install -y nfs-utils
```

- b. On an Ubuntu or Debian instance:

```
sudo apt-get install nfs-common
```

3. Create a new directory on the instance, such as "/nimCVSNFSol01":

```
sudo mkdir /nimCVSNFSol01
```



4. Mount the volume using the appropriate command. Example command from the lab is below:

```
sudo mount -t nfs -o rw,hard,rsize=65536,wsiz=65536,vers=3,tcp 10.53.0.4:/nimCVSNFSol01 /nimCVSNFSol01
```

```
root@vm1:~# sudo mkdir /nimCVSNFSol01
root@vm1:~# sudo mount -t nfs -o rw,hard,rsize=65536,wsiz=65536,vers=3,tcp 10.53.0.4:/nimCVSNFSol01 /nimCVSNFSol01
```

```

root@vm1:~# df
Filesystem              1K-blocks      Used    Available Use% Mounted on
udev                    16409952         0    16409952   0% /dev
tmpfs                   3288328        1580     3286748   1% /run
/dev/sdb5               61145932    19231356     38778832  34% /
tmpfs                   16441628         0     16441628   0% /dev/shm
tmpfs                    5120           0         5120   0% /run/lock
tmpfs                   16441628         0     16441628   0% /sys/fs/cgroup
/dev/loop0              128           128           0 100% /snap/bare/5
/dev/loop1              56832        56832           0 100% /snap/core18/2128
/dev/loop2              66688        66688           0 100% /snap/gtk-common-themes/1515
/dev/loop4              66816        66816           0 100% /snap/gtk-common-themes/1519
/dev/loop3              52224        52224           0 100% /snap/snap-store/547
/dev/loop5              224256      224256           0 100% /snap/gnome-3-34-1804/72
/dev/sdb1               523248         4       523244   1% /boot/efi
tmpfs                   3288324        28     3288296   1% /run/user/1000
10.53.0.4:/gcve-ds-1    107374182400 1136086016 106238096384  2% /base
/dev/mapper/nfsprdv1-prod01 419155968 55384972 363770996 14% /datastore1
/dev/loop8              33280        33280           0 100% /snap/snapd/13270
/dev/loop6              33280        33280           0 100% /snap/snapd/13640
/dev/loop7              56832        56832           0 100% /snap/core18/2246
10.53.0.4:/nimCVSNFSol01 107374182400 256 107374182144  1% /nimCVSNFSol01
root@vm1:~#

```

Creating and Mounting SMB Share to VMs running on VMware Engine

For SMB volumes, make sure the Active Directory connections is configured prior to creating the SMB volume.

Active Directory connections [+ CREATE](#) [DELETE](#) [C](#)

Create a Windows Active Directory connection to your existing AD server. This is a prerequisite step before creating volumes with the SMB protocol type. [Learn more](#)

Filter Search for Active Directory connections by ID, username, DNS, netBIOS, region, etc.

<input type="checkbox"/>	Username	Domain	DNS Servers	NetBIOS Prefix	OU Path	AD Server Name	KDC IP	Region	Status
<input checked="" type="checkbox"/>	administrator	nimgcveval.com	192.168.0.16	nimsmb	CN=Computers			europa-west3	In Use

Once the AD connection is in place, create the volume with the desired service level. The steps are like creating NFS volume except selecting the appropriate protocol.

1. In the Cloud Volumes Console, go to the Volumes page and click Create.
2. On the Create File System page, specify the volume name and billing labels as required for chargeback mechanisms.

[←](#) Create File System

Volume Name

Name *

nimCVSMBvol01

A human readable name used for display purposes.

Billing Label

Label your volumes for billing reports, queries.



Supported with CVS-Performance service type; can be set with CVS service type but not available for billing at this time.

[+ ADD LABEL](#)

3. Select the appropriate service. For GCVE, choose CVS-Performance and desired service level for improved latency and higher performance based on the workload requirements.

Create File System

Service Type

Cloud Volumes Service is offered as two service types: CVS and CVS-Performance. Select the service type that matches your workload needs. [Region availability](#)  varies by service type. [Learn more](#) 

☐ CVS

Offers volumes created with zonal high availability.

☒ CVS-Performance

Offers 3 performance levels and improved latency to address higher performance application requirements.

Volume Replication

☐ Secondary

Select to create volume as a destination target for volume replication. Applicable only to CVS-performance volumes.

- Specify the Google Cloud region for the volume and volume path (The volume path must be unique across all of cloud volumes in the project)

Create File System

Region

Region availability varies by service type.

Region *

europa-west3



Volume will be provisioned in the region you select.

Volume Path *

nimCVSMBvol01



Must be unique to the project.

- Select the level of performance for the volume.

← Create File System

Service Level

Select the performance level required for your workload.

- ☒ Standard
Up to 16 MiB/s per TiB
- ☐ Premium
Up to 64 MiB/s per TiB
- ☐ Extreme
Up to 128 MiB/s per TiB

Snapshot

The snapshot to create the volume from.

6. Specify the size of the volume and the protocol type. In this testing, SMB is used.

← Create File System

Volume Details

Allocated Capacity *

1024

GiB

Allocated size must be between 1 TiB (1024 GiB) and 100 TiB (102400 GiB)

Protocol Type *

SMB

- ☐ Make snapshot directory (.snapshot) visible
Makes .snapshot directory visible to clients. For NFSv4.1 volumes (CVS-Performance only), the directory itself will not be listed but can be accessed to list contents, etc.
- ☐ Enable SMB Encryption
Enable this option only if you require encryption of your SMB data traffic.
- ☐ Enable CA share support for SQL Server, FSLogix
Enable this option only for SQL Server and FSLogix workloads that require continuous availability.
- ☐ Hide SMB Share
Enable this option to make SMB shares non-browsable

7. In this step, select the VPC Network from which the volume will be accessible. Ensure VPC peering is in place.

HINT: If VPC peering has not been done, a pop-up button will be displayed to guide you through the peering commands. Open a Cloud Shell session and execute the appropriate commands to peer your VPC with Cloud Volumes Service producer. In case you decide to prepare VPC peering in

beforehand, refer to these [instructions](#).

Network Details

☐ Shared VPC configuration

Provide the host project name when deploying in a shared VPC service project.

VPC Network Name +

cloud-volumes-vpc

Select the VPC Network from which the volume will be accessible. This cannot be changed later.

☐ Use Custom Address Range

Reserved Address range

netapp-addresses

✓ SHOW SNAPSHOT POLICY

SAVE

CANCEL

8. Click Save to create the volume.

<input type="checkbox"/>		6a4552ed-7378-7302-be28-21a169374f28	nimCVSMBvol01	europa-west3	Available for use	CVS-Performance	Primary	Standard	SMB: \\nimmb-3830.nimgcveval.com\nimCVSMBvol01
--------------------------	--	--------------------------------------	---------------	--------------	-------------------	-----------------	---------	----------	--

To mount the SMB volume, do the following:

1. In the Cloud Console, go to Cloud Volumes > Volumes.
2. Go to the Volumes page
3. Click the SMB volume for which you want to map an SMB share.
4. Scroll to the right, under Show More, click Mount Instructions.

To perform the mounting process from within the Windows guest OS of the VMware VM, follow the below steps:

1. Click the Start button and then click on Computer.
2. Click Map Network Drive.
3. In the Drive list, click any available drive letter.
4. In the folder box, type:

```
\\nimmb-3830.nimgcveval.com\nimCVSMBvol01
```


What network folder would you like to map?

Specify the drive letter for the connection and the folder that you want to connect to:

Drive:

Folder:

Example: \\server\share

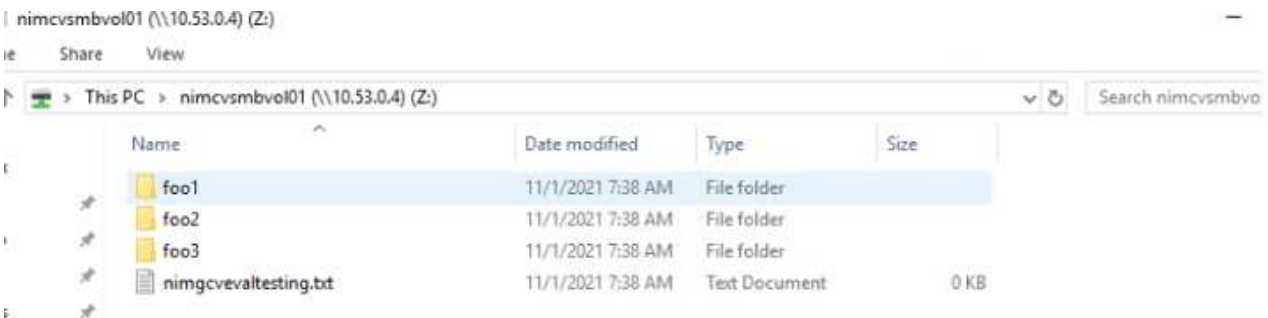
☒ Reconnect at sign-in

☐ Connect using different credentials

[Connect to a Web site that you can use to store your documents and pictures.](#)

To connect every time you log on to your computer, select the Reconnect at sign-in check box.

5. Click Finish.



Region Availability for Supplemental NFS datastores on AWS, Azure, and GCP

Learn more about the the Global Region support for supplemental NFS datastores on AWS, Azure and Google Cloud Platform (GCP).

AWS Region Availability

The availability of supplemental NFS datastores on AWS / VMC is defined by Amazon. First, you need to determine if both VMC and FSxN are available in a specified region. Next, you need to determine if the FSxN supplemental NFS datastore is supported in that region.

- Check the availability of VMC [here](#).
- Amazon's pricing guide offers information on where FSxN (FSx ONTAP) is available. You can find that information [here](#).
- Availability of the FSxN supplemental NFS datastore for VMC is coming soon.

While information is still being released, the following chart identifies the current support for VMC, FSxN and FSxN as a supplemental NFS datastore.

Americas

AWS Region	VMC Availability	FSx ONTAP Availability	NFS Datastore Availability
US East (Northern Virginia)	Yes	Yes	Yes
US East (Ohio)	Yes	Yes	Yes
US West (Northern California)	Yes	No	No
US West (Oregon)	Yes	Yes	Yes
GovCloud (US West)	Yes	Yes	Yes
Canada (Central)	Yes	Yes	Yes
South America (Sao Paulo)	Yes	Yes	Yes

Last updated on: June 2, 2022.

EMEA

AWS Region	VMC Availability	FSx ONTAP Availability	NFS Datastore Availability
Europe (Ireland)	Yes	Yes	Yes
Europe (London)	Yes	Yes	Yes
Europe (Frankfurt)	Yes	Yes	Yes
Europe (Paris)	Yes	Yes	Yes
Europe (Milan)	Yes	Yes	Yes
Europe (Stockholm)	Yes	Yes	Yes

Last updated on: June 2, 2022.

Asia Pacific

AWS Region	VMC Availability	FSx ONTAP Availability	NFS Datastore Availability
Asia Pacific (Sydney)	Yes	Yes	Yes
Asia Pacific (Tokyo)	Yes	Yes	Yes
Asia Pacific (Osaka)	Yes	No	No
Asia Pacific (Singapore)	Yes	Yes	Yes
Asia Pacific (Seoul)	Yes	Yes	Yes
Asia Pacific (Mumbai)	Yes	Yes	Yes
Asia Pacific (Jakarta)	No	No	No
Asia Pacific (Hong Kong)	Yes	Yes	Yes

Last updated on: September 28, 2022.

Azure Region Availability

The availability of supplemental NFS datastores on Azure / AVS is defined by Microsoft. First, you need to determine if both AVS and ANF are available in a specific region. Next, you need to determine if the ANF supplemental NFS datastore is supported in that region.

- Check the availability of AVS and ANF [here](#).
- Check the availability of the ANF supplemental NFS datastore [here](#).

GCP Region Availability

GCP region availability will be released when GCP enters public availability.

Copyright information

Copyright © 2023 NetApp, Inc. All Rights Reserved. Printed in the U.S. No part of this document covered by copyright may be reproduced in any form or by any means—graphic, electronic, or mechanical, including photocopying, recording, taping, or storage in an electronic retrieval system—without prior written permission of the copyright owner.

Software derived from copyrighted NetApp material is subject to the following license and disclaimer:

THIS SOFTWARE IS PROVIDED BY NETAPP “AS IS” AND WITHOUT ANY EXPRESS OR IMPLIED WARRANTIES, INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE, WHICH ARE HEREBY DISCLAIMED. IN NO EVENT SHALL NETAPP BE LIABLE FOR ANY DIRECT, INDIRECT, INCIDENTAL, SPECIAL, EXEMPLARY, OR CONSEQUENTIAL DAMAGES (INCLUDING, BUT NOT LIMITED TO, PROCUREMENT OF SUBSTITUTE GOODS OR SERVICES; LOSS OF USE, DATA, OR PROFITS; OR BUSINESS INTERRUPTION) HOWEVER CAUSED AND ON ANY THEORY OF LIABILITY, WHETHER IN CONTRACT, STRICT LIABILITY, OR TORT (INCLUDING NEGLIGENCE OR OTHERWISE) ARISING IN ANY WAY OUT OF THE USE OF THIS SOFTWARE, EVEN IF ADVISED OF THE POSSIBILITY OF SUCH DAMAGE.

NetApp reserves the right to change any products described herein at any time, and without notice. NetApp assumes no responsibility or liability arising from the use of products described herein, except as expressly agreed to in writing by NetApp. The use or purchase of this product does not convey a license under any patent rights, trademark rights, or any other intellectual property rights of NetApp.

The product described in this manual may be protected by one or more U.S. patents, foreign patents, or pending applications.

LIMITED RIGHTS LEGEND: Use, duplication, or disclosure by the government is subject to restrictions as set forth in subparagraph (b)(3) of the Rights in Technical Data -Noncommercial Items at DFARS 252.227-7013 (FEB 2014) and FAR 52.227-19 (DEC 2007).

Data contained herein pertains to a commercial product and/or commercial service (as defined in FAR 2.101) and is proprietary to NetApp, Inc. All NetApp technical data and computer software provided under this Agreement is commercial in nature and developed solely at private expense. The U.S. Government has a non-exclusive, non-transferrable, nonsublicensable, worldwide, limited irrevocable license to use the Data only in connection with and in support of the U.S. Government contract under which the Data was delivered. Except as provided herein, the Data may not be used, disclosed, reproduced, modified, performed, or displayed without the prior written approval of NetApp, Inc. United States Government license rights for the Department of Defense are limited to those rights identified in DFARS clause 252.227-7015(b) (FEB 2014).

Trademark information

NETAPP, the NETAPP logo, and the marks listed at <http://www.netapp.com/TM> are trademarks of NetApp, Inc. Other company and product names may be trademarks of their respective owners.