



## **VMware for Public Cloud**

NetApp Solutions

NetApp

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# VMware for Public Cloud

## Overview of NetApp Hybrid Multicloud with VMware

Most IT organizations follow the hybrid cloud-first approach. These organizations are in a transformation phase and customers are evaluating their current IT landscape and then migrating their workloads to the cloud based on the assessment and discovery exercise.

The factors for customers migrating to the cloud can include elasticity and burst, data center exit, data center consolidation, end-of-life scenarios, mergers, acquisitions, and so on. The reason for this migration can vary based on each organization and their respective business priorities. When moving to the hybrid cloud, choosing the right storage in the cloud is very important in order to unleash the power of cloud deployment and elasticity.

### VMware Cloud options in Public Cloud

This section describes how each of the cloud providers support a VMware Software Defined Data Center (SDDC) and/or VMware Cloud Foundation (VCF) stack within their respective public cloud offerings.

#### Azure VMware Solution



Azure VMware Solution is a hybrid cloud service that allows for fully functioning VMware SDDCs within the Microsoft Azure public cloud. Azure VMware Solution is a first-party solution fully managed and supported by Microsoft, verified by VMware leveraging Azure infrastructure. This means that when Azure VMware Solution is deployed, customer's get VMware's 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.

#### VMware Cloud on AWS



VMware Cloud on AWS brings VMware's enterprise-class SDDC software to the AWS Cloud with optimized access to native AWS services. Powered by VMware Cloud Foundation, VMware Cloud on AWS integrates VMware's compute, storage, and network virtualization products (VMware vSphere, VMware vSAN, and VMware NSX) along with VMware vCenter Server management, optimized to run on dedicated, elastic, bare-metal AWS infrastructure.

#### Google Cloud VMware Engine



Google Cloud VMware Engine is an infrastructure-as-a-service (IaaS) offering built on Google Cloud's highly

performant scalable infrastructure and VMware Cloud Foundation stack – VMware vSphere, vCenter, vSAN, and NSX-T. This service enables a fast path to the cloud, seamlessly migrating or extending existing VMware workloads from on-premises environments to Google Cloud Platform without the cost, effort ,or risk of rearchitecting applications or retooling operations. It is a service sold and supported by Google, working closely with VMware.



SDDC private cloud and NetApp Cloud Volumes colocation provides the best performance with minimal network latency.

## Did you know?

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

- 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

## Storage configuration

For customers planning to host storage-intensive workloads and scale out on any cloud-hosted VMware solution, the default hyper-converged infrastructure dictates that the expansion should be on both the compute and storage resources.

By integrating with NetApp Cloud Volumes, such as Azure NetApp Files, Amazon FSx for NetApp ONTAP, Cloud Volumes ONTAP (available in all three major hyperscalers), and Cloud Volumes Service for Google Cloud, customers now have options to independently scale their storage separately, and only add compute nodes to the SDDC cluster as needed.

### Notes:

- VMware does not recommend unbalanced cluster configurations, hence expanding storage means adding more hosts, which implies more TCO.
- Only one vSAN environment is possible. Therefore, all storage traffic will compete directly with production workloads.
- There is no option to provide multiple performance tiers to align application requirements, performance, and cost.
- It is very easy to reach the limits of storage capacity of vSAN built on top of the cluster hosts. Use NetApp Cloud Volumes to scale storage to either host active datasets or tier cooler data to persistent storage.

Azure NetApp Files, Amazon FSx for NetApp ONTAP, Cloud Volumes ONTAP (available in all three major hyperscalers), and Cloud Volumes Service for Google Cloud can be used in conjunction with guest VMs. This hybrid storage architecture consists of a vSAN datastore that holds the guest operating system and application binary data. The application data is attached to the VM through a guest-based iSCSI initiator or the NFS/SMB mounts that communicate directly with Amazon FSx for NetApp ONTAP, Cloud Volume ONTAP, Azure NetApp Files and Cloud Volumes Service for Google Cloud respectively. This configuration allows you to easily overcome challenges with storage capacity as with vSAN, the available free space depends on the slack space and storage policies used.

Let's consider a three-node SDDC cluster on VMware Cloud on AWS:

- The total raw capacity for a three-node SDDC = 31.1TB (roughly 10TB for each node).
- The slack space to be maintained before additional hosts are added = 25% = (.25 x 31.1TB) = 7.7TB.
- The usable raw capacity after slack space deduction = 23.4TB
- The effective free space available depends on the storage policy applied.

For example:

- RAID 0 = effective free space = 23.4TB (usable raw capacity/1)
- RAID 1 = effective free space = 11.7TB (usable raw capacity/2)
- RAID 5 = effective free space = 17.5TB (usable raw capacity/1.33)

Thus, using NetApp Cloud Volumes as guest-connected storage would help in expanding the storage and optimizing the TCO while meeting the performance and data protection requirements.

 In-guest storage was the only available option at the time this document was written. As supplemental NFS datastore support becomes available, additional documentation will be available [here](#).

## Points to Remember

- In hybrid storage models, place tier 1 or high priority workloads on vSAN datastore to address any specific latency requirements because they are part of the host itself and within proximity. Use in-guest mechanisms for any workload VMs for which transactional latencies are acceptable.
- Use NetApp SnapMirror® technology to replicate the workload data from the on-premises ONTAP system to Cloud Volumes ONTAP or Amazon FSx for NetApp ONTAP to ease migration using block-level mechanisms. This does not apply to Azure NetApp Files and Cloud Volumes Services. For migrating data to Azure NetApp Files or Cloud Volumes Services, use NetApp XCP, Cloud sync, rysnc or robocopy depending on the file protocol used.
- Testing shows 2-4ms additional latency while accessing storage from the respective SDDCs. Factor this additional latency into the application requirements when mapping the storage.
- For mounting guest-connected storage during test failover and actual failover, make sure iSCSI initiators are reconfigured, DNS is updated for SMB shares, and NFS mount points are updated in fstab.
- Make sure that in-guest Microsoft Multipath I/O (MPIO), firewall, and disk timeout registry settings are configured properly inside the VM.



This applies to guest connected storage only.

## Benefits of NetApp cloud storage

NetApp cloud storage offers the following benefits:

- Improves compute-to-storage density by scaling storage independently of compute.
- Allows you to reduce the host count, thus reducing the overall TCO.
- Compute node failure does not impact storage performance.
- The volume reshaping and dynamic service-level capability of Azure NetApp Files allows you to optimize cost by sizing for steady-state workloads, and thus preventing over provisioning.
- The storage efficiencies, cloud tiering, and instance-type modification capabilities of Cloud Volumes

ONTAP allow optimal ways of adding and scaling storage.

- Prevents over provisioning storage resources are added only when needed.
- Efficient Snapshot copies and clones allow you to rapidly create copies without any performance impact.
- Helps address ransomware attacks by using quick recovery from Snapshot copies.
- Provides efficient incremental block transfer-based regional disaster recovery and integrated backup block level across regions provides better RPO and RTOs.

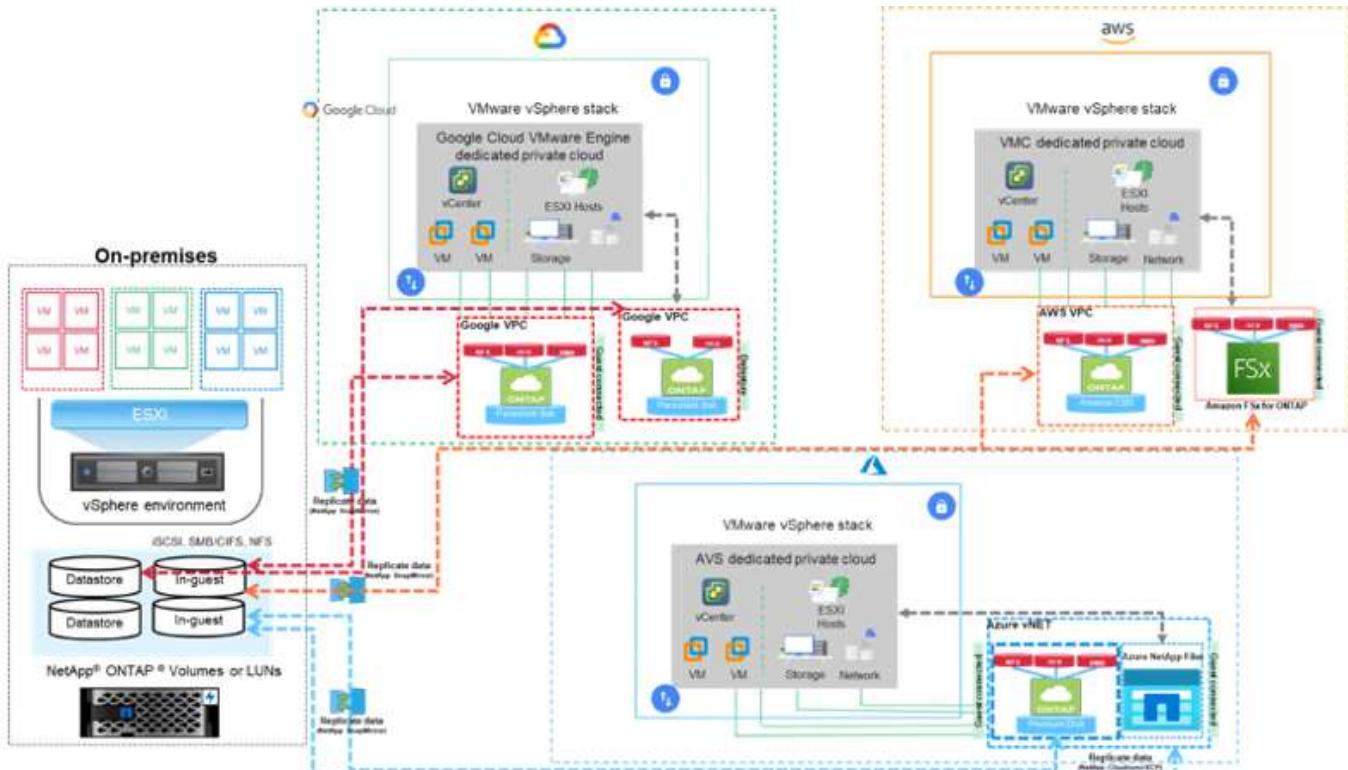
## Assumptions

- SnapMirror technology or other relevant data migration mechanisms are enabled. There are many connectivity options, from on-premises to any hyperscaler cloud. Use the appropriate path and work with the relevant networking teams.
- In-guest storage was the only available option at the time this document was written. As supplemental NFS datastore support becomes available, additional documentation will be available [here](#).

 Engage NetApp solution architects and respective hyperscaler cloud architects for planning and sizing of storage and the required number of hosts. NetApp recommends identifying the storage performance requirements before using the Cloud Volumes ONTAP sizer to finalize the storage instance type or the appropriate service level with the right throughput.

## Detailed architecture

From a high-level perspective, this architecture (shown in the figure below) covers how to achieve hybrid Multicloud connectivity and app portability across multiple cloud providers using NetApp Cloud Volumes ONTAP, Cloud Volumes Service for Google Cloud and Azure NetApp Files as an additional in-guest storage option.



# NetApp Solutions for VMware in Hyperscalers

Learn more about the capabilities that NetApp brings to the three (3) primary hyperscalers - from NetApp as a guest connected storage device or a supplemental NFS datastore to migrating workflows, extending/bursting to the cloud, backup/restore and disaster recovery.

Pick your cloud and let NetApp do the rest!



To see the capabilities for a specific hyperscaler, click on the appropriate tab for that hyperscaler.

Jump to the section for the desired content by selecting from the following options:

- [VMware in the Hyperscalers Configuration](#)
- [NetApp Storage Options](#)
- [NetApp / VMware Cloud Solutions](#)

## VMware in the Hyperscalers Configuration

As with on-premises, planning a cloud based virtualization environment is critical for a successful production-ready environment for creating VMs and migration.

## AWS / VMC

This section describes how to set up and manage VMware Cloud on AWS SDDC and use it in combination with the available options for connecting NetApp storage.



In-guest storage is the only supported method of connecting Cloud Volumes ONTAP to AWS VMC.

The setup process can be broken down into the following steps:

- Deploy and Configure VMware Cloud for AWS
- Connect VMware Cloud to FSx ONTAP

View the detailed [configuration steps for VMC](#).

## Azure / AVS

This section describes how to set up and manage Azure VMware Solution and use it in combination with the available options for connecting NetApp storage.



In-guest storage is the only supported method of connecting Cloud Volumes ONTAP to Azure VMware Solution.

The setup process can be broken down into the following steps:

- Register the resource provider and create a private cloud
- Connect to a new or existing ExpressRoute virtual network gateway
- Validate the network connectivity and access the private cloud

View the detailed [configuration steps for AVS](#).

## GCP / GCVE

This section describes how to set up and manage GCVE and use it in combination with the available options for connecting NetApp storage.



In-guest storage is the only supported method of connecting Cloud Volumes ONTAP and Cloud Volumes Services to GCVE.

The setup process can be broken down into the following steps:

- Deploy and Configure GCVE
- Enable Private Access to GCVE

View the detailed [configuration steps for GCVE](#).

## NetApp Storage Options

NetApp storage can be utilized in several ways - either as guest connected or as a supplemental NFS datastore - within each of the 3 major hyperscalers.

Please visit [Supported NetApp Storage Options](#) for more information.

## 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 \(Google blog\)](#)

## NetApp / VMware Cloud Solutions

With NetApp and VMware cloud solutions, many use cases are simple to deploy in your hyperscaler of choice. VMware defines the primary cloud workload use-cases as:

- Protect (includes both Disaster Recovery and Backup / Restore)
- Migrate
- Extend

**AWS / VMC**

[Browse the NetApp solutions for AWS / VMC](#)

**Azure / AVS**

[Browse the NetApp solutions for Azure / AVS](#)

**GCP / GCVE**

[Browse the NetApp solutions for Google Cloud Platform \(GCP\) / GCVE](#)

## Supported Configurations for NetApp Hybrid Multicloud with VMware

Understanding the combinations for NetApp storage support in the major hyperscalers.

Guest Connected		
Supplemental NFS Datastore	AWS	
CVO FSx ONTAP <a href="#">Details</a>		FSx ONTAP <a href="#">Details</a>
<b>Azure</b>		CVO ANF <a href="#">Details</a>
ANF <a href="#">Details</a>	<b>GCP</b>	
CVO CVS <a href="#">Details</a>		CVS <a href="#">Details</a>

## Configuring the virtualization environment in the cloud provider

Details for how to configure the virtualization environment in each of the supported hyperscalers are covered here.

## AWS / VMC

This section describes how to set up and manage VMware Cloud on AWS SDDC and use it in combination with the available options for connecting NetApp storage.



In-guest storage is the only supported method of connecting Cloud Volumes ONTAP to AWS VMC.

The setup process can be broken down into the following steps:

- Deploy and Configure VMware Cloud for AWS
- Connect VMware Cloud to FSx ONTAP

View the detailed [configuration steps for VMC](#).

## Azure / AVS

This section describes how to set up and manage Azure VMware Solution and use it in combination with the available options for connecting NetApp storage.



In-guest storage is the only supported method of connecting Cloud Volumes ONTAP to Azure VMware Solution.

The setup process can be broken down into the following steps:

- Register the resource provider and create a private cloud
- Connect to a new or existing ExpressRoute virtual network gateway
- Validate the network connectivity and access the private cloud

View the detailed [configuration steps for AVS](#).

## GCP / GCVE

This section describes how to set up and manage GCVE and use it in combination with the available options for connecting NetApp storage.



In-guest storage is the only supported method of connecting Cloud Volumes ONTAP and Cloud Volumes Services to GCVE.

The setup process can be broken down into the following steps:

- Deploy and Configure GCVE
- Enable Private Access to GCVE

View the detailed [configuration steps for GCVE](#).

## Deploy and configure the Virtualization Environment on AWS

As with on-premises, planning VMware Cloud on AWS is critical for a successful production-ready environment for creating VMs and migration.

This section describes how to set up and manage VMware Cloud on AWS SDDC and use it in combination with the available options for connecting NetApp storage.



In-guest storage is currently the only supported method of connecting Cloud Volumes ONTAP (CVO) to AWS VMC.

The setup process can be broken down into the following steps:

## Deploy and configure VMware Cloud for AWS

VMware Cloud on AWS provides for a cloud native experience for VMware based workloads in the AWS ecosystem. Each VMware Software-Defined Data Center (SDDC) runs in an Amazon Virtual Private Cloud (VPC) and provides a full VMware stack (including vCenter Server), NSX-T software-defined networking, vSAN software-defined storage, and one or more ESXi hosts that provide compute and storage resources to your workloads.

This section describes how to set up and manage VMware Cloud on AWS and use it in combination with Amazon FSx for NetApp ONTAP and/or Cloud Volumes ONTAP on AWS with in-guest storage.



In-guest storage is currently the only supported method of connecting Cloud Volumes ONTAP (CVO) to AWS VMC.

The setup process can be broken down into three parts:

### Register for an AWS Account

Register for an [Amazon Web Services Account](#).

You need an AWS account to get started, assuming there isn't one created already. New or existing, you need administrative privileges in the account for many steps in this procedure. See this [link](#) for more information regarding AWS credentials.

### Register for a My VMware Account

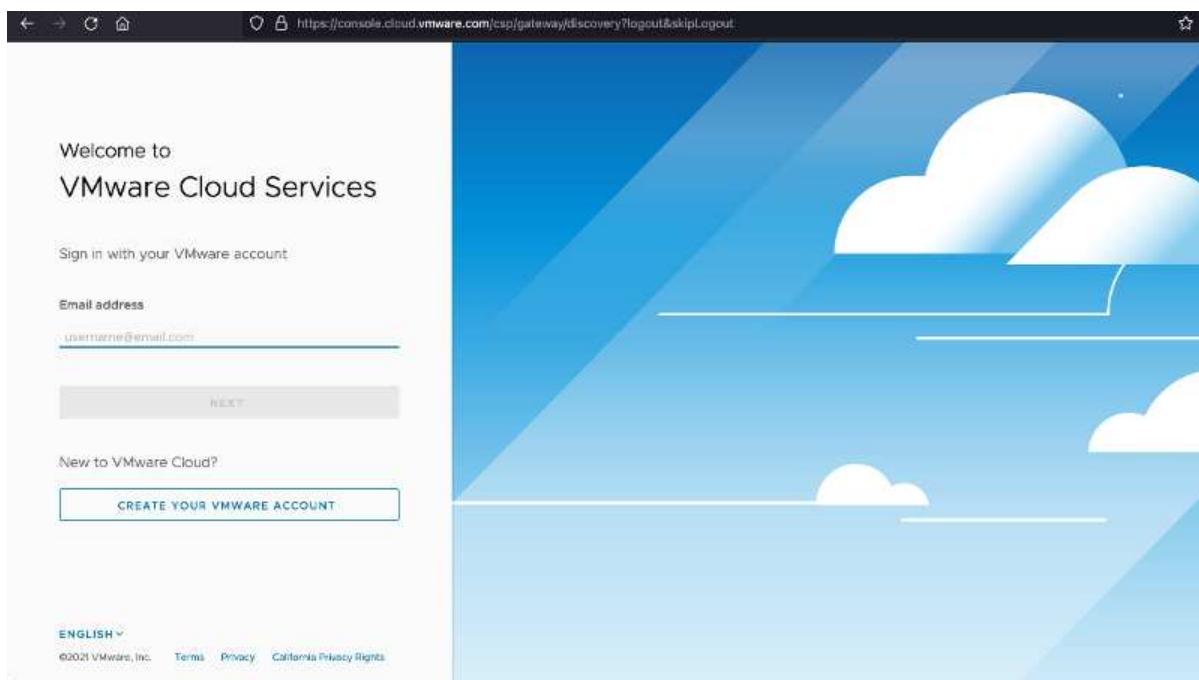
Register for a [My VMware](#) account.

For access to VMware's cloud portfolio (including VMware Cloud on AWS), you need a VMware customer account or a My VMware account. If you have not already done so, create a VMware account [here](#).

## Provision SDDC in VMware Cloud

After the VMware account is configured and proper sizing is performed, deploying a Software-Defined Data Center is the obvious next step for using the VMware Cloud on AWS service. To create an SDDC, pick an AWS region to host it, give the SDDC a name, and specify how many ESXi hosts you want the SDDC to contain. If you don't already have an AWS account, you can still create a starter configuration SDDC that contains a single ESXi host.

1. Log into the VMware Cloud Console using your existing or newly created VMware credentials.



2. Configure the AWS region, deployment, and host type and the SDDC name:



3. Connect to the desired AWS account and execute the AWS Cloud Formation stack.

The screenshot shows the AWS CloudFormation 'Quick create stack' interface. At the top, there's a header bar with the AWS logo, a search bar, and navigation links for services, regions, and support.

**Template**

Template URL:  
https://vmware-sddc.s3.us-west-2.amazonaws.com/1eb9d184-a706-4489-abb8-692aad0e25d0/mq5ijohtclieoh815b75nteq9cc4bddd7ifq07nv7v16fk3G

Stack description:  
This template is created by VMware Cloud on AWS for SDDC deployment and maintenance. Please do not remove.

**Stack name**

Stack name:  
vmware-sddc-formation-a87f31c9-e5ac-4bb4-9d1e-9a3dabd197b7

Stack name can include letters (A-Z and a-z), numbers (0-9), and dashes (-).

**Parameters**

Parameters are defined in your template and allow you to input custom values when you create or update a stack.

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**Stack name**

Stack name:  
vmware-sddc-formation-a87f31c9-e5ac-4bb4-9d1e-9a3dabd197b7

Stack name can include letters (A-Z and a-z), numbers (0-9), and dashes (-).

**Parameters**

Parameters are defined in your template and allow you to input custom values when you create or update a stack.

No parameters.  
There are no parameters defined in your template

**Capabilities**

**Important** The following resource(s) require capabilities: [AWS::IAM::Role]

This template contains Identity and Access Management (IAM) resources that might provide entities access to make changes to your AWS account. Check that you want to create each of these resources and that they have the minimum required permissions. [Learn more](#)

I acknowledge that AWS CloudFormation might create IAM resources.

Cancel Create change set **Create stack**

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The screenshot shows the VMware Cloud SDDC creation interface. On the left, a sidebar lists 'Launchpad', 'SDDCs' (selected), 'Subscriptions', 'Activity Log', 'Tools', and 'Developer Center'. The main area has a header 'SDDC Properties' for 'ntap-fsx-demo - 1 Hosts - us-west-2'. Step 2, 'Connect to AWS', is active, with the sub-step 'Specify the AWS account that you want to connect your SDDC with.' Below it, a note says 'This step gives VMware permission to set up networking correctly for your SDDC on your AWS Infrastructure using cross-account rules.' There are two options: 'Skip for now.' (radio button) and 'Connect to AWS now.' (radio button, selected). A 'Choose an AWS account' dropdown is open, showing 'aws' and 'VMware'. A note below says 'When the CloudFormation stack has completed in your AWS account, the connection will show success below.' A progress bar at the bottom indicates 'Establishing Connection' with an estimated time remaining of 60 seconds.

This screenshot shows the same interface after the connection has been successfully established. The 'Choose an AWS account' dropdown now shows 'aws' with a checkmark. A message says 'Congratulations! Your connection is successfully established.' Below it, details are shown: 'CF Stack: vmware-sddc-formation-af87f3fc9-45ac-4bb4-9dfe-9a33ab897b7' and 'AWS Account ID: [REDACTED]'. To the right, there's a small diagram showing a blue arrow pointing from 'aws' to 'VMware'. The 'NEXT' button is visible at the bottom.



Single-host configuration is used in this validation.

4. Select the desired AWS VPC to connect the VMC environment with.



- Configure the VMC Management Subnet; this subnet contains VMC-managed services like vCenter, NSX, and so on. Do not choose an overlapping address space with any other networks that need connectivity to the SDDC environment. Finally, follow the recommendations for CIDR size notated below.



- Review and acknowledge the SDDC configuration, and then click deploy the SDDC.



The deployment process typically takes approximately two hours to complete.



7. After completion, the SDDC is ready for use.

The screenshot shows the VMware Cloud interface for managing Software-Defined Data Centers (SDDCs). The main title is "Software-Defined Data Centers (SDDC)". On the left sidebar, there are links for "Launched", "Subscriptions", "Activity Log", "Tools", and "Developer Center". The main content area displays a single SDDC named "ntap-fsx-demo" which is "Ready". The SDDC details are as follows:

Region	US West (Oregon)	Clusters	1
Type	VMC on AWS SDDC	Hosts	1
Availability Zones	us-west-2a	Config.	36
VMC on AWS SDDC			

Resource summary:

CPU	Memory	Storage
82.8 GHz	512 GiB	10.37 TiB

At the bottom of the SDDC card, there are buttons for "VIEW DETAILS", "OPEN VCENTER", and "ACTIONS". Below the SDDC card, there are links for "BACK TO TOP" and "GO TO GRID VIEW".

For a step-by-step guide on SDDC deployment, see [Deploy an SDDC from the VMC Console](#).

## Connect VMware Cloud to FSx ONTAP

To connect VMware Cloud to FSx ONTAP, complete the following steps:

- With VMware Cloud deployment completed and connected to AWS VPC, you must deploy Amazon FSx for NetApp ONTAP into a new VPC rather than the original connected VPC (see the screenshot below). FSx (NFS and SMB floating IPs) is not accessible if it is deployed in the connected VPC. Keep in mind that iSCSI endpoints like Cloud Volumes ONTAP work just fine from the connected VPC.



- Deploy an additional VPC in the same region, and then deploy Amazon FSx for NetApp ONTAP into the new VPC.

Configuration of an SDDC group in the VMware Cloud console enables the networking configuration options required to connect to the new VPC where FSx is deployed. In step 3, verify that “Configuring VMware Transit Connect for your group will incur charges per attachment and data transfers” is checked, and then choose Create Group. The process can take a few minutes to complete.

VMware Cloud

### Create SDDC Group

**1. Name and Description** Create a name and description for your group.

Name	sddcgroup01
Description	sddcgroup01

**NEXT**

**2. Membership** Members: 1

**3. Acknowledgement**

Please confirm that you are aware of the following before creating this SDDC Group.

Configuring VMware Transit Connect for your group will incur charges per attachment and data transfers.

Create firewall rules to establish connectivity between the SDDCs in the group. [Learn More](#)

**CREATE GROUP**

VMware Cloud

### Create SDDC Group

**1. Name and Description** Name: sddcgroup01

**2. Membership** Select SDDCs to be part of your group.

Name	Sddc ID	Location	Version	Management CIDR
intap-lx-demo	829a6e22-92a1-42db-ad3d-9e4eb7a90fb6	US West (Oregon)	1.14.0.14	10.45.0.0/23
1				

**NEXT**

**3. Acknowledgement** Review and acknowledge requirements before creating the group.

Please confirm that you are aware of the following before creating this SDDC Group.

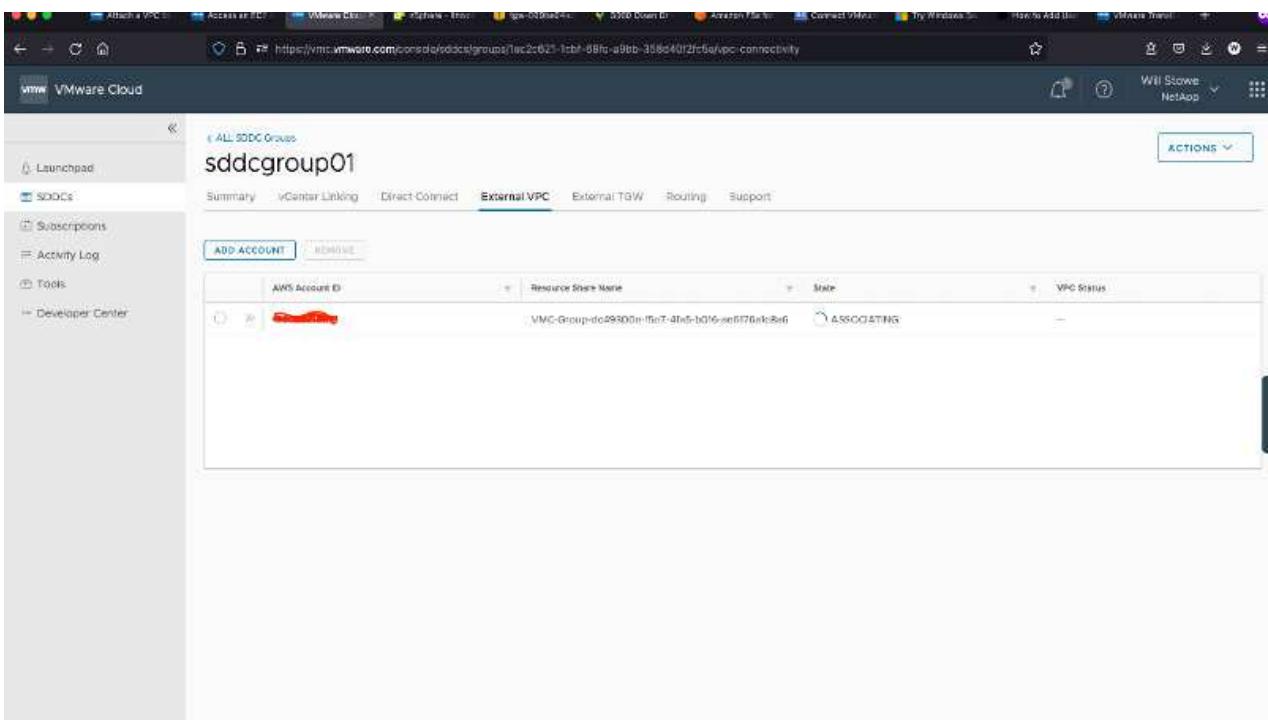
Configuring VMware Transit Connect for your group will incur charges per attachment and data transfers.

Create firewall rules to establish connectivity between the SDDCs in the group. [Learn More](#)

**CREATE GROUP**



3. Attach the newly created VPC to the just created SDDC group. Select the External VPC tab and follow the [instructions for attaching an External VPC](#) to the group. This process can take 10 to 15 minutes to complete.



The screenshot shows the VMware Cloud interface with the URL <https://mc.vmware.com/core/sddc/groups/fe2c821-lcb-80fc-a9bb-350a402f5a5c/connectivity>. The page title is "VMware Cloud". The left sidebar includes "Launchpad", "Subscriptions", "Activity Log", "Tools", and "Developer Center". The main content area has tabs for "Summary", "vCenter Linking", "Direct Connect", "External VPC" (which is selected), "External TOW", "Routing", and "Support". A table titled "ALL SDDC GROUPS" shows one entry for "sddcgroup01". The table columns are "AWS Account ID", "Resource Share Name", "State", and "VPC Status". The entry shows "AWS Account ID" as "12345678901234567890", "Resource Share Name" as "VMC-Group-dc09300e15e74fb5-b016-ee01768e86", "State" as "ASSOCIATED", and "VPC Status" as "...".

4. As part of the external VPC process, you are prompted through the AWS console to a new shared resource via the Resource Access Manager. The shared resource is the [AWS Transit Gateway](#) managed by VMware Transit Connect.

The screenshot shows the AWS Resource Access Manager (RAM) console at the URL <https://us-west-2.console.aws.amazon.com/ram/home?region=us-west-2#home>. The top navigation bar includes "Services", "Search for services, features, marketplace products, and docs", and user information "SSO-Administrator/WillStowe@netapp.com @ cloudshares". The left sidebar has sections for "Shared by me" (Resource shares, Shared resources, Principals), "Shared with me" (Resource shares 1 iteration, Shared resources, Principals), "Permissions library", and "Settings". The main content area is titled "AWS Resource Access Manager" and "Share AWS resources with other AWS accounts". It features a "How it works" diagram showing four steps: 1. AWS Resource Access Manager - "Share resources across AWS accounts or AWS Organizations by creating a Resource Share". 2. Select Resources - "Select the resource(s) that you would like to add to a Resource Share". 3. Specify Principals - "Specify account ID, ARN, or Organization identifier who can access the resources via the Resource Share". 4. Share Resources - "The specified principals will now have access to resources via the Resource Share". To the right, there are sections for "Start sharing your AWS resources with other accounts" (with a "Create a resource share" button), "Pricing" (info about no additional charge), "More resources" (links to "What is AWS Resource Access Manager?", "Getting started", and "Documentation"), and "Your AZ ID" (info about AZ IDs). At the bottom, there are "Use cases" sections for "Manage resources centrally in a multi-account environment" and "Increase efficiency, decrease costs".

The screenshot shows the AWS RAM console interface. On the left, there's a sidebar with navigation options like 'Resource Access Manager', 'Shared by me', 'Resource shares', 'Shared resources', and 'Principals'. Under 'Shared with me', it shows 'Resource shares' (1 invitation), 'Shared resources', and 'Principals'. Below that are 'Permissions library' and 'Settings'. The main content area displays a 'Resource share' titled 'VMC-Group-dc49300e-f5e7-4fa5-b016-ae6176a1e8a6 (051a6fc5-0a1e-4560-853f-e2939d856b0c)'. It includes a summary table with columns for Name, Owner, Invitation date, and Status (Pending). The ARN of the resource share is also listed.

## 5. Create the Transit Gateway Attachment.

The screenshot shows the 'Create transit gateway attachment' wizard in the AWS VPC console. The first step, 'Details', is completed. It shows the following configuration:

- Name tag - optional:** my-transit-gateway-attachment
- Transit gateway ID:** tgw-001646b36ee07a2cb
- Attachment type:** VPC

The second step, 'VPC attachment', is currently being processed. It shows the following configuration:

- DNS support:** checked
- IPv6 support:** unchecked
- VPC ID:** vpc-0d1c754bcc495e805 (vmctsx2.vpc)

## 6. Back on the VMC Console, Accept the VPC attachment. This process can take approximately 10 minutes to complete.

VPC ID	VNC on AWS Region	Transit Gateway Attachment ID	Routes	Status
vpc-0d1c764bcc495e805	US West (Oregon)	tgw-attach-0a4883d6f92c67d64	ADD ROUTE	PENDING

7. While in the External VPC tab, click the edit icon in the Routes column and add in the following required routes:

- A route for the floating IP range for Amazon FSx for NetApp ONTAP [floating IPs](#).
- A route for the floating IP range for Cloud Volumes ONTAP (if applicable).
- A route for the newly created external VPC address space.

VPC ID	VNC on AWS Region	Transit Gateway Attachment ID	Routes	Status
vpc-0d1c764bcc495e805	US West (Oregon)	tgw-attach-0a4883d6f92c67d64	192.168.0.0/24	AVAILABLE

8. Finally, allow bidirectional traffic [firewall rules](#) for access to FSx/CVO. Follow these [detailed steps](#) for compute gateway firewall rules for SDDC workload connectivity.



9. After the firewall groups are configured for both the Management and Compute gateway, the vCenter can be accessed as follows:

The next step is to verify that Amazon FSx ONTAP or Cloud Volumes ONTAP is configured depending on your requirements and that the volumes are provisioned to offload storage components from vSAN to optimize the deployment.

## **Deploy and configure the Virtualization Environment on Azure**

As with on-premises, planning Azure VMware Solution is critical for a successful production-ready environment for creating VMs and migration.

This section describes how to set up and manage Azure VMware Solution and use it in combination with the available options for connecting NetApp storage.

The setup process can be broken down into the following steps:

## Register the resource provider and create a private cloud

To use Azure VMware Solution, first register the resource provider within the identified subscription:

1. Sign in to the Azure portal.
2. On the Azure portal menu, select All Services.
3. In the All Services dialog box, enter the subscription and then select Subscriptions.
4. To view, select the subscription from the subscription list.
5. Select Resource Providers and enter Microsoft.AVS into the search.
6. If the resource provider is not registered, select Register.



Provider	Status
Microsoft.OperationsManagement	Registered
Microsoft.Compute	Registered
Microsoft.ContainerService	Registered
Microsoft.ManagedIdentity	Registered
Microsoft.AVS	Registered
Microsoft.OperationalInsights	Registered
Microsoft.GuestConfiguration	Registered

7. After the resource provider is registered, create an Azure VMware Solution private cloud by using the Azure portal.
8. Sign in to the Azure portal.
9. Select Create a New Resource.
10. In the Search the Marketplace text box, enter Azure VMware Solution and select it from the results.
11. On the Azure VMware Solution page, select Create.
12. From the Basics tab, enter the values in the fields and select Review + Create.

Notes:

- For a quick start, gather the required information during the planning phase.
- Select an existing resource group or create a new resource group for the private cloud. A resource group is a logical container in which the Azure resources are deployed and managed.
- Make sure the CIDR address is unique and does not overlap with other Azure Virtual Networks or on-premises networks. The CIDR represents the private cloud management network and is used for the cluster management services, such as vCenter Server and NSX-T Manager. NetApp recommends using a /22 address space. In this example, 10.21.0.0/22 is used.

## Create a private cloud

Prerequisites   **\*Basics**   Tags   Review and Create

**Project details**

Subscription \* **SaaS Backup Production**  
Resource group \* **(New) NimoAVSDemo**  
[Create new](#)

**Private cloud details**

Resource name \* **nimoavsppriv**  
Location \* **(US) East US 2**  
Size of host \* **AV36 Trial**  
Number of hosts \* **3**  
Find out how many hosts you need

There is no metering for the selected subscription, region, and SKU. No cost data to display.

**CIDR address block**  
Provide IP address for private cloud for cluster management. Make sure these are unique and do not overlap with any other Azure vnets or on-premise networks.

Address block for private cloud \* **10.21.0.0/22**

[Review and Create](#)   [Previous](#)   [Next : Tags >](#)

The provisioning process takes approximately 4–5 hours. After the process is complete, verify that the deployment was successful by accessing the private cloud from the Azure portal. A status of Succeeded is displayed when the deployment is complete.

An Azure VMware Solution private cloud requires an Azure Virtual Network. Because Azure VMware Solution doesn't support on-premises vCenter, additional steps are required to integrate with an existing on-premises environment. Setting up an ExpressRoute circuit and a virtual network gateway is also required. While waiting for the cluster provisioning to complete, create a new virtual network or use an existing one to connect to Azure VMware Solution.

Home >

**nimoavsppriv** [AVS Private cloud](#)

[Delete](#)

**Overview**

**Activity log**

**Access control (IAM)**

**Tags**

**Diagnose and solve problems**

**Settings**

**Locks**

**Manage**

**Connectivity**

**Identity**

**Clusters**

**Essentials**

Resource group <a href="#">(change)</a> <b>NimoAVSDemo</b>	Address block for private cloud <b>10.21.0.0/22</b>
Status <b>Succeeded</b>	Primary peering subnet <b>10.21.0.232/30</b>
Location <b>East US 2</b>	Secondary peering subnet <b>10.21.0.236/30</b>
Subscription <a href="#">(change)</a> <b>SaaS Backup Production</b>	Private Cloud Management network <b>10.21.0.0/26</b>
Subscription ID <b>b58a041a-e464-4497-8be9-9048369ee8e1</b>	vMotion network <b>10.21.1.128/25</b>
Tags <a href="#">(change)</a> <a href="#">Click here to add tags</a>	Number of hosts <b>3</b>

## Connect to a new or existing ExpressRoute virtual network gateway

To create a new Azure Virtual Network (VNet), select the Azure VNet Connect tab. Alternatively, you can create one manually from the Azure portal by using the Create Virtual Network wizard:

1. Go to Azure VMware Solution private cloud and access Connectivity under the Manage option.
2. Select Azure VNet Connect.
3. To create a new VNet, select the Create New option.

This feature allows a VNet to be connected to the Azure VMware Solution private cloud. The VNet enables communication between workloads in this virtual network by automatically creating required components (for example, jump box, shared services such as Azure NetApp Files, and Cloud Volume ONTAP) to the private cloud created in Azure VMware Solution over ExpressRoute.

**Note:** The VNet address space should not overlap with the private cloud CIDR.



4. Provide or update the information for the new VNet and select OK.

## Create virtual network

X

This virtual network enables the communication between workloads in this virtual network (e.g. a Jumphost) to the private cloud created in Azure VMware Solution over an Express route. A default address range and a subnet is selected for this virtual network. For changing the default address range and subnet of this virtual network, follow these steps: Step 1: Change the "Address Range" to desired range (e.g. 172.16.0.0/16). Step 2: Add a subnet under "Subnets" with the name as "GatewaySubnet" and provide subnet's address range in CIDR notation (e.g. 172.16.1.0/24). [Learn more about virtual networks](#)

Name \*

nimoavspiv-vnet

### Address space

The virtual network's address space specified as one or more address prefixes in CIDR notation (e.g. 10.0.0.0/16).

<input type="checkbox"/> Address range	Addresses	Overlap	
<input type="checkbox"/> 172.24.0.0/16	172.24.0.4 - 172.24.255.254 (65531 addresses)	None	
	(0 Addresses)	None	

### Subnets

The subnet's address range in CIDR notation (e.g. 10.0.0.0/24). It must be contained by the address space of the virtual network.

<input type="checkbox"/> Subnet name	Address range	Addresses	
<input type="checkbox"/> GatewaySubnet	172.24.0.0/24	172.24.0.4 - 172.24.0.254 (251 addresses)	
		(0 Addresses)	

The VNet with the provided address range and gateway subnet is created in the designated subscription and resource group.



If you create a VNet manually, create a virtual network gateway with the appropriate SKU and ExpressRoute as the gateway type. After the deployment is complete, connect the ExpressRoute connection to the virtual network gateway containing Azure VMware Solution private cloud using the authorization key. For more information, see [Configure networking for your VMware private cloud in Azure](#).

## Validate the network connect and access to Azure VMware Solution private cloud

Azure VMware Solution does not allow you to manage a private cloud with on-premises VMware vCenter. Instead, jump host is required to connect to the Azure VMware Solution vCenter instance. Create a jump host in the designated resource group and sign in to the Azure VMware Solution vCenter. This jump host should be a Windows VM on the same virtual network that was created for connectivity and should provide access to both vCenter and the NSX Manager.

### Create a virtual machine

Basics Disks Networking Management Advanced Tags Review + create

Create a virtual machine that runs Linux or Windows. Select an image from Azure marketplace or use your own customized image. Complete the Basics tab then Review + create to provision a virtual machine with default parameters or review each tab for full customization. [Learn more](#)

**Project details**

Select the subscription to manage deployed resources and costs. Use resource groups like folders to organize and manage all your resources.

Subscription \*  SaaS Backup Production

Resource group \*  NimoAVSDemo [Create new](#)

**Instance details**

Virtual machine name \*  nimAVSRH

Region \*  (US) East US 2

Availability options  No infrastructure redundancy required

Image \*  Windows Server 2012 R2 Datacenter - Gen2 [See all images](#)

Azure Spot instance

Size \*  Standard\_D2s\_v3 - 2 vcpus, 8 GiB memory (\$130.67/month) [See all sizes](#)

After the virtual machine is provisioned, use the Connect option to access RDP.

The screenshot shows the Azure portal interface for a virtual machine named 'nimAVSJH'. On the left, there's a sidebar with various navigation options like Overview, Activity log, Access control (IAM), Tags, Diagnose and solve problems, Settings, Networking, Connect, Disks, and Size. The 'Connect' option is currently selected. The main pane shows the 'RDP' tab selected under 'Connect with RDP'. A warning message at the top right says, 'To improve security, enable just-in-time access on this VM.' Below that, there are fields for 'IP address' (set to 'Public IP address (52.138.103.135)') and 'Port number' (set to '3389'). A blue button labeled 'Download RDP File' is visible.

Sign in to vCenter from this newly created jump host virtual machine by using the cloud admin user . To access the credentials, go to the Azure portal and navigate to Identity (under the Manage option within the private cloud). The URLs and user credentials for the private cloud vCenter and NSX-T Manager can be copied from here.

The screenshot shows the Azure portal interface for the 'nimoavsppriv' identity settings. The left sidebar has sections for Access control (IAM), Tags, Diagnose and solve problems, Settings, Locks, Manage, Connectivity, Identity (which is selected), Clusters, Placement policies (preview), and Add-ons. The main pane displays 'Login credentials' for vCenter and NSX-T Manager. For vCenter, the Web client URL is https://10.21.0.2/, Admin username is 'cloudadmin@vsphere.local', and Admin password is masked. For NSX-T Manager, the Web client URL is https://10.21.0.3/, Admin username is 'admin', and Admin password is masked. Certificate thumbprints are also listed for both.

In the Windows virtual machine, open a browser and navigate to the vCenter web client URL (<https://10.21.0.2/>) and use the admin user name as **cloudadmin@vsphere.local** and paste the copied password. Similarly, NSX-T manager can also be accessed using the web client URL (<https://10.21.0.3/>) and use the admin user name and paste the copied password to create new segments or modify the existing tier gateways.



The web client URLs are different for each SDDC provisioned.

The screenshot shows the VMware vSphere web interface. At the top, there is a 'Not secure' warning message. Below it, there is a form for logging in with fields for 'Email' (clouadmin@vsphere.local), 'Password', and 'Use Windows session authentication'. A large blue 'LOGIN' button is at the bottom of the form.

The screenshot shows the vSphere Client interface. The main view is the SDDC Datacenter summary page. It shows 0 Virtual Machines and 3 Hosts. On the right, there are detailed resource usage bars: CPU (Used: 18.02 GHz, Capacity: 247.75 GHz), Memory (Used: 246.81 GB, Capacity: 1.88 TB), and Storage (Used: 7.6 TB, Capacity: 41.92 TB).

The Azure VMware Solution SDDC is now deployed and configured. Leverage ExpressRoute Global Reach to connect the on-premises environment to Azure VMware Solution private cloud. For more information, see [Peer on-premises environments to Azure VMware Solution](#).

## Deploy and configure the Virtualization Environment on Google Cloud Platform (GCP)

As with on-premises, planning Google Cloud VMware Engine (GCVE) is critical for a successful production-ready environment for creating VMs and migration.

This section describes how to set up and manage GCVE and use it in combination with the available options for connecting NetApp storage.

The setup process can be broken down into the following steps:

## Deploy and configure GCVE

To configure a GCVE environment on GCP, login to the GCP console and access the VMware Engine portal.

Click on the “New Private Cloud” button and enter the desired configuration for the GCVE Private Cloud. On “Location”, make sure to deploy the private cloud in the same Region/Zone where CVS/CVO is deployed, to ensure the best performance and lowest latency.

Pre-requisites:

- Setup VMware Engine Service Admin IAM role
- [Enable VMWare Engine API access and node quota](#)
- Make sure that the CIDR range doesn't overlap with any of your on-premises or cloud subnets. The CIDR range must be /27 or higher.

The screenshot shows the 'Create Private Cloud' page in the Google Cloud VMware Engine interface. The 'Location' field is highlighted with a red box, indicating it's a key configuration point. Other visible fields include the private cloud name, node type, node count, and CIDR ranges for vSphere/vSAN subnets and HCX deployment networks.

Note: Private cloud creation can take between 30 minutes to 2 hours.

## Enable Private Access to GCVE

Once the Private Cloud is provisioned, configure private access to the Private Cloud for high-throughput and low-latency data-path connection.

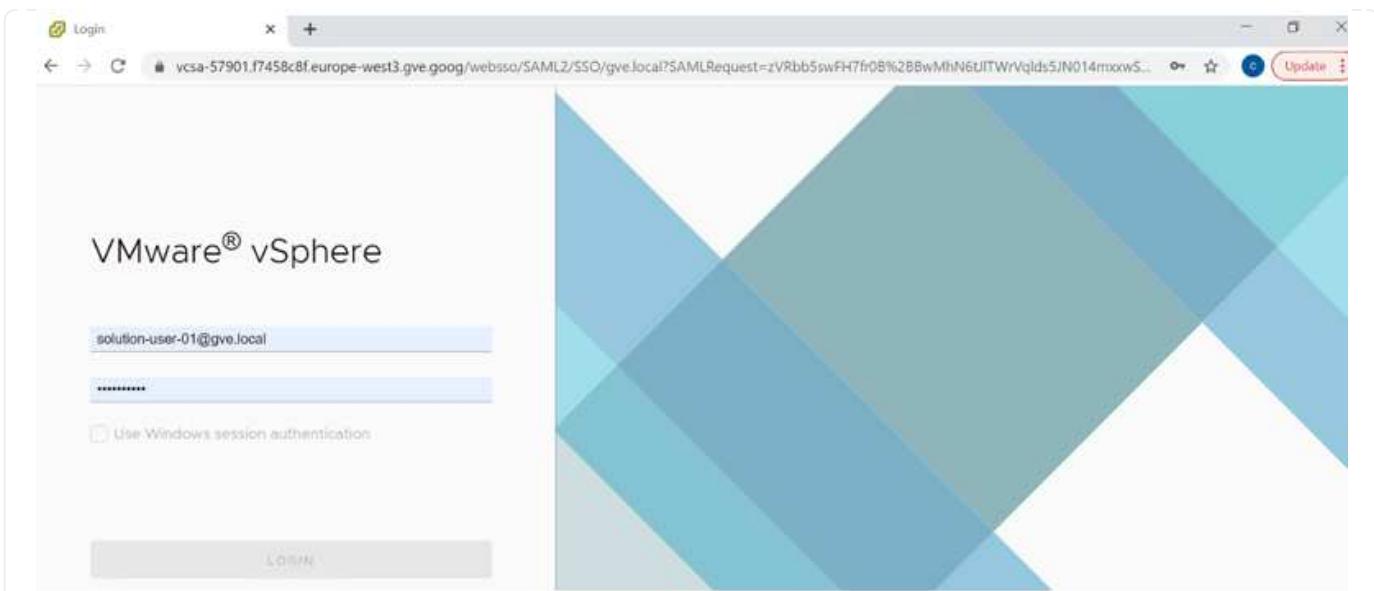
This will ensure that the VPC network where Cloud Volumes ONTAP instances are running is able to communicate with the GCVE Private Cloud. To do so, follow the [GCP documentation](#). For the Cloud Volume Service, establish a connection between VMware Engine and Cloud Volumes Service by performing a one-time peering between the tenant host projects. For detailed steps, follow this [link](#).

Tenant Project ID	Service	Region	Routing Mode	Peered Project ID	Peered VPC	VPC Peering Status	Region Status
ke841388caa56b...	VPC Network	europe-west3	Global	cv-performance-te...	cloud-volumes-vpc	● Active	● Connected
jbd729510b3ebbf...	NetApp CVS	europe-west3	Global	y2b6c17202af6dc...	netapp-tenant-vpc	● Active	● Connected

Sign in to vcenter using the [CloudOwner@gve.local](#) user. To access the credentials, go to the VMware Engine portal, Go to Resources, and select the appropriate private cloud. In the Basic info section, click the View link for either vCenter login info (vCenter Server, HCX Manager) or NSX-T login info (NSX Manager).

In a Windows virtual machine, open a browser and navigate to the vCenter web client URL (<https://10.0.16.6/>) and use the admin user name as [CloudOwner@gve.local](#) and paste the copied password. Similarly, NSX-T manager can also be accessed using the web client URL (<https://10.0.16.11/>) and use the admin user name and paste the copied password to create new segments or modify the existing tier gateways.

For connecting from an on-premises network to VMware Engine private cloud, leverage cloud VPN or Cloud Interconnect for appropriate connectivity and make sure the required ports are open. For detailed steps, follow this [link](#).



## Deploy NetApp Cloud Volume Service supplemental datastore to GCVE

Refer [Procedure to deploy supplemental NFS datastore with NetApp CVS to GCVE](#)

## 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.



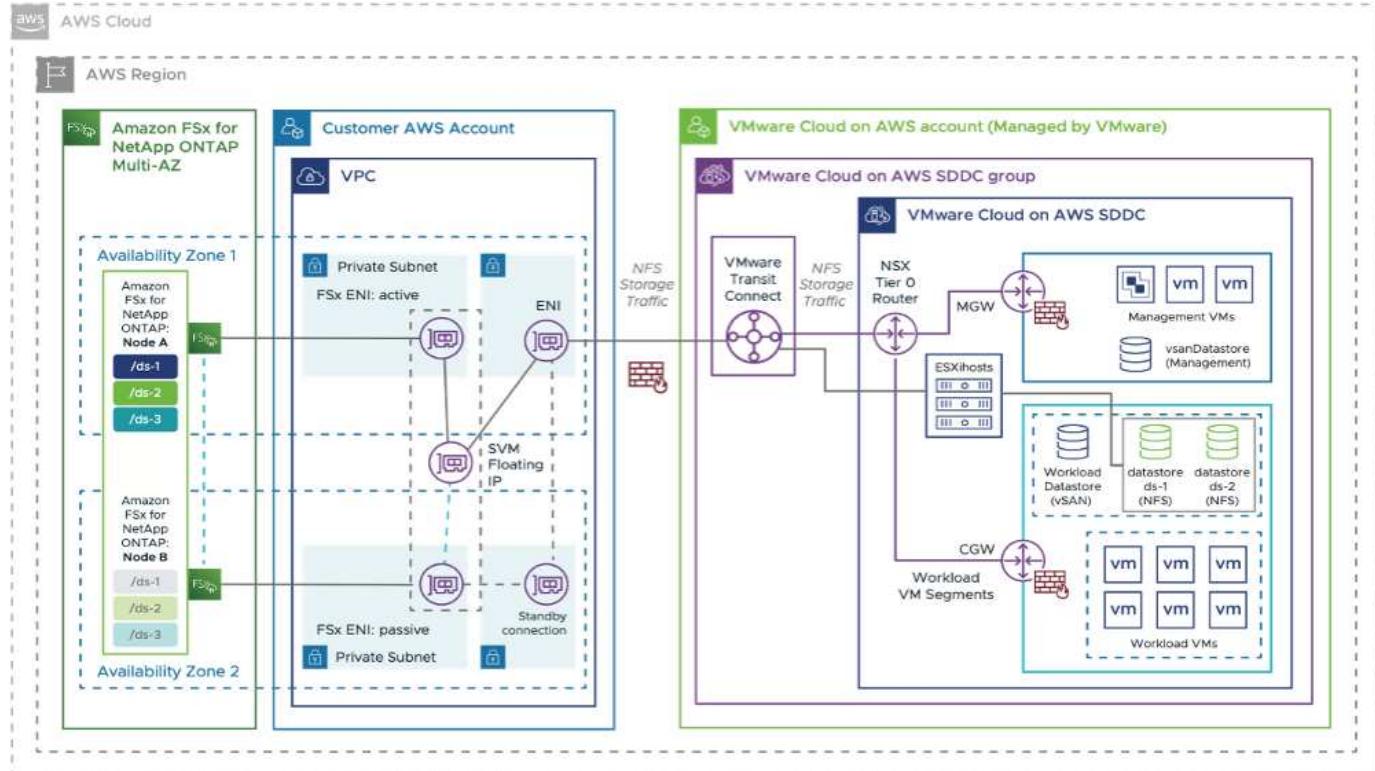
This solution is also available from VMware. Please visit the [VMware Cloud Tech Zone](#) for more information.

## 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.

[Amazon FSX for Ontap VMware Cloud](#)

## 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.

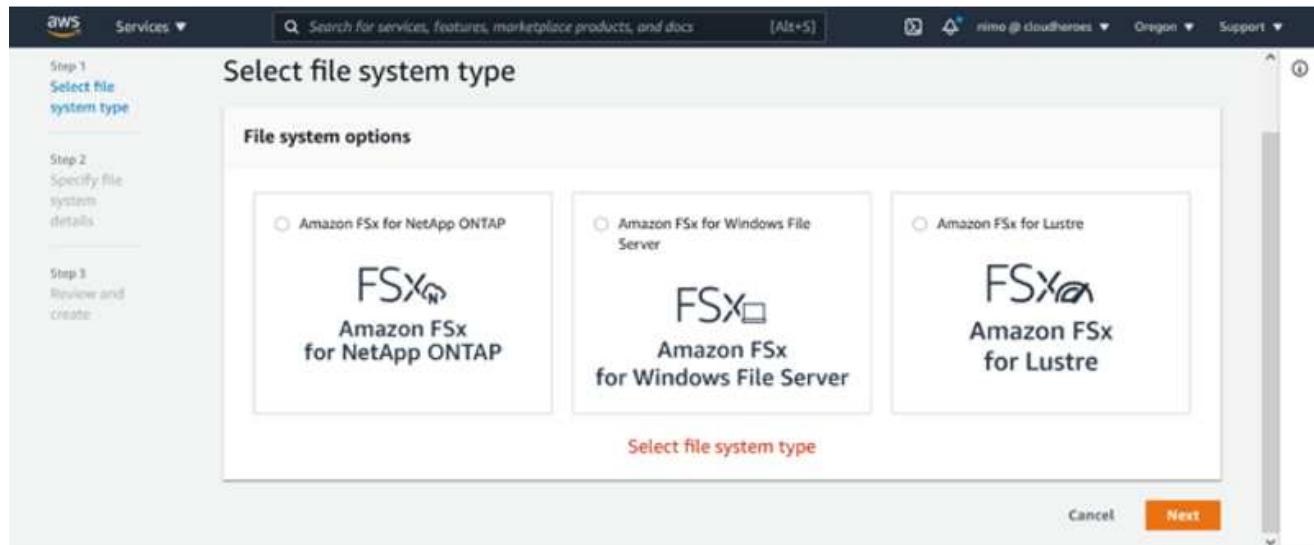


Amazon FSx for NetApp ONTAP and VMware Cloud on AWS must be in the same availability zone to achieve better performance and avoid data transfer charges between availability zones.

## 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.



1. 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.

1. 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](#)

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

SSD storage capacity [Info](#)



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.



1. 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.



VPC Security Groups [Info](#)

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



Preferred subnet [Info](#)

Specify the preferred subnet for your file system.



Standby subnet



### 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, vmcfsx2.vpc is selected from the dropdown.

1. 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

\*\*\*\*\*

1. 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

1. 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



1. Review the file system configuration shown on the Create File System page.

2. Click Create File System.

The screenshot shows the AWS FSx console interface. The top navigation bar includes the AWS logo, Services dropdown, search bar, and user information (nimo @ cloudbearers, Oregon, Support). The main left sidebar has a tree view with 'File systems' selected, showing 'Backups', 'ONTAP' (with 'Storage virtual machines' and 'Volumes' sub-options), 'Windows File Server', 'Lustre' (with 'Data repository tasks'), and 'FSx on Service Quotas'. Below the sidebar are tabs: Network & security, Administration, Storage virtual machines (which is selected and highlighted in orange), Volumes, Backups, and Tags. The main content area displays two tables:

**File systems (3)**

File system name	File system ID	File system type	Status	Deployment type	Storage type	St
fsxtapcifs	fs-014c28399be9c1f9f	ONTAP	Available	Multi-AZ	SSD	1.0
vmcfsvval2	fs-040eacc5d0ac31017	ONTAP	Available	Multi-AZ	SSD	1.0
fsxtapsql	fs-0ab4b447ebd6082aa	ONTAP	Available	Multi-AZ	SSD	2.0

**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
vmcfsvval2svm	svm-095db076341561212	Created	2021-10-15 15:16:54 UTC +01:00	-

Below the tables, the breadcrumb navigation shows: FSx > Storage virtual machines > svm-075dcfbe2cfa2ece9. The specific SVM details page for 'fsxsmbtesting01 (svm-075dcfbe2cfa2ece9)' is displayed, featuring a Summary table with the following data:

SVM ID	Creation time	Active Directory
svm-075dcfbe2cfa2ece9	2021-10-19T15:17:08+01:00	FSXTESTING.LOCAL
SVM name	Lifecycle state	Net BIOS name
fsxsmbtesting01	Created	FSXSMBTESTING01
UUID	Subtype	Fully qualified domain name
4a50e659-30e7-11ec-ac4f-f3ad92a6a735	DEFAULT	FSXTESTING.LOCAL
File system ID	Service account username	Organizational unit distinguished name
fs-040eacc5d0ac31017	administrator	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. nfsdemovol01 is created as depicted below:

**Create volume**

File system  
fs-040eacc5d0ac31017 | vmcfsxval2

Storage virtual machine  
svm-095db076341561212 | vmcfsxval2svm

Volume name  
**nfsdemovol01**

Maximum of 205 alphanumeric characters, plus \_.

Junction path  
**/nfsdemovol01**

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:

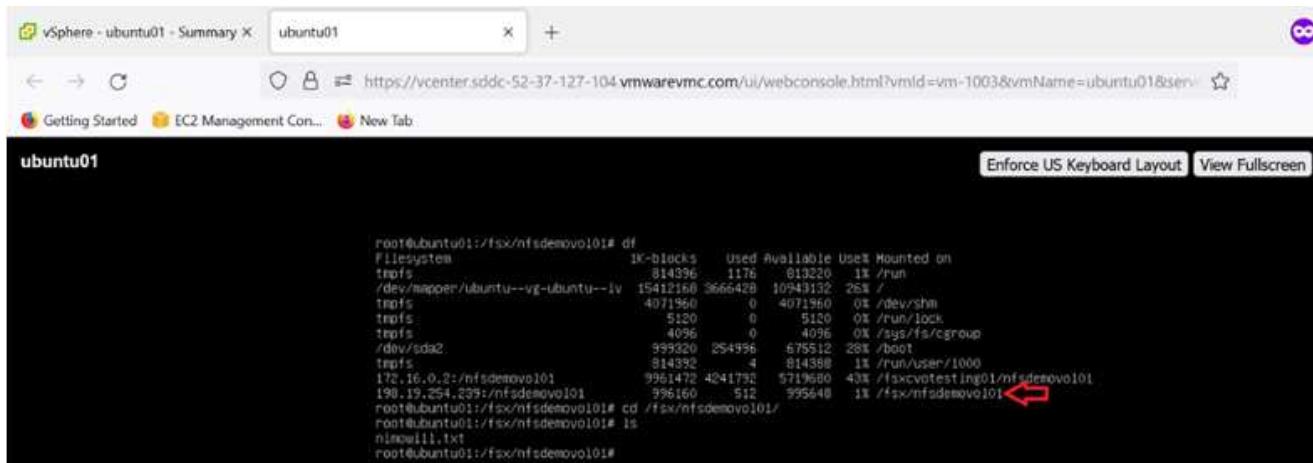
```
$ sudo mkdir /fsx/nfsdemovol01
```

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
```

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



## Mount FSx ONTAP volume on Linux client

## 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	Management IP address
svm-075dcfbe2cfa2ece9.fs-040eacc5d0ac31017.fsx.us-west-2.amazonaws.com	198.19.254.9
NFS DNS name	NFS IP address
svm-075dcfbe2cfa2ece9.fs-040eacc5d0ac31017.fsx.us-west-2.amazonaws.com	198.19.254.9
SMB DNS name	SMB IP address
FSXSMBTESTING01.FSXTESTING.LOCAL	198.19.254.9
iSCSI DNS name	iSCSI IP addresses
iscsi.svm-075dcfbe2cfa2ece9.fs-040eacc5d0ac31017.fsx.us-west-2.amazonaws.com	10.222.2.224, 10.222.1.94

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

Computer Management

File Action View Help

Computer Management (FSXSMBTESTING01.FSXTESTING.LOCAL)

System Tools

- Task Scheduler
- Event Viewer
- Shared Folders
  - Shares
  - Sessions
  - Open Files
- Local Users and Groups
- Performance
- Device Manager

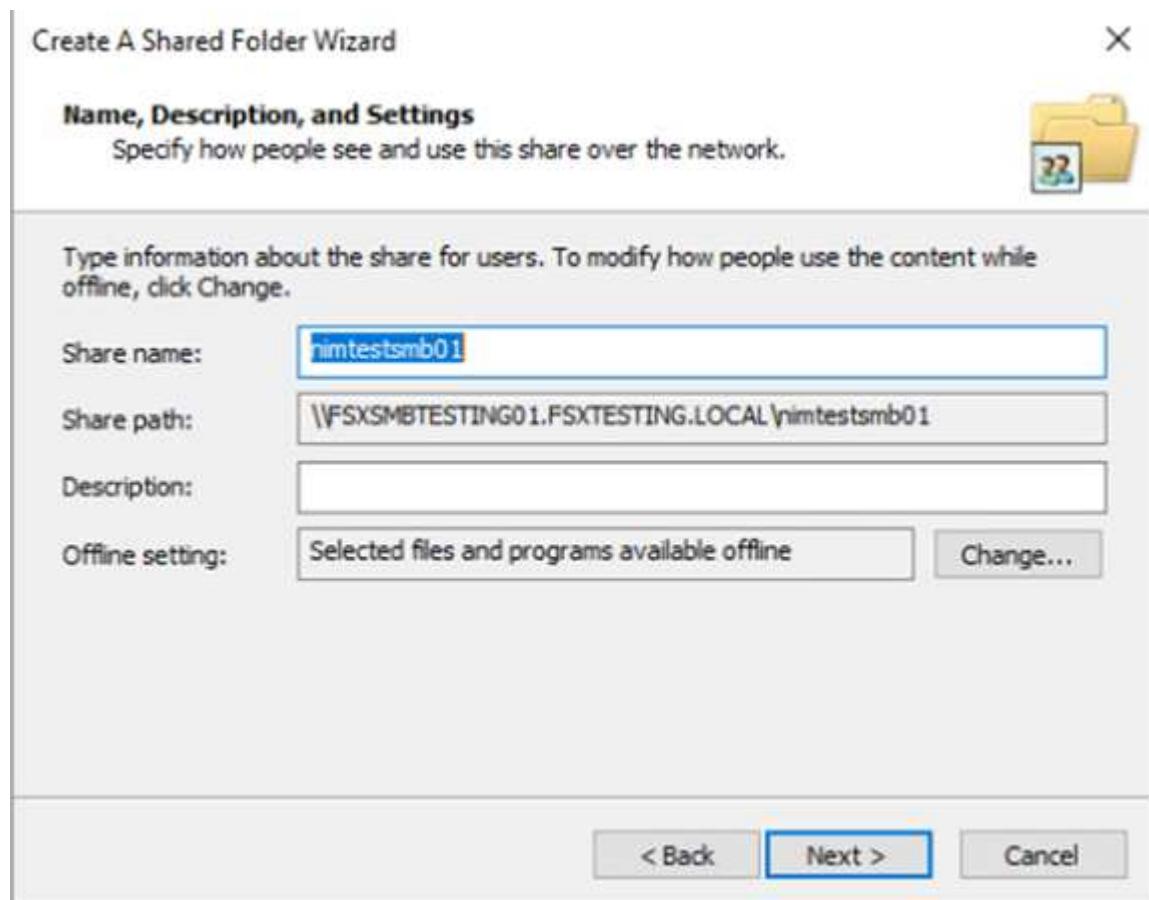
Storage

- Windows Server Backup
- Disk Management

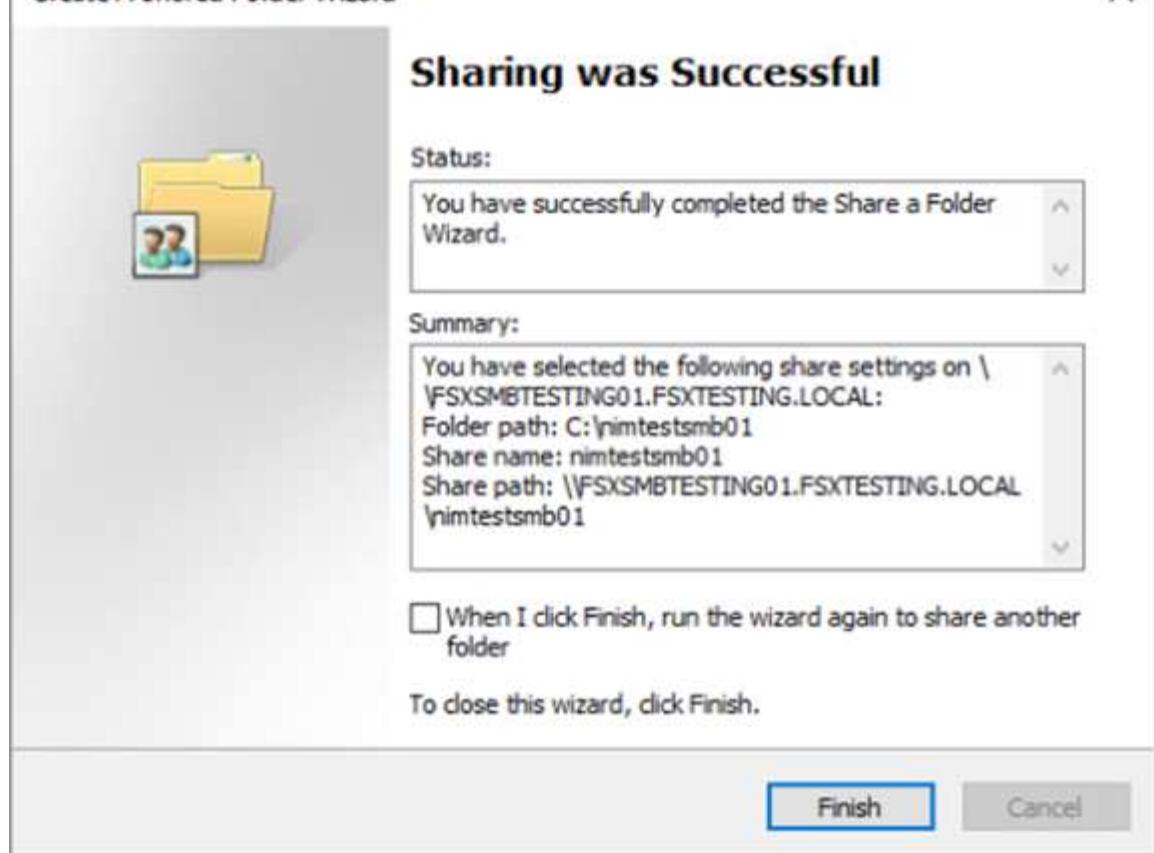
Services and Applications

Share Name	Folder Path	Type	# Client Connections	Description
c\$	C:\	Windows	0	
ipc\$		Windows	1	
smbdemo...	C:\smbdemovol01	Windows	1	
testnimvol	C:\testnimvol	Windows	0	

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



## Create A Shared Folder Wizard



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

1. 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.

The screenshot shows the 'vSphere - vmcd01 - Summary' screen in the VMware Cloud Services interface. The address bar shows the URL: https://vcenter.sddc-52-37-127-104.vmwarevmc.com/u/webconsole.html?vmId=vm-1005&vmName=vmcd01. The main pane displays the 'Computer Management' interface for the 'Computer Management (FSXSMBTESTING01.FSXTESTING.LOCAL)' node. On the left, the navigation tree includes 'Task Scheduler', 'Event Viewer', 'Shares Folders' (which is expanded to show 'Shares' and 'Sessions'), 'Open Files', 'Local Users and Groups', 'Performance', 'Device Manager', 'Storage', 'Windows Server Backup', 'Disk Management', and 'Services and Applications'. The 'Shares' section lists 'This PC > enddemovm01 (\\192.168.254.8) (V)'. The right pane shows a file list for this share, including 'Quarantine', 'Desktop', 'Downloads', 'Documents', 'Pictures', 'This PC', and 'DVD Drive (D:\) 500\_01'. The 'Downloads' folder contains three subfolders: 'new-folded01', 'nimtest01', and 'nimtest02'. The 'Actions' column for the 'Downloads' folder shows 'Share' and 'More Actions' (with 'enddemovm01' selected). A red arrow points to the 'Downloads' folder in the file list.

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

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

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 vmcfsxval2svm -volume nimfsxscsivol -lun nimofsxlun01 -size 5gb -ostype windows -space -reserve enabled
```

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

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

```
FsxId040eacc5d0ac31017::> igrup create -vserver vmcfsxval2svm -igroup winIG -protocol iscsi -ostype windows -initiator iqn.1991-05.com.microsoft:vmcdc01.fsxtesting.local
```

```
FsxId040eacc5d0ac31017::> igrup show
```

Vserver	Igroup	Protocol	OS	Type	Initiators
---------	--------	----------	----	------	------------

```
----- ----- ----- -----
```

```
-----
```

```
vmcfsxval2svm
```

```
              ubuntu01      iscsi      linux      iqn.2021-10.com.ubuntu:01:initiator01
```

```
vmcfsxval2svm
```

```
              winIG      iscsi      windows    iqn.1991-05.com.microsoft:vmcdc01.fsxtesting.local
```

Two entries were displayed.

1. 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.

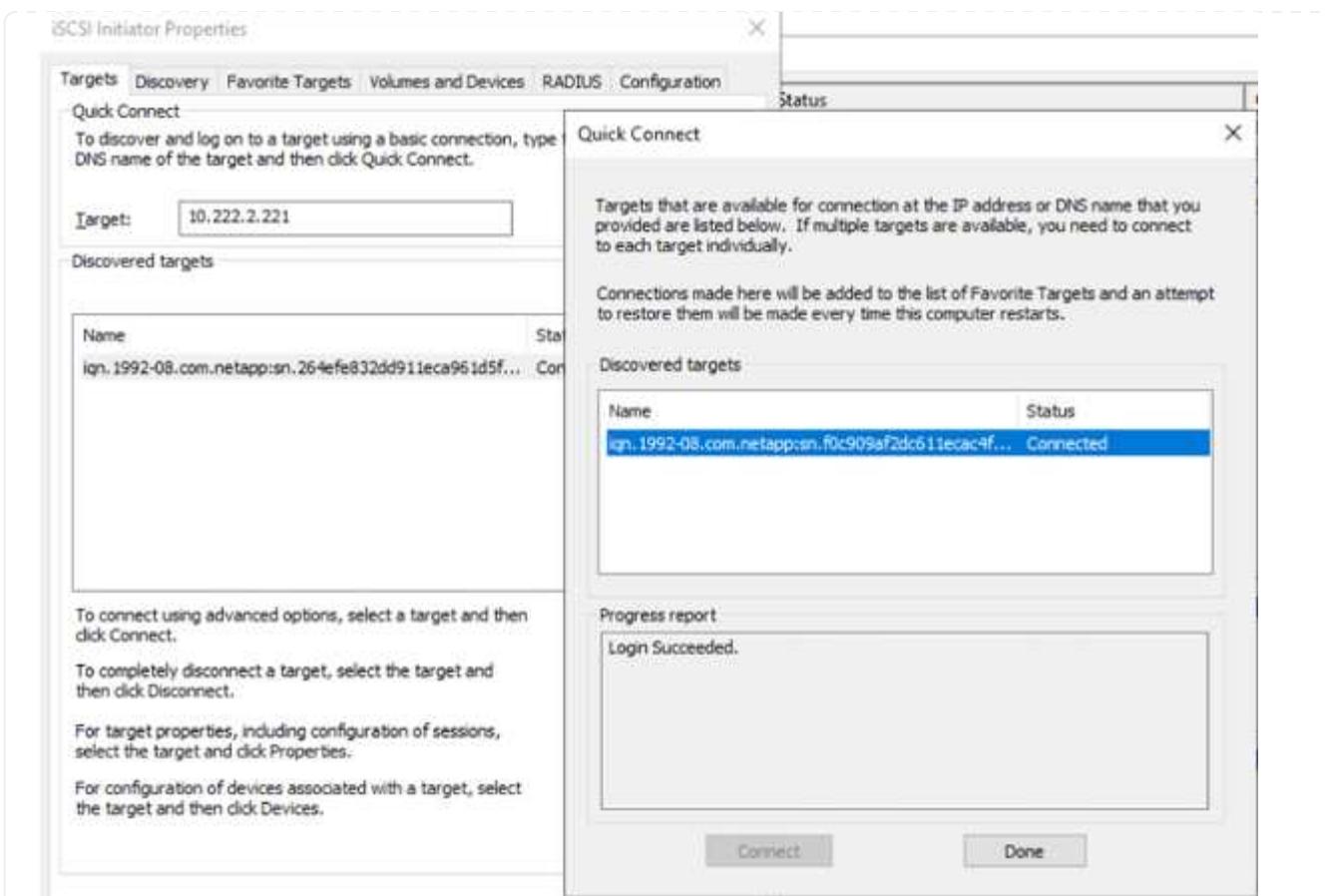
1. Connect the newly provisioned LUN to a Windows VM:

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

- a. RDP to the Windows VM hosted on the VMware Cloud on AWS SDDC.
- b. Navigate to Server Manager > Dashboard > Tools > iSCSI Initiator to open the iSCSI Initiator Properties dialog box.
- 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.

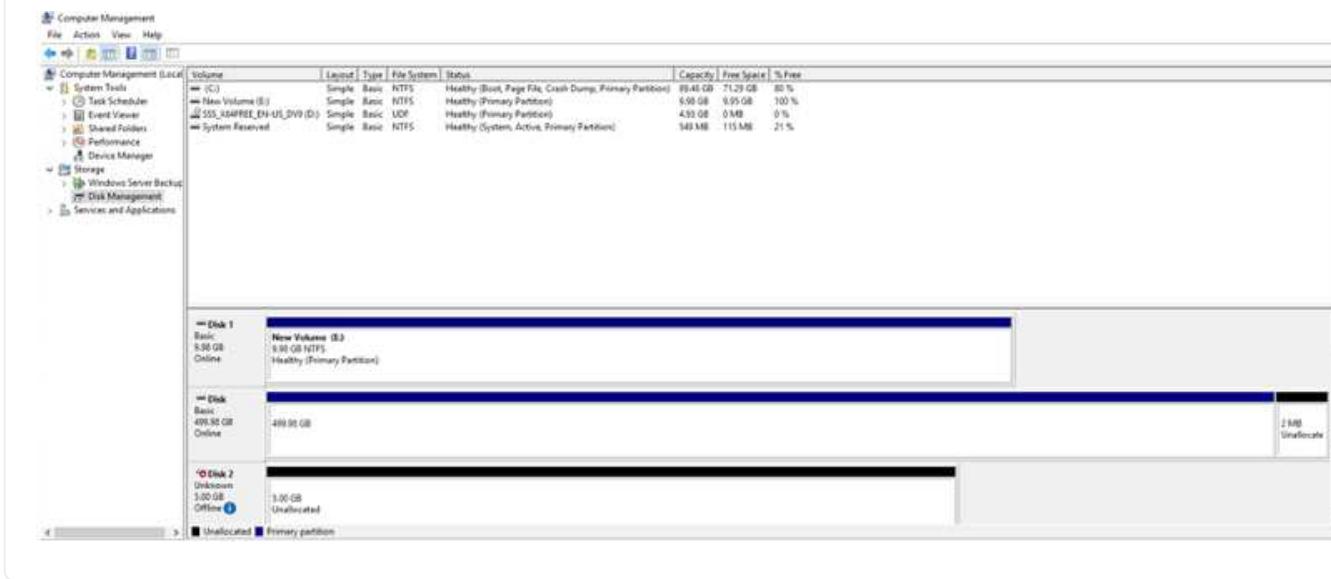


The Windows host must have an iSCSI connection to each node in the cluster. The native DSM selects the best paths to use.



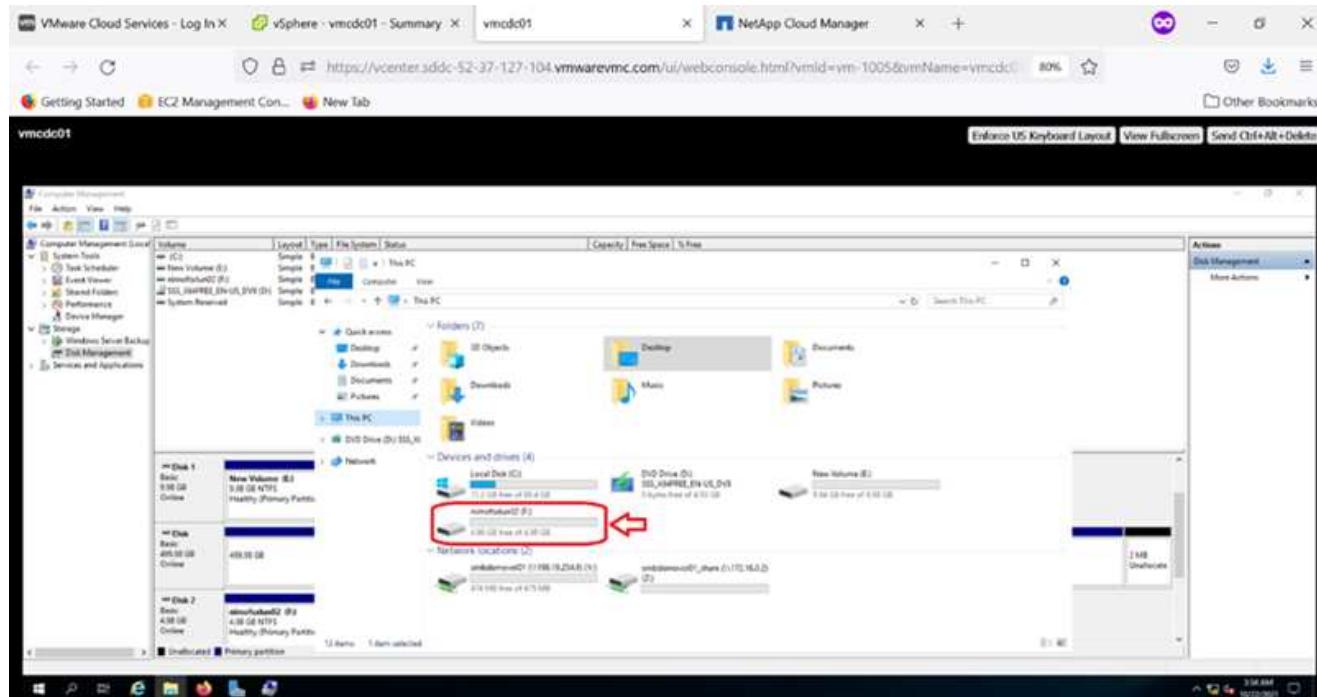
LUNs on the storage virtual machine (SVM) appear as disks to the Windows host. Any new disks that are added are not automatically discovered by the host. Trigger a manual rescan to discover the disks by completing the following steps:

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 your 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.

1. 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.

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

Create a New Working Environment

Details and Credentials

<a href="#">↑ Previous Step</a>	Instance Profile Credential Name	139763910815 Account ID	netapp.com-cloud-volumes-... Marketplace Subscription	<a href="#">Edit Credentials</a>
---------------------------------	-------------------------------------	----------------------------	--	----------------------------------

Details	Credentials
Working Environment Name (Cluster Name) <input type="text" value="fsxvotesting01"/>	User Name <input type="text" value="admin"/>
<a href="#">Add Tags</a> Optional Field   Up to four tags	Password <input type="password" value="*****"/>
	Confirm Password <input type="password" value="*****"/>

[Continue](#)

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

Create a New Working Environment

Services

 Data Sense & Compliance	<input checked="" type="checkbox"/> <a href="#">View details</a>
 Backup to Cloud	<input checked="" type="checkbox"/> <a href="#">View details</a>
 Monitoring	<input checked="" type="checkbox"/> <a href="#">View details</a>

[Continue](#)

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

Create a New Working Environment

HA Deployment Models

<a href="#">↑ Previous Step</a>	<a href="#">Multiple Availability Zones</a>	<a href="#">Single Availability Zone</a>
	<ul style="list-style-type: none"> <li> Provides maximum protection against AZ failures.</li> <li> Enables selection of 3 availability zones.</li> <li> An HA node serves data if its partner goes offline.</li> </ul> <p><a href="#">Extended Info</a></p>	<ul style="list-style-type: none"> <li> Protects against failures within a single AZ.</li> <li> Single availability zone. HA nodes are in a placement group, spread across distinct underlying hardware.</li> <li> An HA node serves data if its partner goes offline.</li> </ul> <p><a href="#">Extended Info</a></p>

1. 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](#)

1. 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](#)

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

## Floating IPs

[↑ 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

172.16.0.1

Floating IP address 1 for NFS and CIFS data

172.16.0.2

Floating IP address 2 for NFS and CIFS data

172.16.0.3

Floating IP address for SVM management (Optional)

172.16.0.4

[Continue](#)

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

## Route Tables

[↑ 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](#)

1. 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](#)

1. 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 &amp; NSS Account

## Cloud Volumes ONTAP Charging Methods

[Learn more about our charging methods](#) Pay-As-You-Go by the hour Bring your own licenseNetApp 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](#)

1. 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](#)

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

Create a New Working Environment      Review & Approve

↑ Previous Step **tsxcvotesting** Show API request

AWS | us-west-2 | HA

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**

- 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) ▾

**Canvas**    Go to Tabular View

Add Working Environment

**vmdsvn12** F5s for ONTAP  
9 Volumes    26.49 GB Capacity    AWS

**fsxcvotesting01** Cloud Volumes ONTAP | AWS | HA  
■ On

**Amazon S3**  
4 Buckets    2 Regions    AWS

**DETAILS**  
Cloud Volumes ONTAP | AWS | HA

**SERVICES**  
Replication: Off    Enable    Details  
Backup & Restore: Loading...    Details

## Additional configurations for SMB volumes

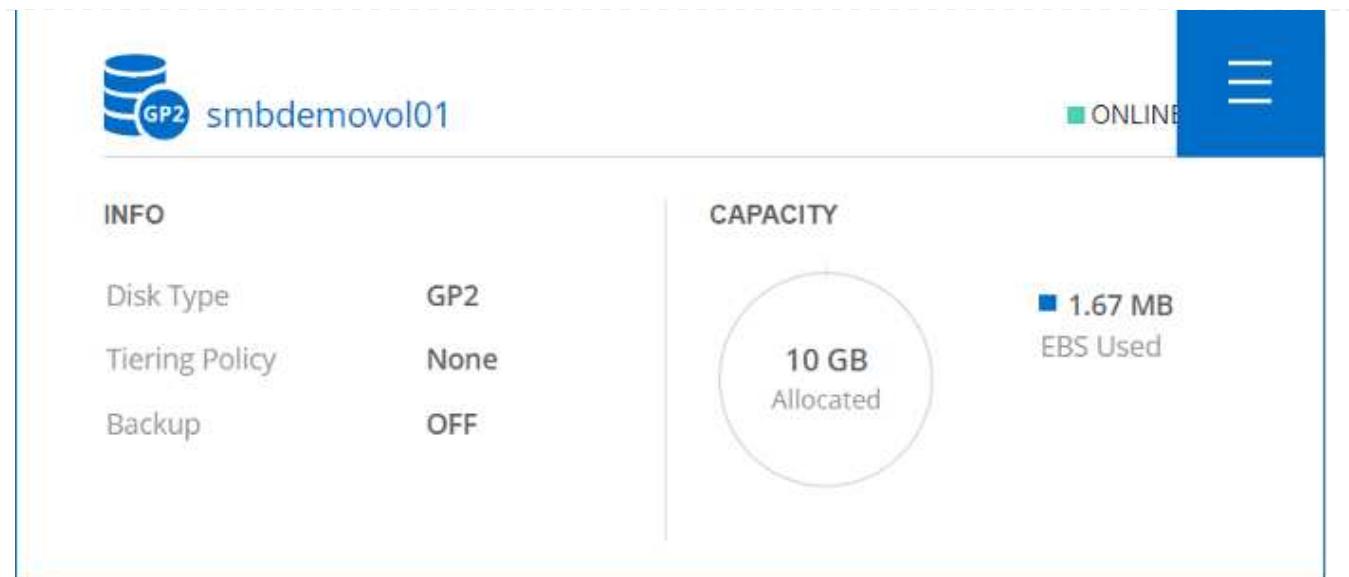
1. After the working environment is ready, make sure the CIFS server is configured with the appropriate DNS and Active Directory configuration parameters. This step is required before you can create the SMB volume.

The screenshot shows the 'Create a CIFS server' configuration page. It includes fields for DNS Primary IP Address (192.168.1.3), Active Directory Domain to join (foxtesting.local), DNS Secondary IP Address (Optional), Credentials authorized to join the domain (Username and Password), and Save and Cancel buttons.

1. 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 has two tabs: 'Details & Protection' and 'Protocol'. In the 'Protocol' tab, the 'CIFS' tab is selected. It shows fields for Share name (smbdemovol01\_share) and Permissions (Full Control). Below that, it shows Users / Groups (Everyone) and a note about valid user separation. A 'Continue' button is at the bottom.

1. 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.



1. 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.
2. 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.

fsxcvotesting01 (Multiple AZs)

Volumes HA Status Cost Replications

Mount Volume smbdemovol01

Access from inside the VPC using Floating IP

Auto failover between nodes  
The IP address automatically migrates between nodes if failures occur

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

Go to your machine and enter this command

\\\172.16.0.2\smbdemovol01\_share

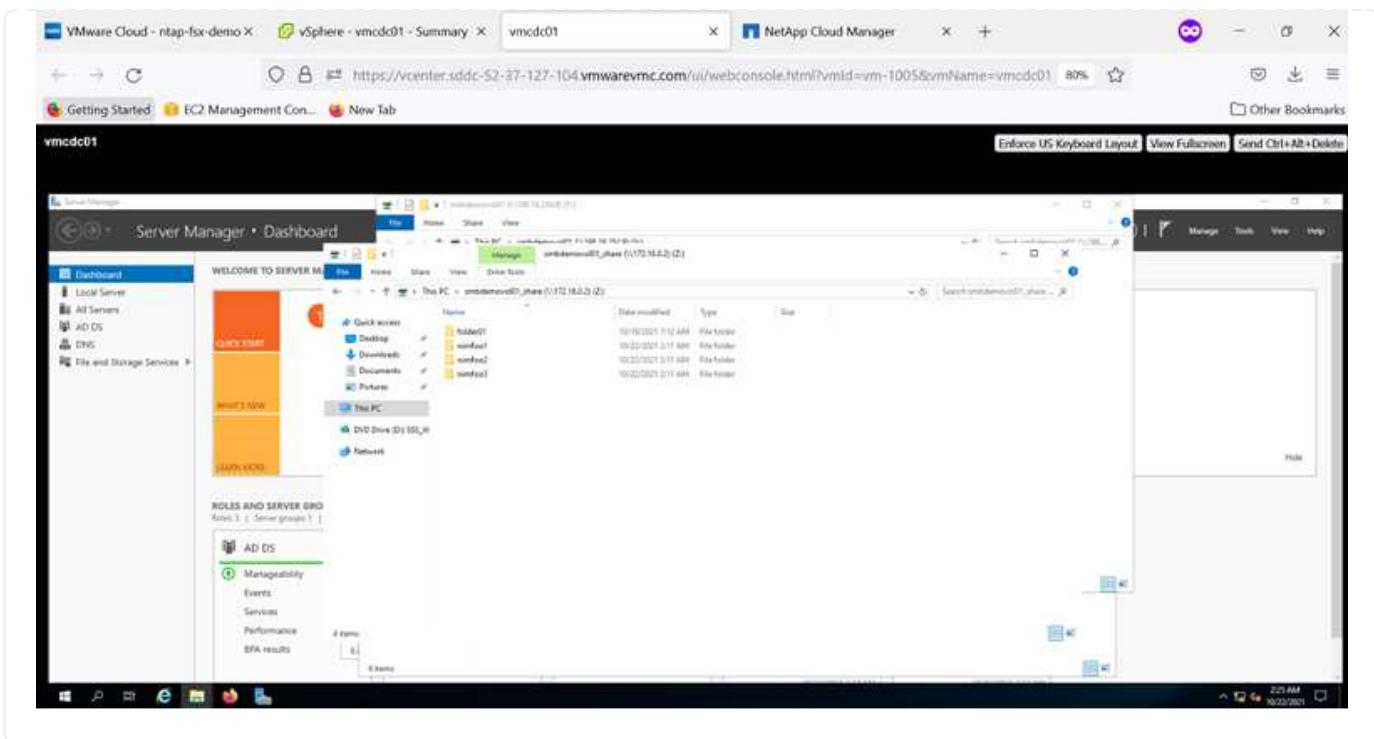
Copy

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

\\\10.222.1.100\smbdemovol01\_share

Copy

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.

Create new volume in fsxvotesting01

Volume Details, Protection & Protocol

Details & Protection

Protocol

Volume Name: nimofsxiscsicvo01 Size (GB): 500

Snapshot Policy: default

Initiator Group

Map Existing Initiator Groups

Operating System Type: Windows

Select Initiator Groups: 1 (of 3) Groups

winIG | windows  
iqn.1991-05.com.microsoft:vmcdc01.fsxtesting01

Continue

VMware Cloud - ntap-fox-demo X vSphere - vmcdc01 - Summary X vmcdc01 X NetApp Cloud Manager X

Getting Started EC2 Management Con... New Tab

vmcdc01

Server Manager + Dashboard

WELCOME TO SERVER M...

File Home Share View

File Tools

Manage umiddemo01\$ share (\\172.16.0.1\2)

Dashboard Local Server All Servers AD DS DNS File and Storage Services

QUICK LINKS WHAT'S NEW LISTS

File Desktop Downloads Documents Pictures

The PC DVD Drive (D) 153, W Network

Name Date modified Type Size

folderv1 09/16/2023 11:12 AM File Folder

folderv2 09/16/2023 11:12 AM File Folder

folderv3 09/16/2023 11:12 AM File Folder

folderv4 09/16/2023 11:12 AM File Folder

File Manager

ROLES AND SERVER GRID

AD DS Manageability Events Services Performance BPA results

2:29 AM 16/09/2023

1. 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.

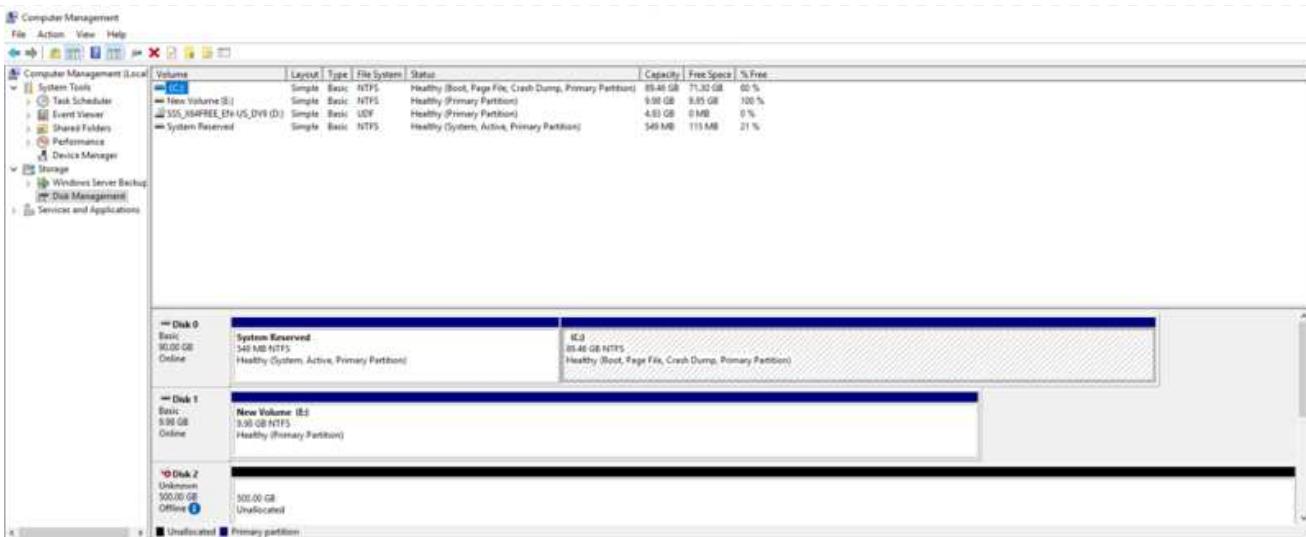


The Windows host must have an iSCSI connection to each node in the cluster. The native DSM selects the best paths to use.



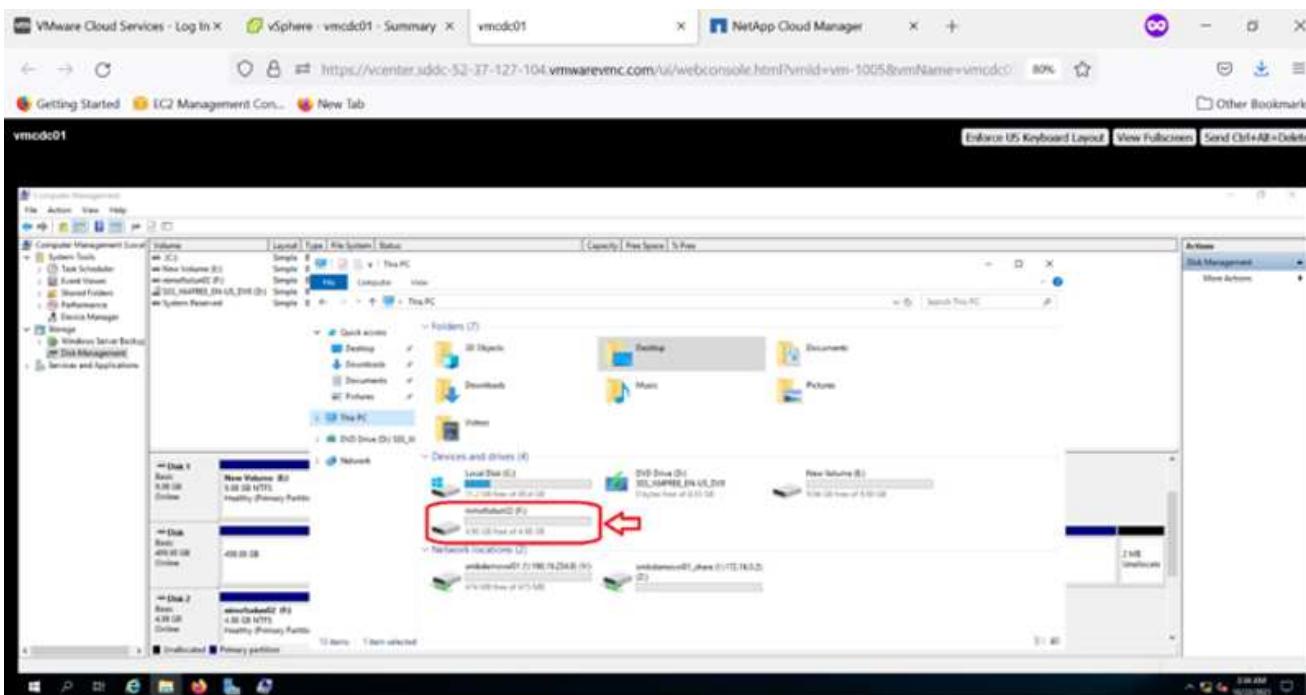
LUNs from the SVM appear as disks to the Windows host. Any new disks that are added are not automatically discovered by the host. Trigger a manual rescan to discover the disks by completing the following steps:

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
```

```
root@ubuntu01:/fsx# mount -t nfs 172.16.0.2:/nfsdemovol01 /fsxcvotesting01/nfsdemovol01_
vSphere - ubuntu01 - Summary × ubuntu01 ✎ + https://vcenter.sddc-52-37-127-104.vmwarevmc.com/ui/webconsole.html?vmId=vm-1003&vmName=ubuntu01&se...
Getting Started EC2 Management Con... New Tab
ubuntu01 Enforce US Keyboard Layout View Fullscreen
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            4071950     0  4071950  0% /dev/shm
tmpfs             5120     0   5120  0% /run/lock
tmpfs              4096     0   4096  0% /sys/fs/cgroup
/dev/sda2        999320  254956   675512  28% /boot
tmpfs            814382     4   814388  1% /run/user/1000
172.16.0.2:/nfsdemovol01  3961472 4241792  5719680 43% /fsxcvotesting01/nfsdemovol01
root@ubuntu01:/fsx/nfsdemovol01# cd /fsx/nfsdemovol01/
root@ubuntu01:/fsx/nfsdemovol01# ls
nimoufull.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' creation form in the Azure portal. The 'Name' field is filled with 'nimoAVSANFDemo'. The 'Subscription' dropdown is set to 'SaaS Backup Production'. The 'Resource group' dropdown is set to 'NimoAVSDemo', with 'Create new' as an option. The 'Location' dropdown is set to 'East US 2'. At the bottom, there 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](#).

The screenshot shows the Azure NetApp Files interface. On the left, there's a navigation bar with 'Create', 'Manage view', and a search bar. The main area displays 'nimoAVSANFDemo | Capacity pools'. A 'Capacity pools' section is visible, along with 'Volumes', 'Data protection', 'Snapshot policies', 'Storage service add-ons', 'NetApp add-ons', and 'Automation'. At the bottom, there's a 'Page' navigation bar. On the right, a 'New capacity pool' dialog box is open, asking for 'Name \*' (nimappool), 'Service level \*' (Standard), 'Size (TiB) \*' (4), and 'QoS type' (Auto). Buttons for 'Create' and 'Discard' are at the bottom of the dialog.

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](#).

The screenshot shows the Azure Virtual Network interface. On the left, there's a navigation bar with 'Overview', 'Activity log', 'Access control (IAM)', 'Tags', 'Diagnose and solve problems', 'Settings', 'Address space', 'Connected devices', 'Subnets' (which is selected), 'DDoS protection', 'Firewall', and 'Security'. The main area displays 'nimoavspiv-vnet | Subnets'. A 'Subnets' section is visible, along with 'GatewaySubnet', 'VMSubnet', and 'StorageSubnet'. On the right, a 'Add subnet' dialog box is open, asking for 'Name \*' (anf.del), 'Subnet address range \*' (172.24.3.0/28), 'Add IPv6 address space' (unchecked), 'NAT gateway' (None), 'Network security group' (None), and 'Route table' (None). Buttons for 'Save' and 'Cancel' are at the bottom of the dialog.

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.

**Join Active Directory**

Primary DNS \* 172.24.1.5  
Secondary DNS  
AD DNS Domain Name \* nimodemo.com  
AD Site Name  
SMB Server (Computer Account) Prefix \* nimsmbr  
Organizational Unit Path  
Join

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

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

**Create a volume**

**Basics**

This page will help you create an Azure NetApp Files volume in your subscription and enable you to access the volume from within your virtual network. [Learn more about Azure NetApp Files](#)

**Volume details**

Volume name *	nimvoltest1
Capacity pool *	nimcappool
Available quota (GiB) *	4096
Quota (GiB) *	100

Review + create < Previous Next : Protocol >

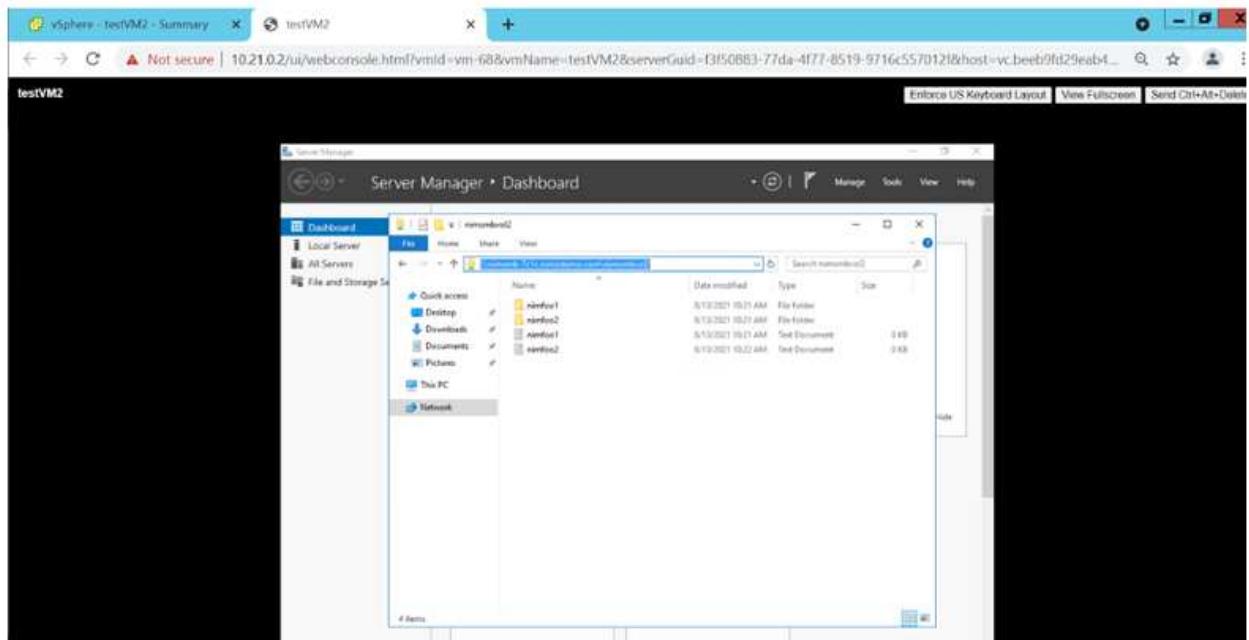
The screenshot shows the Azure NetApp Files portal interface. At the top, there's a navigation bar with 'Home > Azure NetApp Files > nimoAVSANFdemo'. Below it is a title bar 'nimoAVSANFdemo | Volumes' with a 'NetApp account' icon. A search bar 'Search (Ctrl + /)' and a 'Refresh' button are on the right. On the left, a sidebar has icons for 'Quota', 'Properties', 'Locks', 'Azure NetApp Files', and 'Active Directory connections'. The main area is titled 'Search volumes' and contains a table with columns: Name, Quota, Throughput, Protocol type, Mount path, Service level, and Capacity px. Two volumes are listed:

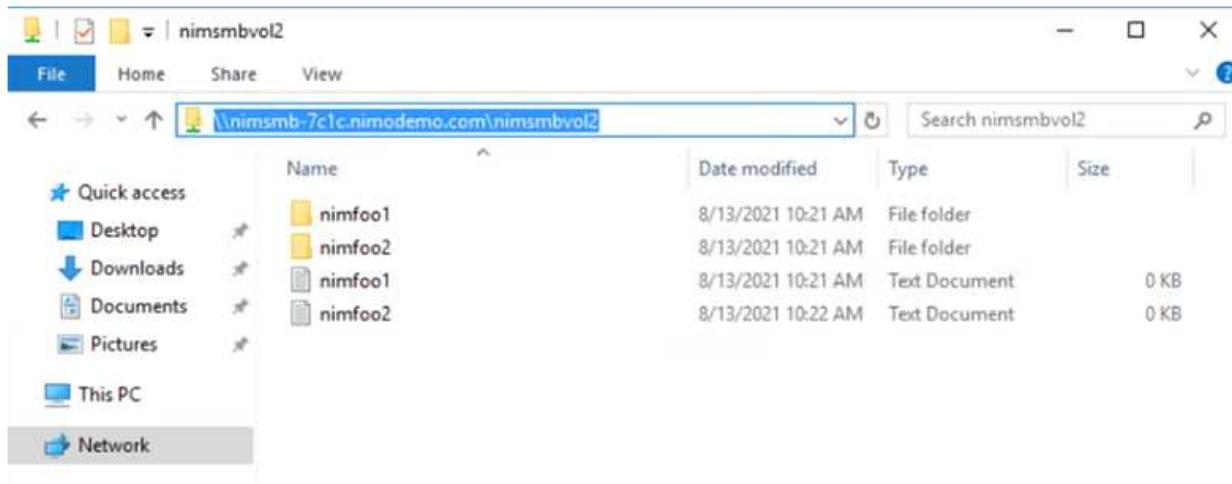
Name	Quota	Throughput	Protocol type	Mount path	Service level	Capacity px
nimsmbvol2	100 GiB	1.6 MiB/s	SMB	\\\nimsmbr-7c1c.nimodr	Standard	nimcappoo
nim voltest1	100 GiB	1.6 MiB/s	NFSv3	172.24.3.4/nim voltest1	Standard	nimcappoo

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.





- 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/nimodemo11
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/nimodemo11
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 your 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

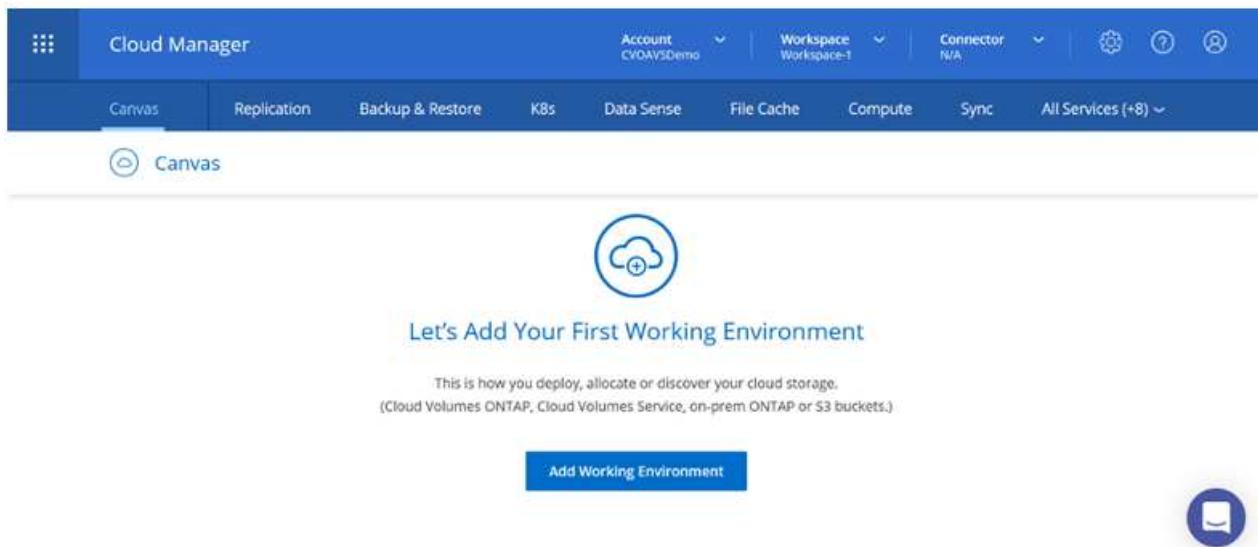
Cloud Volumes ONTAP shares and LUNs can be mounted from VMs that are created in the Azure VMware Solution SDDC environment. The volumes can also be mounted on the Linux client and on Windows client because Cloud Volumes ONTAP supports iSCSI, SMB, and NFS protocols. Cloud Volumes ONTAP volumes can be 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](#).

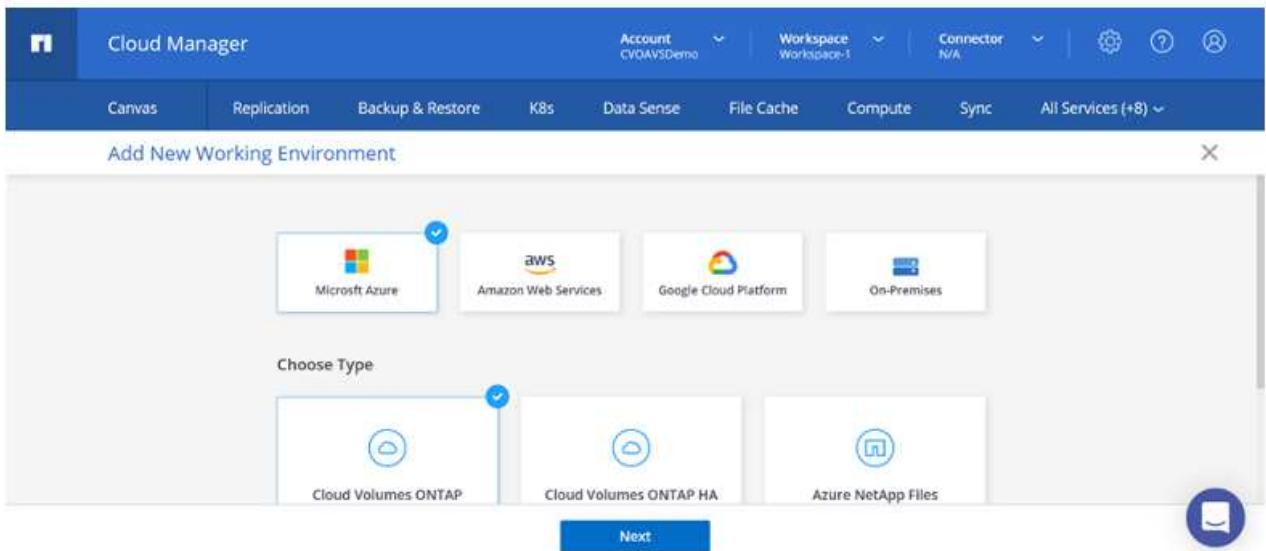


Use [Cloud Volumes ONTAP sizer](#) to accurately size the Cloud Volumes ONTAP instances. Also monitor on-premises performance to use as inputs in the Cloud Volumes ONTAP sizer.

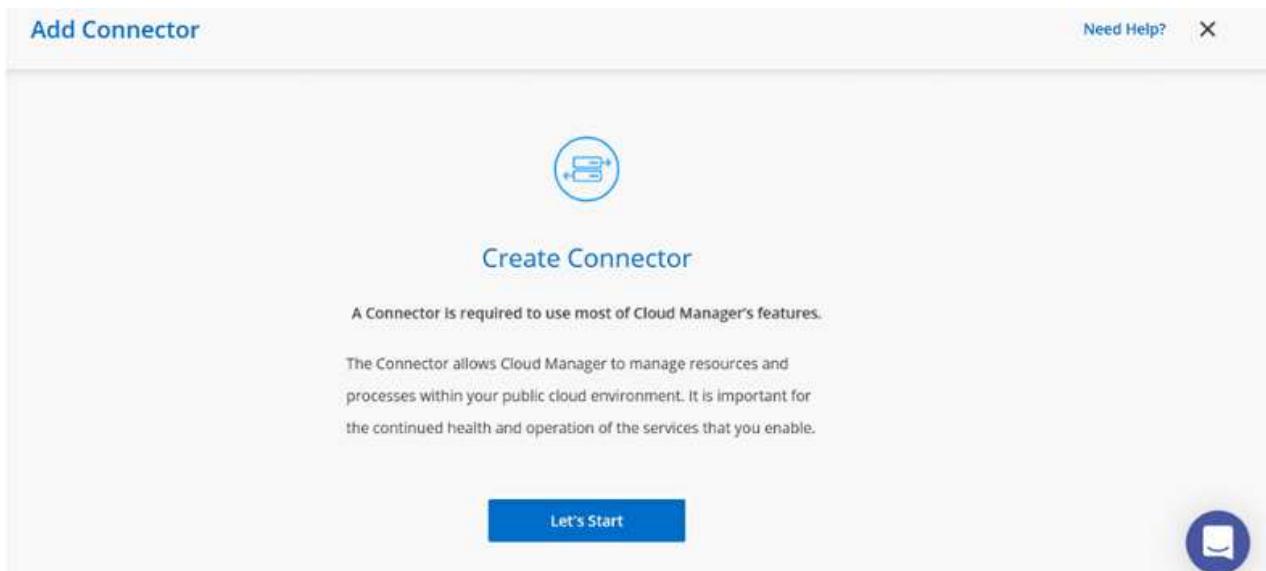
1. Log in to NetApp Cloud Central—the Fabric View screen is displayed. Locate the Cloud Volumes ONTAP tab and select Go to Cloud Manager. After you are logged in, the Canvas screen is displayed.



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.

#### Create a New Working Environment

#### Details and Credentials

Managed Service Ide...	SaaS Backup Prod...	CMCVOSub	<a href="#">Edit Credentials</a>
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.

#### Create a New Working Environment

#### Details and Credentials

Details	Credentials
Working Environment Name (Cluster Name) nimavscVO	User Name admin
<a href="#">+ Add Resource Group Tags</a> 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.

#### Create a New Working Environment

#### Services

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

[Continue](#)

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

Create a New Working Environment

Location & Connectivity

Azure Region East US 2	Resource Group <input checked="" type="radio"/> Create a new group <input type="radio"/> Use an existing group.
Availability Zone Select an Availability Zone	Resource Group Name nimavscvdo-rg
VNet nimavspiv-vnet   NimavSDemo	Security Group <input checked="" type="radio"/> Generated security group <input type="radio"/> Use existing security group
Subnet 172.24.2.0/24	<input checked="" type="checkbox"/> I have verified network connectivity between the Cloud Manager server and the selected VNet.
<a href="#">Continue</a>	

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

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

Cloud Volumes ONTAP Charging Methods <a href="#">Learn more about our charging methods</a>	NetApp Support Site Account (Optional) <a href="#">Learn more about NetApp Support Site (NSS) accounts</a>
 <input checked="" type="radio"/> Pay-As-You-Go by the hour  <input type="radio"/> Bring your own license	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.
<a href="#">Continue</a>	

- 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
<a href="#">Continue</a>			

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

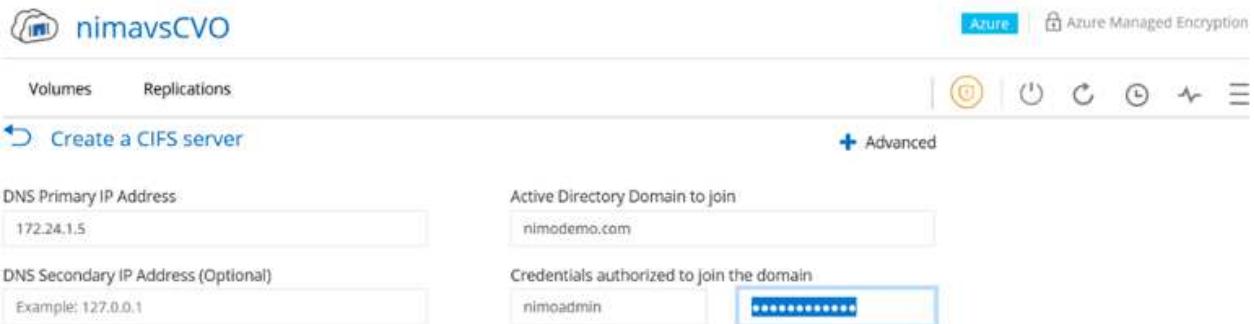
The screenshot shows the 'Review & Approve' step of a wizard. At the top, it displays the environment name 'nimavsCVO' and location 'Azure | East US 2'. Below this are two checked checkboxes: 'I understand that in order to activate support, I must first register Cloud Volumes ONTAP with NetApp.' and 'I understand that Cloud Manager will allocate the appropriate Azure resources to comply with my above requirements.' A horizontal navigation bar below the checkboxes includes tabs for 'Overview' (which is highlighted in blue), 'Networking', and 'Storage'. A large blue 'Go' button is centered at the bottom of the main content area.

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

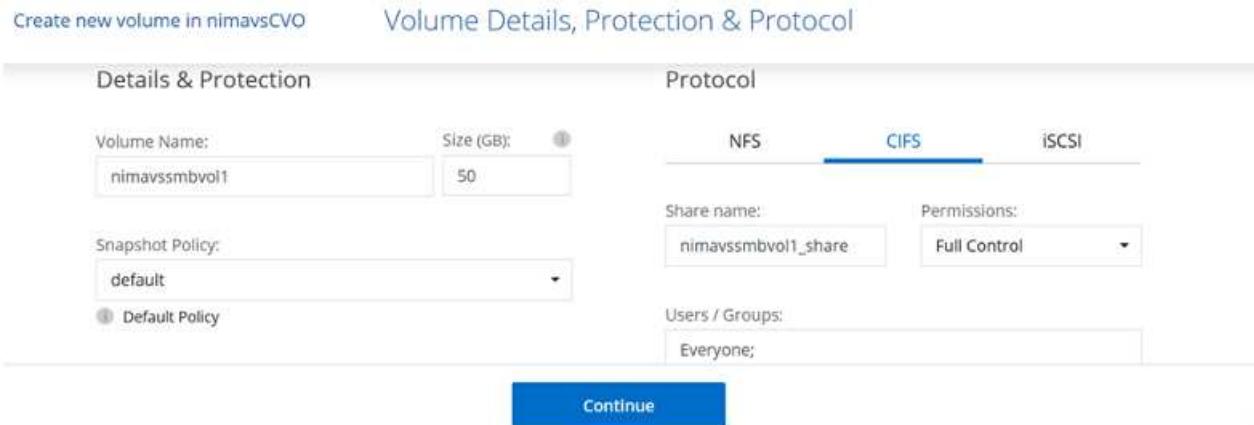
The screenshot shows the 'Canvas' page with the 'nimavsCVO' environment listed. The 'DETAILS' section shows the environment is 'On' and lists 'Cloud Volumes ONTAP | Azure | Single'. The 'SERVICES' section includes tabs for 'Replication' (which is selected) and 'Enter Working Environment'. On the left, there's a summary card for 'nimavsCVO Cloud Volumes ONTAP' labeled 'Freemium' with a '+' and '-' button below it.

## 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.



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.



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 Replications

Volumes

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

nimavssmbvol1 ONLINE

INFO

Disk Type: PREMIUM\_LRS  
Tiering Policy: Auto  
Backup: OFF

CAPACITY

50 GB Allocated

1.74 MB Disk Used  
0 KB Blob Used

4. 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.

5. Copy the following path and use the Map Network Drive option to mount the volume on the VM running on Azure VMware Solution SDDC.

Volumes Replications

Mount Volume nimavssmbvol1

Go to your machine and enter this command

\\172.24.2.8\vimavssmbvol1\_share

Copy

\\172.24.2.8\vimavssmbvol1\_share

Name Date modified Type Size

This folder is empty.

## 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 the 'Add Volume' wizard interface. The 'Protocol' tab is selected, showing options for NFS, CIFS, and iSCSI. The iSCSI tab is highlighted. Below it, a link 'What about LUNs?' is visible. The 'Initiator Group' section contains a radio button for 'Create Initiator Group' which is selected, and an input field containing 'avsvmlG'. The 'Details & Protection' section includes fields for 'Volume Name' (nimavsscsi1), 'Size (GB)' (500), and 'Snapshot Policy' (default). A 'Default Policy' radio button is also present. At the bottom 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.

Volume	Layout	Type	File System	Status	Capacity	Free Space	% Free
(C)	Simple	Basic	NTFS	Healthy (Boot, Page File, Crash Dump, Primary Partition)	39.51 GB	24.99 GB	63 %
(D)	Simple	Basic	UDF	Healthy (Primary Partition)	6.49 GB	0 MB	0 %
System Reserved	Simple	Basic	NTFS	Healthy (System, Active, Primary Partition)	500 MB	169 MB	34 %

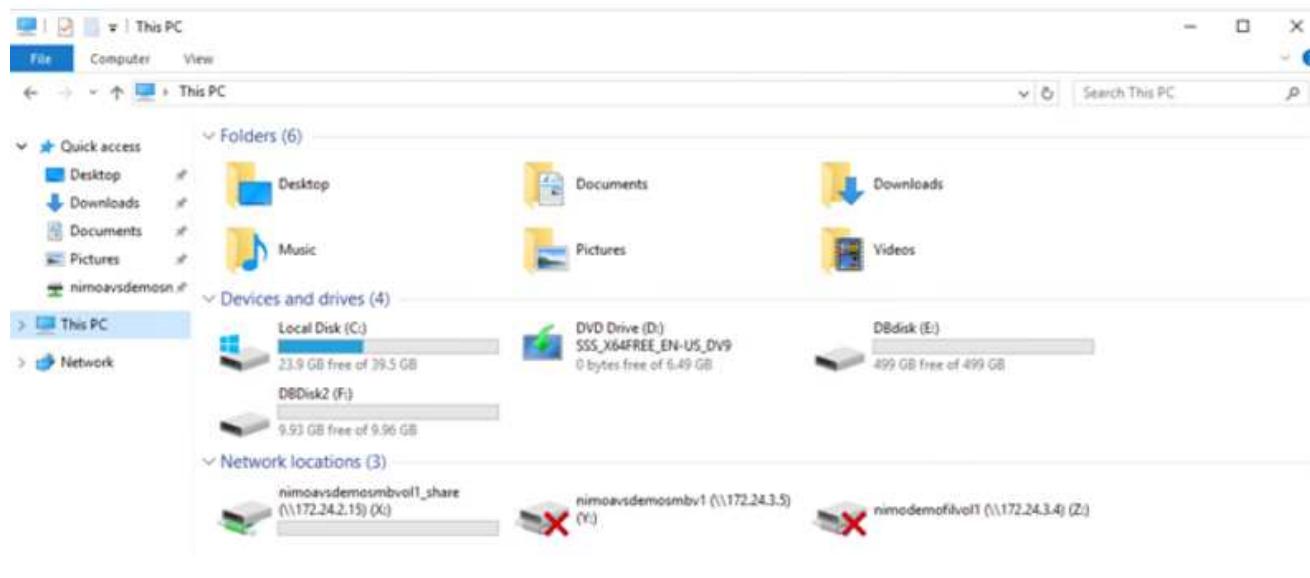
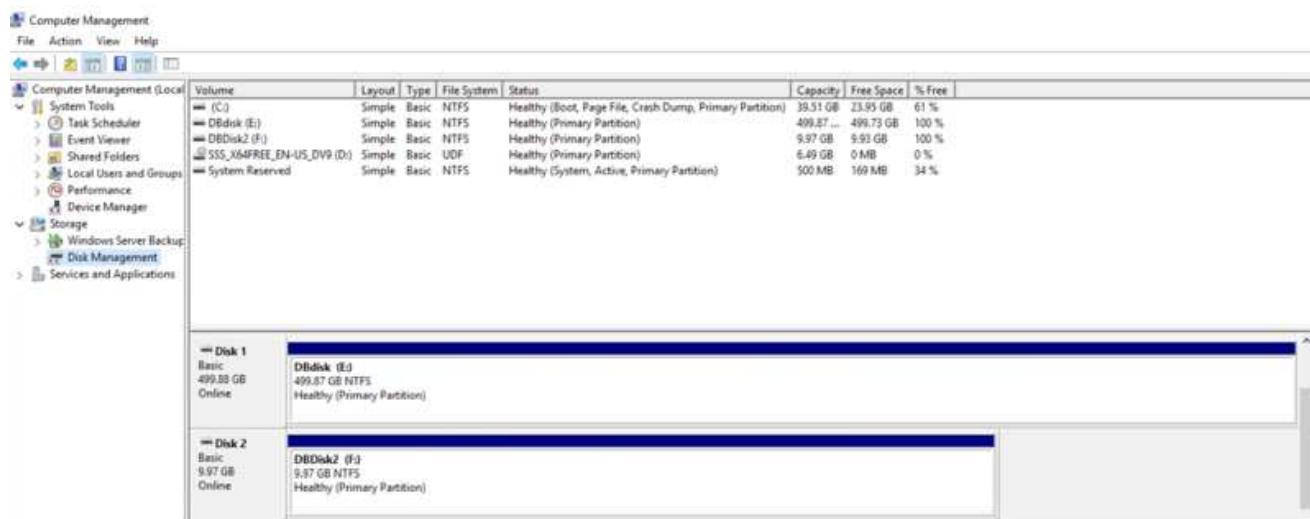
Disk 0	System Reserved	(C)
Basic 40.00 GB Online	500 MB NTFS Healthy (System, Active, Primary Partition)	39.51 GB NTFS Healthy (Boot, Page File, Crash Dump, Primary Partition)

Disk 1	Unknown
50.00 GB Not Initialized	50.00 GB Unallocated

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

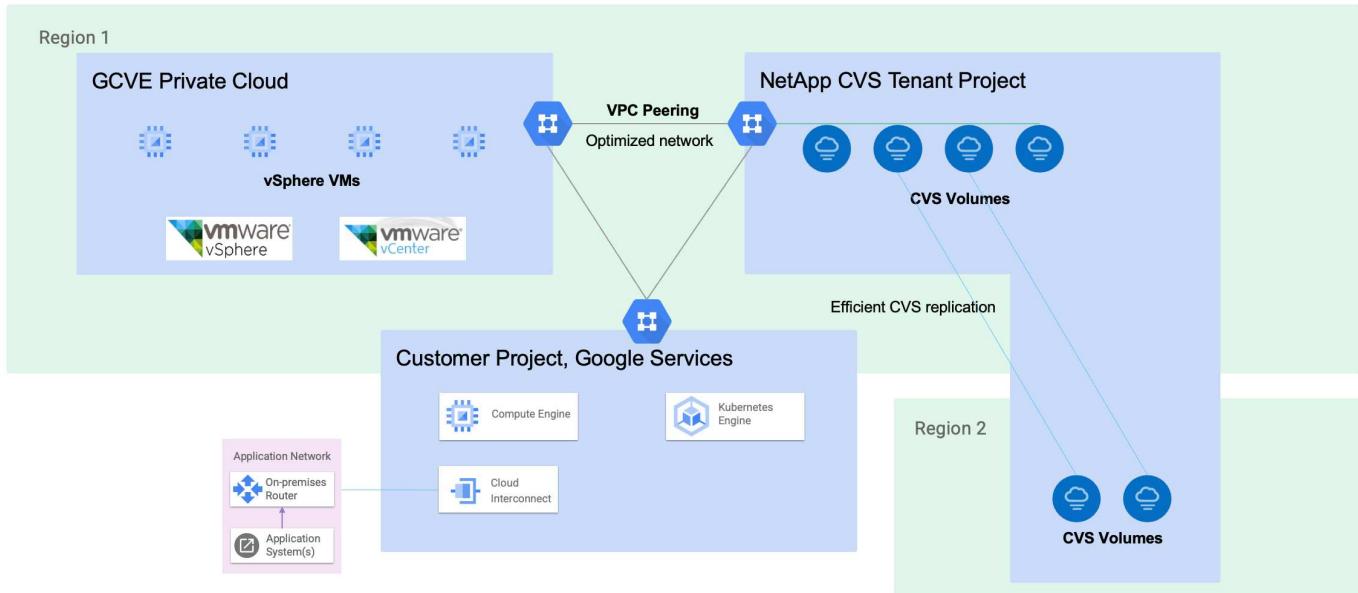


## Google Cloud VMware Engine Supplemental NFS Datastore with NetApp Cloud Volume Service

### Overview

Authors: Suresh Thoppay, NetApp

Customers that require 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 disaster.



## 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.

Cloud Volumes

Storage Pools

Volumes

Backups

Snapshots

Active Directories

Volume Replication

Project Settings

Up to 0.4 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 your 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)

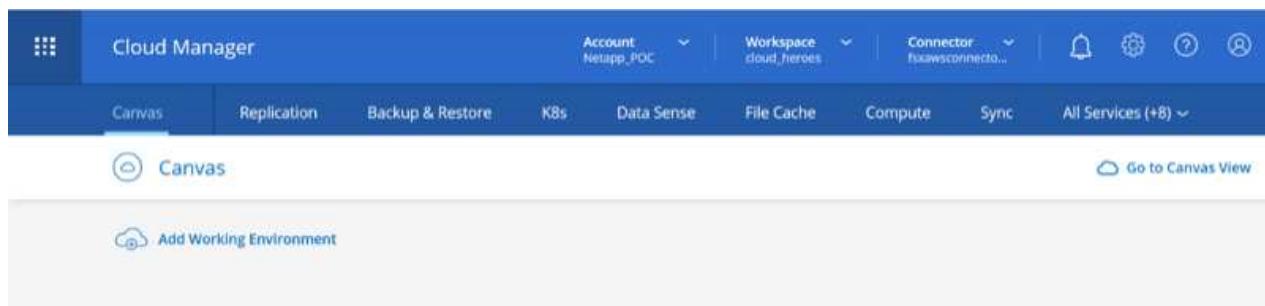
Cloud Volumes ONTAP shares and LUNs can be mounted from VMs that are created in the GCVE private cloud environment. The volumes can also be mounted on the Linux client and on Windows client and LUNS can be accessed on Linux or Windows clients as block devices when mounted over iSCSI because Cloud Volumes 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](#).

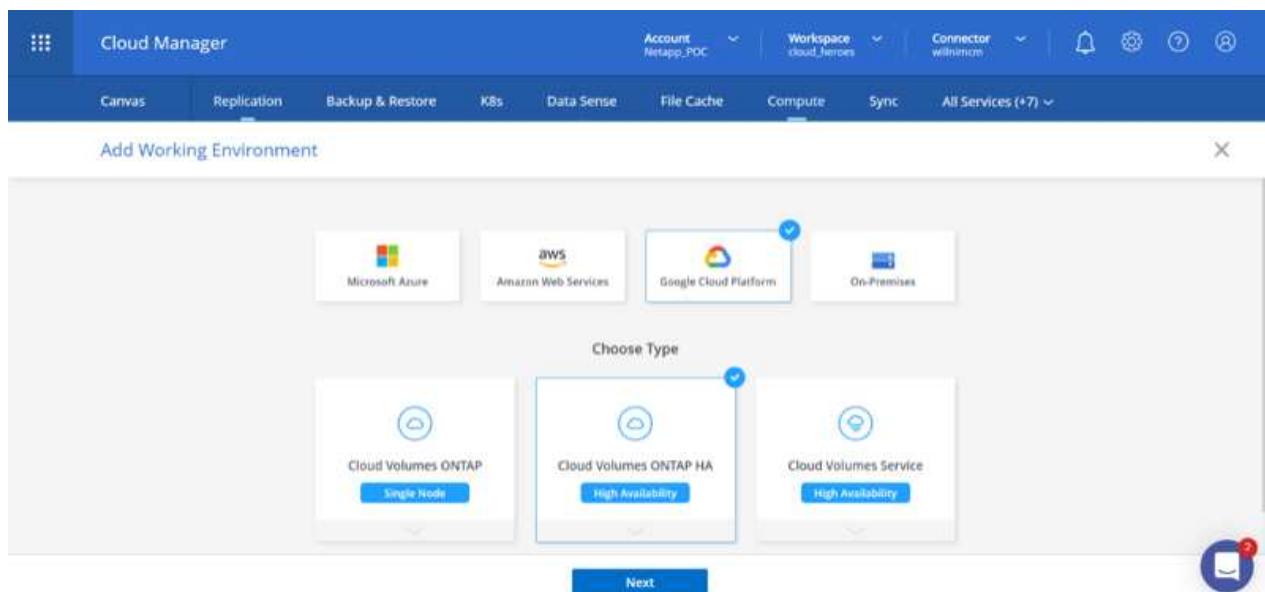


Use [Cloud Volumes ONTAP sizer](#) to accurately size the Cloud Volumes ONTAP instances. Also monitor on-premises performance to use as inputs in the Cloud Volumes ONTAP sizer.

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      HCLMainBillingAccountSubs...  
Google Cloud Project      Marketplace Subscription      Edit Project

Details      Credentials

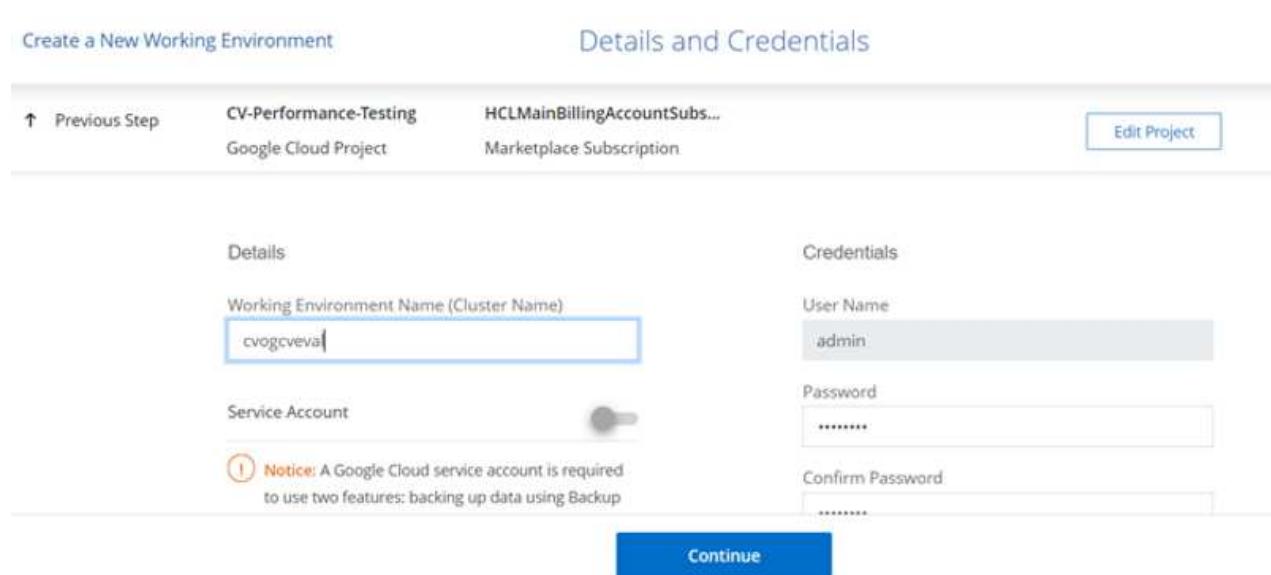
Working Environment Name (Cluster Name)  
cvogcveva

Service Account

**Notice:** A Google Cloud service account is required to use two features: backing up data using Backup & Compliance or Backup to Cloud.

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

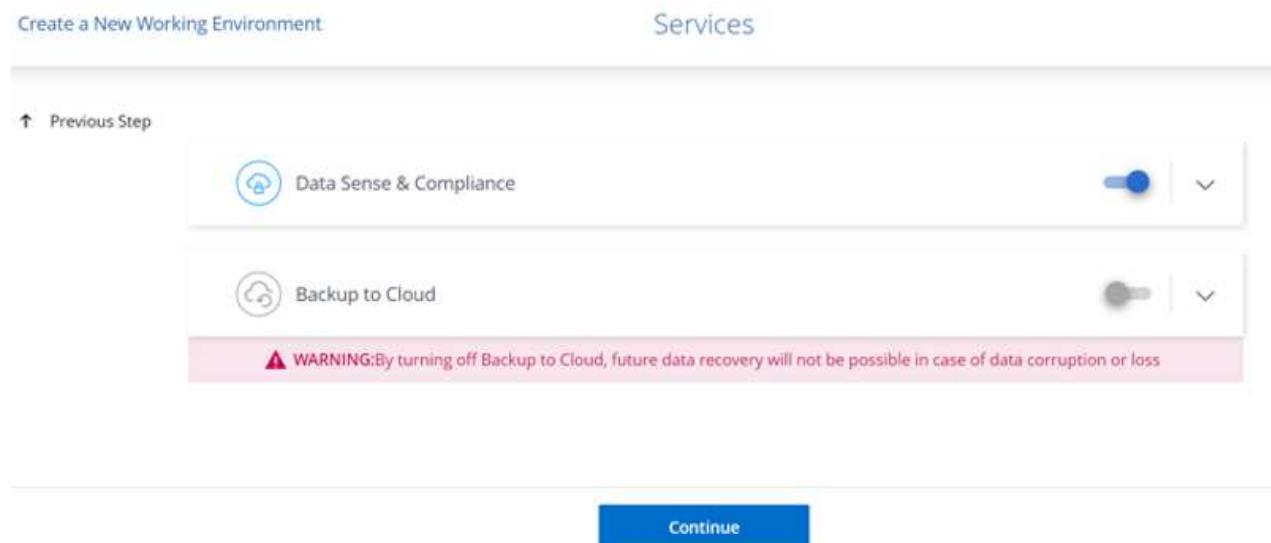
↑ Previous Step

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

GCP Region

europe-west3

Connectivity

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

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](#)

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

Create a New Working Environment      Review & Approve

↑ Previous Step [cvogcveval](#) Show API request

GCP | europe-west3

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 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](#)

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

Cloud Manager

Account: Netapp\_POC   Workspace: cloud\_heroes   Connector: willmccorm

Canvas   Replication   Backup & Restore   KBS   Data Sense   File Cache   Compute   Sync   All Services (+7)

Add Working Environment   Go to Tabular View

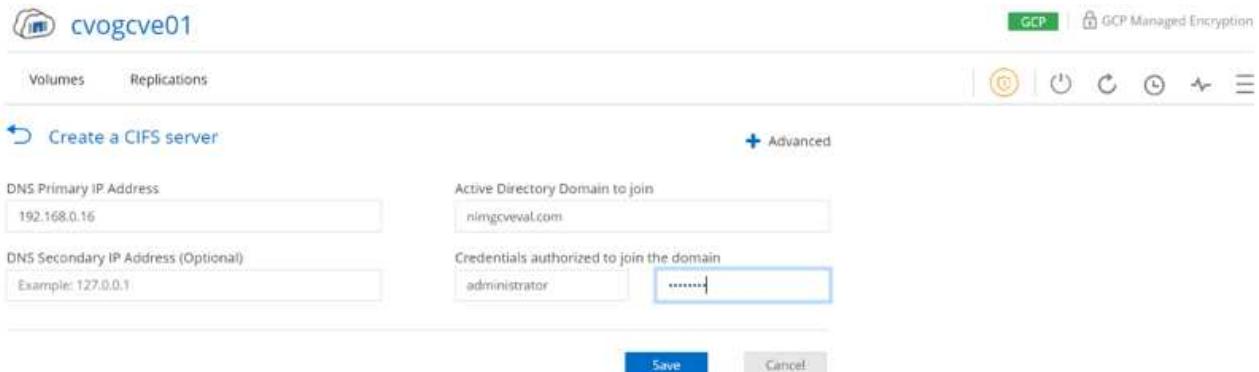
Working Environments

- cvogcve01 Cloud Volumes ONTAP   Freemium
- DatacenterDude Azure NetApp Files   31 Volumes, 9.71 TiB Capacity
- 1 Cloud Volumes ONTAP 43.05 GiB Provisioned Capacity
- 1 FSx for ONTAP (High-Availability) 0 B Provisioned Capacity
- 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.



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 'Create new volume in cvogcve01' screen. The 'Volume Details, Protection & Protocol' tab is selected. The 'Protocol' section is active, showing:

Protocol
NFS
<b>CIFS</b>
iSCSI

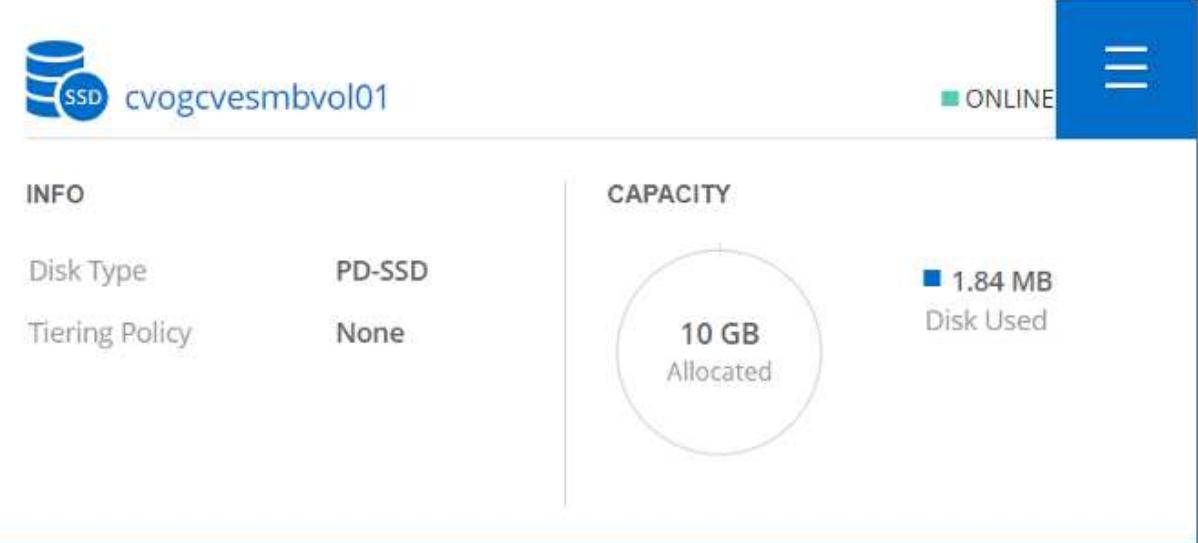
Configuration details for the CIFS protocol:

- Share name: cvogcvesmbvol01\_share
- Permissions: Full Control
- Users / Groups: Everyone
- Valid users and groups separated by a semicolon

A 'Continue' button is at the bottom.

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.



- 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.

The screenshot shows a 'cvogcve01' storage volume. A 'Mount Volume' button is visible, along with a 'Copy' button for the share path '\\10.0.6.251\cvogcvesmbvol01\_share'.

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

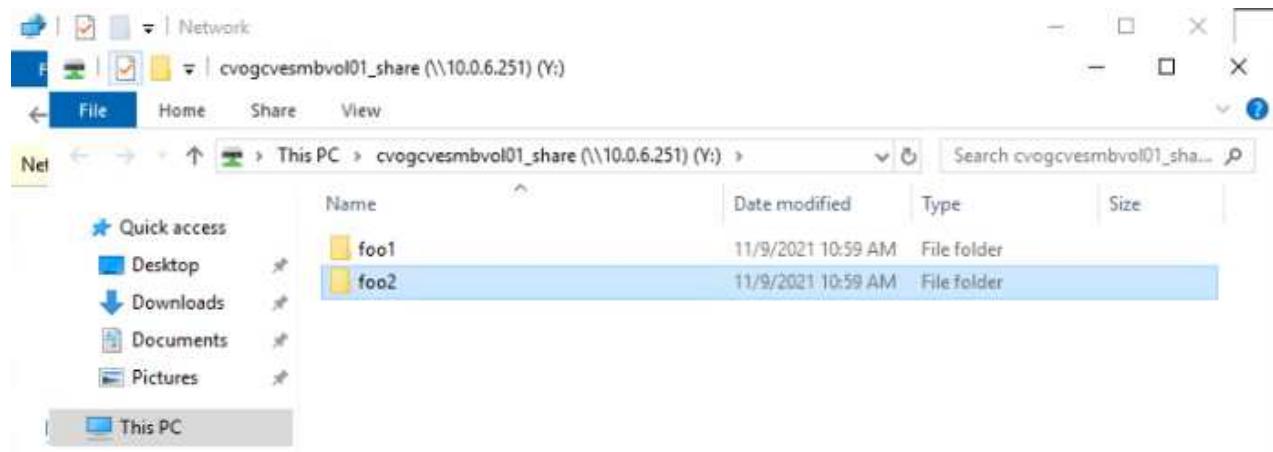
Example: \\server\share

Reconnect at sign-in

Connect using different credentials

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

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



## Connect the LUN on Cloud Volumes ONTAP to a host

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.

The screenshot shows the 'Volume Details, Protection & Protocol' configuration screen. The 'Volume Name' is 'cvogcvescsilun01' and the 'Size (GB)' is '10'. The 'Protocol' tab is selected, showing options for NFS, CIFS, and iSCSI. The iSCSI tab is active. In the 'Initiator Group' section, 'Create Initiator Group' is selected, and the initiator group name is 'WinIG'. The 'Operating System Type' is set to 'Windows'. A 'Continue' button is at the bottom.

Below the configuration screen, a browser window titled 'vSphere - vmdc01 - Summary' is open, showing the 'File Manager' interface. It displays a file structure under 'This PC > vmdc01\_share (f:\172.16.0.2) (D)'. The 'QUICK LINK' section includes 'Desktop', 'Downloads', 'Documents', and 'Pictures'. The 'ROLES AND SERVER GRO' section shows 'AD DS' and 'Management'.

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.

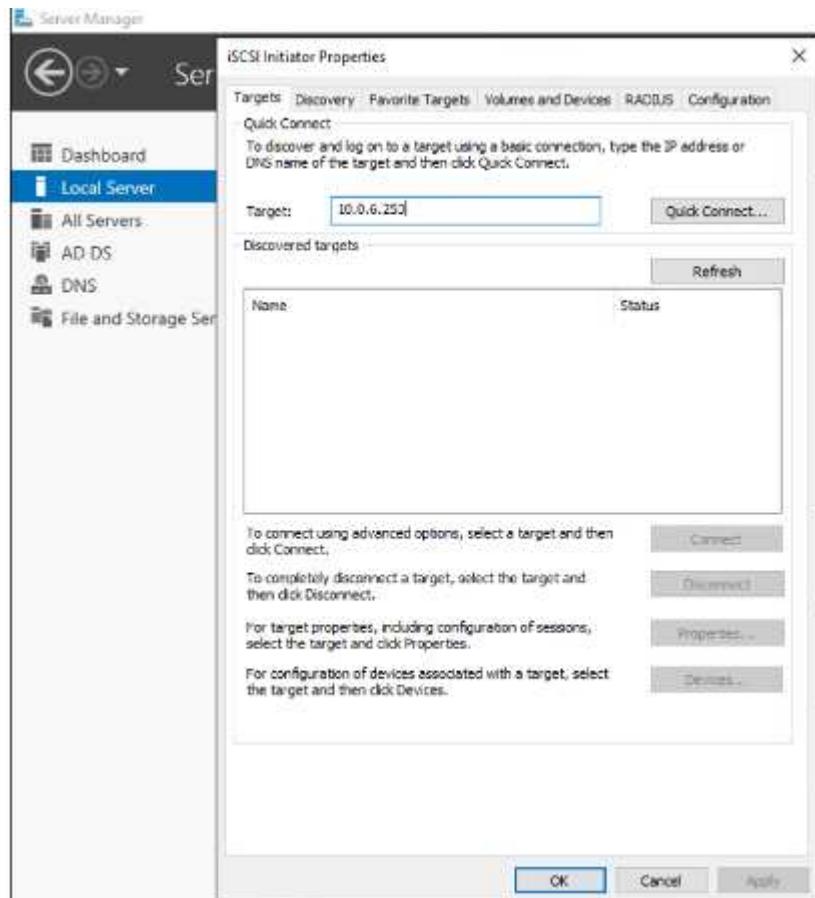
To accomplish the same for the host residing on Google Cloud VMware Engine:

- 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.

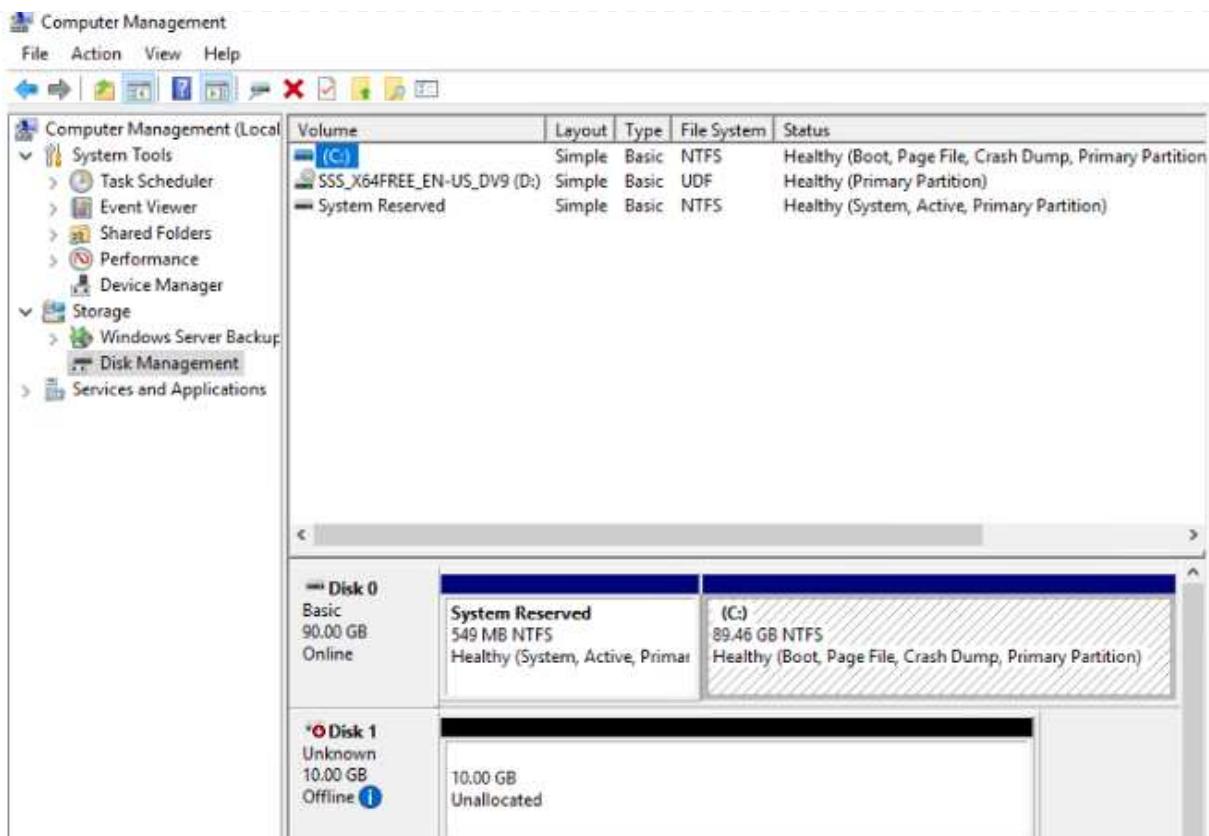


The Windows host must have an iSCSI connection to each node in the cluster. The native DSM selects the best paths to use.



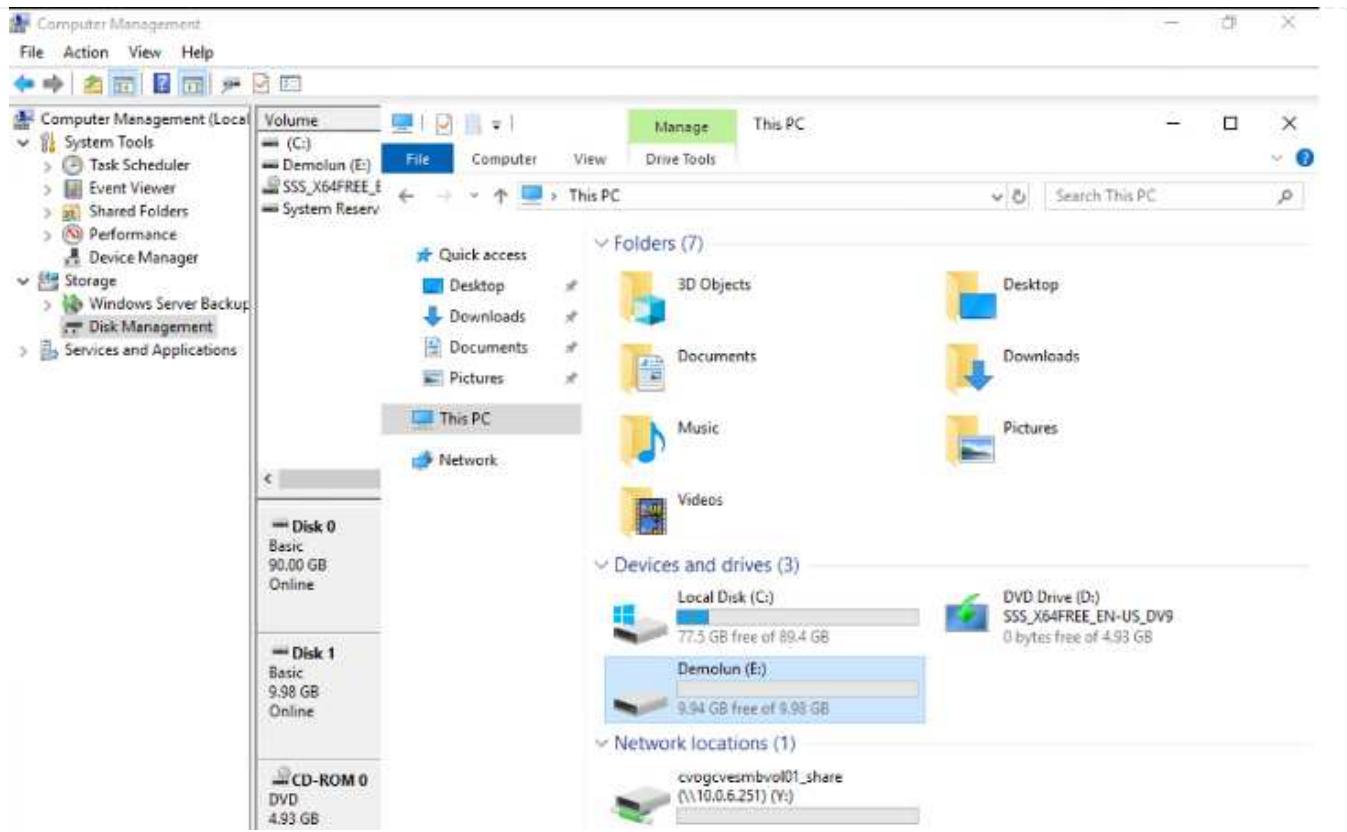
LUNs on storage virtual machine (SVM) appear as disks to the Windows host. Any new disks that are added are not automatically discovered by the host. Trigger a manual rescan to discover the disks by completing the following steps:

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/snappyd/12704
loop5    7:5    0 32.5M  1 loop /snap/snappyd/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
```

```
nilyaz@nilmubu01:~$ 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:



cvogcvenfsvol01

ONLINE

### INFO

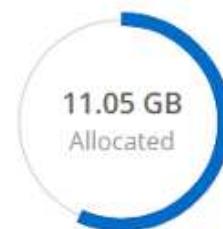
Disk Type

PD-SSD

Tiering Policy

None

### CAPACITY



6.08 GB

Disk Used

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

Volumes

Replications



Mount Volume cvogcvenfsvol01

Go to your Linux machine and enter this mount command

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

Copy

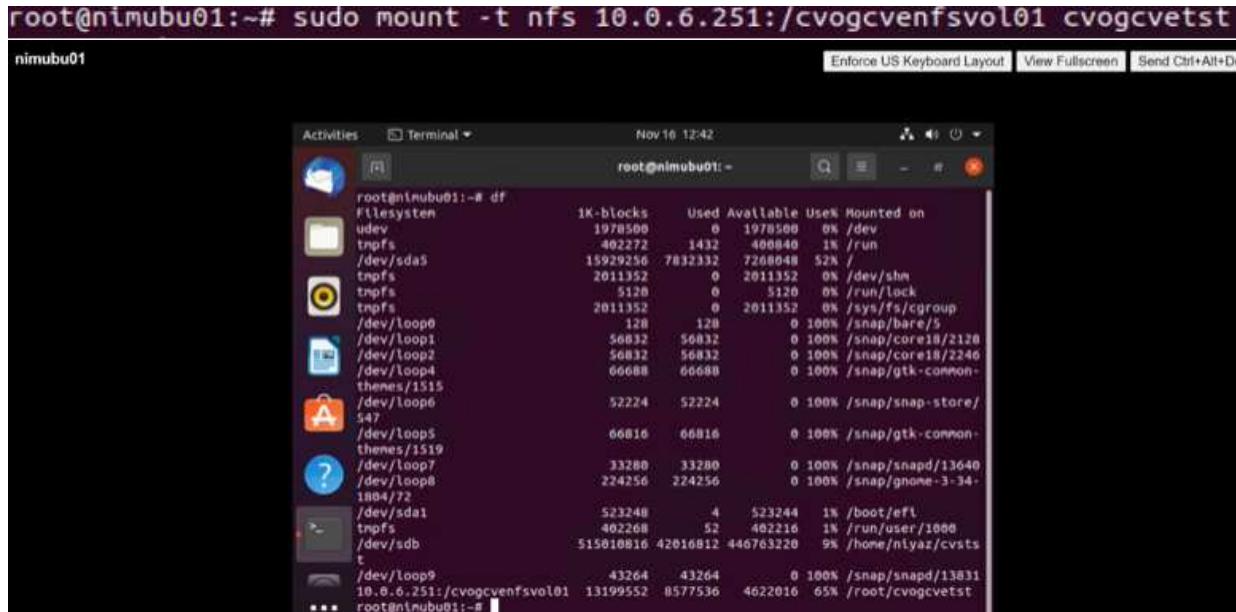
4. Click Copy.
5. Connect to the designated Linux instance.
6. Open a terminal on the instance using secure shell (SSH) and log in with the appropriate credentials.
7. Make a directory for the volume's mount point with the following command.

```
$ 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
```



## 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.

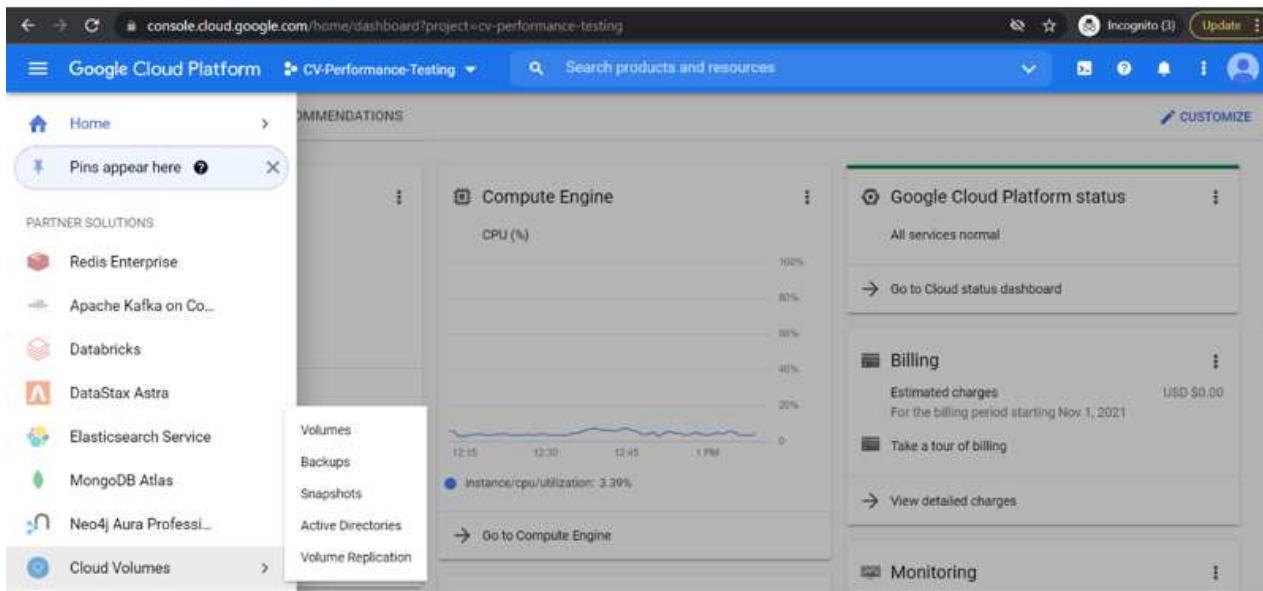
Cloud Volume Service and Google Cloud VMware Engine private cloud must be in the same region.

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

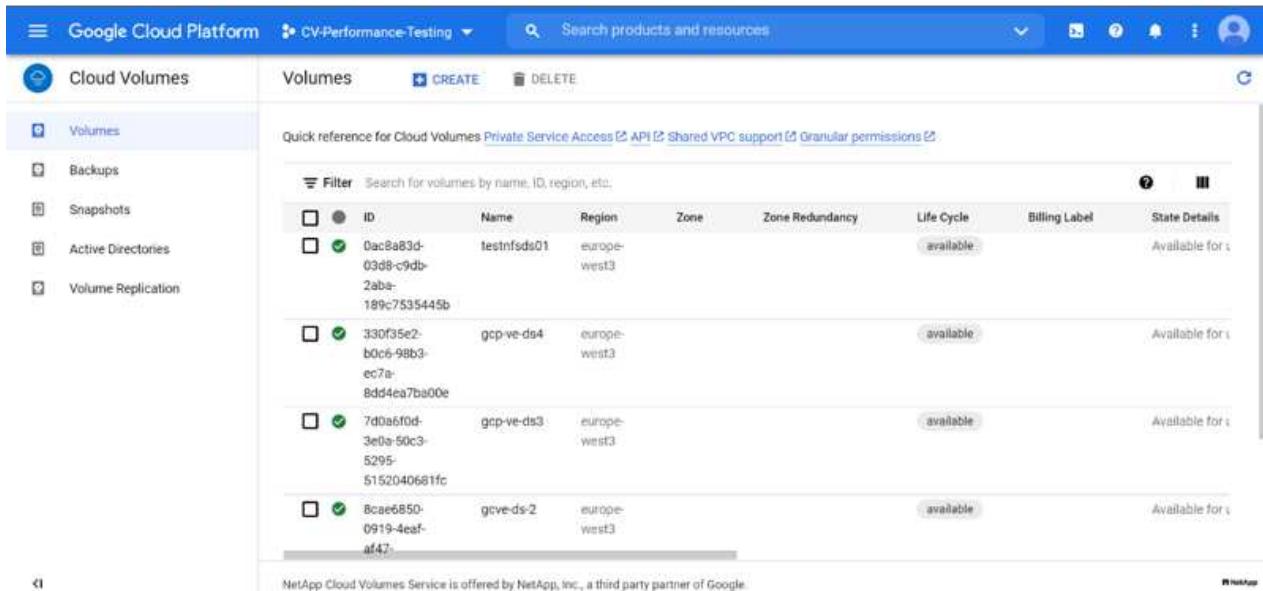
To create and mount NFS volumes, complete the following steps:

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



The screenshot shows the Google Cloud Platform dashboard for the project 'CV-Performance-Testing'. On the left, there's a sidebar titled 'PARTNER SOLUTIONS' with options like Redis Enterprise, Apache Kafka on Cloud, Databricks, DataStax Astra, Elasticsearch Service, MongoDB Atlas, Neo4j Aura Professional, and Cloud Volumes. The 'Cloud Volumes' option is highlighted with a blue border. To its right is a 'RECOMMENDATIONS' section for 'Compute Engine' showing CPU utilization over time. On the far right, there are sections for 'Google Cloud Platform status', 'Billing' (showing estimated charges of \$0.00), and 'Monitoring'.

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



The screenshot shows the 'Volumes' page within the Cloud Volumes service. The left sidebar has options for 'Volumes', 'Backups', 'Snapshots', 'Active Directories', and 'Volume Replication'. The main area displays a table of existing volumes:

ID	Name	Region	Zone	Zone Redundancy	Life Cycle	Billing Label	State Details
Dac8a83d-03db-c9db-2aba-189c7535445b	testnfsds01	europe-west3			available		Available for use
330f35e2-b0c6-98b3-ec7a-8dd4ea7ba00e	gcp-ve-ds4	europe-west3			available		Available for use
7d0a6f0d-3e0a-50c3-5295-5152040681fc	gcp-ve-ds3	europe-west3			available		Available for use
8cae6850-0919-4eaf-af47-	gcve-ds-2	europe-west3			available		Available for use

At the top of the main area, there are buttons for 'CREATE' and 'DELETE'. Below the table, a note says 'NetApp Cloud Volumes Service is offered by NetApp, Inc., a third party partner of Google.'

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

 Cloud Volumes <ul style="list-style-type: none"> <li> Volumes</li> <li> Backups</li> <li> Snapshots</li> <li> Active Directories</li> <li> Volume Replication</li> </ul>	<p><a href="#" style="text-decoration: none;">← Create File System</a></p> <p><b>Volume Name</b></p> <p>Name * <input type="text" value="nimCVNFSvol01"/></p> <p>A human readable name used for display purposes.</p> <p><b>Billing Labels</b></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><a href="#" style="border: 1px solid #ccc; padding: 2px 10px; margin-top: 10px;">+ ADD LABEL</a></p>
---	--

4. 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 <ul style="list-style-type: none"> <li> Volumes</li> <li> Backups</li> <li> Snapshots</li> <li> Active Directories</li> <li> Volume Replication</li> </ul>	<p><a href="#" style="text-decoration: none;">← Create File System</a></p> <p><b>Service Type</b></p> <p>Cloud Volumes Service is offered as two service types: CVS and CVS-Performance. Select the service type that matches your workload needs. <a href="#">Region availability</a> varies by service type. <a href="#">Learn more</a></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><b>Volume Replication</b></p> <p><input type="checkbox"/> Secondary Select to create volume as a destination target for volume replication. Applicable only to CVS-performance volumes.</p>
--	---

5. 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)

 <b>Cloud Volumes</b> <ul style="list-style-type: none"> <li> <a href="#">Volumes</a></li> <li> <a href="#">Backups</a></li> <li> <a href="#">Snapshots</a></li> <li> <a href="#">Active Directories</a></li> <li> <a href="#">Volume Replication</a></li> </ul>	<p><a href="#"> Create File System</a></p> <p><b>Region</b> Region availability varies by service type.</p> <p><b>Region *</b> <input type="text" value="europe-west3"/> <span style="float: right;">? </span></p> <p>Volume will be provisioned in the region you select.</p> <p><b>Volume Path *</b> <input type="text" value="nimCVSNFS01"/> <span style="float: right;"></span></p> <p>Must be unique to the project.</p>
--	--

6. Select the level of performance for the volume.

 <b>Cloud Volumes</b> <ul style="list-style-type: none"> <li> <a href="#">Volumes</a></li> <li> <a href="#">Backups</a></li> <li> <a href="#">Snapshots</a></li> <li> <a href="#">Active Directories</a></li> <li> <a href="#">Volume Replication</a></li> </ul>	<p><a href="#"> Create File System</a></p> <p><b>Service Level</b> 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><b>Snapshot</b> <span style="float: right;">▼</span></p> <p>The snapshot to create the volume from.</p>
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7. Specify the size of the volume and the protocol type. In this testing, NFSv3 is used.

 <b>Cloud Volumes</b> <ul style="list-style-type: none"> <li> <a href="#">Volumes</a></li> <li> <a href="#">Backups</a></li> <li> <a href="#">Snapshots</a></li> <li> <a href="#">Active Directories</a></li> <li> <a href="#">Volume Replication</a></li> </ul>	<p><a href="#"> Create File System</a></p> <p><b>Volume Details</b></p> <p><b>Allocated Capacity *</b> <input type="text" value="1024"/> <span style="float: right;">GiB</span></p> <p>Allocated size must be between 1 TiB (1024 GiB) and 100 TiB (102400 GiB)</p> <p><b>Protocol Type *</b> <input type="text" value="NFSv3"/> <span style="float: right;">▼</span></p> <p><input type="checkbox"/> <b>Make snapshot directory (.snapshot) visible</b> 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"/> <b>Enable LDAP</b> Enables user look up from AD LDAP server for your NFS volumes</p>
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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.

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.

10. Click Save to create the volume.

<input type="checkbox"/>	<input checked="" type="checkbox"/> 4b5ed9e9- bc6d-f3d5- 5a0f- 7da26aed3ed0	nimnfsdemods02	europe-west3	Available for use	CVS- Performance	Primary	Extreme	NFSv3 : 10.53.0.4/nimnfsdemods02
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## 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:

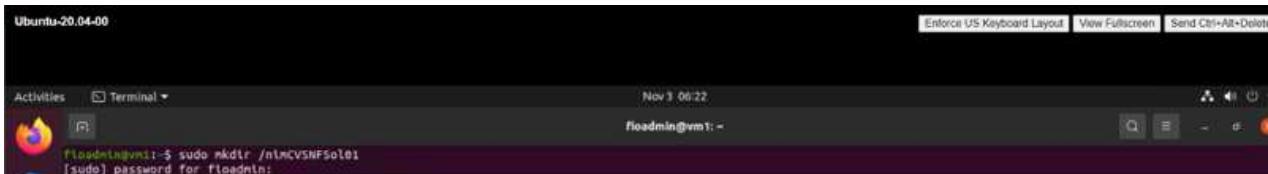
```
sudo yum install -y nfs-utils
```

- b. On an Ubuntu or Debian instance:

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

3. Create a new directory on the instance, such as "/nimCVSNFS01":

```
sudo mkdir /nimCVSNFS01
```



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

```
sudo mount -t nfs -o rw,hard,rsize=65536,wszie=65536,vers=3,tcp  
10.53.0.4:/nimCVSNFS01 /nimCVSNFS01
```

```
root@vm1:~# sudo mkdir nimCVSNFS01  
root@vm1:~# sudo mount -t nfs -o rw,hard,rsize=65536,wszie=65536,vers=3,tcp 10.53.0.4:/nimCVSNFS01 /nimCVSNFS01
```

```
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/nfsprdvg1-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.

The screenshot shows a table of Active Directory connections. There is one row visible:

Username	Domain	DNS Servers	NetBIOS Prefix	OU Path	AD Server Name	KDC IP	Region	Status
administrator	nimgcveval.com	192.168.0.16	nimsmb	CN=Computers			europe-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.

4. 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 \*

Volume will be provisioned in the region you select.

Volume Path \*

Must be unique to the project.

5. 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.

	6a-4552ed-7378-7302-be28-21a16934f28	nimCVSMBvol01	europe-west3	Available for use	CVS-Performance	Primary	Standard	SMB : \\\nimsmb-3830.nimgcveval.com\vimCVSMBvol01
<input type="checkbox"/>								

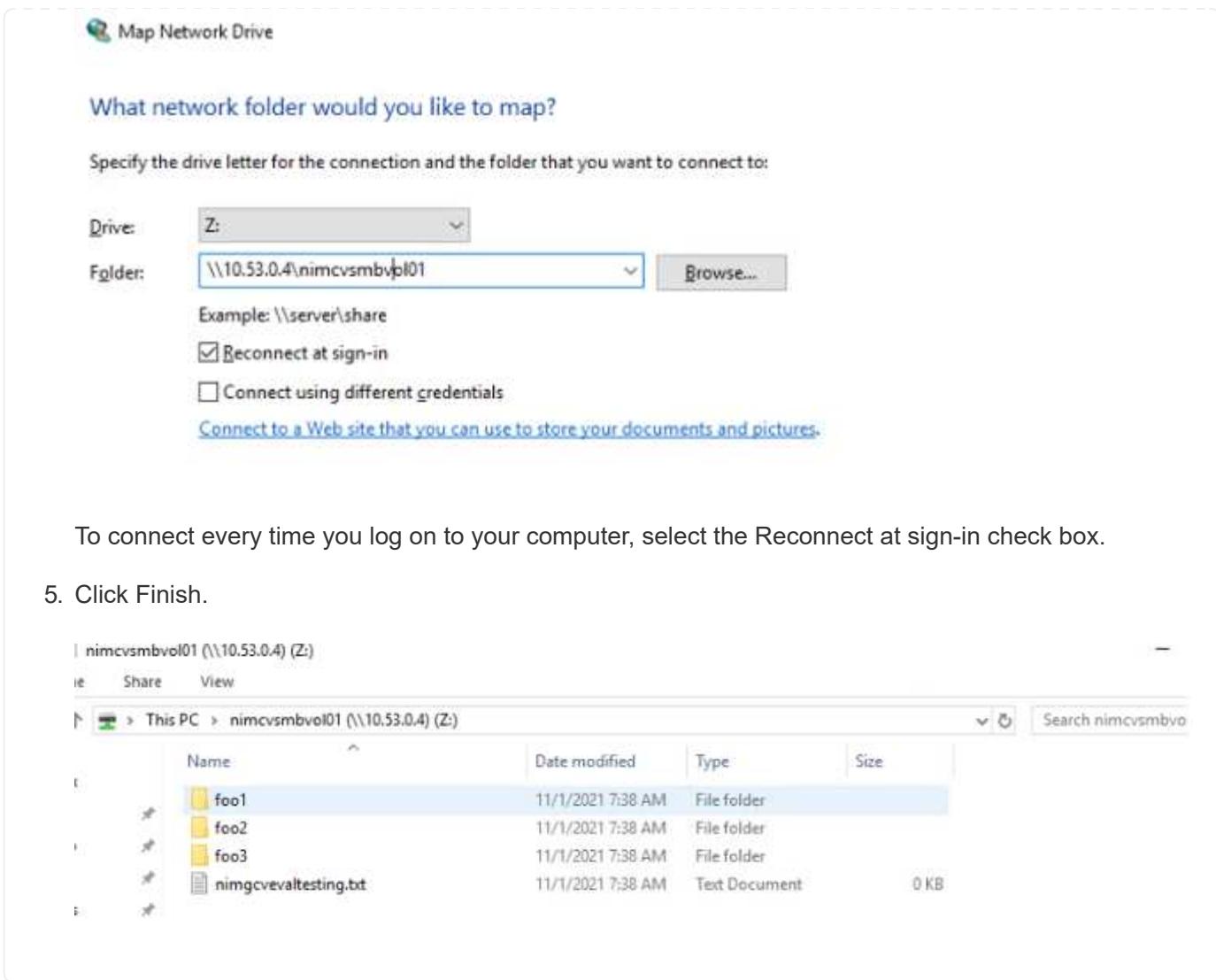
To mount the SMB volume, do the following:

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:

\\\nimsmb-3830.nimgcveval.com\vimCVSMBvol01



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 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

## 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.

# Summary and Conclusion: Why NetApp Hybrid Multicloud with VMware

NetApp Cloud Volumes along with VMware solutions for the major hyperscalers provides great potential for organizations looking to leverage hybrid cloud. The rest of this section provides the use cases that show integrating NetApp Cloud Volumes enables true hybrid Multicloud capabilities.

## Use case #1: Optimizing storage

When performing a sizing exercise using RVtools output, it is always evident that the horsepower (vCPU/vMem) scale is parallel with storage. Many times, organizations find themselves in a situation where the storage space requires drives the size of the cluster well beyond what is needed for horsepower.

By integrating NetApp Cloud Volumes, organizations can realize a vSphere-based cloud solution with a simple migration approach, with no re-platforming, no IP changes, and no architectural changes. Additionally, this optimization enables you to scale the storage footprint while keeping the host count to least amount required in vSphere, but no change to the storage hierarchy, security, or files made available. This allows you to optimize the deployment and reduce the overall TCO by 35–45%. This integration also enables you to scale storage from warm storage to production-level performance in seconds.

## Use case #2: Cloud migration

Organizations are under pressure to migrate applications from on-premises data centers to the Public Cloud for multiple reasons: an upcoming lease expiration; a finance directive to move from capital expenditure (capex) spending to operational expenditures (opex) spending; or simply a top-down mandate to move everything to the cloud.

When speed is critical, only a streamlined migration approach is feasible because re-platforming and refactoring applications to adapt to the cloud's particular IaaS platform is slow and expensive, often taking months. By combining NetApp Cloud Volumes with the bandwidth-efficient SnapMirror replication for guest-connected storage (including RDMs in conjunction with application-consistent Snapshot copies and HCX, cloud specific migration (e.g. Azure Migrate), or third-party products for replicating VMs), this transition is even easier than relying on time-consuming I/O filters mechanisms.

## **Use case #3: Data center expansion**

When a data center reaches capacity limits due to seasonal demand spikes or just steady organic growth, moving to the cloud-hosted VMware along with NetApp Cloud Volumes is an easy solution. Leveraging NetApp Cloud Volumes allows storage creation, replication, and expansion very easily by providing high availability across availability zones and dynamic scaling capabilities. Leveraging NetApp Cloud Volumes helps in minimizing host cluster capacity by overcoming the need for stretch clusters.

## **Use case #4: Disaster recovery to the cloud**

In a traditional approach, if a disaster occurs, the VMs replicated to the cloud would require conversion to the cloud's own hypervisor platform before they could be restored – not a task to be handled during a crisis.

By using NetApp Cloud Volumes for guest-connected storage using SnapCenter and SnapMirror replication from on-premises along with public cloud virtualization solutions, a better approach for disaster recovery can be devised allowing VM replicas to be recovered on fully consistent VMware SDDC infrastructure along with cloud specific recovery tools (e.g. Azure Site Recovery) or equivalent third-party tools such as Veeam. This approach also enables you to perform disaster recovery drills and recovery from ransomware quickly. This also enables you to scale to full production for testing or during a disaster by adding hosts on-demand.

## **Use case #5: Application modernization**

After applications are in the public cloud, organizations will want to take advantage of the hundreds of powerful cloud services to modernize and extend them. With the use of NetApp Cloud Volumes, modernization is an easy process because the application data is not locked into vSAN and allows data mobility for a wide range of use cases, including Kubernetes.

## **Conclusion**

Whether you are targeting an all-cloud or hybrid cloud, NetApp Cloud Volumes provides excellent options to deploy and manage the application workloads along with file services and block protocols while reducing the TCO by making the data requirements seamless to the application layer.

Whatever the use case, choose your favorite cloud/hyperscaler together with NetApp Cloud Volumes for rapid realization of cloud benefits, consistent infrastructure, and operations across on-premises and multiple clouds, bidirectional portability of workloads, and enterprise-grade capacity and performance.

It is the same familiar process and procedures that are used to connect the storage. Remember, it is just the position of the data that changed with new names; the tools and processes all remain the same and NetApp Cloud Volumes helps in optimizing the overall deployment.

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