NetApp Storage in Hyperscaler Clouds
NetApp Solutions
NetApp
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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

This document outlines how to 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.
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.
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**

<table>
<thead>
<tr>
<th>Encryption key</th>
<th>Info</th>
</tr>
</thead>
<tbody>
<tr>
<td>AWS Key Management Service (KMS) encryption key that protects your file system data at rest.</td>
<td>aws/fsx (default)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Description</th>
<th>Account</th>
<th>KMS key ID</th>
</tr>
</thead>
<tbody>
<tr>
<td>Default master key that protects my FSx resources when no other key is defined</td>
<td>139763910815</td>
<td>72745367-7bb0-499c-acc0-4f2c0a80e7c5</td>
</tr>
</tbody>
</table>

**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

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

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:
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:

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

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

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

   ```bash
   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.

   ![Image of df command output](image-url)
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**

<table>
<thead>
<tr>
<th>Management DNS name</th>
<th>Management IP address</th>
</tr>
</thead>
<tbody>
<tr>
<td>svm-075dcfbe2cfa2ece9.fs-040eacc5d0ac31017.fsx-west-2.amazonaws.com</td>
<td>192.168.192.54.9</td>
</tr>
</tbody>
</table>

NFS DNS name

<table>
<thead>
<tr>
<th>NFS DNS name</th>
<th>NFS IP address</th>
</tr>
</thead>
<tbody>
<tr>
<td>svm-075dcfbe2cfa2ece9.fs-040eacc5d0ac31017.fsx-west-2.amazonaws.com</td>
<td>192.168.192.54.9</td>
</tr>
</tbody>
</table>

SMB DNS name

<table>
<thead>
<tr>
<th>SMB DNS name</th>
<th>SMB IP address</th>
</tr>
</thead>
<tbody>
<tr>
<td>FSXSMBTESTING01.FSXTESTING.LOCAL</td>
<td>192.168.192.54.9</td>
</tr>
</tbody>
</table>

iSCSI DNS name

<table>
<thead>
<tr>
<th>iSCSI DNS name</th>
<th>iSCSI IP addresses</th>
</tr>
</thead>
<tbody>
<tr>
<td>iscsi.svm-075dcfbe2cfa2ece9.fs-040eacc5d0ac31017.fsx-west-2.amazonaws.com</td>
<td>10.222.2.224, 10.222.1.94</td>
</tr>
</tbody>
</table>

1. In the Shared Folders tool, choose Shares in the left pane to see the active shares for the Amazon FSx file system.
1. Now choose a new share and complete the 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.
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.

```bash
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.

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

FsxId040eacc5d0ac31017::> igroup 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:
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:

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:

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.
1. Select the add-on services for Cloud Volumes ONTAP deployment, including BlueXP Classification, BlueXP backup and recovery, and Cloud Insights. Click Continue.

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

1. On the Region & VPC page, enter the network information and then click Continue.
1. On the Connectivity and SSH Authentication page, choose connection methods for the HA pair and the mediator.

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

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

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

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

   ![CIFS server configuration interface](image)

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.

   ![Volume creation interface](image)

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.
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.

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:


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:

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
```

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)

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:


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

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

   For more information, see Set up a capacity pool.
3. Configure the delegated subnet for Azure NetApp Files and specify this subnet while creating the volumes. For detailed steps to create delegated subnet, see Delegate a subnet to Azure NetApp Files.

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

If the application is SQL Server, then enable the SMB continuous availability.
To learn more about Azure NetApp Files volume performance by size or quota, see Performance considerations for Azure NetApp Files.

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

To accomplish this, from the Azure portal, click the Volumes blade, and then select the volume to mount and access the mount instructions. Copy the path and use the Map Network Drive option to mount the volume on the VM running on Azure VMware Solution SDDC.
7. To mount NFS volumes on Linux VMs running on Azure VMware Solution SDDC, use this same process. Use volume reshaping or dynamic service level capability to meet the workload demands.

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.

![Cloud Manager screenshot]

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.
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.

6. Select the add-on services for Cloud Volumes ONTAP deployment, including BlueXP Classification, BlueXP backup and recovery, and Cloud Insights. Select the services and then click Continue.

7. Configure the Azure location and connectivity. Select the Azure Region, resource group, VNet, and subnet to be used.
8. Select the license option: Pay-As-You-Go or BYOL for using existing license. In this example, Pay-As-You-Go option is used.

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

10. Accept the two agreements regarding activating support and allocation of Azure resources. To create the Cloud Volumes ONTAP instance, click Go.
11. After Cloud Volumes ONTAP is provisioned, it is listed in the working environments on the Canvas page.
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.

![Create a CIFS server]

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.

![Create new volume in nimavsCVO]

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.
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.

```
\172.24.2.8\nimavssmbvol1_share
```

**Mount Volume nimavssmbvol1**

Go to your machine and enter this command
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.

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:

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:
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**

Customers can expand storage capacity on Google Cloud VMware Engine using NFS supplemental 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
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.

For more info, please refer Creating NFS Volume documentation.

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

To mount NFS Datastore, there should be a private connection exists between GCVE and NetApp CVS project.
For more info, please refer How to setup Private Service Access
Mount NFS datastore

For instructions on how to mount NFS datastore on GCVE, please refer How to create NFS datastore with NetApp CVS

As vSphere hosts are managed by Google, you don’t have access to install NFS vSphere API for Array Integration (VAAI) vSphere Installation Bundle (VIB).
If you need support for Virtual Volumes (vVol), please let us know.
If you like to use Jumbo Frames, please refer Maximum supported MTU sizes on GCP

Savings with NetApp Cloud Volume Service

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

Reference Links

• Google Blog - How to use NetApp CVS as datastores for Google Cloud VMware Engine
• NetApp Blog - A better way to migrate your storage-rich apps to Google Cloud

NetApp Storage Options for GCP

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

Cloud Volumes ONTAP (CVO)

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

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

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

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

Cloud Volumes ONTAP (CVO) as guest connected storage
Deploy Cloud Volumes ONTAP in Google Cloud (Do It Yourself)

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

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

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.

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

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

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

![Create a CIFS server](image)

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.

![Create new volume in cvogcve01](image)

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.
4. 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.

5. 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

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.

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:

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.

```
$ lsblk
NAME   MAJ:MIN RN SIZE RO TYPE MOUNTPOINT
loop0  7:0   0 55.4M 1 loop /snap/core18/2128
loop1  7:1   0 219M 1 loop /snap/gnome-3-34-1804/72
loop2  7:2   0 65.1M 1 loop /snap/gtk-common-themes/1515
loop3  7:3   0 51M  1 loop /snap/snap-store/547
loop4  7:4   0 32.3M 1 loop /snap/snapd/12784
loop5  7:5   0 32.5M 1 loop /snap/snapd/13640
loop6  7:6   0 55.5M 1 loop /snap/core18/2246
loop7  7:7   0  4K  1 loop /snap/bure/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
```
<table>
<thead>
<tr>
<th>Filesystem</th>
<th>Size</th>
<th>Used</th>
<th>Avail</th>
<th>Use%</th>
<th>Mounted on</th>
</tr>
</thead>
<tbody>
<tr>
<td>udev</td>
<td>1.9G</td>
<td>0.1G</td>
<td>0.8G</td>
<td>0%</td>
<td>/dev</td>
</tr>
<tr>
<td>tmpfs</td>
<td>394M</td>
<td>1.5M</td>
<td>392M</td>
<td>1%</td>
<td>/run</td>
</tr>
<tr>
<td>/dev/sda5</td>
<td>16G</td>
<td>7.6G</td>
<td>6.9G</td>
<td>53%</td>
<td>/</td>
</tr>
<tr>
<td>tmpfs</td>
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<td>2.0G</td>
<td>0.0G</td>
<td>0%</td>
<td>/dev/shm</td>
</tr>
<tr>
<td>tmpfs</td>
<td>5.0G</td>
<td>0.0G</td>
<td>5.0G</td>
<td>0%</td>
<td>/run/lock</td>
</tr>
<tr>
<td>tmpfs</td>
<td>2.0G</td>
<td>0.0G</td>
<td>2.0G</td>
<td>0%</td>
<td>/sys/fs/cgroup</td>
</tr>
<tr>
<td>/dev/loop1</td>
<td>219M</td>
<td>219M</td>
<td>0.0K</td>
<td>100%</td>
<td>/snap/gnome-3.34-1804/72</td>
</tr>
<tr>
<td>/dev/loop2</td>
<td>66M</td>
<td>66M</td>
<td>0.0K</td>
<td>100%</td>
<td>/snap/gtk-common-themes/1515</td>
</tr>
<tr>
<td>/dev/loop3</td>
<td>51M</td>
<td>51M</td>
<td>0.0K</td>
<td>100%</td>
<td>/snap/snap-store/547</td>
</tr>
<tr>
<td>/dev/loop0</td>
<td>56M</td>
<td>56M</td>
<td>0.0K</td>
<td>100%</td>
<td>/snap/core18/2128</td>
</tr>
<tr>
<td>/dev/loop4</td>
<td>33M</td>
<td>33M</td>
<td>0.0K</td>
<td>100%</td>
<td>/snap/snapd/2704</td>
</tr>
<tr>
<td>/dev/sda1</td>
<td>511M</td>
<td>4.0K</td>
<td>511M</td>
<td>1%</td>
<td>/boot/efi</td>
</tr>
<tr>
<td>tmpfs</td>
<td>394M</td>
<td>64K</td>
<td>394M</td>
<td>1%</td>
<td>/run/user/1000</td>
</tr>
<tr>
<td>/dev/loop5</td>
<td>33M</td>
<td>33M</td>
<td>0.0K</td>
<td>100%</td>
<td>/snap/snapd/3640</td>
</tr>
<tr>
<td>/dev/loop6</td>
<td>56M</td>
<td>56M</td>
<td>0.0K</td>
<td>100%</td>
<td>/snap/core18/4246</td>
</tr>
<tr>
<td>/dev/loop7</td>
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<td>128K</td>
<td>0.0K</td>
<td>100%</td>
<td>/snap/bare/s</td>
</tr>
<tr>
<td>/dev/loop8</td>
<td>66M</td>
<td>66M</td>
<td>0.0K</td>
<td>100%</td>
<td>/snap/gtk-common-themes/1515</td>
</tr>
<tr>
<td>/dev/sdb</td>
<td>976M</td>
<td>2.6M</td>
<td>974M</td>
<td>1%</td>
<td>/mnt</td>
</tr>
</tbody>
</table>
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:

![Volume Information]

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

![Mount Volume]

Go to your Linux machine and enter this mount command

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

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

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

```bash
sudo mount 10.0.6.251:/cvogcvetst /cvogcvetst
```

**Cloud Volumes Service (CVS)**

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

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

**Cloud Volumes Service (CVS) as guest connected storage**
Configure Cloud Volumes Service with VMware Engine

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

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

To purchase, enable and configure NetApp Cloud Volumes Service for Google Cloud from the Google Cloud Marketplace, follow this detailed guide.
Create a CVS NFS volume to GCVE private cloud

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

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

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

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

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)
6. Select the level of performance for the volume.

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

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.
Mounting NFS exports to VMs running on VMware Engine

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

To mount an NFS volume, do the following:

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

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

1. Use SSH client and SSH to the virtual machine.
2. Install the nfs client on the instance.
   a. On Red Hat Enterprise Linux or SuSE Linux instance:
      
      ```
      sudo yum install -y nfs-utils
      ```
   b. On an Ubuntu or Debian instance:
      
      ```
      sudo apt-get install nfs-common
      ```
3. Create a new directory on the instance, such as "/nimCVSNFSol01":

      ```
      sudo mkdir /nimCVSNFSol01
      ```

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

      ```
      sudo mount -t nfs -o rw,hard,rsize=65536,wsize=65536,vers=3,tcp 10.53.0.4:/nimCVSNFSol01 /nimCVSNFSol01
      ```
```bash
root@vn1:-- df
Filesystem        1K-blocks Used Available Use% Mounted on
udev              16409952    0      16409952      0 %/dev
tmpfs             32881328  1580    32865548    1% /run
/dev/sdb5        61145932 19231356  38774576 34% /dev/shm
tmpfs             16441628    0    16441628      0 %/run/lock
tmpfs             5120        0     5120        0 %/run/lock
/dev/loop0       128        128       0 100% /sys/fs/cgroup
/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/store/547
/dev/loop5       52224     52224       0 100% /snap/store-1-3.3-1844.12
/dev/sdb1        523248     4     523244   1% /boot/efi
tmpfs             3288324    28    3288296    1% /run/user/1000
/dev/mapper/nfsprdv1-prod01 107374182400 1130686016 106238863384 2% /base
/dev/mapper/nfsprdv1-prod01 419155968 55384972 3647709996 14% /datastore1
/dev/loop8        33280     33280       0 100% /snap/snapd/13270
/dev/loop6        33280     33280       0 100% /snap/snapd/13040
/dev/loop7        56832     56832       0 100% /snap/core18/2268
10.53.0.4:/nixCVSNF Somerset 107374182400 256 107374182144 1% /nixCVSNF/Somerset
```
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.

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](image)

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.
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)

5. Select the level of performance for the volume.
6. Specify the size of the volume and the protocol type. In this testing, SMB is used.

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
8. Click Save to create the volume.

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\nimCVSMBvol01
To connect every time you log on to your computer, select the Reconnect at sign-in check box.

5. Click Finish.

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

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

AWS Region Availability

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

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

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

<table>
<thead>
<tr>
<th>AWS Region</th>
<th>VMC Availability</th>
<th>FSx ONTAP Availability</th>
<th>NFS Datastore Availability</th>
</tr>
</thead>
<tbody>
<tr>
<td>US East (Northern Virginia)</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>US East (Ohio)</td>
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<td>Yes</td>
<td>Yes</td>
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<tr>
<td>US West (Northern California)</td>
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<td>No</td>
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<tr>
<td>US West (Oregon)</td>
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<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>GovCloud (US West)</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Canada (Central)</td>
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<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>South America (Sao Paulo)</td>
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<td>Yes</td>
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</table>

Last updated on: June 2, 2022.

### EMEA

<table>
<thead>
<tr>
<th>AWS Region</th>
<th>VMC Availability</th>
<th>FSx ONTAP Availability</th>
<th>NFS Datastore Availability</th>
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<tbody>
<tr>
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<td>Europe (Stockholm)</td>
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Last updated on: June 2, 2022.

### Asia Pacific

<table>
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<tr>
<th>AWS Region</th>
<th>VMC Availability</th>
<th>FSx ONTAP Availability</th>
<th>NFS Datastore Availability</th>
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</thead>
<tbody>
<tr>
<td>Asia Pacific (Sydney)</td>
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<td>Asia Pacific (Jakarta)</td>
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<tr>
<td>Asia Pacific (Hong Kong)</td>
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<td>Yes</td>
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</table>
**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.