

## **Public and Hybrid Cloud**

**NetApp Solutions** 

NetApp July 31, 2024

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# **Public and Hybrid Cloud**

## **NetApp Hybrid Multicloud with VMware Solutions**

## 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, BlueXP Copy and 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

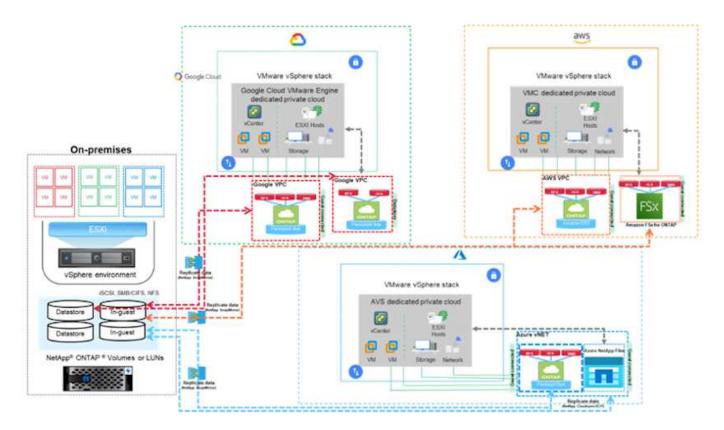
- SnapMirror technology or other relevant data migration mechanisms are enabled. There are many connectivity options, from on-premises to any hyperscaler cloud. Use the appropriate path and work with the relevant networking teams.
- In-guest storage was the only available option at the time this document 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 productionready 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<br>Browse the NetApp solutions for AWS / VMC                           |  |
|--|--|
| Azure / AVS<br>Browse the NetApp solutions for Azure / AVS                       |  |
| GCP / GCVE<br>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<br>Datastore |
|-----------|-----------------------------|-------------------------------|
| AWS       | CVO<br>FSx ONTAP<br>Details | FSx ONTAP<br>Details          |
| Azur<br>e | CVO<br>ANF<br>Details       | ANF<br>Details                |
| GCP       | CVO<br>CVS<br>Details       | CVS<br>Details                |

## 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
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View the detailed configuration steps for VMC.

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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:

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.

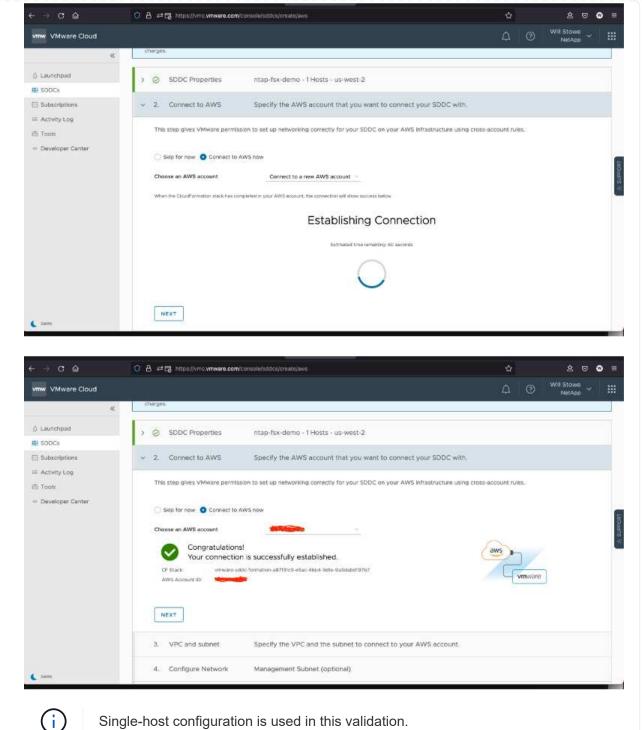
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| Sign in with your VMware account                           |  |  |
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2. Configure the AWS region, deployment, and host type and the SDDC name:

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| 8 Launchpad      | v 1. SDDC Properties   | Give your SDDC a name, choose a size, and specify the AWS region where it will be |   |                      |   |
| E SEECS          |  | created.  |   |                      |   |
| Subscriptions    |  |   |   |                      |   |
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|                  | SDDC Name  | ntap-fsx-demo   |   |                      |   |
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|                  | Host Capacity  | 2 Sockets, 36 Cores, 512 GIB RAM, 10.37 TiB Storage                               |   |                      |   |
|                  | Total Capacity   | 2 Sockets, 36 Cores, 512 GB RAM, 10.37 TiB Storage                                |   |                      |   |
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|                  | NEXT   |   |   |                      |   |
|                  | 2. Connect to AWS  | Specify the AWS account that you want to connect your SDDC with.                  |   |                      |   |
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3. Connect to the desired AWS account and execute the AWS Cloud Formation stack.

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Single-host configuration is used in this validation.

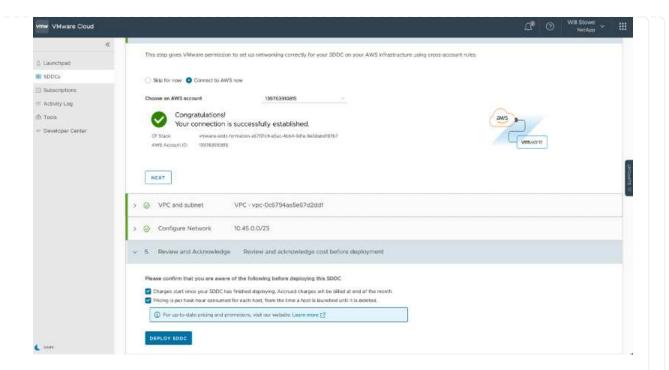
4. Select the desired AWS VPC to connect the VMC environment with.

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|   | v 4. Configure Network Management Subnet (optional)   |     |            |  |

5. 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.

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| <ul> <li>Developer Center</li> </ul> | <ul> <li>4. Configure Network Management Subnet (optional)</li> </ul>   |    |   |                      |   |
|                                      | <ul> <li>Specify a private subnet range (RFC 1918) to be used for vCenter Server, NSX Manager, and ESX hosts.</li> <li>Choose a range that will not overlap with other networks or SDDC group members that connect to this SDDC.</li> <li>Minimum CIDR size: /23 for up to 27 hosts, /20 for up to 25 hosts, /16 for up to 4091 hosts.</li> <li>Reserved CIDRs: 10.0.0.015, 172.31.0.0/46.</li> </ul> |    |   |                      |   |
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|                                      | 5. Review and Acknowledge Review and acknowledge cost before deployment   |    |   |                      |   |
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6. Review and acknowledge the SDDC configuration, and then click deploy the SDDC.



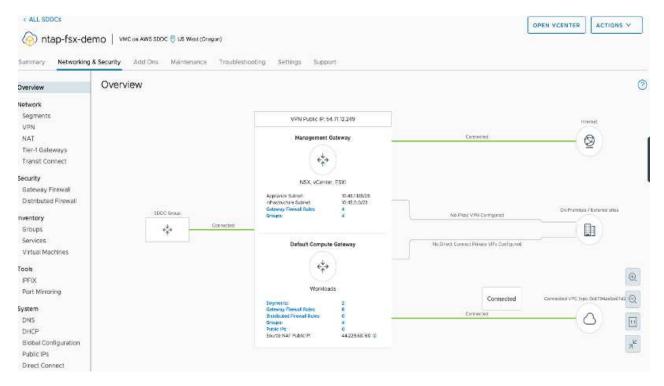
The deployment process typically takes approximately two hours to complete.

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| 🗇 Tools            | intap-fsx-demo   |     |                           |   |
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|                    |  |     |                           |   |
|                    | 28%  |     |                           |   |
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|                    | Estimated time to completion: 86 Minutes   |     |                           |   |
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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.



2. 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.

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| Developer Center  | Developer Center   | K<br>Laurchpat<br>5000k<br>Subscriptions   | 1. Name and Description   | Name: sodcgroup01   |   |            | Д (Ø) негарр V   |
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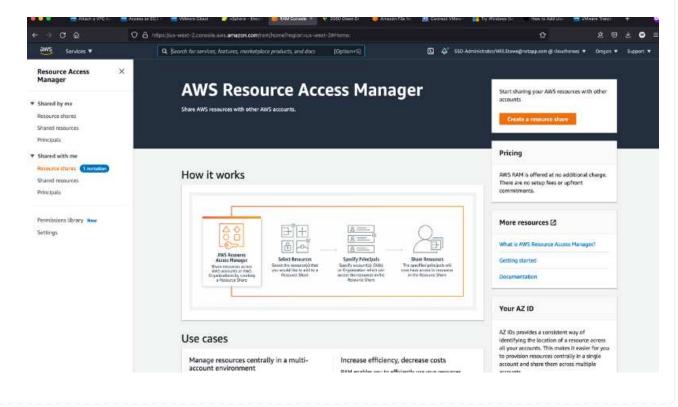
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| ec.                | < Create SDDC Group   |                               |
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3. Attach the newly created VPC to the just created SDDC group. Select the External VPC tab and follow the instructions for attaching an External VPC to the group. This process can take 10 to 15 minutes to complete.

| Wide Cloud       Cloud       Cloud       Wide Cloud       Cloud       Wide Cloud       Clou       Clou       Cloud       Cloud </th <th>ADD ACCOUNT BUILDING</th> <th>· · · Resource State Name</th> <th></th> <th></th> <th></th> <th>Will Stowe<br/>Netaod</th>   | ADD ACCOUNT BUILDING | · · · Resource State Name |                          |               |                                | Will Stowe<br>Netaod |
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| E Subscriptions      | ADD ACCOUNT REPERVE   |                                |                     |
| 🗇 Tools              | AVIS Accessed (D + Resource Stare Name + Mate   | <ul> <li>VPC 0tatus</li> </ul> |                     |
| ··· Developer Center | UMC-Group-dc49300e+15e7-41s5-b016-de6176sle8s6 ASSOCIATED   |                                |                     |
|                      |   |                                |                     |
|                      |   |                                |                     |
|                      |   |                                |                     |
|                      |   |                                |                     |
|                      |   |                                |                     |
|                      |   |                                |                     |
|                      |   |                                |                     |

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.



| Services ¥  | Q. Search for services, features, monketplac  | re products, and docs [Option+5] | 🖸 💠 SSD Administrate          | e/WillStoweginetapp.com @ cleachemes 💌 | Oregen • Support |
|---|---|----------------------------------|-------------------------------|--|------------------|
| Resource Access ×<br>Manager                                  | Resource Access Manager > Shared with me :<br>VMC-Group-dc49300e-f                                      |                                  |                               | e_4560_853f_e2939                      | 185650c)         |
| * Shared by me  | Details and information relating to this resource   |                                  | 0816080 (05180165-081         | 6-4500-0551-62555                      | 10500007         |
| Resource shares<br>Shared resources<br>Principals             | Reject resource share Accept resource   | rce share                        |                               |  |                  |
| Shared with me  | Summary   |                                  |                               |  |                  |
| Resource shares (1mr.tutor)<br>Shared resources<br>Principals | Name<br>VMC-Group-dcx9300a-/5e7-6fa5-b016-<br>ae6176a1e8a6  | Owner<br>645453501102            | Invitation date<br>2021/10/14 | Status<br>O Pending                    |                  |
| Permissions library Real                                      | ARN<br>am:awsramcus-<br>west-2:464453001102:resource-<br>share/051a6fc5-0a1e-4560-853/-<br>e23394655b0; | Receiver<br>139763910815         |                               |  |                  |
|   | <del>a</del>  |                                  |                               |  |                  |
|   |   |                                  |                               |  |                  |
|   |   |                                  |                               |  |                  |
|   |   |                                  |                               |  |                  |
|   |   |                                  |                               |  |                  |

5. Create the Transit Gateway Attachment.

|  | ts attachments (VPCs and VPNs) within th | he same |  |  |  |  |  |
|--|--|---------|--|--|--|--|--|
| ount or across AWS accounts.   |  |         |  |  |  |  |  |
| Details  |  |         |  |  |  |  |  |
| Name tag - optional<br>Creates a tag with the key set to Name and the value set to the specified | string.                                  |         |  |  |  |  |  |
| my-transit-gateway-attachment  |  |         |  |  |  |  |  |
| Transit gateway ID Info  |  |         |  |  |  |  |  |
| tgw-001646b36ee07a2cb  | ·•                                       |         |  |  |  |  |  |
| Attachment type info   |  |         |  |  |  |  |  |
| VPC  | *  |         |  |  |  |  |  |
| VPC attachment   |  |         |  |  |  |  |  |
| Select and configure your VPC attachment.  |  |         |  |  |  |  |  |
| DNS support Info   |  |         |  |  |  |  |  |
| IPv6 support Info  |  |         |  |  |  |  |  |
| VPC ID<br>Select the VPC to actach to the transit gateway  |  |         |  |  |  |  |  |
| And the second of the second second  |  |         |  |  |  |  |  |

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

| ×                             | X XLL SODE Graups  |
|-------------------------------|--|
| Laurenpad                     | sddcgroup01  |
| 500Cs                         | Summary eCanter Linking Direct Connect External VPC External TGW Reuting Support   |
| Subscriptions<br>Activity Log | ADD ACCOUNT SEMONE   |
| Took<br>Developer Center      | AWS Account ID AWS AC |
|                               | VPC/ID     T VMC on AWS Region     Transk Goleway Attachment ID     T     Routes     Status       Vpc:Odic764bcc495e805     US West (Oregon)     tgw-attach-0a4883a6r82c67a64     ADD POVIDE     PChDING   |
|                               |  |

- 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.
  - $\circ\,$  A route for the floating IP range for Cloud Volumes ONTAP (if applicable).
  - $\,\circ\,$  A route for the newly created external VPC address space.

|                               |                            |  |             |                      |          |   |   | ¢ Ø    | Will Stowe<br>NotApp | 90 S |
|-------------------------------|----------------------------|--|-------------|----------------------|----------|---|---|--------|----------------------|------|
| ×                             | < All SDDC Groups          |  |             |                      |          |   |   |        | ACTION               | 15 🗸 |
| Launchpad                     | sddcgroup01                |  |             |                      |          |   |   |        | 1                    |      |
| 5DDCs                         | Summary Center Linking Dir | ect Connect External VPC   | External TG | W Routing            | iupport  |   |   |        |                      |      |
| Subscriptions<br>Activity Log | ADD ACCOUNT                |  |             |                      |          |   |   |        |                      |      |
| Toole<br>Developer Center     | 2005 Account D y           | AVVS Account ID : AVVS Account ID : AVVS Account ID : AVVS Account ID : AVVS Area a count of the second account of the second accoun |             | ifie? 41a5 b0/6-ee61 | fielebaß |   |   |        |                      | ×    |
|                               |                            | vinciis  |             | HC on AWS Region     | Ť        | Tranail Galeway Altecharteri ID<br>19w-attach-0x4883a6782c67d64 | Ť | Routes | Statue               | Ŧ    |
|                               |                            |  |             |                      |          |   |   |        |                      |      |
|                               |                            | <b>2</b> +   |             |                      |          |   |   |        |                      |      |
|                               |                            |  |             |                      |          |   |   |        |                      |      |
|                               |                            |  |             |                      |          |   |   |        |                      |      |

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.

| re Cloud |             |  |                             |  |
|----------|-------------|--|-----------------------------|--|
|          | sddcgroup01 |  |                             |  |
| 4        |             |  |                             |  |
| (ana     |             | Edit Routes<br>Set of routes painting to this attachment<br>@ 18819354.0294 @ 102160.0024 @ (0.02220 |                             |  |
|          |             | The profess can be addreded by somma, space or a now line  | 3 totis, 0 mailta<br>CANCEL |  |
|          |             |  |                             |  |
|          |             |  |                             |  |

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

|       | This SODC will expire                    |            | LEARN    | MORE                     |           |                      |               |          |                |                           |         |                |
|-------|--|------------|----------|--------------------------|-----------|----------------------|---------------|----------|----------------|---------------------------|---------|----------------|
| 45    | W The SOUC we expire                     | in pelesys | 1 FEGAR  | induc.                   |           |                      |               |          |                |                           | 35      | ALE UP         |
|       | « ALL SDOCs                              |            |          |                          |           |                      |               |          | i i            | OPEN VCENTER              |         |                |
|       | ntap-fsx-de                              | mo I w     | AC on AV | is sooc 🙁 us West II     | 2regon)   |                      |               |          | 1              | OPEN VGENTER              |         | ALL ST.        |
|       | to nup for or                            |            |          |                          |           |                      |               |          |                |                           |         |                |
|       | Summery Networking                       | & Security | Add      | Des Makroene             | e Trou    | bleshooting Settings | Support       |          |                |                           |         |                |
|       | Overview                                 | Gatev      | vay F    | irewall                  |           |                      |               |          |                |                           |         |                |
| nder. | Network                                  | Manage     | ment G   | neway Comput             | e Gateway | ê -                  |               |          |                |                           |         |                |
| and a | Segments                                 | 11121120   |          |                          |           | •                    |               |          |                |                           |         |                |
|       | VPN<br>NAT                               |            |          |                          |           |                      |               |          |                | - 1 m                     | CULRY . | 7191.5         |
|       | Tier 1 Gateways                          | + 400      | BULE     | C assess 5               | 1990      | () sectors           |               |          | 5 kh           | e by Name, Path and       | 10010   | 3              |
|       | Transit Connect                          |            |          | Name                     | 1D        | Sources              | Destinations  | Services | Applied To     | Action                    |         |                |
|       | Security                                 | 4          | 0        | elow internet Iro.       | 1099      | 22 vmc-sddc          | Any           | Any      | All Uplinks    | Allow -                   | •       |                |
|       | Gateway Firewall<br>Distributed Firewall |            |          |                          |           | 22 vmc-addc-2        |               |          |                |                           |         |                |
|       |  | 1          |          | allow VMC to VPC         | 1017      | tti emo-sidac        | Connecte.     | Any      | At uptres      | . Allow -                 | •       |                |
|       | Groups                                   |            |          |                          |           | wmc-sddc-2           |               |          |                |                           |         |                |
|       | Services                                 | 1          |          | allow VPC to VMC         | 1016      | 13 Connecte.         | www.eadc      | Acty     | All Uplines    | <ul> <li>Allow</li> </ul> |         | 帝田             |
|       | Virtual Machines                         | 1          | ŏ        | allow to ymchia2         | 1022      | 12 vnc-sddc          | 23 vmds+2.v-  | Any      | All Uplinies   | Allow -                   | •       | 00             |
|       | Tools                                    |            |          |                          |           | www.adde-2           |               |          |                |                           | -       |                |
|       | Port Mirroring                           | -          |          | all from vinctax2        | 1023      | 11 vector2v_         | 📰 vnic-sddc-2 | Απγ      | Atruptinks     | • Allow ~                 | •       | 8 M            |
|       | System                                   | 1.1        |          |                          |           |                      | 23 vmc sddc   |          |                |                           |         |                |
|       | DNS                                      | 1          |          | Default VTI Rule         | 1012      | Ary                  | Any           | Arty     | VPN Tannel In. | • Allow •                 |         | ()<br>()<br>() |
|       | DHCP<br>Global Configuration             |            |          | Default Uplet Ru.        |           | Any                  | Any           | Any      | Ali uphriks    | • Drop -                  | 60      |                |
|       | Public IPs                               | 1.4        |          | Company Street and Links |           | 55                   | 050           | 8        |                | - map                     | -       |                |
|       | Direct Connect                           | CREF       | HESH     |                          |           |                      |               |          |                |                           |         | 7.916          |

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:

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.

| Subscriptions   | ¥=                        | Resource providers                  | ×           |
|---|---------------------------|-------------------------------------|-------------|
| etApp (cloudcontrolproduction.com)<br>+ Add 📋 Manage Policies                                 | Subscription              | « 🦿 Register 🏷 Unregister 💍 Refresh |             |
| few list of subscriptions for which you have<br>ole-based access control (R8AC) permissions   | (e) Resource groups       | Avs                                 | ×           |
| o manage Azure resources. To view<br>ubscriptions for which you have billing                  | III Resources             |                                     |             |
| ccess, click here<br>howing subscriptions in NetApp directory.                                | Preview features          | Provider                            | Status      |
| investig subscriptions in receipp unectory.<br>Ion't see a subscription?<br>witch directories | Usage + quotas            | Microsoft.AVS                       | Registering |
| Ay role 💿 Status 💿  | Policies                  |                                     |             |
| 8 selected V 3 selected V   | Management certificates   |                                     |             |
| Apply   | A My permissions          |                                     |             |
| howing 1 of 1 subscriptions global<br>how only subscriptions selected in the                  | S Resource providers      |                                     |             |
| ubscriptions filter ①   | i Deployments             |                                     |             |
| P Search  | Properties                |                                     |             |
| Subscription name ↑↓  | A Resource locks          |                                     |             |
| < Previous 1 V Next >   | Support + troubleshooting | •                                   |             |

|                                | len au       |
|--------------------------------|--------------|
| Provider                       | Status       |
| Microsoft.OperationsManagement | 📀 Registered |
| Microsoft.Compute              | Registered   |
| Microsoft.ContainerService     | Registered   |
| Microsoft.ManagedIdentity      | 🖉 Registered |
| Microsoft.AVS                  | Registered   |
| Microsoft.OperationalInsights  | 📀 Registered |
| Microsoft.GuestConfiguration   | O 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 onpremises 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.

| Prerequisities *Basics Tags  | Review and Create  |                                |
|--|--|--------------------------------|
| Project details  |  |                                |
| Subscription * ③   | SaaS Backup Production   | ×                              |
| Resource group * ③   | (New) NimoAVSDemo  | ~                              |
|  | Create new   |                                |
| Private cloud details  |  |                                |
| Resource name * 💿  | nimoarspriv  | ~                              |
| Location * 💿   | (US) East US 2   | ~~                             |
| Size of host * ③   | AV36 Trial   | Ŷ                              |
| Number of hosts * ③  | 0  | 3                              |
|  | Find   | out how many hosts you nee-    |
|  | There is no metering for the selected subscrip<br>date to display. | tion, region, and SKU. No cost |
| CIDR address block   |  |                                |
|  | d for cluster management. Make sure these are uniqu                | se and do not overlap with an  |
| Provide IP address for private clou<br>other Azure vnets or on-premise n | etworks.   |                                |

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.

| AVS Private cloud           |   |  |
|-----------------------------|---|--|
| P Search (Ctrl+/)           | a Delete  |  |
| 💁 Overview                  | ^ Essentials  |  |
| Activity log                | Resource group (change)<br>NimoAVSDemo                  | Address block for private cloud 10.21.0.0/22   |
| Access control (IAM)        | Status<br>Succeeded                                     | Primary peering subnet<br>10.21.0.232/30       |
| Diagnose and solve problems | Location<br>East US 2                                   | Secondary peering subnet<br>10.21.0.236/30     |
| Settings                    | Subscription (change)<br>SaaS Backup Production         | Private Cloud Management netwo<br>10.21.0.0/26 |
| A Locks                     | Subscription ID<br>b58a041a-e464-4497-8be9-9048369ee8e1 | vMotion network<br>10.21.1.128/25              |
| Manage                      |   | Number of hosts                                |
| 🚔 Connectivity              |   | 3  |
| 🔍 Identity                  | Tags (change)<br>Click here to add tags                 |  |
| Clusters                    |   |  |

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.

| Search (Ctrl+/)             | » ( | 🔄 Save 🕐 Refresh                |  |   |
|-----------------------------|-----|---------------------------------|--|---|
| Overview                    | ^   | Azure vNet connect Settings     | ExpressRoute Public IP   |   |
| Activity log                |     | -                               |  |   |
| Access control (IAM)        |     |                                 | an Azure virtual network to be connected to<br>nmunication between workloads in this virtu |   |
| Tags                        |     |                                 | d in Azure VMware Solution over ExpressRou<br>lected. You can create a new vNet or use an  |   |
| Diagnose and solve problems |     |                                 | your private cloud CIDR. Learn more about a  |   |
| Settings                    |     | Virtual network                 |  | ~ |
| A Locks                     |     |                                 | Create new   |   |
| Manage                      |     | Address block for vnet          | ж.   |   |
| 👷 Connectivity              |     | Address block for private cloud | 10.21.0.0/22   | D |
| Identity                    |     |                                 |  |   |
| E Clusters                  |     |                                 |  |   |
|                             |     |                                 |  |   |

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

| Azure VMware Solution o<br>default address range an<br>172.16.0.0/16), Step 2: Ad | les the communication between workloads in this virtual n<br>over an Express route. A default address range and a subne<br>d subnet of this virtual network, follow these steps. Step 1:<br>Id a subnet under "Subnets" with the name as "GatewaySu<br>n more about virtual networks C | t is selected for this virtual network. For changing<br>Change the "Address Range" to desired range (e.e. | the<br>g. |
|---|--|---|-----------|
| Name *  | nimoavspriv-vnet   |   | 2         |
| Address space   |  |   |           |
| C 0.001 * 2010 * 0.002 * 0.002 ****   | lress space specified as one or more address prefixes in CIE   | DR notation (e.g. 10.0.0.0/16).   |           |
| Address range   | Addresses  | Overlap   |           |
| 172,24.0.0/16   | 172.24.0.4 - 172.24.255.254 (65531 addresses)  | None  | Ē         |
|   | (0 Addresses)  | None  |           |
|   |  |   |           |
| Subnets   |  |   |           |
|   | ge in CIDR notation (e.g. 10.0.0.0/24). It must be contained   | by the address space of the virtual network.  |           |
|   | ge in CIDR notation (e.g. 10.0.0.0/24). It must be contained<br>Address range  | by the address space of the virtual network.<br>Addresses   |           |
| The subnet's address ran  |  |   | Ē         |

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.

 $(\mathbf{i})$ 

#### 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                 | e a vii     | rtual mae  | chine                                 |                |            |  |          |  |
|------------------------|-------------|------------|---------------------------------------|----------------|------------|--|----------|--|
| Basics                 | Disks       | Networking | Management                            | Advanced       | Tags       | Review + create  |          |  |
| image. Co              | omplete th  |            | n Review + create                     |                |            | zure marketplace or use your o<br>achine with default parameters |          |  |
| Project d              | etails      |            |                                       |                |            |  |          |  |
| Select the<br>manage a |             |            | deployed resource                     | s and costs. U | ise resou  | rce groups like folders to orga                                  | nize and |  |
| Subscripti             | ion * 💿     |            | SaaS Bad                              | kup Productio  | n          |  | ~        |  |
| Re                     | esource g   | roup * 🕕   | NimoAV                                | Demo           | ~          |  |          |  |
|                        |             |            | Create new                            | v.             |            |  | 1        |  |
| Instance               | details     |            |                                       |                |            |  |          |  |
| Virtual ma             | chine nar   | ne * 💿     | nimAV\$84                             |                |            |  | ~        |  |
| Region *               | 0           |            | (US) East                             | US 2           |            |  | ~        |  |
| Availabilit            | y options   | 0          | No infrastructure redundancy required |                |            | quired   | ~        |  |
| Image *                | 0           |            | Wind                                  | iows Server 20 | 12 R2 Da   | tacenter - Gen2  | ~        |  |
|                        |             |            | See all ima                           | ges            |            |  |          |  |
| Azure Spo              | ot instance | e 🖸        |                                       |                |            |  |          |  |
| Size * 🛈               |             |            | Standard                              | _D2s_v3 - 2 vo | pus, 8 Gil | 8 memory (\$130.67/month)  | $\sim$   |  |
|                        |             |            | See all size                          | es.            |            |  |          |  |

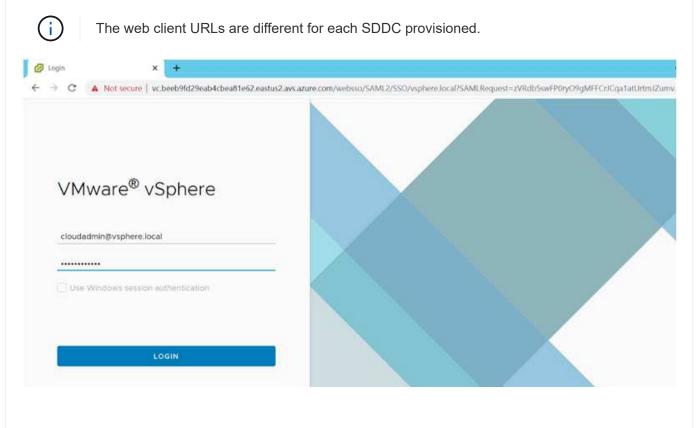
After the virtual machine is provisioned, use the Connect option to access RDP.

| Virtual machine             | t …   |
|-----------------------------|---|
|                             | ▲ To improve security, enable just-in-time access on this VM. →   |
| Overview                    |   |
| Activity log                | RDP SSH BASTION   |
| Access control (IAM)        | Connect with RDP  |
| 🗧 Tags                      | To connect to your virtual machine via RDP, select an IP address, optionally change the port number, and download the |
| Diagnose and solve problems | RDP file.   |
|                             | IP address *  |
| iettings                    | Public IP address (52.138.103.135)  |
| 2 Networking                | Port number *   |
| 9 Connect                   | 3389  |
| Did.                        | Download RDP File   |
| B Disks                     |   |

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.

| AVS Private cloud            | · · · · · · · · · · · ·                 |  |   |
|------------------------------|---|--|---|
| Search (Ctrl+/)              | « Login credentials                     |  |   |
| Access control (IAM)         | <ul> <li>vCenter credentials</li> </ul> |  |   |
| 🧳 Tags                       | Web client URL 💿                        | https://10.21.0.2/                       | Ð |
| Diagnose and solve problems  | Admin username                          | cloudadmin@vsphere.local                 | D |
| Settings                     | Admin password ①                        |  |   |
| A Locks                      | Certificate thumbprint ③                | AE26B15ASCE38DC069D35F045F088CA6343475EC | Ð |
| Manage                       | NSX-T Manager credentials               |  |   |
| 🤶 Connectivity               | Web client URL ①                        | https://10.21.0.3/                       | D |
| 🖳 Identity                   | Admin username ①                        | admin                                    | Ð |
| le Clusters                  | Admin openanie ()                       |  | H |
| Placement policies (preview) | Admin password 💿                        | D  |   |
| + Add-ons                    | Certificate thumbprint ①                | B2B722EA683958283EE159007246D5166D0509D3 | Ð |

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.



| vm vSphere Client                             | Menu V Q Search in all environment         |                         | C 0                    | ✓ cloudadmin@VSPHERELC            | CAL~ (                              |
|---|--|-------------------------|------------------------|-----------------------------------|-------------------------------------|
|   | 😰 vc.beeb9fd29eab4cbea                     | 81e62.eastus2.avs.az    | ure.com                | 5 -                               |                                     |
| wc.beeb9fd29eab4cbea83e     m SDDC-Datacenter | Sum. Mon. Confi. Permis                    | s., Datace, Hosts & C., | V. Datast_             | Netw_ Linked vCenter Se           | Free 20173 Ore                      |
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|   | Custom Attributes                          | ~                       | Tags                   |                                   | ^                                   |
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| Recent Tasks Alarms                           |  |                         |                        |                                   |                                     |
| Task Name 🗢 Target                            | ~ Status ~ Details                         | ~ Initiator ~ Queue     | d For 🛛 👻 Start Time 🕁 | ✓ Completion Time ✓               | Server                              |
| Undeploy plug in 🔗 vc.beeb9fc                 | 29 VMware vRops<br>Completed Client Plugin | VSPHERELOCALL_ 8 ms     | 08/12/2021, 1<br>AM    | 1.38:11 08/12/2021.11.38:11<br>AM | vt.beeb%fd2%cab                     |

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:

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

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

• 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.

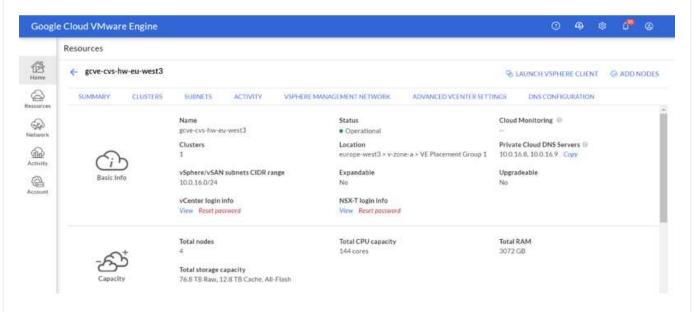
| Private Cloud name *   |                |
|--|----------------|
| NiMoGCVE   |                |
| Location *   |                |
| us-east4 > v-zone-a > VE Placer  | nent Group 2 • |
| Node type *  |                |
| ve1-standard-72  |                |
| 2x2.6 GHz, 36 Cores (72 HT), 768 (<br>19.2 TB Raw, 3.2 TB Cache (All-Fla |                |
| Node count *   |                |
| 3  |                |
| (3to3)   |                |
| vSphere/vSAN subnets CIDR  | range *        |
| 192.168.100.0  |                |
| IP Range: 192.168.100.0 - 192.168  | 103.255        |
| HCX Deployment Network C   | IDR range      |
| 192.168.104.0  |                |

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.

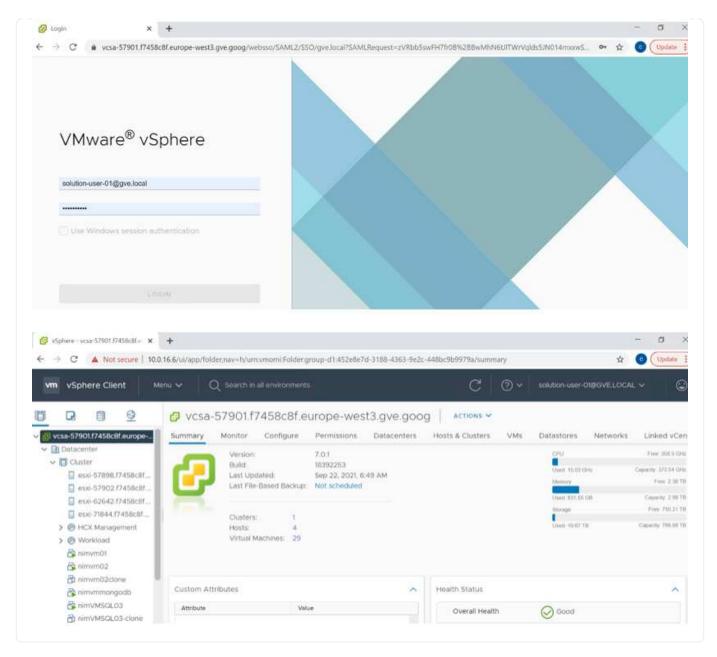
| Tenant P 🕅 🗍 🌲  | Service     | \$<br>Region | \$<br>Routing Mode | $\frac{A}{T}$ | Peered Project ID 🗘 | Peered VPC        | * | VPC Peering Sta ≑          | <b>Region Status</b> |
|-----------------|-------------|--------------|--------------------|---------------|---------------------|-------------------|---|----------------------------|----------------------|
| ke841388caa56b  | VPC Network | europe-west3 | Global             |               | cv-performance-te   | cloud-volumes-vpc |   | Active                     | Connected            |
| jbd729510b3ebbf | NetApp CVS  | europe-west3 | Global             |               | y2b6c17202af6dc     | netapp-tenant-vpc |   | <ul> <li>Active</li> </ul> | 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

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.



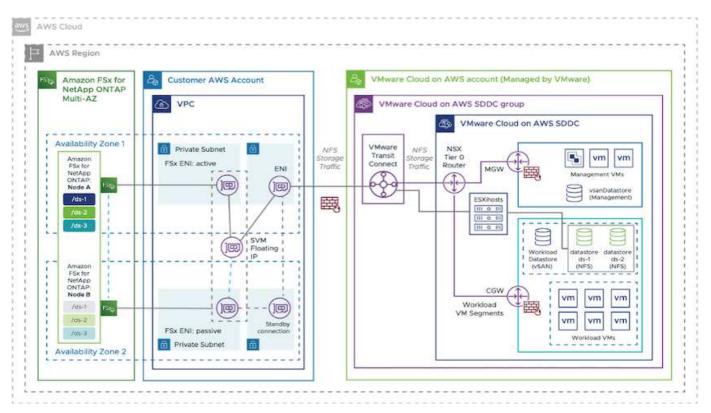
(i)

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, highperforming, 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.

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.

| Step 1<br>Select file<br>system type     | Select file system type     |   |  | ^ ©  |
|--|-----------------------------|---|--|------|
| Step 2<br>Specify file                   | File system options         |   |  |      |
| details<br>Sop 3<br>Neview and<br>create | Amazon FSx for NetApp ONTAP | Amazon FSx for Windows File<br>Server<br>FSX<br>Amazon FSx<br>for Windows File Server | Amazon FSx for Lustre<br>FSX<br>Amazon FSx<br>for Lustre | l    |
|  |                             | Select file system type   |  |      |
|  |                             | Select file system type   | Cancel   | Next |

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.

| reation method   |  |
|--|--|
| <ul> <li>Quick create</li> <li>Use recommended best-practice configurations.</li> <li>Most configuration options can be changed after<br/>the file system is created.</li> </ul> | <ul> <li>Standard create</li> <li>You set all of the configuration options, including<br/>specifying performance, networking, security,<br/>backups, and maintenance.</li> </ul> |

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

| File system name - optional In   | fo  |          |
|--|---|----------|
| vmcfsxval2   |   |          |
| Maximum of 256 Unicode letters, wh   | tespace, and numbers, plus + - = : /                                    |          |
| SSD storage capacity Info  |   |          |
| 1024 0   |   |          |
| Minimum 1024 GB; Maximum 192 TB  |   |          |
| Provisioned SSD IOPS<br>Amazon FSx provides 3 IOPS per GB on<br>needed.  | f storage capacity. You can also provision additional SSD IOP           | S as     |
| Automatic (3 IOPS per GB of a state of a | SSD storage)  |          |
| O User-provisioned   |   |          |
| Throughput capacity Info<br>The sustained speed at which the file<br>burst to higher speeds for periods of   | server hosting your file system can serve data. The file server<br>ime. | can also |
| 512 MB/s (Recommended)   | *   |          |

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.

| Virtual Private Cloud (VPC) Info<br>Specify the VPC from which your file system is accessible.                              |   |
|---|---|
| vmcfsx2.vpc   vpc-0d1c764bcc495e805   | v |
| VPC Security Groups Info<br>Specify VPC Security Groups to associate with your file system's network interface.             |   |
| Choose VPC security group(s)  | ٧ |
| 5g-018896ea218164ccb (default) ×  |   |
| Preferred subnet Info<br>Specify the preferred subnet for your file system.   |   |
| subnet02.sn   subnet-013675849a5b99b3c (us-west-2b)   |   |
| Standby subnet  |   |
| subnet01.sn   subnet-0ef956cebf539f970 (us-west-2a)   |   |
| VPC route tables<br>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<br>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.

| Encryption key Info<br>AWS Key Management Service (KMS) encryption key that protects                        | your file system data at re | st.                                      |
|---|-----------------------------|--|
| aws/fsx (default)   |                             | •  |
| Description   | Account                     | KMS key ID                               |
| Default master key that protects my FSx resources<br>when no other key is defined                           | 139763910815                | 72745367-7bb0-499c-<br>acc0-4f2c0a80e7c5 |
| File system administrative password<br>Password for this file system's "fsxadmin" user, which you can use t | o access the ONTAP CLI o    | r REST API.                              |
| O Don't specify a password  |                             |  |
|   |                             |  |
| Specify a password  |                             |  |
| <ul> <li>Specify a password</li> <li>Password</li> </ul>  |                             |  |
|   |                             |  |
| Password  |                             |  |

 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.

| Storage virtual machine name  |  |
|---|--|
| vmcfsxval2svm   |  |
| SVM administrative password<br>Password for this SVM's "vsadmin" user, which you can use to access the ONTAP CLI or REST API. |  |
| O Don't specify a password  |  |
| <ul> <li>Specify a password</li> </ul>  |  |
| Password  |  |
| ******  |  |
| Confirm password  |  |
| ******  |  |
| Active Directory<br>Joining an Active Directory enables access from Windows and MacOS clients over the SMB protocol.          |  |
| <ul> <li>Do not join an Active Directory</li> </ul>   |  |
| Join an Active Directory  |  |

 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   |      |
| val1  |      |
| Maximum of 203 alphanumeric characters, plus<br>Junction path   |      |
| /vol1   |      |
| The location within your file system where your volume will be mounted.   |      |
| Volume size   |      |
| 1024  | 0    |
| Minimum 20 MiB; Maximum 104857600 MiB   |      |
| Storage efficiency<br>Select whether you would like to enable ONTAP storage efficiencies on your volume: deduplicat<br>compression, and compaction. | ion, |
| Enabled (recommended)   |      |
| O Disabled  |      |
| Capacity pool tiering policy<br>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.

| Backups <ul> <li>Q. File file system</li> <li>Q. File file system</li> <li>Pile</li> <li>Storage virtual machines</li> <li>Virture Quates</li> <li>G. Find storage virtual machines</li> <li>Virture Quates</li> <li>Multi-AZ</li> <li>Storage virtual machines</li> <li>Virture Quates</li> <li>Multi-AZ</li> <li>Storage virtual machines</li> <li>Virture Quates</li> <li>Multi-AZ</li> <li>Storage virtual machines</li> <li>Virture Quates</li> <li>Kontagoid</li> <li>Multi-AZ</li> <li>Storage virtual machines</li> <li>Virture Quates</li> <li>Virture Quates</li> <li>Kontagoid</li> <li>Kontagoid</li></ul>   | File Status □ Deployment Storage   type ○ Available Multi-A2 SSD   7 ONTAP ○ Available Multi-A2 SSD   0a O Create storage virtual machine     1 > ○ P P    2021-10-19 15:17:08 UTC -    ed 2021-10-15 15:16:54 UTC -   1 > ○ Dele   |
|--|---|
| Backups          Orizar<br>Storage virtual machines<br>SVM name         SVM ID         Status         SVM ID         Status         SVM name         Svm-075dcfbe2cfa2ecce9         Svm-075dcfbe                                       | File Status Deployment Storage   type v Storage type   f ONTAP Available Multi-AZ SSD   7 ONTAP Available Multi-AZ SSD   aa ONTAP Q Available Multi-AZ SSD   aa ONTAP Q Available Multi-AZ SSD   aa ONTAP Q Available Multi-AZ SSD   aa Volumes Backups Tags Image: Status   c Actions Create storage virtual machine Status   ad 2021-10-19 15:17:08 FSXTESTING.LOCAL   ad 2021-10-15 15:16:54 UTC   ad 2021-10-15 15:16:54 UTC   ad 2021-10-15 15:16:54 UTC   ad 2021-10-15 15:16:54 UTC  |
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| Storage virtual machines<br>Volumes       File system ID       File system ID       File system ID       File system ID       Prophymetry Status       Prophymetry Storage       Storage       Storage       Storage       Multi-AZ       SSD         Inter positiony tasks       Inter position y tasks   | <ul> <li>system type v</li> <li>Status v</li> <li>Deployment type v</li> <li>Storage type v</li> <li>Multi-AZ</li> <li>SSD</li> <li>ONTAP</li> <li>Available</li> <li>Multi-AZ</li> <li>SSD</li> <li>ONTAP</li> <li>ONTAP</li></ul>         |
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| Storage virtual machines (SVMs) (2)       C       Actions       Create storage virtual machines         Q       Find storage virtual machines       <1>         SVM name       SVM ID       V       Status       Creation time       Active Director         SVM name       SVM ID       V       Status       Creation time       Active Director         fsxsmbtesting01       svm-075dcfbe2cfa2ece9       O       2021-10-19 15:17:08 UTC       FSXTESTING.LC         vmcfsxval2svm       svm-075dcfbe2cfa2ece9       O       2021-10-15 15:16:54 UTC       -         Storage virtual machines       svm-075dcfbe2cfa2ece9       Delete       Up         Storage virtual machines       svm-075dcfbe2cfa2ece9       -       -         Storage virtual machines       svm-075dcfbe2cfa2ece9       Delete       Up         Storage virtual machines       svm-075dcfbe2cfa2ece9       Delete       Up         Storage virtual machines       svm-075dcfbe2cfa2ece9       Pelete       Up         Storage virtual machines       svm-075dcfbe2cfa2ece9       Pelete       Up         Storage virtual machines       svm-075dcfbe2cfa2ece9       Pelete       Up         Storage virtual machines       svm-075dcfbe2cfa2ece9       Fitesystem       Pelete       Up   | C       Actions ▼       Create storage virtual machine         < 1 > ②         s ▼       Creation time       Active Directory ▼         ed       2021-10-19 15:17:08 UTC<br>+01:00       FSXTESTING.LOCAL         ed       2021-10-15 15:16:54 UTC<br>+01:00       -         2ecce9)       Delete       Update  |
| Q. Find storage virtual machines       < 1 >         SVM name       ▼       SVM ID       ▼       Status       ▼       Creation time       ▲       Active Director         Image: symbol sym  | $\langle 1 \rangle \otimes$ s $\nabla$ Creation time $\wedge$ Active Directory $\nabla$ 2021-10-19 15:17:08 UTC +01:00 FSXTESTING.LOCAL 2021-10-15 15:16:54 UTC - ed +01:00 - 20221-2021-2021-2021-2021-2021-2021-20  |
| Delete       Upd         Summary       Creation time       Active Directory         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         Subtype       Fully qualified domain name  |   |
| 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       Subtype     Fully qualified domain name  | Active Directory  |
| svm-075dcfbe2cfa2ece9     2021-10-19T15:17:08+01:00     FSXTESTING.LOCAL       SVM name     Lifecycle state     Net BIOS name       fsxsmbtesting01     Created     FSXSMBTESTING01       Subtype     Fully qualified domain name  | Active Directory  |
| SVM name     Lifecycle state     Net BIOS name       fsxsmbtesting01     Image: Created     FSXSMBTESTING01       Subtype     Fully qualified domain name  | )1:00 FSXTESTING.LOCAL  |
| fsxsmbtesting01 D Subtype Fully qualified domain name  |   |
| fsxsmbtesting01 D Subtype Fully qualified domain name  |   |
| UND STATES OF STATES   | rokon control ( )   |
| UUU DEFAULT EXTECTIVE LOCAL  | Fully qualified domain name   |
| 4a50e659-30e7-11ec-ac4f- DEFAULT FSXTESTING.LOCAL  | FSXTESTING.LOCAL  |

File system ID

fs-040eacc5d0ac31017

Service account username administrator

Organizational unit distinguished name CN=Computers

For more detailed information, see Getting started with Amazon FSx for NetApp ONTAP.

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

- 1. Open the Amazon FSx console.
- 2. In the left navigation pane, choose File systems, and then choose the ONTAP file system that you want to create a volume for.
- 3. Select the Volumes tab.
- 4. Select the Create Volume tab.
- 5. The Create Volume dialog box appears.

For demo purposes, an NFS volume is created in this section that can be easily mounted on VMs running on VMware cloud on AWS. nfsdemovol01 is created as depicted below:

|  | ,                           |
|--|-----------------------------|
| 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 mount   | rð.                         |
| Volume size  |                             |
| 1024   | [0]                         |
| Minimum 20 MiB: Maximum 104857600 MiB  |                             |
|  |                             |
| Storage efficiency<br>Select whether you would like to enable ONTAP storage efficiencies or<br>compression, and compaction.                            | your volume: deduplication, |
| Storage efficiency<br>Select whether you would like to enable ONTAP storage efficiencies or<br>compression, and compaction.                            | your volume: deduplication, |
| Storage efficiency<br>Select whether you would like to enable ONTAP storage efficiencies or<br>compression, and compaction.<br>C Enabled (recommended) | your volume: deduplication, |
| Storage efficiency<br>Select whether you would like to enable ONTAP storage efficiencies or  |                             |

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
```

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

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

| 😰 vSphere - ubuntu01 - Summary ×         | ubuntu01 × +  | C          |
|--|---|------------|
| $\leftrightarrow \rightarrow \mathbf{C}$ | O A ≓ https://vcenter.sddc-52-37-127-104 vmwarevmc.com/ui/webconsole.html?vmld=vm-1003&vmName=ubuntu01&serv ☆   |            |
| 📵 Getting Started 🥫 EC2 Managem          | ment Con 😸 New Tab  |            |
| ubuntu01                                 | rootfubuntu01:/fs:/nfsdemovo101# df         IX-blocks         Used Avs11able         Use: Mounted on           filesystem         IX-blocks         Used Avs11able         Use: Mounted on           toofs         814936         1175         013220         1X /run           /dev/mapper/ubuntuvg-ubuntuiv         15412160         3666428         10943132         258 /           toofs         4071960         0         4071960         00 /run/lock           toofs         5200         0 0% /run/lock         1095           toofs         4096         0 4071960         0% /run/lock           toofs         4096         0 4096         0% /run/lock           toofs         11520         11 /run/vser/lock           toofs         999220         254396         675512         281 /boot           toofs         814392         4 814388         11 /run/vser/1000         127,16.0,22/nfsdemovo101         9961472 4241781         5719680         433 /faxcwotesting01/nfsdemovo101           190,15.254,235r/nfsdemovo101         995410         13 /faxcwotesting01/nfsdemovo101         127,16.0,21/nfsdemovo101         13 /faxcwotesting01/nfsdemovo101           190,15.254,235r/nfsdemovo101#         95540         13 /faxcwotesting01/nfsdemovo101         17001000000000000000000000000000000000 | Fullscreen |

Mount FSx ONTAP volume on Linux client

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.



Tp 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.

Management IP address

198.19.254.9

198.19.254.9

SMB IP address

198.19.254.9

iSCSI IP addresses

10.222.2.224, 10.222.1.94

NFS IP address

# Endpoints

Management DNS name

svm-075dcfbe2cfa2ece9.fs-040eacc5d0ac31017.fsx.us-

west-2.amazonaws.com

NFS DNS name

svm-075dcfbe2cfa2ece9.fs-040eacc5d0ac31017.fsx.us-

west-2.amazonaws.com

SMB DNS name

FSXSMBTESTING01.FSXTESTING.LOCAL

**iSCSI DNS** name

iscsi.svm-075dcfbe2cfa2ece9.fs-040eacc5d0ac31017.fsx.us-

west-2.amazonaws.com

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

|   | 100 xil   |  |  |                                       |  |             |
|---|---|--|--|---------------------------------------|--|-------------|
| <ul> <li>System Tools</li> <li>Task Scheduler<br/>Event Viewer</li> <li>Shared Folders</li> <li>Shared Folders</li> <li>Shares</li> <li>Sessions</li> <li>Open Files</li> <li>Local Users and Groups</li> <li>Performance</li> <li>Device Manager</li> <li>Storage</li> <li>Windows Server Backup</li> <li>Disk Management</li> <li>Services and Applications</li> </ul>  | /BTESTING01.FSXTESTING.LOCAL)   | Share Name<br>Ba cS<br>B ipcS<br>B smbdemo<br>B testnimvol | Folder Path<br>C:\<br>C:\smbdemovol01<br>C:\testnimvol | Type<br>Windows<br>Windows<br>Windows | # Client Connections<br>0<br>1<br>1<br>0 | Description |
| Now choose a ne   | ew share and complete   | the Create   | a Shared Fol   | der wizaı                             | rd.                                      |             |
|   |   |  |  |                                       | ~  |             |
|   |   |  |  |                                       | ×  |             |
| Name, Description<br>Specify how potential of the second seco | on, and Settings<br>eople see and use this sha<br>bout the share for users.   |  |  | he conten                             | 22                                       |             |
| Name, Description<br>Specify how po<br>Type information a<br>offline, click Chang   | on, and Settings<br>eople see and use this sha<br>bout the share for users.   |  |  | he conten                             | 22                                       |             |
| Name, Description<br>Specify how po<br>Type information al<br>offline, click Chang<br>Share name:   | on, and Settings<br>eople see and use this sha<br>bout the share for users.   | To modify ho   | w people use t   |                                       | 22                                       |             |
|   | on, and Settings<br>eople see and use this sha<br>bout the share for users.<br>e.<br>nimtestsmb01                               | To modify ho   | w people use t   |                                       | 22                                       |             |
| Name, Description<br>Specify how po<br>Type information al<br>offline, click Chang<br>Share name:<br>Share path:  | on, and Settings<br>eople see and use this sha<br>bout the share for users.<br>e.<br>nimtestsmb01                               | To modify ho   | w people use t   | tsmb01                                | 22                                       |             |
| Name, Description<br>Specify how port<br>Type information all<br>offline, click Chang<br>Share name:<br>Share path:<br>Description:   | on, and Settings<br>eople see and use this sha<br>bout the share for users.<br>e.<br><u>nimtestsmb01</u><br>\\FSXSMBTESTING01.F | To modify ho   | w people use t   | tsmb01                                | t while                                  |             |

< Back

Next >

Cancel

| Status:                                   | was Successful  |
|---|---|
| You have su                               |   |
|   |   |
| 35  | cessfully completed the Share a Folder  |
| Summary:                                  |   |
| VFSXSMBTES<br>Folder path:<br>Share name: | ected the following share settings on \<br>TING01.FSXTESTING.LOCAL:<br>C:\nimtestsmb01<br>nimtestsmb01<br>\VFSXSMBTESTING01.FSXTESTING.LOCAL<br>1 |
| When I clic<br>folder                     | k Finish, run the wizard again to share another   |
| To dose this v                            | izard, dick Finish.   |

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.

| When the the terminal termin  | Sphere - vmcdc01 - Summary $\times$ | vmcdc01  | × 🚺 Sign out   | ×                     | +                  | 0                       | - 0  | 8          |
|---|-------------------------------------|--|--|-----------------------|--------------------|-------------------------|--|------------|
| ← → C O A   | at https://vcenter.addc-5/          | 2-37-127-104.vmwarevr  | nc.com/ui/webconsole.htm   | l?vmld=vm-10058cvmNan | ne=vmcdc( 67%      |                         | 0  | *          |
| 🔞 Getting Started 🥫 EC2 Management Con.   | 🥶 New Tab                           |  |  |                       |                    |                         | C Other  | Bookma     |
| vmcdc01   |                                     |  |  |                       | Geforce            | US Keyboard Layout View | Fullstream Sand  | Chil+Alt+O |
| Formation Management<br>File Action View Hidge  | #18 M •1                            | and the second sec | da gorandi ne za esta ( de p   |                       | - 5                | ×                       |  | 0          |
| ** * # m = a = 10 m   |                                     | New DiverNois<br>- ambdame-edit (1.100.10.254.0) (1)   | 10   |                       | 6 land outpermitte |                         |  |            |
| Empose Heapment EXDMITEREDUCE SUITSINGLOCAL)     Of Lytem Tool     Too Stabular     Ford Stabular     Submit Tales     S | ShareName                           | ern<br>mentslær01<br>mentslæ<br>mentslæ<br>mentslæ   | Determodyland Trave<br>10/10/2011/02/04 Ale-Anaw<br>10/2021/02/25/34 Ale-Anaw<br>10/2021/02/25/34 Ale-Are-Anaw<br>10/2021/02/25/34 Ale-Are-Anaw<br>10/22/05/32/34 Ale-Are-Anaw | Stee.                 |                    |                         | Actions<br>James<br>More Acts<br>antidemental<br>More Jack | 1          |

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:

- 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::> igroup create -vserver vmcfsxval2svm -igroup
winIG -protocol iscsi -ostype windows -initiator ign.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:

|                 | acc5d0ac31017::> lun map -vserve<br>sxscsivol/nimofsxlun01 -igroup w |        | val2svm - | path    |
|-----------------|--|--------|-----------|---------|
| FsxId040e       | acc5d0ac31017::> lun show  |        |           |         |
| Vserver<br>Size | Path   | State  | Mapped    | Туре    |
|                 |  |        |           |         |
| vmcfsxval       | 2svm   |        |           |         |
| 5gb             | /vol/blocktest01/lun01   | online | mapped    | linux   |
| vmcfsxval       | 2svm   |        |           |         |
| 5gb             | /vol/nimfsxscsivol/nimofsxlun01                                      | online | mapped    | windows |

Two entries were displayed.

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

To connect the new LUN tor 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.

|  | es RADIUS Configu           |                                 |  |
|--|-----------------------------|---------------------------------|--|
| Quick Connect  |                             | Status                          |  |
| To discover and log on to a target using a basic connectio<br>DNS name of the target and then dick Quick Connect.  | n, type Quick Conn          | ect                             | :  |
| Target: 10.222.2.221   | provided a                  | re listed below. If multiple ta | on at the IP address or DNS name that you<br>argets are available, you need to connect |
| Discovered targets   | to each tar                 | get individually.               |  |
|  | Connection                  | s made here will be added to    | o the list of Favorite Targets and an attempt  |
|  | to restore                  | them will be made every time    |  |
| Name   | Sta                         |                                 |  |
| ign. 1992-08.com.netapp:sn. 264efe832dd911eca961d5f  | Con Discovered              | d targets                       |  |
|  | Name                        |                                 | Status   |
|  | ing 1007                    | 02 com nationeren fürstönen     | f2dc611ecac4f Connected  |
|  |                             |                                 |  |
|  |                             |                                 |  |
| To connect using advanced options, select a target and the   |                             |                                 |  |
| To connect using advanced options, select a target and the<br>click Connect.<br>To completely disconnect a target, select the target and<br>then click Disconnect. | hen Progress r<br>Login Sur |                                 |  |
| dick Connect.<br>To completely disconnect a target, select the target and  | Login Sur                   |                                 |  |

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.

| * * * * *                                     | A REPORT OF A R | 1.5.5.14  | 1.0.0         | 1.4.5.5   | 1000000 | 100000000  |       |   |   |      |          |
|---|---|---|---------------|---|---------|------------|-------|---|---|------|----------|
| Computer Management (Local<br>() System Teals | = (C)   | Simple Bas                                      | e File System | <ul> <li>Isten</li> <li>Healthy Bout, Page File, Crash Durry, Fornary Partition)</li> </ul> |         | Free Spale | 30%   |   |   |      | _        |
| 1 ( Task Scheduler                            | - New Volume (E)  | Simple Are                                      | in NTFS       | Healthy (Primary Patition)  | 9.98-08 | 9.95 GB    | 100 % |   |   |      |          |
| > III Event Viewer                            | SSS_REAPPER_DH-US   |   |               | Healthy (Primary Partition)   | 4.90.08 | 0348       | 0%    |   |   |      |          |
| 3 Blaned Folders                              | an System Reserved  | Single Bas                                      | e NTES        | Healthy Oystem, Active, Frimary Partition)  | 140 ME  | 115 MB     | 21%   |   |   |      |          |
| Or Performance     Device Manager             | 200   |   |               |   |         |            |       |   |   |      |          |
| Storage                                       |   |   |               |   |         |            |       |   |   |      |          |
| > 🚯 Windows Server Backup                     | 4   |   |               |   |         |            |       |   |   |      |          |
| 🖓 Disk Management                             |   |   |               |   |         |            |       |   |   |      |          |
| En Services and Applications                  |   |   |               |   |         |            |       |   |   |      |          |
|   |   |   |               |   |         |            |       |   |   |      |          |
|   |   |   |               |   |         |            |       |   |   |      |          |
|   |   |   |               |   |         |            |       |   |   |      |          |
|   |   |   |               |   |         |            |       |   |   |      |          |
|   |   |   |               |   |         |            |       |   |   |      |          |
|   |   |   |               |   |         |            |       |   |   |      |          |
|   |   |   |               |   |         |            |       |   |   |      |          |
|   |   |   |               |   |         |            |       |   |   |      |          |
|   | Basic Net<br>5.55 GB 5.5  | Volume (E)                                      |               |   |         |            |       |   | - |      |          |
|   | Basic Net<br>9.96 GB 9.90   | Volume (5.)<br>38 WPS<br>Ny (Frimary Partition) |               |   |         |            |       |   | - |      |          |
|   | Basic Net<br>9.96 GB 9.90   | OB NTPS   |               |   |         |            |       |   |   |      |          |
|   | Basic Ne<br>5.95 GB 5.9<br>Online 16  | OB NTPS   |               |   |         |            |       |   |   |      |          |
|   | Basic Ne<br>5.55 GB 5.9<br>Oxfine 19<br>19<br>Basic   | 08 NTFS<br>Ny (Primary Partition)               |               |   |         |            |       |   |   | -    |          |
|   | Basic Ner<br>5.55 GB 5.9<br>Colline His<br>His<br>His<br>Basic<br>400.55 GB 440                                 | OB NTPS   |               |   |         |            |       |   |   | 2.50 |          |
|   | Basic Ne<br>5.55 GB 5.9<br>Oxfine 19<br>19<br>Basic   | 08 NTFS<br>Ny (Primary Partition)               | e.            |   |         |            |       |   |   |      |          |
|   | Basic Ner<br>5.55 GB 5.9<br>Colline His<br>His<br>His<br>Basic<br>400.55 GB 440                                 | 08 NTFS<br>Ny (Primary Partition)               |               |   |         |            |       |   |   |      | Al afect |
|   | Basic Ne<br>S36 GB S3<br>Chilme Ho<br>M Disk Basic<br>40138 GB C0<br>Coline 40<br>Coline 2                      | 08 NTFS<br>Ny (Primary Partition)               |               |   |         |            |       |   |   |      |          |
|   | Basic Ne<br>5.56 GB 5.5<br>Online Ho<br>Month<br>Basic<br>AVLSE CB 400<br>Online 400                            | 38 HATPS<br>My (Primury PostStan)<br>e GB       |               |   |         |            |       | _ |   |      |          |

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.

| $\leftarrow \rightarrow c$                           | 0  | 8 =                     | https://vcenter                       | sddc-5  | 2-37-127-104.vmwa            | revmc.com/ui       | /webconsole.h                        | tml/vmld=vm-100 | 58xmName | e+vmcdc0   | 875 1           |               | 9           | ± =           |
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# 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

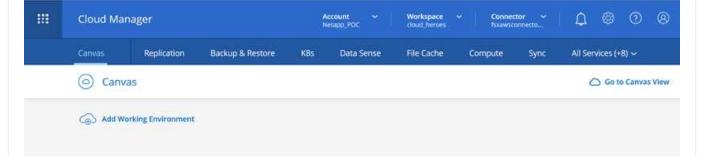
Cloud Volumes ONTAP shares and LUNs can be mounted from VMs that are created in the VMware Cloud on AWS SDDC environment. The volumes can also be mounted on native AWS VM Linux Windows clients, and LUNS can be accessed on Linux or Windows clients as block devices when mounted over iSCSI because Cloud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



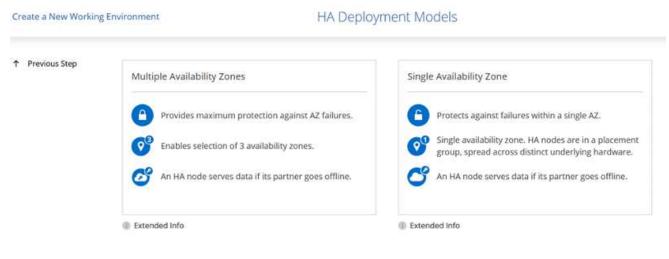
1. On the Cloud Manager home page, click Add a Working Environment and then select AWS as the cloud and the type of the system configuration.

| <br>Cloud Ma | nager          |                  |                  |            |                 | Account<br>Netabo, P  |      | Workspace ~         | Connector ~ | 0 | (i) | 0 | 8 |
|--------------|----------------|------------------|------------------|------------|-----------------|-----------------------|------|---------------------|-------------|---|-----|---|---|
| Canvas       | Replication    | Backup & Restore | K8s              | Data Sense | File Cache.     | Compute               | Sync | Ali Services (+8) ~ |             |   |     |   |   |
| Add Work     | ding Environme | nt               |                  |            |                 |                       |      |                     |             |   |     |   | × |
|              |                | 20 - T           | Loft Azure       | Amazon Wa  | Second Second   | Google Cloud Platform |      | On Premises         |             |   |     |   |   |
|              |                | Cloud            | O<br>I Volumes O | NTAP       | Claud Volumes O | •                     |      | Sx for ONTAP        |             |   |     |   |   |
|              |                |                  | Single Node      |            | ( regravate)    |                       | -    | westaburey.         |             |   |     |   | C |

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

| Treate a New Working Environ | nment                               | Detail   | and Credentials                                      |                   |
|------------------------------|-------------------------------------|--|--|-------------------|
| Previous Step                | Instance Profile<br>Credential Name | 139763910815<br>Account ID                           | netapp.com-cloud-volumes<br>Marketplace Subscription | Edit Credentials  |
|                              | Details                             |  | Credentials  |                   |
|                              | Working Environment N               | Vame (Cluster Name)                                  | User Name  |                   |
|                              | fsxcvotesting01                     |  | admin  |                   |
|                              |                                     |  | Password   |                   |
|                              | Add Tags                            | Optional Field Up to four tags                       | •••••  |                   |
|                              |                                     |  | Confirm Password                                     |                   |
|                              |                                     |  | *******  |                   |
|                              | ind recovery, and                   | ud Volumes ONTAF<br>Cloud Insights. Clio<br>Services | ? deployment, including Blue<br>k Continue.          | XP Classification |
| B Data S                     | Sense & Compliance                  |  |  | -                 |
|                              |                                     |  |  |                   |
| Backu                        | up to Cloud                         |  |  | • •               |

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



Continue

**-**

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

(III)

Monitoring

|               |                 |                |         | VPC                                      |                          | Security group                 |    |
|---------------|-----------------|----------------|---------|--|--------------------------|--------------------------------|----|
|               | US West   Ore   | gon            | ٠       | vpc-0d1c764bcc495e805 -<br>10.222.0.0/16 |                          | Use a generated security group | 7  |
|               | Node 1          | 14-0<br>14-2   |         | Node 2:                                  |                          | Mediator:                      |    |
|               |                 |                |         | E  |                          |                                |    |
|               | Availability Zo | ne             |         | Availability Zone                        |                          | Availability Zone              | •2 |
|               | us-west-za      |                |         | us-west-2b                               |                          | us-west-2c                     | •  |
|               | Subnet          |                |         | Subnet                                   |                          | Subnet                         | -  |
|               | 10.222.1.0/2    | 4              | *       | 10.222.2.0/24                            | •                        | 10.222.3.0/24                  | ٠  |
| Previous Step |                 |                |         |  |                          |                                |    |
|               | anaan<br>aanaa  |                |         |  | 1000 0000<br>A           | Mediator                       |    |
|               |                 | Authentication | Method  | 0  | Security Gr              |                                |    |
|               | Pa              | assword        |         | •  | Use a ger                | nerated security group         | ौ  |
|               |                 |                |         |  | Key Pair Na              | ime                            |    |
|               |                 |                |         |  | nimokey                  |                                |    |
|               |                 |                |         |  | Internet Co<br>Public IP | nnection Method                |    |
|               |                 |                |         |  | PUDIIC IP                | address                        |    |
|               |                 |                |         |  |                          |                                |    |
|               |                 |                |         |  |                          |                                |    |
|               |                 |                |         | Cont                                     | tinue                    |                                |    |
|               |                 |                |         | e const                                  |                          |                                |    |
| Specify the f | loating IP add  | resses ar      | nd then | click Continue.                          |                          |                                |    |
|               |                 |                |         |  |                          |                                |    |
|               |                 |                |         |  |                          |                                |    |
|               |                 |                |         |  |                          |                                |    |

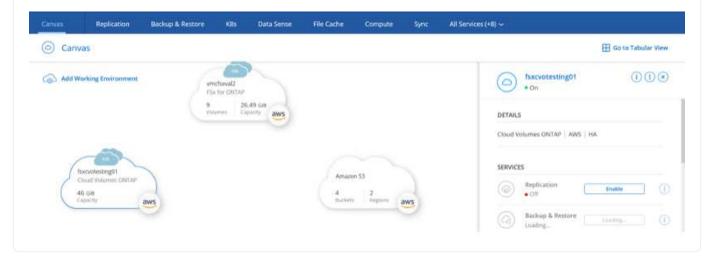
|                       | Environment              |   | Floating IPs                                   |                                |        |
|-----------------------|--------------------------|---|--|--------------------------------|--------|
| Previous Step         |                          | are required for cluster and SVM a<br>is if failures occur. To access the d |  |                                |        |
|                       | You mu                   | ist specify IP addresses that are o   | utside of the CIDR blocks for a                | all VPCs in the selected AWS r | egion. |
|                       |                          | Floating IP address for   | cluster management                             |                                |        |
|                       |                          | 172.16.0.1  |  |                                |        |
|                       |                          | Floating IP address 1 fo  | or NFS and CIFS data                           |                                |        |
|                       |                          | 172.16.0.2  |  |                                |        |
|                       |                          | Floating IP address 2 fo  | or NFS and CIFS data                           |                                |        |
|                       |                          | 172.16.0.3  |  |                                |        |
|                       |                          | Floating IP address for   | SVM management (Optional)                      |                                |        |
|                       |                          | 172.16.0.4  |  |                                |        |
|                       |                          |   | Continue                                       |                                |        |
| Continue.             |                          | es to include routes t  | 5  |                                |        |
| reate a New Working E | nvironment               | F   | Route Tables                                   |                                |        |
|                       |                          |   |  |                                |        |
|                       | Name                     | Ade   | ditional information ()                        | Associate with Subnet          | Tags   |
|                       | Name                     |   | ID<br>rtb-00b2d30c3f68fdbdd                    | Associate with Subnet          | Tags   |
|                       |                          | Main<br>Yes   | ID<br>rtb-00b2d30c3f68fdbdd                    | 1029-07 10                     |        |
|                       |                          | Main  | ID<br>rtb-00b2d30c3f68fdbdd                    | 1029-07 10                     |        |
|                       |                          | Main<br>Yes   | ID<br>rtb-00b2d30c3f68fdbdd                    | 1029-07 10                     |        |
|                       |                          | Main<br>Yes   | ID<br>rtb-00b2d30c3f68fdbdd                    | 1029-07 10                     |        |
|                       |                          | Main<br>Yes   | ID<br>rtb-00b2d30c3f68fdbdd                    | 1029-07 10                     |        |
|                       |                          | Main<br>Yes   | ID<br>rtb-00b2d30c3f68fdbdd                    | 1029-07 10                     |        |
|                       | 1 Route Tables   The mai | Main<br>Yes<br>in route table is the default for the                        | ID<br>rtb-00b2d30c3f68fdbdd<br>VPC<br>Continue | 1029-07 10                     |        |
| 1. On the Data        | 1 Route Tables   The mai | Main<br>Yes   | ID<br>rtb-00b2d30c3f68fdbdd<br>VPC<br>Continue | 1029-07 10                     |        |
| 1. On the Data        | 1 Route Tables   The mai | Main<br>Yes<br>in route table is the default for the                        | ID<br>rtb-00b2d30c3f68fdbdd<br>VPC<br>Continue | 1029-07 10                     |        |
| 1. On the Data        | 1 Route Tables   The mai | Main<br>Yes<br>in route table is the default for the                        | ID<br>rtb-00b2d30c3f68fdbdd<br>VPC<br>Continue | 1029-07 10                     |        |
| 1. On the Data        | 1 Route Tables   The mai | Main<br>Yes<br>in route table is the default for the                        | ID<br>rtb-00b2d30c3f68fdbdd<br>VPC<br>Continue | 1029-07 10                     |        |
| 1. On the Data        | 1 Route Tables   The mai | Main<br>Yes<br>in route table is the default for the                        | ID<br>rtb-00b2d30c3f68fdbdd<br>VPC<br>Continue | 1029-07 10                     |        |
| 1. On the Data        | 1 Route Tables   The mai | Main<br>Yes<br>in route table is the default for the                        | ID<br>rtb-00b2d30c3f68fdbdd<br>VPC<br>Continue | 1029-07 10                     |        |
| 1. On the Data        | 1 Route Tables   The mai | Main<br>Yes<br>in route table is the default for the                        | ID<br>rtb-00b2d30c3f68fdbdd<br>VPC<br>Continue | 1029-07 10                     |        |
| 1. On the Data        | 1 Route Tables   The mai | Main<br>Yes<br>in route table is the default for the                        | ID<br>rtb-00b2d30c3f68fdbdd<br>VPC<br>Continue | 1029-07 10                     |        |
| 1. On the Data        | 1 Route Tables   The mai | Main<br>Yes<br>in route table is the default for the                        | ID<br>rtb-00b2d30c3f68fdbdd<br>VPC<br>Continue | 1029-07 10                     |        |

| reate a New Working Envir   | onment   | Data Encryptio   |  |
|---|--|--|--|
| Previous Step   | AWS Ma   | naged Encryption   |  |
|   |  | ble for data encryption and decryptior<br>WS key management services.  | n operations. Key management   |
|   | Default Master   | Key: aws/ebs   |  |
| 1. Select the license<br>Pay-As-You-Go o  | e option: Pay-As-You-Go or BY<br>ption is used.  | Continue<br>OL for using an existing lie   | cense. In this example, the  |
| reate a New Working Envi  | ronmentCloud Volumes ONTAI   | <ul> <li>Charging methods &amp; r</li> </ul>   | NSS ACCOUNT  |
| Cloud Volumes ONTAP C   | harging Methods  | NetApp Support Site  | Account (Optional)   |
| 4. A)   |  |  | Account <i>(Optional)</i><br>op Support Site (NSS) accounts  |
| Cloud Volumes ONTAP C   | ging methods   | Learn more about NetAp   | op Support Site (NSS) accounts<br>lumes ONTAP to support,you   |
| Cloud Volumes ONTAP C<br>Learn more about our charg   | o by the hour  | Learn more about NetAp<br>To register this Cloud Vo<br>should add NetApp Sup<br>Don't have a NetApp Sup<br>finish deploying this syst  | op Support Site (NSS) accounts<br>lumes ONTAP to support,you   |
| Cloud Volumes ONTAP C<br>Learn more about our charg<br>Pay-As-You-G<br>Bring your ow<br>1. Select between s<br>deployed on the V  | ging methods<br>o by the hour<br>m license<br>everal preconfigured packages<br>/Ms running on the VMware clo   | Learn more about NetAp<br>To register this Cloud Vo<br>should add NetApp Sup<br>Don't have a NetApp Sup<br>finish deploying this syst<br>Support Registration ont<br>ontinue   | op Support Site (NSS) accounts<br>lumes ONTAP to support, you<br>port Site Account.<br>opport Site account?Select go to<br>tem.After its created, use the<br>sign to create an NSS account                           |
| Cloud Volumes ONTAP C<br>Learn more about our charg<br>O Pay-As-You-G<br>O Bring your ow<br>1. Select between s<br>deployed on the V<br>Create a New Working Enviror      | ging methods<br>o by the hour<br>m license<br>everal preconfigured packages<br>/Ms running on the VMware clo   | Learn more about NetAp<br>To register this Cloud Vo<br>should add NetApp Supp<br>Don't have a NetApp Sup<br>finish deploying this syst<br>Support Registration ont<br>ontinue<br>available based on the ty<br>bud on AWS SDDC.<br>Packages | op Support Site (NSS) accounts<br>lumes ONTAP to support, you<br>port Site Account.<br>opport Site account?Select go to<br>tem.After its created, use the<br>tion to create an NSS account<br>ype of workload to be  |
| Cloud Volumes ONTAP C<br>Learn more about our charg<br>Pay-As-You-G<br>Cloud Volumes ONTAP C<br>Pay-As-You-G<br>Bring your ow<br>1. Select between s<br>deployed on the V | ging methods<br>o by the hour<br>m license<br>everal preconfigured packages<br>/Ms running on the VMware clo<br>ment Preconfigured<br>econfigured Cloud Volumes ONTAP system that best | Learn more about NetAp<br>To register this Cloud Vo<br>should add NetApp Supp<br>Don't have a NetApp Sup<br>finish deploying this syst<br>Support Registration ont<br>ontinue<br>available based on the ty<br>bud on AWS SDDC.<br>Packages | op Support Site (NSS) accounts<br>Numes ONTAP to support, you<br>bort Site Account.<br>Opport Site account?Select go to<br>tem.After its created, use the<br>tion to create an NSS account<br>Appe of workload to be |

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

| eate a New Working E         | nvironment                    |  |                        | Review 8           | & Approve   |   |                 |
|------------------------------|-------------------------------|--|------------------------|--------------------|---|---|-----------------|
| Previous Step<br>TSXCvotesti | ne                            |  |                        |                    |   |   | Show API reques |
|                              | vest-2 HA                     |  |                        |                    |   |   |                 |
|                              |                               |  |                        |                    |   |   |                 |
| Alleston Hallen              | mes ONTAP instan              | ne will be need  | stered with NetAnn to  | most under the NCS | S Account mehad   |   |                 |
| This Cloud Volu              |                               | and the second sec | istered with NetApp su |                    |   | os información atlantes                         |                 |
| This Cloud Volu              |                               | and the second sec |                        |                    | S Account <b>mchad</b> .<br>ply with my above requirements. <b>Mo</b> | re information >                                |                 |
| This Cloud Volu              | nd that Cloud Mana            | ger will alloca  |                        |                    |   | re information >                                |                 |
| This Cloud Volu              | nd that Cloud Mana            | ger will alloca<br>orking  | ate the appropriate AV |                    |   |   |                 |
| This Cloud Volu              | nd that Cloud Mana            | ger will alloca  | ate the appropriate AV |                    |   | re information ><br>Multiple Availability Zones |                 |
| This Cloud Volu              | nd that Cloud Mana<br>w Netwo | ger will alloca<br>orking<br>Cloud Volume  | ate the appropriate AV |                    | ply with my above requirements. Mo                                    |   |                 |

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



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.

| Volumes HA Status Cost Replications |                        |                      | 0 0 | C | ٩ | 4 |
|-------------------------------------|------------------------|----------------------|-----|---|---|---|
| Create a CIFS server                |                        | + Advanced           |     |   |   |   |
| DNS Primary IP Address              | Active Directory Doma  | ain to join          |     |   |   |   |
| 192.168.1.3                         | fixtestinglocal        |                      |     |   |   |   |
| DNS Secondary IP Address (Optional) | Credentials authorized | d to join the domain |     |   |   |   |
| Example: 127.0.0.1                  | Username               | Password             |     |   |   |   |

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.

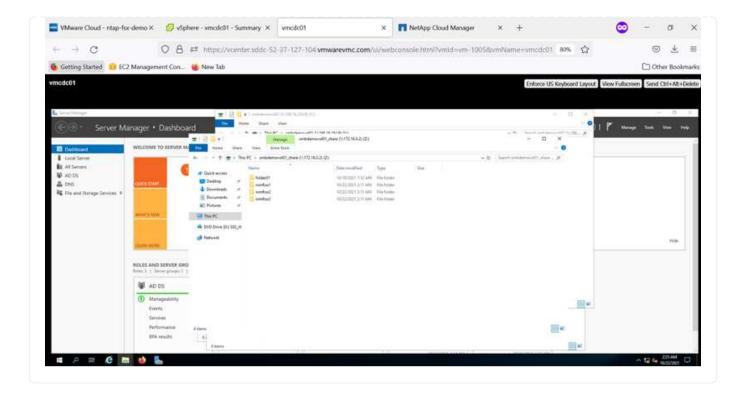
| Details & Protection |            | Protocol                 |                         |        |  |
|----------------------|------------|--------------------------|-------------------------|--------|--|
| Volume Name:         | Size (G8): | NFS                      | CIFS                    | iSCSI  |  |
| smbdemovol01         | 100        |                          |                         |        |  |
|                      |            | Share name:              | Permission              | 151    |  |
| Snapshot Policy:     |            | smbdemovol01_sha         | are Full Cont           | trol • |  |
| default              | •          |                          |                         |        |  |
| Default Policy       |            | Users / Groups:          |                         |        |  |
|                      |            | Everyone;                |                         |        |  |
|                      |            | Valid users and groups s | eparated by a semicolon |        |  |

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

| INFO           |      | CAPACITY  |                |
|----------------|------|-----------|----------------|
| Disk Type      | GP2  |           | <b>1.67 MB</b> |
| Tiering Policy | None | 10 GB     | EBS Used       |
| Backup         | OFF  | Allocated |                |

- 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.

| (HA) fsxcvotesting01 (Multiple AZs)                                   | AWS 🗄 AWS  |
|---|--|
| Volumes HA Status Cost Replications                                   | う (U) (10)   |
| Mount Volume smbdemovol01   |  |
| Access from inside the VPC using Floating IP                          | Access from outside the VPC using AWS Private IP   |
| Auto failover between nodes   | No auto failover between nodes   |
| The IP address automatically migrates between nodes if failures occur | The IP address does not migrate between nodes if failures occur                          |
| Go to your machine and enter this command                             | To avoid traffic between nodes, mount the volume by using the primary node's IP address: |
| \\172.16.0.2\smbdemovo101_share                                       | \\10.222.1.100\smbdemovo101_share  |
|   | If the primary node epes 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.

|  | Details & Protection  |                               |  |                 | Protocol  |                          |                      |  |
|--|---|-------------------------------|--|-----------------|---|--------------------------|----------------------|--|
|  | Volume Name:  | S                             | ize (GB):  | 0               | NE  | 5                        | CIFS                 | iscsi  |
|  | nimofsxiscsicvo01   |                               | 500  |                 |   |                          | W                    | /hat about LUNs? ())   |
|  | Snapshot Policy:  |                               |  |                 | Initiator Gr  | oup                      |                      |  |
|  | default   |                               |  | •               | <ul> <li>Map Existing Initiator Groups</li> <li>Create Initiator Group</li> </ul> |                          |                      |  |
|  | Default Policy  |                               |  |                 | Operating S   | ystem Type               |                      |  |
|  |   |                               |  |                 | Windows   |                          |                      | •  |
|  |   |                               |  |                 | Select Initiat  | tor Groups:              |                      | 1 (of 3) Groups  |
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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.

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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.

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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.

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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 Isblk cmd from the shell.

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_
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**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 onpremises 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.

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.

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| re NetApp Files makes it easy to migrate and   | East US 2                                 | ~ |   |            |          |   |
| complex, file-based applications with no code<br>ange. With support for multiple protocols and<br>grated data protection, storage management is<br>simple, fast, and reliable. |   |   |   |            |          |   |
| Create NetApp account  |   |   |   |            |          |   |
| Learn more of  | Create Download a template for automation |   |   |            |          |   |

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.

| Azure NetApp Files         |                              |     |                            |                         |                         | New capacity pool | ×  |
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|                            | NetApp add-ons               |     |                            |                         |                         |                   |    |
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| < Page 1 V of 1 >          | Tasks (preview)              |     |                            |                         |                         | Create Discard    |    |

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.

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| 🛖 Firewall                        |                           |                            |                                  |
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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.

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|                                       | Azure NetApp Files               |   | Organizational Unit Path 💿               |
|                                       | Active Directory connections     |   |  |
|                                       | Storage service                  |   |  |
| < Page 1 V of 1 >                     | Capacity pools                   |   | Join                                     |

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

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

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| Azure NetApp Files          |       | nimvoltest     |               | 100 GiB |    | 1.6 MiB/s  |    | NFSv3         |    | 172.24.3.4/nim |        | Standard      |    | nimcapp  |

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.

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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.

| ilesystem                | 1K-blocks | Used    | Available | Use% | Mounted on           |
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| dev/loop0                | 56832     | 56832   | 0         | 100% | /snap/core18/2128    |
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| /dev/loop4               | 33152     | 33152   | 0         | 100% | /snap/snapd/12764    |
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For more information, see Dynamically change the service level of a volume.

## Cloud Volumes ONTAP (CVO)

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

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

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

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

## Cloud Volumes ONTAP (CVO) as guest connected storage

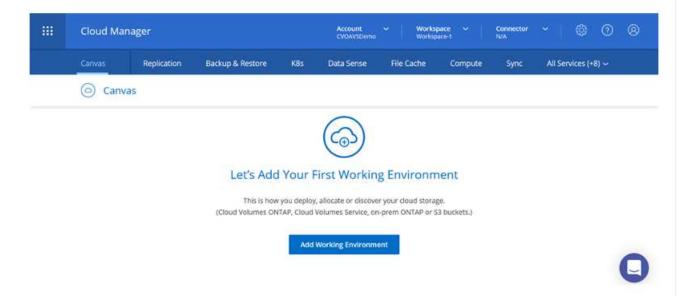
Cloud Volumes ONTAP shares and LUNs can be mounted from VMs that are created in the Azure VMware Solution SDDC environment. The volumes can also be mounted on the Linux client and on Windows client because Cloud Volumes ONTAP supports iSCSI, SMB, and NFS protocols. Cloud Volumes ONTAP volumes can be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

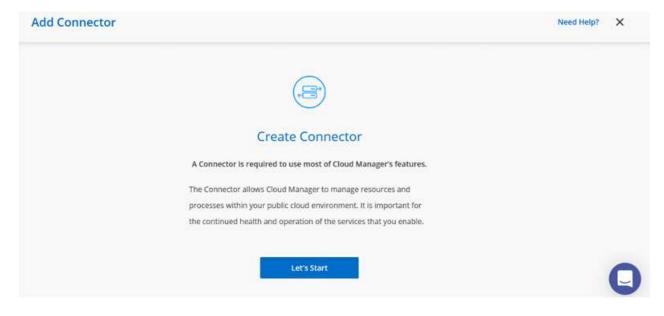
1. Log in to NetApp Cloud Central—the Fabric View screen is displayed. Locate the Cloud Volumes ONTAP tab and select Go to Cloud Manager. After you are logged in, the Canvas screen is displayed.



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.

| Canvas  | Replication    | Backup & Restore | K8s D                   | ata Sense 🛛 🖓 Fil | e Cache | Compute     | Sync | All Services | (+8) 🛩 |   |
|---------|----------------|------------------|-------------------------|-------------------|---------|-------------|------|--------------|--------|---|
| Add New | Working Enviro | nment            |                         |                   |         |             |      |              |        | × |
|         |                | 0                |                         |                   |         |             |      |              |        |   |
|         |                | crostt Azure Ama | aws<br>zon Web Services | Google Cloud P    | Satform | On-Premiser |      |              |        |   |
|         |                |                  |                         |                   |         |             |      |              |        |   |
|         | Choose         | Туре             |                         |                   |         |             |      |              |        |   |
|         |                | 0                |                         | 0                 |         | a           |      |              |        |   |
|         |                | 9                |                         | 9                 |         | (uu)        |      |              |        |   |

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



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

| Managed Service Ide SaaS Backup Prod |                    | CMCVOSub                 | Edit Credentials |
|--------------------------------------|--------------------|--------------------------|------------------|
| Credential Name                      | Azure Subscription | Marketplace Subscription |                  |
| Details                              |                    | Credentials              |                  |
| Working Environment Nam              | e (Cluster Name)   | User Name                |                  |
| nimavsCVO                            |                    | admin                    |                  |
|                                      |                    | Password                 |                  |
|                                      |                    | Continue                 |                  |

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

| Details                                    | Credentials      |
|--|------------------|
| Working Environment Name (Cluster Name)    | User Name        |
| nimavsCVO                                  | admin            |
|  | Password         |
| Add Resource Group Tags     Optional Field | •••••            |
|  | Confirm Password |
|  | ********         |

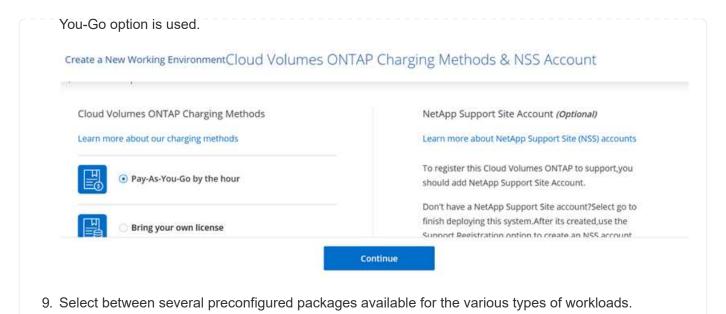
6. Select the add-on services for Cloud Volumes ONTAP deployment, including BlueXP Classification, BlueXP backup and recovery, and Cloud Insights. Select the services and then click Continue.

| Data Sense & Compliance | <b>•</b> •• • |
|-------------------------|---------------|
| Backup to Cloud         | -• ·          |
| (Jul) Monitoring        | <b>-</b>      |

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

| Azure Region                           |            | Resource Group  |
|--|------------|---|
| East US 2                              |            | Create a new group     Use an existing group  |
| Availability Zone                      | (Optional) | Resource Group Name   |
| Select an Availability Zone            | •          | nimassCVO-rg  |
| vNet<br>nimoavspriz-vnet   NimoAVSDemo |            | Security Group  |
| Subnet                                 |            | Generated security group     Ose existing security group  |
| 172.24.2.0/24                          | •          |   |
|  |            | I have verified network connectivity between the Cloud<br>Manager server and the selected VNet. |

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



- Create a New Working Environment
   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

   Image: Configuration of the production workloads Up to 500GB of storage
   Image: Configuration of the production workloads
   Image: Configuration of the production workloads

   Image: Configuration of the production workloads
   Image: Configuration of the production workloads
   Image: Configuration of the production workloads
- 10. Accept the two agreements regarding activating support and allocation of Azure resources. To create the Cloud Volumes ONTAP instance, click Go.

|                   | New Working Environ       | er en et allere             | Review & Approve   |
|-------------------|---------------------------|-----------------------------|--|
| imavsCVO          |                           |                             |  |
| Ature East US 2   |                           |                             |  |
| I understand that | in order to activate supp | oort, I must first register | Cloud Volumes ONTAP with NetApp. More information >                    |
| I understand that | Cloud Manager will alloc  | ate the appropriate Azu     | are resources to comply with my above requirements. More information > |
| Overview          | Networking                | Storage                     |  |
|                   |                           |                             |  |
|                   |                           |                             |  |

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

| G Add ₩ | forking Environment |                     |  |   |               | IVSCVO    |                                       |
|---------|---------------------|---------------------|--|---|---------------|-----------|---------------------------------------|
|         |                     | nimavsCVO           |  | - | DETAILS       |           |                                       |
|         | C                   | Cloud Volumes ONTAP |  |   | Cloud Volumes | ONTAP Azi | ure   Single                          |
|         |                     |                     |  |   | SERVICES      |           |                                       |
|         |                     |                     |  |   | Reoli         | ration    | · · · · · · · · · · · · · · · · · · · |

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.

| imavsCVO                             |                                 | Azur | - 11 | • | Manage |   |   |
|--------------------------------------|---------------------------------|------|------|---|--------|---|---|
| Volumes Replications                 | 1                               | 0    | Ċ    | C | ٢      | 4 | П |
| Create a CIFS server                 | + Advanced                      |      |      |   |        |   |   |
|                                      | Active Directory Domain to join |      |      |   |        |   |   |
| DNS Primary IP Address               | Active Directory Domain to Join |      |      |   |        |   |   |
| DNS Primary IP Address<br>172.24.1.5 | nimodemo.com                    |      |      |   |        |   |   |
|                                      |                                 |      |      |   |        |   |   |

 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.

| Details & Protection |            |   | Protocol            |             |       |
|----------------------|------------|---|---------------------|-------------|-------|
| Volume Name:         | Size (GB); | 0 | NFS                 | CIFS        | iSCSI |
| nimavssmbvol1        | 50         |   |                     | -           |       |
|                      |            |   | Share name:         | Permissions | 5).   |
| Snapshot Policy:     |            |   | nimavssmbvol1_share | Full Contro | • Ic  |
| default              |            | • |                     |             |       |
| ③ Default Policy     |            |   | Users / Groups:     |             |       |
|                      |            |   | Everyone;           |             |       |

3. After the volume is provisioned, it will be availabe 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               |                         |                                |           |
|-----------------------|-------------------------|--------------------------------|-----------|
|                       |                         |                                |           |
| Volume 50 GB Alloca   | ated 1.74 MB Total Used | (1.74 MB in Disk, 0 KB in Blo  | b)        |
| Fordifie Do GD Filloc |                         | fin the in easy of the in easy |           |
| -                     |                         |                                |           |
| imaur                 | smbvol1                 |                                | ONLINE    |
| Tillidy3              | SITIOVOIT               |                                | ONLINE    |
| INFO                  |                         | CAPACITY                       |           |
| in o                  |                         | GARAGITI                       |           |
| Disk Type             | PREMIUM_LRS             |                                | 1.74 MB   |
| Territory Ballow      | Auto                    | 50 GB                          | Disk Used |
| Lipring Louiny        |                         | Allocated                      |           |
| Tiering Policy        |                         |                                | 0 GB      |
| Backup                | OFF                     |                                |           |

- 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

|                |        |                  |             |               |          | 100            |     |                            |     |
|----------------|--------|------------------|-------------|---------------|----------|----------------|-----|----------------------------|-----|
|                |        |                  |             |               |          |                |     |                            |     |
| 👤   🛃 🗧 🕇 nin  | navssm | bvol1_share      |             |               |          |                |     | - 0                        |     |
| File Home      | Share  | View             |             |               |          |                |     |                            | 1   |
| ← → + ↑ 💆      | 11172  | 24.2.8\nimivosmt | buol1_share |               |          |                | ~ 0 | Search nimavssmbvoll_share | 6.3 |
|                |        | Name             | 0           | Date modified | Туре     | Size           |     |                            |     |
| 🖈 Quick access |        |                  |             |               |          | 25 A           |     |                            |     |
| Desktop        | 1      |                  |             |               | This fol | lder is empty. |     |                            |     |
| Downloads      | 1      |                  |             |               |          |                |     |                            |     |
| Documents      | *      |                  |             |               |          |                |     |                            |     |
| Pictures       | 1      |                  |             |               |          |                |     |                            |     |
| 💻 This PC      |        |                  |             |               |          |                |     |                            |     |
|                |        |                  |             |               |          |                |     |                            |     |

#### 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.

| Details & Protection |            |   | Protocol          |               |                        |
|----------------------|------------|---|-------------------|---------------|------------------------|
| Volume Name:         | Size (GB): | Ð | NFS               | CIFS          | iSCSI                  |
| nimavsscsi1          | 500        |   |                   |               | What about LUNs? 🕕     |
| Snapshot Policy:     |            |   | Initiator Group 🍈 |               |                        |
| default              |            | • | Map Existing Init | liator Groups | Create Initiator Group |
| Default Policy       |            |   | Initiator Group   |               |                        |
|                      |            |   | avsvmlG           |               |                        |

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.

|  | Connect   |   |  |             | Configuratio         |
|--|---|---|--|-------------|----------------------|
|  |   | og on to a target us<br>target and then clci                                      | ng a basic connection, t<br>k Quick Connect. | type the IP | address or           |
| Target   | 2 17  | 2.24.2.9  |  | Q           | uck Connect          |
| Discove  | ered target   | ti i  |  |             |                      |
|  | 13000054  |   |  |             | Refresh              |
| Name   |   |   |  | Status      |                      |
|  |   |   |  |             |                      |
| didk Co  | onnect.   |   | relect a target and then                     |             | Cornect              |
| dick Co<br>To con                                | onnect.   | connect a target, se  | elect a target and then                      |             | Connect<br>Deconnect |
| dick Co<br>To con<br>then d<br>For tar           | onnect.<br>Ipletely dis<br>ick Disconn<br>get proper                              | connect a target, se<br>rect.   | lect the target and guration of sessions,    |             |                      |
| dick Co<br>To con<br>then d<br>For tar<br>select | onnect.<br>pletely dis<br>ick Disconn<br>get proper<br>the target<br>infiguration | connect a target, se<br>sect.<br>rises, including config<br>and click Properties. | lect the target and guration of sessions,    |             | Decement             |

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.

| omputer Management (Local)   | Volume                | Layout | Type      | File System     | Status  | Capacity      | Free Space   | 75 Fran |
|--|-----------------------|--------|-----------|-----------------|---|---------------|--------------|---------|
| System Tools   | = (C)                 |        | Basic     |                 | Healthy (Boot, Paga File, Crash Dump, Primary Parti |               | 24.99 GB     | 63 %    |
| Task Scheduler   | SSS_X64FREE_EN-US_DVI |        | BASH      |                 | Healthy (Primary Partition)                         | 6.49 GB       | 0.M8         | 05      |
| Event Viewer     Exent Viewer     Dared Folders     Local Users and Groups     Ordennance     Device Manager     Storage     Windows Server Backup     Tink Management     Services and Applications | 👐 System Reierved     | Simple | Batic     | NTFS            | Healthy System, Active, Primary Partition)          | 500 MB        | 169 MB       | 34.5    |
|  |                       |        |           |                 |   |               |              |         |
|  | 40.00 G8 500 ME       |        | ive. Prin | tary Partition) | (C.)<br>39.51 de NTFS<br>Heathy (Boot, Page F       | e, Crash Dump | Pomary Parti | 5cn)    |

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

|   |  |  |   | · · · · · · · · · · · · · · · · · · ·                             |   | -11                                    |                                    |   |       |                |   |   |        |
|---|--|--|---|---|---|--|------------------------------------|---|-------|----------------|---|---|--------|
| Computer Management (Jocal<br>System Tools<br>Charl Scheduler<br>Sheet Viewer<br>Sheet Stales<br>Consultation<br>Consultation<br>Device Manager<br>Device Manager<br>Device Manager<br>Dick Managerownt<br>Senices and Applications   | <ul> <li>(C)</li> <li>DBdisk (E)</li> <li>DBDisk2 (F)</li> <li>SSS_X64FREE_EN-</li> <li>System Reserved</li> </ul>   | Simple<br>Simple<br>Simple<br>IS_DV9 (D1) Simple   | Type FileSystem<br>Besix NTF5<br>Besix NTF5<br>Besix NTF5<br>Besix NTF5<br>Besix NTF5 | Healthy (Boot,<br>Healthy (Prim<br>Healthy (Prim<br>Healthy (Prim | ary Partition)                                      | 499.87 49<br>9.97 GB 9.9<br>6.49 GB 01 | 1.95 GB<br>19.73 GB<br>93 GB<br>MB | 55 Free 61 %<br>61 %<br>100 %<br>00 %<br>00 %<br>34 % |       |                |   |   |        |
|   | 499.83 GB<br>Online  | DBdisk (Ed)<br>99.87 GE NTFS<br>Healthy (Primary Part  | tion)   |   |   |  |                                    |   |       |                |   |   |        |
|   | Online   | lealthy (Primary Part  |   |   |   |  |                                    |   |       |                |   |   |        |
| 1 🕑 🛄 🛛 This PC   | view   |  |   |   |   |  |                                    |   |       |                | - | • | >      |
| File Computer V   | view<br>his PC   |  |   |   |   |  |                                    |   | v 0   | Search This PC | - |   | ×<br>p |
| File Computer V   |  | )  |   |   |   |  |                                    |   | v 0   | Search This PC | - |   |        |
| File     Computer     N   | his PC<br>Y Folders (6   | )<br>ktop  |   |   | Documents   |  | Downl                              | oads  | v   ð | Search This PC | - |   |        |
| Computer     N       →      ↑     ↑       Desktop     #       Downloads     #       Documents     #       Pictures     #  | his PC   |  |   |   | Documents   |  | Dovini                             |   | v   0 | Search This PC |   |   |        |
| File     Computer     N   | his PC   | iktop<br>sic   |   |   |   |  |                                    |   | v     | Search This PC |   |   |        |
| File     Computer     N       ←     →     ↑     ▲     T       # Quick access     ■     Desktop     #       ■ Desktop     #       ■ Downloads     #       ■ Documents     #       ■ Pictures     #   | his PC<br>V Folders (6<br>De<br>M<br>V Devices a<br>Lo   | iktop<br>sic   | GB  |   |   |  | Videos                             |   |       | Search This PC |   |   |        |
| File     Computer     N       (-     -     ↑     Image: The second seco | his PC<br>Folders (6<br>bit of the second | sic<br>nd drives (4)<br>al Disk (Cc)<br>9 GB free of 39.5<br>Disk2 (Fi)<br>3 GB free of 9.96 |   |   | Pictures<br>DVD Drive (D.)<br>SSS_X844REE_EN-US_DV9 |  | Videos                             | (E)   |       | Search This PC |   |   |        |

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



## Deployment steps to mount NFS datastore from NetApp CVS on GCVE

#### **Provision CVS-Performance Volume**

The NetApp Cloud Volume Service volume can be either provisioned by Using Google Cloud Console Using NetApp BlueXP portal or API

#### Mark that CVS volume as non-deletable

To avoid accidental deletion of volume while VM is running, ensure the volume is marked as nondeletable as shown in screenshot below. image::gcp\_ncvs\_ds02.png[NetApp CVS non-deletable option] 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

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.

| <br>Cloud Ma | nager              |                  |     | Account ~  | Workspace<br>cloud_heroes | <ul> <li>Connect<br/>fixawsc</li> </ul> | tor 🛩 |                     |
|--------------|--------------------|------------------|-----|------------|---------------------------|---|-------|---------------------|
| Canvas       | Replication        | Backup & Restore | K8s | Data Sense | File Cache                | Compute                                 | Sync  | All Services (+8) ~ |
| Canv         | as                 |                  |     |            |                           |   |       | Go to Canvas View   |
| 🕢 Add W      | orking Environment |                  |     |            |                           |   |       |                     |

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.

| <br>Cloud Ma | inager          |                  |     |                   | Account ~<br>Netapp_POC | Workspace<br>doud_heroe |             | Connector<br>willnimm |          | ۵ | 0 | 0 | 8 |
|--------------|-----------------|------------------|-----|-------------------|-------------------------|-------------------------|-------------|-----------------------|----------|---|---|---|---|
| Canvas       | Replication     | Backup & Restore | K8s | Data Sense        | File Cache              | Compute                 | Sync        | All Service           | s (+7) ~ |   |   |   |   |
| Add Worl     | king Environmer | nt               |     |                   |                         |                         |             |                       |          |   |   |   | × |
|              |                 |                  |     |                   |                         | 0                       |             |                       |          |   |   |   |   |
|              |                 | Microsoft Azure  | Ama | aws               | Congle Cloud Plat       | orm .                   | On-Premises |                       |          |   |   |   |   |
|              |                 |                  |     |                   |                         |                         |             |                       |          |   |   |   |   |
|              |                 |                  |     | Choos             | e Type                  |                         |             |                       |          |   |   |   |   |
|              |                 | 0                |     | 0                 |                         | 0                       | 0           |                       |          |   |   |   |   |
|              |                 | Cloud Volumes ON | TAP | Assessor includes | es ONTAP HA             | 0.025 01.00101          | mes Service |                       |          |   |   |   |   |
|              |                 | Single Node      |     |                   | uitahiiny               | 1.0                     |             |                       |          |   |   |   |   |
|              |                 |                  |     |                   |                         |                         |             |                       |          |   |   |   | C |

3. Provide the details of the environment to be created including the environment name and admin credentials. After you are done, click Continue.

| Previous Step | CV-Performance-Testing                                    | HCLMainBillingAccountSubs |                  | Calls Deplease |
|---------------|---|---------------------------|------------------|----------------|
|               | Google Cloud Project                                      | Marketplace Subscription  |                  | Edit Project   |
|               | Details   |                           | Credentials      |                |
|               | Working Environment Name                                  | (Cluster Name)            | User Name        |                |
|               | cvogcveva   |                           | admin            |                |
|               | C   | -                         | Password         |                |
|               | Service Account   |                           |                  |                |
|               | Notice: A Google Cloud se<br>to use two features: backing |                           | Confirm Password |                |

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.

| 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 | of data corruption or loss |
|               |  |                            |

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

| Previous Step                                  | Location  | Connectivity  |
|--|---|---|
|  | GCP Region  | VPC   |
|  | europe-west3 •  | cloud-volumes-vpc •   |
|  | GCP Zone  | Subnet  |
|  | europe-west3-c •  | 10.0.6.0/24   |
|  |   | Firewall Policy   |
|  | <ul> <li>I have verified connectivity between the target VPC and Google<br/>Cloud storage.</li> </ul>   | <ul> <li>Generated firewall policy</li> <li>Use existing firewall policy</li> </ul>   |
| reemium o                                      | cense option: Pay-As-You-Go or BYOL for us<br>ption is used. Then, click on Continue.   |   |
| reemium o<br>Create a New W                    | cense option: Pay-As-You-Go or BYOL for us<br>ption is used. Then, click on Continue.<br>forking Environment Cloud Volumes ONTAP Cha  | sing existing license. In this example,<br>arging Methods & NSS Account   |
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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.

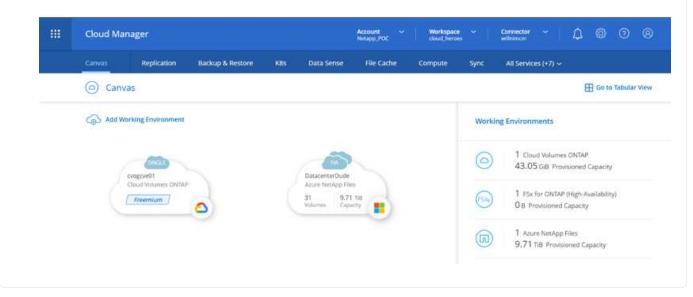
HINT: Hoover your mouse over the tiles for details or customize CVO components and ONTAP version by clicking on Change Configuration.

| Select a pre                                      | configured Cloud Volumes ONTAP system that best<br>Preconfigured settings can be r |   | onfiguration. Change Configuration          |
|---|--|---|---|
|   | 50   | \$0   | <u>.</u>                                    |
| POC and small workloads<br>Up to 500GB of storage | Database and application data<br>production workloads                              | Cost effective DR<br>Up to 500GB of storage | Highest performance production<br>workloads |

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

| Lreate a New Work                                       | ing Environment  | Review & Approve   |   |                 |
|---|--|--|---|-----------------|
| Previous Step   | act3   |  |   | Show API reques |
| This Cloud Volumes O                                    | NTAP instance will be registered with NetApp                   |  |   |                 |
| <ul> <li>I understand that</li> <li>Overview</li> </ul> | Cloud Manager will allocate the appropriate Networking Storage | GCP resources to comply with my above requirements. More | nformation >                            |                 |
|   |  |  |   |                 |
| Storage System:   | Cloud Volumes ONTAP  | Cloud Volumes ONTAP runs on                              | : n2-standard-4                         |                 |
| Storage System:<br>License Type:                        | Cloud Volumes ONTAP<br>Cloud Volumes ONTAP Freemium            | Cloud Volumes ONTAP runs on<br>Encryption:               | : n2-standard-4<br>Google Cloud Managed |                 |

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



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.

| Cvogcve01                           |   | GCP Managed Encryption |
|-------------------------------------|---|------------------------|
| Volumes Replications                |   | © ∪ c ⊙ ≁ Ξ            |
| Create a CIFS server                | + Advanced                                |                        |
| DNS Primary IP Address              | Active Directory Domain to join           |                        |
| 192.168.0.16                        | nimgeveval.com                            |                        |
| DN5 Secondary IP Address (Optional) | Credentials authorized to join the domain |                        |
| Example: 127.0.0.1                  | administrator                             |                        |

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.

| Volume Name:     | Size (GB):    |   |  |                   |       |
|------------------|---------------|---|--|-------------------|-------|
|                  | - e c t a c b | 0 | NFS  | CIFS              | iSCSI |
| cvogcvesmbvol01  | 10            |   | and the second s |                   |       |
|                  |               |   | Share name:  | Permissions:      |       |
| Snapshot Policy: |               |   | cvogcvesmbvol01_share  | Full Contro       | •     |
| default          |               | • |  |                   |       |
| Default Policy   |               |   | Users / Groups:  |                   |       |
|                  |               |   | Everyone;  |                   |       |
|                  |               |   | Valid users and groups separat   | ed by a semicolon |       |

3. After the volume is provisioned, it will be availabe 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.

| INFO           |        | CAPACITY           |           |
|----------------|--------|--------------------|-----------|
| Disk Type      | PD-SSD |                    | ■ 1.84 MB |
| Tiering Policy | None   | 10 GB<br>Allocated | Disk Used |

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.

| Volu                            | mes  | Replications   |  |                |                  |          |          |          |
|---------------------------------|--|--|--|----------------|------------------|----------|----------|----------|
|                                 | Nount Vo   | lume cvog  | gcvesmbvo  | 101            |                  |          |          |          |
| o to yo                         | ur machine a   | and enter this   | command  |                |                  |          |          |          |
| \\10.                           | 0.6.251\cv   | ogcvesmbvol0   | 1_share  |                | Ē                | Сору     |          |          |
|                                 |  |  |  |                |                  |          | -        |          |
| nning c                         | on the Goog  | le Cloud VM  | the Map Netwo<br>ware Engine.<br>nd the folder that ye |                |                  | ount the | volume o | n the VN |
| nning c                         | on the Goog  | le Cloud VM  | ware Engine.   |                |                  | ount the | volume o | n the VN |
| nning c<br>pecify the<br>Drive: | on the Goog<br>e drive letter for<br>Y:  | le Cloud VM  | ware Engine.<br>nd the folder that y                   | ou want to cor |                  | ount the | volume o | n the VN |
| nning c<br>pecify the<br>Drive: | on the Goog<br>e drive letter for<br>Y:  | le Cloud VM <sup>1</sup><br>the connection a<br>\cvogcvesmbvol   | ware Engine.<br>nd the folder that y                   | ou want to cor | nect to:         | ount the | volume o | n the VN |
| nning c<br>pecify the<br>Drive: | on the Goog<br>e drive letter for<br>Y:<br>\\10.0.6.25                                       | le Cloud VM <sup>1</sup><br>the connection a<br>\cvogcvesmbvol<br>erver\share                            | ware Engine.<br>nd the folder that y                   | ou want to cor | nect to:         | ount the | volume o | n the VN |
| nning c                         | on the Goog<br>e drive letter for<br>Y:<br>\\\10.0.6.25'<br>Example: \\3<br>Reconne          | le Cloud VM <sup>1</sup><br>the connection a<br>\cvogcvesmbvol<br>erver\share                            | ware Engine.<br>nd the folder that ye                  | ou want to cor | nect to:         | ount the | volume o | n the VN |
| nning c<br>pecify the<br>Drive: | on the Goog<br>e drive letter for<br>Y:<br>\\10.0.6.25<br>Example: \\d<br>Reconne<br>Connect | le Cloud VM<br>the connection a<br>\cvogcvesmbvol<br>erver\share<br>ct at sign-in<br>using different cre | ware Engine.<br>nd the folder that ye                  | ou want to cor | nect to:<br>owse |          | volume o | n the VN |
| nning c<br>pecify the<br>Drive: | on the Goog<br>e drive letter for<br>Y:<br>\\10.0.6.25<br>Example: \\d<br>Reconne<br>Connect | le Cloud VM<br>the connection a<br>\cvogcvesmbvol<br>erver\share<br>ct at sign-in<br>using different cre | ware Engine.<br>nd the folder that ye<br>ol_share      | ou want to cor | nect to:<br>owse |          | volume o | n the VN |

Once mapped, it can be easily accessed, and the NTFS permissions can be set accordingly. 💣 l 📝 📗 🕶 l Network - 0 X 📭 👳 🗌 🔄 😇 🕴 cvogcvesmbvol01\_share (\\10.0.6.251) (Y:) - 0 × Home Share View 0 4 ← → \* ↑ ★ > This PC > cvogcvesmbvol01\_share (\\10.0.6.251) (Y:) > ✓ Ŏ Search cvogcvesmbvol01\_sha... , P Net 1 Name Date modified Туре Size # Quick access foo1 11/9/2021 10:59 AM File folder 📃 Desktop 4 11/9/2021 10:59 AM File folder foo2 Downloads Documents ġ, Pictures Ŕ This PC

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.

|  | Details & Pr  | rotection  |                          |   |  | Protocol            |                                 |                        |               |                          |
|--|---|--|--------------------------|---|--|---------------------|---------------------------------|------------------------|---------------|--------------------------|
|  | Volume Name:  |  | Size                     | (GB): (G)   |  | NFS                 | CIP                             | s                      | iscsi         |                          |
|  | cvogcvescsilur  | 101  | 10                       | ŧ   |  |                     |                                 | What a                 | bout LUNs?    | 0                        |
|  | Snapshot Policy:  |  |                          |   |  | Initiator Group     | 0                               |                        |               |                          |
|  | default   |  |                          |   |  | Map Existin         | g Initiator Groups              | Create I               | nitiator Grou | ą                        |
|  | Default Policy  | 1  |                          |   |  | Initiator Group     |                                 |                        |               |                          |
|  |   |  |                          |   |  | WinlG               |                                 |                        |               |                          |
|  |   |  |                          |   |  |                     |                                 |                        |               |                          |
|  |   |  |                          |   |  | Operating Syste     | m Type                          |                        |               |                          |
|  |   |  |                          |   |  | Windows             |                                 |                        |               | - A.                     |
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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.

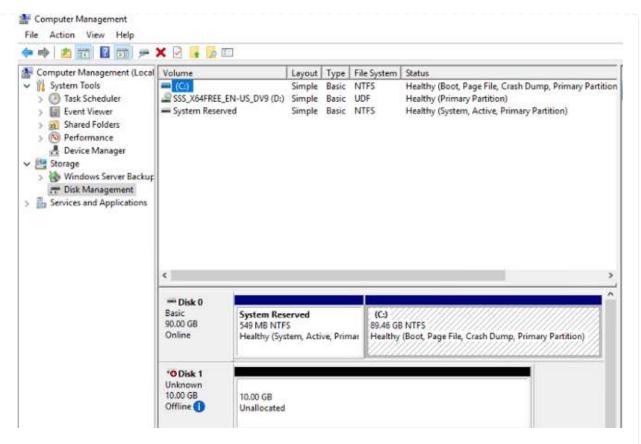


The Windows host must have an iSCSI connection to each node in the cluster. The native DSM selects the best paths to use.

| ←)⊙ • Ser            | iSCSI Initiato   | r Properties   |                |                  | - 2 |
|----------------------|--|--|----------------|------------------|-----|
| <u> </u>             |  | covery Favorite Targets Volumes an   | d Devices RACO | US Configuration |     |
|                      | Quick Conn   |  |                |                  |     |
| Dashboard            |  | r and log on to a target using a basic co<br>of the target and then click Quick Conne                      |                | P address or     |     |
| Local Server         |  |  | _              |                  |     |
| All Servers          | Target:  | 10.0.6.250   |                | Quick Connect    | J.  |
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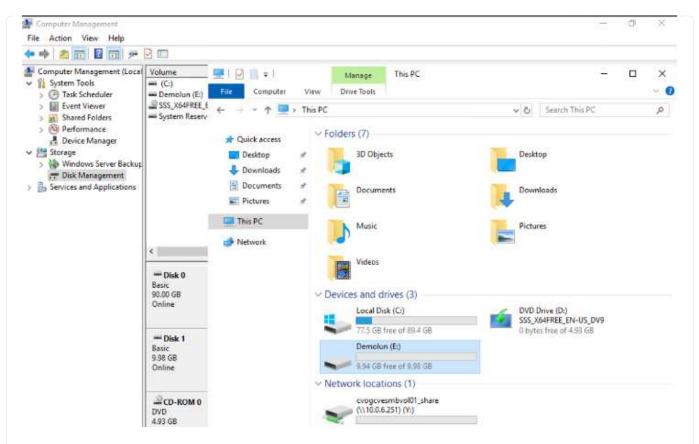
LUNs on storage virtual machine (SVM) appear as disks to the Windows host. Any new disks that are added are not automatically discovered by the host. Trigger a manual rescan to discover the disks by completing the following steps:

- 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.

| nlyaz@ | ntmubu01 | :-\$ | lsblk |     |      | and the second |  |
|--------|----------|------|-------|-----|------|--|--|
| NAME   | MAJ:MIN  | RM   | SIZE  | RO  | TYPE | MOUNTPOINT   |  |
| loop0  | 7:0      | 0    | 55.4M | 1   | loop | /snap/core18/2128  |  |
| loop1  | 7:1      | Θ    | 219M  | 1   | loop | /snap/gnome-3-34-1804/72   |  |
| loopz  | 7:2      |      | 65.1M | 1   | loop | /snap/gtk-common-themes/1515   |  |
| Loop3  | 7:3      | Θ    | 51M   | 1   | loop | /snap/snap-store/547   |  |
| Loop4  | 7:4      | 0    | 32.3M | 1   | loop | /snap/snapd/12704  |  |
| loop5  | 7:5      | θ    | 32.5M | 1   | loop | /snap/snapd/13640  |  |
| loop6  | 7:6      | Θ    | 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  |     | part | /boot/eft  |  |
| -sda2  | 8:2      | 0    | 1K    | 0   | part |  |  |
| -sda5  | 8:5      | Θ    | 15.50 | 0   | part | 1  |  |
| sdb    | 8:16     | 0    | 16    | . 0 | disk |  |  |

| iyaz@ninubuð |      |      |       |      |                              |  |
|--------------|------|------|-------|------|------------------------------|--|
| ilesystem    | Size | Used | Avail | Use% | Mounted on                   |  |
| idev         | 1.9G | 0    | 1.9G  | 0%   | /dev                         |  |
| mpfs         | 394M | 1.5M | 392M  | 1%   | /run                         |  |
| dev/sda5     | 16G  | 7.6G | 6.9G  | 53%  | 7                            |  |
| mpfs         | 2.0G | 0    | 2.00  | 0%   | /dev/shm                     |  |
| mpfs         | 5.0M | 0    | 5.0M  | 0%   | /run/lock                    |  |
| mpfs         | 2.0G | 0    | 2.00  | 0%   | /sys/fs/cgroup               |  |
| dev/loop1    | 219M | 219M | 0     | 100% | /snap/gnome-3-34-1804/72     |  |
| dev/loop2    | 66M  | 66M  | 0     | 166% | /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  | 8     | 100% | /snap/snapd/12764            |  |
| dev/sda1     | 511M | 4.0K | 511M  | 1%   | /boot/efi                    |  |
| mpfs         | 394M | 64K  | 394M  | 1%   | /run/user/1000               |  |
| dev/loop5    | 33M  | 33M  | 0     | 100% | /snap/snapd/13640            |  |
| dev/loop6    | 56M  | 56M  | 8     | 100% | /snap/core18/2246            |  |
| dev/loop7    | 128K | 128K |       |      | /snap/bare/5                 |  |
| dev/loop8    | 66M  | 66M  | 8     | 100% | /snap/gtk-common-themes/1519 |  |
| dev/sdb      | 976M | 2.6M | 987M  | 1%   | /mnt                         |  |

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:

| NFO            |        | CAPACITY              |                |
|----------------|--------|-----------------------|----------------|
| Disk Type      | PD-SSD |                       | <b>6.08</b> GB |
| Tiering Policy | None   | 11.05 GB<br>Allocated | 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



- 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.

| oot@nimubu01: | 1 3000     |                            | : 10 0               | 1.6.2      | 51: 11               | CVC  | nac          | Ve              |        |         | 101 CV00          | cvetst          |
|---------------|------------|----------------------------|----------------------|------------|----------------------|------|--------------|-----------------|--------|---------|-------------------|-----------------|
|               |            | Hourse come                |                      |            |                      |      |              |                 |        |         |                   |                 |
| mubu01        |            |                            |                      |            |                      |      |              | 1185 14         |        |         | t View Fullscreen | Control Inc.    |
| mubuor        |            |                            |                      |            |                      | E    | ntorce       | USK             | ryboan | a Layou | t View Fullscreen | Send CIn+Alt+De |
|               |            |                            |                      |            |                      |      |              |                 |        |         |                   |                 |
|               | Activities | 🖾 Terminal 🕶               | No                   | w 16 12:42 |                      |      |              | - ^             | 40 0   | 5 -     |                   |                 |
|               |            |                            | roote                | polmubu01: |                      | Q    |              |                 |        |         |                   |                 |
|               |            | oot@ninubu01:-# df         |                      |            |                      |      |              |                 |        | 1       |                   |                 |
|               |            | llesysten                  | 1K-blocks<br>1978500 | Used       | Available<br>1978500 |      | Hour<br>/dex |                 | n)     |         |                   |                 |
|               |            | npfs                       | 402272               | 1432       | 400840               |      | Iru          |                 |        |         |                   |                 |
|               |            | dev/sda5                   |                      | 7832332    | 7268048              |      |              |                 |        |         |                   |                 |
|               |            | nofs<br>nofs               | 2011352<br>5120      | 8          | 2011352<br>5120      |      |              | //shn<br>i/lock |        |         |                   |                 |
|               |            | nots                       | 2011352              | 2 a        | 2011352              |      |              | i/fi/c          |        |         |                   |                 |
|               |            | dev/loop@                  | 128                  | 126        |                      |      |              | p/bar           |        |         |                   |                 |
|               |            | dev/loop1                  | 56832                | 56832      |                      |      |              | ip/cor          |        |         |                   |                 |
|               |            | dev/loop2<br>dev/loop4     | 56832<br>66688       | 56832      | 2                    | 100% | /sna         | p/cor<br>p/gtk  | e18/2  | 240     |                   |                 |
|               |            | heres/1515                 | 00088                | 00088      | •                    | 100% | / 5.04       | ip/gen          | conn   | ion.    |                   |                 |
|               |            | dev/Loop6<br>47            | 52224                | 52224      | 0                    | 100% | /sna         | ep/sna          | p-sto  | re/     |                   |                 |
|               |            | dev/loop5<br>henes/1519    | 66816                | 66816      | 0                    | 100% | /sna         | p/gtk           | -conn  | ion+    |                   |                 |
|               |            | dev/loop7                  | 33280                | 33280      |                      | 100% | Isna         | p/sna           | od/13  | 640     |                   |                 |
|               | 1          | dev/loop8<br>864/72        | 224256               | 224256     |                      |      |              | p/gno           |        |         |                   |                 |
|               |            | dev/sda1                   | 523248               | - 4        | 523244               | 1%   | /bee         | t/eft           |        |         |                   |                 |
|               |            | nofs                       | 402268               | 52         | 402216               |      |              | v/user          |        |         |                   |                 |
|               |            | dev/sdb                    | 515010816            | 42016812   | 446763228            | 9%   | /hor         | ne/nly          | az/cv  | sts     |                   |                 |
|               |            | dev/loop9                  | 43264                | 43264      |                      | 100% | 7504         | p/sna           | od/13  | 831     |                   |                 |
|               |            | 0.0.6.251:/cvogcvenfsvol01 |                      |            |                      |      |              |                 |        |         |                   |                 |

#### **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.

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

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

|    |  | erm : | <ul> <li>CV-Performance-Ter</li> </ul> | tong 👻 🔍 Search products and resource | 84.           | × 2 0   |            |
|----|--|-------|--|---------------------------------------|---------------|---|------------|
| ħ  | Home                                   | >     | OMMENDATIONS                           |                                       |               |   | CUSTOM     |
| ĸ  | Pins appear here                       | ×     |  |                                       |               |   |            |
| RT | NER SOLUTIONS                          |       | 1                                      | Compute Engine                        | 1             | <ul> <li>Google Cloud Platform status</li> <li>All services normal</li> </ul> | 1          |
| 2  | Redis Enterprise<br>Apache Kafka on Co |       |  |                                       | 1025.<br>1055 | → Go to Cloud status dashboard  |            |
| 2  | Databricks                             |       |  |                                       | 40%           | Billing   | 1          |
| 5  | DataStax Astra                         |       | Volumes                                |                                       | 20%           | Estimated charges<br>For the billing period starting Nov 1, 2021              | USD \$0.00 |
| *  | Elasticsearch Service<br>MongoDB Atlas |       | Backups                                | 12:15 12:30 12:45 1.9M                | 0)            | Take a tour of billing  |            |
| ٦  | Neo4j Aura Professi                    |       | Snapshots<br>Active Directories        | → Go to Compute Engine                |               | View detailed charges   |            |
| 5  | Cloud Volumes                          | >     | Volume Replication                     | *                                     |               | Monitoring  |            |

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

| -       |  |   |        |  |                   |                  |                |                          |            |             |    |      |           |      |
|---------|--|---|--------|--|-------------------|------------------|----------------|--------------------------|------------|-------------|----|------|-----------|------|
| 9       | Cloud Volumes                            | Volu  | mes    | CREA   | TE DELE           | TE               |                |                          |            |             |    |      |           |      |
|         | Volumes                                  | Quick !   | eferer | nce for Cloud Volum  | es Private Servic | e Access 🖾 AP    | 112 Shared VPC | Support 🖉 Granular permi | ssions 🗹   |             |    |      |           |      |
| Backups |  | Titler Search for volumes by name, 10, region, etc. |        |  |                   |                  |                |                          |            | 0           | ш  |      |           |      |
| Ð       | Snapshots                                |   |        | ID   | Name              | Region           | Zone           | Zone Redundancy          | Life Cycle | Billing Lab | el | Stat | e Detail  | is i |
|         | Active Directories<br>Volume Replication |   | 0      | 0ac8a83d-<br>03d8-c9db-<br>2aba-                                 | testnfsds01       | europe-<br>west3 |                |                          | available  |             |    | Avai | ilable fo | bř s |
|         |  |   | 0      | 189c7535445b<br>330f35e2-<br>b0c6-98b3-<br>ec7a-<br>8dd4ea7ba00e | gcpive-ds4        | europe-<br>westa |                |                          | available  |             |    | Avai | ilable fo | bri  |
|         |  |   | 0      | 7d0a6f0d-<br>3e0a-50c3-<br>5295-<br>5152040681fc                 | gcp-ve-ds3        | europe-<br>west3 |                |                          | available  |             |    | Ayai | ilable fo | or s |
|         |  |   | 0      | 8cae6850-<br>0919-4eaf-<br>af47-                                 | gcve-ds-2         | europe-<br>west3 |                |                          | available  |             |    | Avai | ilable fo | or a |

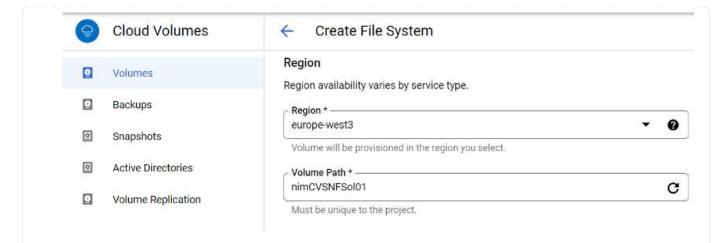
3. On the Create File System page, specify the volume name and billing labels as required for chargeback mechanisms.

| Oloud Volumes      | ← Create File System   |
|--------------------|--|
| 2 Volumes          |  |
| Backups            | Volume Name Name *   |
| Snapshots          | nimCVNFSvol01  |
| Active Directories | A human readable name used for display purposes.   |
| Volume Replication | Billing Labels   |
|                    | Label your volumes for billing reports, queries.<br>Supported with CVS-Performance service type; can be set with CVS service type but not<br>available for billing at this time. |
|                    | + ADD LABEL  |

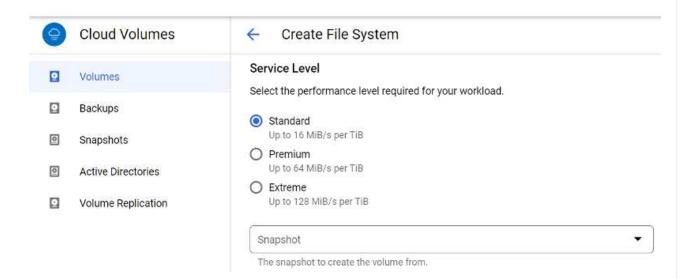
4. Select the appropriate service. For GCVE, choose CVS-Performance and desired service level for improved latency and higher performance based on the application workload requirements.

| 9 | Cloud Volumes      | ← Create File System   |
|---|--------------------|--|
|   | Volumes            | Service Type   |
|   | Backups            | Cloud Volumes Service is offered as two service types: CVS and CVS-Performance.<br>Select the service type that matches your workload needs. Region availability 🖸 varies by<br>service type. Learn more 🖄 |
| 0 | Snapshots          | service type. Learn note E   |
| 0 | Active Directories | O CVS<br>Offers volumes created with zonal high availability.  |
| Ø | Volume Replication | CVS-Performance<br>Offers 3 performance levels and improved latency to address higher performance<br>application requirements.   |
|   |                    | Volume Replication   |
|   |                    | Secondary<br>Select to create volume as a destination target for volume replication. Applicable only to<br>CVS-performance volumes.  |

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.

| - |                    | Volume Details   |
|---|--------------------|--|
| 2 | Volumes            | Allocated Capacity *   |
| Q | Backups            | line Gib   |
|   |                    | Allocated size must be between 1 TiB (1024 GiB) and 100 TiB (102400 GiB)   |
| 0 | Snapshots          | Protocol Type *  |
| 0 | Active Directories | NFSv3  |
| Ø | Volume Replication | Make snapshot directory (.snapshot) visible  |
|   |                    | Makes .snapshot directory visible to clients. For NFSv4.1 volumes (CVS-Performance only,<br>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  |

8

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 | Cloud Volumes      | ← Create File System  |
|---|--------------------|---|
|   | Volumes            | Network Details   |
|   | Backups            | Provide the host project name when deploying in a shared VPC service project.                     |
| 0 | Snapshots          | VPC Network Name *  |
| 0 | Active Directories | Select the VPC Network from which the volume will be accessible. This cannot be changed<br>later. |
| 0 | Volume Replication | Use Custom Address Range  |
|   |                    | Reserved Address range<br>netapp-addresses  |

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

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

| 0              | Cloud Volume       | s 🗧                    | - Cr            | eate File Sy             | stem            |                       |                                    |
|----------------|--------------------|------------------------|-----------------|--------------------------|-----------------|-----------------------|------------------------------------|
|                | Volumes            | E                      | xport           | Policy                   |                 |                       |                                    |
|                | Backups            | F                      | Rules           |                          |                 |                       |                                    |
| 0              | Snapshots          |                        | Item 1          | 1                        |                 |                       | ~ ~ <b>1</b>                       |
| 0              | Active Directories |                        | Allow<br>0.0.0  | ved Clients 1 *<br>).0/0 |                 |                       |                                    |
|                | Volume Replication |                        | Acces           | s                        |                 |                       |                                    |
|                |                    |                        |                 | ad & Write<br>ad Only    |                 |                       |                                    |
|                |                    |                        | Root A          | Access                   |                 |                       |                                    |
|                |                    |                        | Or Or           |                          |                 |                       |                                    |
|                |                    |                        | O of            |                          |                 |                       |                                    |
|                |                    |                        | Protoc          | ol Type (Select          | at least 1 of 1 | the below options)    |                                    |
|                |                    |                        | Must s<br>NFSv4 |                          | l type NFSv3. ( | Optional for Protocol | Type Both. Do not select for       |
|                |                    |                        |                 | lows Matching            | Clients for NF  | SV3                   |                                    |
| 10. Click Save | to create the      | volume.                |                 |                          |                 |                       |                                    |
|                |                    | europe- Anala<br>west3 | ble for use     | CVS-<br>Performance      | Primary         | Extreme               | NFSv3 : 10.53.0.4 /niminfademods02 |
| /04260603      | HELL .             |                        |                 |                          |                 |                       |                                    |

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
```

```
oot@vm1:-# sudo mkdlr nlmCVSNFSol01
oot@vm1:-# sudo mount -t nfs -o rw,hard,rsize=65536,wsize=65536,vers=3,tcp 10.53.0.4:/nimCVSNFSol01 /nimCVSNFSol01
```

| filesystem                   | 1K-blocks    | Used           | Available    | Use% | Mounted on                   |
|------------------------------|--------------|----------------|--------------|------|------------------------------|
| udev                         | 16409952     | 0.00           | 16409952     | 0%   | /dev                         |
| tnpfs                        | 3288328      | 1588           | 3286748      | 1%   | /run                         |
| /dev/sdb5                    | 61145932     | 19231356       | 38778832     | 34%  | 1                            |
| tnpfs                        | 16441628     | 0              | 16441628     | 8%   | /dev/shm                     |
| tnpfs                        | 5120         | 0              | \$120        | 6%   | /run/lock                    |
| tnpfs                        | 16441628     | a              | 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-connon-thenes/1519 |
| /dev/loop3                   | 52224        | 52224          | 0            | 100% | /snap/snap-store/S47         |
| /dev/loop5                   | 224256       | 224256         | 0            | 100% | /snap/gnone-3-34-1804/72     |
| /dev/sdb1                    | 523248       | - 10 - 10 - 10 | 523244       | 18   | /boot/efi                    |
| tnpfs                        | 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       | 363778996    | 14%  | /datastore1                  |
| /dev/loop8                   | 33280        | 33280          | 0            | 100% | /snap/snapd/13278            |
| /dev/loop6                   | 33280        | 33280          | 0            | 100% | /snap/snapd/13640            |
| /dev/loop7                   | 56832        | 56832          | 0            | 100% | /snap/core18/2246            |
| 10.53.0.4:/nlmCVSNFSol01     | 107374182400 | 256            | 107374182144 | 1%   | /nimCVSNFSol01               |
| root@vm1:-#                  |              |                |              |      |                              |

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

| ctive | Directory conr                 | ections                 | CREATE           | DELETE   |                          |                       |                     |         |            |   |
|-------|--------------------------------|-------------------------|------------------|--|--------------------------|-----------------------|---------------------|---------|------------|---|
|       |                                |                         |                  | server. This is a prerequisite                 | step before creating vol | umes with the SMB pro | tocol type. Learn r | more (2 |            |   |
|       |                                |                         |                  |  |                          |                       |                     |         |            |   |
| 포 Fil | ter Search for Act             | ive Directory connectio | ons by ID, usern | ame, DNS, netBIOS, region, e                   | tc.                      |                       |                     |         | 0          | ш |
| ⊽ Fil | ter Search for Act<br>Username | Domain                  | DNS Servers      | ame, DNS, netBIOS, region, e<br>NetBIOS Prefix | OU Path                  | AD Server Name        | KDC IP              | Region  | ()<br>Stat |   |

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.



## 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.



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. <u>Region availability</u> is varies by service type. Learn more is



Offers volumes created with zonal high availability.



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.

| europe-west3   | - 0 |
|--|-----|
| Volume will be provisioned in the region you select. |     |

Must be unique to the project.

nimCVSMBvol01

5. Select the level of performance for the volume.

C

| Se          | rvice Level   |  |
|-------------|---|--|
| Se          | ect the performance level required for your workload.   |  |
| 0           | Standard<br>Up to 16 MiB/s per TiB  |  |
| 0           | Premium<br>Up to 64 MIB/s per TIB   |  |
| 0           | Extreme<br>Up to 128 MiB/s per TiB  |  |
| s           | napshot 🔹   |  |
| -<br>T      | he snapshot to create the volume from.  |  |
|             | Create File System  |  |
| Vo          | lume Details  |  |
|             | lume Details  |  |
| A           |   |  |
| A<br>1      | located Capacity *  |  |
| A<br>1<br>A | llocated Capacity *   |  |
|             | llocated Capacity *<br>024 GiB  |  |
|             | llocated Capacity *   |  |
| A<br>1<br>A | Ilocated Capacity *   |  |
| A<br>1<br>A | Ilocated Capacity *<br>D24 GiB<br>Ilocated size must be between 1 TiB (1024 GiB) and 100 TiB (102400 GiB)<br>Totocol Type *<br>MB T<br>Make snapshot directory (.snapshot) visible<br>Makes .snapshot directory visible to clients. For NFSv4.1 volumes (CVS-Performance only),<br>the directory itself will not be listed but can be accessed to list contents, etc.   |  |
|             | Ilocated Capacity *   |  |
|             | Ilocated Capacity *   |  |
|             | Ilocated Capacity *<br>D24 GiB<br>Iocated size must be between 1 TiB (1024 GiB) and 100 TiB (102400 GiB)<br>Totocol Type *<br>MB T<br>Make snapshot directory (.snapshot) visible<br>Makes .snapshot directory visible to clients. For NFSv4.1 volumes (CVS-Performance only),<br>the directory itself will not be listed but can be accessed to list contents, etc.<br>Enable SMB Encryption<br>Enable this option only if you require encryption of your SMB data traffic.<br>Enable CA share support for SQL Server, FSLogix<br>Enable this option only for SQL Server and FSLogix workloads that require continuous |  |
|             | Idecated Capacity *   |  |

|    |                        | PC configur          |                  | ihen deployir     | ng in a shar        | ed VPC ser  | vice project. |   |
|----|------------------------|----------------------|------------------|-------------------|---------------------|-------------|---------------|---|
|    | PC Networ<br>oud-volur | k Name *<br>nes-vpc  |                  |                   |                     |             |               | •   |
|    | elect the V<br>ter.    | PC Network f         | rom whic         | h the volume      | will be acc         | essible. Th | is cannot be  | changed   |
|    | Use Cust               | tom Address          | Range            |                   |                     |             |               |   |
| Re | eserved Ad             | idress range         |                  |                   |                     |             |               |   |
| ne | etapp-add              | resses               |                  |                   |                     |             |               |   |
| S  | AVE                    | CANCEL<br>create the | volume.          | Available for use | CVS-                | Primary     | Standard      | SMB : \\reimant>2830.reingcveval.com\reimCV3MBe |
|    |                        | nimCVSMBvoi01        | europe-<br>west3 | Available for use | CVS-<br>Performance | Primary     | Standard      | SMB : \\nimamb-3830.nimgcveval.com\nimCVS       |

- 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

| What n                            | etwork folder would you lik   | ke to map?                    |                    |             |          |              |
|-----------------------------------|---|-------------------------------|--------------------|-------------|----------|--------------|
| Specify th                        | ne drive letter for the connection and  | d the folder that you want to | connect to:        |             |          |              |
| Drive:                            | Z:  | ~                             |                    |             |          |              |
| Folder:                           | \\10.53.0.4\nimcvsmbvpl01   | ~                             | Browse             |             |          |              |
|                                   | Example: \\server\share   |                               |                    |             |          |              |
|                                   | Reconnect at sign-in  |                               |                    |             |          |              |
|                                   | Connect using different crea  | lentials                      |                    |             |          |              |
|                                   | Connect to a Web site that you  | can use to store your docum   | ents and pictures. |             |          |              |
|                                   |   |                               |                    |             |          |              |
| Click Fir                         | vol01 (\\10.53.0.4) (Z:)  | to your computer, sele        | ect the Recon      | nect at sig | n-in che | ck box.<br>– |
| Click Fir                         | nish.<br>vol01 (\\10.53.0.4) (Z:)   |                               | ect the Recon      | nect at sig | n-in che | -            |
| Click Fir<br>nimevsmbv<br>e Share | nish.<br>vol01 (\\10.53.0.4) (Z:)<br>View   |                               | ect the Recon      | nect at sig |          | -            |
| Click Fir                         | nish.<br>vol01 (\\10.53.0.4) (Z:)<br>View<br>is PC → nimcvsmbvol01 (\\10.53.0.4) (Z         | 9                             |                    |             |          | -            |
| Click Fir<br>nimevsmbv<br>e Share | nish.<br>vol01 (\\10.53.0.4) (Z:)<br>View<br>is PC > nimcvsmbvol01 (\\10.53.0.4) (Z<br>Name | :)<br>Date modified           | Туре               |             |          | ck box.<br>– |

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

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

## **AWS Region Availability**

£.

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

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

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

## Americas

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

Last updated on: June 2, 2022.

## EMEA

| AWS Region         | VMC Availability | FSx ONTAP Availability | NFS Datastore<br>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<br>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.

# VMware Hybrid Cloud Use Cases

## Use Cases for NetApp Hybrid Multicloud with VMware

An overview of the use cases of importance to IT organization when planning hybridcloud or cloud-first deployments.

## Popular Use Cases

Use cases include:

- Disaster recovery,
- Hosting workloads during data center maintenance, \* quick burst in which additional resources are required beyond what's provisioned in the local data center,
- VMware site expansion,

- Fast migration to the cloud,
- Dev/test, and
- Modernization of apps leveraging cloud supplemental technologies.

Throughout this documentation, cloud workload references will be detailed using the VMware use-cases. These use-cases are:

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

## Inside the IT Journey

Most organizations are on a journey to transformation and modernization. As part of this process, companies are trying use their existing VMware investments while leveraging cloud benefits and exploring ways to make the migration process as seamless as possible. This approach would make their modernization efforts very easy because the data is already in the cloud.

The easiest answer to this scenario is VMware offerings in each hyperscaler. Like NetApp® Cloud Volumes, VMware provides a way to move or extend on-premises VMware environments to any cloud, allowing you to retain existing on-premises assets, skills, and tools while running workloads natively in the cloud. This reduces risk because there will be no service breaks or a need for IP changes and provides the IT team the ability to operate the way they do on-premises using existing skills and tools. This can lead to accelerated cloud migrations and a much smoother transition to a hybrid Multicloud architecture.

## Understanding the Importance of Supplemental NFS Storage Options

While VMware in any cloud delivers unique hybrid capabilities to every customer, limited supplemental NFS 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—and that can increase costs by 35–40 percent or more for storage intensive workloads. These workloads just need additional storage, not additional horsepower. But that means paying for additional hosts.

Let's consider this scenario:

A customer requires just five hosts for CPU and memory, but has a lot of storage needs, and needs 12 hosts to meet the storage requirement. This requirement ends up really tipping the financial scale by having to buy the additional horsepower, when they only need to increment the storage.

When you're planning cloud adoption and migrations, it's always important to evaluate the best approach and take the easiest path that reduces total investments. The most common and easiest approach for any application migration is rehosting (also known as lift and shift) where there is no virtual machine (VM) or data conversion. Using NetApp Cloud Volumes with VMware software-defined data center (SDDC), while complementing vSAN, provides an easy lift-and-shift option.

# NetApp Solutions for Amazon VMware Managed Cloud (VMC)

Learn more about the solutions that NetApp brings to AWS.

VMware defines the cloud workloads into one of three categories:

• Protect (including both Disaster Recovery and Backup / Restore)

- Migrate
- Extend

Browse the available solutions in the following sections.

## Protect

- Disaster Recovery with VMC on AWS (guest connected)
- Veeam Backup & Restore in VMC with FSx for ONTAP
- Disaster Recovery (DRO) with FSx for ONTAP and VMC
- Using Veeam Replication and FSx for ONTAP for Disaster recovery to VMware Cloud on AWS

## Migrate

Migrate Workloads to FSxN datastore using VMware HCX

# Extend

COMING SOON!!

## NetApp Solutions for Azure VMware Solution (AVS)

Learn more about the solutions that NetApp brings to Azure.

VMware defines the cloud workloads into one of three categories:

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

Browse the available solutions in the following sections.

### Protect

- Disaster Recovery with ANF and JetStream (supplemental NFS datastore)
- Disaster Recovery with ANF and CVO (guest connected storage)
- Disaster Recovery (DRO) with ANF and AVS
- Using Veeam Replication and Azure NetApp Files datastore for disaster recovery to Azure VMware Solution

## Migrate

• Migrate Workloads to Azure NetApp Files datastore using VMware HCX

## Extend

COMING SOON!!

## NetApp Solutions for Google Cloud VMware Engine (GCVE)

Learn more about the solutions that NetApp brings to GCP.

VMware defines the cloud workloads into one of three categories:

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

Browse the available solutions in the following sections.

#### Protect

- Application Disaster Recovery with SnapCenter, Cloud Volumes ONTAP and Veeam Replication
- Application Consistent Disaster Recovery with NetApp SnapCenter and Veeam Replication to NetApp CVS on GCVE

### Migrate

- Workload Migration using VMware HCX to NetApp Cloud Volume Service NFS datastore
- VM Replication using Veeam to NetApp Cloud Volume Service NFS datastore

### Extend

COMING SOON!!

# **NetApp Capabilities for AWS VMC**

Learn more about the capabilities that NetApp brings to the AWS VMware Cloud (VMC) - 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.

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

- Configuring VMC in AWS
- NetApp Storage Options for VMC
- NetApp / VMware Cloud Solutions

## **Configuring VMC in AWS**

As with on-premises, planning a cloud based virtualization environment is critical for a successful productionready 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 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.

## NetApp Storage Options for VMC

NetApp storage can be utilized in several ways - either as guess connected or as a supplemental NFS datastore - within AWS VMC.

Please visit Supported NetApp Storage Options for more information.

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.

## **Solution Use Cases**

With NetApp and VMware cloud solutions, many use cases are simple to deploy in your AWS VMC. Use cases are defined for each of the VMware defined cloud areas:

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

Browse the NetApp solutions for AWS VMC

## Protecting Workloads on AWS / VMC

### TR-4931: Disaster Recovery with VMware Cloud on Amazon Web Services and Guest Connect

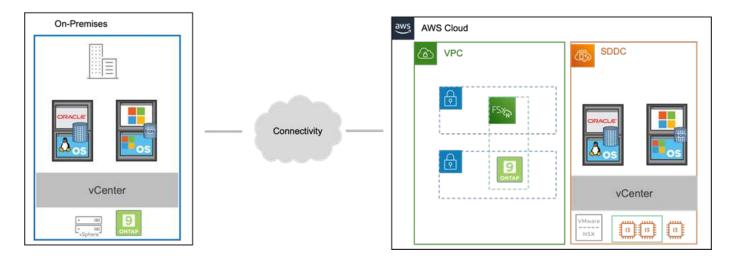
A proven disaster recovery (DR) environment and plan is critical for organizations to ensure that business-critical applications can be rapidly restored in the event of a major outage. This solution focuses on demonstrating DR use cases with a focus on VMware and NetApp technologies, both on-premises and with VMware Cloud on AWS.

Authors: Chris Reno, Josh Powell, and Suresh Thoppay - NetApp Solutions Engineering

## Overview

NetApp has a long history of integration with VMware as evidenced by the tens of thousands of customers that have chosen NetApp as their storage partner for their virtualized environment. This integration continues with guest-connected options in the cloud and recent integrations with NFS datastores as well. This solution focuses on the use case commonly referred to as guest-connected storage.

In guest-connected storage, the guest VMDK is deployed on a VMware-provisioned datastore, and application data is housed on iSCSI or NFS and mapped directly to the VM. Oracle and MS SQL applications are used to demonstrate a DR scenario, as shown in the following figure.



## Assumptions, pre-requisites and component overview

Before deploying this solution, review the overview of the components, the required pre-requisites to deploy the solution and assumptions made in documenting this solution.

### DR Solution Requirements, Pre-requisities and Planning

### Performing DR with SnapCenter

In this solution, SnapCenter provides application-consistent snapshots for SQL Server and Oracle application data. This configuration, together with SnapMirror technology, provides high-speed data replication between our on-premises AFF and FSx ONTAP cluster. Additionally, Veeam Backup & Replication provides backup and restore capabilities for our virtual machines.

In this section, we cover the configuration of SnapCenter, SnapMirror, and Veeam for both backup and restore.

The following sections cover configuration and the steps needed to complete a failover at the secondary site:

### Configure SnapMirror relationships and retention schedules

SnapCenter can update SnapMirror relationships within the primary storage system (primary > mirror) and to secondary storage systems (primary > vault) for the purpose of long-term archiving and retention. To do so, you must establish and initialize a data replication relationship between a destination volume and a source volume using SnapMirror.

The source and destination ONTAP systems must be in networks that are peered using Amazon VPC peering, a transit gateway, AWS Direct Connect, or an AWS VPN.

The following steps are required for setting up SnapMirror relationships between an on-premises ONTAP system and FSx ONTAP:



Refer to the FSx for ONTAP – ONTAP User Guide for more information on creating SnapMirror relationships with FSx.

For the source ONTAP system residing on-premises, you can retrieve the inter-cluster LIF information from System Manager or from the CLI.

1. In ONTAP System Manager, navigate to the Network Overview page and retrieve the IP addresses of Type: Intercluster that are configured to communicate with the AWS VPC where FSx is installed.

| Buckets<br>Otrees          |                    |          |            |         |               |              |              |         |                   |                                |       |
|----------------------------|--------------------|----------|------------|---------|---------------|--------------|--------------|---------|-------------------|--------------------------------|-------|
| Quotas                     | Network Interfaces | Portsets |            |         |               |              |              |         |                   |                                |       |
| Storage VMs                | + Add              |          |            |         |               |              |              |         | Q Search 👲 De     | ownload 👻 Filter 👄 Show/H      | ide 🗸 |
| Tiers<br>NETWORK A         | Name               | Status   | Storage VM | IPspace | Address 0     | Current Node | Current Port | Portset | Protocols         | Туре                           | Th    |
| Overview                   | veeam_repo         | ٥        | Backup     | Default | 10.61.181.179 | E13A300_1    | a0a-181      |         | SMB/CIFS, NFS, S3 | Data                           |       |
| Ethernet Ports<br>FC Ports | CM01               | ٥        |            | Default | 10.61.181.180 | E13A300_1    | 101-181      |         |                   | Cluster/Node Mgmt              | _     |
| EVENTS & JOBS              | HC_NI              | 0        |            | Default | 10.61.181.183 | E13A300_1    | a0a-181      |         |                   | Intercluster,Cluster/Node Mgmt |       |
| PROTECTION 🗸               | HC_N2              | 0        |            | Default | 10.61.181.184 | E13A300_2    | 181-60e.     |         |                   | Intercluster,Cluster/Node Mgmt |       |
|                            | llf_ora_svm_614    | ٢        | 013_010    | Default | 10.61.181.185 | E13A300_1    | a0a-181      |         | SMB/CIFS, NFS, FL | Data                           |       |

2. To retrieve the Intercluster IP addresses for FSx, log into the CLI and run the following command:

FSx-Dest::> network interface show -role intercluster

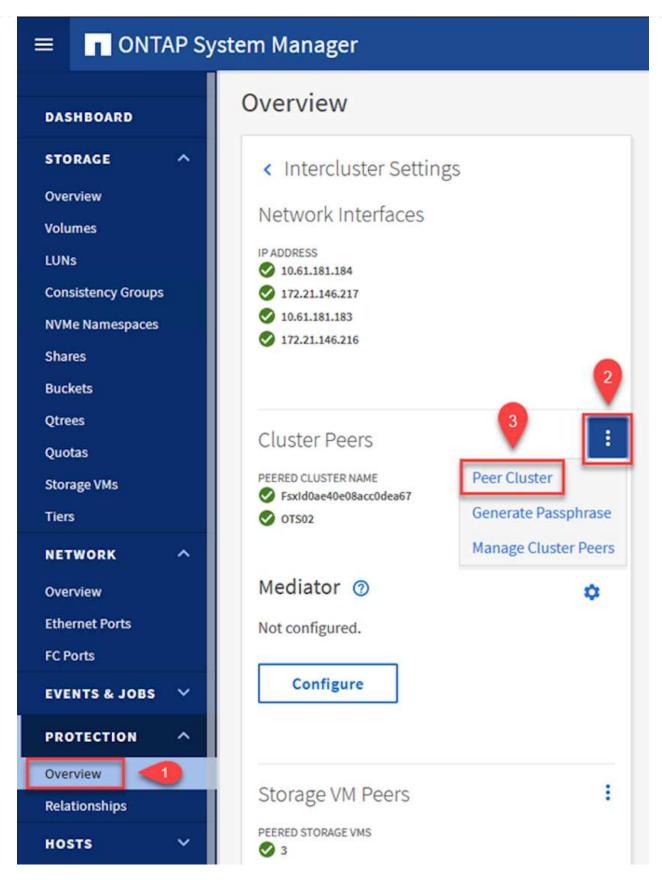
|            | Logical     | Status     | Network         | Current       | Current   | Is   |
|------------|-------------|------------|-----------------|---------------|-----------|------|
| /server    | Interface   | Admin/Oper | Address/Mask    | Node          | Port      | Home |
|            |             |            |                 |               |           |      |
| sxId0ae40e | 08acc0dea67 |            |                 |               |           |      |
|            | inter_1     | up/up      | 172.30.15.42/25 | FsxId0ae40e08 | acc0dea6' | 7-01 |
|            |             |            |                 |               | e0e       | true |
|            | inter_2     | up/up      | 172.30.14.28/26 | FsxId0ae40e08 | acc0dea6  | 7-02 |
|            |             |            |                 |               | e0e       | true |

To establish cluster peering between ONTAP clusters, a unique passphrase entered at the initiating ONTAP cluster must be confirmed in the other peer cluster.

1. Set up peering on the destination FSx cluster using the cluster peer create command. When prompted, enter a unique passphrase that is used later on the source cluster to finalize the creation process.

```
FSx-Dest::> cluster peer create -address-family ipv4 -peer-addrs
source_intercluster_1, source_intercluster_2
Enter the passphrase:
Confirm the passphrase:
```

2. At the source cluster, you can establish the cluster peer relationship using either ONTAP System Manager or the CLI. From ONTAP System Manager, navigate to Protection > Overview and select Peer Cluster.



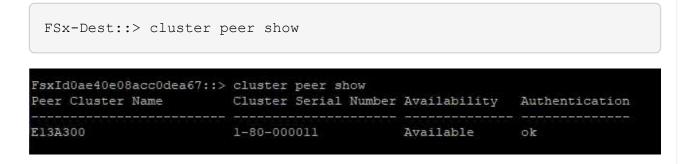
- 3. In the Peer Cluster dialog box, fill out the required information:
  - a. Enter the passphrase that was used to establish the peer cluster relationship on the destination FSx cluster.

- b. Select Yes to establish an encrypted relationship.
- c. Enter the intercluster LIF IP address(es) of the destination FSx cluster.
- d. Click Initiate Cluster Peering to finalize the process.

Peer Cluster

| Local   | Rer   |
|---|---|
| STORAGE VM PERMISSIONS  | PASSPHRASE 🕐  |
| All storage VMs (incl ×   | •••••   |
| Storage VMs created in the future also will be given permissions. | It cannot be determined from the passphrase wheth<br>this relationship was encrypted. Is the relationship<br>encrypted? |
| 2   | Yes No  |
|   | To generate passphrase, Launch Remote Cluste  |
|   | Intercluster Network Interfaces IP Addresses  |
| 3   | 172.30.15.42  |
|   | 172.30.14.28  |
|   | Cancel  |
|   | + Add   |
| 4   |   |

4. Verify the status of the cluster peer relationship from the FSx cluster with the following command:



#### Establish SVM peering relationship

The next step is to set up an SVM relationship between the destination and source storage virtual machines that contain the volumes that will be in SnapMirror relationships.

1. From the source FSx cluster, use the following command from the CLI to create the SVM peer relationship:

```
FSx-Dest::> vserver peer create -vserver DestSVM -peer-vserver
Backup -peer-cluster OnPremSourceSVM -applications snapmirror
```

- 2. From the source ONTAP cluster, accept the peering relationship with either ONTAP System Manager or the CLI.
- 3. From ONTAP System Manager, go to Protection > Overview and select Peer Storage VMs under Storage VM Peers.



- 4. In the Peer Storage VM's dialog box, fill out the required fields:
  - The source storage VM
  - The destination cluster
  - The destination storage VM



5. Click Peer Storage VMs to complete the SVM peering process.

SnapCenter manages retention schedules for backups that exist as snapshot copies on the primary storage system. This is established when creating a policy in SnapCenter. SnapCenter does not manage retention policies for backups that are retained on secondary storage systems. These policies are managed separately through a SnapMirror policy created on the secondary FSx cluster and associated with the destination volumes that are in a SnapMirror relationship with the source volume.

When creating a SnapCenter policy, you have the option to specify a secondary policy label that is added to the SnapMirror label of each snapshot generated when a SnapCenter backup is taken.



On the secondary storage, these labels are matched to policy rules associated with the destination volume for the purpose of enforcing retention of snapshots.

The following example shows a SnapMirror label that is present on all snapshots generated as part of a policy used for daily backups of our SQL Server database and log volumes.

| Colored and an address |                     | - 0 |
|------------------------|---------------------|-----|
| Select secondary       | replication options | 5 🕕 |

Update SnapMirror after creating a local Snapshot copy.

Update SnapVault after creating a local Snapshot copy.

| Secondary policy label | Custom Label 🔹 🚺 |
|------------------------|------------------|
|                        | sql-daily        |
| Error retry count      | 3 0              |

For more information on creating SnapCenter policies for a SQL Server database, see the SnapCenter documentation.

You must first create a SnapMirror policy with rules that dictate the number of snapshot copies to retain.

1. Create the SnapMirror Policy on the FSx cluster.

FSx-Dest::> snapmirror policy create -vserver DestSVM -policy
PolicyName -type mirror-vault -restart always

2. Add rules to the policy with SnapMirror labels that match the secondary policy labels specified in the SnapCenter policies.

```
FSx-Dest::> snapmirror policy add-rule -vserver DestSVM -policy
PolicyName -snapmirror-label SnapMirrorLabelName -keep
#ofSnapshotsToRetain
```

The following script provides an example of a rule that could be added to a policy:

```
FSx-Dest::> snapmirror policy add-rule -vserver sql_svm_dest -policy
Async SnapCenter SQL -snapmirror-label sql-ondemand -keep 15
```



Create additional rules for each SnapMirror label and the number of snapshots to be retained (retention period).

#### **Create destination volumes**

To create a destination volume on FSx that will be the recipient of snapshot copies from our source volumes, run the following command on FSx ONTAP:

```
FSx-Dest::> volume create -vserver DestSVM -volume DestVolName
-aggregate DestAggrName -size VolSize -type DP
```

Create the SnapMirror relationships between source and destination volumes

To create a SnapMirror relationship between a source and destination volume, run the following command on FSx ONTAP:

```
FSx-Dest::> snapmirror create -source-path
OnPremSourceSVM:OnPremSourceVol -destination-path DestSVM:DestVol -type
XDP -policy PolicyName
```

#### Initialize the SnapMirror relationships

Initialize the SnapMirror relationship. This process initiates a new snapshot generated from the source volume and copies it to the destination volume.

FSx-Dest::> snapmirror initialize -destination-path DestSVM:DestVol

Deploy and configure Windows SnapCenter server on-premises.

### Deploy Windows SnapCenter Server on premises

This solution uses NetApp SnapCenter to take application-consistent backups of SQL Server and Oracle databases. In conjunction with Veeam Backup & Replication for backing up virtual machine VMDKs, this provides a comprehensive disaster recovery solution for on-premises and cloud-based datacenters.

SnapCenter software is available from the NetApp support site and can be installed on Microsoft Windows systems that reside either in a domain or workgroup. A detailed planning guide and installation instructions can be found at the NetApp Documentation Center.

The SnapCenter software can be obtained at this link.

After it is installed, you can access the SnapCenter console from a web browser using *https://Virtual\_Cluster\_IP\_or\_FQDN:8146*.

After you log into the console, you must configure SnapCenter for backup SQL Server and Oracle databases.

To add storage controllers to SnapCenter, complete the following steps:

1. From the left menu, select Storage Systems and then click New to begin the process of adding your storage controllers to SnapCenter.

| <b>N</b> | letApp SnapC    | enter® | D                    |              |              | S 🖓 🖬 .   | 👤 scadmin 🛛 SnapCe | nterAdmin 🛛 🖡 Sign O |
|----------|-----------------|--------|----------------------|--------------|--------------|-----------|--------------------|----------------------|
| <        |                 | ONTA   | P Storage            |              |              |           |                    | <u> </u>             |
|          | Dashboard       | Туре   | ONTAP SVMs           | • Search     | n by Name    |           |                    | Hew Date             |
| 9        | Resources       | ONTA   | AP Storage Connectio | ns           |              |           |                    |                      |
| •        | Monitor         |        | Name 🔢               | IP           | Cluster Name | User Name | Platform           | Controller Licens    |
| <b>a</b> | Reports         |        | Backup               | 172.16.13.17 | 172.16.13.17 |           | AFF                | ~                    |
|          |                 |        | <u>FS02</u>          | 172.16.13.17 | 172.16.13.17 |           | AFF                | ~                    |
| <u>^</u> | Hosts           |        | ora svm              | 172.16.13.17 | 172.16.13.17 |           | AFF                | ~                    |
|          | Storage Systems |        | ora svm dest         |              | 172.30.15.42 |           | AFF                | Not applicable       |
| ÷.       | Settings        |        | <u>sql_svm</u>       | 172.16.13.17 | 172.16.13.17 |           | AFF                | ~                    |
|          |                 |        | sal sym_dest         |              | 172.30.15.42 |           | AFF                | Not applicable       |
| ▲        | Alerts          |        | svm HCApps           |              | 172.30.15.42 |           | AFF                | Not applicable       |

2. In the Add Storage System dialog box, add the management IP address for the local on-premises ONTAP cluster and the username and password. Then click Submit to begin discovery of the storage system.

| Add Storage System              |   |
|---------------------------------|---|
| Add Storage System              | 3   |
| Storage System                  | 10.61.181.180   |
| Username                        | admin   |
| Password                        | •••••   |
| Event Management                | System (EMS) & AutoSupport Settings   |
| Send AutoSuppor                 | t notification to storage system  |
|                                 | server events to syslog   |
| More Options : Pl               | atform, Protocol, Preferred IP etc  |
| at the bottom of the Add Storag | Reset<br>FSx ONTAP system to SnapCenter. In this case, select More Options<br>be System window and click the check box for Secondary to designate<br>ary storage system updated with SnapMirror copies or our primary |

| Platform     | FAS   | •       | Secondary 🚯 |   |
|--------------|-------|---------|-------------|---|
| Protocol     | HTTPS | •       |             |   |
| Port         | 443   |         |             |   |
| Timeout      | 60    | seconds | 0           |   |
| Preferred IP |       |         |             | 0 |

### Add hosts to SnapCenter

The next step is adding host application servers to SnapCenter. The process is similar for both SQL Server and Oracle.

- 1. From the left menu, select Hosts and then click Add to begin the process of adding storage controllers to SnapCenter.
- 2. In the Add Hosts window, add the Host Type, Hostname, and the host system Credentials. Select the plug-in type. For SQL Server, select the Microsoft Windows and Microsoft SQL Server plug-in.

|          | etApp | • SnapCenter®                |   |                       |  |    |   |
|----------|-------|------------------------------|---|-----------------------|--|----|---|
| >        | Man   | aged Hosts                   |   |                       |  |    |   |
|          | Se    | arch by Name                 |   | Add Host              |  |    |   |
| 0        |       | Name                         | 臣 | Host Type             | Windows  | •  |   |
|          |       | oraclesry_01.sddc.netapp.com |   | Host Name             | sqlsrv-01.sddc.netapp.com                        |    |   |
|          |       | oraclesry 02.sddc.netapp.com |   | Credentials           | sddc-jpowell                                     | •  | + |
| ណ៍       |       | oraclesry_03.sddc.netapp.com |   |                       |  |    |   |
| A        |       | oraclesry 04.sddc.netapp.com |   | Select Plug-ins to In | stall SnapCenter Plug-ins Package 4.6 for Window | /S |   |
| 20       |       | oraclesrv_05.sddc.netapp.com |   |                       | Microsoft Windows                                |    |   |
| a second |       | oraclesry_06.sddc.netapp.com |   |                       | Microsoft SQL Server                             |    |   |
| #        |       | oraclesry_07.sddc.netapp.com |   |                       | Microsoft Exchange Server     SAP HANA           |    |   |
| A        |       | oraclesry_08.sddc.netapp.com |   | A More Options : Po   | ort, gMSA, Install Path, Custom Plug-Ins         |    |   |
|          |       | oraclesry 09.sddc.netapp.com |   |                       |  |    |   |
|          |       | oraclesry 10.sddc.netapp.com |   | Submit Cancel         | ]  |    |   |

3. For Oracle, fill out the required fields in the Add Host dialog box and select the check box for the Oracle Database plug-in. Then click Submit to begin the discovery process and to add the host to SnapCenter.

| Host Type              | Linux   | • |   |
|------------------------|---|---|---|
| Host Name              | oraclesrv_11.sddc.netapp.com                    |   |   |
| Credentials            | root  |   |   |
|                        | stall SnapCenter Plug-ins Package 4.6 for Linux |   | e |
|                        |   |   | e |
| Select Plug-ins to In: | Stall SnapCenter Plug-ins Package 4.6 for Linux |   |   |

Policies establish the specific rules to be followed for a backup job. They include, but are not limited to, the backup schedule, replication type, and how SnapCenter handles backing up and truncating transaction logs.

| <         | Global Settings Policie | s Users and Access                      | Roles Credential | Software               |  |  |  |
|-----------|-------------------------|---|------------------|------------------------|--|--|--|
| Dashboard | Microsoft SQL Server    |   |                  |                        |  |  |  |
| Resources | Search by Name          |   | New              | Modily                 |  |  |  |
| Monitor   | Name JE                 | Backup Type                             | Schedule Type    | Replication            |  |  |  |
|           | SQL-Daily               | Full and Log backup                     | Daily            | SnapVault              |  |  |  |
| Reports   | SOL Handle              | Full and Log backup                     | Hourly           | SnapVault              |  |  |  |
|           | SQL-Hourly              | · - · · · · · · · · · · · · · · · · · · |                  |                        |  |  |  |
| Hosts     | SQL-Hourly-Logs         | Log backup                              | Hourly           | SnapVault              |  |  |  |
|           | SQL-Hourly-Logs         |   |                  | SnapVault<br>SnapVault |  |  |  |

For complete information on creating policies for SQL Server backups, see the SnapCenter documentation.

For complete information on creating policies for Oracle backups, see the SnapCenter documentation.

## Notes:

- As you progress through the policy creation wizard, take special note of the Replication section. In this section you stipulate the types of secondary SnapMirror copies that you want taken during the backups process.
- The "Update SnapMirror after creating a local Snapshot copy" setting refers to updating a SnapMirror relationship when that relationship exists between two storage virtual machines residing on the same cluster.
- The "Update SnapVault after creating a local SnapShot copy" setting is used to update a SnapMirror relationship that exists between two separate cluster and between an on-premises ONTAP system and Cloud Volumes ONTAP or FSxN.

The following image shows the preceding options and how they look in the backup policy wizard.

| 1 Name        | Select secondary replication options ()     |                       |                |   |  |
|---------------|---|-----------------------|----------------|---|--|
| 2 Backup Type | Update SnapMirror a                         | fter creating a local | Snapshot copy. |   |  |
| 3 Retention   | Update SnapVault aft                        | er creating a local S | napshot copy.  |   |  |
| e netenion    |   |                       |                |   |  |
|               | Secondary policy label                      | Choose                | *              | ( |  |
| 4 Replication | Secondary policy label<br>Error retry count | Choose                | С <u>е</u>     | 0 |  |

## Create SnapCenter Resource Groups

Resource Groups allow you to select the database resources you want to include in your backups and the policies followed for those resources.

- 1. Go to the Resources section in the left-hand menu.
- 2. At the top of the window, select the resource type to work with (In this case Microsoft SQL Server) and then click New Resource Group.

|          | letApp SnapC    |                      |                |                | •             | 🗠 😲 - 👤 scad                    | lmin SnapCenterA        | dmin 🛛 🗊 Sign Out |           |
|----------|-----------------|----------------------|----------------|----------------|---------------|---------------------------------|-------------------------|-------------------|-----------|
| <        |                 | Microsoft SQL Server |                |                |               |                                 |                         |                   |           |
|          | Dashboard       | View                 | Resource Group | •              | earch by name | Y                               | 2                       | New Resource G    |           |
| 9        | Resources       | 19                   | Name           | Resource Count | Tags          | Policies                        | Last Backup             | Overall Status    |           |
| ✤        | Monitor         |                      |                | SQLSRV-01      | 1             |                                 | SQL-Daily<br>SQL-Hourly | 05/11/2022        | Completed |
| <b>M</b> | Reports         |                      |                |                |               | SQL-<br>OnDemand<br>SQL-Weekly  |                         |                   |           |
| h        | Hosts           |                      | 501 501 02     |                |               |                                 | 02/20/2022              | Failed            |           |
| -        | Storage Systems |                      | SQLSRV-02      | 1              |               | SQL-Daily<br>SQL-Hourly<br>SQL- | 03/28/2022              | Failed            |           |
| =        | Settings        |                      |                |                |               | OnDemand<br>SQL-Weekly          |                         |                   |           |
| 4        | Alerts          |                      | SQLSRV-03      | 1              |               | SQL-Daily                       | 05/11/2022              | Completed         |           |

The SnapCenter documentation covers step-by-step details for creating Resource Groups for both SQL Server and Oracle databases.

For backing up SQL resources, follow this link.

For Backing up Oracle resources, follow this link.

## Deploy and configure Veeam Backup Server

Veeam Backup & Replication software is used in the solution to back up our application virtual machines and archive a copy of the backups to an Amazon S3 bucket using a Veeam scale-out backup repository (SOBR). Veeam is deployed on a Windows server in this solution. For specific guidance on deploying Veeam, see the Veeam help Center Technical documentation.

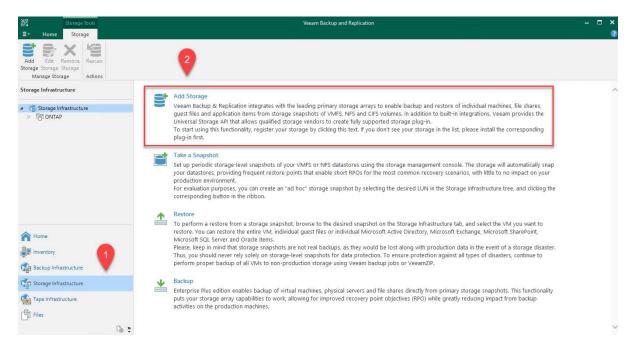
After you deploy and license the software, you can create a scale-out backup repository (SOBR) as target storage for backup jobs. You should also include an S3 bucket as a backup of VM data offsite for disaster recovery.

See the following prerequisites before getting started.

- 1. Create an SMB file share on your on-premises ONTAP system as the target storage for backups.
- 2. Create an Amazon S3 bucket to include in the SOBR. This is a repository for the offsite backups.

First, add the ONTAP storage cluster and associated SMB/NFS filesystem as storage infrastructure in Veeam.

1. Open the Veeam console and log in. Navigate to Storage Infrastructure and then select Add Storage.

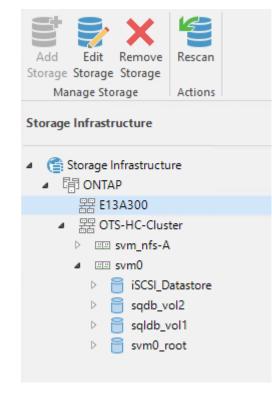


- 2. In the Add Storage wizard, select NetApp as the storage vendor and then select Data ONTAP.
- 3. Enter the management IP address and check the NAS Filer box. Click Next.

|   | Data ONTAP storage by specifying DNS name or IP address.  |     |
|---|---|-----|
| Name  | Management server DNS name or IP address:   |     |
| Nume  | 10.61.181.180   |     |
| Credentials   | Description:  |     |
| NAS Filer   | Created by SDDC\jpowell at 5/17/2022 10:34 AM.  |     |
| Analy   |   |     |
| Apply   |   |     |
| Summary   | Role:<br>Block or file storage for VMware vSphere<br>Block storage for Microsoft Windows servers<br>NAS filer |     |
| Add your credentials  | < Previous Next > Finish Cances the ONTAP cluster.  | el  |
| New NetApp Data ONTAP Sto<br>Credentials<br>Specify account w | torage<br>with storage administrator privileges.  |     |
|   |   |     |
| Name  | Credentials:  |     |
|   | Credentials:           MCIEUC\Admin (HCIEUC\Admin, last edited: 98 days ago)         Add.                     |     |
| Credentials   | Add.         Manage accounts  |     |
|   | HCIEUC\Admin (HCIEUC\Admin, last edited: 98 days ago)       Add.  |     |
| Credentials   | Manage accounts         Protocol:   | ••• |
| Credentials<br>NAS Filer<br>Apply                             | Manage accounts         Protocol:   |     |
| Credentials<br>NAS Filer                                      | Manage accounts         Protocol:   |     |
| Credentials<br>NAS Filer<br>Apply                             | Manage accounts         Protocol:   |     |
| Credentials<br>NAS Filer<br>Apply                             | Manage accounts         Protocol:   |     |
| Credentials<br>NAS Filer<br>Apply                             | Manage accounts         Protocol:   |     |
| Credentials<br>NAS Filer<br>Apply                             | Manage accounts         Protocol:   |     |
| Credentials<br>NAS Filer<br>Apply                             | Manage accounts         Protocol:   | ••• |
| Credentials<br>NAS Filer<br>Apply                             | Manage accounts         Protocol:   |     |
| Credentials<br>NAS Filer<br>Apply                             | Manage accounts         Protocol:   |     |
| Credentials<br>NAS Filer<br>Apply                             | Manage accounts         Protocol:   | ••• |

| New NetApp Data ONTAP St      | orage  | ×      |
|-------------------------------|--|--------|
| NAS Filer<br>Specify how this | storage can be accessed by file backup jobs. |        |
| Name                          | Protocol to use:                             |        |
| Credentials                   |  |        |
| NAS Filer                     | Create required export rules automatically   |        |
|                               | Volumes to scan:                             |        |
| Apply                         | All volumes                                  | Choose |
| Summary                       | Backup proxies to use:                       |        |
|                               | Automatic selection                          | Choose |
|                               |  |        |
|                               |  |        |
|                               |  |        |
|                               |  |        |
|                               |  |        |
|                               |  |        |
|                               |  |        |
|                               |  |        |
|                               |  |        |
|                               | < Previous Apply Finish                      | Cancel |

6. Complete the Apply and Summary pages of the wizard and click Finish to begin the storage discovery process. After the scan completes, the ONTAP cluster is added along with the NAS filers as available resources.



7. Create a backup repository using the newly discovered NAS shares. From Backup Infrastructure, select Backup Repositories and click the Add Repository menu item.

|   | Backup Proxies         |
|---|------------------------|
|   | Backup Repositories 2  |
|   | External Repositories  |
| Þ | Scale-out Repositories |
|   | WAN Accelerators       |
|   | Service Providers      |
| 4 | 🕂 SureBackup           |
|   | 🕂 Application Groups   |
|   | 📇 Virtual Labs         |
| 4 | Canada Servers         |
|   | VMware vSphere         |
|   | e Microsoft Windows    |
|   |                        |
|   |                        |
|   |                        |
|   |                        |

8. Follow all steps in the New Backup Repository Wizard to create the repository. For detailed information on creating Veeam Backup Repositories, see the Veeam documentation.

New Backup Repository

### Share

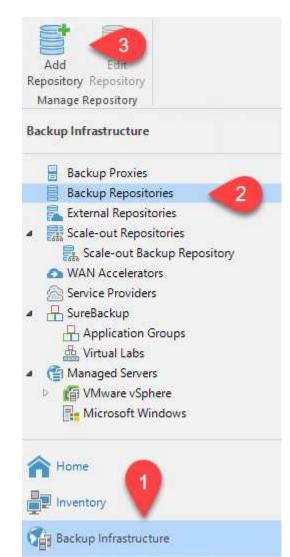
Type in UNC path to share (mapped drives are not supported), specify share access credentials and how backup jobs should write data to this share.

| Name                       | Shared folder:<br>\\172.21.162.181\VBRRepo Browse  |
|----------------------------|--|
| Share                      | Userver\folder format  |
| Repository                 | This share requires access credentials:  |
| Mount Server               | R sddc\administrator (sddc\administrator, last edited: 85 days ago)  |
| Review<br>Apply<br>Summary | Gateway server:   Automatic selection  The following server:  veeam.sddc.netapp.com (Backup server)  Use this option to improve performance and reliability of backup to a NAS located in a remote site. |
|                            | < Previous Next > Finish Cancel  |
|                            |  |

 $\times$ 

The next step is to add the Amazon S3 storage as a backup repository.

1. Navigate to Backup Infrastructure > Backup Repositories. Click Add Repository.



2. In the Add Backup Repository wizard, select Object Storage and then Amazon S3. This starts the New Object Storage Repository wizard.

# Add Backup Repository

Select the type of backup repository you want to add.

| _ |   | 5 |
|---|---|---|
|   |   | - |
|   |   |   |
|   |   | - |
|   |   |   |
| _ | _ | - |
| _ |   | _ |

Direct attached storage

Microsoft Windows or Linux server with internal or direct attached storage. This configuration enables data movers to run directly on the server, allowing for fastest performance.



Network attached storage

Network share on a file server or a NAS device. When backing up to a remote share, we recommend that you select a gateway server located in the same site with the share.



Þ

Deduplicating storage appliance

Dell EMC Data Domain, ExaGrid, HPE StoreOnce or Quantum DXi. If you are unable to meet the requirements of advanced integration via native appliance API, use the network attached storage option instead.



On-prem object storage system or a cloud object storage provider. Object storage can only be used as a Capacity Tier of scale-out backup repositories, backing up directly to object storage is not currently supported.

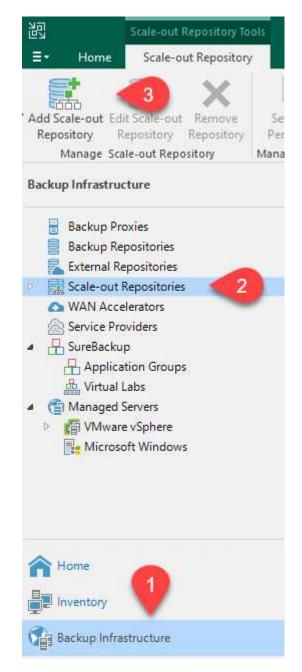
- 3. Provide a name for your object storage repository and click Next.
- 4. In the next section, provide your credentials. You need an AWS Access Key and Secret Key.

| Account ACCOUNT AKIAX4H43ZT557HXQT2W (last edited: 107 days ago)  | Add  loud accounts             |
|---|--------------------------------|
| Manage cloud  | loud accounts                  |
|   |                                |
| Bucket AWS region:  |                                |
| Summary   |                                |
|   |                                |
|   |                                |
|   |                                |
|   |                                |
|   |                                |
|   |                                |
|   |                                |
|   |                                |
|   |                                |
|   |                                |
|   |                                |
|   |                                |
|   |                                |
| □ Use the following gateway server:   |                                |
| Use the following gateway server:   |                                |
|   |                                |
| Use the following gateway server:<br>veeam.sddc.netapp.com (Backup server)  |                                |
| veeam.sddc.netapp.com (Backup server)   | erver is specified, all scale- |
| veeam.sddc.netapp.com (Backup server)<br>Select a gateway server to proxy access to Amazon S3. If no gateway server | erver is specified, all scale- |
| veeam.sddc.netapp.com (Backup server)   | erver is specified, all scale- |
| veeam.sddc.netapp.com (Backup server)<br>Select a gateway server to proxy access to Amazon S3. If no gateway server | erver is specified, all scale- |
| veeam.sddc.netapp.com (Backup server)<br>Select a gateway server to proxy access to Amazon S3. If no gateway server | erver is specified, all scale- |
| veeam.sddc.netapp.com (Backup server)<br>Select a gateway server to proxy access to Amazon S3. If no gateway server | erver is specified, all scale- |

×

Now that we have added our storage repositories to Veeam, we can create the SOBR to automatically tier backup copies to our offsite Amazon S3 object storage for disaster recovery.

1. From Backup Infrastructure, select Scale-out Repositories and then click the Add Scale-out Repository menu item.



- 2. In the New Scale-out Backup Repository provide a name for the SOBR and click Next.
- 3. For the Performance Tier, choose the backup repository that contains the SMB share residing on your local ONTAP cluster.

| New Scale-out Backup Reposito            | у   | ×      |
|--|---|--------|
| Performance Tier<br>Select backup reposi | tories to use as the landing zone and for the short-term retention. |        |
| Name                                     | Extents:  | Add    |
| Performance Tier                         | Name  |        |
| Placement Policy                         |   | Remove |

- 4. For the Placement Policy, choose either Data Locality or Performance based your requirements. Select next.
- 5. For Capacity Tier we extend the SOBR with Amazon S3 object storage. For the purposes of disaster recovery, select Copy Backups to Object Storage as Soon as They are Created to ensure timely delivery of our secondary backups.

| New Scale-out Backup Repo | isitory   |             |  |
|---------------------------|---|-------------|--|
|                           | orage to copy backups to for redundancy and DR purposes. Older backups can be moved to obje<br>duce long-term retention costs while preserving the ability to restore directly from offloaded back  |             |  |
| Name                      | Extend scale-out backup repository capacity with object storage:  |             |  |
| Performance Tier          | Amazon S3 Repo 🗸 🗸  | Add         |  |
| Placement Policy          | Define time windows when uploading to capacity tier is allowed  | Window      |  |
| Capacity Tier             | Copy backups to object storage as soon as they are created  | e conied to |  |
| Archive Tier              | Create additional copy of your backups for added redundancy by having all backups copied to<br>the capacity tier as soon as they are created on the performance tier.   |             |  |
| Summary                   | Move backups to object storage as they age out of the operational restore window<br>Reduce your long-term retention costs by moving older backups to object storage<br>while preserving the ability to restore directly from offloaded backups. | completely  |  |
|                           | Move backup files older than 14 🛕 days (your operational restore window)  | Override    |  |
|                           | Encrypt data uploaded to object storage     Password:     Manage passwords  | Add         |  |
|                           | manage passionas  |             |  |
|                           | < Previous Next > Finish  | Cancel      |  |
| -inally, select Apply     | and Finish to finalize creation of the SOBR.  |             |  |

### Create the scale-out backup repository jobs

The final step to configuring Veeam is to create backup jobs using the newly created SOBR as the backup destination. Creating backup jobs is a normal part of any storage administrator's repertoire and we do not cover the detailed steps here. For more complete information on creating backup jobs in Veeam, see the Veeam Help Center Technical Documentation.

### BlueXP backup and recovery tools and configuration

To conduct a failover of application VMs and database volumes to VMware Cloud Volume services running in AWS, you must install and configure a running instance of both SnapCenter Server and Veeam Backup and Replication Server. After the failover is complete, you must also configure these tools to resume normal backup operations until a failback to the on-premises datacenter is planned and executed.

### Deploy secondary Windows SnapCenter Server

SnapCenter Server is deployed in the VMware Cloud SDDC or installed on an EC2 instance residing in a VPC with network connectivity to the VMware Cloud environment.

SnapCenter software is available from the NetApp support site and can be installed on Microsoft Windows systems that reside either in a domain or workgroup. A detailed planning guide and installation instructions can be found at the NetApp documentation center.

You can find the SnapCenter software at this link.

### Configure secondary Windows SnapCenter Server

To perform a restore of application data mirrored to FSx ONTAP, you must first perform a full restore of the on-premises SnapCenter database. After this process is complete, communication with the VMs is reestablished and application backups can now resume using FSx ONTAP as the primary storage.

To achieve this, you must complete the following items on the SnapCenter Server:

- 1. Configure the computer name to be identical to the original on-premises SnapCenter Server.
- 2. Configure networking to communicate with VMware Cloud and the FSx ONTAP instance.
- 3. Complete the procedure to restore the SnapCenter database.
- 4. Confirm that SnapCenter is in Disaster Recovery mode to make sure that FSx is now the primary storage for backups.
- 5. Confirm that communication is reestablished with the restored virtual machines.

### Deploy secondary Veeam Backup & Replication server

You can install the Veeam Backup & Replication server on a Windows server in the VMware Cloud on AWS or on an EC2 instance. For detailed implementation guidance, see the Veeam Help Center Technical Documentation.

To perform a restore of virtual machines that have been backed up to Amazon S3 storage, you must install the Veeam Server on a Windows server and configure it to communicate with VMware Cloud, FSx ONTAP, and the S3 bucket that contains the original backup repository. It must also have a new backup repository configured on FSx ONTAP to conduct new backups of the VMs after they are restored.

To perform this process, the following items must be completed:

- 1. Configure networking to communicate with VMware Cloud, FSx ONTAP, and the S3 bucket containing the original backup repository.
- 2. Configure an SMB share on FSx ONTAP to be a new backup repository.
- 3. Mount the original S3 bucket that was used as part of the scale-out backup repository on premises.
- 4. After restoring the VM, establish new backup jobs to protect SQL and Oracle VMs.

For more information on restoring VMs using Veeam, see the section "Restore Application VMs with Veeam Full Restore".

### SnapCenter database backup for disaster recovery

SnapCenter allows for the backup and recovery of its underlying MySQL database and configuration data for the purpose of recovering the SnapCenter server in the case of a disaster. For our solution, we recovered the SnapCenter database and configuration on an AWS EC2 instance residing in our VPC. For more information on this step, see this link.

### SnapCenter backup prerequisites

The following prerequisites are required for SnapCenter backup:

- A volume and SMB share created on the on-premises ONTAP system to locate the backed-up database and configuration files.
- A SnapMirror relationship between the on-premises ONTAP system and FSx or CVO in the AWS account. This relationship is used for transporting the snapshot containing the backed-up SnapCenter database and configuration files.
- Windows Server installed in the cloud account, either on an EC2 instance or on a VM in the VMware Cloud SDDC.
- SnapCenter installed on the Windows EC2 instance or VM in VMware Cloud.

- Create a volume on the on-premises ONTAP system for hosting the backup db and config files.
- Set up a SnapMirror relationship between on-premises and FSx/CVO.
- Mount the SMB share.
- Retrieve the Swagger authorization token for performing API tasks.
- Start the db restore process.
- Use the xcopy utility to copy the db and config file local directory to the SMB share.
- On FSx, create a clone of the ONTAP volume (copied via SnapMirror from on-premises).
- Mount the SMB share from FSx to EC2/VMware Cloud.
- Copy the restore directory from the SMB share to a local directory.
- Run the SQL Server restore process from Swagger.

SnapCenter provides a web client interface for executing REST API commands. For information on accessing the REST APIs through Swagger, see the SnapCenter documentation at this link.

After you have navigated to the Swagger page, you must retrieve an authorization token to initiate the database restore process.

1. Access the SnapCenter Swagger API web page at *https://<SnapCenter Server IP>:8146/swagger/*.

| SnapCenter A   | PI <sup>—</sup>   |  |
|--|---|--|
| [ Base URL: /api ]   |   |  |
| https://snapcenter.sddc.netapp.com:814   | 6/Content/swagger/SnapCenter.yaml                                 |  |
| Manage your SnapCenter Server u<br>To access the swagger documenta<br>https://{SCV_hostname}.{SCV_host | tion of "SnapCenter Plug-in for VMware vSphere" API's, please use |  |
| xpand the Auth section a   | and click Try it Out.   |  |
| Expand the Auth section a  | and click Try it Out.   |  |
| Auth   | and click Try it Out.   |  |

3. In the UserOperationContext area, fill in the SnapCenter credentials and role and click Execute.

| The                                 |   |     |
|-------------------------------------|---|-----|
| TokenNeverExpires                   | Token never expires   |     |
| (query)                             | false v   |     |
| UserOperationContext * re<br>object | uired<br>User credentials   |     |
| (body)                              | Edit Value Model  |     |
|                                     | <pre>{     "UserOperationContext": {         "UJer": {             "Name": "localhost\\scadmin",             "Passphrase": "NetApp321",             "Rolename": "SnapCenterAdmin"         }     } }</pre> |     |
|                                     |   | li. |
|                                     | Cancel  |     |
|                                     | Parameter content type application/json   |     |
|                                     | Execute   |     |

4. In the Response body below, you can see the token. Copy the token text for authentication when executing the backup process.

| 200 | Response body  |
|-----|--|
|     | "PluginName": null,  |
|     | "Hostid": 0,   |
|     | "RoleId": null,  |
|     | "JobIds": null   |
|     | łz.  |
|     | "User": (  |
|     | "Token":   |
|     | $\label{eq:second} $$ KDG=tsV6EOdtdAmAYpe8q5SG6wcoGaSjwHE6jrNy5CsY63HKD5LkoZLIESRNAhpGJJ0U0DynENdgtVGDZnvx+I/ZJZIn5H1NZrj6BaBCsV6EOdtdAmAYpe8q5SG6wcoGaSjwHE6jrNy5CsY63HKD5LkoZLIESRNAhpGJJ0U0DynENdgtVGDZnvx+I/ZJZIn5H1NZrj6BaBCsV6EOdtdAmAYpe8q5SG6wcoGaSjwHE6jrNy5CsY63HKD5LkoZLIESRNAhpGJJ0U0DynENdgtVGDZnvx+I/ZJZIn5H1NZrj6BaBCsV6EOdtdAmAYpe8q5SG6wcoGaSjwHE6jrNy5CsY63HKD5LkoZLIESRNAhpGJJ0U0DynENdgtVGDZnvx+I/ZJZIn5H1NZrj6BaBCsV6EOdtdAmAYpe8q5SG6wcoGaSjwHE6jrNy5CsY63HKD5LkoZLIESRNAhpGJ0U0DynENdgtVGDZnvx+I/ZJZIn5H1NZrj6BaBCsV6EOdtdAmAYpe8q5SG6wcoGaSjwHE6jrNy5CsY63HKD5LkoZLIESRNAhpGJ0U0DynENdgtVGDZnvx+I/ZJZIn5H1NZrj6BaBCsV6EOdtdAmAYpe8q5SG6wcoGaSjwHE6jrNy5CsY63HKD5LkoZLIESRNAhpGJ0U0DynENdgtVGDZnvx+I/ZJZIn5H1NZrj6BaBCsV6EOdtdAmAYpe8q5SG6wcoGaSjwHE6jrNy5CsY64HKD5LkoZLIESRNAhpGJ0U0DynENdgtVGDZnvx+I/ZJZIn5H1NZrj6BaBCsV6EOdtdAmAYpe8q5SG6wcoGaSjwHE6jrNy5CsY63HKD5LkoZLIESRNAhpGJ0U0DynENdgtVGDZnvx+I/ZJZIn5H1NZrj6BaBCsV6EOdtdAmAYpe8q5SG6wcoGaSjwHE6jrNy5CsY63HKD5LkoZLIESRNAhpGJ0U0DynENdgtVGDZnvx+I/ZJZIn5H1NZrj6BaBCsV6EOdtdAmAYpe8q5SG6wcoGaSjwHE6jrNy5CsY6ABCsV6EOdtdAmAYpe8q5SG6wcoGaSjwHE6jrNy5CsY6ABCsV6EOdtdAmAYpe8q5SG6wcoGaSjwHE6jrNy5CsY6ABCsV6EOdtdAmAYpe8q5SG6wcoGaSjwHE6jrNy5CsY6ABCsV6EOdtdAmAYpe8q5SG7baBCsV6EOdtdAmAYpe8q5BCsV6EOdtdAmAYpe8q5BCsV6EOdtdAmAYpe8q5BCsV6EOdtdAmAYpe8q5BCsV6EOdtdAmAYpe8q5BCsV6EOdtdAmAYpe8q5BCsV6EOdtdAmAPCsV6AACsV6EOdtdAmAYpe8q5BCsV6AABCsV6EOdtdAmAPCsV6AABCsV6AABCsV6B$ |
|     | CLfGTApg1GmcagT08bqb5bMTx07EcdrAidzAXUDb3GyLGKW0GdwKzSeUwKj3uVupnk1E3lskK6PRBv9RS8j0qHQvo4v4RL0hhTnhwPhV   |
|     | 9/23nFeJVP/p1Ev4vrV/zeZVTUHFHUM069XRe5cuW9nwyj4b015Y5FN3XDkjQ",  |
|     | "Name": "SCAdmin",   |
|     | "TokenHashed": null,   |
|     | "Туре": "",  |
|     | "TokenTime": "2022-03-22T14:21:57.3665661-07:00",  |
|     | "Id": "1",   |
|     | "FullName": "SCAdmin",   |
|     | "Host": null,  |
|     | "Author": null,  |
|     | "UserName": "",  |
|     | "Domain": "", Downie   |
|     | "Passphrase": "",  |

Next go to the Disaster Recovery area on the Swagger page to begin the SnapCenter backup process.

1. Expand the Disaster Recovery area by clicking it.

# Disaster Recovery GET /4.6/disasterrecovery/server/backup POST /4.6/disasterrecovery/server/backup DELETE /4.6/disasterrecovery/server/backup Deletes the existing Snapcenter DR backup. POST /4.6/disasterrecovery/server/backup Deletes /4.6/disasterrecovery/server/restore Stats Stats POST /4.6/disasterrecovery/server/restore Stats Stats POST /4.6/disasterrecovery/server/restore Stats Stats

2. Expand the /4.6/disasterrecovery/server/backup section and click Try it Out.



3. In the SmDRBackupRequest section, add the correct local target path and select Execute to start the backup of the SnapCenter database and configuration.



The backup process does not allow backing up directly to an NFS or CIFS file share.

| Name                                   | Description   |
|--|---|
| Token * required<br>string<br>(header) | User authorization token                                    |
| (header)                               | TUHFHUM069XRe5cuW9nwyj4b0I5Y5FN3XDkjQ==                     |
| SmDRBackupRequest * required           | Parameters to take Backup                                   |
| object<br>(body)                       | Edit Value Model  |
|  | <pre>{     "TargetPath": "C:\\SnapCenter_Backups\\" }</pre> |
|  | Cancel Parameter content type application/json ~            |
|  | Execute   |

Log into SnapCenter to review log files when starting the database restore process. Under the Monitor section, you can view the details of the SnapCenter server disaster recovery backup.

| inap | Center Server disaster recovery backup   |     |
|------|--|-----|
| ~ •  | SnapCenter Server disaster recovery backup   | ^   |
| ~    | Precheck validation  |     |
| 4    | Disaster recovery backup of 'oraclesrv_04.sddc.netapp.com'   |     |
| ~    | Disaster recovery backup of SnapCenter Server 'SnapCenter.sddc.netapp.com'                                       |     |
| ~    | Disaster recovery backup of 'oraclesrv_02.sddc.netapp.com'   |     |
| ~    | Disaster recovery backup of 'oraclesrv_03.sddc.netapp.com'   |     |
| ~    | Disaster recovery backup of 'oraclesrv_05.sddc.netapp.com'   |     |
| ~    | Disaster recovery backup of 'oraclesrv_07.sddc.netapp.com'   |     |
| ~    | Disaster recovery backup of 'sqlsrv-02.sddc.netapp.com'  |     |
| ~    | Disaster recovery backup of 'sqlsrv-03.sddc.netapp.com'  |     |
| ~    | Disaster recovery backup of 'oraclesrv_10.sddc.netapp.com'   |     |
| 1    | Disaster recovery backup of 'sqlsrv-04.sddc.netapp.com'  |     |
| ~    | Disaster recovery backup of 'sqlsrv-01.sddc.netapp.com'  |     |
| ~    | Disaster recovery backup of 'sqlsrv-05.sddc.netapp.com'  |     |
| ~    | Disaster recovery backup of 'oraclesrv_09.sddc.netapp.com'   |     |
| ~    | Disaster recovery backup of 'sqlsrv-06.sddc.netapp.com'  |     |
| ~    | Disaster recovery backup of 'sqlsrv-07.sddc.netapp.com'  |     |
|      | k Name: SnapCenter Server disaster recovery backup Start Time: 03/23/2022 10:27:11 AM End Time: 03/23/20<br>7 AM | )22 |

Next you must move the backup from the local drive on the SnapCenter server to the CIFS share that is used to SnapMirror copy the data to the secondary location located on the FSx instance in AWS. Use xcopy with specific options that retain the permissions of the files.

Open a command prompt as Administrator. From the command prompt, enter the following commands:

```
xcopy <Source_Path> \\<Destination_Server_IP>\<Folder_Path> /O /X
/E /H /K
xcopy c:\SC_Backups\SnapCenter_DR \\10.61.181.185\snapcenter_dr /O
/X /E /H /K
```

### Failover

### Disaster occurs at primary site

For a disaster that occurs at the primary on-premises datacenter, our scenario includes failover to a secondary site residing on Amazon Web Services infrastructure using VMware Cloud on AWS. We assume that the virtual machines and our on-premises ONTAP cluster are no longer accessible. In addition, both the SnapCenter and Veeam virtual machines are no longer accessible and must be rebuilt at our secondary site.

This section address failover of our infrastructure to the cloud, and we cover the following topics:

- SnapCenter database restore. After a new SnapCenter server has been established, restore the MySQL database and configuration files and toggle the database into disaster recovery mode in order to allow the secondary FSx storage to become the primary storage device.
- Restore the application virtual machines using Veeam Backup & Replication. Connect the S3 storage that contains the VM backups, import the backups, and restore them to VMware Cloud on AWS.
- Restore the SQL Server application data using SnapCenter.
- Restore the Oracle application data using SnapCenter.

SnapCenter supports disaster recovery scenarios by allowing the backup and restore of its MySQL database and configuration files. This allows an administrator to maintain regular backups of the SnapCenter database at the on-premises datacenter and later restore that database to a secondary SnapCenter database.

To access the SnapCenter backup files on the remote SnapCenter server, complete the following steps:

- 1. Break the SnapMirror relationship from the FSx cluster, which makes the volume read/write.
- 2. Create a CIFS server (if necessary) and create a CIFS share pointing to the junction path of the cloned volume.
- 3. Use xcopy to copy the backup files to a local directory on the secondary SnapCenter system.
- 4. Install SnapCenter v4.6.
- 5. Ensure that SnapCenter server has the same FQDN as the original server. This is required for the db restore to be successful.

To start the restore process, complete the following steps:

- 1. Navigate to the Swagger API web page for the secondary SnapCenter server and follow the previous instructions to obtain an authorization token.
- 2. Navigate to the Disaster Recovery section of the Swagger page, select /4.6/disasterrecovery/server/restore, and click Try it Out.

| POST         | /4.6/disasterrecovery/server/restore Starts SnapCenter Server Restore. |            |
|--------------|--|------------|
| Starts SnapC | enter Server Restore.  |            |
| Parameters   |  | Try it out |

3. Paste in your authorization token and, in the SmDRResterRequest section, paste in the name of the backup and the local directory on the secondary SnapCenter server.

| Name  | Description  |
|---|--|
| Token <sup>* required</sup>                       | User authorization token   |
| (header)  | KIYxOg==rMXzS7EPIGRzTXjfton6Q+JoNGpueQt  |
| SmDRRestoreRequest * required<br>object<br>(body) | Parameters to take for Restore   |
|   | <pre>{     "BackupName": "SnapCenter.sddc.netapp.com_03-23-2022_12.38.00.6713",     "BackupPath": "C:\\SnapCenter\\" }</pre> |

4. Select the Execute button to start the restore process.

5. From SnapCenter, navigate to the Monitor section to view the progress of the restore job.

| <                 | Jobs     | Schedules | Events Logs   |
|-------------------|----------|-----------|---|
| Dashboard         | search   | by name   |   |
| Resources         | Jobs - F | ilter     |   |
| Monitor           | ID       | Status    | Name  |
| ណ៍ Reports        | 20482    | 4         | SnapCenter Server Disaster Recovery                                 |
|                   | 20481    | 4         | SnapCenter Server disaster recovery backup                          |
| Hosts             | 20480    | ×         | SnapCenter Server disaster recovery backup                          |
| - Storage Systems | 20475    | ~         | Backup of Resource Group 'SQLSRV-09' with policy 'SQL-Hourly'       |
| E Settings        | 20474    | ~         | Backup of Resource Group 'SQLSRV-05' with policy 'SQL-Hourly'       |
|                   | 20473    | 2         | Backup of Resource Group 'OracleSrv_06' with policy 'Oracle-Hourly' |
| Alerts            | 20472    | ×         | SnapCenter Server disaster recovery backup                          |

# Job Details

SnapCenter Server Disaster Recovery

- SnapCenter Server Disaster Recovery
- Prepare for restore job
- Precheck validation
- Saving original server state
- Schedule restore
- Repository restore
- Config restore
  - Reset MySQL password
- 6. To enable SQL Server restores from secondary storage, you must toggle the SnapCenter database into Disaster Recovery mode. This is performed as a separate operation and initiated on the Swagger API web page.
  - a. Navigate to the Disaster Recovery section and click /4.6/disasterrecovery/storage.
  - b. Paste in the user authorization token.
  - c. In the SmSetDisasterRecoverySettingsRequest section, change EnableDisasterRecover to true.
  - d. Click Execute to enable disaster recovery mode for SQL Server.

| Token * required<br>string                                | User authorization token                          |
|---|---|
| (header)  | KIYxOg==rMXzS7EPIGRzTXjfton6Q+JoNGpueQt           |
| SmSetDisasterRecoverySettingsRequest * required<br>object | Parameters to enable or disable the DR mode       |
| (body)  | Edit Value Model                                  |
|   | <pre>{     "EnableDisasterRecovery": true }</pre> |
| $\bigcirc$  |   |
| (i) See comments regarding addit                          | ional procedures.                                 |

Restore application VMs with Veeam full restore

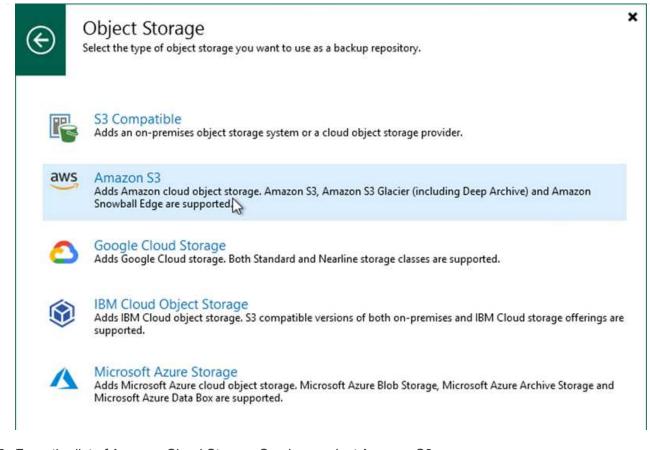
From the secondary Veeam server, import the backups from S3 storage and restore the SQL Server and Oracle VMs to your VMware Cloud cluster.

To import the backups from the S3 object that was part of the on-premises scale-out backup repository, complete the following steps:

1. Go to Backup Repositories and click Add Repository in the top menu to launch the Add Backup Repository wizard. On the first page of the wizard, select Object Storage as the backup repository type.

|      | ackup Repository<br>type of backup repository you want to add.   |
|------|--|
| 0000 | Direct attached storage<br>Microsoft Windows or Linux server with internal or direct attached storage. This configuration enables data<br>movers to run directly on the server, allowing for fastest performance.                                |
| 1    | Network attached storage<br>Network share on a file server or a NAS device. When backing up to a remote share, we recommend that you<br>select a gateway server located in the same site with the share.   |
| ¥    | Deduplicating storage appliance<br>Dell EMC Data Domain, ExaGrid, HPE StoreOnce or Quantum DXi. If you are unable to meet the requirements of<br>advanced integration via native appliance API, use the network attached storage option instead. |
| -    | Object storage<br>On-prem object storage system or a cloud object storage provider. Object storage can only be used as a Capacity<br>Tier of scale-out backup repositories, backing up directly to object storage is not currently supported.    |

2. Select Amazon S3 as the Object Storage type.



3. From the list of Amazon Cloud Storage Services, select Amazon S3.



4. Select your pre-entered credentials from the drop-down list or add a new credential for accessing the cloud storage resource. Click Next to continue.

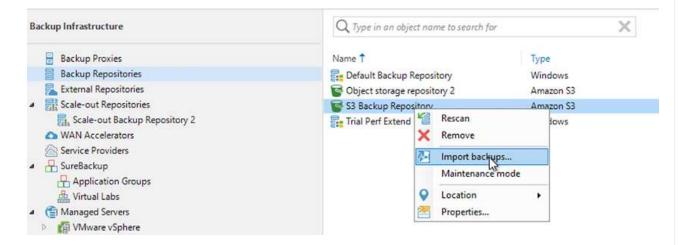
| Name Credentials:<br>Account Manage cloud accounts<br>Bucket<br>Summary Global<br>Use the following gateway server:   |     | account to use for connecting to Amazon S3 storage bucket. | Specify AWS a |
|---|-----|--|---------------|
| Account Manage cloud accounts Bucket Summary  |     | Credentials:   | Name          |
| Bucket AWS region:<br>Global  | Add | 🕅 AKIAX4H43ZT53YJXPY2Y (last edited: 33 days ago)          | Assessment    |
| ummary  |     | Manage cloud accounts                                      | ccount        |
| ummary  |     | AWS region:  | ucket         |
|   |     | Global   |               |
|   |     |  |               |
| EC2AMAZ-3POTKQV (Backup server)   |     | Use the following gateway server:                          |               |
| Select a gateway server to proxy access to Amazon S3. If no gateway server is specified, all<br>backup repository extents must have direct Internet access. |     |  |               |

5. On the Bucket page, enter the data center, bucket, folder, and any desired options. Click Apply.

| Name    | Data center:   |   |
|---------|--|---|
|         | US East (N. Virginia)  |   |
| Account | Bucket:  |   |
| Bucket  | ehcveeamrepo   | Browse                                    |
| Summary | Folder:  |   |
| Junning | 1000   | Browse                                    |
|         | RTP  Limit object storage consumption to: 10  TB This is a soft limit to help control your object storage spend. If the specified lim already running backup offload tasks will be allowed to complete, but no new Make recent backups immutable for: 30  August Protects backups from modification or deletion by ransomware, hackers or modification or deletion by ranso | nit is exceeded,<br>tasks will be started |

To import the backups from the S3 repository that was added in the previous section, complete the following steps.

1. From the S3 backup repository, select Import Backups to launch the Import Backups wizard.



2. After the database records for the import have been created, select Next and then Finish at the summary screen to start the import process.

| 2      | vhile we're preparing object storage repository. |          |
|--------|--|----------|
| nport  | Message  | Duration |
| immary | Starting infrastructure item update process      | 0:00:16  |
|        | Creating database records for repository         | 0:00:04  |
|        |  |          |
|        |  |          |
|        |  |          |
|        |  |          |
|        |  |          |
|        |  |          |
|        |  |          |
|        |  |          |
|        |  |          |
|        |  |          |
|        |  |          |
|        |  |          |
|        |  |          |
|        |  |          |

3. After the import is complete, you can restore VMs into the VMware Cloud cluster.

| nitiated by: EC2AMAZ-3POTKQV\vadmin End time: 4/6/2022 3:04:57 PM  | Name:        | Configuration Database Resynchr  | Status:      | Success             |          |
|--|--------------|--|--------------|---------------------|----------|
| Log       Duration         Message       Duration         Starting backup repositories synchronization       Constraints         Enumerating repositories       Constraints         Found 1 repository       Constraints         Processing capacity tier extent of S3 Backup Repository 2       0:03:23         S3 Backup Repository: added 2 unencrypted       0:03:20         Importing backup 2 out of 2       0:03:15 | Action type: | and the second |              |                     |          |
| Message       Duration         Starting backup repositories synchronization       Duration         Enumerating repositories  | nitiated by: | EC2AMAZ-3P01KQV\vadmin   | End time:    | 4/6/2022 3:04:57 PM |          |
| Starting backup repositories synchronization       Starting backup repositories synchronization         Enumerating repositories       Found 1 repository         Processing capacity tier extent of S3 Backup Repository 2       0:03:23         S3 Backup Repository: added 2 unencrypted       0:03:20         Importing backup 2 out of 2       0:03:15  | Log          |  |              |                     |          |
| C Enumerating repositories         C Found 1 repository         O Processing capacity tier extent of S3 Backup Repository 2         0:03:23         0:03:23         0:03:20         0:Importing backup 2 out of 2  | Message      |  |              |                     | Duration |
| <ul> <li>Found 1 repository</li> <li>Processing capacity tier extent of S3 Backup Repository 2</li> <li>S3 Backup Repository: added 2 unencrypted</li> <li>O:03:20</li> <li>Importing backup 2 out of 2</li> <li>O:03:15</li> </ul>  | Starting b   | packup repositories synchronization  |              |                     |          |
| Processing capacity tier extent of S3 Backup Repository 2       0:03:23         S3 Backup Repository: added 2 unencrypted       0:03:20         Importing backup 2 out of 2       0:03:15  | C Enumera    | ting repositories  |              |                     |          |
| S3 Backup Repository: added 2 unencrypted       0:03:20         Importing backup 2 out of 2       0:03:15  | S Found 1    | repository   |              |                     |          |
| Importing backup 2 out of 2 0:03:15  | Processin    | ng capacity tier extent of S3 Backup Repo  | ository 2    |                     | 0:03:23  |
|  | 🕑 S3 Backu   | p Repository: added 2 unencrypted  |              |                     | 0:03:20  |
| Backup repositories synchronization completed successfully   | 🕑 Importing  | g backup 2 out of 2  |              |                     | 0:03:15  |
|  | 🕑 Backup r   | epositories synchronization completed s  | successfully |                     |          |
|  |              |  |              |                     |          |
|  |              |  |              |                     |          |
|  |              |  |              |                     |          |
|  |              |  |              |                     |          |
|  |              |  |              |                     |          |
|  |              |  |              |                     | Close    |

To restore SQL and Oracle virtual machines to the VMware Cloud on AWS workload domain/cluster, complete the following steps.

1. From the Veeam Home page, select the object storage containing the imported backups, select the VMs to restore, and then right click and select Restore Entire VM.

|                              | azon Microsoft Google<br>C2 Azure laas CE<br>Restore to Cloud Actions | 1   |    |
|------------------------------|---|---|----|
| Home                         | Q Type in an object name to search (                                  | for 🗙   |    |
| Jobs     Backup     Backups  | Job Name 1<br>B Cracle Servers<br>Cracle Servers                      | Creation Time<br>3/27/2022 1:00 AM<br>3/27/2022 1:00 AM | Re |
| (S Object Storage (Imported) | SQLSRV-01   | Instant recovery  | 11 |
| Last 24 Hours                | SQLSRV-02   | Instant disk recovery                                   | 1  |
| Success                      | SQLSRV-04   | Restore entire VM                                       | 1  |
|                              | SQLSRV-05   | Restore virtual disks                                   | 1  |
|                              | SQLSRV-06   | Restore VM files  | 11 |
|                              | SQLSRV-07   | Restore guest files                                     | 1  |
|                              | SQLSRV-08   |   |    |
|                              | SQLSRV-09   | Restore to Amazon EC2                                   |    |
|                              | SQLSRV-10   | Restore to Microsoft Azure                              |    |
|                              |   | Restore to Google CE                                    |    |
|                              |   | Export backup   |    |
|                              |   | 🙀 Delete from disk                                      |    |

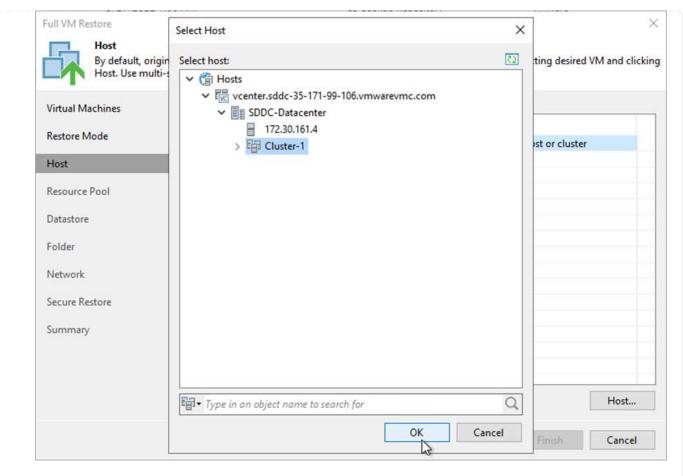
2. On the first page of the Full VM Restore wizard, modify the VMs to backup if desired and select Next.

|               | 151.)   |               | _  |
|---------------|---------|---------------|--|
|               |         | Restore point | Add  |
| (Contraction) | 62.7 GB |               |  |
|               |         |               | Point  |
|               |         |               | Remove   |
|               |         |               |  |
|               |         |               |  |
|               |         |               |  |
|               |         |               |  |
|               |         |               |  |
|               |         |               |  |
|               |         |               | Q         Type in a VM name for instant lookup           Name         Size         Restore point |

3. On the Restore Mode page, select Restore to a New Location, or with Different Settings.

| Full VM Restore                  | ×   |  |  |  |  |
|----------------------------------|---|--|--|--|--|
| Restore Mode<br>Specify whethe   | e<br>er selected VMs should be restored back to the original location, or to a new location or with different settings.   |  |  |  |  |
| Virtual Machines<br>Restore Mode | <ul> <li>Restore to the original location</li> <li>Quickly initiate the restore of selected VM to its original location, with the original name and<br/>settings. This option minimizes the chance of user input error.</li> </ul>            |  |  |  |  |
| Host<br>Resource Pool            | Restore to a new location, or with different settings<br>Customize the restored VM location, and change its settings. The wizard will automatically populate<br>all controls with the original VM settings as the defaults.                   |  |  |  |  |
| Datastore<br>Folder              | Staged restore<br>Run the selected VM directly from backup files in the isolated DataLab to make changes to the<br>guest OS or applications prior to placing the VM into production environment.  |  |  |  |  |
| Network<br>Secure Restore        | Pick proxy to use   |  |  |  |  |
| Summary                          |   |  |  |  |  |
|                                  | Quick rollback (restore changed blocks only)<br>Allows for quick VM recovery in case of guest OS software problem, or user error. Do not use this<br>option when recovering from disaster caused by hardware or storage issue, or power loss. |  |  |  |  |
|                                  | < Previous Next > Finish Cancel   |  |  |  |  |

4. On the host page, select the Target ESXi host or cluster to restore the VM to.

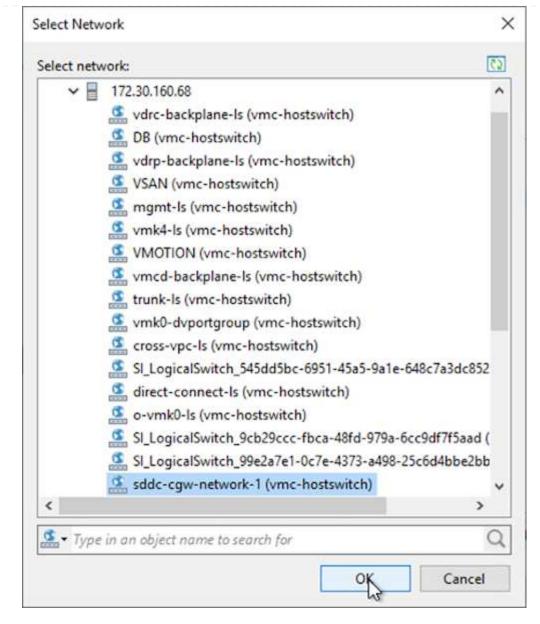


5. On the Datastores page, select the target datastore location for both the configuration files and hard disk.

| Virtual Machines | Files location:                  |        |                       |                  |
|------------------|----------------------------------|--------|-----------------------|------------------|
| Restore Mode     | File GINAL SQLSRV-04             | Size   | Datastore             | Disk type        |
| Host             | Configuration files              |        | WorkloadDatastore (VM |                  |
|                  | 📼 Hard disk 1 (SQLSR             | 100 GB | WorkloadDatastore (VM | Same as source   |
| Resource Pool    |                                  |        |                       |                  |
| Datastore        |                                  |        |                       |                  |
| Folder           |                                  |        |                       |                  |
| Network          |                                  |        |                       |                  |
| Secure Restore   |                                  |        |                       |                  |
| Summary          |                                  |        |                       |                  |
|                  |                                  |        |                       |                  |
|                  |                                  |        |                       |                  |
|                  | Select multiple VMs to apply set |        |                       | atastore Disk Ty |

6. On the Network page, map the original networks on the VM to the networks in the new target location.

| Virtual Machines | Network connections:        |               |  |
|------------------|-----------------------------|---------------|--|
| Restore Mode     | Source                      | Target        |  |
|                  | Management 181 (DSwitch)    | Not connected |  |
| Host             | Data - A - 3374 (DSwitch)   | Not connected |  |
| Resource Pool    | 💁 Data - B - 3375 (DSwitch) | Not connected |  |
| Datastore        |                             |               |  |
| Datastore        |                             |               |  |
| Folder           |                             |               |  |
| Network          |                             |               |  |
| Secure Restore   |                             |               |  |
|                  |                             |               |  |
| Summary          |                             |               |  |
|                  |                             |               |  |
|                  |                             |               |  |
|                  |                             |               |  |



7. Select whether to scan the restored VM for malware, review the summary page, and click Finish to start the restore.

## **Restore SQL Server application data**

The following process provides instructions on how to recover a SQL Server in VMware Cloud Services in AWS in the event of a disaster that renders the on-premises site inoperable.

The following prerequisites are assumed to be complete in order to continue with the recovery steps:

- 1. The Windows Server VM has been restored to the VMware Cloud SDDC using Veeam Full Restore.
- 2. A secondary SnapCenter server has been established and SnapCenter database restore and configuration has been completed using the steps outlined in the section "SnapCenter backup and restore process summary."

After the restore of the VM is complete, you must configure networking and other items in preparation for rediscovering the host VM within SnapCenter.

- 1. Assign new IP addresses for Management and iSCSI or NFS.
- 2. Join the host to the Windows domain.
- 3. Add the hostnames to DNS or to the hosts file on the SnapCenter server.



If the SnapCenter plug-in was deployed using domain credentials different than the current domain, you must change the Log On account for the Plug-in for Windows Service on the SQL Server VM. After changing the Log On account, restart the SnapCenter SMCore, Plug-in for Windows, and Plug-in for SQL Server services.



To automatically rediscover the restored VMs in SnapCenter, the FQDN must be identical to the VM that was originally added to the SnapCenter on premises.

### Configure FSx storage for SQL Server restore

To accomplish the disaster recovery restore process for a SQL Server VM, you must break the existing SnapMirror relationship from the FSx cluster and grant access to the volume. To do so, complete the following steps.

1. To break the existing SnapMirror relationship for the SQL Server database and log volumes, run the following command from the FSx CLI:

FSx-Dest::> snapmirror break -destination-path DestSVM:DestVolName

2. Grant access to the LUN by creating an initiator group containing the iSCSI IQN of the SQL Server Windows VM:

FSx-Dest::> igroup create -vserver DestSVM -igroup igroupName
-protocol iSCSI -ostype windows -initiator IQN

3. Finally, map the LUNs to the initiator group that you just created:

```
FSx-Dest::> lun mapping create -vserver DestSVM -path LUNPath igroup
igroupName
```

4. To find the path name, run the lun show command.

#### Set up the Windows VM for iSCSI access and discover the file systems

- 1. From the SQL Server VM, set up your iSCSI network adapter to communicate on the VMware Port Group that has been established with connectivity to the iSCSI target interfaces on your FSx instance.
- 2. Open the iSCSI Initiator Properties utility and clear out the old connectivity settings on the Discovery, Favorite Targets, and Targets tabs.
- 3. Locate the IP address(es) for accessing the iSCSI logical interface on the FSx instance/cluster. This can be found in the AWS console under Amazon FSx > ONTAP > Storage Virtual Machines.

| Endpoints  |   |
|--|---|
| Management DNS name<br>svm-045c077375d3d9799.fs-0ae40e08acc0dea67.fsx.us-east-1.amazonaws.com  | Management IP address 198.19.254.53               |
| NFS DNS name svm-045c077375d3d9799.fs-0ae40e08acc0dea67.fsx.us-east-1.amazonaws.com            | NFS IP address 198.19.254.53                      |
| iSCSI DNS name<br>iscsi.svm-045c077375d3d9799.fs-0ae40e08acc0dea67.fsx.us-east-1.amazonaws.com | iSCSI IP addresses<br>172.30.15.101, 172.30.14.49 |

4. From the Discovery tab, click Discover Portal and enter the IP addresses for your FSx iSCSI targets.

| SCSI Init | iator Proper                | ties                              |                     |        |               | × |
|-----------|-----------------------------|-----------------------------------|---------------------|--------|---------------|---|
| Targets   | Discovery                   | Favorite Targets                  | Volumes and Devices | RADIUS | Configuration |   |
|           | t portals<br>system will lo | ok for Targets on fo              | blowing portals:    |        | Refresh       |   |
| Addr      | ess                         | Port                              | Adapter             | I      | P address     |   |
| To ac     | id <mark>a</mark> target p  | ortal, <mark>dick Discover</mark> | Portal.             | Disco  | over Portal   |   |
|           | move a targ<br>dick Remove  |                                   | address above and   |        | Remove        |   |

| Discover Target Portal                                 |   |
|--|---|
| Enter the IP address or DNS name want to add.          | and port number of the portal you       |
| To change the default settings of the Advanced button. | he discovery of the target portal, dick |
|  |   |
| IP address or DNS name:                                | Port: (Default is 3260.)                |

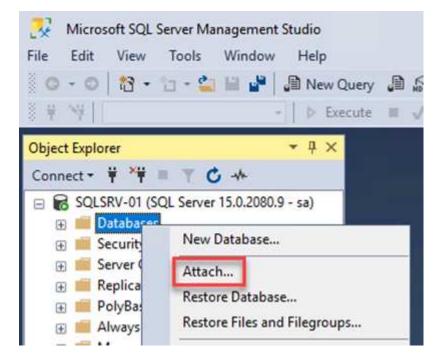
5. On the Target tab, click Connect, select Enable Multi-Path if appropriate for your configuration and then click OK to connect to the target.

| argets                                       | Discovery   | Favorite Targets  | Volumes and Devices  | RADIUS     | Configuration |  |
|--|---|---|--|------------|---------------|--|
|  | Connect   |   |  |            |               |  |
|  |   | g on to a target usir<br>arget and then click   | ng a basic connection, to<br>Quick Connect.                              | ype the IP | address or    |  |
| Target                                       | :   |   |  | Q          | iidk Connect  |  |
| Discove                                      | ered targets  |   |  |            |               |  |
|  |   |   |  |            | Refresh       |  |
| Name   |   |   |  | Status     |               |  |
| ign, 19                                      | 992-08.com.   | netapp:sn.5918b03   | 3f9ef411ecb007495  | Inactive   |               |  |
|  |   |   |  |            |               |  |
|  |   |   |  |            | 1             |  |
|  |   | dvanced options, s  | elect a target and then  |            | Connect       |  |
|  | nect using a  | dvanced options, s  | elect a target and then  |            | 1<br>Connect  |  |
| dick Co                                      |   |   | elect a target and then  |            | 1<br>Connect  |  |
| dick Co                                      | onnect.   |   | elect a target and then  |            |               |  |
| dick Co<br>To Co<br>th Co                    | onnect.<br>onnect To Ta<br>orget name:  | arget   |  |            |               |  |
| click Co<br>To<br>Co<br>Fo<br>Fo<br>Fo<br>Fo | onnect.<br>onnect To Ta<br>orget name:  | arget   | elect a target and then<br>9ef411ecb0074956fb75                          | f45c:vs.6  |               |  |
| dick Co<br>Tc Co<br>Fc Ta<br>Se 19<br>Fc 19  | onnect.<br>onnect To Ta<br>rget name:<br>2-08.com.ne<br>Add this con<br>This will mak | arget<br>tapp:sn.5918b03f9  | 9ef411ecb0074956fb75<br>f Favorite Targets.<br>natically attempt to rest |            |               |  |
| dick Co<br>To Co<br>Fo Ta<br>Se 19<br>Fo Th  | onnect.<br>onnect To Ta<br>rget name:<br>2-08.com.ne<br>Add this con<br>This will mak | etapp:sn. 5918b03f9<br>nection to the list of<br>the system autor<br>every time this comp | 9ef411ecb0074956fb75<br>f Favorite Targets.<br>natically attempt to rest |            |               |  |

6. Open the Computer Management utility and bring the disks online. Verify that they retain the same drive letters that they previously held.

| Basic<br>579.98 GB<br>Online | MSSQL_DATA (E:)<br>579.98 GB NTFS<br>Healthy (Primary Partition) |         |
|------------------------------|--|---------|
| *O Disk 2<br>Basic           |  |         |
| 99.98 GB<br>Offline          | Online   |         |
|                              | Properties   |         |
| CD-ROM                       | Help   | 1. Test |

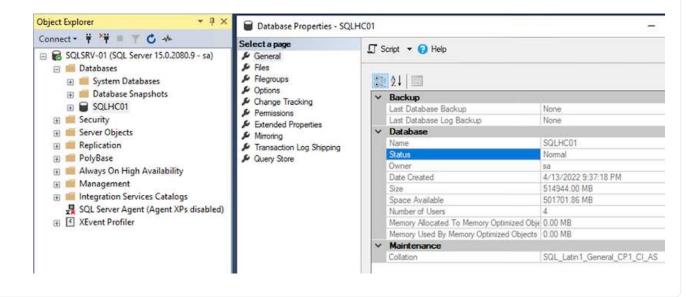
1. From the SQL Server VM, open Microsoft SQL Server Management Studio and select Attach to start the process of connecting to the database.



2. Click Add and navigate to the folder containing the SQL Server primary database file, select it, and click OK.

| Locate Database Files - So   | QLSRV-01     |                    |            | 1.11            |    | × |
|--|--------------|--------------------|------------|-----------------|----|---|
| Database Data File location:   | E:\MSSQL 20  | )19\MSSQL15.MSSQLS | ERVEF 🖒    |                 |    | 2 |
| C:<br>SRECYCLE.BIN<br>SRECYCLE.BIN<br>MSSQL 2019<br>MSSQL 15.MSS<br>MSSQL<br>DATA<br>System Volume Infor |              | SQLHC01_01.md      | 2          |                 |    |   |
| 1.   |              |                    |            |                 |    |   |
|  | LHC01_01.mdf |                    | Database D | )ata Files(*.md | f) |   |

- 3. If the transaction logs are on a separate drive, choose the folder that contains the transaction log.
- 4. When finished, click OK to attach the database.



With the SnapCenter database restored to its previous state, it automatically rediscovers the SQL Server hosts. For this to work correctly, keep in mind the following prerequisites:

- SnapCenter must be placed in Disaster Recover mode. This can be accomplished through the Swagger API or in Global Settings under Disaster Recovery.
- The FQDN of the SQL Server must be identical to the instance that was running in the on-premises datacenter.
- The original SnapMirror relationship must be broken.
- The LUNs containing the database must be mounted to the SQL Server instance and the database attached.

To confirm that SnapCenter is in Disaster Recovery mode, navigate to Settings from within the SnapCenter web client. Go to the Global Settings tab and then click Disaster Recovery. Make sure that the Enable Disaster Recovery checkbox is enabled.

|          | letApp Snap(    | Center®                                   |
|----------|-----------------|---|
| <        |                 | Global Settings Policies Users and Access |
|          | Dashboard       |   |
| 9        | Resources       | Global Settings                           |
|          | Monitor         |   |
| <b>M</b> | Reports         | Hypervisor Settings ()                    |
| A        | Hosts           | Notification Server Settings 🚯            |
| ł        | Storage Systems | Configuration Settings ()                 |
| ÷        | Settings        | Purge Jobs Settings                       |
| A        | Alerts          | Domain Settings 🚯                         |
|          |                 | CA Certificate Settings ()                |
|          |                 | Disaster Recovery                         |
|          |                 | Senable Disaster Recovery Apply           |
|          |                 |   |

## **Restore Oracle application data**

The following process provides instructions on how to recover Oracle application data in VMware Cloud Services in AWS in the event of a disaster that renders the on-premises site inoperable.

Complete the following prerequisites to continue with the recovery steps:

- 1. The Oracle Linux server VM has been restored to the VMware Cloud SDDC using Veeam Full Restore.
- 2. A secondary SnapCenter server has been established and the SnapCenter database and configuration files have been restored using the steps outlined in this section "SnapCenter backup and restore process summary."

To make the secondary storage volumes hosted on the FSxN instance accessible to the Oracle servers, you must first break the existing SnapMirror relationship.

1. After logging into the FSx CLI, run the following command to view the volumes filtered by the correct name.

```
FSx-Dest::> volume show -volume VolumeName*
FsxId0ae40e08acc0dea67::> volume show -volume oraclesrv 03*
Vserver
         Volume
                      Aggregate
                                   State
                                              Type
                                                         Size Available Used%
ora svm dest
         oraclesrv_03_u01_dest
                      aggrl
                                   online
                                              DP
                                                        100GB
                                                                 93.12GB
                                                                            6%
ora svm dest
         oraclesrv_03_u02_dest
                      aggrl
                                   online
                                              DP
                                                        200GB
                                                                 34.98GB
                                                                            82%
ora svm dest
         oraclesrv 03 u03 dest
                      aggrl
                                              DP
                                                        150GB
                                                                 33.37GB
                                                                            778
                                   online
3 entries were displayed.
FsxId0ae40e08acc0dea67::>
```

2. Run the following command to break the existing SnapMirror relationships.

FSx-Dest::> snapmirror break -destination-path DestSVM:DestVolName

```
FsxId0ae40e08acc0dea67::> snapmirror break -destination-path ora_svm_dest:oraclesrv_03_u02_dest
Operation succeeded: snapmirror break for destination "ora_svm_dest:oraclesrv_03_u02_dest".
FsxId0ae40e08acc0dea67::> snapmirror break -destination-path ora_svm_dest:oraclesrv_03_u03_dest
```

Operation succeeded: snapmirror break for destination "ora svm dest:oraclesrv 03 u03 dest".

3. Update the junction-path in the Amazon FSx web client:

FSx > Volumes > fsvol-01167370e9b7aefa0 oraclesrv\_03\_u01\_dest (fsvol-01167370e9b7aefa0) Attach Actions 🔺 Update volume Summary Create backup Delete volume Volume ID Creation time SVM ID 2022-03-08T14:52:09-05:00 svm-02b2ad25c6b2e5bc2 fsvol-01167370e9b7aefa0 🗇 Lifecycle state Junction path Volume name ⊘ Created - 🗇 oraclesrv\_03\_u01\_dest Volume type Tiering policy name UUID ONTAP SNAPSHOT\_ONLY 3d7338ce-9f19-11ecb007-4956fb75f45c Size Tiering policy cooling period (days) 100.00 GB 🗇 2 File system ID fs-0ae40e08acc0dea67 Storage efficiency enabled Disabled **Resource ARN** arn:aws:fsx:useast-1:541696183547:volume/fs-0ae40e08acc0dea67/fsvol-01167370e9b7aefa0 🗇

4. Add the junction path name and click Update. Specify this junction path when mounting the NFS volume from the Oracle server.

# Update volume

## Junction path

# /oraclesrv\_03\_u01\_dest

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

#### Volume size

102400

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.

| You can optionally enable automatic tiering of your data to lowe |                                |
|--|--------------------------------|
| Snapshot Only  | er-cost capacity pool storage. |
| Shapshot Only  |                                |
|  |                                |

\$

In Cloud Manager, you can obtain the mount command with the correct NFS LIF IP address for mounting the NFS volumes that contain the Oracle database files and logs.

1. In Cloud Manager, access the list of volumes for your FSx cluster.

| HCApps | Overview Volume:            | S                          |              |           |
|--------|-----------------------------|----------------------------|--------------|-----------|
|        | 50 Volumes<br>Volume Name ÷ | State ÷                    | Storage VM 🔹 | Disk Type |
|        | oraclesrv_02_<br>u02_dest   | <ul> <li>Online</li> </ul> | ora_svm_dest | SSD       |
|        | oraclesrv_02_<br>u03_dest   | • Online                   | ora_svm_dest | SSD       |
|        | oraclesrv_03_<br>u01_dest   | <ul> <li>Online</li> </ul> | ora_svm_dest | SSD       |

2. From the action menu, select Mount Command to view and copy the mount command to be used on our Oracle Linux server.

| Account ~                   | Information   | or 🗸  |        |
|-----------------------------|---|-------|--------|
|                             | Edit  |       |        |
|                             | Clone   |       |        |
|                             | Restore from Snapshot copy  |       |        |
|                             | Create a Snapshot copy  |       |        |
| Capacity Pool Us            | Mount Command   |       |        |
| 0 B                         | Change Tiering Policy   |       |        |
| 0 B                         | Delete  |       |        |
|                             | Snapshot  |       |        |
| Go to your linux m          | Mount Volume NFS<br>oraclesrv_03_u01_dest<br>achine and enter this mount comm                       | nand  |        |
| Mount Command               |   |       |        |
| mount 198.19.2              | 54.180:/oraclesrv_03_u01_dest <d< td=""><td>est_d</td><td>🗇 Сору</td></d<>                          | est_d | 🗇 Сору |
| <u></u>                     |   |       |        |
| already exist on the Oracle | to the Oracle Linux Server. The directorie<br>Linux host.<br>er, use the mount command to mount the |       |        |

FSx-Dest::> mount -t oracle server ip:/junction-path

Repeat this step for each volume associated with the Oracle databases.



To make the NFS mount persistent upon rebooting, edit the /etc/fstab file to include the mount commands.

5. Reboot the Oracle server. The Oracle databases should start up normally and be available for use.

#### Failback

Upon successful completion of the failover process outlined in this solution, SnapCenter and Veeam resume their backup functions running in AWS, and FSx for ONTAP is now designated as primary storage with no existing SnapMirror relationships with the original on-premises datacenter. After normal function has resumed on premises, you can use a process identical to the one outlined in this documentation to mirror data back to the on-premises ONTAP storage system.

As is also outlined in this documentation, you can configure SnapCenter to mirror the application data volumes from FSx for ONTAP to an ONTAP storage system residing on premises. Similarly, you can configure Veeam to replicate backup copies to Amazon S3 using a scale-out backup repository so that those backups are accessible to a Veeam backup server residing at the on-premises datacenter.

Failback is outside the scope of this documentation, but failback differs little from the detailed process outlined here.

#### Conclusion

The use case presented in this documentation focuses on proven disaster recovery technologies that highlight the integration between NetApp and VMware. NetApp ONTAP storage systems provide proven data-mirroring technologies that allow organizations to design disaster recovery solutions that span on-premises and ONTAP technologies residing with the leading cloud providers.

FSx for ONTAP on AWS is one such solution that allows for seamless integration with SnapCenter and SyncMirror for replicating application data to the cloud. Veeam Backup & Replication is another well-known technology that integrates well with NetApp ONTAP storage systems and can provide failover to vSphere-native storage.

This solution presented a disaster recovery solution using guest connect storage from an ONTAP system hosting SQL Server and Oracle application data. SnapCenter with SnapMirror provides an easy-to-manage solution for protecting application volumes on ONTAP systems and replicating them to FSx or CVO residing in the cloud. SnapCenter is a DR-enabled solution for failing over all application data to VMware Cloud on AWS.

#### Where to find additional information

To learn more about the information that is described in this document, review the following documents and/or websites:

· Links to solution documentation

NetApp Hybrid Multicloud with VMware Solutions

## Veeam Backup & Restore in VMware Cloud, with Amazon FSx for ONTAP

Veeam Backup & Replication is an effective and reliable solution for protecting data in VMware Cloud. This solution demonstrates the proper setup and configuration for using Veeam Backup and Replication to backup and restore application VMs residing on FSx for ONTAP NFS datastores in VMware Cloud.

Author: Josh Powell - NetApp Solutions Engineering

## Overview

VMware Cloud (in AWS) supports the use of NFS datastores as supplemental storage, and FSx for NetApp ONTAP is a secure solution for customers who need to store large amounts of data for their cloud applications that can scale independent of the number of ESXi hosts in the SDDC cluster. This integrated AWS storage service offers highly efficient storage with all of the traditional NetApp ONTAP capabilities.

## **Use Cases**

This solution addresses the following use cases:

- Backup and restore of Windows and Linux virtual machines hosted in VMC using FSx for NetApp ONTAP as a backup repository.
- Backup and restore of Microsoft SQL Server application data using FSx for NetApp ONTAP as a backup repository.
- Backup and restore of Oracle application data using FSx for Netapp ONTAP as a backup repository.

## NFS Datastores Using Amazon FSx for ONTAP

All virtual machines in this solution reside on FSx for ONTAP supplemental NFS datastores. Using FSx for ONTAP as a supplemental NFS datastore has several benefits. For example, it allows you to:

- Create a scalable and highly available file system in the cloud without the need for complex setup and management.
- Integrate with your existing VMware environment, allowing you to use familiar tools and processes to manage your cloud resources.
- Benefit from the advanced data management features provided by ONTAP, such as snapshots and replication, to protect your data and ensure its availability.

This list provides the high level steps necessary to configure Veeam Backup & Replication, execute backup and restore jobs using FSx for ONTAP as a backup repository, and perform restores of SQL Server and Oracle VMs and databases:

- 1. Create the FSx for ONTAP file system to be used as iSCSI backup repository for Veeam Backup & Replication.
- 2. Deploy Veeam Proxy to distribute backup workloads and mount iSCSI backup repositories hosted on FSx for ONTAP.
- 3. Configure Veeam Backup Jobs to backup SQL Server, Oracle, Linux and Windows virtual machines.
- 4. Restore SQL Server virtual machines and individual databases.
- 5. Restore Oracle virtual machines and individual databases.

#### Prerequisites

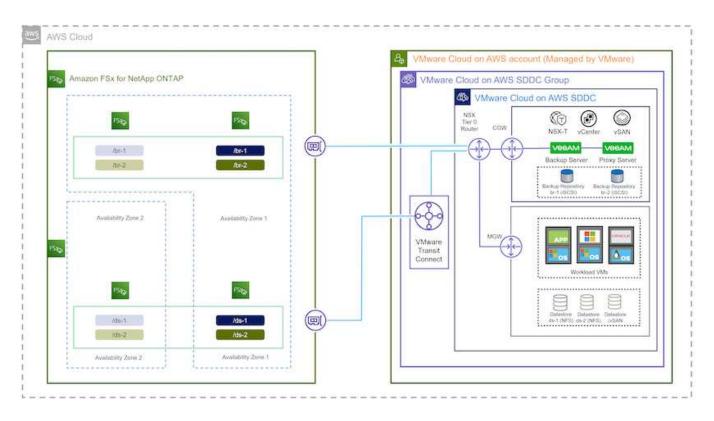
The purpose of this solution is to demonstrate data protection of virtual machines running in VMware Cloud and located on NFS Datastores hosted by FSx for NetApp ONTAP. This solution assumes the following components are configured and ready for use:

- 1. FSx for ONTAP filesystem with one or more NFS datastores connected to VMware Cloud.
- 2. Microsoft Windows Server VM with Veeam Backup & Replication software installed.
  - vCenter server has been discovered by the Veeam Backup & Replication server using their IP address or fully qualified domain name.
- 3. Microsoft Windows Server VM to be installed with Veeam Backup Proxy components during the solution deployment.
- 4. Microsoft SQL Server VMs with VMDKs and application data residing on FSx for ONTAP NFS datastores. For this solution we had two SQL databases on two separate VMDKs.
  - Note: As a best practice database and transaction log files are placed on separate drives as this will improve performance and reliability. This is in part due to the fact that transaction logs are written sequentially, whereas database files are written randomly.
- 5. Oracle Database VMs with VMDKs and application data residing on FSx for ONTAP NFS datastores.
- 6. Linux and Windows file server VMs with VMDKs residing on FSx for ONTAP NFS datastores.
- 7. Veeam requires specific TCP ports for communication between servers and components in the backup environment. On Veeam backup infrastructure components, the required firewall rules are automatically created.

For a full listing of the network port requirements refer to the Ports section of the Veeam Backup and Replication User Guide for VMware vSphere.

#### **High Level Architecture**

The testing / validation of this solution was performed in a lab that may or may not match the final deployment environment. For more information, please refer to the following sections.



## Hardware / Software Components

The purpose of this solution is to demonstrate data protection of virtual machines running in VMware Cloud and located on NFS Datastores hosted by FSx for NetApp ONTAP. This solution assumes the following components are already configured and ready for use:

- · Microsoft Windows VM's located on an FSx for ONTAP NFS Datastore
- · Linux (CentOS) VM's located on an FSx for ONTAP NFS Datastore
- Microsoft SQL Server VM's located on an FSx for ONTAP NFS Datastore
  - Two databases hosted on separate VMDK's
- Oracle VM's located on an FSx for ONTAP NFS Datastore

#### **Solution Deployment**

In this solution we provide detailed instructions for deploying and validating a solution utilizing Veeam Backup and Replication software to perform backup and recovery of SQL Server, Oracle, and Windows and Linux file server virtual machines in a VMware Cloud SDDC on AWS. The Virtual Machines in this solution reside on a supplemental NFS datastore hosted by FSx for ONTAP. In addition, a separate FSx for ONTAP file system is used to host iSCSI volumes that will be used for Veeam backup repositories.

We will go over FSx for ONTAP file system creation, mounting iSCSI volumes to be used as backup repositories, creating and running backup jobs, and performing VM and database restores.

For detailed information on FSx for NetApp ONTAP refer to the FSx for ONTAP User Guide.

For detailed information on Veeam Backup and Replication refer to the Veeam Help Center Technical Documentation site.

For considerations and limitations when using Veeam Backup and Replication with VMware Cloud on AWS, refer to VMware Cloud on AWS and VMware Cloud on Dell EMC Support. Considerations and Limitations.

## **Deploy Veeam Proxy server**

A Veeam proxy server is a component of the Veeam Backup & Replication software that acts as an intermediary between the source and the backup or replication target. The proxy server helps to optimize and accelerate data transfer during backup jobs by processing data locally and can use different Transport Modes to access data using VMware vStorage APIs for Data Protection or through direct storage access.

When choosing a Veeam proxy server design it is important to consider the number of concurrent tasks and the transport mode or type of storage access desired.

For sizing the number of proxy servers, and for their system requirements, refer to the Veeam VMware vSphere Best Practice Guide.

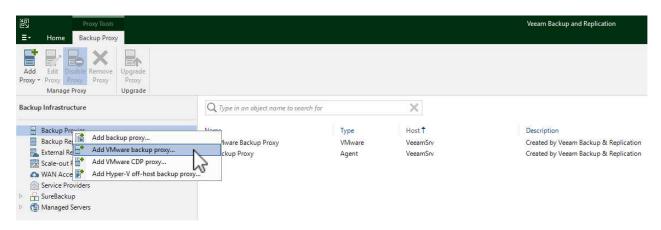
The Veeam Data Mover is a component of the Veeam Proxy Server and utilizes a Transport Mode as a method for obtaining VM data from the source and transferring it to the target. The transport mode is specified during the configuration of the backup job. It is possible to increase the efficiency backups from NFS datastores by using direct storage access.

For more information on Transport Modes refer to the Veeam Backup and Replication User Guide for VMware vSphere.

In the following step we cover deployment of the Veeam Proxy Server on a Windows VM in the VMware Cloud SDDC.

In this step the Veeam Proxy is deployed to an existing Windows VM. This allows backup jobs to be distributed between the primary Veeam Backup Server and the Veeam Proxy.

- 1. On the Veeam Backup and Replication server, open the administration console and select **Backup Infrastructure** in the lower left menu.
- 2. Right click on Backup Proxies and click on Add VMware backup proxy... to open the wizard.



3. In the Add VMware Proxy wizard click the Add New... button to add a new proxy server.

| erver        | Choose server:                    | _        |
|--------------|-----------------------------------|----------|
|              | VeeamSrv (Backup server)          | Add New. |
| raffic Rules | Proxy description:                | -        |
| ummary       |                                   |          |
|              | Transport mode:                   | 1.41     |
|              | Automatic selection               | Choose   |
|              | Connected datastores:             |          |
|              | Automatic detection (recommended) | Choose   |
|              | Max concurrent tasks:             |          |

• Fill out the DNS name or IP address

4.

- $\circ$  Select an account to use for Credentials on the new system or add new credentials
- Review the components to be installed and then click on Apply to begin the deployment

| Vame        | Message   | Duration |
|-------------|---|----------|
| Credentials | Starting infrastructure item update process             | 0:00:03  |
| reactions   | Collecting hardware info                                |          |
| eview       | Detecting operating system                              |          |
|             | 🕐 Detecting OS version                                  |          |
| Apply       | 🖉 Creating temporary folder                             |          |
|             | Package VeeamTransport.msi has been uploaded            | 0:00:05  |
| ummary      | Package VeeamGuestAgent_x86.msi has been uploaded       |          |
|             | 💙 Package VeeamGuestAgent_x64.msi has been uploaded     |          |
|             | Package VeeamLogBackupService_x86.msi has been uploaded | 0:00:01  |
|             | Package VeeamLogBackupService_x64.msi has been uploaded |          |
|             | Installing package Transport                            | 0:00:19  |
|             |   |          |
|             |   |          |
|             |   |          |
|             |   |          |
|             |   |          |

5. Back in the **New VMware Proxy** wizard, choose a Transport Mode. In our case we chose **Automatic Selection**.

| Choose a se             | Transport Mode  | x<br>ux servers added to the |
|-------------------------|---|------------------------------|
| Managed Se              | Backup proxy transport mode:  | lux servers added to the     |
| Server<br>Traffic Rules | Automatic selection<br>Data retrieval mode is selected automatically by analyzing backup proxy<br>configuration and reachable VMFS and NFS datastores. Transport modes<br>allowing for direct storage access will be used whenever possible.  | 2/2022 9 ~ Add New           |
| Apply<br>Summary        | <ul> <li>Direct storage access         Data is retrieved directly from shared storage, without impacting production hosts. For block storage, backup proxy server must be connected into SAN fabric via hardware or software HBA, and have VMFS volumes mounted.     </li> <li>Virtual appliance         Data is retrieved directly from storage through hypervisor I/O stack by hot adding backed up virtual disks to a backup proxy VM. Datastores containing protected VMs must be connected to a host running backup proxy VM.     </li> <li>Network         Data is retrieved from storage through hypervisor network stack using NBD protocol over host management interface. This mode has no special setup requirements. Recommended for 10 Gb Ethernet or faster.     </li> <li>Options              Failover to network mode if primary mode fails, or is unavailable             Enable host to proxy traffic encryption in Network mode (NBDSSL)      </li> </ul> | Choose                       |

6. Select the Connected datastores that you want the VMware Proxy to have direct access to.

#### New VMware Proxy

#### Server

Choose a server for VMware backup proxy. You can choose between any Microsoft Windows or Linux servers added to the Managed Servers which are not assigned a VMware backup proxy role already.

| Server        | Choose server:   |         |
|---------------|--|---------|
|               | veeamproxy.demozone.com (Created by VEEAMSRV\Administrator at 12/22/2022 9 🗸 | Add New |
| Traffic Rules | Proxy description:   |         |
| Apply         | Created by VEEAMSRV\Administrator at 12/22/2022 9:11 PM.                     |         |
| ~             |  |         |
| Summary       |  |         |
| Summary       | Transport mode:  |         |
| Summary       | Transport mode:<br>Direct storage access                                     | Choose  |
| Summary       |  | Choose  |

199

X

| Select objects:    |   | [        | to er |  |
|--------------------|---|----------|-------|--|
| 🗸 😭 Hosts and Disk | s<br>Ic-52-3 <mark>4-17</mark> -99.vmwarevmc.co | m        | )21   |  |
|                    |   |          |       |  |
|                    |   |          |       |  |
| Type in an object  | name to search for                              |          | a     |  |
|                    | 0   | K Cancel |       |  |

7. Configure and apply any specific network traffic rules such as encryption or throttling that are desired. When complete click on the **Apply** button to complete the deployment.

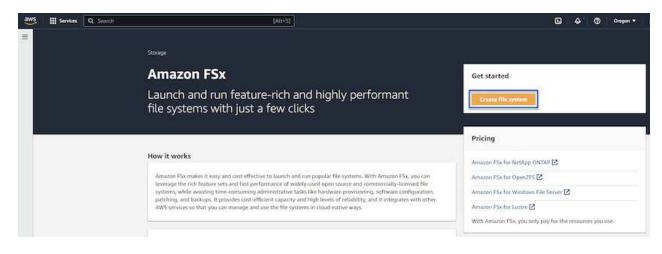
| Server        | Network traffic rules<br>Throttling is global, | s control encryption an<br>with set bandwidth spl | d throttling of<br>it equally acro | network traffic based o<br>ss all backup proxies fa | on the destination.<br>Iling into the rule. |
|---------------|--|---|------------------------------------|---|---|
| Traffic Rules | The following netwo                            | ork traffic rules ap <mark>ply</mark> to          | this proxy:                        |   |   |
| Apply         | Name   | Encryption<br>Enabled                             | Throttling<br>Disabled             | Time period   | Wiene                                       |
| Summary       |  |   |                                    |   |   |
|               | Manage network tra                             | ffic rules  |                                    |   |   |
|               |  |   |                                    |   |   |
|               |  |   |                                    |   |   |
|               |  |   |                                    |   |   |
|               |  |   |                                    |   |   |

## Configure storage and Backup Repositories

The primary Veeam Backup server and Veeam Proxy server have access to a backup repository in the form of direct connected storage. In this section we cover creating an FSx for ONTAP file system, mounting iSCSI LUNs to the Veeam servers and creating Backup Repositories.

Create an FSx for ONTAP file system that will be used to host the iSCSI volumes for the Veeam Backup Repositories.

1. In the AWS console, Go to FSx and then **Create file system** 



2. Select Amazon FSx for NetApp ONTAP and then Next to continue.

| Amazon F5x for NetApp ONTAP  | <ul> <li>Amazon FSx for OpenZFS</li> </ul>  | Amazon FSx for Windows File Server   | <ul> <li>Amazon FSx for Lustre</li> </ul>                   |
|--|---|--|---|
| FSXa   | FSX <sub>z=</sub>   | FSx□   | FSX   |
| Amazon FSx<br>for NetApp ONTAP   | Amazon FSx<br>for OpenZFS   | Amazon FSx<br>for Windows File Server  | Amazon FSx<br>for Lustre                                    |
| and a second contraction of the second secon | use-rich high-noclormance and highly-reliable   | torage built on NetApp's popular ONTAP file system and   | I fully managed by AWS.                                     |
|  |   | nning on AWS or on-premises) via industry-standard NF  |   |
| Broadly accessible from Linux, Windows, ar<br>Provides ONTAP's popular data manageme   | nd macOS compute instances and containers (ru<br>int capabilities like Snapshots, SnapMirror (for d   | nning on AWS or on-premises) via industry-standard NF<br>ata replication), FlexClone (for data cloning), and data co                             | 5, SMB, and iSCSI protocols.                                |
| Broadly accessible from Linux, Windows, an<br>Provides ONTAP's popular data manageme<br>Delivers hundreds of thousands of IOPS wi  | nd macOS compute instances and containers (nu<br>int capabilities like Snapshots, SnapMirror (for d<br>th consistent sub-millisecond latencies, and up 1  | nning on AWS or on-premises) via industry-standard NF<br>ata replication), FlexClone (for data cloning), and data co<br>to 3 GB/s of throughput. | 5, SMB, and iSCSI protocols.                                |
| Broadly accessible from Linux, Windows, an<br>Provides ONTAP's popular data manageme<br>Delivers hundreds of thousands of IOPS wi<br>Offers highly-available and highly-durable  | nd macOS compute instances and containers (nu<br>ent capabilities like Snapshots, SnapMirror (for d<br>th consistent sub-millisecond latencies, and up i<br>multi-AZ SSD storage with support for cross-ree | nning on AWS or on-premises) via industry-standard NF<br>ata replication), FlexClone (for data cloning), and data co                             | S, SMB, and ISCSI protocols.<br>impression / deduplication. |

3. Fill in the file system name, deployment type, SSD storage capacity and the VPC in which the FSx for ONTAP cluster will reside. This must be a VPC configured to communicate with the virtual machine network in VMware Cloud. Click on **Next**.

| Creation method   |  |
|---|--|
| Quick create<br>Use recommended best-practice configurations. Most<br>configuration options can be changed after the file<br>system is created. | Standard create<br>You set all of the configuration options, including<br>specifying performance, networking, security, backups,<br>and maintenance. |
| Quick configuration   |  |
| File system name - optional Info BackupFSxN   |  |
| Maximum of 256 Unicode letters, whitespace, and numbers, plus +   | -=:/   |
| Deployment type Info O Multi-AZ Single-AZ   |  |
| SSD storage capacity Info<br>4096 GiB<br>Minimum 1024 GiB; Maximum 192 TiB  |  |
| Virtual Private Cloud (VPC) Info  |  |
| Specify the VPC from which your file system is accessible.<br>Demo-FsxforONTAP-VPC   vpc-05596abe79cb653b7                                      | <b> ▲</b>  |
| Storage efficiency<br>Select whether you would like to enable ONTAP's storage efficiency<br>Enabled (recommended)                               | y features: deduplication, compression, and compaction   |
| ) Disabled  |  |

4. Review the deployment steps and click on **Create File System** to begin the file system creation process.

Create and configure the iSCSI LUNs on FSx for ONTAP and mount to the Veeam backup and proxy servers. These LUNs will later be used to create Veeam backup repositories.



Creating an iSCSI LUN on FSx for ONTAP is a multi-step process. The first step of creating the volumes can be accomplished in the Amazon FSx Console or with the NetApp ONTAP CLI.



For more information on using FSx for ONTAP, see the FSx for ONTAP User Guide.

1. From the NetApp ONTAP CLI create the initial volumes using the following command:

```
FSx-Backup::> volume create -vserver svm_name -volume vol_name
-aggregate aggregate_name -size vol_size -type RW
```

2. Create LUNs using the volumes created in the previous step:

```
FSx-Backup::> lun create -vserver svm_name -path
/vol/vol_name/lun_name -size size -ostype windows -space-allocation
enabled
```

3. Grant access to the LUNs by creating an initiator group containing the iSCSI IQN of the Veeam backup and proxy servers:

FSx-Backup::> igroup create -vserver svm\_name -igroup igroup\_name
-protocol iSCSI -ostype windows -initiator IQN



To complete the preceding step you will need to first retrieve the IQN from the iSCSI initiator properties on the Windows servers.

4. Finally, map the LUNs to the initiator group that you just created:

```
FSx-Backup::> lun mapping create -vserver svm_name -path
/vol/vol_name/lun_name igroup igroup_name
```

5. To mount the iSCSI LUNs, log into the Veeam Backup & Replication Server and open iSCSI Initiator Properties. Go to the **Discover** tab and enter the iSCSI target IP address.

| scover Target Portal   | × <sub>infigur</sub>   | ation |
|--|------------------------|-------|
| nter the IP address or DNS name and port number of the por<br>ant to add.          | resh                   |       |
| change the default settings of the discovery of the target p<br>e Advanced button. | oortal, dick<br>Idress |       |
| address or DNS name: Port: (Default is 3   | 260.)                  |       |
| 0.49.0.154 3260  |                        |       |
| Advanced OK  | Cancel                 | h;    |
| then dick Remove.  | Remove                 |       |
| SNS servers  |                        |       |
| The system is registered on the following iSNS servers:                            | Refresh                |       |
| Name   |                        |       |
|  |                        |       |
| To add an iSNS server, dick Add Server.  | Add Server             |       |

6. On the **Targets** tab, highlight the inactive LUN and click on **Connect**. Check the **Enable multi-path** box and click on **OK** to connect to the LUN.

| irgets Discovery   | Favorite Targets                               | Volumes and Devices                           | RADIUS     | Configuration         |  |
|--|--|---|------------|-----------------------|--|
| Quick Connect  |  |   |            |                       |  |
| To discover and k<br>DNS name of the   | g on to a target usir<br>target and then click | ng a basic connection, t<br>Quick Connect.    | ype the IP | address or            |  |
| Target:  |  |   | Qu         | iid: Connect          |  |
| Discovered target  | s (;   |   | E.         | 8 M.                  |  |
|  |  |   |            | Refresh               |  |
| Name   |  |   | Status     |                       |  |
| 0.0223042  | .netapp:sn.d9aad3c                             | d818011edbfcd87a                              | 20020465   |                       |  |
| iqn. 1992-08.com   | 4. 55  | 10 0.001                                      | Inactive   | -                     |  |
| iqn. 1992-08.com   | 4. 55  | d818011edbfcd87a<br>elect a target and then   | Inactive   | Connect               |  |
| iqn. 1992-08.com<br>To connect using<br>dick Connect.  | advanced options, se                           | elect a target and then                       | Inactive   | Connect<br>Disconnect |  |
| To connect using<br>dick Connect.<br>To completely dist<br>then click Disconn<br>For target proper | advanced options, se                           | elect a target and then<br>ect the target and | Inactive   |                       |  |

7. In the Disk Management utility initialize the new LUN and create a volume with the desired name and drive letter. Check the **Enable multi-path** box and click on **OK** to connect to the LUN.

| 🚧 🧼 🖄 📷 🖬 🖬 🗩 🗹   | dume             | Laugust Tune               | File Surtem  | Ctatur   |                  |               |
|---|------------------|----------------------------|--|--|------------------|---------------|
| <ul> <li>System Tools</li> <li>Task Scheduler</li> <li>Event Viewer</li> <li>Shared Folders</li> <li>Local Users and Groups</li> <li>Performance</li> <li>Device Manager</li> <li>Storage</li> <li>Windows Server Backur</li> <li>Disk Management</li> <li>Services and Applications</li> </ul> | New Simple Volum | n<br>on this partition, yo | nat this volume<br>nat this volume<br>le following sett<br>NTFS<br>Default<br>Backup_<br>nat | it first.<br>e, and if so, what settings y<br>tings:<br>Target | you want to use. | nary Partitio |

8. Repeat these steps to mount the iSCSI volumes on the Veeam Proxy server.

In the Veeam Backup and Replication console, create backup repositories for the Veeam Backup and Veeam Proxy servers. These repositories will be used as backup targets for the virtual machines backups.

1. In the Veeam Backup and Replication console click on **Backup Infrastructure** in the lower left and then select **Add Repository** 

| Repository Tools   |                |
|--|----------------|
| ∃ •         Home         Backup Repository   |                |
| Add Edit Rescan<br>Repository Repository<br>Manage Repository Tools  |                |
| Backup Infrastructure  |                |
| <ul> <li>Backup Proxies</li> <li>Backup Repositories</li> </ul>  |                |
| <ul> <li>External Repositories</li> <li>Scale-out Repositories</li> <li>WAN Accelerators</li> <li>Service Providers</li> </ul> |                |
| <ul> <li>SureBackup</li> <li>Managed Servers</li> </ul>  |                |
| A Home   |                |
| Inventory  |                |
| Backup Infrastructure  |                |
| Storage Infrastructure   |                |
| Tape Infrastructure  |                |
| Files  |                |
|  | [ <sub>@</sub> |

2. In the New Backup Repository wizard, enter a name for the repository and then select the server from the drop-down list and click on the **Populate** button to choose the NTFS volume that will be used.

| Name         | Repository server:            |                                     |              |          |
|--------------|-------------------------------|-------------------------------------|--------------|----------|
| Server       | veeamproxy.demozone.com (Crea | ted by VEEAMSRV\Administrator at 12 | /22/2022 9 🗸 | Add New  |
|              | Path                          | Capacity                            | Free         | Populate |
| Repository   | @ C:\                         | 89.4 GB                             | 74 GB        |          |
| Mount Server | ⊂ E\                          | 1.9 TB                              | 1.9 TB       |          |
|              |                               |                                     |              |          |
| Review       |                               |                                     |              |          |
| Apply        |                               |                                     |              |          |
| Summary      |                               |                                     |              |          |
| Janninary    |                               |                                     |              |          |
|              |                               |                                     |              |          |
|              |                               |                                     |              |          |
|              |                               |                                     |              |          |
|              |                               |                                     |              |          |
|              |                               |                                     |              |          |
|              |                               |                                     |              |          |

- 3. On the next page choose a Mount server that will be used to mount backups to when performing advanced restores. By default this is the same server that has the repository storage connected.
- 4. Review your selections and click on **Apply** to start the backup repository creation.

| Name             | The following components will be processed on si  | erver veeamproxy.demozone.com: |
|------------------|---|--------------------------------|
|                  | Component name  | Status                         |
| erver            | Transport   | already exists                 |
| Repository       | vPower NFS  | will be installed              |
|                  | Mount Server  | will be installed              |
| Mount Server     |   |                                |
| Apply<br>Summary |   |                                |
|                  | Search the repository for existing backups and<br>Import guest file system index data to the context of the system index data to the system index data to the context of the system index data to the system index |                                |
|                  |   |                                |

## Configure Veeam backup jobs

Backup jobs should be created utilizing the the Backup Repositories in the previous section. Creating backup jobs is a normal part of any storage administrator's repertoire and we do not cover all of the steps here. For more complete information on creating backup jobs in Veeam, see the Veeam Help Center Technical Documentation.

In this solution separate backup jobs were created for:

- Microsoft Windows SQL Servers
- Oracle database servers
- · Windows file servers
- · Linux file servers

- 1. Enable application-aware processing to create consistent backups and perform transaction log processing.
- 2. After enabling application-aware processing add the correct credentials with admin privileges to the application as this may be different than the guest OS credentials.

| 🔧 Use         | guest OS   | credent  | ials  |      |                    | ~       | Add    |
|---------------|------------|----------|-------|------|--------------------|---------|--------|
| Archived      | loos       |          |       |      | Manage ac          | ounts   |        |
|               | 1000-000   | archived | lloos |      |                    |         |        |
| 122           |            |          | -     |      | 1. • 200 0000      |         |        |
| Delet         | ALC: NO.   |          |       |      | hours              |         |        |
| O Delet       | te logs ov | ver:     | 10    | *    | GB                 |         |        |
| 🗌 Back        | up logs e  | every:   | 15    | 4    | minutes            |         |        |
|               | n log ba   |          |       |      |                    |         |        |
|               |            | 1        |       | - 85 | je-level backup is | deleted |        |
| OK            | eep only   | last 15  |       | day  | s of log backups   |         |        |
| Concession of | shipping   |          |       |      |                    | 1.10    |        |
| Auto          | omatic se  | election |       |      |                    |         | Choose |
|               |            |          |       |      |                    |         |        |
|               |            |          |       |      |                    |         |        |
|               |            |          |       |      |                    |         |        |
|               |            |          |       |      |                    |         |        |

3. To manage the retention policy for the backup check the **Keep certain full backups longer for archival purposes** and click the **Configure...** button to configure the policy.

| Con | figure GFS   |         | ×      |                                   |
|-----|--|---------|--------|-----------------------------------|
|     | Keep weekly full backups for: 15 🚔 weeks                   |         |        | 10:3 ~                            |
|     | If multiple full backups exist, use the one from:          | Sunday  | ~      | packup                            |
|     | Keep monthly full backups for: 12 📮 months                 |         |        |                                   |
|     | Use weekly full backup from the following week of a month: | First   | ~      | Configure                         |
|     | Keep yearly full backups for: 1 🔅 years                    |         |        |                                   |
|     | Use monthly full backup from the following month:          | January | $\sim$ |                                   |
|     |  |         |        | Ve recommend to ma<br>d off-site. |
| c.  | ve As Default OK   | Cance   | 4      |                                   |

## **Restore Application VMs with Veeam full restore**

Performing a full restore with Veeam is the first step in performing an application restore. We validated that full restores of our VMs powered on and all services were running normally.

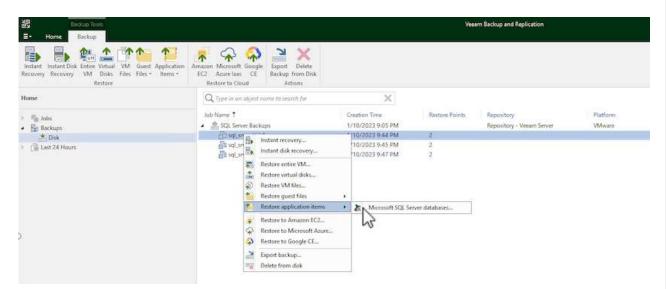
Restoring servers is a normal part of any storage administrator's repertoire and we do not cover all of the steps here. For more complete information on performing full restores in Veeam, see the Veeam Help Center Technical Documentation.

#### **Restore SQL Server databases**

Veeam Backup & Replication provides several options for restoring SQL Server databases. For this validation we used the Veeam Explorer for SQL Server with Instant Recovery to execute restores of our SQL Server databases. SQL Server Instant Recovery is a feature that allows you to quickly restore SQL Server databases without having to wait for a full database restore. This rapid recovery process minimizes downtime and ensures business continuity. Here's how it works:

- Veeam Explorer mounts the backup containing the SQL Server database to be restored.
- The software **publishes the database** directly from the mounted files, making it accessible as a temporary database on the target SQL Server instance.
- While the temporary database is in use, Veeam Explorer **redirects user queries** to this database, ensuring that users can continue to access and work with the data.
- In the background, Veeam **performs a full database restore**, transferring data from the temporary database to the original database location.
- Once the full database restore is complete, Veeam Explorer **switches user queries back to the original** database and removes the temporary database.

1. In the Veeam Backup and Replication console, navigate to the list of SQL Server backups, right click on a server and select **Restore application items** and then **Microsoft SQL Server databases...**.



2. In the Microsoft SQL Server Database Restore Wizard select a restore point from the list and click on **Next**.

| lestore Point | VM name: sql_srv_wkld_1<br>VM size: 43.9 GB<br>O Restore from the latest available backup   | Original ho               | st: vcenter.sddc-44-235-223-88.vm                  |
|---------------|---|---------------------------|--|
| ummary        | <ul> <li>Restore from this restore point:</li> <li>Created</li> <li>less than a day ago (9:44 PM Tuesday</li> <li>less than a day ago (9:07 PM Tuesday</li> </ul> | Type<br>Increment<br>Full | Backup<br>SQL Server Backups<br>SQL Server Backups |
|               |   | _                         |  |

3. Enter a **Restore reason** if desired and then, on the Summary page, click on the **Browse** button to launch Veeam Explorer for Microsoft SQL Server.

| Microsoft S | SQL Server | Database | Restore |
|-------------|------------|----------|---------|
|-------------|------------|----------|---------|

| estore Point    | Summary:   |
|-----------------|--|
| eason<br>ummary | VM name: sql_srv_wkld_1<br>Restore point:<br>Current: sql_srv_wkld_1 less than a day ago (9:07 PM Tuesday 1/10/2023) |
|                 |  |
|                 |  |
|                 |  |
|                 |  |
|                 |  |
|                 |  |
|                 |  |

4. In Veeam Explorer expand the list of database instances, right click and select **Instant recovery** and then the specific restore point to recover to.

| à<br>∎• Home                            | Database   |  | sql_srv_wkld_   | 1 as of less than a day ago (9:07 PM Tuesday 1/10/2023) - Veeam Explorer for Microsoft SQL Serv  |
|---|--|--|---|--|
| Instant<br>Recovery •<br>stant Recovery | Database * Database * Sch  |  | Export<br>Files * Schema *<br>Export                            |  |
| Databases                               |  |  | Database Info   |  |
| A 🔚 SQLSRV-(<br>A 🔚 Defau               | ilt Instance   |  | Name:<br>Backup created:  | DATA_01<br>1/10/2023 9:07 PM   |
| 🤲 D/<br>🦲 D.                            |  | Instant recovery of Instant recovery t |   | 0/2023, 9:07 PM to SQLSRV-01   |
|   | Restore database  Restore schema   |  | Available Restore   | Period   |
|   | Export backup       •         Export files       •         Export schema       • |  | Database Files<br>Primary database file<br>E:\MSSQL 2019\MSSQL1 | 15.MSSQLSERVER\MSSQL\DATA\DATA_01.mdf  |
|   |  |  | E:\MSSQL 2019\MSSQL1<br>E:\MSSQL 2019\MSSQL1                    | I log files<br>15.MSSQLSERVER\MSSQL\LOGS\DATA_log.ldf<br>15.MSSQLSERVER\MSSQL\DATA\DATA_02.ndf<br>15.MSSQLSERVER\MSSQL\DATA\DATA_03.ndf<br>15.MSSQLSERVER\MSSQL\DATA\DATA_04.ndf |

5. In the Instant Recovery Wizard specify the switchover type. This can either be automatically with minimal downtime, manually, or at a specified time. Then click the **Recover** button to begin the restore process.

| Specify switchover type: |   |                      |
|--------------------------|---|----------------------|
| Auto                     |   |                      |
|                          | formed automatically with minimal possible downtime     | once the database is |
| O Manual                 |   |                      |
| Switchover can be pe     | formed manually at any point in time after the database | e is ready.          |
| Scheduled at:            | 1/10/2023 10:16 PM                                      |                      |
|                          |   |                      |
|                          |   |                      |
|                          |   |                      |
|                          |   |                      |
|                          | Back  | Cancel               |
|                          | Doca Record   | Curreer              |

| Databases                     | Instant Recovery Inf                            | 0   |          |
|-------------------------------|---|---|----------|
| Instant Recovery (1)          | Status  | Starting (restored)   |          |
| DATA DI                       | SQL Serven                                      | SQLSRV-01   |          |
| <ul> <li>SQLSRV-01</li> </ul> | Target names                                    | DATA 01   |          |
| - E Default Instance          | Target point in time:                           | 1/10/2023 9:07 PM   |          |
| DATA_01                       | Restore point:                                  | sąl_srv_wkld_T  |          |
| DASA_02                       | Switchover mode                                 | Auto  |          |
|                               | Database Files                                  |   |          |
|                               | Ratur   | Persistent  |          |
|                               | Primary database file<br>ENMSSQL 2019/MSSQL 15. | MSSGLSERVER/MSSGL/0ATA/0ATA_01.mdf  |          |
|                               | EVMSSQL 2019VMSSQL15<br>EVMSSQL 2019VMSSQL15    | MSSQLSBNRENMSSQLLDOSID, NATA_Jog Aff<br>MSSQLSBNRENMSSQLDOSID, NATA_Q2, mdf<br>MSSQLSBNRENMSSQLDOSID, Q1, mdf<br>MSSQLSBNRENMSSQLDOSID, Q1, mdf |          |
|                               | Action  |   | Duration |
|                               | 😋 listarit Recovery start                       | ed at 1/10/2023 10:12:06 PM   |          |
|                               | Putrishing database                             |   | 00:35    |
|                               | 🙁 Copying target files                          |   | 08.28    |
|                               | 🙁 😋 Database published a                        | 1/10/2023 10:12:42 PM   |          |
|                               | Synchronizing files                             |   |          |
|                               | Seady für switchover                            |   |          |
|                               | Ø Detaching database                            |   |          |
|                               | Canad data the set of the set                   |   |          |

For more detailed information on performing SQL Server restore operations with Veeam Explorer refer to the Microsoft SQL Server section in the Veeam Explorers User Guide.

### **Restore Oracle databases with Veeam Explorer**

Veeam Explorer for Oracle database provides the ability to perform a standard Oracle database restore or an uninterrupted restore using Instant Recovery. It also supports publishing databases for fast access, recovery of Data Guard databases and restores from RMAN backups.

For more detailed information on performing Oracle database restore operations with Veeam Explorer refer to the Oracle section in the Veeam Explorers User Guide.

In this section an Oracle database restore to a different server is covered using Veeam Explorer.

1. In the Veeam Backup and Replication console, navigate to the list of Oracle backups, right click on a server and select **Restore application items** and then **Oracle databases...**.

| 観 Backup Tools<br>En Home Backup   |   |  | Vee                      | am Backup and Replication              |
|--|---|--|--------------------------|--|
| Instant Disk Entire Virtual VM Guest Application Recovery VM Disks Files Files Files - Restore | Amazon Microsoft Google<br>EC2 Acruze laas CE<br>Restore to Cloud   |  |                          |  |
| Home   | $\tilde{\mathbf{Q}}$ . Type in an object name to search for   | ×  |                          |  |
| <ul> <li>Alge Jobs</li> <li>Alge Backup</li> <li>Backups</li> <li>▲ Disk</li> </ul>            | Job Name 1<br>▲ 알 Oracle Backups<br>I ora_sry_01<br>II ora_sry_02   | Creation Time<br>1/20/2023 2:24 PM<br>1/20/2023 6:00 PM<br>1/20/2023 6:02 PM | Restore Points<br>6<br>4 | Repository<br>Repository - Veeam Serve |
| Success<br>Warning<br>Failed   | SOL Serve     Instant recovery     Instant disk recovery     Restore entire VM     Restore virtual disks     Restore VM files     Restore quest files | **20/2023 6:01 PM<br>10/2023 9:05 PM   | 5                        | Repository - Veeam Serve               |
|  | Restore application item  | Fa Noracle databases.  |                          |  |
|  | Restore to Armazon EC2  | -0   |                          |  |

2. In the Oracle Database Restore Wizard select a restore point from the list and click on **Next**.

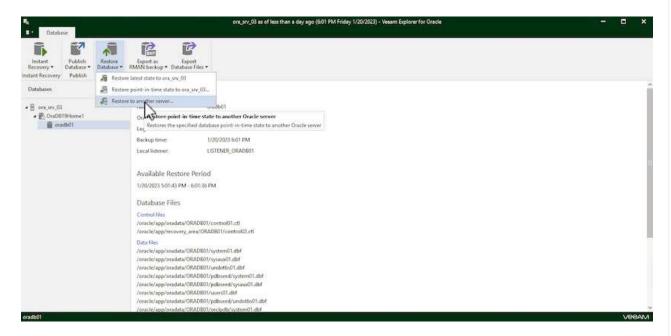
| Restore Point | VM name: ora_srv_03  | Original ho | ost: vcenter.sddc-44-235-223-88.vm. |
|---------------|--|-------------|-------------------------------------|
| Reason        | VM size: 38.5 GB   |             |                                     |
| Summary       | <ul> <li>Restore from the latest available backup</li> <li>Restore from this restore point:</li> </ul> |             |                                     |
|               | Created  | Туре        | Backup                              |
|               | 🕑 less than a day ago (6:01 PM Friday 1/   | Increment   | Oracle Backups                      |
|               | Iess than a day ago (5:01 PM Friday 1/   |             | Oracle Backups                      |
|               | Iess than a day ago (4:02 PM Friday 1/ Iess than a day ago (3:47 PM Friday 1/                          |             | Oracle Backups                      |
|               | Iess than a day ago (3:47 PM Friday 1/   |             | Oracle Backups<br>Oracle Backups    |
|               |  |             |                                     |

3. Enter a **Restore reason** if desired and then, on the Summary page, click on the **Browse** button to launch Veeam Explorer for Oracle.

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| Oracle Database Restore | >   |
|-------------------------|---|
| DRACLE' Summary         |   |
| Review the re           | store point settings, and click Browse to exit the wizard and open Veeam Explorer for Oracle, where you will be able<br>bases to restore. |
| Restore Point           | Summary:  |
| Reason                  | VM name: ora_srv_03<br>Restore point:   |
| Summary                 | Current: ora_srv_03 less than a day ago (6:01 PM Friday 1/20/2023)  |
|                         |   |
|                         |   |
|                         |   |
|                         |   |
|                         |   |
|                         |   |
|                         |   |
|                         |   |
|                         |   |
|                         |   |
|                         | < Previous Next > Browse Cancel   |
|                         | Cancel  |
|                         | 5   |

4. In Veeam Explorer expand the list of database instances, click on the database to be restored and then from the **Restore Database** drop-down menu at the top select **Restore to another server...** 



5. In the Restore Wizard specify the restore point to restore from and click Next.

| Specify restore point                     |                  |                                       |             |            |           |           |                      |
|---|------------------|---------------------------------------|-------------|------------|-----------|-----------|----------------------|
| Specify point in time you w               | ant to restore f | he databas                            | e to:       |            |           |           |                      |
| Restore to the point in                   | time of the sel  | ected imag                            | e-level bac | ckup       |           |           |                      |
| Restore to a specific po                  | int in time (rec | uires redo                            | log backu   | ps)        |           |           |                      |
| 5:01 PM<br>1/20/2023                      |                  |                                       |             |            |           | —Q        | 6:01 PM<br>1/20/2023 |
|   | Fri              | day, Januai                           | y 20, 2023  | 6:01 PM    |           |           |                      |
| Perform restore to                        | the specific tra | nsaction                              |             |            |           |           |                      |
| Enables you to revi<br>database to the mo |                  |                                       |             |            |           | ne, and i | restore the          |
| 🦺 To enable this                          | functionality, s | pecify the s                          | taging Or   | acle serve | r under M | enu > 0   | ptions.              |
|   |                  | • • • • • • • • • • • • • • • • • • • |             |            |           |           |                      |

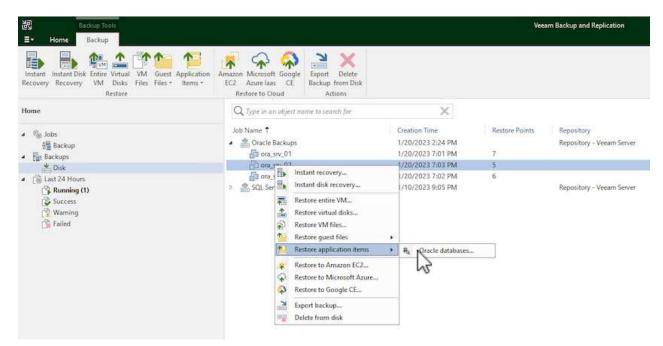
6. Specify the target server the database will be restored to and the account credentials and click **Next**.

| Server:   | ora_srv_01                          | ` | SSH port: | 22       |
|-----------|-------------------------------------|---|-----------|----------|
| Account:  | oracle                              |   |           | Advanced |
| Password: | [Click here to change the password] |   |           |          |
| Private   | key is required for this connection |   |           |          |
| Private   | key:                                |   |           | Browse   |
| Passph    | rase:                               |   |           |          |
|           |                                     |   |           |          |
|           |                                     |   |           |          |
|           |                                     |   |           |          |
|           |                                     |   |           |          |

| Control files                                    | ~ |
|--|---|
| /oracle/app/oradata/oradb01/control01.ctl        |   |
| /oracle/app/recovery_area/oradb01/control02.ctl  |   |
| Data files                                       |   |
| /oracle/app/oradata/oradb01/system01.dbf         |   |
| /oracle/app/oradata/oradb01/sysaux01.dbf         |   |
| /oracle/app/oradata/oradb01/undotbs01.dbf        |   |
| /oracle/app/oradata/oradb01/pdbseed/system01.dbf |   |
| /oracle/app/oradata/oradb01/pdbseed/sysaux01.dbf |   |
| /oracle/app/oradata/oradb01/users01.dbf          |   |

In this section a database is published to an alternate server for fast access without launching a full restore.

1. In the Veeam Backup and Replication console, navigate to the list of Oracle backups, right click on a server and select **Restore application items** and then **Oracle databases...**.



2. In the Oracle Database Restore Wizard select a restore point from the list and click on Next.

| Restore Point<br>Reason<br>Summary | VM name: ora_srv_02<br>VM size: 38.1 GB<br>Restore from the latest available backup<br>Restore from this restore point: | Original ho | ost: vcenter.sddc-44-235-223-88.vm. |
|------------------------------------|---|-------------|-------------------------------------|
|                                    | Created   | Туре        | Backup                              |
|                                    | 🕑 less than a day ago (7:03 PM Friday 1/  | Increment   | Oracle Backups                      |
|                                    | 🕒 less than a day ago (6:02 PM Friday 1/  |             | Oracle Backups                      |
|                                    | less than a day ago (5:02 PM Friday 1/  |             | Oracle Backups                      |
|                                    | I less than a day ago (4:03 PM Friday 1/ I less than a day ago (3:49 PM Friday 1/                                       |             | Oracle Backups<br>Oracle Backups    |
|                                    |   |             |                                     |

- 3. Enter a **Restore reason** if desired and then, on the Summary page, click on the **Browse** button to launch Veeam Explorer for Oracle.
- 4. In Veeam Explorer expand the list of database instances, click on the database to be restored and then from the **Publish Database** drop-down menu at the top select **Publish to another server...**

| Databa                                  | se                    |                       |                        |            |                            |                                 |
|---|-----------------------|-----------------------|------------------------|------------|----------------------------|---------------------------------|
| Instant<br>Recovery •                   | Publish<br>Database • | Restore<br>Database • | Export as<br>RMAN back | ;<br>up▼ C | Export<br>Database Files • |                                 |
| nstant Recovery                         | Publis                | h to another s        | erver                  | Expor      | t                          |                                 |
| Databases                               | hire-states           | 1                     | Databa                 | ise Int    | fo                         |                                 |
| <ul> <li>ora_srv_02</li> <li></li></ul> |                       | Name:<br>Oracle Sl    | D:                     |            | oradb01<br>oradb01         |                                 |
| ora 📗                                   | db01                  |                       | Log mod<br>Backup t    |            |                            | ARCHIVELOG<br>1/20/2023 7:03 PM |
|   |                       |                       | Local list             | ener:      | ı                          | ISTENER_ORADB01                 |

- 5. In the Publish wizard, specify the restore point at which to publish the database from and click **Next**.
- 6. Finally, specify the target linux file system location and click on **Publish** to begin the restore process.

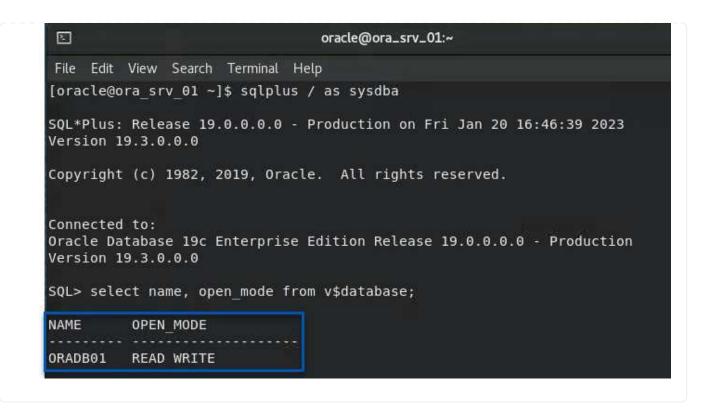
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| Restore to a different location: |                |        |
|----------------------------------|----------------|--------|
|                                  | pp/product/19c | Browse |
| Global Database Name: oradb01.   | demozone.com   |        |
| Oracle SID: oradb01              |                |        |
|                                  |                |        |
|                                  |                |        |
|                                  |                |        |

7. Once the publish has completed log into the target server and run the following commands to ensure the database is running:

oracle@ora\_srv\_01> sqlplus / as sysdba

SQL> select name, open\_mode from v\$database;



### Conclusion

VMware Cloud is a powerful platform for running business-critical applications and storing sensitive data. A secure data protection solution is essential for businesses that rely on VMware Cloud to ensure business continuity and help protect against cyber threats and data loss. By choosing a reliable and robust data protection solution, businesses can be confident that their critical data is safe and secure, no matter what.

The use case presented in this documentation focuses on proven data protection technologies that highlight the integration between NetApp, VMware, and Veeam. FSx for ONTAP is supported as supplemental NFS datastores for VMware Cloud in AWS and is used for all virtual machine and application data. Veeam Backup & Replication is a comprehensive data protection solution designed to help businesses improve, automate, and streamline their backup and recovery processes. Veeam is used in conjunction with iSCSI backup target volumes, hosted on FSx for ONTAP, to provide a secure and easy to manage data protection solution for application data residing in VMware Cloud.

### **Additional Information**

To learn more about the technologies presented in this solution refer to the following additional information.

- FSx for ONTAP User Guide
- Veeam Help Center Technical Documentation
- VMware Cloud on AWS Support. Considerations and Limitations

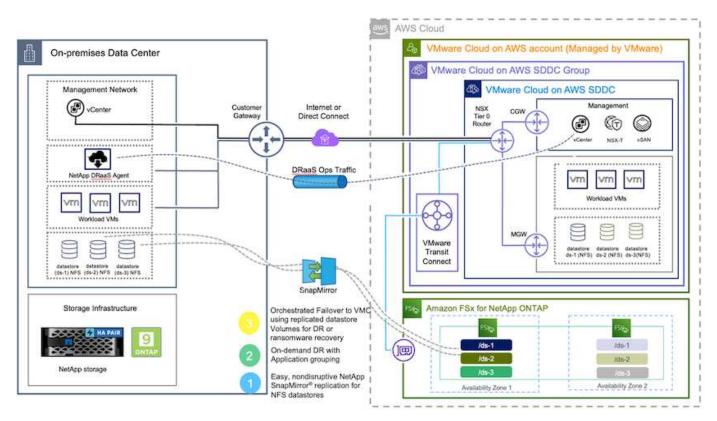
### TR-4955: Disaster Recovery with FSx for ONTAP and VMC (AWS VMware Cloud)

Disaster Recovery Orchestrator (DRO; a scripted solution with UI) can be used to seamlessly recover workloads replicated from on-premises to FSx for ONTAP. DRO automates the recovery from the SnapMirror level, through VM registration to VMC, to network mappings directly on NSX-T. This feature is included with all VMC environments.

# Overview

Disaster recovery to cloud is a resilient and cost-effective way of protecting the workloads against site outages and data corruption events (for example, ransomware). With NetApp SnapMirror technology, on-premises VMware workloads can be replicated to FSx for ONTAP running in AWS.

Disaster Recovery Orchestrator (DRO; a scripted solution with UI) can be used to seamlessly recover workloads replicated from on-premises to FSx for ONTAP. DRO automates the recovery from the SnapMirror level, through VM registration to VMC, to network mappings directly on NSX-T. This feature is included with all VMC environments.



# **Getting started**

## Deploy and configure VMware Cloud on AWS

VMware Cloud on AWS provides 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 the workloads. To configure a VMC environment on AWS, follow the steps at this link. A pilot-light cluster can also be used for DR purposes.



In the initial release, DRO supports an existing pilot-light cluster. On-demand SDDC creation will be available in an upcoming release.

## Provision and configure FSx for 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 the popular NetApp ONTAP file system. Follow the steps at this link to provision and configure FSx for ONTAP.

# Deploy and configure SnapMirror to FSx for ONTAP

The next step is to use NetApp BlueXP and discover the provisioned FSx for ONTAP on AWS instance and replicate the desired datastore volumes from an on-premises environment to FSx for ONTAP with the appropriate frequency and NetApp Snapshot copy retention:

| NetApp BlueXP   | Account Y Workspace<br>nimolab nimolab                            | Connector AWSConnCtd                        |
|---|---|---|
| Canvas     My Working Environments                    | My Opportunities New  | 🖽 Go to Tabular View                        |
| + Add Working Environment                             | C Enable Services   | (i)     |
| PSx for ONTAP<br>7 13.01 Till<br>Votumes Capacity aws | ntaphci-a300e9u25<br>Dm-Pramises ONTAP<br>131.27 Till<br>Capecity | DETAILS<br>On-Premises ONTAP                |
| al<br>0   |   | SERVICES                                    |
| DemofSxN     PSx for ONTAP                            | ANF<br>Azura NetApp Files   | Backup and recovery . (1)                   |
| 5 4.74 TiB<br>Volumes Capacity BWS                    | () Failed   | Copy & sync 1,57 ma (1)<br># On Data Synced |
|   |   | Loading                                     |
| Azure Blob Storage                                    | Amazon 53   | Classification Enable (                     |
| 0<br>Bhorisge Accounts                                | Buckets aws -++   | Enter Working Environment                   |

Follow the steps in this link to configure BlueXP. You can also use the NetApp ONTAP CLI to schedule replication following this link.



A SnapMirror relationship is a prerequisite and must be created beforehand.

## **DRO** installation

To get started with DRO, use the Ubuntu operating system on a designated EC2 instance or virtual machine to make sure you meet the prerequisites. Then install the package.

## Prerequisites

- Make sure that connectivity to the source and destination vCenter and storage systems exists.
- DNS resolution should be in place if you are using DNS names. Otherwise, you should use IP addresses for the vCenter and storage systems.
- Create a user with root permissions. You can also use sudo with an EC2 instance.

## **OS requirements**

- Ubuntu 20.04 (LTS) with minimum of 2GB and 4 vCPUs
- The following packages must be installed on the designated agent VM:

- Docker
- Docker-compose
- ∘ Jq

Change permissions on docker.sock: sudo chmod 666 /var/run/docker.sock.



The deploy.sh script executes all the required prerequisites.

### Install the package

1. Download the installation package on the designated virtual machine:

git clone https://github.com/NetApp/DRO-AWS.git



The agent can be installed on-premises or within an AWS VPC.

2. Unzip the package, run the deployment script, and enter the host IP (for example, 10.10.10.10).

tar xvf DRO-prereq.tar

3. Navigate to the directory and run the deploy script as follows:

```
sudo sh deploy.sh
```

4. Access the UI using:

```
https://<host-ip-address>
```

with the following default credentials:

Username: admin Password: admin

The password can be changed using the "Change Password" option.

| ■ NetApp   |     |
|--|-----|
| Disaster Recovery Orchestrator     Kinging Industrie with Data | FSX |
| Pastword   |     |
| Lopin  |     |

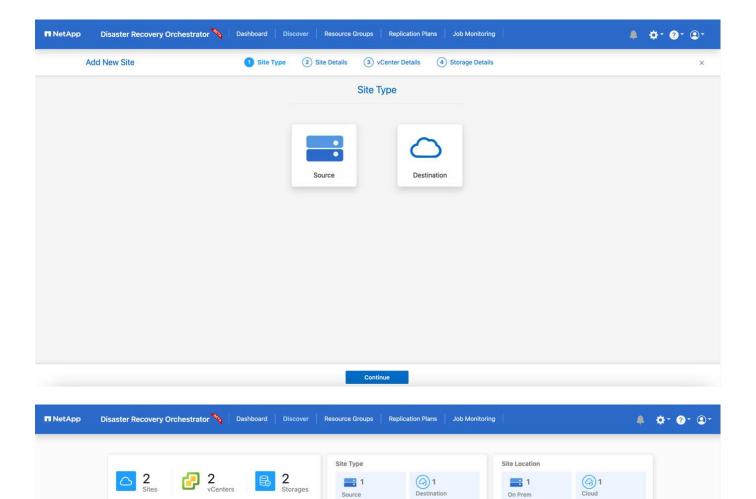
## **DRO** configuration

After FSx for ONTAP and VMC have been configured properly, you can begin configuring DRO to automate the recovery of on-premises workloads to VMC by using the read-only SnapMirror copies on FSx for ONTAP.

NetApp recommends deploying the DRO agent in AWS and also to the same VPC where FSx for ONTAP is deployed (it can be peer connected too), so that the DRO agent can communicate through the network with your on-premises components as well as with the FSx for ONTAP and VMC resources.

The first step is to discover and add the on-premises and cloud resources (both vCenter and storage) to DRO. Open DRO in a supported browser and use the default username and password (admin/admin) and Add Sites. Sites can also be added using the Discover option. Add the following platforms:

- On-premises
  - On-premises vCenter
  - ONTAP storage system
- Cloud
  - VMC vCenter
  - FSx for ONTAP



Q O Add New Site

Success

Success

•••

•••

• 44.235.223.88

• 172.21.253.160

View VM List

| Once added, DRO performs automatic discovery and displays the VMs that have corresponding SnapMirror     |
|--|
| replicas from the source storage to FSx for ONTAP. DRO automatically detects the networks and portgroups |
| used by the VMs and populates them.  |

2 Sites

Cloud

On Prem

Destination

Source

Cloud

On Prem

1

1

1

1

| Back                   |                                 | VM List                        |                           |              |                       |
|------------------------|---------------------------------|--------------------------------|---------------------------|--------------|-----------------------|
|                        |                                 | Site: On Prem   vCenter: 172.2 | 1.253.160                 |              |                       |
|                        |                                 |                                | VM Protection             |              |                       |
|                        | 10<br>latastores                | 219<br>Virtual Machines        | S Protected               | ()<br>Unprof | 216<br>ected          |
|                        |                                 |                                |                           |              |                       |
| 38 vMs                 |                                 |                                |                           | ٩            | Create Resource Group |
| VM Name                | C VM Status                     | ₩ VM State (1)                 | 🗢 DetaStore               | C CPU        | († 1) Memory (MB) (†  |
|                        | O Not Protected                 | (1) Powered On                 | A300_NF5_D504             | 16           | 65536                 |
| a300-vcsa02            |                                 |                                |                           |              |                       |
| a300-vesa02<br>PFSense | 0 Not Protected                 | (1) Powered On                 | A300_NF5_D504             | 4            | 8192                  |
|                        | 1.51 according Sci              |                                | A300_NFS_D504             |              | 8192<br>16384         |
| PFSense                | O Not Protected                 | (၂) Powered On                 | Construction and a second | 4            |                       |
| PFSense<br>PFSense260  | Not Protected     Not Protected | ්) Powered On<br>() Powered On | A300_NFS_D504             | 4            | 16384                 |

The next step is to group the required VMs into functional groups to serve as resource groups.

### **Resource groupings**

After the platforms have been added, you can group the VMs you want to recover into resource groups. DRO resource groups allow you to group a set of dependent VMs into logical groups that contain their boot orders, boot delays, and optional application validations that can be executed upon recovery.

To start creating resource groups, complete the following steps:

- 1. Access Resource Groups, and click Create New Resource Group.
- 2. Under **New resource group**, select the source site from the dropdown and click **Create**.
- 3. Provide Resource Group Details and click Continue.
- 4. Select the appropriate VMs using the search option.
- 5. Select the boot order and boot delay (secs) for the selected VMs. Set the order of the power-on sequence by selecting each VM and setting up the priority for it. Three is the default value for all VMs.

Options are as follows:

- 1 The first virtual machine to power on
- 3 Default
- 5 The last virtual machine to power on
- 6. Click Create Resource Group.

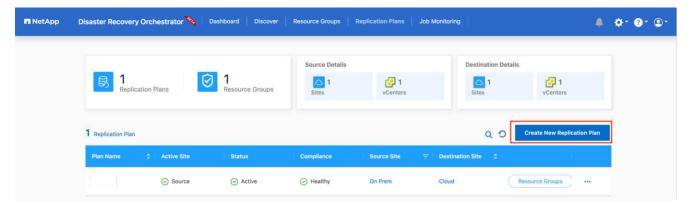
| n NetApp | Disaster Recovery Orchestrator 💊 | Dashboard Discover Resou | ce Groups Replication Plans Job Monito | oring 🔶 🐥                     | <b>*- @-</b> ( |
|----------|----------------------------------|--------------------------|--|-------------------------------|----------------|
|          | Resource Group                   | C 1 <sub>Site</sub>      | Center                                 | S<br>Virtual Machines         |                |
|          | 1 Resource Group                 |                          |  | Q 🕤 Create New Resource Group |                |
|          | Resource Group Name              | Site Name                |  | ≂ VM List                     |                |
|          | DemoRG1                          | On Prem                  | 172.21.253.160                         | View VM List                  |                |

## **Replication plans**

You need a plan to recover applications in the event of a disaster. Select the source and destination vCenter platforms from the drop down and pick the resource groups to be included in this plan, along with the grouping of how applications should be restored and powered on (for example, domain controllers, then tier-1, then tier-2, and so on). Such plans are sometimes also called blueprints. To define the recovery plan, navigate to the **Replication Plan** tab and click **New Replication Plan**.

To start creating a replication plan, complete the following steps:

1. Access Replication Plans, and click Create New Replication Plan.



2. Under **New Replication Plan**, provide a name for the plan and add recovery mappings by selecting the source site, associated vCenter, destination site, and associated vCenter.

| NetApp Disaster Recovery Orchestra | ator 💊 Dashboard Discover Resource Groups  | Replication Plans Job Monitoring                                | ≜ ¢* ?* ©* |
|------------------------------------|--|---|------------|
| Create New Replication             | Replication Plan and Site Details (2) Select Resource                                    | Groups (3) Set Execution Order (4) Set VM Del                   | ails ×     |
|                                    | Replication  | n Plan Details  |            |
|                                    | Plan Name  |   | 0          |
|                                    |  |   |            |
|                                    |  | ry Mapping  |            |
|                                    | Source Site Select Source Site +   | Destination Site Select Destination Site                        |            |
|                                    | Source vCenter   | Destination vCenter   | 0          |
|                                    | Select Source vCenter ~  | Select Destination vCenter +                                    |            |
|                                    |  |   |            |
|                                    |  |   |            |
|                                    |  |   |            |
|                                    | Pre-requisite - You must configure SnapMirror rela<br>create successful replication plan | tionships between the source site and target site to $$\times$$ |            |
|                                    | co   | Intinue   |            |

3. After Recovery mapping is completed, select the cluster mapping.

| Create New Replication<br>Plan | 1 Replication Plan and Site Details | 2 Select Resource | Groups (3) Set Execution Order | Set VM Details |  |
|--------------------------------|-------------------------------------|-------------------|--------------------------------|----------------|--|
|                                |                                     | Replication       | Plan Details                   |                |  |
|                                | Plan Name                           |                   |                                | 0              |  |
|                                | DemoRP                              |                   |                                |                |  |
|                                |                                     | Recovery          | / Mapping                      |                |  |
|                                | Source Site                         | 0                 | Destination Site               | 0              |  |
|                                | On Prem                             | · ·               | Cloud                          | Ψ.             |  |
|                                | Source vCenter                      | 0                 | Destination vCenter            | 0              |  |
|                                | 172.21.253.160                      |                   | 44.235.223.88                  |                |  |
|                                |                                     | Cluster           | Mapping                        |                |  |
|                                | Source Site Resource                | O Destination     | on Site Resource               |                |  |
|                                | TempCluster                         | •                 | Cluster-1 ~                    | Add            |  |
|                                |                                     |                   |                                |                |  |
|                                | Source Resource                     | Destination       | Resource                       |                |  |
|                                | A300-Cluster01                      | Cluster-1         |                                | Delete         |  |

- 4. Select **Resource Group Details** and click **Continue**.
- 5. Set the execution order for the resource group. This option enables you to select the sequence of operations when multiple resource groups exist.
- 6. After you are done, select the network mapping to the appropriate segment. The segments should already be provisioned within VMC, so select the appropriate segment to map the VM.
- 7. Based on the selection of VMs, datastore mappings are automatically selected.



SnapMirror is at the volume level. Therefore, all VMs are replicated to the replication destination. Make sure to select all VMs that are part of the datastore. If they are not selected, only the VMs that are part of the replication plan are processed.

| NetApp Disaster Recovery Of<br>Create New Replication<br>Plan | rchestrator 💊 Dashboard Disco | Ver         Resource Groups         Replication Plans         Job Monitoring                · Select Resource Groups               • Select Resource Groups               • Select Resource Groups | * • • • • * |
|---|-------------------------------|--|-------------|
|   |                               | Replication Plan Details   |             |
|   |                               | Select Execution Order   |             |
|   | Resource Group Name           | Execution Order  |             |
|   | DemoRG1                       | 3  |             |
|   | No more<br>Source Resource    | Network Mapping Source/Destination network resources available for mapping Destination Resource  |             |
|   | VLAN 3375                     | Destination Resource sddc-cgw-network-1 Delete   |             |
|   |                               | DataStore Mapping  |             |
|   | Source DataStore              | Destination Volume   |             |
|   | DRO_Mini                      | DRO_Mini_copy  |             |
|   |                               |  |             |
|   |                               | Previous   |             |

8. Under the VM details, you can optionally resize the VM's CPU and RAM parameters; this can be very helpful when recovering large environments to smaller target clusters or for conducting DR tests without having to provision a one-to-one physical VMware infrastructure. Also, you can modify the boot order and boot delay (seconds) for all the selected VMs across the resource groups. There is an additional option to modify the boot order if there are any changes required from those selected during the resource-group boot-order selection. By default, the boot order selected during resource-group selection is used; however, any modifications can be performed at this stage.

|                |             | VM Details  |  |                          |  |
|----------------|-------------|-------------|--|--------------------------|--|
| 3 vms          |             |             |  | م                        |  |
| VM Name        | No. of CPUs | Memory (MB) | NIC/IP                                   | Boot Order<br>■ Override |  |
| Resource Group | : DemoRG1   |             |  |                          |  |
| Mini_Test01    | 1           | 2048        | O Static<br>O Dynamic                    | 3                        |  |
| Mini_Test02    | 1           | 2048        | <ul><li>Static</li><li>Dynamic</li></ul> | 2                        |  |
| Mini_Test03    | 1           | 2048        | O Static<br>O Dynamic                    | 1                        |  |
|                |             |             |  |                          |  |
|                |             |             |  |                          |  |
|                |             |             |  |                          |  |
|                |             |             |  |                          |  |

9. Click Create Replication Plan.

| Source Details Destination Details                              |
|---|
| Replication Plans Resource Groups Sites vCenters Sites vCenters |

After the replication plan is created, the failover option, the test-failover option, or the migrate option can be exercised depending on the requirements. During the failover and test-failover options, the most recent SnapMirror Snapshot copy is used, or a specific Snapshot copy can be selected from a point-in-time Snapshot copy (per the retention policy of SnapMirror). The point-in-time option can be very helpful if you are facing a corruption event like ransomware, where the most recent replicas are already compromised or encrypted. DRO shows all available points in time. To trigger failover or test failover with the configuration specified in the replication plan, you can click **Failover** or **Test failover**.

|                    | 1.11                       |                            | Source Details |             | Destination D              | etails                      |
|--------------------|----------------------------|----------------------------|----------------|-------------|----------------------------|-----------------------------|
| Replic             | cation Plans               | Resource Groups            | C 1<br>Sites   | vCenters    | Contraction 1<br>Sites     | Centers                     |
| 2 Replication Plan | 15                         |                            |                |             | 9.0                        | Create New Replication Plan |
| Plan Name          | C Active Site              | Status                     | Compliance     | Source Site | 😇 🔰 Destination Site 🛛 🗘 🛔 |                             |
| DemoRP             | ⊘ Source                   | <ul> <li>Active</li> </ul> | Healthy        | On Prem     | Cloud                      | Resource Groups .           |
| DemoRP             | <ul> <li>Source</li> </ul> | <ul> <li>Active</li> </ul> | Healthy        | On Prem     | Cloud                      | Plan Details<br>Resource    |
|                    |                            |                            |                |             |                            | Edit Plan                   |
|                    |                            |                            |                |             |                            | Failover                    |
|                    |                            |                            |                |             |                            | Test Failover               |
|                    |                            |                            |                |             |                            | Migrate                     |
|                    |                            |                            |                |             |                            | Run Compliance              |

| Failover Details   | × |
|--|---|
| <ul> <li>Volume Snapshot Details</li> <li>Use latest snapshot i</li> <li>Select specific snapshot i</li> </ul> |   |
| Start Failover   |   |

The replication plan can be monitored in the task menu:

| Back | Failover Steps<br>Replication Plan: DemoRP                |           |                 |  |
|------|---|-----------|-----------------|--|
| ~    | Breaking SnapMirror relationships (in parallel)           | © Success | 11.3 Seconds 🕡  |  |
| ~    | Mounting volumes and creating datastores (in parallel)    | Success   | 34.7 Seconds 🛈  |  |
| ~    | Registering VMs (in parallel)                             | ⊙ Success | 13.2 Seconds () |  |
| ~    | Powering on VMs in protection group - DemoRG1 - in target | © Success | 95.8 Seconds 🕕  |  |
| ~    | Updating replication status                               | Success   | 0.5 Seconds 🕕   |  |
|      |   |           |                 |  |
|      |   |           |                 |  |

After failover is triggered, the recovered items can be seen in the VMC vCenter (VMs, networks, datastores). By default, the VMs are recovered to the Workload folder.

| 2                                  | 2<br>Transfer Coupe | I Augustation Pre-      | 219            | 9 Promotional UNAs                         | · 214<br>Uppendet |
|------------------------------------|---------------------|-------------------------|----------------|--|-------------------|
| Datamati<br>2<br>Statistics        | C Z                 | Septing: Canada         |                |  | innetitie Ver ()  |
| eContre Americany<br>3<br>Contract | 22<br>Failer        | Do from<br>112 at Ada W | ) <del>.</del> | 2005<br>Onat<br>41256.221.00<br>40.404.100 |                   |
| 23<br>Entertory                    | o 45                |                         |                |  |                   |
| Zelastern                          |                     |                         |                |  |                   |
| Estatore                           |                     | Replication Have        |                |  |                   |

Failback can be triggered at the replication-plan level. For a test failover, the tear-down option can be used to roll back the changes and remove the FlexClone relationship. Failback related to failover is a two-step process. Select the replication plan and select **Reverse data sync**.

| 🗖 NetApp | Disaster Recovery Orc | chestrator 💊 🛛 Da          | ashboard Discover           | Resource Groups | Replication Plans            | Job Monitoring | 1                   |                                | ¢* @* ®* |
|----------|-----------------------|----------------------------|-----------------------------|-----------------|------------------------------|----------------|---------------------|--------------------------------|----------|
|          | Replication           | Plans                      | 1<br>Resource Groups        | Source Details  | 2 1<br>vCenters              |                | Destination Details | vCenters                       |          |
|          | 2 Replication Plans   |                            |                             |                 |                              |                | 4.0                 | bate New Replication Plan      |          |
|          | Plan Name 🗘           | O Destination              | 3 Status                    | Compliance      | On Prem                      | Cloud          |                     | urce Groups                    |          |
|          | DemoRP                | <ul> <li>Source</li> </ul> | <ul> <li>Active</li> </ul>  | Healthy         | On Prem                      | Cloud          | Resor               | Plan Details Reverse Data Sync |          |
|          |                       |                            |                             |                 |                              |                |                     | Fallback                       |          |
| ■ NetApp | Disaster Recovery Orc | :hestrator 🗞 🛛 Di          | ashboard Discover           | Resource Groups | Replication Plans            | Job Monitoring | ţ.                  | 4                              | ¢* 0* ©* |
|          | Back                  |                            |                             |                 | a Sync Steps<br>Plan: DemoRP |                |                     |                                |          |
|          | ✓ Powerin             | ig off VMs in protection g | group - DemoRG1 - in source |                 |                              |                | J In progress       | - 💿                            |          |
|          | ∽ Reversir            | ng SnapMirror relationshi  | ips (in parallel)           |                 |                              |                | ✓ Initialized       | - 🛈                            |          |

Once completed, you can trigger failback to move back to original production site.

|       | Replication         | on Plans         | 1<br>Resource Groups       | Source Details              | VCenters          | Destina        | 1 Centers                 |                |
|-------|---------------------|------------------|----------------------------|-----------------------------|-------------------|----------------|---------------------------|----------------|
|       | 2 Replication Plans | Active Site      | Status                     | Compliance                  | Source Site       |                | Create New Rep            | lication Plan  |
|       | DemoRP              | O Destination    | <ul> <li>Active</li> </ul> | <ul> <li>Healthy</li> </ul> | On Prem           | Cloud          | Resource Groups<br>Plan D | )              |
|       | DemoRP              | ⊘ Source         | <ul> <li>Active</li> </ul> | <ul> <li>Healthy</li> </ul> | On Prem           | Cloud          | Resource                  |                |
| etApp | Disaster Recovery 0 | Drchestrator 🦄 🛛 | Dashboard Discover         | Resource Groups             | Replication Plans | Job Monitoring |                           | <b>≜</b> ¢• €• |
|       | Back                |                  |                            |                             |                   |                |                           |                |

| ~ | Powering off VMs in protection group - DemoRG1 - in target | C In progress | - ① |
|---|--|---------------|-----|
| ~ | Unregistering VMs in target (in parallel)                  | ✓ Initialized | - ① |
| ~ | Unmounting volumes in target (in parallel)                 | ✓ Initialized | - ① |
| ~ | Breaking reverse SnapMirror relationships (in parallel)    | ✓ Initialized | - ① |
| ~ | Updating VM networks (in parallel)                         | ✓ Initialized | - ① |
| ~ | Powering on VMs in protection group - DemoRG1 - in source  | ✓ Initialized | - ① |
| ~ | Deleting reverse SnapMirror relationships (in parallel)    | ✓ Initialized | - ① |
| ~ | Resuming SnapMirror relationships to target (in parallel)  | ✓ Initialized | - ① |

From NetApp BlueXP, we can see that replication health has broken off for the appropriate volumes (those that were mapped to VMC as read-write volumes). During test failover, DRO does not map the destination or replica volume. Instead, it makes a FlexClone copy of the required SnapMirror (or Snapshot) instance and exposes the FlexClone instance, which does not consume additional physical capacity for FSx for ONTAP. This process makes sure that the volume is not modified and replica jobs can continue even during DR tests or triage workflows. Additionally, this process makes sure that, if errors occur or corrupted data is recovered, the recovery can be cleaned up without the risk of the replica being destroyed.

| III NetApp | Disaster Recovery Orches  | strator 💊 Dashboard D     | iscover   Resource Groups   Replic          | cation Plans Job Monitoring |                                       |                      | ¢* @* ®* |
|------------|---------------------------|---------------------------|---|-----------------------------|---------------------------------------|----------------------|----------|
|            | Constant 2<br>Sites       | Resource Group            | Plans 2                                     | 219<br>VMs                  | Protected VMs<br>3<br>Protected       | 0 216<br>Unprotected |          |
|            | Environments              |                           | Topology Canvas                             |                             |                                       | Immersive View ()    |          |
|            | 2<br>Virtual Environments | 2<br>Storage Environments |   |                             |                                       |                      |          |
|            | vCenter Summary           |                           |   | $\rightarrow$               | aws                                   |                      |          |
|            | Custers 3                 | C 22<br>Folders           | On Prem<br>172.21.253.160<br>172.21.254.210 |                             | Cloud<br>44,235,223,88<br>10,49,0,191 |                      |          |
|            | 23<br>Datastores          | 9 45<br>Networks          |   |                             |                                       |                      |          |
|            | Execution Jobs            |                           | Replication Plans                           |                             |                                       |                      |          |
|            | <b>Ø</b> 3                | O<br>In Progress          | Replication Plan                            | Active Site                 | Status                                |                      |          |
|            | Total Jobs                | and collines              | DemoRP                                      | <ul> <li>Source</li> </ul>  | O Activ                               | •).                  |          |

### Ransomware recovery

Recovering from ransomware can be a daunting task. Specifically, it can be hard for IT organizations to pinpoint where the safe point of return is and, once that is determined, to protect recovered workloads from reoccurring attacks from, for example, sleeping malware or vulnerable applications.

DRO addresses these concerns by enabling you to recover your system from any available point in time. You can also recover workloads to functional and yet isolated networks so that applications can function and communicate with each other in a location where they are not exposed to north-south traffic. This gives your security team a safe place to conduct forensics and make sure there is no hidden or sleeping malware.

### **Benefits**

- Use of the efficient and resilient SnapMirror replication.
- Recovery to any available point in time with Snapshot copy retention.
- Full automation of all required steps to recover hundreds to thousands of VMs from the storage, compute, network, and application validation steps.
- Workload recovery with ONTAP FlexClone technology using a method that doesn't change the replicated volume.
  - $\circ\,$  Avoids risk of data corruption for volumes or Snapshot copies.
  - Avoids replication interruptions during DR test workflows.
  - Potential use of DR data with cloud computing resources for workflows beyond DR such as DevTest, security testing, patch or upgrade testing, and remediation testing.
- CPU and RAM optimization to help lower cloud costs by allowing recovery to smaller compute clusters.

#### Using Veeam Replication and FSx for ONTAP for Disaster recovery to VMware Cloud on AWS

Amazon FSx for NetApp ONTAP integration with VMware Cloud on AWS is an AWS-

managed external NFS datastore built on NetApp's ONTAP file system that can be attached to a cluster in the SDDC. It provides customers with flexible, high-performance virtualized storage infrastructure that scales independently of compute resources.

Author: Niyaz Mohamed - NetApp Solutions Engineering

## Overview

For those customers looking to use VMware Cloud on AWS SDDC as the disaster recovery target, FSx for ONTAP datastores can be used to replicate data from on-premises using any validated third-party solution that provides VM replication capability. By adding FSx for ONTAP datastore, it will enable cost optimised deployment than building VMware cloud on AWS SDDC with enormous amount of ESXi hosts just to accommodate the storage.

This approach also helps customers to use pilot light cluster in VMC along with FSx for ONTAP datastores to host the VM replicas. The same process can also be extended as a migration option to VMware Cloud on AWS by gracefully failing over the replication plan.

## **Problem Statement**

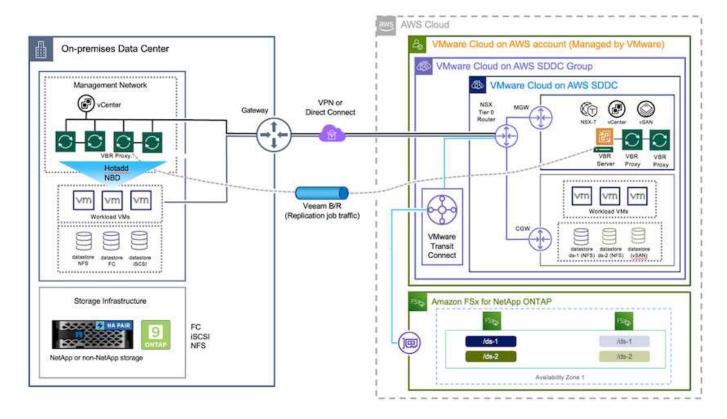
This document describes how to use FSx for ONTAP datastore and Veeam Backup and replication to set up disaster recovery for on-premises VMware VMs to VMware Cloud on AWS using the VM replication functionality.

Veeam Backup & Replication allows onsite and remote replication for disaster recovery (DR). When virtual machines are replicated, Veeam Backup & Replication creates an exact copy of the VMs in the native VMware vSphere format on the target VMware Cloud on AWS SDDC cluster and keeps the copy synchronized with the original VM.

Replication provides the best recovery time objective (RTO) values as there is a copy of a VM in the ready-tostart state. This replication mechanism ensures that the workloads can quickly start in VMware Cloud on AWS SDDC in case of a disaster event. The Veeam Backup & Replication software also optimizes traffic transmission for replication over WAN and slow connections. In addition, it also filters out duplicate data blocks, zero data blocks, swap files and excluded VM guest OS files, and compresses the replica traffic.

To prevent replication jobs from consuming the entire network bandwidth, WAN accelerators and network throttling rules can be put in place. The replication process in Veeam Backup & Replication is job driven which means replication is performed by configuring replication jobs. In case of a disaster event, failover can be triggered to recover the VMs by failing over to its replica copy.

When failover is performed, a replicated VM takes over the role of the original VM. Fail over can be performed to the latest state of a replica or to any of its good known restore points. This enables ransomware recovery or isolated testing as needed. In Veeam Backup & Replication, failover and failback are temporary intermediate step that should be further finalized. Veeam Backup & Replication offers multiple options to handle different disaster recovery scenarios.



# **Solution Deployment**

### **High level steps**

- 1. Veeam Backup and Replication software is running in on-premises environment with appropriate network connectivity.
- Configure VMware Cloud on AWS, see the VMware Cloud Tech Zone article VMware Cloud on AWS integration with Amazon FSx for NetApp ONTAP Deployment Guide to deploy, configure VMware Cloud on AWS SDDC and FSx for ONTAP as NFS datastore. (A pilot-light environment set up with a minimal configuration can be used for DR purposes. VMs will fail over to this cluster in the event of an incident, and additional nodes can be added).
- 3. Set up replication jobs to create VM replicas using Veeam Backup and Replication.
- 4. Create failover plan and perform failover.
- 5. Switch back to production VMs once the disaster event is complete and primary site is Up.

### Pre-requisites for Veeam VM Replication to VMC and FSx for ONTAP datastores

- 1. Ensure Veeam Backup & Replication backup VM is connected to the source vCenter as well as the target VMware cloud on AWS SDDC clusters.
- 2. The backup server must be able to resolve short names and connect to source and target vCenters.
- 3. The target FSx for ONTAP datastore must have enough free space to store VMDKs of replicated VMs

For additional information, refer to "Considerations and Limitations" covered here.

### **Deployment Details**

Veeam Backup & Replication leverages VMware vSphere snapshot capabilities and during replication, Veeam Backup & Replication requests VMware vSphere to create a VM snapshot. The VM snapshot is the point-in-time copy of a VM that includes virtual disks, system state, configuration and so on. Veeam Backup & Replication uses the snapshot as a source of data for replication.

To replicate VMs, follow the below steps:

- 1. Open the Veeam Backup & Replication Console.
- 2. On the Home view, select Replication Job > Virtual machine > VMware vSphere.
- 3. Specify a job name and select the appropriate advanced control checkbox. Click Next.
  - Select the Replica seeding check box if connectivity between on-premises and AWS has restricted bandwidth.
  - Select the Network remapping (for AWS VMC sites with different networks) check box if segments on VMware Cloud on AWS SDDC do not match that of on-premises site networks.
  - If the IP addressing scheme in on-premises production site differs from the scheme in the AWS VMC site, select the Replica re-IP (for DR sites with different IP addressing scheme) check box.



4. Select the VMs that needs to be replicated to FSx for ONTAP datastore attached to VMware Cloud on AWS SDDC in the Virtual Machines step. The Virtual machines can be placed on vSAN to fill the available vSAN datastore capacity. In a pilot light cluster, the usable capacity of a 3-node cluster will be limited. The rest of the data can be replicated to FSx for ONTAP datastores. Click Add, then in the Add Object window select the necessary VMs or VM containers and click Add. Click Next.

### Virtual Machines

Select one or more VMs to replicate. Use exclusion settings to exclude specific VMs and virtual disks from replication.

|                                | Name         | Туре            | Size    | ^ | Add         |
|--------------------------------|--------------|-----------------|---------|---|-------------|
| Virtual Machines               | TestVeeam21  | Virtual Machine | 873 MB  |   | Remove      |
| Destination                    | TestVeeam22  | Virtual Machine | 890 MB  |   | nethave     |
| Destribution                   | TestVeeam23  | Virtual Machine | 883 MB  |   | C.          |
| Network                        | TestVeeam24  | Virtual Machine | 879 MB  |   | Exclusions  |
|                                | TestVeeam25  | Virtual Machine | 885 MB  |   | Source      |
| Job Settings                   | TestVeeam26  | Virtual Machine | 883 MB  |   |             |
| <b>B</b> + <b>T</b> - <b>C</b> | TestVeeam27  | Virtual Machine | 879 MB  |   |             |
| Data Transfer                  | TestVeeam28  | Virtual Machine | 880 MB  |   | 🕈 Up        |
| Guest Processing               | TestVeeam29  | Virtual Machine | 878 MB  |   | + Down      |
| j                              | TestVeeam30  | Virtual Machine | 876 MB  |   |             |
| Schedule                       | TestVeeam31  | Virtual Machine | 888 MB  |   |             |
|                                | TestVeeam32  | Virtual Machine | 881 MB  |   |             |
| Summary                        | TestVeeam33  | Virtual Machine | 877 MB  |   |             |
|                                | TestVeeam34  | Virtual Machine | 875 MB  |   | -           |
|                                | TestVeeam35  | Virtual Machine | 882 MB  |   | Recalculate |
|                                | WinSQL401    | Virtual Machine | 20.3 GB |   |             |
|                                | WinSQL405    | Virtual Machine | 24.2 GB |   | Total size: |
|                                | Phone course | 10.1 14.4 1.5   |         | Y | 120 GB      |

5. After that, select the destination as VMware Cloud on AWS SDDC cluster / host and the appropriate resource pool, VM folder and FSx for ONTAP datastore for VM replicas. Then Click **Next**.

| Choose               |
|----------------------|
| Choose               |
| Choose               |
| N1947A 1050/AC94/100 |
|                      |
| Choose               |
|                      |
| Choose               |
| Choose               |
|                      |
|                      |

6. In the next step, create the mapping between source and destination virtual network as needed.

| Name             | Network mapping:                                |                    | 10.1/  |
|------------------|---|--------------------|--------|
| Virtual Machines | Source network                                  | Target network     | Add    |
| Destination      | SVM_3508 (vDS-Switch0)<br>VM_3510 (vDS-Switch0) | SepSeg SegmentTemp | Edit   |
| Network          |   |                    | Remove |
| Job Settings     |   |                    |        |
| Data Transfer    |   |                    |        |
| Guest Processing |   |                    |        |
| Schedule         |   |                    |        |
| Summary          |   |                    |        |
|                  |   |                    |        |
|                  |   |                    |        |

- 7. In the **Job Settings** step, specify the backup repository that will store metadata for VM replicas, retention policy and so on.
- 8. Update the **Source** and **Target** proxy servers in the **Data Transfer** step and leave **Automatic** selection (default) and keep **Direct** option selected and click **Next**.
- 9. At the **Guest Processing** step, select **Enable application-aware processing** option as needed. Click **Next**.

| Name<br>Virtual Machines | Enable application-aware processing<br>Detects and prepares applications for consistent backup, performs transaction logs<br>configures the OS to perform required application restore steps upon first boot. | processing, and |
|--------------------------|---|-----------------|
| Destination              | Customize application handling options for individual machines and applications<br>Guest interaction proxy:   | Applications    |
| Network                  | Automatic selection   | Choose          |
| lob Settings             | Guest QS credentials:   |                 |
| Data Transfer            |   | Add             |
|                          | Manage accounts   |                 |
| Suest Processing         | Customize guest OS credentials for individual machines and operating systems  | Credentials     |
| Schedule                 | Verify network connectivity and credentials for each machine included in the job  | Test Now        |
|                          |   |                 |

- 10. Choose the replication schedule to run the replication job to run on a regular basis.
- 11. At the **Summary** step of the wizard, review details of the replication job. To start the job right after the wizard is closed, select the **Run the job when I click Finish** check box, otherwise leave the check box unselected. Then click **Finish** to close the wizard.

| Tell An Constant Cons | ingent Depert  |   |              |                            |   |                               |   |  |   |
|--|--|---|--------------|----------------------------|---|-------------------------------|---|--|---|
| Name   | $Q_{\rm c}$ (specimum states) and the second                       | (for -)   | ×            | T Allades                  |   |                               |   |  |   |
| <ul> <li>Sy Max</li> <li>B Instance</li> <li>S Instance</li> </ul>   | Name 7<br>Bill ANP, Appleb01                                       | Type<br>Wavan Replication                                   | Chiarth<br>B | Slatun<br>Stupped          | Last Num<br>2 days apr                  | Last Result<br>Failed         | Next Run<br>Heat scheduled+                           | Turget<br>Outer-1                          | County of MEAABERSENDI-Administration at 2/16/202-  |
| Se feedy<br>Se Active (1)  | 間 455 Sex3601<br>豪 FS-R_18984_20238518<br>豪 FS-R_Repited1_20230313 | Wheney Replication<br>White Replication<br>White reflection | 16           | Shayed<br>Shayed<br>Shaped | 21 days ann<br>2 days agu<br>6 days agu | Success<br>Success<br>Success | cost scheduled+<br>rect scheduled+<br>cost scheduled+ | Cluber 1<br>172.30.190.68<br>172.30.190.68 | Created by VERANBERSDOY Advantator at 3/18/202.<br>Created by VERANBERSDOY Advantator at 1/16/202.<br>Created by VERANBERSDOY Advantator at 1/12/202. |
| Endown Flans     (an 24 Hours     (b Socran     Socran     Socran     Socran   |  |   |              |                            |   |                               |   |  | -   |

Once the replication job starts, the VMs with the suffix specified will be populated on the destination VMC SDDC cluster / host.

| E* Home View Job  |  |   |   |  | Vecom Rockup a                           | nd Replication |  |                   |            |                |                 |   |
|---|--|---|---|--|--|----------------|--|-------------------|------------|----------------|-----------------|---|
| ban Sam Kny Statetes Report   | Gene Duzble Delete   |   |   |  |  |                |  |                   |            |                |                 |   |
| Jub Control Details   | Manage Job   |   |   | 1.4  |  |                |  |                   |            |                |                 |   |
| fome  | Q. Type in an object name to a   | anth fur  |   | ×  |  |                |  |                   |            |                |                 |   |
| The Jobs  | Name   | Type  | Objects   | Status   | Lest Run                                 | Last Result    | Next Run   | Target            | Descriptio | in 1           |                 |   |
| SP Replication  | 辦 AVS_Repict001  | Whyare Replicatio   | 0 2   | Stopped  | 19 days ago                              | Success        | <not scheduled=""></not>   | Ouster-1          | Created by | VEEAMERPSRV    | 03-Administret  | or at 2/16/2023 2:12 AM   |
| E Replicas  | 谢 ANF_Replob01   | WAwave Replicatio   | n 6   | Stopped  | 6 days ago                               | Falled         | <not scheduled+<="" td=""><td>Cluster-1</td><td>Created by</td><td>Y VEEAMERPSRV</td><td>03\Administrat</td><td>or Mt 2/16/2023 T:27 AM</td></not> | Cluster-1         | Created by | Y VEEAMERPSRV  | 03\Administrat  | or Mt 2/16/2023 T:27 AM   |
| 🔂 Seady   | 書 FSaN, Replice01, 20230313  | Whivare Replicatio  | n 5.  | Stopped  | 3 days ago                               | Success        | <not scheduled=""></not>   | 172.30.160.66     | Created by | Y VEEAMBICPSRV | /05\Adwinistrat | or #13/15/2023 2:53 AM  |
| Fallover Plans  | 密F5x10_16V84_20230316  | Mware Replicatio  | n 16  | Stopped  | I days ago                               | Success        | unot scheduled>  | 172.30.160.68     | Created by | Y VEFAMERPSAV  | 05,Administrat  | or at 3/16/2023 6-57 AM   |
|   | Processing rate: 49<br>Bottlenuck: Pro<br>Name 5   | MB/s Re<br>ny Tra<br>stue Act   | occued<br>ed<br>milemet   | 256 GB (100%)<br>256 GB<br>38.9 MB (+996+  | STATUS<br>Success<br>Warnings<br>0 Emose |                | 16 O   | UGHISUT (ALL TIME | 1          |                | 1               | Speed 201 M   |
|   |  |   |   |  |  |                |  |                   |            |                |                 | 67.09   |
|   | TestVeean02  | Success O :   | Processing Test   | /eeam06  |  |                |  |                   |            |                |                 |   |
|   |  |   | Processing Test<br>Processing Test  |  |  |                |  |                   |            |                |                 | 13:21   |
|   | 🚰 TestVecano3 🔇  | Succes O  | 1. Star 1. Star 1.  | /eesm07  |  |                |  |                   |            |                |                 | 13.21   |
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For additional information for Veeam replication, refer to How Replication Works.

#### Step 2: Create a failover plan

When the initial replication or seeding is complete, create the failover plan. Failover plan helps in performing failover for dependent VMs one by one or as a group automatically. Failover plan is the blueprint for the order in which the VMs are processed including the boot delays. The failover plan also helps to ensure that critical dependant VMs are already running.

To create the plan, navigate to the new sub section called Replicas and select Failover Plan. Choose the appropriate VMs. Veeam Backup & Replication will look for the closest restore points to this point in time and use them to start VM replicas.



The failover plan can only be added once the initial replication is complete and the VM replicas are in Ready state.



The maximum number of VMs that can be started simultaneously when running a failover plan is 10.



During the failover process, the source VMs will not be powered off.

To create the Failover Plan, do the following:

- 1. On the Home view, select Failover Plan > VMware vSphere.
- 2. Next, provide a name and a description to the plan. Pre and Post-failover script can be added as required. For instance, run a script to shutdown VMs before starting the replicated VMs.

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| Backup Replication<br>Job - Job - Policy<br>Primary Jobs<br>Home  | New Fallover Plan<br>General           | ind description for this failover plan, and optionally specify scripts to trigger before and after the failover.   |
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3. Add the VMs to the plan and modify the VM boot order and boot delays to meet the application dependencies.

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For additional information for creating replication jobs, refer Creating Replication Jobs.

During failover, the source VM in the production site is switched over to its replica at the disaster recovery site. As part of the failover process, Veeam Backup & Replication restores the VM replica to the required restore point and moves all I/O activities from the source VM to its replica. Replicas can be used not only in case of a disaster, but also to simulate DR drills. During failover simulation, the source VM remains running. Once all the necessary tests have been conducted, you can undo the failover and return to normal operations.



Make sure network segmentation is in place to avoid IP conflicts during DR drills.

To start the failover plan, simply click in **Failover Plans** tab and right click on the failover plan. Select **Start**. This will failover using the latest restore points of VM replicas. To fail over to specific restore points of VM replicas, select **Start to**.

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| estore type: Failover Plan<br>initiated by: VEEAMBKPSRV05\Administrator<br>M name Status<br>TestVeeam02 Processing<br>TestVeeam03 Processing<br>TestVeeam04 Processing<br>TestVeeam05 Processing<br>TestVeeam06 Processing<br>TestVeeam07 Processing<br>TestVeeam08 Processing<br>TestVeeam08 Processing<br>TestVeeam08 Processing<br>TestVeeam08 Processing<br>TestVeeam08 Processing<br>TestVeeam08 Processing<br>TestVeeam10 Processing<br>TestVeeam10 Processing<br>TestVeeam10 Processing<br>TestVeeam10 Processing<br>TestVeeam10 Processing<br>TestVeeam13 Pending<br>TestVeeam13 Pending<br>TestVeeam14 Pending<br>TestVeeam16 Pending<br>TestVeeam16 Pending<br>TestVeeam16 Pending<br>TestVeeam16 Pending<br>TestVeeam16 Pending<br>TestVeeam16 Pending<br>TestVeeam16 Pending<br>TestVeeam16 Pending   | Start t<br>Log<br>Message<br>Processing VM: TestVeeam01<br>Waiting 0 sec before the next VM<br>Processing VM: TestVeeam03<br>Waiting 0 sec before the next VM<br>Processing VM: TestVeeam04<br>Waiting 0 sec before the next VM<br>Processing VM: TestVeeam05<br>Waiting 0 sec before the next VM<br>Processing VM: TestVeeam06<br>Waiting 0 sec before the next VM<br>Processing VM: TestVeeam07<br>Waiting 0 sec before the next VM<br>Processing VM: TestVeeam07<br>Waiting 0 sec before the next VM<br>Processing VM: TestVeeam07<br>Waiting 0 sec before the next VM<br>Processing VM: TestVeeam08<br>Waiting 0 sec before the next VM<br>Processing VM: TestVeeam09<br>Waiting 0 sec before the next VM<br>Processing VM: TestVeeam09  | ime: 3/23/2023 11:<br>1<br>1<br>1<br>1                               | 53:59 PM |               | Dui<br>0:<br>0:<br>0:<br>0:<br>0:<br>0:<br>0:<br>0:<br>0:<br>0:<br>0:<br>0:       | k00:23<br>k00:23<br>k00:22<br>k00:22<br>k00:22<br>k00:22<br>k00:22   |   |
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| Restore type:       Failover Plan         initiated by:       VEEAMBKPSRV05\Administrator         VM name       Status         TestVeeam02       Processing         TestVeeam03       Processing         TestVeeam04       Processing         TestVeeam05       Processing         TestVeeam06       Processing         TestVeeam07       Processing         TestVeeam08       Processing         TestVeeam09       Processing         TestVeeam09       Processing         TestVeeam09       Processing         TestVeeam09       Processing         TestVeeam10       Processing         TestVeeam11       Pending         TestVeeam13       Pending         TestVeeam14       Pending         TestVeeam15       Pending         TestVeeam14       Pending         WinSQL401       Pending         WinSQL402       Pending         WinSQL404       Pending         WinSQL403       Pending        | Start t<br>Log<br>Message<br>Processing VM: TestVeeam01<br>Waiting 0 sec before the next VM<br>Processing VM: TestVeeam03<br>Waiting 0 sec before the next VM<br>Processing VM: TestVeeam04<br>Waiting 0 sec before the next VM<br>Processing VM: TestVeeam05<br>Waiting 0 sec before the next VM<br>Processing VM: TestVeeam06<br>Waiting 0 sec before the next VM<br>Processing VM: TestVeeam07<br>Waiting 0 sec before the next VM<br>Processing VM: TestVeeam07<br>Waiting 0 sec before the next VM<br>Processing VM: TestVeeam07<br>Waiting 0 sec before the next VM<br>Processing VM: TestVeeam08<br>Waiting 0 sec before the next VM<br>Processing VM: TestVeeam09<br>Waiting 0 sec before the next VM<br>Processing VM: TestVeeam09  | ime: 3/23/2023 11:<br>1<br>1<br>1<br>1                               | 53:59 PM |               | Dui<br>0:<br>0:<br>0:<br>0:<br>0:<br>0:<br>0:<br>0:<br>0:<br>0:<br>0:<br>0:<br>0: | <ul> <li>k00:23</li> <li>k00:23</li> <li>k00:22</li> <li>k00:22</li> <li>k00:22</li> <li>k00:22</li> <li>k00:22</li> <li>k00:22</li> <li>k00:22</li> </ul>                                 |   |
| Restore type:       Failover Plan         nitiated by:       VEEAMBKPSRV05\Administrator         VM name       Status         TestVeeam02       Processing         TestVeam03       Processing         TestVeeam04       Processing         TestVeeam05       Processing         TestVeeam06       Processing         TestVeeam07       Processing         TestVeeam07       Processing         TestVeeam07       Processing         TestVeeam07       Processing         TestVeeam07       Processing         TestVeeam07       Processing         TestVeeam08       Processing         TestVeeam10       Processing         TestVeeam11       Pending         TestVeeam13       Pending         TestVeeam14       Pending         TestVeeam15       Pending         TestVeeam14       Pending         TestVeeam15       Pending         WinSQL401       Pending         WinSQL404       Pending   | Start to<br>Log<br>Message<br>Processing VM: TestVeeam01<br>Waiting 0 sec before the next VM<br>Processing VM: TestVeeam03<br>Waiting 0 sec before the next VM<br>Processing VM: TestVeeam04<br>Waiting 0 sec before the next VM<br>Processing VM: TestVeeam05<br>Waiting 0 sec before the next VM<br>Processing VM: TestVeeam06<br>Waiting 0 sec before the next VM<br>Processing VM: TestVeeam07<br>Waiting 0 sec before the next VM<br>Processing VM: TestVeeam08<br>Waiting 0 sec before the next VM<br>Processing VM: TestVeeam08<br>Waiting 0 sec before the next VM<br>Processing VM: TestVeeam09<br>Waiting 0 sec before the next VM<br>Processing VM: TestVeeam10<br>Waiting 0 sec before the next VM | ime: 3/23/2023 11:<br>1<br>1<br>1<br>1<br>1<br>1<br>1<br>1<br>1<br>1 | 53:59 PM |               | Dui<br>0:<br>0:<br>0:<br>0:<br>0:<br>0:<br>0:<br>0:<br>0:<br>0:<br>0:<br>0:<br>0: | <ul> <li>k00:23</li> <li>k00:23</li> <li>k00:22</li> <li>k00:22</li> <li>k00:22</li> <li>k00:22</li> <li>k00:22</li> <li>k00:22</li> <li>k00:22</li> <li>k00:22</li> <li>k00:22</li> </ul> |   |

The state of the VM replica changes from Ready to Failover and VMs will start on the destination VMware Cloud on AWS SDDC cluster / host.

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| 8 8 8  | Cluster-1 Actions<br>Summary Montal Configure Permissions Heats   | VMs Datastores Networks Updates  |  |  |
| 15:00C-Datacenter           172:30:80:68           172:30:80:68           172:30:80:68           172:30:80:68           172:30:80:68           172:30:80:68           172:30:80:68           172:30:80:68           172:30:80:68           172:30:80:68           172:30:80:80           18:10:80:80           19:10:80:80           10:10:80:80 | Custer Details  | B Capacity and Usage Let update at 155 me<br>CHU BAR OF CHU BAR OF A<br>16.62 (HT undat at 155 me<br>Henory BAR OF A<br>242.03 m Bar of A<br>242.03 m Bar of A<br>3,352.09 m KM OF<br>atoute<br>the<br>UKW KTATS | VSphere DRS<br>Couter DRS team ()<br>VM DRS team ()<br>DRS<br>Recommendations:<br>DRS Feature:<br>0<br>VM DRS team ()<br>DRS<br>Recommendations:<br>DRS Feature:<br>0<br>VM DRS team ()<br>DRS | 11<br>3 Vila<br>3 Vila<br>3 Vila<br>3 Vila<br>6 Vila |
| (2) TestVeeam00<br>(2) TestVeeam12<br>(2) TestVeeam12<br>(2) TestVeeam15<br>(2) TestVeeam16<br>(2) TestVeeam16<br>(2) TestVeeam16<br>(2) WesSQL400<br>(2) WesSQL400<br>(2) WesSQL400<br>(2) WesSQL400  | Related Objects II VSphere HA<br>Datacenter Bit SDOC-Datacenter Prestine HA<br>Prestine HA<br>Heat Montaning:<br>VM Montaning | Dualing<br>Dualing<br>Dualing<br>Dualing<br>VM and Application Memberry  | VSAN VSAV usage 3.19 Tb/0.37 TB (00.79%) VSAV usage 0.019 Tb/0.37 TB (00.79%) VSAV Insath © OK VSAN Pertemance IOPS, throughput, and latency statistics for the past 2 hours. KOPS ©           | II<br>Detais *<br>Detais<br>Detais                   |

Once the failover is complete, the status of the VMs will change to "Failover".

| Name 7          | Init Tiane  |  |  |   |  |   |   |  |
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Veeam Backup & Replication stops all replication activities for the source VM until its replica is returned to the Ready state.

For detailed information about failover plans, refer to Failover Plans.

When the failover plan is running, it is considered as an intermediate step and needs to be finalized based on the requirement. The options include the following:

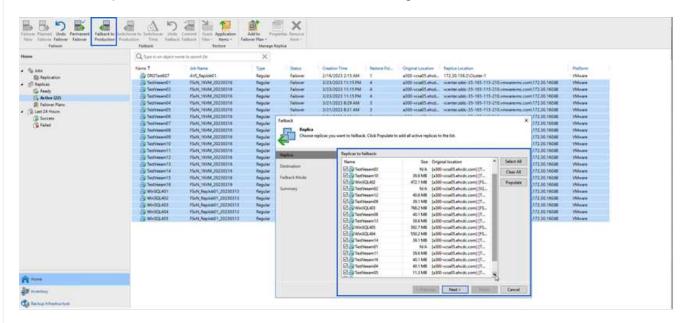
• Failback to production - switch back to the original VM and transfer all changes that took place while the VM replica was running to the original VM.



When you perform failback, changes are only transferred but not published. Choose **Commit failback** (once the original VM is confirmed to work as expected) or **Undo failback** to get back to the VM replica If the original VM is not working as expected.

- **Undo failover** switch back to the original VM and discard all changes made to the VM replica while it was running.
- **Permanent Failover** permanently switch from the original VM to a VM replica and use this replica as the original VM.

In this demo, Failback to production was chosen. Failback to the original VM was selected during the Destination step of the wizard and "Power on VM after restoring" check box was enabled.



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Failback commit is one of the ways to finalize failback operation. When failback is committed, it confirms that the changes sent to the VM which is failed back (the production VM) are working as expected. After the commit operation, Veeam Backup & Replication resumes replication activities for the production VM.

For detailed information about the failback process, refer Veeam documentation for Failover and Failback for replication.

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| E Faliper Plans  | Statissen04  | PS-N_18VM_20230316<br>PS-N_18VM_20230316              | Replie<br>Replie   | Faillack<br>Faillack  | 1/24/2023 148 AM  | - C   |  | vision and 15-10-115-210 meaning control 172 30 16008  | Videore              |
| Ta Last 24 Moury   | Continuendo .  | Plan, INVA, 20230314                                  | Fergular   | FallerA.  | MACTOR STATE  | 1   |  | reams add -13-145-115-210 cmastering cam 172.56 16668  | Villens              |
| (S house   | Co Testiment?  | FtaN 18VM 20230316                                    | Replie   | Failtack  | 3/34/2023 1/13 AM   | 2   |  | 1007001 add: 23-003-113-210 cmcaretons cont/172.30 1604  | Whene                |
| () Warring   | Testveentill   | FLN 18VM 2020016                                      | Reporter   | Tailant.  | 1/24/2023 1/28 AM   | 10  |  | manter add-15-185-115-215 umummime.com/172.0516568   | Videoww              |
| C Falad  | Testforen00  | PSeN,16VM,20230318                                    | Report   | Failurb   | 8/24/2022 1.27 AM   | 2   |  | 10 million and 25-165-115-210 company cont 112 30 18048  | Witness              |
|  | - Terrissen 12   | F549,14944,25220316                                   | Tappint  | Faituch.  | 1/54/2023 1/27 AM   |   | alto-statt mut.  | scanar add: 25-165-115-210.umages-roc.com.172.30.16008   | Waters               |
|  | CQ Textment II   | FERCHWALDEDDITE                                       | Fepalet  | Failure   | 1/24/2023 1-44 AM   | - C   | a100-vr1e05.etes   | 104000 addit 23-163-115-212-00-00-00-00-00-00-00-00-00-00-00-00-00   | Vitage               |
|  | 27 Permanenta  | FS/N,18VM,00230316                                    | Report /   | failurs.  | B/04/0003 127 AM  |   | #100-stra01abutt.  | 104100 alle 25-165-115-210.000 and an inc card, 172.30.58048   | Warmer               |
|  | Januar 13  | PERCHANCELED IN                                       | Repular  | Tallinik  | 1/3A/2023 1/34 AM   | 5   |  | viame add: 25-103-115-210-immericanity/22.30.25008   | Videon               |
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|  | Scientissen15  | APPLICEDC WART WAR                                    | Repúlar :  | Fallock   | 1/04/2023 1:25 AM   | *   |  | scarser abit. 25-143-115-210.cm.are-mc.com/172.30.16008  | - Minan              |
|  | EQ Textossamile  | FIGH, NEVA, 20230210                                  | Replier  | Faillets.   | B/2A/202X 1/32 AM   |   |  | Name and 31-181-115-210 amage mc com/172.30 1606   | Villeet              |
|  | WHOCH APT  | PSels, Replate(1, 20230113                            | Repaire  | Fathers   | 5/24/2023 1/37 AM   | - Si  |  | reams add: 13-105-115-210  | Ween                 |
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| 1. 相当出门 :  | Americans  |   |  |   |   |   |  |  |                      |
| Sup Replication CDP Railup Copy Re<br>b+ Job = Policy Copy Inb =   | An  |   |  |   |   |   |  |  |                      |
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| chup Feydicarbon CDP Backsop Copy Te<br>Is - Jols - Palicy Copy - Init -<br>Primary Inth - Austiliary Initia<br>me<br>Tg Adva  | Redered Actions  | Flan, Baymond (, 20130111                             | Napole<br>X  | Talbert<br>States   | Alter Could to Base   | End free<br>school for  |  |  |                      |
| chap flaghilition (201) Bachap Copy Inte<br>8 + John - Parky Copy Inte<br>Interpretent<br>me<br>1/2 Ann<br>1/2 Ann<br>1/2 Ann<br>1/2 Ann   | Renter Faller<br>Renter Faller<br>Renter Control (1997)<br>Renter Control  | Flan, Baymond (, 20130111                             | Require<br>X<br>Service Test   | Patherst<br>2004<br>Secrets   | Size 2003 1 28 Ave  | 1/24/2023   | 200 AM   |  |                      |
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| day feptication (20) Backup Cay fe<br>to ba - Arico Cay features for<br>freewy tota Anality tota<br>The Anal   | Restored and the second and the seco   | Flan, Baymond (, 20130111                             | Require<br>X<br>Second Fablest<br>Correct Fablest  | falled<br>Dote:<br>Screen<br>Screen   | Start Time 1<br>Start Time 1  | 3/24/2023<br>3/24/2023<br>3/24/2023   | 200 AM<br>200 AM<br>200 AM<br>200 AM   |  |                      |
| chap Englanden COP Building Copy Tail<br>Training Join Analysis<br>Training Join Analysis<br>Training Join Analysis<br>Training Join Analysis<br>Training Joint Training<br>Training Joint Training<br>Training Training<br>Training<br>Training<br>Training<br>Training<br>Training<br>Training<br>Training<br>Training<br>Training<br>Training<br>Training<br>Training<br>Training<br>Training<br>Training<br>Training<br>Training<br>Training<br>Training<br>Training<br>Training<br>Training<br>Training<br>Training<br>Training<br>Training<br>Training<br>Training<br>Training<br>Training<br>Training<br>Training<br>Training<br>Training<br>Training<br>Training<br>Training<br>Training<br>Training<br>Training<br>Training<br>Training<br>Training<br>Training<br>Training<br>Training<br>Training<br>Training<br>Training<br>Training<br>Training<br>Training<br>Training<br>Training<br>Training<br>Training<br>Training<br>Training<br>Training<br>Training<br>Training<br>Training<br>Training<br>Training<br>Training<br>Training<br>Training<br>Training<br>Training<br>Training<br>Training<br>Training<br>Training<br>Training<br>Training<br>Training<br>Training<br>Training<br>Training<br>Training<br>Training<br>Training<br>Training<br>Training<br>Training<br>Training<br>Training<br>Training<br>Training<br>Training<br>Training<br>Training<br>Training<br>Training<br>Training<br>Training<br>Training<br>Training<br>Training<br>Training<br>Training<br>Training<br>Training<br>Training<br>Training<br>Training<br>Training<br>Training<br>Training<br>Training<br>Training<br>Training<br>Training<br>Training<br>Training<br>Training<br>Training<br>Training<br>Training<br>Training<br>Training<br>Training<br>Training<br>Trai | Attions<br>Attions<br>Attions<br>Attions<br>Attions<br>Attions<br>Attions<br>Attions<br>Attions<br>Attions<br>Attions<br>Attions<br>Attions<br>Attions<br>Attions<br>Attions<br>Attions<br>Attions<br>Attions<br>Attions<br>Attions<br>Attions<br>Attions<br>Attions<br>Attions<br>Attions<br>Attions<br>Attions<br>Attions<br>Attions<br>Attions<br>Attions<br>Attions<br>Attions<br>Attions<br>Attions<br>Attions<br>Attions<br>Attions<br>Attions<br>Attions<br>Attions<br>Attions<br>Attions<br>Attions<br>Attions<br>Attions<br>Attions<br>Attions<br>Attions<br>Attions<br>Attions<br>Attions<br>Attions<br>Attions<br>Attions<br>Attions<br>Attions<br>Attions<br>Attions<br>Attions<br>Attions<br>Attions<br>Attions<br>Attions<br>Attions<br>Attions<br>Attions<br>Attions<br>Attions<br>Attions<br>Attions<br>Attions<br>Attions<br>Attions<br>Attions<br>Attions<br>Attions<br>Attions<br>Attions<br>Attions<br>Attions<br>Attions<br>Attions<br>Attions<br>Attions<br>Attions<br>Attions<br>Attions<br>Attions<br>Attions<br>Attions<br>Attions<br>Attions<br>Attions<br>Attions<br>Attions<br>Attions<br>Attions<br>Attions<br>Attions<br>Attions<br>Attions<br>Attions<br>Attions<br>Attions<br>Attions<br>Attions<br>Attions<br>Attions<br>Attions<br>Attions<br>Attions<br>Attions<br>Attions<br>Attions<br>Attions<br>Attions<br>Attions<br>Attions<br>Attions<br>Attions<br>Attions<br>Attions<br>Attions<br>Attions<br>Attions<br>Attions<br>Attions<br>Attions<br>Attions<br>Attions<br>Attions<br>Attions<br>Attions<br>Attions<br>Attions<br>Attions<br>Attions<br>Attions<br>Attions<br>Attions<br>Attions<br>Attions<br>Attions<br>Attions<br>Attions<br>Attions<br>Attions<br>Attions<br>Attions<br>Attions<br>Attions<br>Attions<br>Attions<br>Attions<br>Attions<br>Attions<br>Attions<br>Attions<br>Attions<br>Attions<br>Attions<br>Attions<br>Attions<br>Attions<br>Attions<br>Attions<br>Attions<br>Attions<br>Attions<br>Attions<br>Attions<br>Attions<br>Attions<br>Attions<br>Attions<br>Attions<br>Attions<br>Attions<br>Attions<br>Attions<br>Attions<br>Attions<br>Attions<br>Attions<br>Attions<br>Attions<br>Attions<br>Attions<br>Attions<br>Attions<br>Attions<br>Attions<br>Attions<br>Attions<br>Attions<br>Attions<br>Attions<br>Attions<br>Attions<br>Attions<br>Attions<br>Attions<br>Attions<br>Attions<br>Attions<br>Attions<br>Attions<br>Attions<br>Attions<br>Attions<br>Attions<br>Attions<br>Attions<br>Attions<br>Attions<br>Attions<br>Attions<br>Attions<br>Attions<br>Attions<br>Attions<br>Attions<br>Attions<br>Attions<br>Attions<br>Att | Flan, Baymond (, 20130111                             | Require<br>X<br>Second Fallock<br>General Fallock<br>General Fallock   | falled<br>2000<br>Screen<br>Screen<br>Screen  | 304 0003 1199 AN<br>Sant Time 1<br>Schurgsto 2017 AN<br>Schurgsto 2017 AN   | 3/24/2023<br>3/24/2023<br>3/24/2023<br>3/24/2023  | 200 AM<br>206 AM<br>206 AM<br>206 AM   |  |                      |
| chap Feptications COP Building Copy Fe<br>Financy Join Copy - Tain A<br>Financy Join Annual Copy - Tain A<br>Automorp Nets<br>Phase Annual Copy - Tain A<br>Phase Annual Copy - Tai  | Restance Constraints   | Flan, Baymond (, 20130111                             | Register<br>X<br>Sector Yes<br>Corrent Fallwork<br>Corrent Fallwork<br>Corrent Fallwork<br>Corrent Fallwork  | faitheat<br>Social<br>Social<br>Social<br>Social  | 3040003 1 194444  | 3/34/2023<br>3/24/2023<br>3/24/2023<br>3/24/2023<br>3/24/2023   | 206 AM<br>206 AM<br>206 AM<br>206 AM<br>206 AM<br>206 AM   |  |                      |
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| See Frequencies COT Building Copy Take<br>In Just Park Copy Take<br>Primery Nets Austing Nets<br>Bing Antise<br>See Antise<br>See Antise<br>See Antise Takes<br>See Antis  | Average of the second sec  | Flan, Baymond (, 20130111                             | Require<br>Sector Testing<br>Connect Failures<br>Connect Failures<br>Connect Failures<br>Connect Failures<br>Connect Failures<br>Connect Failures  | father)<br>Source<br>Source<br>Source<br>Source<br>Source<br>Sources<br>Sources   | SecTime 1<br>SecTime 1<br>ISACUUT 2014<br>ISACUUT 201 | 3/24/2023<br>3/24/2023<br>3/24/2023<br>3/24/2023<br>3/24/2023<br>3/24/2023<br>3/24/2023<br>3/24/2023  | 206 AM<br>206 AM<br>206 AM<br>206 AM<br>206 AM<br>206 AM<br>206 AM<br>206 AM<br>206 AM<br>206 AM   | version and 21-112-112-212 answers of a set 172-242 Million  |                      |
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| See Feedbackers COI Building Copy Take<br>Training Nets Austing Copy Take<br>Primary Nets Austing Nets<br>See Address See Australia<br>Se Addres 10<br>Se Addres 10<br>Se Address See Australia<br>Se Copy See Australia<br>Se Address See Australia<br>Sec Address See Australia<br>Sec Address Sec Address   | Average of the second sec  | Flan, Baymond (, 20130111                             | Inquire<br>Sector Top<br>Correct Fallows<br>Correct Fallows   | Tertest<br>Tersine<br>Socian<br>Socian<br>Socian<br>Socian<br>Socian<br>Socian<br>Socian<br>Socian<br>Socian<br>Socian  | SecTime 1<br>SecTime 1<br>Indext023 SetTem<br>Indext023 SetTem<br>Indext023 SetTem<br>Indext023 SetTem<br>Indext023 SetTem<br>Indext023 SetTem<br>Indext023 SetTem  | <ul> <li>5/54/2023</li> </ul> | 206 AM<br>206 AM   |  |                      |
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| Copy Englandon COP Building Copy File<br>The Vac Protocol<br>Protocol Links<br>Protocol Links<br>Proto   | Avidence   | Flan, Baymond 1, 20130111                             | Negative<br>Sectors Tops<br>Connet Fallows<br>Connet Fallows   | Robert<br>Robert<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Screen<br>Sc  | Start Time 1<br>15447021 2014 198444<br>19447021 2014<br>19447021 2014  | 5/24/2023<br>1/24/2023<br>1/24/2023<br>1/24/2023<br>1/24/2023<br>1/24/2023<br>1/24/2023<br>1/24/2023<br>1/24/2023<br>1/24/2023<br>1/24/2023<br>1/24/2023<br>1/24/2023<br>1/24/2023  | 200 and 3 and<br>201 and<br>202 and<br>202 and<br>202 and<br>203 and  | Task succe   | essful               |
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After failback to production is successful, the VMs are all restored back to the original production site.

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# Conclusion

FSx for ONTAP datastore capability enables Veeam or any validated third-party tool to provide low-cost DR solution using Pilot light cluster and without standing up large number of hosts in the cluster just to accommodate the VM replica copy. This provides a powerful solution to handle a tailored, customized disaster recovery plan and also allows to reuse existing backup products in house to meet the DR needs, thus enabling cloud-based disaster recovery by exiting DR datacentres on-premises. Failover can be done as planned failover or failover with a click of a button when disaster occurs, and decision is made to activate the DR site.

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

https://netapp.hosted.panopto.com/Panopto/Pages/Embed.aspx?id=15fed205-8614-4ef7-b2d0-b061015e925a

# Migrating Workloads on AWS / VMC

TR 4942: Migrate Workloads to FSx ONTAP datastore using VMware HCX

A common use case for VMware Cloud (VMC) on Amazon Web Services (AWS), with its supplemental NFS datastore on Amazon FSx for NetApp ONTAP, is the migration of VMware workloads. VMware HCX is a preferred option and provides various migration methods to move on-premises virtual machines (VMs) and their data, running on any VMware supported datastores, to VMC datastores, which includes supplemental NFS datastores on FSx for ONTAP.

Author(s): NetApp Solutions Engineering

# Overview: Migrating virtual machines with VMware HCX, FSx ONTAP supplemental datastores, and VMware Cloud

VMware HCX is primarily a mobility platform that is designed to simplify workload migration, workload rebalancing, and business continuity across clouds. It is included as part of VMware Cloud on AWS and offers many ways to migrate workloads and can be used for disaster recovery (DR) operations.

This document provides step-by-step guidance for deploying and configuring VMware HCX, including all its main components, on-premises and on the cloud data center side, which enables various VM migration mechanisms.

For more information, see Introduction to HCX Deployments and Install Checklist B - HCX with a VMware Cloud on AWS SDDC Destination Environment.

## **High-level steps**

This list provides the high-level steps to install and configure VMware HCX:

- 1. Activate HCX for the VMC software-defined data center (SDDC) through VMware Cloud Services Console.
- 2. Download and deploy the HCX Connector OVA installer in the on-premises vCenter Server.
- 3. Activate HCX with a license key.
- 4. Pair on-premises VMware HCX Connector with VMC HCX Cloud Manager.
- 5. Configure the network profile, compute profile, and service mesh.
- 6. (Optional) Perform Network Extension to extend the network and avoid re-IP.
- 7. Validate the appliance status and ensure that migration is possible.
- 8. Migrate the VM workloads.

## Prerequisites

Before you begin, make sure the following prerequisites are met. For more information, see Preparing for HCX Installation. After the prerequisites are in place, including connectivity, configure and activate HCX by generating a license key from the VMware HCX Console at VMC. After HCX is activated, the vCenter Plug- in is deployed and can be accessed by using the vCenter Console for management.

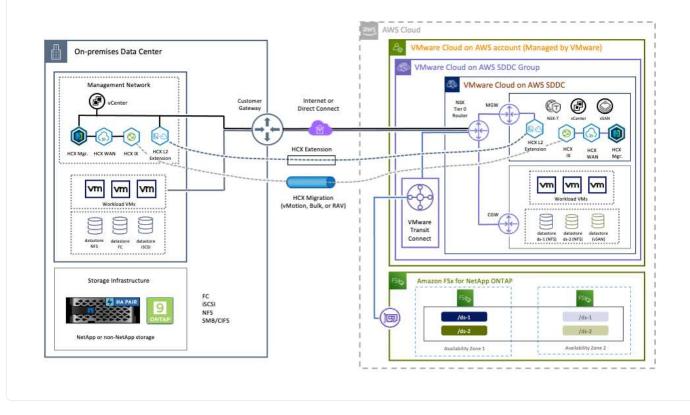
The following installation steps must be completed before proceeding with HCX activation and deployment:

- 1. Use an existing VMC SDDC or create a new SDDC following this NetApp link or this VMware link.
- 2. The network path from the on-premises vCenter environment to the VMC SDDC must support migration of VMs by using vMotion.
- 3. Make sure the required firewall rules and ports are allowed for vMotion traffic between the onpremises vCenter Server and the SDDC vCenter.
- 4. The FSx for ONTAP NFS volume should be mounted as a supplemental datastore in the VMC SDDC. To attach the NFS datastores to the appropriate cluster, follow the steps outlined in this NetApp link or this VMware link.

## **High Level Architecture**

For testing purposes, the on-premises lab environment used for this validation was connected through a site-to-site VPN to AWS VPC, which allowed on-premises connectivity to AWS and to VMware cloud SDDC through External transit gateway. HCX migration and network extension traffic flows over the internet between on-premises and VMware cloud destination SDDC. This architecture can be modified to use Direct Connect private virtual interfaces.

The following image depicts the high-level architecture.



# **Solution Deployment**

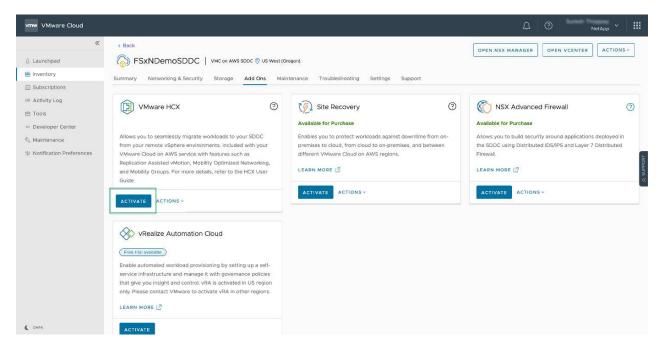
Follow the series of steps to complete the deployment of this solution:

To perform the installation, complete the following steps:

- 1. Log in to the VMC Console at vmc.vmware.com and access Inventory.
- 2. To select the appropriate SDDC and access Add- ons, click View Details on SDDC and select the Add Ons tab.
- 3. Click Activate for VMware HCX.



This step takes up to 25 minutes to complete.



- 4. After the deployment is complete, validate the deployment by confirming that HCX Manager and its associated plug-ins are available in vCenter Console.
- 5. Create the appropriate Management Gateway firewalls to open the ports necessary to access HCX Cloud Manager.HCX Cloud Manager is now ready for HCX operations.

For the on-premises Connector to communicate with the HCX Manager in VMC, make sure that the appropriate firewall ports are open in the on-premises environment.

- 1. From the VMC Console, navigate to the HCX Dashboard, go to Administration, and select the Systems Update tab. Click Request a Download Link for the HCX Connector OVA image.
- 2. With the HCX Connector downloaded, deploy the OVA in the on-premises vCenter Server. Right- click vSphere Cluster and select the Deploy OVF Template option.

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|  | Deploy OVF Template                                 | Select an OVF template × select an OVF template from remote URL or local file system  |               |
| • 11 AND CARACTER  | Select an OVF template     Select a name and folder | Enter a URL to download and install the OVF package from the internet, or browse to a location accessible from your computer,<br>such as a local hard drive, a network share, or a CD/DVD drive.<br>O URL | The           |
| 0 atto-es<br>0 atto-es   | 3 Select a compute resource<br>4 Jewiew details     | Kito Lititut 2 venotesk ver entrest 2 lititotes segued 1 see  |               |
| <ul> <li>G ANF_HC</li> <li>G ANFDAT</li> <li>G AVEANE</li> </ul> | 3. Select storage                                   | UPLOAD FILES VMware-HCX-Connector-4: ova  |               |
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- 3. Enter the required information in the Deploy OVF Template wizard, click Next and then Finish to deploy the VMware HCX Connector OVA.
- 4. Power on the virtual appliance manually.For step- by- step instructions, go to VMware HCX User Guide.

After you deploy the VMware HCX Connector OVA on-premises and start the appliance, complete the following steps to activate HCX Connector. Generate the license key from the VMware HCX Console at VMC and input the license during the VMware HCX Connector setup.

- 1. From the VMware Cloud Console, go to Inventory, select the SDDC, and click View Details. From the Add Ons tab, in the VMware HCX tile, click Open HCX.
- 2. From the Activation Keys tab, click Create Activation Key. Select the System Type as HCX Connector and click Confirm to generate the key. Copy the activation key.

| scriptions Activation Ke | sobcs     |                      |  |                   |           |    |                                    | C DAR |
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| tivation Keys            |           |                      |  |                   |           |    | CREATE ACTIVATIO                   | NIKEY |
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A separate key is required for each HCX Connector deployed on-premises.

3. Log in to the on-premises VMware HCX Connector at "https://hcxconnectorIP:9443" using administrator credentials.



Use the password defined during the OVA deployment.

4. In the Licensing section, enter the activation key copied from step 2 and click Activate.



The on-premises HCX Connector must have internet access for the activation to complete successfully.

- 5. Under Datacenter Location, provide the desired location for installing the VMware HCX Manager onpremises. Click Continue.
- 6. Under System Name, update the name and click Continue.
- 7. Select Yes and then Continue.
- 8. Under Connect Your vCenter, provide the IP address or fully qualified domain name (FQDN) and the credentials for the vCenter Server and click Continue.



Use the FQDN to avoid communication issues later.

9. Under Configure SSO/PSC, provide the Platform Services Controller's FQDN or IP address and click Continue.



Enter the vCenter Server's IP address or FQDN.

- 10. Verify that the information is entered correctly and click Restart.
- 11. After complete, the vCenter Server is displayed as green. Both the vCenter Server and SSO must

have the correct configuration parameters, which should be the same as the previous page.



This process should take approximately 10–20 minutes and for the plug-in to be added to the vCenter Server.

| m HCX Manager                      | Dashboard                     | Applance Summary          | Configuration   | Administration |      | 772.21.254                   | IS7 Version 4.410<br>Type : Connector | admir |
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| VMware-HCX<br>FODN:                | -440<br>VMware-HCX-440        |                           |                 |                | 0    | CPU<br>Used 1407 MHZ         | Free 688 MHZ<br>Capacity 2095 MHZ     | 67%   |
| IP Address:<br>Version:<br>Uptime: | 4.4.1.0<br>20 days, 21 hours, |                           |                 |                | 0    | Memory<br>Used 9691 MB       | Free 2316 MB<br>Capacity 12008 MB     | 81%   |
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#### Step 4: Pair on-premises VMware HCX Connector with VMC HCX Cloud Manager

1. To create a site pair between the on-premises vCenter Server and the VMC SDDC, log in to the onpremises vCenter Server and access the HCX vSphere Web Client Plug- in.

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2. Under Infrastructure, click Add a Site Pairing. To authenticate the remote site, enter the VMC HCX Cloud Manager URL or IP address and the credentials for the CloudAdmin role.

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HCX information can be retrieved from the SDDC Settings page.

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3. To initiate the site pairing, click Connect.



VMware HCX Connector must be able to communicate with the HCX Cloud Manager IP over port 443.

4. After the pairing is created, the newly configured site pairing is available on the HCX Dashboard.

The VMware HCX Interconnect (HCX-IX) appliance provides secure tunnel capabilities over the internet and private connections to the target site that enable replication and vMotion-based capabilities. The interconnect provides encryption, traffic engineering, and an SD-WAN. To create the HCI-IX Interconnect Appliance, complete the following steps:

1. Under Infrastructure, select Interconnect > Multi-Site Service Mesh > Compute Profiles > Create Compute Profile.



Compute profiles contain the compute, storage, and network deployment parameters required to deploy an interconnect virtual appliance. They also specify which portion of the VMware data center will be accessible to the HCX service.

For detailed instructions, see Creating a Compute Profile.

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- After the compute profile is created, create the network profile by selecting Multi-Site Service Mesh > Network Profiles > Create Network Profile.
- 3. The network profile defines a range of IP address and networks that will be used by HCX for its virtual appliances.



This will require two or more IP address. These IP addresses will be assigned from the management network to virtual appliances.

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For detailed instructions, see Creating a Network Profile.



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If you are connecting with an SD-WAN over the internet, you have to reserve public IPs under the Networking and Security section.

4. To create a service mesh, select the Service Mesh tab within the Interconnect option and select onpremises and VMC SDDC sites.

The service mesh establishes a local and remote compute and network profile pair.

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| () Activity Logs<br>A Alerts<br>DICE   | VIEW APPLIANCES RESYNC EDIT DELETE HORE-   |                          |

Part of this process involves deploying HCX appliances that will be automatically configured on both the source and target sites, creating a secure transport fabric.

5. Select the source and remote compute profiles and click Continue.

| Create Service Mesh   | 3 2 3 3 5   |            |
|---|---|------------|
| Select Compute Profiles<br>select one compute profile each in the source and remote pites for activating hybridity services. The select<br>select Source Compute Profile (Crusteria ) | bors will define the resources, where Virtual Machines will be able to consume HCX services.<br>Select Bemode Computer Profile   Computer/site/comp |            |
| 📩 Hint 3006 exc00 kinum zamljačkom 22021 in in critical (regi state for servar zongute.   |   | •• CONTINU |
|   |   |            |

6. Select the service to be activated and click Continue.

| Edit Service Mesh  |   | 1 2 3 4   | 5   |   | ×  |
|--|---|---|---|---|--|
| Select Services to be activated  |   |   |   |   |  |
| CS Assisted Migration Service can't be<br>SRM totegration Service cannot be set  | e selected as one or both the compute profiles as<br>ected as they are not scenard with this HCK with | Hected in previous step doesn't have these services act<br>likition.  | Wated.  |   |  |
| Hybot Hansoned (<br>Hybot Hansoned (<br>Hybot Hansoned Hybot<br>Print Hybot Hybot<br>Pasterfective @<br>App2014 Seasoned St Hansoneses |   | Case-closed Websenkingston ()<br>Etiniciantese Piscarehiatity<br>Of Anished Meyeritie ()<br>Di Anished Meyeritie () | Buik Migration ()<br>Kundowsteine Klosebale Klosebale | Replication Assisted vMotion Migration ()<br>Astronomic Vision Processing | Neteor Edimon ()<br>Motorialese Phoenigibuling |
|  | Vicature has not been activated   |   |   |   | CONTINUE                                       |



An HCX Enterprise license is required for Replication Assisted vMotion Migration, SRM Integration, and OS Assisted Migration.

7. Create a name for the service mesh and click Finish to begin the creation process. The deployment should take approximately 30 minutes to complete. After the service mesh is configured, the virtual infrastructure and networking required to migrate the workload VMs has been created.

| ≡ vichere Gent Q   |            |                      |   |  |            |   |               |                   | C 2              |              |       |
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### Step 6: Migrating Workloads

HCX provides bidirectional migration services between two or more distinct environments such as onpremises and VMC SDDCs. Application workloads can be migrated to and from HCX activated sites using a variety of migration technologies such as HCX bulk migration, HCX vMotion, HCX Cold migration, HCX Replication Assisted vMotion (available with HCX Enterprise edition), and HCX OS Assisted Migration (available with HCX Enterprise edition).

To learn more about available HCX migration technologies, see VMware HCX Migration Types

The HCX-IX appliance uses the Mobility Agent service to perform vMotion, Cold, and Replication Assisted vMotion (RAV) migrations.



The HCX-IX appliance adds the Mobility Agent service as a host object in the vCenter Server. The processor, memory, storage and networking resources displayed on this object do not represent actual consumption on the physical hypervisor hosting the IX appliance.

|  | 172.21.254.82 Actions  |
|--|--|
| <u>)</u> Ø = Ø                               | Summary Monitor Configure Permissions VMs Resource Pools Datastores Networks Updates |
| <ul> <li>galoo-vcsa01.ehcdc.com</li> </ul>   | Hypervisor. VMware ESXI, 7.0.3, 20305777   |
| - 🗈 A300-DataCenter                          | Model: VMware Mobility Platform Processor Type: VMware Virtual Processor             |
| > []] A300-Duster01                          | o Logical Processors: 768<br>NICs: 8   |
| > D TempCluster                              | Virtual Machines: 0  |
| > 🚺 172.21.254.80                            | State Connected<br>Uptime: 29 days   |
| > 🚺 172.21.254.82                            | - Ch.  |
| 3 # a300-esxi02.ehcdc.com (Maintenance Mode) |  |

### VMware HCX vMotion

This section describes the HCX vMotion mechanism. This migration technology uses the VMware vMotion protocol to migrate a VM to VMC SDDC. The vMotion migration option is used for migrating the VM state of a single VM at a time. There is no service interruption during this migration method.



Network Extension should be in place (for the port group in which the VM is attached) in order to migrate the VM without the need to make an IP address change.

1. From the on-premises vSphere client, go to Inventory, right- click on the VM to be migrated, and select HCX Actions > Migrate to HCX Target Site.

| 😑 vSphere Client 🛛 Q, iss   | Actions -HCX_Photon_34<br>Power               | 5 |   | C S venezative coc com >  | ٢       |
|---|---|---|---|---|---------|
|   | Guest OS<br>Shapahots<br>Coon Remote Console  | 2 | on_14   > D 명 후 왕 (1 actions<br>/ Configure Permissions Datalatores Networks Scapitions Updates   |   |         |
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| appo-essibilitiencec.com  | VM Policies                                   |   | F-Addresses (72.2123.0.1)     View ALC 2 P ADDRESSES     View ALC 2 P ADDRESSES     View ALC 2 P ADDRESSES  | 1718.61 M   |         |
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| B HOLPHON H   | db dat Settings .                             |   | Custon Athlibute  |   | ^       |
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| tive antities D VMs migrated to cost  | All Side Recovery actions<br>HOX Actions      | - | CONCERNMENT A MALE CONCERNMENTATION & MALE CONTROLOGY & 45.54   | 09/13/2022 # 45-04 . #300-vcta01 encot com  | 14.0    |

2. In the Migrate Virtual Machine wizard, select the Remote Site Connection (target VMC SDDC).

| ✓ Select Connection   |   |   |                                 | C Related | connecti |
|---|---|---|---------------------------------|-----------|----------|
| (there are 2 records found)   |   |   |                                 |           |          |
| Source: VMware-HCX-440 / VC a300  | -vcsa01.ehcdc.com → Destination: (select) |   |                                 |           |          |
| HCX Cloud - FSxNDemoSDDC / VC. v<br>https://doc.sdoc/54/100-6/08/vmwarevinc.com | center.sddc-54-188-6-128.vmwarevmc.com    |   |                                 |           |          |
| 0   | / VC 172.30.156.2                         |   |                                 |           |          |
| https://172.30.156.9  |   |   |                                 |           |          |
| ✓ Transfer and Placement:   |   |   |                                 |           |          |
|   | (Mandatory: Storage)                      |   | (Migration Profile)             |           | ~        |
|   | Same format as source                     | ~ | (Optional: Switchover Schedule) |           | 0        |
| > Switchover:   |   |   |                                 |           |          |
|   |   |   |                                 |           |          |
| V Extended Options:   |   |   |                                 |           |          |
| Edit Extended Options   |   |   |                                 |           |          |
| O selected  |   |   |                                 | 0,        |          |
| VM for Migration  | Disk / Memory / vCPU                      |   | Migration Info                  |           |          |
| C Loading data  |   |   |                                 |           |          |
| C costing data.   |   |   |                                 |           |          |
|   |   |   |                                 |           |          |
|   |   |   |                                 |           |          |
|   |   |   |                                 |           |          |
|   |   |   |                                 |           |          |

3. Add a group name and under Transfer and Placement, update the mandatory fields (Cluster, Storage, and Destination Network), Click Validate.

| > Ø Source: VMware-HCX-440 / V<br>→ Ø Destination: HCX Cloud - FSx<br>intex Pick side 54-888-6-108 imwareving of | NDemoSDDC / VI | dc.com<br>C vcenter.sddc-54-188-6-128.vmwaren | /mc.com         |                                 | C Relaad Connect        |
|--|----------------|---|-----------------|---------------------------------|-------------------------|
| roup Name: vMotion-vm14-2-vmc  |                |   | Batch size: 1vm | / 2.GB/ 2.GB/ 1vcPu             | Select VMs for Migratio |
| <ul> <li>Transfer and Placement:</li> </ul>  |                |   |                 |                                 | *                       |
| Compute-ResourcePool   |                | DemoDS01 (1644.08/19.18)                      |                 | vMotion                         | ~                       |
| Workloads  |                | Same format as source                         |                 | (Optional: Switchover Schedule) | 0                       |
| Switchover:  |                |   |                 |                                 |                         |
| E Force Power-off VM   |                | Remove Shapshots     Force unmount ISO Images |                 |                                 |                         |
| VM for Migration   |                | Disk / Memory / vCPU                          |                 | Migration Info                  | (à                      |
| V HCX_Photon_14  | o              | 2 GB / 2 GB / 1 VCPU                          |                 |                                 |                         |
| Compute-ResourcePool   | 2              | DemoDS01 (#844G871978)                        | 2               | vMotion                         | ~                       |
| Workloads  |                | Same format as source                         | *               |                                 |                         |
| E Force Power-off VM   |                |   |                 |                                 |                         |

4. After the validation checks are complete, click Go to initiate the migration.



The vMotion transfer captures the VM active memory, its execution state, its IP address, and its MAC address. For more information about the requirements and limitations of HCX vMotion, see Understanding VMware HCX vMotion and Cold Migration.

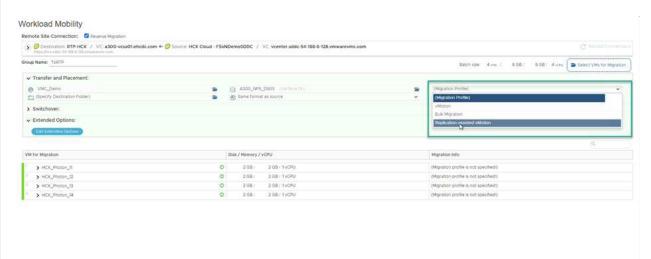
5. You can monitor the progress and completion of the vMotion from the HCX > Migration dashboard.

|   |             |  |   |  |   |           |                         |  |  |                             | KOCKOM V 🛞 (        |
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#### VMware Replication Assisted vMotion

As you might have noticed from VMware documentation, VMware HCX Replication Assisted vMotion (RAV) combines the benefits of bulk migration and vMotion. Bulk migration uses vSphere Replication to migrate multiple VMs in parallel—the VM gets rebooted during switchover. HCX vMotion migrates with no downtime, but it is performed serially one VM at a time in a replication group. RAV replicates the VM in parallel and keeps it in sync until the switchover window. During the switchover process, it migrates one VM at a time with no downtime for the VM.

The following screenshot show the migration profile as Replication Assisted vMotion.



The duration of the replication might be longer compared to the vMotion of a small number of VMs. With RAV, only sync the deltas and include the memory contents. The following is a screenshot of the migration status—it shows how the start time of the migration is the same and the end time is different for each VM.

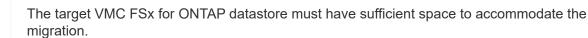
GO VALIDATE M SAVE CLOSE

| vSphere Client.             | Q.                   |         |  |         |               |             |            |           |                     |      |                  |       |                 |      |                   | 5     | & chooled rive driv |                    | ଇ ସ                                   |
|-----------------------------|----------------------|---------|--|---------|---------------|-------------|------------|-----------|---------------------|------|------------------|-------|-----------------|------|-------------------|-------|---------------------|--------------------|---------------------------------------|
| 1.1.1.T                     | <                    | Migrati | on                                       |         |               |             |            |           |                     |      |                  |       |                 |      |                   |       |                     |                    |                                       |
| HCX<br>© Deviced            |                      |         | soling Et Manage                         | ment    | TO HER        | ATE         | 21.0       |           |                     |      |                  |       |                 |      |                   |       |                     | (mag) (1           |                                       |
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For additional information about the HCX migration options and on how to migrate workloads from onpremises to VMware Cloud on AWS using HCX, see the VMware HCX User Guide.



VMware HCX vMotion requires 100Mbps or higher throughput capability.



# Conclusion

Whether you are targeting all-cloud or hybrid cloud and data residing on any type/vendor storage in onpremises, Amazon FSx for NetApp ONTAP along with HCX provide excellent options to deploy and migrate the workloads while reducing the TCO by making the data requirements seamless to the application layer. Whatever the use case, choose VMC along with FSx for ONTAP datastore 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 used to connect the storage and migrate VMs using VMware vSphere replication, VMware vMotion or even NFC copy.

# Takeaways

The key points of this document include:

- You can now use Amazon FSx ONTAP as a datastore with VMC SDDC.
- You can easily migrate data from any on-premises datacenter to VMC running with FSx for ONTAP datastore
- You can easily grow and shrink the FSx ONTAP datastore to meet the capacity and performance requirements during migration activity.

# Where to find additional information

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

VMware Cloud documentation

https://docs.vmware.com/en/VMware-Cloud-on-AWS/

Amazon FSx for NetApp ONTAP documentation

https://docs.aws.amazon.com/fsx/latest/ONTAPGuide

VMware HCX User Guide

• https://docs.vmware.com/en/VMware-HCX/4.4/hcx-user-guide/GUID-BFD7E194-CFE5-4259-B74B-991B26A51758.html

# Region Availability – Supplemental NFS datastore for VMC

Learn more about the the Global Region support for AWS, VMC and FSx ONTAP.



NFS datastore will be available in regions where both services (VMC and FSx ONTAP) are available.

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<br>Availability |
|----------------------------------|------------------|------------------------|-------------------------------|
| US East (Northern<br>Virginia)   | Yes              | Yes                    | Yes                           |
| US East (Ohio)                   | Yes              | Yes                    | Yes                           |
| US West (Northern<br>California) | Yes              | No                     | No                            |
| US West (Oregon)                 | Yes              | Yes                    | Yes                           |
| GovCloud (US West)               | Yes              | Yes                    | Yes                           |
| Canada (Central)                 | Yes              | Yes                    | Yes                           |
| South America (Sao<br>Paulo)     | Yes              | Yes                    | Yes                           |

Last updated on: June 2, 2022.

# EMEA

| AWS Region         | VMC Availability | FSx ONTAP Availability | NFS Datastore<br>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<br>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                           |

# **NetApp Capabilities for Azure AVS**

Learn more about the capabilities that NetApp brings to the Azure VMware Solution (AVS) - 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.

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

- Configuring AVS in Azure
- NetApp Storage Options for AVS
- NetApp / VMware Cloud Solutions

## **Configuring AVS in Azure**

As with on-premises, planning a cloud based virtualization environment is critical for a successful productionready 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.



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.

## **NetApp Storage Options for AVS**

NetApp storage can be utilized in several ways - either as guess connected or as a supplemental NFS datastore - within Azure AVS.

Please visit Supported NetApp Storage Options for more information.

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.

# Solution Use Cases

With NetApp and VMware cloud solutions, many use cases are simple to deploy in Azure AVS. se cases are defined for each of the VMware defined cloud areas:

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

Browse the NetApp solutions for Azure AVS

# Protecting Workloads on Azure / AVS

## Disaster Recovery with ANF and JetStream

Disaster recovery to cloud is a resilient and cost-effective way of protecting the workloads against site outages and data corruption events (for example, ransomware). Using the VMware VAIO framework, on-premises VMware workloads can be replicated to Azure Blob storage and recovered, enabling minimal or close to no data loss and near-zero RTO.

JetStream DR can be used to seamlessly recover the workloads replicated from on-premises to AVS and specifically to Azure NetApp Files. It enables cost-effective disaster recovery by using minimal resources at the DR site and cost-effective cloud storage. JetStream DR automates recovery to ANF datastores via Azure Blob Storage. JetStream DR recovers independent VMs or groups of related VMs into recovery site infrastructure according to network mapping and provides point-in-time recovery for ransomware protection.

This document provides an understanding of the JetStream DR principles of operations and its main components.

- 1. Install JetStream DR software in the on-premises data center.
  - a. Download the JetStream DR software bundle from Azure Marketplace (ZIP) and deploy the JetStream DR MSA (OVA) in the designated cluster.
  - b. Configure the cluster with the I/O filter package (install JetStream VIB).
  - c. Provision Azure Blob (Azure Storage Account) in the same region as the DR AVS cluster.
  - d. Deploy DRVA appliances and assign replication log volumes (VMDK from existing datastore or shared iSCSI storage).
  - e. Create protected domains (groups of related VMs) and assign DRVAs and Azure Blob Storage/ANF.
  - f. Start protection.
- 2. Install JetStream DR software in the Azure VMware Solution private cloud.
  - a. Use the Run command to install and configure JetStream DR.
  - b. Add the same Azure Blob container and discover domains using the Scan Domains option.
  - c. Deploy required DRVA appliances.
  - d. Create replication log volumes using available vSAN or ANF datastores.
  - e. Import protected domains and configure RocVA (recovery VA) to use ANF datastore for VM placements.
  - f. Select the appropriate failover option and start continuous rehydration for near-zero RTO domains or VMs.
- During a disaster event, trigger failover to Azure NetApp Files datastores in the designated AVS DR site.
- 4. Invoke failback to the protected site after the protected site has been recovered.Before starting, make sure that the prerequisites are met as indicated in this link and also run the Bandwidth Testing Tool (BWT) provided by JetStream Software to evaluate the potential performance of Azure Blob storage and its replication bandwidth when used with JetStream DR software. After the pre-requisites, including connectivity, are in place, set up and subscribe to JetStream DR for AVS from the Azure Marketplace. After the software bundle is downloaded, proceed with the installation process described above.

When planning and starting protection for a large number of VMs (for example, 100+), use the Capacity Planning Tool (CPT) from the JetStream DR Automation Toolkit. Provide a list of VMs to be protected together with their RTO and recovery group preferences, and then run CPT.

CPT performs the following functions:

- Combining VMs into protection domains according to their RTO.
- Defining the optimal number of DRVAs and their resources.
- Estimating required replication bandwidth.
- Identifying replication log volume characteristics (capacity, bandwidth, and so on).
- Estimating required object storage capacity, and more.



The number and content of domains prescribed depend upon various VM characteristics such as average IOPS, total capacity, priority (which defines failover order), RTO, and others.

## Install JetStream DR in On-Premises Datacenter

JetStream DR software consists of three major components: JetStream DR Management Server Virtual Appliance (MSA), DR Virtual Appliance (DRVA), and host components (I/O Filter packages). MSA is used to install and configure host components on the compute cluster and then to administer JetStream DR software. The following list provides a high-level description of the installation process:

- 1. Check prerequisites.
- 2. Run the Capacity Planning Tool for resource and configuration recommendations (optional but recommended for proof-of-concept trials).
- 3. Deploy the JetStream DR MSA to a vSphere host in the designated cluster.
- 4. Launch the MSA using its DNS name in a browser.
- 5. Register the vCenter server with the MSA.To perform the installation, complete the following detailed steps:
- After JetStream DR MSA has been deployed and the vCenter Server has been registered, access the JetStream DR plug-in using the vSphere Web Client. This can be done by navigating to Datacenter > Configure > JetStream DR.

| vm vSphere Client   | Menu 🗸 🛛 🔍 Search in a  | environments   | C ⑦ ~ Administrator@EHCDC.COM ~             |
|---|---|--|---|
| a300-vcsa.ehcdc.com   | A300-DataCen  | er ACTIONS ~<br>Infigure Permissions Hosts & Clusters VMs Datasto  | stores Networks Updates                     |
| <ul> <li>A300-DataCenter</li> <li>A300-Cluster</li> <li>a300-esxi02.eh</li> <li>a300-esxi03.eh</li> </ul> | <ul> <li>More         Alarm Definitions         Scheduled Tasks     </li> </ul> | Jet/Sbream DR<br>Protected Domains Statistics Storage Sites Applia | lances Configurations Task Log              |
| a300-esxi04.eh  | Network Protocol Pr   | Site Details   | Alarm Setting                               |
| a300-esxi05.eh  | JetStream DR  | vCenter Server Hostname 172 2                                      | 2 21 253 160                                |
| ANFJSDR-MSA0  |   | Management Appliance Hostname ANFJ                                 | IFJSDR-msa                                  |
| 🔂 AuctionAppA0  |   | Software Version 4.0.0   | 0.0.443                                     |
| 🔂 AuctionAppA2  |   | Subscription ID 0000   | 000000-0000-0000-0000-00000000001 Configure |
| 🖧 AuctionAppA3  |   | Tenant ID / Application ID - CC                                    | Configure                                   |
| 😤 AuctionAppB0  |   | Application Secret + Cr  | Configure                                   |

7. From the JetStream DR interface, select the appropriate cluster.

| 172 21 253 160   |                   |  |   |  |
|--|-------------------|--|---|--|
| A REAL PROPERTY AND A REAL |                   |  |   |  |
| Configure Clusters   |                   |  |   |  |
|  | Select All        | Clear All  | ٩   |  |
| Cluster Name 🔺   | Datacenter Name 🔺 |  | _   |  |
| A300-Cluster   | A300-DataCenter   |  |   |  |
|  |                   |  |   | c  |
|  |                   |  | ~   | Host Details 🔺   |
|  | Ca                | ancel Cor  | nfigure   |  |
|  |                   |  |   |  |
|  |                   |  |   |  |
|  | Cluster Name 🛦    | Select All Cluster Name  Datacenter Name  A300-Cluster A300-DataCenter | Select All Clear All Clear All Cluster Name  A300-Cluster A300-DataCenter | Select All Clear All Q<br>Cluster Name A Datacenter Name A<br>A300-Cluster A300-DataCenter |

8. Configure the cluster with the I/O filter package.

| <i>letStream DR</i> Protected Domains Statistics | Storage Sites Appliances Configurations Task Log           |
|--|--|
| Storage Sites                                    | Add Storage Site   |
| + Add Storage Site Scan Domains                  | ^  |
| Name A   | Storage Site Type *  |
| No Storage Site configured.                      |  |
|  | Access Type *  |
|  |  |
|  | Storage Site Name (Provide a name to identify this Site) * |
| Storage Site Details Alarms                      | ANFDemoblobrepo  |
| Storage Site Details Alarms                      | Acure Blob Storage Account Name *                          |
|  | anfdrdemostor  |
| No storage site selected. Select a storage       | Azure Blob Storage Account Key *                           |
|  |  |
|  | Cancel Add Storage Site                                    |
|  |  |

- 9. Add Azure Blob Storage located at the recovery site.
- 10. Deploy a DR Virtual Appliance (DRVA) from the Appliances tab.



DRVAs can be automatically created by CPT, but for POC trials we recommend configuring and running the DR cycle manually (start protection > failover > failback).

The JetStream DRVA is a virtual appliance that facilitates key functions in the data replication process. A protected cluster must contain at least one DRVA, and typically one DRVA is configured per host. Each DRVA can manage multiple protected domains.

| JetStream DR<br>Protected Domains Statistics | Deploy New DR Virtual A   | ppliance (DRVA)                       |                 |      |            |        |           |        |
|--|---------------------------|---------------------------------------|-----------------|------|------------|--------|-----------|--------|
| DRVAs (DR Virtual Appliances)                | 1. General                | 2. DRVA VM                            | 3. DRVA Netw    | vork | 4. Summary | ^      |           | Q      |
| + Deploy New DRVA                            | Name                      |                                       | ANFdemo001      |      |            |        | Badalla A | ~      |
| Name 🔺                                       | Description (Optional)    |                                       |                 |      |            |        | Details 🔺 |        |
| No DR Virtual Appliance configured.          | Datacenter                |                                       | A300-DataCenter |      |            |        |           |        |
|  | Cluster                   |                                       | A300-Cluster    |      |            | 11     |           |        |
|  | Resource Pool (Optiona    | 1)                                    | -               |      |            |        |           |        |
|  | VM Folder (Optional)      |                                       | -               |      |            |        |           | $\sim$ |
| Replication Log Volume                       | Datastore                 |                                       | A300_NFS_DS04   |      |            |        |           |        |
| replication Log volume                       | Number Of CPUs            |                                       | 8               |      |            |        |           |        |
| + New Replication Log Volume                 | Memory Size               |                                       | 32GB            |      |            |        |           | Q      |
| Disk Path Name 🔺                             | Management Network        |                                       | VM_187          |      |            |        | Details 🔺 |        |
| No DRVA selected. Select a DRVA to vi        | Host(iofilter) to DRVA Da | ta Network                            | VM_187          |      |            |        |           |        |
|  | Replication Network to 0  | Object Store                          | VM_187          |      |            |        |           |        |
|  | Replication Log Network   | C C C C C C C C C C C C C C C C C C C | VM_187          |      |            | $\sim$ |           | $\sim$ |
|  |                           |                                       | Cancel          | Back | Deploy     | ]      |           |        |

In this example, four DRVA's were created for 80 virtual machines.

- 1. Create replication log volumes for each DRVA using VMDK from the datastores available or independent shared iSCSI storage pools.
- 2. From the Protected Domains tab, create the required number of protected domains using information

about the Azure Blob Storage site, DRVA instance, and replication log. A protected domain defines a specific VM or set of VMs within the cluster that are protected together and assigned a priority order for failover/failback operations.

| elect Protected Domai | in: 🗸 Ci | reate Protected Domain                 |                 |            |   | + Create |  |
|-----------------------|----------|--|-----------------|------------|---|----------|--|
|                       |          |  |                 | •          |   |          |  |
|                       |          | 1. General                             | 2. Primary Site | 3. Summary |   |          |  |
|                       |          |  |                 |            | ^ |          |  |
|                       |          | Protected Domain Name                  | ANFPD001        |            |   |          |  |
|                       |          | Priority Level (Optional)              | 1               |            |   |          |  |
|                       |          | Total estimated data size to be protec | ted 1000GB      |            |   |          |  |
|                       |          | DR Virtual Appliance                   | ANFdemo001      |            |   |          |  |
|                       |          | Compression                            | Yes             |            |   |          |  |
|                       |          | Compression Level                      | Default         |            |   |          |  |
|                       |          | Normal GC Storage Overhead             | 50%             |            |   |          |  |
|                       |          | Maximum GC Storage Overhead            | 300%            |            |   |          |  |
|                       |          | Replication Log Storage                | /dev/sdb        |            |   |          |  |
|                       |          | Replication Log Size                   | 94.31GB         |            |   |          |  |
|                       |          | Metadata Size                          | 31.56GB         |            | ~ |          |  |
|                       |          |  | Cancel          | Back Crea  |   |          |  |

3. Select VMs you want to protect and start VM protection of the protected domain. This begins data replication to the designated Blob Store.

Verify that the same protection mode is used for all VMs in a protected domain.

Write- Back(VMDK) mode can offer higher performance.

| elect Protected Domain: ANFPD001 | Start | Protection                                 |   |            |                  |          |       | reate               | Delete                           |            |
|----------------------------------|-------|--|---|------------|------------------|----------|-------|---------------------|----------------------------------|------------|
| ecoverable / Total VMs           |       | tion Mode for selected VMs<br>e-Back(VMDK) |   |            |                  |          | q     |                     |                                  | Edit Detai |
| eplication Status                |       | VM Name                                    | - | # of Disks | Protection Mode  |          | ų     | ANFDemo             | W.                               | 1          |
| emaining Background Data         | 1     | 1  | × |            |                  |          |       | and a second second | 21.253.160)<br>hter\A300-Cluster |            |
| urrent RPO                       |       | AuctionAppA1                               |   | 1          | Write-Back(VMDK) | ~        | ^     | bled                | Itel 1 ASOU-CIUSIEI              |            |
|                                  |       | AuctionAppB1                               |   | 1          | Write-Back(VMDK) | ~        |       | non rei             |                                  |            |
| Protected VMs Settings Ala       |       | AuctionDB1                                 |   | 2          | Write-Back(VMDK) | ~        |       |                     |                                  |            |
|                                  |       | AuctionLB1                                 |   | 1          | Write-Back(VMDK) | ~        | _     |                     |                                  |            |
| + Start Protection               |       | AuctionMSQ1                                |   | 1          | Write-Back(VMDK) | ~        |       |                     |                                  | q          |
|                                  |       | AuctionNoSQL1                              |   | 2          | Write-Back(VMDK) | ~        |       |                     |                                  |            |
| VM Name 🛦                        |       | AuctionWebA1                               |   | 1          | Write-Back(VMDK) | ~        |       | kground I           | Dat Details                      |            |
| No VM is protected.              |       | AuctionWebB1                               |   | 1          | Write-Back(VMDK) | ~        |       |                     |                                  |            |
|                                  |       | Client1                                    |   | 1          | Write-Back(VMDK) | ~        |       |                     |                                  |            |
|                                  |       | D00D01                                     |   | 0          |                  |          | •     |                     |                                  |            |
|                                  |       |  |   |            | Cancel Sta       | rt Prote | ction |                     |                                  |            |

Verify that replication log volumes are placed on high performance storage.



i

Failover run books can be configured to group the VMs (called Recovery Group), set boot order sequence, and modify the CPU/memory settings along with IP configurations.

# Install JetStream DR for AVS in an Azure VMware Solution private cloud using the Run command

A best practice for a recovery site (AVS) is to create a three-node pilot-light cluster in advance. This allows the recovery site infrastructure to be preconfigured, including the following items:

- Destination networking segments, firewalls, services like DHCP and DNS, and so on.
- Installation of JetStream DR for AVS
- Configuration of ANF volumes as datastores, and moreJetStream DR supports near-zero RTO mode for mission- critical domains. For these domains, destination storage should be preinstalled. ANF is a recommended storage type in this case.



Network configuration including segment creation should be configured on the AVS cluster to match on-premises requirements.

Depending on the SLA and RTO requirements, continuous failover or regular (standard) failover mode can be used. For near-zero RTO, continuous rehydration should be started at the recovery site.

To install JetStream DR for AVS on an Azure VMware Solution private cloud, complete the following steps:

1. From the Azure portal, go to the Azure VMware solution, select the private cloud, and select Run command > Packages > JSDR.Configuration.



The default CloudAdmin user in Azure VMware Solution doesn't have sufficient privileges to install JetStream DR for AVS. Azure VMware Solution enables simplified and automated installation of JetStream DR by invoking the Azure VMware Solution Run command for JetStream DR.

The following screenshot shows installation using a DHCP-based IP address.

| Microsoft Azure                                       | D. Seath noi                    | uncers, services, and door.15+i)  | EI E 🖓 🕜 🔘 🖓 niyazihnetapp.com  |
|---|---------------------------------|---|---|
| Home > ANFDataClus                                    |                                 |   | Run command - Install-JetDRWithDHCP ×   |
| ANFDataClus   R                                       | un command —                    |   | This top level Cindlet Downloads JetCh buncle from MMS, creates a new use, assigns  |
| JP Seirch (Chil+/)                                    | < O Refeish R Feedback          |   | elevated privileges to the user, deploys settle Management Server Appliance/MSA,<br>registers vCenter to the JetDr MSA, configures cluster. |
| <ul> <li>Access control (AM)</li> <li>Tags</li> </ul> | Packages Run execution statue   |   | Command parameters  |
| <ul> <li>Diagnose and solve problems</li> </ul>       | <ul> <li>Name</li> </ul>        | Description   | RegisterWoolp (2)   |
| Settings  | V ISDRConfiguration 724 Power   | et Monte for configuration of efforces forfeine an Arth Ser and one forfeine inc for named  | ProtectedOuter*   |
| A Loda  | Disable letDRforChater          | This Crediet unconfigures a cluster but doesn't uninstall JerDR completely so other clusters  | Outer1  |
|   |                                 | policiji.   | Datastore * (j)   |
| Vanage  | Unable-JetDNJ or/Cuater         | This Critilet configures an additional cluster for profection. It installs vibs to all hosts in the   | viarCatatore  |
| Connectivity  | Install-SetONMANDERCP           | This top level Gridlet Downloads JetDr bundle from MMS, creates a new user, assigns elevi   | Witane* ()  |
| Chasters.   |                                 | registers vCenter to the JetDr MSA, configures cluster.   | ahfpval-msa<br>Ckuther * (C)  |
| Identity  | install-tet2004WebStates1P      | This top level Cindlet Downloads JerDr bundle from MMS, onstes a new user, assigns elev-<br>registers vCenter to the JerDr MSA, configures cluster. | Deter-1   |
| Storage (proview)                                     | Inste PrefightietDRmital        | This Crediet checks and doplays current state of the system it checks whether the minimal   | r- Credential ()  |
| Placement policies                                    |                                 | 4 boots if the cluster details are correct, if there is already a VM with the same name provid  | Overname *  |
| + Add-ons   | Invoke Prefight)etERUNinstall   | This Crititlet checks and displays current state of the system it checks whether the minimal  | root  |
| T ADD-DOB   |                                 | 4 hosts, if the cluster details are correct and if any VCenter is registered to the MSA.  | Password *  |
| Workload Networking                                   | University SetDit               | The top level Ondiet creates a new user, assigns elevated philleges to the user, unconfigu  |   |
| 🔄 Segments  | > Microsoft/AVS/Management 4141 | winds childeb for administrator well take in managing Azare VMMeet Doutrons   | HistName (i)  |
| DHCF  |                                 |   | actival-ma  |
| Port manusing   |                                 |   | Network * (j)   |
| DHS   |                                 |   | DRSeg   |
|   |                                 |   | 2010  |
| Operation   |                                 |   | Detain  |
| Run command   | -                               |   | Retain up to  |

2. After JetStream DR for AVS installation is complete, refresh the browser. To access the JetStream DR UI, go to SDDC Datacenter > Configure > JetStream DR.

| Protected Domains Statis     | stics Storage Sites /   | Appliances          | Configurations Task | Log          |       |
|------------------------------|-------------------------|---------------------|---------------------|--------------|-------|
| Site Details                 |                         |                     |                     | Alarm Set    | tting |
| vCenter Server Hostname      | 172.30.156.2            |                     |                     |              |       |
| Management Appliance Hostnan | ne anfjsval-msa         |                     |                     |              |       |
| Software Version             | 4.0.2.450               |                     |                     |              |       |
| Subscription ID              | - Configure             |                     |                     |              |       |
| Tenant ID / Application ID   | - Configure             |                     |                     |              |       |
| Application Secret           | - Configure             |                     |                     |              |       |
| Configure Cluster            | ade 🛍 Unconfigure 🛠 Res | solve Configure Iss | ue                  |              | C     |
| Cluster Name                 | Datacenter Name         | Status 🔺            | Software Version    | Host Details | 5 🔺   |
| Cluster-1                    | SDDC-Datacenter         | 📀 Ok                | 4.0.2.132           | Details      |       |

3. From the JetStream DR interface, add the Azure Blob Storage account that was used to protect the on-premises cluster as a storage site and then run the Scan Domains option.

|             | Protected Domain | Description              | Recoverable V | VMs | Import |   |   | ^      |   |
|-------------|------------------|--------------------------|---------------|-----|--------|---|---|--------|---|
| Storage Sit | ANFPD000         | Protected Domain Tile0   | 20            | 20  | Import |   | ^ |        |   |
| + Add Stora | ANFPD001         | ÷                        | 20            | 20  | Import |   |   |        | C |
| Name 🔺      | ANFPD002         | Protected Domain 02      | 20            | 20  | Import |   |   |        |   |
| ANFDemoble  | ANFPD003         | Protected Domain Tile 03 | 20            | 20  | Import |   | ~ |        | 1 |
|             | <                |                          |               |     |        | > |   |        |   |
|             |                  |                          |               |     |        |   |   |        |   |
|             |                  |                          |               |     |        |   |   |        |   |
| Storage Si  |                  |                          |               |     |        |   |   |        |   |
|             |                  |                          |               |     |        |   |   | 10     |   |
| Storage Ac  |                  |                          |               |     |        |   |   | $\sim$ |   |

4. After the protected domains are imported, deploy DRVA appliances. In this example, continuous rehydration is started manually from the recovery site using the JetStream DR UI.



These steps can also be automated using CPT created plans.

- 5. Create replication log volumes using available vSAN or ANF datastores.
- 6. Import the protected domains and configure the Recovery VA to use the ANF datastore for VM placements.

| ct Protected Domain: | Continuous Failover Protected Do | main            |                   |                |                   | 🖬 Delete  |         | More |
|----------------------|----------------------------------|-----------------|-------------------|----------------|-------------------|-----------|---------|------|
| le                   | • •                              | •               | •                 | •              |                   |           |         | Det  |
| overable / Total VMs | 1. General 2a. Failover Settings | 2b. VM Settings | 3. Recovery V     | 4. DR Settings | 5. Summary        | reporec   |         |      |
|                      | Protected Domain Name            |                 | ANFPD002          |                |                   | 253.160 ) |         |      |
|                      | Datacenter                       |                 | SDDC-Datacenter   |                |                   |           |         |      |
|                      | Cluster                          |                 | Cluster-1         |                |                   |           |         |      |
|                      | Resource Pool (Optional)         |                 | -                 |                |                   |           |         |      |
| otected VMs Setti    | VM Folder (Optional)             |                 | -                 |                |                   | 1000      |         |      |
|                      | Datastore                        |                 | ANFRecoDSU002     |                |                   | 1000      |         |      |
|                      | Internal Network                 |                 | DRSeg             |                |                   |           |         |      |
| VM Name 🔺            | External Replication Network     |                 | DRSeg             |                |                   |           | Details |      |
| AuctionAppA2         | Management Network               |                 | DRSeg             |                |                   |           | Details |      |
| AuctionAppB2         | Storage Site                     |                 | ANFDemoblobrepore |                |                   | Details   |         |      |
| AuctionDB2           | DR Virtual Appliance             |                 | ANFRecDRVA003     |                |                   |           | Details |      |
| AuctionLB2           | Poplication Los Storago          |                 | idouledb          |                |                   | $\sim$    | Details |      |
| AuctionMSQ2          |                                  |                 |                   | ncel Back      | Continuous Failov | er        | Details |      |
| AuctionNoSQL2        |                                  |                 |                   |                |                   |           | Details |      |



Make sure that DHCP is enabled on the selected segment and enough IPs are available. Dynamic IPs are temporarily used while domains are recovering. Each recovering VM (including continuous rehydration) requires an individual dynamic IP. After recovery is complete, the IP is released and can be reused.

7. Select the appropriate failover option (continuous failover or failover). In this example, continuous rehydration (continuous failover) is selected.

| Protected Domains Statistics    | Storage Sites A | ppliances   | Configuratio | ons       | Task Log    |             |
|---------------------------------|-----------------|-------------|--------------|-----------|-------------|-------------|
| Select Protected Domain: ANFPD0 | 00 View all     |             | + Create     | 1         | Delete      | ■More       |
| Mode                            | Imported        | Configura   | ations       |           | O Restore   |             |
| Recoverable / Total VMs         | 20 / 20         | Storage Si  | te           | 1         | → Failover  |             |
|                                 |                 | Owner Site  | 9            | RE        | → Continuo  | us Failover |
|                                 |                 |             |              |           | → Test Fail | over        |
| Protected VMs Settings A        | larms           |             |              |           |             |             |
|                                 |                 |             |              |           |             | c           |
| VM Name 🔺                       | Protecti        | on Status 🔺 | F            | rotectio  | n Mode 🔺    | Details     |
| AuctionAppA0                    | 📀 Reco          | verable     | v            | Vrite-Bac | k(VMDK)     | Details     |
| AuctionAppB0                    | @ Reco          |             | ũ.           | Vrite Dec | k(VMDK)     | Details     |

Performing Failover / Failback

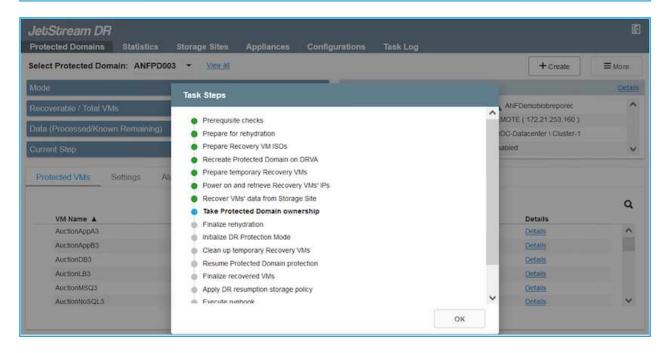
1. After a disaster occurs in the protected cluster of the on-premises environment (partial or full failure), trigger the failover.



CPT can be used to execute the failover plan to recover the VMs from Azure Blob Storage into the AVS cluster recovery site.

After failover (for continuous or standard rehydration) when the protected VMs have been started in AVS, protection is automatically resumed and JetStream DR continues to replicate their data into the appropriate/original containers in Azure Blob Storage.

| JebSbream DR<br>Protected Domains Stati | Complete Continuous Failove | r for Protected Domain ANFPD003  |             |          |  | 10     |
|---|-----------------------------|--|-------------|----------|--|--------|
| Select Protected Domain: Al             | VM Network Mapping          |  |             |          | O Fallover   | ≡ More |
| Interior and                            | Protected VM Network A      | Recovery VM Network  |             | ^        |  |        |
| Atöde-                                  | VM_3510                     | DRSeg  |             | ^        | and the second s |        |
| Receiverable / Total VMs                |                             |  |             |          | nobiobioporec  | 1      |
| Ente (Processed/Known Roma              |                             |  |             |          | 72.21.253 150 )  |        |
| Line (Procession Now Feature            | Force Failover              |  |             |          | penter ( Guster-1)   |        |
| Current Step                            |                             |  |             |          |  | *      |
| Protocled VMs Settings                  | required<br>Complete ow     | er of Protected Domain requested. Administrator co<br>nership of this Protected Domain will be taken over<br>you want to continue? | 000005-00-0 | ×        |  | Q      |
|   | Other S                     | Cancel   | Confirm     |          |  | .4     |
| AuctionAppA3                            | Plannes canves              |  |             |          | letails<br>Intails   | 10     |
| AuctonAbcB3                             | Force Failover              |  |             |          | attact .   |        |
| AuctionDBS                              |                             |  |             |          | MARK .   |        |
| AuctionEB3                              |                             |  |             |          | Riats  |        |
| AutonitiStra                            |                             |  |             |          | Dist.  |        |
| AuctionNoSQE3                           |                             |  |             |          | and the second s | 16     |
| 040/09/0925554                          |                             | Cancel   | Complete    | Failover | Man.   |        |
|   |                             |  |             |          |  |        |



The task bar shows progress of failover activities.

2. When the task is complete, access the recovered VMs and business continues as normal.

| Protected Domains                    | Continuous Rehydration Task        | Result                      |   |
|--------------------------------------|------------------------------------|-----------------------------|---|
| elect Protected Dom                  | ain: Al 🕢 Task Completed Successfu | Task Completed Successfully |   |
| vlode                                |                                    |                             | Edt Detai   |
| Recoverable / Total VI               | Protected Domain                   | ANFPD003                    | nobiobreporec   |
|                                      | This Recovery status               | © Success                   | 2 30 156 2 )  |
| teplication Status                   | Total VMs Recovered                | 20                          | tenter \ Cluster-1  |
| temaining Backgroun                  | testFGP0 Status:                   |                             | the second se |
| Current RPO Runbook Execution Status |                                    | Not defined                 |   |
|                                      |                                    | <ul> <li>Success</li> </ul> | ~   |
|                                      | Post-script Execution Status       | Not defined                 |   |
| Protected VMs                        | Settings                           |                             |   |
| + Start Protection                   | Barry Pro                          |                             | Q   |
| UM Name A                            |                                    |                             | t D Details   |
| AuctionAppA3                         |                                    |                             | Details   |
| AuctionApp83                         |                                    |                             | Detais  |
| AuctionDB3                           |                                    |                             | Details   |
| AuctionLB3                           |                                    |                             | Details   |
| AuctionMSQ3                          |                                    |                             | Dismiss Details   |
| AuctionNoSQL3                        | - ROSANCIALA                       | WOR INCODERCIMUNT           | Details V   |

After the primary site is up and running again, failback can be performed. VM protection is resumed and data consistency should be checked.

3. Restore the on-premises environment. Depending upon the type of disaster incident, it might be necessary to restore and/or verify the configuration of the protected cluster. If necessary, JetStream DR software might need to be reinstalled.



Note: The recovery\_utility\_prepare\_failback script provided in the Automation Toolkit can be used to help clean the original protected site of any obsolete VMs, domain information, and so on.

4. Access the restored on-premises environment, go to the Jetstream DR UI, and select the appropriate protected domain. After the protected site is ready for failback, select the Failback option in the UI.

| Select Protected Domain: ANFPD003 | <u>View all</u>                                      |                                    | + Create | Delete           | ■More           |
|-----------------------------------|--|------------------------------------|----------|------------------|-----------------|
| Mode                              | Running in Failover                                  | Running in Failover Configurations |          | O Restore        |                 |
| Active Site                       | 172.30.156.2   | Storage Site                       | ANF      | O Resume Contin  | ubus Rehydratio |
| Recoverable / Total VMs           | 20 / 20  | Owner Site                         |          | REMOT ← Failback |                 |
| Protected VMs Settings Alarms     |  |                                    |          |                  |                 |
| VM Name                           | Protection Stat                                      | us 🔺 Protection Mo                 | de 🛦     | Details          | c               |
| AuctionAppA3                      | Recoverable  | Write-Back(VMI                     | ок)      | Details          | -               |
| AuctionAppB3                      | Recoverable  | Write-Back(VMI                     | DK)      | Details          |                 |
|                                   | Recoverable  | Write-Back(VMI                     | эк)      | Details          |                 |
| AuctionDB3                        |  |                                    | 340      | Details          |                 |
| AuctionLB3<br>AuctionLB3          | Recoverable  | Write-Back(VMI                     | JR)      | Octans           |                 |
|                                   | <ul> <li>Recoverable</li> <li>Recoverable</li> </ul> | Write-Back(VMI<br>Write-Back(VMI   |          | Details          |                 |



The CPT generated failback plan can also be used to initiate the return of the VMs and their data from the object store back to the original VMware environment.



Specify the maximum delay after pausing VMs in the recovery site and restarting in the protected site. This time includes completing replication after stopping failover VMs, the time to clean recovery site, and the time to recreate VMs in protected site. The NetApp recommended value is 10 minutes.

Complete the failback process, and then confirm the resumption of VM protection and data consistency.

# **Ransomeware Recovery**

Recovering from ransomware can be a daunting task. Specifically, it can be hard for IT organizations to determine the safe point of return and, once determined, how to ensure that recovered workloads are safeguarded from the attacks reoccurring (from sleeping malware or through vulnerable applications).

JetStream DR for AVS together with Azure NetApp Files datastores can address these concerns by allowing organizations to recover from available points in time, so that workloads are recovered to a functional, isolated network if required. Recovery allows applications to function and communicate with each other while not exposing them to north- south traffic, thereby giving security teams a safe place to perform forensics and other necessary remediation.

| lect Protected Domai   | Failback Prot | ected Domain          |                 |                 |             |             |            | Delete  | ≡ More    |
|------------------------|---------------|-----------------------|-----------------|-----------------|-------------|-------------|------------|---|-----------|
| ode                    | 1. General    | 2a. Fallback Settings | 2b. VM Settings | 3. Recovery VA  | 4. DR 5     | ettings     | 5. Summary |   | Edit Deta |
| ctive Site             |               |                       |                 |                 |             |             |            | ∧ :po   |           |
| ecoverable / Total VMs | Protected [   | Jomain Name           |                 | ANFPD003        |             |             |            | 56.2.)  |           |
|                        | Failback Da   | tacenter              |                 | A300-DataCenter |             |             |            | 100   |           |
|                        | Failback Cl   | uster                 |                 | A300-Cluster    |             |             |            | 1.000   | 1         |
| Destantiants (2)       | Failback Re   | source Pool           |                 | 2               |             |             |            | 1000  |           |
| Protected VMs Se       | VM Folder     | (Optional)            |                 | ÷               |             |             |            | 1.000   |           |
|                        | Failback Da   | tastore               |                 | A300_NFS_DS02   |             |             |            | 1000  | Q         |
| VM Name                | Maximum D     | elay After Stopping   |                 | 60 Minutes      |             |             |            |   | 0.3       |
| AuctionAppA3           | Internal Net  | twork                 |                 | VM_187          |             |             |            |   | ^         |
| AuctionAppB3           | External Re   | plication Network     |                 | VM_187          |             |             |            | 1000  |           |
| AuctionDB3             | Manageme      | nt Network            |                 | VM_187          |             |             |            | ~   |           |
| AuctionEB3             |               |                       |                 |                 | Cancel      | Back        | Failback   |   |           |
| AuctionMSQ3            |               |                       | Recoveration    | 14              | Write-Back( | IN APPLICE. | Det        | and the second se |           |

## Disaster Recovery with CVO and AVS (guest-connected storage)

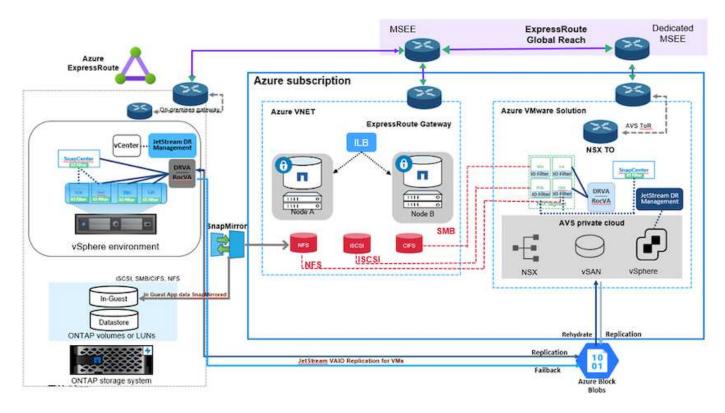
Disaster recovery to cloud is a resilient and cost-effective way of protecting workloads against site outages and data corruption events such as ransomware. With NetApp SnapMirror, on-premises VMware workloads that use guest-connected storage can be replicated to NetApp Cloud Volumes ONTAP running in Azure.

# Overview

Authors: Ravi BCB and Niyaz Mohamed, NetApp

This covers application data; however, what about the actual VMs themselves. Disaster recovery should cover all dependent components, including virtual machines, VMDKs, application data, and more. To accomplish this, SnapMirror along with Jetstream can be used to seamlessly recover workloads replicated from on-premises to Cloud Volumes ONTAP while using vSAN storage for VM VMDKs.

This document provides a step-by-step approach for setting up and performing disaster recovery that uses NetApp SnapMirror, JetStream, and the Azure VMware Solution (AVS).



# Assumptions

This document focuses on in-guest storage for application data (also known as guest connected), and we assume that the on-premises environment is using SnapCenter for application-consistent backups.



This document applies to any third-party backup or recovery solution. Depending on the solution used in the environment, follow best practices to create backup policies that meet organizational SLAs.

For connectivity between the on-premises environment and the Azure virtual network, use the express route global reach or a virtual WAN with a VPN gateway. Segments should be created based on the on-premises vLAN design.



There are multiple options for connecting on-premises datacenters to Azure, which prevents us from outlining a specific workflow in this document. Refer to the Azure documentation for the appropriate on-premises-to-Azure connectivity method.

## **Deploying the DR Solution**

## **Solution Deployment Overview**

- 1. Make sure that application data is backed up using SnapCenter with the necessary RPO requirements.
- 2. Provision Cloud Volumes ONTAP with the correct instance size using Cloud manager within the appropriate subscription and virtual network.
  - a. Configure SnapMirror for the relevant application volumes.
  - b. Update the backup policies in SnapCenter to trigger SnapMirror updates after the scheduled jobs.
- 3. Install the JetStream DR software in the on-premises data center and start protection for virtual machines.
- 4. Install JetStream DR software in the Azure VMware Solution private cloud.
- 5. During a disaster event, break the SnapMirror relationship using Cloud Manager and trigger failover of virtual machines to Azure NetApp Files or to vSAN datastores in the designated AVS DR site.
  - a. Reconnect the ISCSI LUNs and NFS mounts for the application VMs.
- 6. Invoke failback to the protected site by reverse resyncing SnapMirror after the primary site has been recovered.

## **Deployment Details**

### Configure CVO on Azure and replicate volumes to CVO

The first step is to configure Cloud Volumes ONTAP on Azure (Link) and replicate the desired volumes to Cloud Volumes ONTAP with the desired frequencies and snapshot retentions.

| Health Status 💠 | Source Volume                         | Target Volume =                       | Total Transfer Time | Status | Mirror State | Last Successful Transfer               | e |
|-----------------|---------------------------------------|---------------------------------------|---------------------|--------|--------------|--|---|
| 0               | gcsdrsqldb_sc46<br>ntaphci-a300e9u25  | gcsdrsqidb_sc46_copy<br>ANFCVODRDemo  | 17 seconds          | idle   | snapmirrored | May 6, 2022, 11:43:18 AM<br>105.06 KiB |   |
| 0               | gcsdrsqlhld_sc46_copy<br>ANFCVODRDemo | gcsdrsqlhid_sc46<br>ntaphci-a300e9u25 | 7 seconds           | idle   | snapmirrored | May 6, 2022, 11:42:20 AM<br>7.22 MiB   |   |
| $\odot$         | gcsdrsqilog_sc46<br>ntaphci-a300e9u25 | gcsdrsqilog_sc46_copy<br>ANFCVODRDemo | 16 seconds          | idle   | snapmirrored | May 6, 2022, 11:43:52 AA<br>130.69 KiB |   |

#### Configure AVS hosts and CVO data access

Two important factors to consider when deploying the SDDC are the size of the SDDC cluster in the Azure VMware solution and how long to keep the SDDC in service. These two key considerations for a disaster recovery solution help reduce the overall operational costs. The SDDC can be as small as three hosts, all the way up to a multi-host cluster in a full-scale deployment.

The decision to deploy an AVS cluster is primarily based on the RPO/RTO requirements. With the Azure VMware solution, the SDDC can be provisioned just in time in preparation for either testing or an actual disaster event. An SDDC deployed just in time saves on ESXi host costs when you are not dealing with a disaster. However, this form of deployment affects the RTO by a few of hours while SDDC is being provisioned.

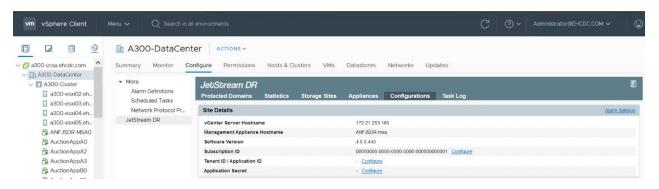
The most common deployed option is to have SDDC running in an always-on, pilot-light mode of operation. This option provides a small footprint of three hosts that are always available, and it also speeds up recovery operations by providing a running baseline for simulation activities and compliance checks, thus avoiding the risk of operational drift between the production and DR sites. The pilot-light cluster can be scaled up quickly to the desired level when needed to handle an actual DR event.

To configure AVS SDDC (be it on-demand or in pilot-light mode), see Deploy and configure the Virtualization Environment on Azure. As a prerequisite, verify that the guest VMs residing on the AVS hosts are able to consume data from Cloud Volumes ONTAP after connectivity has been established.

After Cloud Volumes ONTAP and AVS have been configured properly, begin configuring Jetstream to automate the recovery of on-premises workloads to AVS (VMs with application VMDKs and VMs with inguest storage) by using the VAIO mechanism and by leveraging SnapMirror for application volumes copies to Cloud Volumes ONTAP.

JetStream DR software consists of three major components: the JetStream DR Management Server Virtual Appliance (MSA), the DR Virtual Appliance (DRVA), and host components (I/O filter packages). The MSA is used to install and configure host components on the compute cluster and then to administer JetStream DR software. The installation process is as follows:

- 1. Check the prerequisites.
- 2. Run the Capacity Planning Tool for resource and configuration recommendations.
- 3. Deploy the JetStream DR MSA to each vSphere host in the designated cluster.
- 4. Launch the MSA using its DNS name in a browser.
- 5. Register the vCenter server with the MSA.
- After JetStream DR MSA has been deployed and the vCenter Server has been registered, navigate to the JetStream DR plug-in with the vSphere Web Client. This can be done by navigating to Datacenter > Configure > JetStream DR.



- 7. From the JetStream DR interface, complete the following tasks:
  - a. Configure the cluster with the I/O filter package.

| JetStream DR                                    |                           |                             |          |                |
|---|---------------------------|-----------------------------|----------|----------------|
| Protected Domains Statistics Storage Sites A    | Appliances Configurations | Task Log                    |          |                |
| Site Details                                    |                           |                             |          | Alarm Settings |
| vCenter Server Hostname                         | 172.21.253.160            |                             |          |                |
| Management Appliance Hostname                   | ANFJSDR-msa               |                             |          |                |
| Software Version                                | 4.0.0.443                 |                             |          |                |
| Subscription ID                                 | 00000000-0000-0000        | -0000-00000000001 Configure |          |                |
| Tenant ID / Application ID                      | - Configure               |                             |          |                |
| Application Secret                              | - Configure               |                             |          |                |
| Configured Clusters                             | Configure Clusters        |                             |          |                |
| Configure Cluster 1 Upgrade 1 Unconfigure 1 Res |                           | Select All Clear All        | Q        | ٩              |
| Cluster Name 🔺                                  | Cluster Name 🔺            | Datacenter Name             | sion 🔺   | Host Details 🔺 |
| No cluster configured                           | A300-Cluster              | A300-DataCenter             | *        |                |
|   |                           | 12                          | -        |                |
|   |                           | Cancel                      | onfigure |                |

b. Add the Azure Blob storage located at the recovery site.

| Storage Sites                              | Add Storage Site   |   |
|--|--|---|
| + Add Storage Site                         | Stirage Ste Type *   |   |
| Name 🛦                                     | Azure Blob Storage   |   |
| No Storage Site configured.                |  |   |
|  | Access Type *  |   |
|  | Key Access   |   |
|  | Storage Site Name (Provide a name to identify this Site) * |   |
|  | ANFDemoblobrepo  |   |
| Storage Site Details Alarma                |  |   |
|  | Acure Blob Storage Account Name *                          |   |
|  | aniordemostor  | _ |
| No storage site selected. Select a storage | Agure Bob Storage Account Key *                            |   |
|  | ······································                     |   |
|  | Cancel Add Storage Site                                    |   |

8. Deploy the required number of DR Virtual Appliances (DRVAs) from the Appliances tab.

(i)

Use the capacity planning tool to estimate the number of DRVAs required.

| <i>JetStream DR</i><br>Protected Domains Statistics Storag | e Sites Appliances | Configurations | Task Log      |                          |           | 1 |
|--|--------------------|----------------|---------------|--------------------------|-----------|---|
| DRVAs (DR Virtual Appliances)                              |                    |                |               |                          |           |   |
| + Deproy New DRVA TUpgrade TUpcor                          | figure             |                |               |                          |           | Q |
| Name A   |                    | Status 🔺       | Child Alarm   | Software Version 🔺       | Details 🔺 |   |
|  |                    |                |               |                          |           |   |
| Replication Log Volume                                     |                    |                |               |                          |           |   |
| Replication Log Volume<br>+ New Replication Log Volume     |                    |                |               |                          |           | ٩ |
|  |                    | Status         | Child Alarm 🔺 | Size (available/total) 🔺 | Details 🔺 | ۵ |

| Protected Domains Statistics Storage Sites                    |                               |            |                               |            |           | _ |
|---|-------------------------------|------------|-------------------------------|------------|-----------|---|
| DRVAs (DR Virtual Appliances)                                 | 1. General                    | 2. DRVA VM | 3. DRVA Network               | 4. Summary |           |   |
| + Deploy New DRVA   | Name                          |            | GCSDRPD001                    |            |           | ñ |
| Name A  | Description (Optional)        |            | Protected Domain for VMs with | ANF and JS | Details 🔺 |   |
| No DR Virtual Appliance configured                            | Datacenter                    |            | A300-DataCenter               |            |           |   |
|   | Cluster                       |            | A300-Cluster                  |            |           |   |
|   | Resource Pool (Optional)      |            | 1                             |            |           |   |
|   | VM Folder (Optional)          |            | .e.,                          |            |           |   |
| Replication Log Volume  | Datastore                     |            | A300_NFS_vMotion              |            |           |   |
| Replication Log volume  | Number Of CPUs                |            | 8                             |            |           |   |
| + New Replication Log Volume                                  | Memory Size                   |            | 32GB                          |            |           |   |
| Disk Path Name 🔺  | Management Network            |            | VM_187                        |            | Details 🔺 |   |
| No DRVA selected. Select a DRVA to view replication log volum | Host(iofilter) to DRVA Data N | letwork    | VM_187                        |            |           |   |
|   | Replication Network to Obje   | ct Store   | VM_187                        |            |           |   |
|   | Replication Log Network       |            | VM_187                        |            |           |   |
|   |                               |            | Cancel Back                   | Ditelon    |           |   |

9. Create replication log volumes for each DRVA using the VMDK from the datastores available or the independent shared iSCSI storage pool.

| JebSbream DR<br>Protected Domains Statistics Storage Sites A | ppliances Configurations | Task Log      |                          |           | 1 |
|--|--------------------------|---------------|--------------------------|-----------|---|
| DRVAs (DR Virtual Appliances)                                |                          |               |                          |           |   |
| + Deploy New DRVA TUrprade Dunconfigure                      |                          |               |                          |           | Q |
| Name A   | Status 🔺                 | Child Alarm 🔺 | Software Version         | Details A |   |
| GCSDRPD001   | Running                  | 00            | 4.0.0.134                | Detain    |   |
| + New Replication Log Volume                                 |                          |               |                          |           | c |
| Disk Path Name   | Status.                  | Child Alarm   | Size (available/total) 🔺 | Details A |   |
| idev/sdb   | O Ok                     | 00            | 179 88 GB / 200 GB       | Detats    |   |
|  |                          |               |                          |           |   |
| 중사가 전 사람이 집에 집에 있는 것이 있는 것이 있는 것이 있는 것이 같이 있다.               |                          |               |                          |           |   |
| Replication Log Volume Details                               |                          |               |                          |           |   |

10. From the Protected Domains tab, create the required number of protected domains using information about the Azure Blob Storage site, the DRVA instance, and the replication log. A protected domain defines a specific VM or set of application VMs within the cluster that are protected together and assigned a priority order for failover/failback operations.

| JetStream DR<br>Protected Domains Statistics Storage Sites<br>Select Protected Domain: - <u>Viewall</u> | Appliances Confinuations Task Loc<br>Create Protected Domain |                       |             |       | + Create # Morrs |
|---|--|-----------------------|-------------|-------|------------------|
|   | 1. General 2. Pr   | rimary Site           | J. Summary  | 4     |                  |
|   | Protected Domain Name  | GCSDRPD_Demo01        |             | 28- X |                  |
|   | Priority Level (Optional)                                    | 2                     |             |       |                  |
|   | Description  | Protection domain ANF |             |       |                  |
|   | Total estimated data size to be protected                    | 1000GB                |             |       |                  |
|   | DR Virtual Appliance   | GCSDRPD001            |             |       |                  |
|   | Compression  | Yes                   |             |       |                  |
|   | Compression Level  | Default               |             | 88    |                  |
|   | Normal GC Storage Overhead                                   | 50%                   |             |       |                  |
|   | Maximum GC Storage Overhead                                  | 300%                  |             |       |                  |
|   | Replication Log Storage                                      | /dev/sdb              |             |       |                  |
|   | Panlication I on Size  | 50GR                  |             |       |                  |
|   |  | Cancel 6              | Back Create |       |                  |

| Select Protected Domain: * View all | Create Protected Domain     |                       |            |             | + Create |
|-------------------------------------|-----------------------------|-----------------------|------------|-------------|----------|
|                                     | 1. General                  | 2. Primary Site       | 3. Summary |             |          |
|                                     | Compression                 | Yes                   |            | *           |          |
|                                     | Compression Level           | Default               |            |             |          |
|                                     | Normal GC Storage Overhead  | 50%                   |            |             |          |
|                                     | Maximum GC Storage Overhead | 300%                  |            |             |          |
|                                     | Replication Log Storage     | /dev/sdb              |            | 13          |          |
|                                     | Replication Log Size        | 50GB                  |            | 10 <b>0</b> |          |
|                                     | Metadata Size               | 31.56GB               |            |             |          |
|                                     | Primary Site Datacenter     | A300-DataCenter       |            |             |          |
|                                     | Primary Site Cluster        | A300-Cluster          |            |             |          |
|                                     | Storage Site                | ANFDRDemoFailoverSite |            |             |          |
|                                     | Enable PITR                 | No                    |            |             |          |
|                                     |                             | Cancel                | lack Creat |             |          |

11. Select the VMs to be protected and group the VMs into applications groups based on dependency. Application definitions allow you to group sets of VMs into logical groups that contain their boot orders, boot delays, and optional application validations that can be executed upon recovery.



Make sure that the same protection mode is used for all VMs in a protected domain.

| ebStream DR<br>rotected Domains Statistics Storage Sites   | Appliances Configurations Task Lt |               |               |          |                                |
|--|-----------------------------------|---------------|---------------|----------|--------------------------------|
| ecovernitie / Total VMs  |                                   |               |               |          | + Create Delians               |
| ecoverador / rocar vives   | Protection Mode for selected VMs  |               |               | q        | ANFERENCIOF alloverSite        |
| A distant in the second s |                                   | 101223        |               | <u> </u> | LOCAL ( 177 21 253 165 )       |
| smaining Background Data   | VM Name 🔺                         | # of Disks Pr |               | 12       | A300-DataCienter \A300-Cluster |
|  | ElasticWebA2                      |               |               | 2.5      | Disabled                       |
|  | ElasticWebA3                      |               |               | 3 I I I  |                                |
| Protected VMs Settings Alarms  | ElasticWebB0                      |               | nite-Through  | Υ.       |                                |
|  | ElasticWebB2                      |               |               | *        |                                |
| + Start Protection Construction  | ElasticWebB3                      |               | one Through   | 9 .<br>9 |                                |
| VM Name 🔺  | GCS-DR-DC                         | 14            | Write-Through | - I.     | Background Data A Details      |
| NO VIA is producted  | GCS-DR-LinVM01                    |               | Vinte-Through | 1        |                                |
|  | C GCS-DR-SCA                      |               | Ynte-Through  | -        |                                |
|  | GCS-DR-SQL01                      |               | Write-Through |          |                                |
|  | GCS-DR-WeVM01                     |               | Write-Through | ~        |                                |
|  | gas-drva-GCSDRPD001               | 2 1           |               | ¥.       |                                |
|  | PrimeClient                       | 2 1           |               | ×.       |                                |
|  | Standby0                          | 1             | when Through  | Ψ        |                                |
|  | Standby1                          | 1             |               |          |                                |
|  | Standby2                          | 1 V           |               | 93 I.    |                                |
|  | Standby3                          | <b>4</b> V    | With Through  | × .      |                                |
|  | VMmark-Template01                 | 11            | Timough       | M. 8     |                                |
|  |                                   |               |               |          |                                |

12. Make sure that replication log volumes are placed on high- performance storage.

| elect Protected Domain: GCSDRPD_Demo01 * | Start Protection                 |            |                  |   | + Create   | Dolete: |        |
|--|----------------------------------|------------|------------------|---|--|---------|--------|
| ecoverable / Total VMs                   | Persetter Wate for Levense Wa    |            |                  | 1                                       |  |         | Eas De |
| replication Status                       | Write-Back(VMDK)                 |            |                  | ٩                                       |  |         |        |
| lemaining Background Data                | VM Name 🔺                        | # of Disks | Protection Mode  |   | LOCAL ( 172 23 253 160<br>A300-DataCenter 1 A300 |         |        |
| arrent RPO                               | ElasticWebA2                     | 1          | Write Through: 5 |   | Disabled   | SSMIT   |        |
| 101111 (D.52)                            | ElasticWebA3                     | 1          | White-Through N  |   |  |         |        |
| Protected Vills Settings Atarms          | EiasticWebB0                     | 1          | white-Through .  |   |  |         |        |
| Providence value - Penninger - Penninger | <ul> <li>ElasticWebB1</li> </ul> | 1          | Willis-Through   |   |  |         |        |
| + Start Protection                       | ElasticWeb82                     | 1          | Write-Through    | 8 I I                                   |  |         |        |
|  | ElasticWeb63                     | 1          | Write-Tracogle A |   |  |         |        |
| VM Name 🔺                                | GCS-DR-DC                        | 1          | White-Back(VMDK) | 2                                       | Background Data 🔺                                | Details |        |
| No VM is protected.                      | GCS-DR-LinVM01                   | 3          | Write-Back(VMDK) | 2                                       |  |         |        |
|  | GCS-DR-SCA                       | 1          | Write-Back(VMDK) |   |  |         |        |
|  | GCS-DR-SQL01                     | 1          | Write-Back(VMDK) | -                                       |  |         |        |
|  | GCS-DR-WeVM01                    | 1          | Write-Back(VMDK) |   |  |         |        |
|  | jss-dva-GCSDRPD001               | 2          | Witte-Through N  | 67 - E                                  |  |         |        |
|  | PrimeClient                      | 2          | Write-Through    | 5 C C C C C C C C C C C C C C C C C C C |  |         |        |
|  | Standby0                         | 1          | vinte-Trenutt >  | 8 U -                                   |  |         |        |
|  | Standby1                         | 1          | Wim-Through A    | 2. I.                                   |  |         |        |
|  | Standby2                         | 1          | White-Through S  |   |  |         |        |
|  | Standby3                         | -1         | Write Through I  | 5 L L                                   |  |         |        |
|  | VMmark-Template01                | 1          | Will-Through N   | 68. j                                   |  |         |        |
|  |                                  |            | Cancel Start P   | rotection                               |  |         |        |

13. After you are done, click Start Protection for the protected domain. This starts data replication for the selected VMs to the designated Blob store.

| Protected Domains Statistics Storage Sites   | Appliances Configuration                          | is Task Log     |                                    |                                      |                              | Running Tasks                     |
|--|---|-----------------|------------------------------------|--------------------------------------|------------------------------|-----------------------------------|
| elect Protected Domain: GCSDRPD_Demo01 -   | View all  |                 |                                    |                                      | + (                          | Start Protection (GCS-DR-SCA) 50% |
| tecoverable / Total VMs  |   | 0/5             | Configurations                     |                                      |                              | Start Protection (GCS-DR-Win 50%  |
| eplication Status  |   | ок              | Storage Site                       |                                      |                              | Start Protection (GCS-DR-Lin 50%  |
| emaining Background Data   |   | 0 B             | Owner Site<br>Datacenter \ Cluster |                                      | LOCAL (172.2<br>A300-DataCen | Start Protection (GCS-DR-DC) 50%  |
| urrent RPO   |   | -               | Point-in-time Recover              | у                                    | Disabled                     | Start Protection (GCS-DR-SQ. 50%  |
| Protected VMs Settings Alarms  |   |                 |                                    |                                      |                              | Configure VMDK Re _ Completed     |
|  |   |                 |                                    |                                      |                              |                                   |
| + Start Protection II Stop Protection  |   |                 |                                    |                                      |                              |                                   |
| + Start Protection   | Protection Status                                 | Replication Sta | atus 🔺                             | Protection Mode 🔺                    | Background Dat               | ta A Details                      |
| The strategy of the strategy o | Protection Status   Protection Status  Protection | Replication Sta |                                    | Protection Mode  Mote-Back(VMDK)     | Background Da                | Details                           |
| VM Name A  |   | Replication Sta |                                    |                                      |                              |                                   |
| VM Name ▲     GCS-DR-DC  | Initializing                                      |                 |                                    | Write-Back(VMDK)                     |                              | Details                           |
| VM Name ▲     GCS-DR-DC     GCS-DR-LinVM01   | Initializing     Initializing                     | *               |                                    | Write-Back(VMDK)<br>Write-Back(VMDK) | •                            | Details<br>Details                |

14. After replication is completed, the VM protection status is marked as Recoverable.

| select Protected Domain: GCSDRPD_Demo                          | 01 👻 <u>View all</u>                                 |                                   |   | + Create                        | Delete                        | ≡ More    |  |
|--|--|-----------------------------------|---|---------------------------------|-------------------------------|-----------|--|
| lecoverable / Total VMs  |  | 5/5                               | Configurations  |                                 |                               | Edit Deta |  |
| teplication Status   |  | ок                                | Storage Site  | ANFDRDemoFailo                  | verSite                       |           |  |
|  |  |                                   | Owner Site  | LOCAL ( 172.21.253.16           | ( 0                           |           |  |
| emaining Background Data                                       |  | 0 B                               | Datacenter \ Cluster A300-DataCenter \ A300           |                                 |                               | 0-Cluster |  |
| urrent RPO   |  | 0s                                | Point-in-time Recovery                                | Disabled                        |                               |           |  |
| Protected VMs Settings Alarms                                  |  |                                   |   |                                 |                               |           |  |
| + Start Protection   | Brotection Status                                    |                                   | ur. 1. Drotection Mode 4                              | Beckeround Data                 | Dotaile                       | ۵         |  |
| + Start Protection VM Name                                     | Protection Status                                    | Replication Statu                 |   | Background Data ▲<br>0 8        | Details<br>Details            | ٩         |  |
| + Start Protection   | Protection Status ▲ © Recoverable © Recoverable      |                                   | us Protection Mode  Write-Back(VMDK) Write-Back(VMDK) | Background Data ▲<br>0 B<br>0 B | Details<br>Details<br>Details |           |  |
| Start Protection     Stop Protection     VM Name     GCS-DR-DC | Recoverable  | Replication Statu                 | Write-Back(VMDK)                                      | 0.8                             | Deteils                       |           |  |
| + Start Protection  VM Name  GCS-DR-DC  GCS-DR-LinVM01         | <ul> <li>Recoverable</li> <li>Recoverable</li> </ul> | Replication Statu<br>© 0K<br>© 0K | Write-Back(VMDK)<br>Write-Back(VMDK)                  | 0 B<br>0 B                      | Details<br>Details            |           |  |



Failover runbooks can be configured to group the VMs (called a recovery group), set the boot order sequence, and modify the CPU/memory settings along with the IP configurations.

15. Click Settings and then click the runbook Configure link to configure the runbook group.

| elect Protected Domain: GCSDRPD_Demo01  View all |       |                        | + Create                 | Delete  | ≡ More    |
|--|-------|------------------------|--------------------------|---------|-----------|
| Recoverable / Total VMs                          | 5/5   | Configurations         |                          |         | Edit Deta |
| Replication Status                               | OK    | Storage Site           | ANFDRDemoFailover        | Site    |           |
|  | 25.00 | Owner Site             | LOCAL ( 172.21.253.160 ) |         |           |
| Remaining Background Data                        | 0 B   | Datacenter \ Cluster   | A300-DataCenter \ A300-C | lluster |           |
| Current RPO                                      | 0s    | Point-in-time Recovery | Disabled                 |         |           |
| Protected VIAs Settings Alarms                   |       |                        |                          |         |           |
| Failover Runbook Not Configured Configure        |       |                        |                          |         |           |
| Test Failover Runbook Not Configured Configure   |       |                        |                          |         |           |
| Failback Runbook 🔓 Not Configured Configure      |       |                        |                          |         |           |
| Memory Setting Not Configured Configure          |       |                        |                          |         |           |
| GC Settings Configured Configure                 |       |                        |                          |         |           |
| Concurrency Settings Not Configured Configure    |       |                        |                          |         |           |

16. Click the Create Group button to begin creating a new runbook group.

If needed, in the lower portion of the screen, apply custom pre-scripts and post-scripts to automatically run prior to and following operation of the runbook group. Make sure that the Runbook scripts are residing on the management server.

| JetStream DR<br>Protected Domains Statistics Storage Sit | es / Failover Runbook Settings |                   |            |                                |             |
|--|--------------------------------|-------------------|------------|--------------------------------|-------------|
| Select Protected Domain: GCSDRPD_Demo01                  | - Ver + Create Group           | Delete Group      |            | + Create Delete                | ≡ More      |
| Recoverable / Total VMs                                  | O Group Name                   | # of VM Power Off | Retain MAC |                                | Edit Detail |
| Replication Status                                       | O 🗌 Independent VMs            | 5                 |            | ANFDRDemoFalloverSite          | 9           |
|  |                                |                   |            | LOCAL ( 172 21 253 160 )       |             |
| Remaining Background Data                                |                                |                   |            | A300-DataCenter \ A300-Cluster |             |
| Current RPO  |                                |                   |            | Disabled                       |             |
| Protected VMs Settings Alarms                            | 0 0                            |                   | - 11       |                                |             |
| Failover Runbook Configured Defails                      |                                |                   |            |                                |             |
| Test Failover Runbook Configured Details                 |                                |                   |            |                                |             |
| Failback Runbook Configured Details                      |                                |                   |            |                                |             |
| Memory Setting Not Configured Configure                  |                                |                   |            |                                |             |
| GC Settings Configured Configure                         |                                |                   |            |                                |             |
| Concurrency Settings Not Configured Configure            |                                |                   |            |                                |             |

17. Edit the VM settings as required. Specify the parameters for recovering the VMs, including the boot sequence, the boot delay (specified in seconds), the number of CPUs, and the amount of memory to allocate. Change the boot sequence of the VMs by clicking the up or down arrows. Options are also provided to Retain MAC.

| otected Domain: GCSDRPD_Demo | 1. General     | 2. Select VM  | 5              |       | M Settings |        | 4. Summ |   |
|------------------------------|----------------|---------------|----------------|-------|------------|--------|---------|---|
| nie / Total VMs              | Retain MAC     |               | Power Off      | f VMs |            |        | O Reset | - 14  |
| an Status                    | VM Name        | Boot Sequence | Root Delay     | CPU   | Memory     | Script | NIC     | NFDRDembFuloverSite   |
| g Background Clina           | GCS-DR-WinVM01 | 11 1          | DS DS DS DS DS | 32    | 64 GB      | Config | View    | A DATA |
|                              | GCS-DR-SCA     | 21 4          | 0s             | 4     | 16 GB      | Config | View    |   |
| P0                           | GCS-DR-DC      | 3 By          | 0s             | 4     | 16 GB      | Config | View    |   |
| ed vita Settings Alarma      | GCS-DR-LinVM01 | 41 4          | 0s             | 2     | 4 GB       | Contig | View    |   |
| Settings Months              | GCS-DR-SQL01   | 57 4          | 0s             | 4     | 8 GB       | Config | View    |   |
|                              |                |               |                |       |            |        |         |   |
|                              |                |               |                |       |            |        |         |   |

18. Static IP addresses can be manually configured for the individual VMs of the group. Click the NIC View link of a VM to manually configure its IP address settings.

 $(\mathbf{i})$ 

| Select Protected Domain: GCSDRPD_Demo   | 1. General     | 2. Select VM: | i .        | 3. Edit VI | M Settings |        | 4. Summa | iry. | + Create         | Delete  | 業) |
|---|----------------|---------------|------------|------------|------------|--------|----------|------|------------------|---------|----|
| Recoverable / Total VMs   | Retain MAC     |               | Power Off  | f VMs      |            |        | O Reset  | 1    |                  |         |    |
| Replication Status  | VM Name        | Boot Sequence | Reat Dalay | CPU        | Memory     | Script | NIC      |      | VEDRIDHINGEANOVI |         |    |
| Remaining Background Palls  | GCS-DR-WinVM01 | 1↑↓           | Os         | 32         | 64 GB      | Config |          |      |                  |         |    |
| Contraction of the second s               | GCS-DR-SCA     | 214           | 0s         | 4          | 16 GB      | Config | 25       |      | DataCentari A300 | Cluster |    |
| Clateri APO   | GCS-DR-LinVM01 | 31 4          | 0s         | 2          | 4 GB       | Config | View     |      |                  |         |    |
| Second second second second   | GCS-DR-SQLOT   | 47 4          | 0s         | 4          | 8 GB       | Conto  | Xiew     |      |                  |         |    |
| Protected Ville Settings Alarma   | GCS-DR-DC      | 51 4          | 0s.        | 4          | 16 GB      | Config | Xiew     |      |                  |         |    |
| Memory Setting Not Configured Configure<br>GC Settings Configured Configure<br>Descurptions Settings For Configured Configure |                |               |            |            |            |        |          |      |                  |         |    |
|   |                |               |            |            |            |        |          |      |                  |         |    |
| GC Settings Configured Configures   |                |               |            |            |            |        |          |      |                  |         |    |
| GC Settings Configured Configures   |                |               |            |            |            |        |          |      |                  |         |    |

19. Click the Configure button to save NIC settings for the respective VMs.

| Label   |                                | Network Name                            | Key                              | PCI Slot #            | IP                                     |      |
|---|--------------------------------|---|----------------------------------|-----------------------|--|------|
| 245 Y | cadapter 1                     | VM_3510                                 | 4000                             | 192                   | Configure                              | aty  |
| Re  |                                |   |                                  |                       |  | - 84 |
| VM Na<br>GCS-E<br>Uburti  | Configur                       | e Static IP Address                     |                                  |                       |  | 1    |
| GCSD  | IP Address -                   |   |                                  |                       |  |      |
| 6CS-E<br>00   | 172.21.2                       | 54.185                                  |                                  |                       | _                                      | 1    |
| 0.01  | Subret Mask                    |   |                                  |                       |  |      |
|   | 255.255.2                      | 255.0                                   |                                  |                       | _                                      |      |
|   | Gataway *<br>172.21.2          | 54.1                                    |                                  |                       |  |      |
|   | 0.000                          |   |                                  |                       | _                                      |      |
|   | DNS -<br>172.30.1              | 53 20                                   |                                  |                       |  |      |
|   |                                |   |                                  |                       |  |      |
|   | DNS Suff                       | ix.                                     |                                  |                       | _                                      |      |
|   |                                |   |                                  |                       |  |      |
|   |                                | Pasat                                   | 0.000                            | at Cant               |  |      |
|   |                                | Reset                                   | Can                              | Cont                  | igure                                  |      |
|   |                                |   |                                  |                       | Close                                  | Nez  |
| dimine and  |                                |   |                                  |                       |  |      |
|   | Demo e                         | •                                       | •                                | •                     | +oun ()                                |      |
|   | 1. Ger<br>Group Na<br>Number o | me                                      | 3. Edit VM 5<br>GCSRecovery<br>5 | iettings 4. Summ      | ary<br>•<br>•<br>•<br>•                |      |
|   | Distance of the                | Ts MAC addresses                        | true<br>Taise                    |                       | LENTE 21,255 Ho<br>Disconnel 1 AMP Co. |      |
|   | Group                          | mangering and boot sequence change with | be applied to both Fallover a    | and Failback runbook. |  |      |
|   |                                | Success                                 |                                  |                       |  |      |

The status of both the failover and failback runbooks is now listed as Configured. Failover and failback runbook groups are created in pairs using the same initial group of VMs and settings. If necessary, the settings of any runbook group can be individually customized by clicking its respective Details link and making changes.

A best practice for a recovery site (AVS) is to create a three-node pilot-light cluster in advance. This allows the recovery site infrastructure to be preconfigured, including the following:

- Destination networking segments, firewalls, services like DHCP and DNS, and so on
- Installation of JetStream DR for AVS
- Configuration of ANF volumes as datastores and more

JetStream DR supports a near-zero RTO mode for mission-critical domains. For these domains, destination storage should be preinstalled. ANF is a recommended storage type in this case.



Network configuration including segment creation should be configured on the AVS cluster to match on-premises requirements.



Depending on the SLA and RTO requirements, you can use continuous failover or regular (standard) failover mode. For near-zero RTO, you should start continuous rehydration at the recovery site.

 To install JetStream DR for AVS on an Azure VMware Solution private cloud, use the Run command. From the Azure portal, go to Azure VMware solution, select the private cloud, and select Run command > Packages > JSDR.Configuration.



The default CloudAdmin user of the Azure VMware Solution doesn't have sufficient privileges to install JetStream DR for AVS. The Azure VMware Solution enables simplified and automated installation of JetStream DR by invoking the Azure VMware Solution Run command for JetStream DR.

The following screenshot shows installation using a DHCP-based IP address.

| Home > ANFDataClus  |                                 |  | Run command - Install-JetDRWithDHCP   |  |  |
|---|---------------------------------|--|---|--|--|
| ANFDataClus   Run   | command –                       |  |   |  |  |
| P Seatch (Ctrt+/) =   | 🔘 Refresh 🛱 Feedback            |  | This top invel CmdHet Downloads JetDr bundle from MMS, creates a new user, assigns<br>elevated privileges to the user, deploys JetDr Management Server Appliance(MSA),<br>registers vsmere to the JetDr MSA, configures duster. |  |  |
| Access control (JAM)  | Packages Run execution status   |  | Command parameters  |  |  |
| <ul> <li>Tagi</li> </ul>  |                                 |  | RegisterWithip 🕥  |  |  |
| Diagnose and solve problems   | <ul> <li>Name</li> </ul>        | Description  | Due Due   |  |  |
| Settings  | V SOR Configuration 224 Powers  | er Manute für samfguretum af Jettimmen Software an 2015. Sein jettimmen Software, für, für sussent | ProtectedCluster * (  |  |  |
| A Locks   | Disable-JetDRForChater          | This Cmdlet unconfigures a cluster but doesn't uninstall JetDR completely so other clusters        | ers Cluster-1   |  |  |
| E cools   | Classic Control Second          | policies.  | Detastore * ()  |  |  |
| Manage  | Enable-JetORForCluster          | This Cindlet configures an additional duster for protection. It installs vibs to all hosts in the  | vsanDatastore   |  |  |
| Connectivity  | Install-JetDRWithDHCP           | This top level Cridlet Downloads JetDr bundle from MMS, creates a new user, assigns elev-          | VMName* ()  |  |  |
| Custers   | and the second second second    | registers vCenter to the JetDr MSA, coofigures cluster.  | antjoval-mea  |  |  |
| Contraction of the second s | Install-JetDRWittStaticIP       | This top level Crititlet Downloads JetDr bundle from MMS, creates a new user, assigns elevi        | Ouster* ()  |  |  |
| dentity   | a desire restances and a second | registers vCenter to the JetDr MSA, configures cluster.  | Outer-1   |  |  |
| Storage (preview)   | Invoke PreflightletDRinutall    | This Cindlet checks and displays current state of the system it checks whether the minimal         | Credential ()   |  |  |
| Placement policies  |                                 | 4 hosts, if the cluster details are correct, if there is already a VM with the same name provid    | Username *  |  |  |
| + Add-oni   | Invoke-PreflightletDRUminstall  | This Cindlet checks and displays current state of the system it checks whether the minimal         | root  |  |  |
|   |                                 | 4 hosts, if the cluster details are correct and if any VCenter is registered to the MSA            | Password *  |  |  |
| Workload Networking   | Uninstall-JetDR                 | The top level Cmdlet creates a new user, assigns elevated privilleges to the user, unconfigu       |   |  |  |
| Segments  | > MicrosoftAVSManagement +147   | Version and lats for estimatively level takes in managing Assex VMMeek Southans                    | HostName ()   |  |  |
| T DHCP  |                                 |  | anfoval msa   |  |  |
| Port mirroring  |                                 |  | Network* ()   |  |  |
| DIDNS   |                                 |  | DiSeg   |  |  |
| a nuo   |                                 |  |   |  |  |
| Operations  |                                 |  | Details   |  |  |
| Run command   |                                 |  | Retain up to  |  |  |

2. After JetStream DR for AVS installation is complete, refresh the browser. To access the JetStream DR UI, go to SDDC Datacenter > Configure > JetStream DR.

| Site Details            |           |             |          |               |       |                  |          | Alarm Set    | tti |
|-------------------------|-----------|-------------|----------|---------------|-------|------------------|----------|--------------|-----|
| vCenter Server Hostna   | me        | 172.30.15   | 56.2     |               |       |                  |          |              |     |
| Management Appliance    | Hostname  | anfjsval-n  | nsa      |               |       |                  |          |              |     |
| Software Version        |           | 4.0.2.450   | i.       |               |       |                  |          |              |     |
| Subscription ID         |           | - Config    | ure      |               |       |                  |          |              |     |
| Tenant ID / Application | ID        | - Config    | ure      |               |       |                  |          |              |     |
| Application Secret      |           | - Config    | ure      |               |       |                  |          |              |     |
| Configure Cluster       | 1 Upgrade | Duconfigure | 🛠 Resolv | e Configure l | Issue |                  |          |              |     |
| Cluster Name            |           | Datacenter  | Name 🔺   | Status A      |       | Software Version | <b>A</b> | Host Details | 5   |
| Cluster-1               |           | SDDC-Data   | center   | 🕝 Ok          |       | 4.0.2.132        |          | Details      |     |

- 3. From the JetStream DR interface, complete the following tasks:
  - a. Add the Azure Blob Storage account that was used to protect the on-premises cluster as a storage site and then run the Scan Domains option.
  - b. In the pop-up dialog window that appears, select the protected domain to import and then click its Import link.

| Protected Domain Description     | Recoverable V VMs |   |  |  |  |
|----------------------------------|-------------------|---|--|--|--|
| GCSDRPD_Demo01 Protection domain | in ANF 5 5        | Imoget  | _  |  | ٩  |
|                                  |                   |   |  | en Filob Storage                               | ~  |
|                                  |                   |   |  | re Blob Storage                                |  |
|                                  |                   | Protected Domain Description recoverable V Vita<br>GCSDRPD_Demo01 Protection domain ANF 5 5 5 | GCSDRPD_Demo01 Protection domain ANF 5 5 Imond | GCSDRPD_Demo01 Protection domain ANF 5 5 Imogd | GCSDRPD_Demo01 Protection domain ANF 5 5 Imond |

4. The domain is imported for recovery. Go to the Protected Domains tab and verify that the intended domain has been selected or choose the desired one from the Select Protected Domain menu. A list of the recoverable VMs in the protected domain is displayed.

| Select Protected Domain: GCSDRPD_Demo01 👻 View all |                                    |                | +                                     | Create | Delete                        | ≡More |
|--|------------------------------------|----------------|---------------------------------------|--------|-------------------------------|-------|
| Mode   | Imported                           | Configurations |                                       |        |                               | Deta  |
| Recoverable / Total VMs                            | 5/5                                | Storage Site   | ANFDemoblobreporec                    |        |                               |       |
|  |                                    | Owner Site     |                                       |        |                               |       |
| Protected VMs Settings Alarms O O                  |                                    |                |                                       |        |                               |       |
|  |                                    |                |                                       |        |                               |       |
| VM Name 🔺  | Protection Status                  |                | Protection Mode 🔺                     |        | Details                       |       |
|  | Protection Status<br>@ Recoverable |                | Protection Mode 🔺<br>Write-Back(VMDK) |        | Details<br>Details            |       |
| VM Name 🔺  |                                    |                |                                       |        | Details                       |       |
| VM Name ▲<br>GCS-DR-DC                             | O Recoverable                      |                | Write-Back(VMDK)                      |        | Details<br>Details            |       |
| VM Name A<br>GCS-DR-DC<br>GCS-DR-LinvM01           | Recoverable     Recoverable        | •<br>•         | Write-Back(VMDK)<br>Write-Back(VMDK)  |        | Details<br>Details<br>Details | (     |

5. After the protected domains are imported, deploy DRVA appliances.

These steps can also be automated using CPT- created plans.

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- 6. Create replication log volumes using available vSAN or ANF datastores.
- 7. Import the protected domains and configure the recovery VA to use an ANF datastore for VM placements.

| ect Protected Domain:    | Continuous Failover Protected Domai | n                              |                |            | Delete    | =        | More |
|--------------------------|-------------------------------------|--------------------------------|----------------|------------|-----------|----------|------|
| ie -                     | General 2a. Failover Settings       | 2b. VM Settings 3. Recovery VA | 4. DR Settings | 5. Summary |           |          | Dela |
| coverable / Total VMs    | i, General 2a. Pallover settings    | 20. VM Settings 5. Recovery VA | 4. DK settings | 5. Summary | ~ reporec |          | 1    |
| CONTRACTOR CONTRACTOR    | Protected Domain Name               | ANFPD002                       |                |            | 253,160)  |          |      |
|                          | Datacenter                          | SDDC-Datacenter                |                |            | 1.00      |          |      |
|                          | Cluster                             | Cluster-1                      |                |            |           |          | 8    |
|                          | Resource Pool (Optional)            | 1 Children Children            |                |            |           |          |      |
| rotected VMs Setti       | VM Folder (Optional)                |                                |                |            |           |          |      |
|                          | Datastore                           | ANFRecoDSU002                  |                |            |           |          |      |
|                          | Internal Network                    | DRSeg                          |                |            |           |          | C    |
| VM Name 🔺                | External Replication Network        | DRSeg                          |                |            |           | Details  |      |
| AuctionAppA2             | Management Network                  | DRSeg                          |                |            | -         | Details  | 1    |
| AuctionAppB2             | Storage Site                        | ANFDemoblobreporec             |                |            |           | Details  |      |
|                          | and the first state of the          | ANFRecDRVA003                  |                |            |           | Details  |      |
| AuctionDB2<br>AuctionLB2 | DR Virtual Appliance                | ANTROLUNIVAUUS                 |                |            | ~         | Details: |      |

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Make sure that DHCP is enabled on the selected segment and that enough IPs are available. Dynamic IPs are temporarily used while domains are recovering. Each recovering VM (including continuous rehydration) requires an individual dynamic IP. After recovery is complete, the IP is released and can be reused.

8. Select the appropriate failover option (continuous failover or failover). In this example, continuous rehydration (continuous failover) is selected.



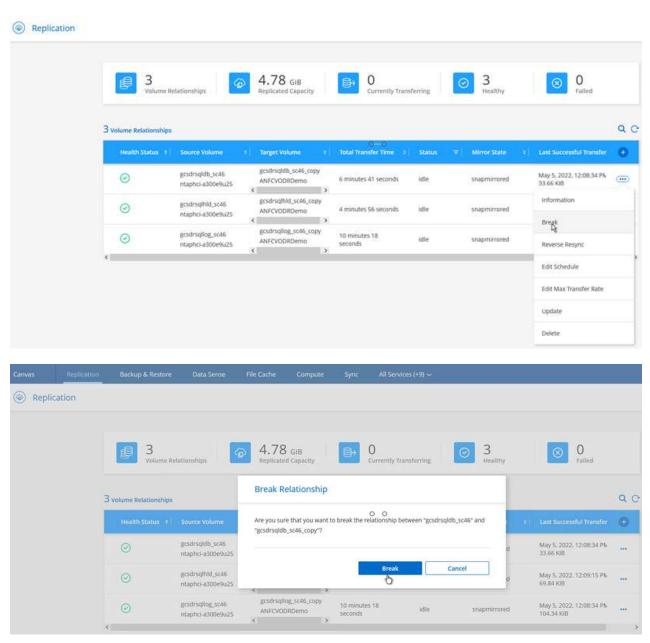
Although Continuous Failover and Failover modes differ on when configuration is performed, both failover modes are configured using the same steps. Failover steps are configured and performed together in response to a disaster event. Continuous failover can be configured at any time and then allowed to run in the background during normal system operation. After a disaster event has occurred, continuous failover is completed to immediately transfer ownership of the protected VMs to the recovery site (near-zero RTO).

| JebSbream DR<br>Protected Domains Statistics Storage Sites Appliances | Configurations Task | Log  |                   |                       |       |
|---|---------------------|--|-------------------|-----------------------|-------|
| elect Protected Domain: GCSDRPD_Demo01 👻 View all                     |                     |  | + Create          | Delete                | ■More |
| fode  | Imported            | Configurations   |                   | O Restore             |       |
| tecoverable / Total VMs   | 5/5                 | 5/5 Storage Site ANFDemobilobrepo<br>Owner Site REMOTE (172.21.253.1 |                   |                       |       |
|   |                     |  |                   | + Continuous Failover |       |
|   |                     |  |                   | → Test Failover       | 0     |
| Protected VMs Settings Alarms O O                                     |                     |  |                   |                       |       |
|   |                     |  |                   |                       | 0     |
| VM Name 🔺   | Protection Status   | •  | Protection Mode 🔺 | Details               |       |
| GCS-DR-DC   | Recoverable         |  | Write-Back(VMDK)  | Details               |       |
| GCS-DR-LinVM01  | Recoverable         |  | Write-Back(VMDK)  | Details               |       |
| GCS-DR-SCA  | Recoverable         |  | Write-Back(VMDK)  | Details               |       |
| GCS-DR-SQL01  | Recoverable         |  | Write-Back(VMDK)  | Details               |       |
| GCS-DR-WinVM01  | O Recoverable       |  | Write-Back(VMDK)  | Details               |       |

The continuous failover process begins, and its progress can be monitored from the UI. Clicking the blue icon in the Current Step section exposes a pop-up window showing details of the current step of the failover process.

#### **Failover and Failback**

1. After a disaster occurs in the protected cluster of the on-premises environment (partial or complete failure), you can trigger the failover for VMs using Jetstream after breaking the SnapMirror relationship for the respective application volumes.



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This step can easily be automated to facilitate the recovery process.

2. Access the Jetstream UI on AVS SDDC (destination side) and trigger the failover option to complete failover. The task bar shows progress for failover activities.

In the dialog window that appears when completing failover, the failover task can be specified as planned or assumed to be forced.

|   | <ul> <li>View all</li> </ul>  |                        |                        | + Create          | S Fullover         | ≣Mor    |  |
|---|---|------------------------|------------------------|-------------------|--------------------|---------|--|
| de  | Continuous Rehydration in Progress  | Configurations         |                        |                   |                    | Details |  |
| coverable / Total VMs                           | 4/4   | Storage Site           |                        |                   | reporec            | ^       |  |
|   | 329.01 GB / 6.19 GB   | Owner Site             |                        | REMOTE ( 172.21.2 |                    |         |  |
| ta (Processed/Known Remaining)                  | Contract of the | Datacenter \ Cluster   |                        | SDDC-Datacenter   | Cluster-1          |         |  |
| rrent Step                                      | Recover VMs' data from Storage Site   | Point-in-time Recovery |                        | Disabled          |                    | Ŷ       |  |
| Protected VMs Settings Alarms                   | 0 0   |                        |                        |                   |                    |         |  |
|   |   |                        |                        |                   |                    | Q       |  |
| VM Name   | Protection Status   |                        |                        | n Mode 🔺          | Details            | ^       |  |
| GCS-DR-DC<br>GCS-DR-LinVI/01                    | Recoverable   |                        | Write-Bac<br>Write-Bac |                   | Détails<br>Détails |         |  |
| GCS-DR-SCA                                      | © Recoverable   |                        | Write-Bac              |                   | Details            |         |  |
| GCS-DR-SQL01                                    | Recoverable   |                        |                        |                   |                    |         |  |
| GCS-DR-WinVM01                                  | @ Recoverable   |                        | Write-Bac<br>Write-Bac |                   | Details<br>Details |         |  |
| VM_3510   | Recovery VM Network<br>DRStretchSeg   | 3.<br>22               | ~                      |                   |                    |         |  |
|   |   |                        |                        |                   |                    |         |  |
|   |   |                        |                        |                   |                    |         |  |
| 0 0   |   |                        |                        |                   |                    |         |  |
| O O<br>Other Settings                           |   |                        | × .                    |                   |                    |         |  |
| Other Settings Planned Fallover  Force Fallover | required because of network configuration:  | Configure              | ~ ~                    |                   |                    |         |  |

Forced failover assumes the primary site is no longer accessible and ownership of the protected domain should be directly assumed by the recovery site.

| Ð | Force Failover of Pro<br>required! | tected Domain reques    | ted. Adminis   | trator consent is               |
|---|------------------------------------|-------------------------|----------------|---------------------------------|
|   | Complete ownership<br>Site.        | o of this Protected Dom | ain will be ta | aken over <mark>b</mark> y this |
|   | Are you sure you wa                | nt to continue?         |                |                                 |
|   |                                    | c                       | Cancel         | Confirm                         |

| rotected VM Network ▲ Recovery VM Network<br>M_3510 DRStretchSeg ▼                  | ^ ^ |
|---|-----|
| M_3510 DRStretchSeg -   | A   |
|   |     |
| 0.0   | ~ ~ |
| her Settings  | _   |
| Planned Failover  |     |
| Force Failover  |     |
| Some VM's guest credential are required because of network configuration: Configure |     |

3. After continuous failover is complete, a message appears confirming completion of the task. When the task is complete, access the recovered VMs to configure ISCSI or NFS sessions.

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The failover mode changes to Running in Failover and the VM status is Recoverable. All the VMs of the protected domain are now running at the recovery site in the state specified by the failover runbook settings.

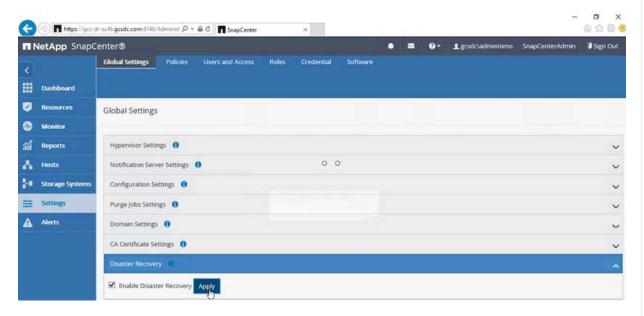
To verify the failover configuration and infrastructure, JetStream DR can be operated in test mode (Test Failover option) to observe the recovery of virtual machines and their data from the object store into a test recovery environment. When a failover procedure is executed in test mode, its operation resembles an actual failover process.

| elect Protected Domain: GCSDRPD002             | Task Completed Successfully with | h warnings            | + Create Delete Ettore                            |  |  |  |
|--|----------------------------------|-----------------------|---|--|--|--|
| łode -   | ×.                               |                       | Edit Data   |  |  |  |
| OCOLUMN CONTRACTORY                            | Protected Domain                 | GCSDRPD002            | ANECVODR  |  |  |  |
| becoverable / Total VMs                        | VMs Recovery Status              | Success with warnings | OC4L (17230.158.2.)<br>DDC-Datacenter ( Cluster-1 |  |  |  |
|  | Total VMs Recovered              | 4                     |   |  |  |  |
| ethalming-Background Data CSRecovery03 Status: |                                  | enabled               |   |  |  |  |
| emaining background bala                       |                                  |                       |   |  |  |  |
| urrent RPO                                     | Pre-script Execution Status      | Not defined           |   |  |  |  |
|  | Runbook Execution Status         | O Success             |   |  |  |  |
| Protected VMs Settings Atarms                  | Post-script Execution Status     | Not defined           |   |  |  |  |
| + Start Protection                             |                                  |                       | c   |  |  |  |
| VIII Name A                                    |                                  | N                     | ackground Data 🔺 Details                          |  |  |  |
| GCS-DR-SC46                                    |                                  | 2                     | B Details   |  |  |  |
| GCS-DR-SOL03                                   |                                  |                       | B Datals  |  |  |  |
| GCSDR-W2K16-01                                 |                                  |                       | 8 Details   |  |  |  |
| UbuntuSrv001                                   |                                  |                       | B Details   |  |  |  |

4. After the virtual machines are recovered, use storage disaster recovery for in-guest storage. To

demonstrate this process, SQL server is used in this example.
5. Log into the recovered SnapCenter VM on AVS SDDC and enable DR mode.
a. Access the SnapCenter UI using the browserN.
Image: the star and the star and

- b. In the Settings page, navigate to Settings > Global Settings > Disaster Recovery.
- c. Select Enable Disaster Recovery.
- d. Click Apply.



e. Verify whether the DR job is enabled by clicking Monitor > Jobs.



NetApp SnapCenter 4.6 or later should be used for storage disaster recovery. For previous versions, application-consistent snapshots (replicated using SnapMirror) should be used and manual recovery should be executed in case previous backups must be recovered in the disaster recovery site.

6. Make sure that the SnapMirror relationship is broken.

| Canvas | Replication | Backup & Restore                          | Data Sense  | File Cad      | iche Compute  | Sync         | All Services          | (+9) ~         |  |  |     |
|--------|-------------|---|---|---------------|---|--------------|-----------------------|----------------|--|--|-----|
|        |             |   |   |               |   |              |                       |                |  |  |     |
|        |             | J<br>Volume Re                            | lationships   |               | 1.78 GIB  | (i)          | 0<br>Currently Transf | ferring        | ⊘ 3<br><sub>Healthy</sub>                            | ⊗ 0<br>Failed  |     |
|        |             |   |   |               |   |              |                       |                |  |  |     |
|        |             | 3 Volume Relationships                    |   |               |   |              |                       |                |  |  | Q   |
|        |             | 3 Volume Relationships<br>Health Status 🗧 | Source Volume   | - 11 m        | arget Volume  | e   Total Tr | 0—0<br>ansfer Time ≠  | Status         | Mirror State   | e 🔰 Last. Successful Transfer  | Q ( |
|        |             |   | Source Volume<br>gcsdrsqldb_sc46<br>ntaphci-a300e9u25 | ge            | csdrsqldb_sc46_copy<br>NFCVODRDemo  |              |                       | Status<br>Idle | <ul> <li>Mirror State</li> <li>broken-off</li> </ul> | <ul> <li>Last Successful Transfer</li> <li>May 5, 2022, 12:08:34 Pk<br/>33:66 KiB</li> </ul> | 0   |
|        |             | Health Status 🗧                           | gcsdrsqldb_sc46                                       | gc<br>AN<br>¢ | csdrsqldb_sc46_copy<br>NFCVODRDemo<br>csdrsqlhld_sc46_copy<br>NFCVODRDemo | 6 minut      | ansfer Time 🗧         |                |  | May 5, 2022, 12:08:34 PM   | 0   |

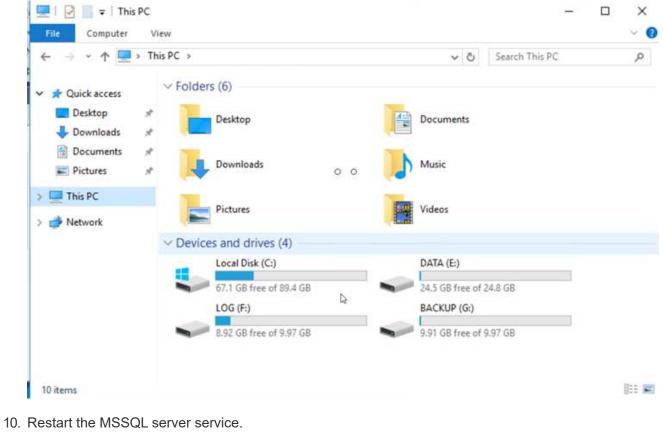
7. Attach the LUN from Cloud Volumes ONTAP to the recovered SQL guest VM with same drive letters.

| 📅 Disk Manageme                        | nt        |       |             |            |          |          | 0 <del>7-1</del> 8 | × |
|--|-----------|-------|-------------|------------|----------|----------|--------------------|---|
| File Action View                       | w Help    |       |             |            |          |          |                    |   |
| (= =) 🖬 🕅                              | 🖬   🗩 🗹 ( | (H)   |             |            |          |          |                    |   |
| Volume                                 | Layout    | Туре  | File System | Status     | Capacity | Free Spa | % Free             |   |
|  | Simple    | Basic |             | Healthy (R | 450 MB   | 450 MB   | 100 %              |   |
| -                                      | Simple    | Basic |             | Healthy (E | 99 MB    | 99 MB    | 100 %              |   |
| - (C:)                                 | Simple    | Basic | NTFS        | Healthy (B | 89.45 GB | 67.03 GB | 75 %               |   |
| BACKUP (G:)                            | Simple    | Basic | NTFS        | Healthy (P | 9.97 GB  | 9.92 GB  | 99 %               |   |
| DATA (E:)                              | Simple    | Basic | NTFS        | Healthy (P | 24.88 GB | 24.57 GB | 99 %               |   |
| - LOG (F:)                             | Simple    | Basic | NTFS        | Healthy (P | 9.97 GB  | 8.93 GB  | 90 %               |   |
| 10000000000000000000000000000000000000 |           |       |             |            | 0        | 0        |                    |   |

8. Open iSCSI Initiator, clear the previous disconnected session and add the new target along with multipath for the replicated Cloud Volumes ONTAP volumes.

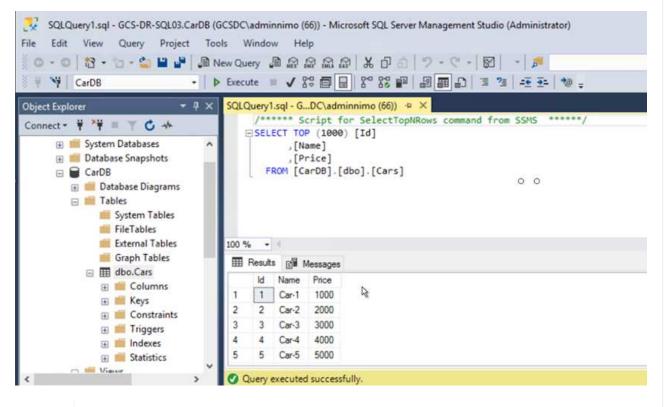
|                             | iator Proper  |  |  |          |               |
|-----------------------------|---------------|--|--|----------|---------------|
| l'argets                    | Discovery     | Favorite Targets                           | Volumes and Devices                        | RADIUS   | Configuration |
| To disc<br>DNS na<br>Target | ame of the ta | on to a target usin<br>arget and then dick | ng a basic connection, t<br>Quick Connect. |          | address or    |
| Discove                     | ered targets  |  |  |          | Refresh       |
| Name                        |               |  |  | Status   |               |
|                             | 92-08.com.    | netapp:sn.547772c                          | cc47811ecbb62000                           | Connecte | d             |
| ign. 19                     |               |  |  |          |               |

9. Make sure that all the disks are connected using the same drive letters that were used prior to DR.



| 🗢 🄿   📷   🖼 🗵    | 0 😼 🛛 🖬 🖿 🖿 🔲 🕪   |   |  |         |   |  |
|------------------|---|---|--|---------|---|--|
| Services (Local) | Services (Local)  SQL Server (MSSQLSERVER)  | Name  | Description  | Status  | Startup Type  | Log '  |
|                  | 1   | 🖏 SQL Full-text Filter Daemon   | Service to la  | Running | Manual  | NT   |
|                  | Stop the service<br>Pause the service<br>Restart the service<br>Description:<br>Provides storage, processing and<br>controlled access of data, and rapid<br>transaction processing. | SQL Server (MSSQLSERVER)<br>SQL Server Agent (MSSC<br>SQL Server Browser<br>SQL Server CEIP service<br>SQL Server Integration S<br>SQL Server Integration S<br>SQL Server VSS Writer<br>SSDP Discovery<br>State Repository Service<br>Still Image Acquisition E<br>Storage Service<br>Storage Tiers Managem<br>Superfetch<br>Sync Host_df83a<br>System Event Notification S | Provides sto<br>Start<br>Stop<br>Pause <sup>O</sup> O<br>Resume<br>Resume<br>All Tasks<br>Refresh<br>Properties<br>Help<br>This service<br>Monitors sy | -       | Automatic<br>Automatic<br>Automatic<br>Automatic<br>Automatic<br>Automatic<br>Manual<br>Manual<br>Manual<br>Manual<br>Manual<br>Automatic (D<br>Automatic | GCS<br>GCS<br>Loc<br>NT<br>NT<br>Loc<br>Loc<br>Loc<br>Loc<br>Loc<br>Loc<br>Loc |

11. Make sure that the SQL resources are back online.



In the case of NFS, attach the volumes using the mount command and update the /etc/fstab entries.

At this point, operations can be run and business continues normally.

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On the NSX-T end, a separate dedicated tier-1 gateway can be created for simulating failover scenarios. This ensures that all workloads can communicate with each other but that no traffic can route in or out of the environment, so that any triage, containment, or hardening tasks can be performed without risk of cross-contamination. This operation is outside of the scope of this document, but it can easily be achieved for simulating isolation.

After the primary site is up and running again, you can perform failback. VM protection is resumed by Jetstream and the SnapMirror relationship must be reversed.

- 1. Restore the on-premises environment. Depending on the type of disaster incident, it might be necessary to restore and/or verify the configuration of the protected cluster. If necessary, JetStream DR software might need to be reinstalled.
- 2. Access the restored on-premises environment, go to the Jetstream DR UI, and select the appropriate protected domain. After the protected site is ready for failback, select the Failback option in the UI.



The CPT-generated failback plan can also be used to initiate the return of the VMs and their data from the object store back to the original VMware environment.

| JebStream DR<br>Protected Domains Statistics Storage Sites Appliances Configu | rations Task Log                |                  |                           |       |
|---|---------------------------------|------------------|---------------------------|-------|
| Select Protected Domain: GCSDRPD_Demo01 🔻 View all                            |                                 | + Create         | 🗑 Delete 🛛 🗮 M            | lore  |
| Mode Rur  | ning in Failover Configurations |                  | O Restore                 |       |
| Active Site   | 172.30.156.2 Storage Site       | ANFCVODR         | O Resume Continuous Rehyd | ratio |
| Recoverable / Total VMs   | 4/4 Owner Site                  | REMOTE ( 172.3   | + Fallback                |       |
| Protected VMs Settings Alarms O O   |                                 |                  |                           | c     |
| VM Name 🔺   | Protection Status               | Protection Mode  | Details                   |       |
| GCS-DR-DC   | Recoverable                     | Write-Back(VMDK) | Details                   | '     |
| GCS-DR-LinVM01  | Recoverable                     | Write-Back(VMDK) | Details                   |       |
| GCS-DR-SCA  | Recoverable                     | Write-Back(VMDK) | Details                   |       |
| GCS-DR-SQL01  | Recoverable                     | Write-Back(VMDK) | Details                   |       |
| GCS-DR-WinVM01  | Recoverable                     | Write-Back(VMDK) | Details                   |       |



Specify the maximum delay after pausing the VMs in the recovery site and restarting them in the protected site. The time need to complete this process includes the completion of replication after stopping failover VMs, the time needed to clean the recovery site, and the time needed to recreate VMs in the protected site. NetApp recommends 10 minutes.

| •            | •                     | •               | •                |       |          | 0          |
|--------------|-----------------------|-----------------|------------------|-------|----------|------------|
| . General    | 2a. Failback Settings | 2b. VM Settings | 3. Recovery VA   | 4. DR | Settings | 5. Summary |
| Failback Da  | tacenter              |                 | A300-DataCenter  |       |          |            |
| Failback Clu | uster                 |                 | A300-Cluster     |       |          |            |
| Failback Re  | source Pool           |                 | *                |       |          |            |
| VM Folder (  | Optional)             |                 |                  |       |          |            |
| Failback Da  | tastore               |                 | A300_NFS_vMotion |       |          |            |
| Maximum D    | elay After Stopping   |                 | 10 Minutes       |       |          |            |
| Internal Net | woRk                  |                 | VM_187           |       |          |            |
| External Re  | plication Network     |                 | VM_187           |       |          |            |
| Managemen    | it Network            |                 | VM_187           |       |          |            |
| Storage Site | 9                     |                 | ANFCVODR         |       |          |            |
| DR Virtual A | ppliance              |                 | GCSDRVA002       |       |          |            |
| Replication  | Log Storage           |                 | /dev/sdb         |       |          |            |

3. Complete the failback process and then confirm the resumption of VM protection and data consistency.

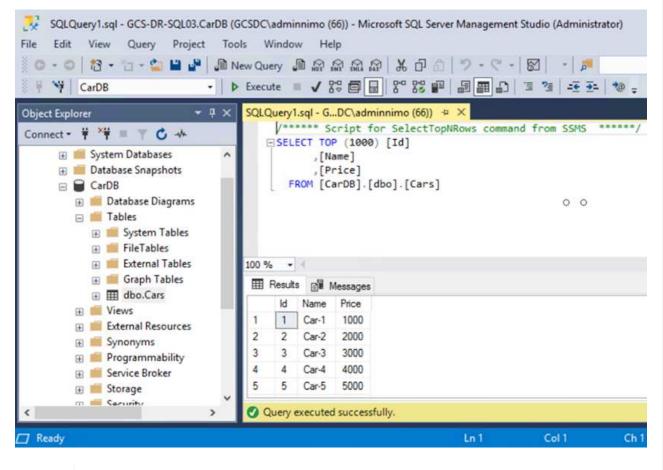
| Jet/Stream DR<br>Protected Domains Statistics Storage Si | Failback Task Result         |             |   |  |
|--|------------------------------|-------------|---|--|
| Select Protected Domain: GCSDRPD002 -                    | Task Completed Successfully  |             |   |  |
| Recoverable / Total VMs                                  | Protected Domain             | GCSDRPD002  |   |  |
| Replication Status                                       | VMs Recovery Status          | Success     |   |  |
| Remaining Background Data                                | Total VMs Recovered          | 4           |   |  |
| Contraining Dataground Dota                              | GCSRecovery03 Status:        |             |   |  |
| Current RPO  | Pre-script Execution Status  | Not defined |   |  |
|  | Runbook Execution Status     | Success     |   |  |
| Protected VMs Settings Alarms                            | Post-script Execution Status | Not defined | 3 |  |

4. After the VMs are recovered, disconnect the secondary storage from the host and connect to the primary storage.

| $\odot$ | gcsdrsqldb_sc46<br>ntaphci-a300e9u25  | 14 | gcsdrsqldb_sc46_copy<br>ANFCVODRDemo  | • | 6 minutes 41 seconds     | idle | broken-off | May 5. 2022. 12:08:34 PN<br>33.66 KiB | • |
|---------|---------------------------------------|----|---------------------------------------|---|--------------------------|------|------------|---------------------------------------|---|
| $\odot$ | gcsdrsqlhld_sc46<br>ntaphci-a300e9u25 | 14 | gcsdrsqlhld_sc46_copy<br>ANFCVODRDemo | • | 4 minutes 56 seconds     | idle | broken-off | Information                           |   |
| $\odot$ | gcsdrsqllog_sc46<br>ntaphci-a300e9u25 | 3  | gcsdrsqllog_sc46_copy<br>ANFCVODRDemo | • | 10 minutes 18<br>seconds | idle | broken-off | Reverse Resync                        |   |
|         |                                       |    |                                       |   |                          |      |            | Edit Schedule                         |   |
|         |                                       |    |                                       |   |                          |      |            | Edit Max Transfer Rate                |   |
|         |                                       |    |                                       |   |                          |      |            | Delete                                |   |

| Volume Re            | lationships                           | 6.54 GIB<br>Replicated Capacity       | Currently Trans       | sferring | O 3<br>Healthy       | S O Failed                             |   |
|----------------------|---------------------------------------|---------------------------------------|-----------------------|----------|----------------------|--|---|
| Volume Relationships | 1                                     |                                       | 0 0                   |          |                      |  | Q |
| Health Status 🗧      | Source Volume ÷                       | Target Volume +                       | Total Transfer Time 🔹 | Status   | ■ Mirror State     ■ | Last Successful Transfer               | Ð |
| $\odot$              | gcsdrsqldb_sc46<br>ntaphcl-a300e9u25  | gcsdrsqldb_sc46_copy<br>ANFCVODRDemo  | 19 seconds            | idle     | snapmirrored         | May 6, 2022, 11:03:000A<br>5.73 MiB    |   |
| 0                    | gcsdrsqlhld_sc46_copy<br>ANFCVODRDemo | gcsdrsqlhld_sc46<br>ntaphci-a300e9u25 | 1 minute 46 seconds   | idle     | snapmirrored         | May 6, 2022, 11:01:39 AN<br>800.76 MIB |   |
| $\odot$              | gcsdrsqllog_sc46<br>ntaphci-a300e9u25 | gcsdrsqllog_sc46_copy<br>ANFCVODRDemo | 51 seconds            | idle     | snapmirrored         | May 6, 2022, 11:03:15 AN<br>785.8 MiB  |   |

- 5. Restart the MSSQL server service.
- 6. Verify that the SQL resources are back online.



To failback to the primary storage, make sure that the relationship direction remains the same as it was before the failover by performing a reverse resync operation.

To retain the roles of primary and secondary storage after the reverse resync operation, perform the reverse resync operation again.

This process is applicable to other applications like Oracle, similar database flavors, and any other applications using guest-connected storage.

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As always, test the steps involved for recovering the critical workloads before porting them into production.

# Benefits of this solution

- Uses the efficient and resilient replication of SnapMirror.
- Recovers to any available points in time with ONTAP snapshot retention.
- Full automation is available for all required steps to recover hundreds to thousands of VMs, from the storage, compute, network, and application validation steps.
- SnapCenter uses cloning mechanisms that do not change the replicated volume.
  - This avoids the risk of data corruption for volumes and snapshots.
  - Avoids replication interruptions during DR test workflows.
  - Leverages the DR data for workflows beyond DR, such as dev/test, security testing, patch and upgrade testing, and remediation testing.
- CPU and RAM optimization can help lower cloud costs by enabling recovery to smaller compute clusters.

### TR-4955: Disaster Recovery with Azure NetApp Files (ANF) and Azure VMware Solution (AVS)

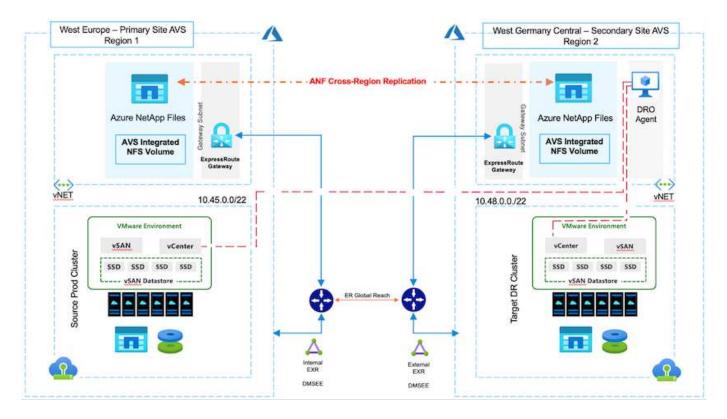
Disaster recovery using block-level replication between regions within the cloud is a resilient and cost-effective way of protecting the workloads against site outages and data corruption events (for example, ransomware).

Author(s): Niyaz Mohamed, NetApp Solutions Engineering

## Overview

With Azure NetApp files (ANF) cross-region volume replication, VMware workloads running on an Azure VMware Solution (AVS) SDDC site using Azure NetApp files volumes as an NFS datastore on the primary AVS site can be replicated to a designated secondary AVS site in the target recovery region.

Disaster Recovery Orchestrator (DRO) (a scripted solution with a UI) can be used to seamlessly recover workloads replicated from one AVS SDDC to another. DRO automates recovery by breaking replication peering and then mounting the destination volume as a datastore, through VM registration to AVS, to network mappings directly on NSX-T (included with all AVS private clouds).



### Prerequisites and general recommendations

- Verify that you have enabled cross-region replication by creating replication peering. See Create volume replication for Azure NetApp Files.
- You must configure ExpressRoute Global Reach between the source and target Azure VMware Solution private clouds.
- You must have a service principal that can access resources.
- The following topology is supported: primary AVS site to secondary AVS site.
- Configure the replication schedule for each volume appropriately based on business needs and the datachange rate.



Cascading and fan- in and fan- out topologies are not supported.

### **Getting started**

#### **Deploy Azure VMware Solution**

The Azure VMware Solution (AVS) is a hybrid cloud service that provides fully functional 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.

To configure an AVS private cloud on Azure, follow the steps in this link for NetApp documentation and in this link for Microsoft documentation. A pilot- light environment set up with a minimal configuration can be used for DR purposes. This setup only contains core components to support critical applications, and it can scale out and spawn more hosts to take the bulk of the load if a failover occurs.



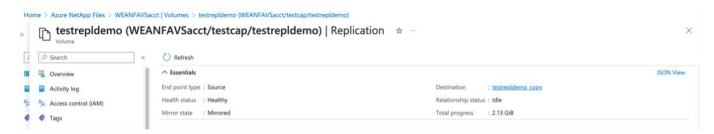
In the initial release, DRO supports an existing AVS SDDC cluster. On-demand SDDC creation will be available in an upcoming release.

## Provision and configure Azure NetApp Files

Azure NetApp Files is a high-performance, enterprise-class, metered file- storage service. Follow the steps in this link to provision and configure Azure NetApp Files as a NFS datastore to optimize AVS private cloud deployments.

#### Create volume replication for Azure NetApp Files-powered datastore volumes

The first step is to set up cross- region replication for the desired datastore volumes from the AVS primary site to the AVS secondary site with the appropriate frequencies and retentions.



Follow the steps in this link to set up cross-region replication by creating replication peering. The service level for the destination capacity pool can match that of the source capacity pool. However, for this specific use case, you can select the standard service level and then modify the service level in the event of a real disaster or DR simulations.

A cross- region replication relationship is a prerequisite and must be created beforehand.

### **DRO** installation

To get started with DRO, use the Ubuntu operating system on the designated Azure virtual machine and make sure you meet the prerequisites. Then install the package.

### **Prerequisites:**

- · Service principal that can access resources.
- Make sure that appropriate connectivity exists to the source and destination SDDC and Azure NetApp Files instances.
- DNS resolution should be in place if you are using DNS names. Otherwise, use IP addresses for vCenter.

### OS requirements:

- Ubuntu Focal 20.04 (LTS)The following packages must be installed on the designated agent virtual machine:
- Docker
- Docker- compose
- JqChange docker.sock to this new permission: sudo chmod 666 /var/run/docker.sock.



The deploy.sh script executes all required prerequisites.

The steps are as follows:

1. Download the installation package on the designated virtual machine:

```
git clone https://github.com/NetApp/DRO-Azure.git
```



The agent must be installed in the secondary AVS site region or in the primary AVS site region in a separate AZ than the SDDC.

2. Unzip the package, run the deployment script, and enter the host IP (for example, 10.10.10.10).

```
tar xvf draas_package.tar
Navigate to the directory and run the deploy script as below:
sudo sh deploy.sh
```

- 3. Access the UI using the following credentials:
  - Username: admin
  - Password: admin

|  | ■ NetApp  |   |
|--|---|---|
|  | Disaster Recovery Orchestrator<br>Degree Engine function with that     Username |   |
|  | Pasiward  |   |
|  | - English I   | _ |
|  |   | - |

### **DRO** configuration

After Azure NetApp Files and AVS have been configured properly, you can begin configuring DRO to automate the recovery of workloads from the primary AVS site to the secondary AVS site. NetApp recommends deploying the DRO agent in the secondary AVS site and configuring the ExpressRoute gateway connection so that the DRO agent can communicate via the network with the appropriate AVS and Azure NetApp Files components.

The first step is to Add credentials. DRO requires permission to discover Azure NetApp Files and the Azure VMware Solution. You can grant the required permissions to an Azure account by creating and setting up an Azure Active Directory (AD) application and by obtaining the Azure credentials that DRO needs. You must bind

the service principal to your Azure subscription and assign it a custom role that has the relevant required permissions. When you add source and destination environments, you are prompted to select the credentials associated with the service principal. You need to add these credentials to DRO before you can click Add New Site.

To perform this operation, complete the following steps:

- 1. Open DRO in a supported browser and use the default username and password (admin/admin). The password can be reset after the first login using the Change Password option.
- 2. In the upper right of the DRO console, click the **Settings** icon, and select **Credentials**.
- 3. Click Add New Credential and follow the steps in the wizard.
- 4. To define the credentials, enter information about the Azure Active Directory service principal that grants the required permissions:
  - · Credential name
  - Tenant ID
  - Client ID
  - · Client secret
  - Subscription ID

You should have captured this information when you created the AD application.

5. Confirm the details about the new credentials and click Add Credential.

| NetApp Disaster Recovery Orchestrator 🍾 Dashboard Discovery | er   Resource Groups   Replication Plans   J | ob Monitoring | 4 🗢 🛛 🔍 |
|---|--|---------------|---------|
| Add New Credential  | Credentials Details                          | τ             | ×       |
|   | Enter Credentials                            | Details       |         |
|   | Credential Name                              | •             |         |
|   | Tenant Id                                    |               |         |
|   | Client Id                                    |               |         |
|   | Client Secret                                |               |         |
|   | Subscription Id                              |               |         |
|   | L  |               |         |
|   |  |               |         |
|   | Add Credential                               |               |         |

After you add the credentials, it's time to discover and add the primary and secondary AVS sites (both vCenter and the Azure NetApp files storage account) to DRO. To add the source and destination site, complete the following steps:

- 6. Go to the **Discover** tab.
- 7. Click Add New Site.
- 8. Add the following primary AVS site (designated as **Source** in the console).

- SDDC vCenter
- Azure NetApp Files storage account
- 9. Add the following secondary AVS site (designated as **Destination** in the console).
  - SDDC vCenter
  - Azure NetApp Files storage account

| Resource Groups   Replication Plans   Job Monitoring       Discovery Orchestrator >>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>> | ÷ | ¢ | ? | 9 |
|--|---|---|---|---|
| Add New Site () Site Type (2) Site Details (3) vCenter Details (4) Storage Details                                     |   |   |   | × |
| Site Type  |   |   |   |   |
| Source Destination   |   |   |   |   |
| Continue   |   |   |   |   |

10. Add site details by clicking **Source**, entering a friendly site name, and select the connector. Then click **Continue**.



For demonstration purposes, adding a source site is covered in this document.

- 11. Update the vCenter details. To do this, select the credentials, Azure region, and resource group from the dropdown for the primary AVS SDDC.
- 12. DRO lists all the available SDDCs within the region. Select the designated private cloud URL from the dropdown.
- 13. Enter the cloudadmin@vsphere.local user credentials. This can be accessed from Azure Portal. Follow the steps mentioned in this link. Once done, click **Continue**.

| Add New Site | 🕑 Site Type 🤇                         | ) Site Details 3 vCenter Details 4 | ) Storage Details    |  |
|--------------|---------------------------------------|------------------------------------|----------------------|--|
|              |                                       | Source AVS Private Cloud           |                      |  |
|              | Select Credentials                    | Azure Region                       | Azure Resource Group |  |
|              | DemoCred -                            | West Europe 👻                      | ANFAVSVal2 v         |  |
|              | Add New Credential IS                 |                                    |                      |  |
|              |                                       | AVS Details                        |                      |  |
|              |                                       | Ava octalia                        |                      |  |
|              | Web Clien                             | URL                                | 0                    |  |
|              |                                       | ANFDataClus                        | *                    |  |
|              | Username                              |                                    | 0                    |  |
|              | · · · · · · · · · · · · · · · · · · · | min@vsphere.local                  |                      |  |
|              |                                       |                                    |                      |  |
|              | Password                              |                                    | 0                    |  |
|              |                                       | •••••                              |                      |  |
|              |                                       | Accept self-signed certificates    |                      |  |
|              |                                       |                                    |                      |  |
|              |                                       |                                    |                      |  |

14. Select the Source Storge details (ANF) by selecting the Azure Resource group and NetApp account.

## 15. Click Create Site.

| p | Disaster Recovery Orchestrator 💊 🕴 Dashbo | pard Discover Resource Grou | ups   Replication Plans   Job Monitoring |  | A 3              |
|---|---|-----------------------------|--|--|------------------|
|   | C 2<br>Sites 2 vCenter                    | s 2<br>Storages             | Site Type                                | Site Location                          | (a) 2<br>Cloud   |
|   |   |                             | TORITE ACTIVITIES                        |  |                  |
|   | 2 Sites Site Name                         | ≎   Site Type = 〒   Locatio | in                                       | Discovery Status                       | Q O Add New Site |
|   |   |                             |  |  |                  |
|   | DemoDest                                  | Destination Cloud           | 1 1                                      | <ul> <li>https://10.75.0.2/</li> </ul> | ⊘ Success        |

Once added, DRO performs automatic discovery and displays the VMs that have corresponding cross- region replicas from the source site to the destination site. DRO automatically detects the networks and segments used by the VMs and populates them.

| Disaster Recovery Orchestrator | Dashboard Docover   R | esource Groups Replication Plans Jo            | b Monitoring  |                                | <u>.</u>        |
|--------------------------------|-----------------------|--|---------------|--------------------------------|-----------------|
| Back                           |                       | VM List<br>Site: DemoSRC   vCenter: https://17 | 72.30.156.2/  |                                |                 |
| 2 2                            | lastores              | 128<br>Virtual Machines                        | VM Potection  | <mark>126</mark><br>Unprotecte |                 |
| 128 vm                         |                       |  |               | Q s                            |                 |
| VM Name                        | 211 MM Mature         |  | DetaStore     | : i ou                         | C Memory (MB) C |
| HDBench_251                    | O Not Protected       | () Powered On                                  | vianDatastore | 8                              | 8192            |
| hci-fio-datastore-13984-0-1    | 0 Not Protected       | Powered Off                                    | HCItstDS      | 32                             | 65536           |
| ICCA2005-WD-R1                 | O Not Protected       | (1) Powered On                                 | vianDatastore |                                | 34336           |
| ICCA2005-NE-R1                 | 0 Not Protected       | () Powered On                                  | vsanDataitore | 1                              | 3072            |
| ICCA0505-01-81                 | 0 Not Protected       | () Powered On                                  | vsanDatastore | 8                              | 3072            |
| HCK_Demo_05                    | O Not Protected       | O Powered Off                                  | Demo002       | 7                              | 2048            |
|                                |                       |  |               |                                |                 |

The next step is to group the required VMs into their functional groups as resource groups.

### **Resource groupings**

After the platforms have been added, group the VMs you want to recover into resource groups. DRO resource groups allow you to group a set of dependent VMs into logical groups that contain their boot orders, boot delays, and optional application validations that can be executed upon recovery.

To start creating resource groups, click the **Create New Resource Group** menu item.

1. Access Resource Grou\*ps and click \*Create New Resource Group.

| NetApp | Disaster Recovery Orchestrator 💊 📔 Dashi | ward   Discover   Resource Groups   Re | plication Plans   Job Monitoring | 4 O                           | ? 9 |
|--------|--|--|----------------------------------|-------------------------------|-----|
|        | Resource Group                           | Site                                   | CP 1                             | 2<br>Virtual Machines         |     |
|        | 1 Resource Group                         |  |                                  | Q D Create New Resource Group |     |
|        | Resource Group Name                      | 🗢 📋 Site Name                          |                                  | ≂   VM list                   |     |
|        | DemoRG                                   | DemoSRC                                | https://172.30.156.2/            | View VM List                  |     |

- 2. Under New Resource Group, select the source site from the dropdown and click Create.
- 3. Provide the resource group details and click **Continue**.
- 4. Select appropriate VMs using the search option.
- 5. Select the Boot Order and Boot Delay (secs) for all the selected VMs. Set the order of the power- on sequence by selecting each virtual machine and setting up the priority for it. The default value for all virtual machines is 3. The options are as follows:
  - The first virtual machine to power on
  - Default

• The last virtual machine to power on

| NetApp Disaster Recovery Orchestrator | Dashboard Dis |                       | Replication Plans | Job Monitoring |             | 🌲 🔅 😨 🤇 |
|---------------------------------------|---------------|-----------------------|-------------------|----------------|-------------|---------|
| Edit Resource Group                   |               | Resource Group Detail | is 🕢 Select VMs   | s 🚯 Boot order | r and Delay |         |
|                                       |               |                       | Boot order an     | d Delay        |             |         |
|                                       | VM Name       | Boot Order 🕥          |                   | Boot Delay     | (secs)      |         |
|                                       | QALin1        | 3                     | 10                | , Ö            | 12          |         |
|                                       | QALin         | 3                     | 10                | 0              | [0]         |         |

### 6. Click Create Resource Group.

| Disaster Recovery Orchestrator 💊 📗 | Dashboard   Discover   Resource Groups   Re | plication Plans   Job Monitoring | A 3                           |
|------------------------------------|---|----------------------------------|-------------------------------|
| 2 1<br>Resource Group              | C 1<br>Ste                                  | P 1                              | Virtual Machines              |
| 1 Resource Group                   |   |                                  | Q O Create New Resource Group |
| Resource Group Name                |   |                                  | ≂   VM List                   |
| DemoRG                             | DemoSRC                                     | https://172.30.156.2/            | View VM List                  |

## **Replication plans**

You must have a plan to recover applications in the event of a disaster. Select the source and destination vCenter platforms from the drop down, pick the resource groups to be included in this plan, and also include the grouping of how applications should be restored and powered on (for example, domain controllers, tier-1, tier-2, and so on). Plans are often called blueprints as well. To define the recovery plan, navigate to the Replication Plan tab, and click **New Replication Plan**.

To start creating a replication plan, complete the following steps:

1. Navigate to Replication Plans and click Create New Replication Plan.

| Disaster Recovery Orchestrator 💊 🛛 Dashboard 🗍 Discover 📔 R | tesource Groups   Replication Plans   Job Monitoring |                     |                             |
|---|--|---------------------|-----------------------------|
|   | Source Details                                       | Destination Details | _                           |
| Replication Plans   | IPS Sites VCenters                                   | Sites vC            | Centers                     |
| 1 Replication Plan  |  | a o 🖸               | Treate New Replication Plan |
| Plan Name   | Compliance Source Site                               |                     | l i i                       |
| DemoRP ② Source ④ Active                                    | A Partially Healthy DemoSRC                          | DemoDest Resource ( | Groups                      |

2. On the **New Replication Plan**, provide a name for the plan and add recovery mappings by selecting the Source Site, associated vCenter, Destination Site, and associated vCenter.

| NetApp Disaster Recovery Orchestrator | Dashboard Discover Resource Groups Repli                                | cation Plans Job Monitoring                           | 🌲 🌣 😗 😩 |
|---------------------------------------|---|---|---------|
| Create New Replication Plan           | <ul> <li>Replication Plan and Site Details</li> <li>Select R</li> </ul> | esource Groups ③ Set Execution Order ④ Set VM Details | ×       |
|                                       | Replica   | ation Plan Details                                    |         |
|                                       | Plan Name   |   | 0       |
|                                       | DemoRP  |   |         |
|                                       | Rec   | overy Mapping   |         |
|                                       | Source Site   | Destination Site                                      | 0       |
|                                       | DemoSRC   | DemoDest  | •       |
|                                       | Source vCenter  | Destination vCenter                                   | 0       |
|                                       | https://172.30.156.2/   | + https://10.75.0.2/                                  | •       |
|                                       | C   | uster Mapping   |         |
|                                       | Source Site Resource 0 De   | stination Site Resource                               |         |
|                                       | Cluster-1 *   | Cluster-1 - Add                                       |         |
|                                       |   |   |         |
|                                       | Source Resource D   | estination Resource                                   |         |
|                                       | No  | Mappings added!                                       |         |
|                                       |   | Continue  |         |

3. After recovery mapping is complete, select the **Cluster Mapping**.

| NetApp Disaster Recovery Orchestrator | Dashboard Discover Resource Gro                                    | oups   Replication Pla | ns Job Monitoring                                |   |  | ۵ | ۰ | ? | 9 |
|---------------------------------------|--|------------------------|--|---|--|---|---|---|---|
| Create New Replication Plan           | (1) Replication Plan and Site Details                              | 2 Select Resource G    | roups (3) Set Execution Order (4) Set VM Details |   |  |   |   |   | × |
| Replication Plan Details              |  |                        |  |   |  |   |   |   |   |
|                                       | Plan Name  |                        |  | 0 |  |   |   |   |   |
|                                       | DemoRP   |                        |  |   |  |   |   |   |   |
| Recovery Mapping                      |  |                        |  |   |  |   |   |   |   |
|                                       | Source Site  | 0                      | Destination Site                                 | 0 |  |   |   |   |   |
|                                       | DemoSRC  |                        | DemoDest   | ~ |  |   |   |   |   |
|                                       | Source vCenter   | 0                      | Destination vCenter                              | 0 |  |   |   |   |   |
|                                       | https://172.30.156.2/  | *                      | https://10.75.0.2/                               | * |  |   |   |   |   |
|                                       |  |                        |  |   |  |   |   |   |   |
|                                       | No more Source/Destination cluster resources available for mapping |                        |  |   |  |   |   |   |   |
|                                       | Source Resource  | Destination Re         | source   |   |  |   |   |   |   |
|                                       | Cluster-1  | Cluster-1              | Delete   |   |  |   |   |   |   |
|                                       |  |                        |  |   |  |   |   |   |   |
|                                       |  |                        |  |   |  |   |   |   |   |
|                                       |  | Cont                   | tinue  |   |  |   |   |   |   |

- 4. Select Resource Group Details and click Continue.
- 5. Set the execution order for the resource group. This option enables you to select the sequence of operations when multiple resource groups exist.
- 6. Once done, set network mapping to the appropriate segment. The segments should already be provisioned on the secondary AVS cluster, and, to map the VMs to those, select the appropriate segment.
- 7. Datastore mappings are automatically selected based on the selection of VMs.



Cross- region replication (CRR) is at the volume level. Therefore, all VMs residing on the respective volume are replicated to the CRR destination. Make sure to select all VMs that are part of the datastore, because only virtual machines that are part of the replication plan are processed.

| NetApp Disaster Recovery Orchestrator 💊 | Dashboard   Discover   Resource G | iroups   Replication Plans   Job N   | Aonitoring                             | 4 | ۰. | ? | 9 |
|---|-----------------------------------|--------------------------------------|--|---|----|---|---|
| Create New Replication Plan             | Replication Plan and Site Details | Select Resource Groups 3             | Set Execution Order (4) Set VM Details |   |    |   | × |
|   |                                   | Replication Plan Det                 | ails                                   |   |    |   |   |
|   |                                   | Select Execution Orde                | r -                                    |   |    |   |   |
|   | Resource Group Name               |                                      | Execution Order 👔                      |   |    |   |   |
|   | DemoRG                            |                                      | 3 [0]                                  |   |    |   |   |
|   |                                   | Network Mapping                      |  |   |    |   |   |
|   | No more !                         | Source/Destination network resources | available for mapping                  |   |    |   |   |
|   | Source Resource                   | Destination Resource                 |  |   |    |   |   |
|   | SepSeg                            | SegDR                                | Delete                                 |   |    |   |   |
|   |                                   | DataStore Mapping                    |  |   |    |   |   |
|   | Source DataStore                  | Destination Volume                   |  |   |    |   |   |
|   | TestSrc01                         | gwc_ntap_acct/gwc_DRO_cp/testsrci    | О1сору                                 |   |    |   |   |
|   |                                   |                                      |  |   |    |   |   |
|   |                                   | Previous                             | NG.                                    |   |    |   |   |

8. Under VM details, you can optionally resize the VMs CPU and RAM parameters. This can be very helpful when you are recovering large environments to smaller target clusters or when you are conducting DR tests without having to provision a one-to-one physical VMware infrastructure. Also, modify the boot order and boot delay (secs) for all the selected VMs across the resource groups. There is an additional option to modify the boot order if any changes are required from what you selected during resource- group boot-order selection. By default, the boot order selected during resource- group selection is used, however any modifications can be performed at this stage.

| etApp Disaster Recovery Orchestrator 💊 | Dashboard Discover    | Resource Groups Replicati     | ion Plans   Job Monitorin | g   |                            |   | 4 | ٠ | ? ( | 9 |
|--|-----------------------|-------------------------------|---------------------------|---|----------------------------|---|---|---|-----|---|
| Create New Replication Plan            | Replication Plan and  | I Site Details 🕜 Select Resou | rce Groups 🕢 Set Exe      | tution Order                                | Set VM Details             |   |   |   |     |   |
|  |                       | v                             | 'M Details                |   |                            |   |   |   |     |   |
|  | 2 vms                 |                               |                           |   |                            | ٩ |   |   |     |   |
|  | VM Name               | No. of CPUs                   | Memory (MB)               | NIC/IP                                      | Boot Order 💿<br>E Override |   |   |   |     |   |
|  | Resource Group : Demo | RG                            |                           | 1   |                            |   |   |   |     |   |
|  | QALin1                | 1                             | a 1024 a                  | Static<br>Dynamic                           | 3                          | 0 |   |   |     |   |
|  | QALin                 | 4                             | 0 1024 0                  | <ul> <li>Static</li> <li>Dynamic</li> </ul> | 3                          | 0 |   |   |     |   |
|  |                       |                               |                           |   |                            |   |   |   |     |   |
|  |                       |                               |                           |   |                            |   |   |   |     |   |
|  |                       |                               |                           |   |                            |   |   |   |     |   |
|  |                       |                               |                           |   |                            |   |   |   |     |   |
|  |                       |                               |                           |   |                            |   |   |   |     |   |
|  |                       |                               |                           |   |                            |   |   |   |     |   |

9. Click **Create Replication Plan**. After the replication plan is created, you can exercise the failover, test failover, or migrate options depending on your requirements.

| Sites vCenters  | Sites                    | Centers                     |
|---|--------------------------|-----------------------------|
|   | 4.0                      | Create New Replication Plan |
| Compliance Source Site<br>A Partially Healthy DemoSRC |                          |                             |
|   |                          | Plan Details<br>Edit Plan   |
|   |                          | Fallover<br>Test Fallover   |
|   | Compliance   Source Site |                             |

During the failover and test failover options, the most recent snapshot is used, or a specific snapshot can be selected from a point-in-time snapshot. The point-in-time option can be very beneficial if you are facing a corruption event like ransomware, where the most recent replicas are already compromised or encrypted. DRO shows all available time points.

|                    |                 | _  | Source Details |                                     | Destination Details |                        |      |
|--------------------|-----------------|--|----------------|-------------------------------------|---------------------|------------------------|------|
| B 1<br>Replicat    | tion Plans      | Resource Groups  | Sites          | U 1<br>vCenters                     | Sites 1             | vCenters               |      |
|                    |                 | Testfailover Details   |                |                                     | ×                   |                        |      |
| 1 Replication Plan |                 | <ul> <li>Use latest snapshot ()</li> <li>Select specific snapshot</li> </ul> | o              |                                     | ^ Q                 | Create New Replication | Plan |
| Plan Name          | ≎   Active Site | Volume   | ~              | Snapshot                            | ¢t                  | <u>1</u> ,1            |      |
| DemoRP             | ⊘ Source        | WEANFAVSacct/testcap/te  | stsrc01        | Select Snapshot                     |                     | Resource Groups        |      |
|                    |                 |  |                | 2023-04-28                          |                     |                        |      |
|                    |                 |  |                | 2023-04-28T11:31:55.000Z - gwc_ntap | Din :               |                        |      |
|                    |                 |  |                | 2023-04-28T11:21:54.000Z - gwc_ntap |                     |                        |      |

To trigger failover or test failover with the configuration specified in the replication plan, you can click **Failover** or **Test Failover**. You can monitor the replication plan in the task menu.

| Back |   |           |               |
|------|---|-----------|---------------|
|      | Test Failover Steps<br>Replication Plan: DemoRP               |           |               |
| ~    | Cloning volumes for test (in parallel)                        | ⊘ Success | 0.7 Seconds 🛈 |
| ~    | Mounting cloned volumes and creating datastores (in parallel) | ⊘ Success | 0.9 Seconds 🛈 |
| ~    | Registering VMs (in parallel)                                 | ⊘ Success | 0.1 Seconds 🕕 |

After failover is triggered, the recovered items can be seen in the secondary site AVS SDDC vCenter (VMs, networks, and datastores). By default, the VMs are recovered to Workload folder.

|     | C 2<br>Stee                              | 1<br>Resource Group       | B 1               |            | 128<br>Mit | Protected VMs         | 0 127<br>Ungestiected |  |
|-----|--|---------------------------|-------------------|------------|------------|-----------------------|-----------------------|--|
| 6   | ironments<br>31 2<br>irtual Environments | 2<br>All Storige Accounts | Topology Canvan   |            |            |                       | Immensive View 🔿      |  |
|     | C Summary                                | D 14<br>Folders           |                   | A          |            |                       |                       |  |
| E.  | 12<br>Datastores                         |                           |                   |            |            |                       |                       |  |
| Den | cution Joba                              |                           | Replication Plans |            |            |                       | 1                     |  |
|     | D 1<br>Hal Solar                         | C1<br>million             | Replication Flat  | Addres Sta | (Status    | ning in Failover Mode |                       |  |

Failback can be triggered at the replication plan level. In case of test failover, the tear down option can be used to roll back the changes and remove the newly created volume. Failbacks related to failover are a two- step process. Select the replication plan and select **Reverse Data sync**.

| B 1 Department Inter               | Source Details                           | Destination Details       | 01                       |
|------------------------------------|--|---------------------------|--------------------------|
| Replication Plans Resource         | Groups Sites vCent                       |                           | nters                    |
|                                    |  |                           |                          |
| 1 Replication Plan                 |  | Q D Cre                   | ate New Replication Plan |
| Plan Name 🗘   Active Site   Status | Compliance Source Si                     | te 👳   Destination Site 🗘 | I I.                     |
| DemoRP                             | ining In Failover Modi 🥥 Healthy DemosRo | C DemoDest Resource Gr    | oups)                    |
|                                    |  |                           |                          |

After this step is complete, trigger failback to move back to the primary AVS site.

From the Azure portal, we can see that the replication health has been broken off for the appropriate volumes that were mapped to the secondary site AVS SDDC as read/write volumes. During test failover, DRO does not map the destination or replica volume. Instead, it creates a new volume of the required cross- region replication snapshot and exposes the volume as a datastore, which consumes additional physical capacity from the capacity pool and ensures that the source volume is not modified. Notably, replication jobs can continue during DR tests or triage workflows. Additionally, this process makes sure that the recovery can be cleaned up without the risk of the replica being destroyed if errors occur or corrupted data is recovered.

# **Ransomware recovery**

Recovering from ransomware can be a daunting task. Specifically, it can be difficult for IT organizations to pinpoint what the safe point of return is, and, once that's determined, how to ensure that recovered workloads are safeguarded from the attacks reoccurring (for example, from sleeping malware or through vulnerable applications).

DRO addresses these concerns by allowing organizations to recover from any available point-in-time. Workloads are then recovered to functional and yet isolated networks, so that applications can function and communicate with each other but are not exposed to any north- south traffic. This process gives security teams a safe place to conduct forensics and identify any hidden or sleeping malware.

# Conclusion

The Azure NetApp Files and Azure VMware disaster recovery solution provide you with the following benefits:

- Leverage efficient and resilient Azure NetApp Files cross- region replication.
- Recover to any available point-in-time with snapshot retention.
- Fully automate all required steps to recover hundreds to thousands of VMs from the storage, compute, network, and application validation steps.
- Workload recovery leverages the "Create new volumes from the most recent snapshots" process, which doesn't manipulate the replicated volume.
- Avoid any risk of data corruption on the volumes or snapshots.
- Avoid replication interruptions during DR test workflows.
- Leverage DR data and cloud compute resources for workflows beyond DR, such as dev/test, security testing, patch and upgrade testing, and remediation testing.
- CPU and RAM optimization can help lower cloud costs by allowing recovery to smaller compute clusters.

# Where to find additional information

To learn more about the information that is described in this document, review the following documents and/or websites:

· Create volume replication for Azure NetApp Files

https://learn.microsoft.com/en-us/azure/azure-netapp-files/cross-region-replication-create-peering

Cross-region replication of Azure NetApp Files volumes

https://learn.microsoft.com/en-us/azure/azure-netapp-files/cross-region-replication-introduction#service-level-objectives

Azure VMware Solution

https://learn.microsoft.com/en-us/azure/azure-vmware/introduction

• Deploy and configure the Virtualization Environment on Azure

# Setup AVS on Azure

• Deploy and configure Azure VMware Solution

https://learn.microsoft.com/en-us/azure/azure-vmware/deploy-azure-vmware-solution?tabs=azure-portal

## Using Veeam Replication and Azure NetApp Files datastore for disaster recovery to Azure VMware Solution

Azure NetApp Files (ANF) datastores decouples storage from compute and unlocks the flexibility needed for any organisation to take their workloads to the cloud. It provides customers with flexible, high-performance storage infrastructure that scales independently of compute resources. Azure NetApp Files datastore's simplifies and optimizes the deployment alongside Azure VMware Solution (AVS) as a disaster recovery site for on premises VMWare environments.

# Overview

Azure NetApp Files (ANF) volume based NFS datastores can be used to replicate data from on-premises using any validated third-party solution that provides VM replication capability. By adding Azure NetApp Files datastores, it will enable cost optimised deployment vs building an Azure VMware Solution SDDC with enormous amount of ESXi hosts to accommodate the storage. This approach is called a "Pilot Light Cluster". A pilot light cluster is a minimal AVS host configuration (3 x AVS nodes) along with Azure NetApp Files Datastore capacity.

The objective is to maintain a low-cost infrastructure with all the core components to handle a failover. A pilot light cluster can scale out and provision more AVS hosts if a failover does occur. And once the failover is complete and normal operations are restored, the pilot light cluster can scale back down to low-cost mode of operations.

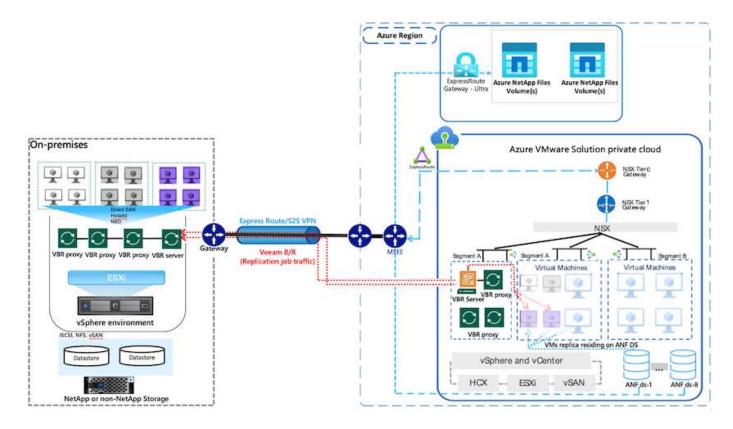
## Purposes of this document

This article describes how to use Azure NetApp Files datastore with Veeam Backup and replication to set up disaster recovery for on-premises VMware VMs to (AVS) using the Veeam VM replication software functionality.

Veeam Backup & Replication is a backup and replication application for virtual environments. When virtual machines are replicated, Veeam Backup & Replication is replicated from on AVS, the software will create an exact copy of the VMs in the native VMware vSphere format on the target AVS SDDC cluster. Veeam Backup & Replication will keep the copy synchronized with the original VM. Replication provides the best recovery time objective (RTO) as there is a mounted copy of a VM at the DR site in a ready-to-start state.

This replication mechanism ensures that the workloads can quickly start in a AVS SDDC in the case of a disaster event. The Veeam Backup & Replication software also optimizes traffic transmission for replication over WAN and slow connections. In addition, it also filters out duplicate data blocks, zero data blocks, swap files, and "excluded VM guest OS files". The software will also compress the replica traffic. To prevent replication jobs from consuming the entire network bandwidth, WAN accelerators and network throttling rules can be utilized.

The replication process in Veeam Backup & Replication is job driven which means replication is performed by configuring replication jobs. In the case of a disaster event, failover can be triggered to recover the VMs by failing over to its replica copy. When failover is performed, a replicated VM takes over the role of the original VM. Failover can be performed to the latest state of a replica or to any of its good known restore points. This enables ransomware recovery or isolated testing as needed. Veeam Backup & Replication offers multiple options to handle different disaster recovery scenarios.



# **Solution Deployment**

## **High level steps**

- 1. Veeam Backup and Replication software is running in an on-premises environment with appropriate network connectivity.
- 2. Deploy Azure VMware Solution (AVS) private cloud and attach Azure NetApp Files datastores to Azure VMware Solution hosts.

A pilot-light environment set up with a minimal configuration can be used for DR purposes. VMs will fail over to this cluster in the event of an incident, and additional nodes can be added).

- 3. Set up replication job to create VM replicas using Veeam Backup and Replication.
- 4. Create failover plan and perform failover.
- 5. Switch back to production VMs once the disaster event is complete and primary site is Up.

## Pre-requisites for Veeam VM Replication to AVS and ANF datastores

- 1. Ensure the Veeam Backup & Replication backup VM is connected to the source as well as the target AVS SDDC clusters.
- 2. The backup server must be able to resolve short names and connect to source and target vCenters.
- 3. The target Azure NetApp Files datastore must have enough free space to store VMDKs of replicated VMs.

For additional information, refer to "Considerations and Limitations" covered here.

## **Deployment Details**

Veeam Backup & Replication leverages VMware vSphere snapshot capabilities/During replication, Veeam Backup & Replication requests VMware vSphere to create a VM snapshot. The VM snapshot is the pointin-time copy of a VM that includes virtual disks, system state, configuration and metadata. Veeam Backup & Replication uses the snapshot as a source of data for replication.

To replicate VMs, follow the below steps:

- 1. Open the Veeam Backup & Replication Console.
- 2. On the Home view. Right click the jobs node and select Replication Job > Virtual machine.
- 3. Specify a job name and select the appropriate advanced control checkbox. Click Next.
  - Select the Replica seeding check box if connectivity between on-premises and Azure has restricted bandwidth.

\*Select the Network remapping (for AVS SDDC sites with different networks) check box if segments on Azure VMware Solution SDDC do not match that of on-premises site networks.

• If the IP addressing scheme in on-premises production site differs from the scheme in the target AVS site, select the Replica re-IP (for DR sites with different IP addressing scheme) check box.

| Name                | Name:  |
|---------------------|--|
| irtual Machines     | AVS_20230522_RepJob01  |
| incodi ividerinines | Description:   |
| Destination         | Created by VEEAMBKPSRV05\Administrator at 5/21/2023 10:52 PM.  |
| Network             |  |
| ob Settings         | Show advanced controls:  |
| Data Transfer       | Replica seeding (for low bandwidth DR sites)   |
| Data Transfer       | Network remapping (for DR sites with different virtual networks)   |
| Guest Processing    | Replica re-IP (for DR sites with different IP addressing scheme)   |
| Schedule            |  |
| Summary             |  |
|                     |  |
|                     | High priority<br>Backup infrastructure resources are offered to high priority jobs first. Use this option for jobs<br>sensitive to the start time, or jobs with strict RPO requirements. |

4. Select the VMs to be replicated to Azure NetApp Files datastore attached to a Azure VMware Solution SDDC in the Virtual Machines\* step. The Virtual machines can be placed on vSAN to fill the available vSAN datastore capacity. In a pilot light cluster, the usable capacity of a 3-node cluster will be limited. The rest of the data can be easily placed on Azure NetApp Files datastores so that the VMs can recovered, and cluster can be expanded to meet the CPU/mem requirements. Click Add, then in the Add Object window select the necessary VMs or VM containers and click Add. Click Next.

## Virtual Machines

Select one or more VMs to replicate. Use exclusion settings to exclude specific VMs and virtual disks from replication.

|                  | Name        | Type            | Size    | ^ | Add           |
|------------------|-------------|-----------------|---------|---|---------------|
| Virtual Machines | TestVeeam21 | Virtual Machine | 873 MB  |   | Remove        |
| Destination      | TestVeeam22 | Virtual Machine | 890 MB  |   | Nethaye       |
|                  | TestVeeam23 | Virtual Machine | 883 MB  |   | Total III and |
| Vetwork          | TestVeeam24 | Virtual Machine | 879 MB  |   | Exclusions    |
|                  | TestVeeam25 | Virtual Machine | 885 MB  |   | Source        |
| ob Settings      | TestVeeam26 | Virtual Machine | 883 MB  |   |               |
| Data Transfer    | TestVeeam27 | Virtual Machine | 879 MB  |   |               |
| Jata Transfer    | TestVeeam28 | Virtual Machine | 880 MB  |   | 🕈 Up          |
| Suest Processing | TestVeeam29 | Virtual Machine | 878 MB  |   | + Down        |
| j                | TestVeeam30 | Virtual Machine | 876 MB  |   |               |
| Schedule         | TestVeeam31 | Virtual Machine | 888 MB  |   |               |
|                  | TestVeeam32 | Virtual Machine | 881 MB  |   |               |
| Summary          | TestVeeam33 | Virtual Machine | 877 MB  |   |               |
|                  | TestVeeam34 | Virtual Machine | 875 MB  |   | -             |
|                  | TestVeeam35 | Virtual Machine | 882 MB  |   | Recalculate   |
|                  | WinSQL401   | Virtual Machine | 20.3 GB |   |               |
|                  | WinSQL405   | Virtual Machine | 24.2 GB |   | Total size:   |
|                  | F2          |                 |         | * | 120 GB        |

5. After that, select the destination as Azure VMware Solution SDDC cluster / host and the appropriate resource pool, VM folder and FSx for ONTAP datastore for VM replicas. Then click **Next**.

| Name             | Host or cluster:                                    | 1      |
|------------------|---|--------|
| /irtual Machines | Cluster-1   | Choose |
| Destination      | Resource pool:                                      |        |
| Vetwork          | Resources   | Choose |
| ob Settings      | Pick resource pool for selected replicas VM folder: |        |
| Data Transfer    | vm  | Choose |
| Guest Processing | Pick VM folder for selected replicas                |        |
| Schedule         | Datastore:  |        |
| schedule         | ds001 [152.6 GB free] ds001 is an ANF Datastore     | Choose |
| Summary          | Pick datastore for selected virtual disks           |        |
|                  |   |        |
|                  |   |        |
|                  |   |        |

6. In the next step, create the mapping between source and destination virtual network as needed.

| Name   | Network mapping:                         |                | 101/   |
|--|--|----------------|--------|
| Virtual Machines   | Source network<br>SVM_3508 (vDS-Switch0) | Target network | Add    |
| Destination  | SVM_3510 (vDS-Switch0)                   | 🕵 SegmentTemp  | Remove |
| Job Settings<br>Data Transfer<br>Guest Processing<br>Schedule<br>Summary |  |                |        |

- 7. In the **Job Settings** step, specify the backup repository that will store metadata for VM replicas, retention policy and so on.
- 8. Update the **Source** and **Target** proxy servers in the **Data Transfer** step and leave **Automatic** selection (default) and keep **Direct** option selected and click **Next**.
- 9. At the **Guest Processing** step, select **Enable application-aware processing** option as needed. Click **Next**.

| Vame<br>/irtual Machines | Enable application-aware processing<br>Detects and prepares applications for consistent backup, performs transaction logs<br>configures the OS to perform required application restore steps upon first boot. | processing, and |
|--------------------------|---|-----------------|
| Destination              | Customize application handling options for individual machines and applications<br>Guest interaction proxy:   | Applications    |
| letwork                  | Automatic selection   | Choose          |
| ob Settings              | Guest OS credentials:   |                 |
| ata Transfer             |   | Add             |
|                          | Manage accounts   |                 |
| uest Processing          | Customize guest OS credentials for individual machines and operating systems  | Credentials     |
| chedule                  | Verify network connectivity and credentials for each machine included in the job  | Test Now        |
| ummary                   |   |                 |
|                          |   |                 |
|                          |   |                 |

10. Choose the replication schedule to run the replication job to run on a regular basis.

| Name                              | 🗹 Run the job automatically  | t             |       |                    |              |          |              |
|-----------------------------------|--|---------------|-------|--------------------|--------------|----------|--------------|
| Virtual Machines                  | Daily at this time:  | 10:00 PM      | ÷     | Everyday           |              | ~        | Days         |
|                                   | <ul> <li>Monthly at this time:</li> </ul>                                    | 10:00 PM      | ÷     | Fourth 💎           | Saturday     | ~        | Months       |
| Destination                       | O Periodically every:  | 1             | s.    | Hours              |              | $\sim$   | Schedule     |
| Network                           | <ul> <li>After this job:</li> </ul>  | Replication   | Job   | 2 (Created by VEEA | AMBKPSRV05\A | dministr | ator at 6/6/ |
| lob Settings                      | Automatic retry Retry failed items proc                                      | cessing:      | 3     | 🔹 times            |              |          |              |
| Data Transfer<br>Guest Processing | Wait before each retry<br>Backup window                                      | attempt for:  | 10    | 🔹 minutes          |              |          |              |
| Schedule<br>Summary               | Terminate job if it exce<br>If the job does not cor<br>terminated to prevent | mplete within | alloc | ated backup wind   |              |          | Window       |

11. At the **Summary** step of the wizard, review details of the replication job. To start the job right after the

wizard is closed, select the **Run the job when I click Finish** check box, otherwise leave the check box unselected. Then click **Finish** to close the wizard.

|   |   | _      | _ | _ |   |
|---|---|--------|---|---|---|
|   |   | 57     |   |   | l |
|   |   |        |   |   | I |
| 1 | 4 | $\sim$ |   |   | t |
| - |   |        | 6 | = | I |
|   | - |        | 1 | - | 3 |

# Summary

The job's settings have been saved successfully. Click Finish to exit the wizard.

| Name             | Summary:                            |             |
|------------------|-------------------------------------|-------------|
|                  | Name: AVS_20230522_RepJob01         | ^           |
| /irtual Machines | Type: VMware Replication            |             |
|                  | Source items:                       |             |
| Destination      | TestVeeam21 (a300-vcsa05.ehcdc.com) |             |
| Connocion        | TestVeeam22 (a300-vcsa05.ehcdc.com) |             |
| Network          | TestVeeam23 (a300-vcsa05.ehcdc.com) |             |
| vetwork          | TestVeeam24 (a300-vcsa05.ehcdc.com) |             |
|                  | TestVeeam25 (a300-vcsa05.ehcdc.com) |             |
| ob Settings      | TestVeeam26 (a300-vcsa05.ehcdc.com) |             |
|                  | TestVeeam27 (a300-vcsa05.ehcdc.com) |             |
| )ata Transfer    | TestVeeam28 (a300-vcsa05.ehcdc.com) |             |
|                  | TestVeeam29 (a300-vcsa05.ehcdc.com) |             |
| Guest Processing | TestVeeam30 (a300-vcsa05.ehcdc.com) |             |
|                  | TestVeeam31 (a300-vcsa05.ehcdc.com) |             |
| Schedule         | TestVeeam32 (a300-vcsa05.ehcdc.com) |             |
| circulate        | TestVeeam33 (a300-vcsa05.ehcdc.com) |             |
|                  | TestVeeam34 (a300-vcsa05.ehcdc.com) |             |
| ummary           | TestVeeam35 (a300-vcsa05.ehcdc.com) |             |
|                  | WinSQL401 (a300-vcsa05.ehcdc.com)   |             |
|                  | WinSQL405 (a300-vcsa05.ehcdc.com)   |             |
|                  | WinSQL404 (a300-vcsa05.ehcdc.com)   | ~           |
|                  | M6-COL 402 (-1000E -L -J)           | *           |
|                  | Run the job when I click Finish     |             |
|                  |                                     |             |
|                  |                                     |             |
|                  | < Previous Next > Fi                | nish Cancel |

Once the replication job starts, the VMs with the suffix specified will be populated on the destination AVS SDDC cluster / host.

|         | Sheren   |        |   | T. 1 44 |         |   |         |             |             |
|---------|--|--------|---|---------|---------|---|---------|-------------|-------------|
| A state | 1741<br>1744<br>1744<br>1744<br>1744<br>1744<br>1744<br>1744 | -      | - | 1.      | e Fater |   | <br>111 | - Transmine |             |
|         | 100  |        | - |         | 104     |   |         |             | . beg at Au |
|         | -  | -      | 1 |         | H       | 1 |         |             |             |
|         | 7  | ti ana |   |         |         |   |         |             |             |
|         |  |        |   |         |         |   |         |             |             |

For additional information for Veeam replication, refer How Replication Works

#### Step 2: Create a failover plan

When the initial replication or seeding is complete, create the failover plan. Failover plan helps in performing failover for dependent VMs one by one or as a group automatically. Failover plan is the blueprint for the order in which the VMs are processed including the boot delays. The failover plan also helps to ensure that critical dependant VMs are already running.

To create the plan, navigate to the new sub section called **Replicas** and select **Failover Plan**. Choose the appropriate VMs. Veeam Backup & Replication will look for the closest restore points to this point in time and use them to start VM replicas.



The failover plan can only be added once the initial replication is complete and the VM replicas are in Ready state.



The maximum number of VMs that can be started simultaneously when running a failover plan is 10



During the failover process, the source VMs will not be powered off

To create the Failover Plan, do the following:

1. On the Home view. Right click the Replicas node and select Failover Plans > Failover Plan > VMware vSphere.

| Backup Replication CDP B<br>Job * Job * Policy C | ackup Copy<br>opy * Job *<br>Auxiliary Jobs | Restore Failover<br>Plan •<br>Restore Acti |                       |         |         |             |
|--|---|--|-----------------------|---------|---------|-------------|
| Home   |   | Q Type in an object name                   | 🗙 🍸 All jobs          |         |         |             |
| Jobs   |   | Name 🗸                                     | Туре                  | Objects | Status  | Last Run    |
| 猶 Replication                                    |   | 🔅 Replication Job 2                        | VMware Replication    | 1       | Stopped | 63 days ago |
| Replicas<br>Ready<br>Active (4)                  |   | AVS_20230522_RepJob(                       | 01 VMware Replication | 20      | Stopped | 8 days ago  |

2. Next provide a name and a description to the plan. Pre and Post-failover script can be added as required. For instance, run a script to shutdown VMs before starting the replicated VMs.

| eneral          | Name:<br>ANF_AVS_FP01  |        |
|-----------------|--|--------|
| irtual Machines | Description:   |        |
| ummary          | Created by VEEAMBKPSRV05\Administrator at 5/24/2023 9:08 AM. |        |
|                 | Pre-failover script:   |        |
|                 | Bro  | wsear  |
|                 | Post-failover script:  |        |
|                 | Bro  | WSRIII |
|                 |  |        |
|                 |  |        |
|                 |  |        |

3. Add the VMs to the plan and modify the VM boot order and boot delays to meet the application dependencies.

|                  | Virtual machines: |       |                        |   |           |
|------------------|-------------------|-------|------------------------|---|-----------|
| General          | Name              | Delay | Replica state          | ^ | Add VN    |
| Virtual Machines | TestVeeam21       | 2 sec | 63 days ago (5:52 AM T |   |           |
| Summary          | TestVeeam23       | 2 sec | 7 days ago (10:12 AM T | - | Remov     |
| Summary          | TestVeeam24       | 2 sec | 7 days ago (10:20 AM T |   | Set Delay |
|                  | TestVeeam22       | 2 sec | 7 days ago (10:10 AM T | - |           |
|                  | WinSQL401         | 2 sec | 7 days ago (3:52 AM Tu |   |           |
|                  | WinSQL405         | 2 sec | 8 days ago (4:05 PM Mo |   |           |
|                  | TestVeeam25       | 2 sec | 7 days ago (10:14 AM T |   |           |
|                  | TestVeeam26       | 2 sec | 7 days ago (10:17 AM T |   |           |
|                  | TestVeeam27       | 2 sec | 7 days ago (10:18 AM T |   |           |
|                  | TestVeeam28       | 2 sec | 7 days ago (10:14 AM T |   |           |
|                  | TestVeeam29       | 2 sec | 7 days ago (10:18 AM T |   |           |
|                  | TestVeeam30       | 2 sec | 7 days ago (10:15 AM T |   |           |
|                  | TestVeeam31       | 2 sec | 7 days ago (10:21 AM T |   |           |
|                  | TestVeeam32       | 2 sec | 7 days ago (10:13 AM T |   |           |
|                  | TestVeeam33       | 2 sec | 7 days ago (10:15 AM T | 1 | t Up      |
|                  | TestVeeam34       | 2 sec | 7 days ago (10:14 AM T |   | T Up      |
|                  | TestVeeam35       | 2 sec | 7 days ago (10:20 AM T |   | + Down    |

During failover, the source VM in the production site is switched over to its replica at the disaster recovery site. As part of the failover process, Veeam Backup & Replication restores the VM replica to the required restore point and moves all I/O activities from the source VM to its replica. Replicas can be used not only in case of a disaster, but also to simulate DR drills. During failover simulation, the source VM remains running. Once all the necessary tests have been conducted, you can undo the failover and return to normal operations.



Make sure network segmentation is in place to avoid IP conflicts during failover.

To start the failover plan, simply click in **Failover Plans** tab and right click on your failover plan. Select **\*Start**. This will failover using the latest restore points of VM replicas. To fail over to specific restore points of VM replicas, select **Start to**.

| Start Start Retry Undo Statistics E<br>to | dit Delete            |   |           |               |
|---|-----------------------|---|-----------|---------------|
| Home                                      | Q Type in an object i | name to search for  |           | $\times$      |
| 🛚 🆓 Jobs                                  | Name 1                | Platform  | Status    | Number of VMs |
| 續 Replication                             | ANF_AVS_FP01          | VMware  | Completed | 20            |
| Elicas                                    | Ê                     |   |           |               |
| Ready                                     | 8                     | and the second se |           |               |
| Active (4)                                | 1 A                   | S Undo  |           |               |
| Failover Plans                            | lal                   | I Statistics  |           |               |
| Last 24 Hours                             |                       | < Delete  | -         |               |
| 🔯 Success                                 | 1                     | and the second second   |           |               |

| Name: ANF_AVS_FP01<br>Restore type: Failover Plan<br>Initiated by: VEEAMBKPSRV05 | Admi | Status: In progress<br>Start time: 8/9/2023 3:37:41 AM<br>nistrator <u>Cancel</u> | restore task |
|--|------|---|--------------|
| VM name Status   | ^    | Log   |              |
| TestVeeam21 🕑 Proce  |      | Message   | Duration ^   |
| TestVeeam23 🜔 Proce  |      | Waiting 2 sec before the next VM  | 0:00:02      |
| TestVeeam24 🕑 Proce  |      | Processing VM: TestVeeam22  | 0:00:13      |
| TestVeeam22 🜔 Proce  |      | S Waiting 2 sec before the next VM  | 0:00:02      |
| WinSQL401 () Proce   |      | Processing VM: WinSQL401  | 0:00:10      |
| WinSQL405 🜔 Proce  |      | 😳 Waiting 2 sec before the next VM  | 0:00:02      |
| TestVeeam25 🜔 Proce  |      | Processing VM: WinSQL405  | 0:00:08      |
| TestVeeam26 🕑 Proce  |      | 🙄 Waiting 2 sec before the next VM  | 0:00:02      |
| TestVeeam27 🜔 Pendi  |      | Processing VM: TestVeeam25  | 0:00:06      |
| TestVeeam28 🜔 Pendi  |      | S Waiting 2 sec before the next VM  | 0:00:02      |
| TestVeeam29 🜔 Pendi  |      | Processing VM: TestVeeam26  | 0:00:04      |
| TestVeeam30 🜔 Pendi  |      | SWaiting 2 sec before the next VM   | 0:00:02      |
| TestVeeam31 🜔 Pendi  |      | Processing VM: TestVeeam27  | 0:00:02      |
| TestVeeam32 🜔 Pendi  |      | Waiting 2 sec before the next VM  | 0:00:02      |
| 🛅 TestVeeam33 🕟 Pendi  | ~    |   | v            |

The state of the VM replica changes from Ready to Failover and VMs will start on the destination Azure VMware Solution (AVS) SDDC cluster / host.

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Once the failover is complete, the status of the VMs will change to "Failover".

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| D <sub>6</sub>              |                            |  |                                 |                 |                                |                |                                   |                        |           |



Veeam Backup & Replication stops all replication activities for the source VM until its replica is returned to the Ready state.

For detailed information about failover plans, refer Failover Plans.

When the failover plan is running, it is considered as an intermediate step and needs to be finalized based on the requirement. The options include the following:

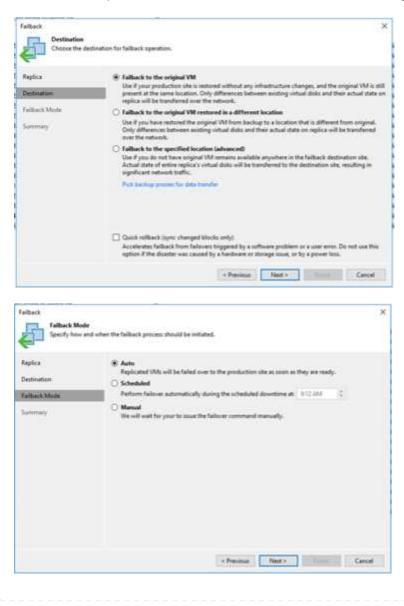
• Failback to production - switch back to the original VM and transfer all changes that took place while the VM replica was running to the original VM.



When you perform failback, changes are only transferred but not published. Choose **Commit failback** (once the original VM is confirmed to work as expected) or Undo failback to get back to the VM replica If the original VM is not working as expected.

- **Undo failover** switch back to the original VM and discard all changes made to the VM replica while it was running.
- **Permanent Failover** permanently switch from the original VM to a VM replica and use this replica as the original VM.

In this demo, Failback to production was chosen. Failback to the original VM was selected during the Destination step of the wizard and "Power on VM after restoring" check box was enabled.



| Replice  | Replices to faillack  |                    |          |  |            |         |  |
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Failback commit is one of the ways to finalize failback operation. When failback is committed, it confirms that the changes sent to the VM which is failed back (the production VM) are working as expected. After the commit operation, Veeam Backup & Replication resumes replication activities for the production VM.

For detailed information about the failback process, refer Veeam documentation for Failover and Failback for replication.

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After failback to production is successful, the VMs are all restored back to the original production site.

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# Conclusion

Azure NetApp Files datastore capability enables Veeam or any validated third-party tool to provide a low-cost DR solution by leveraging Pilot light clusters instead of standing up a large cluster only to accommodate VM replicas. This provides an efficacious way to handle a tailored, customized disaster recovery plan and to reuse existing backup products in house for DR, enabling cloud-based disaster recovery by exiting on-premises DR datacenters. It is possible to failover by clicking a button in case of disaster or to failover automatically if a

disaster occurs.

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

https://netapp.hosted.panopto.com/Panopto/Pages/Embed.aspx?id=2855e0d5-97e7-430f-944a-b061015e9278

# Migrating Workloads on Azure / AVS

## TR-4940: Migrate workloads to Azure NetApp Files datastore using VMware HCX - Quickstart guide

One of the most common use cases for the Azure VMware Solution and Azure NetApp Files datastore is the migration of VMware workloads. VMware HCX is a preferred option and provides various migration mechanisms to move on-premises virtual machines (VMs) and its data to Azure NetApp Files datastores.

Author(s): NetApp Solutions Engineering

# Overview: Migrating virtual machines with VMware HCX, Azure NetApp Files datastores, and Azure VMware solution

VMware HCX is primarily a migration platform that is designed to simplify application migration, workload rebalancing, and even business continuity across clouds. It is included as part of Azure VMware Solution Private Cloud and offers many ways to migrate workloads and can be used for disaster recovery (DR) operations.

This document provides step-by-step guidance for provisioning Azure NetApp Files datastore followed by downloading, deploying, and configuring VMware HCX, including all its main components in on-premises and the Azure VMware Solution side including Interconnect, Network Extension, and WAN optimization for enabling various VM migration mechanisms.



VMware HCX works with any datastore type as the migration is at the VM level. Hence this document is applicable to existing NetApp customers and non-NetApp customers who are planning to deploy Azure NetApp Files with Azure VMware Solution for a cost-effective VMware cloud deployment.

## **High-level steps**

This list provides the high-level steps necessary to install and configure HCX Cloud Manager on the Azure cloud side and install HCX Connector on-premises:

- 1. Install HCX through the Azure portal.
- 2. Download and deploy the HCX Connector Open Virtualization Appliance (OVA) installer in the onpremises VMware vCenter Server.
- 3. Activate HCX with the license key.
- 4. Pair the on-premises VMware HCX Connector with Azure VMware Solution HCX Cloud Manager.
- 5. Configure the network profile, compute profile, and service mesh.
- 6. (Optional) Perform network extension to avoid re-IP during migrations.
- 7. Validate the appliance status and ensure that migration is possible.
- 8. Migrate the VM workloads.

## Prerequisites

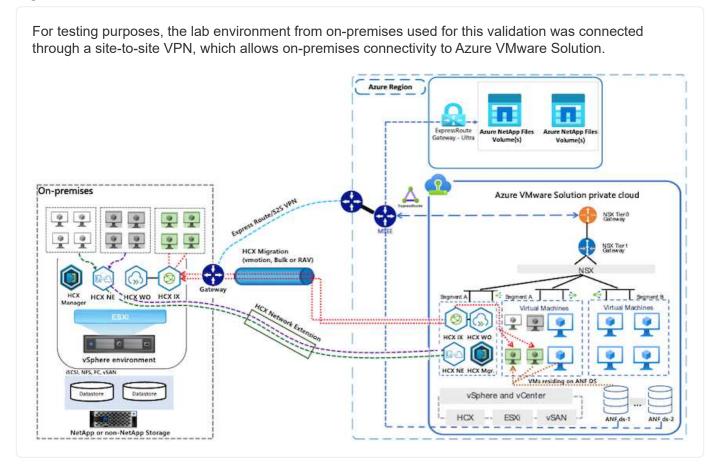
Before you begin, make sure the following prerequisites are met. For more information, see this link. After the prerequisites, including connectivity, are in place, configure and activate HCX by generating the license key from the Azure VMware Solution portal. After the OVA installer is downloaded, proceed with the installation process as described below.



HCX advanced is the default option and VMware HCX Enterprise edition is also available through a support ticket and supported at no additional cost.

- Use an existing Azure VMware solution software-defined data center (SDDC) or create a private cloud by using this NetApp link or this Microsoft link.
- Migration of VMs and associated data from the on-premises VMware vSphere- enabled data center requires network connectivity from the data center to the SDDC environment. Before migrating workloads, set up a site-to-site VPN or Express route global reach connection between the on-premises environment and the respective private cloud.
- The network path from on-premises VMware vCenter Server environment to the Azure VMware Solution private cloud must support the migration of VMs by using vMotion.
- Make sure the required firewall rules and ports are allowed for vMotion traffic between the onpremises vCenter Server and SDDC vCenter. On the private cloud, routing on the vMotion network is configured by default.
- Azure NetApp Files NFS volume should be mounted as a datastore in Azure VMware Solution. Follow the steps detailed in this link to attach Azure NetApp Files datastores to Azure VMware Solutions hosts.

## **High Level Architecture**

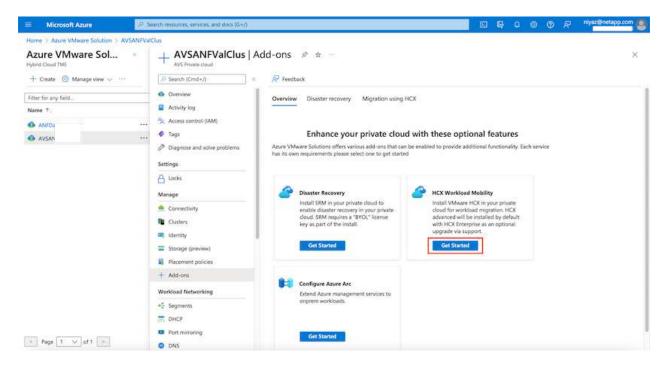


# **Solution Deployment**

Follow the series of steps to complete the deployment of this solution:

To perform the installation, complete the following steps:

- 1. Log in to the Azure Portal and access the Azure VMware Solution private cloud.
- 2. Select the appropriate private cloud and access Add-ons. This can be done by navigating to **Manage** > **Add-ons**.
- 3. In the HCX Workload Mobility section, click Get Started.



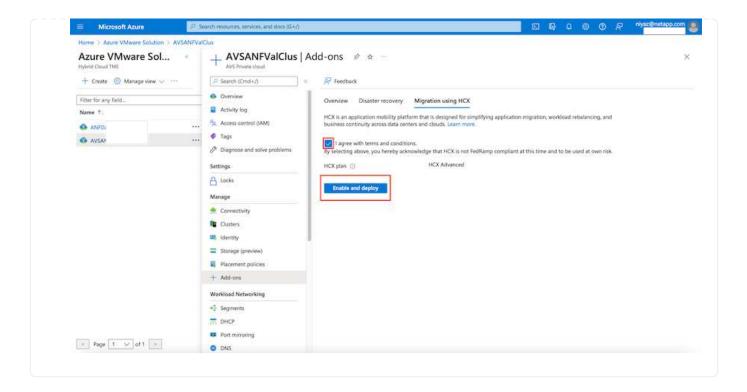
4. Select the I Agree with Terms and Conditions option and click Enable and Deploy.



The default deployment is HCX Advanced. Open a support request to enable the Enterprise edition.



The deployment takes approximately 25 to 30 minutes.



For the on-premises Connector to connect to the HCX Manager in Azure VMware Solution, make sure the appropriate firewall ports are open in the on-premises environment.

To download and install HCX Connector in the on-premises vCenter Server, complete the following steps:

From the Azure portal, go to the Azure VMware Solution, select the private cloud, and select Manage > Add-ons > Migration using HCX and copy the HCX Cloud Manager portal to download the OVA file.



Use the default CloudAdmin user credentials to access the HCX portal.

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| < Page 1 v of 1 >  | Port mirroring  |   |                    |

2. After you access the HCX portal with cloudadmin@vsphere.local using the jumphost, navigate to Administration > System Updates and click Request Download Link.



Either download or copy the link to the OVA and paste it into a browser to begin the download process of the VMware HCX Connector OVA file to deploy on the onpremises vCenter Server.

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| m VMware HCX   |   |                             |                |        |      |                  | C               | @~ =~             | cloudadmi            |
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3. After the OVA is downloaded, deploy it on to the on-premises VMware vSphere environment by using the **Deploy OVF Template** option.

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4. Enter all the required information for the OVA deployment, click **Next**, and then click **Finish** to deploy the VMware HCX connector OVA.

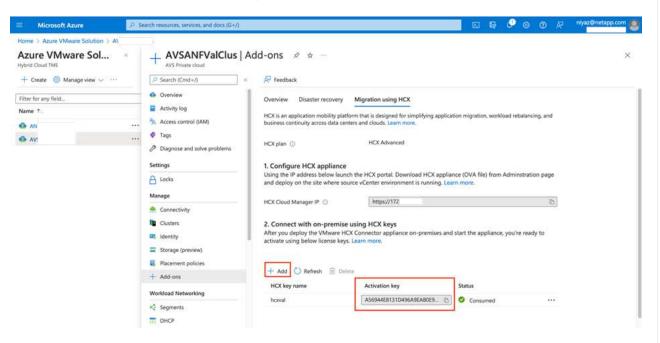


Power on the virtual appliance manually.

For step-by-step instructions, see the VMware HCX User Guide.

After you deploy the VMware HCX Connector OVA on-premises and start the appliance, complete the following steps to activate HCX Connector. Generate the license key from the Azure VMware Solution portal and activate it in VMware HCX Manager.

- 1. From the Azure portal, go to the Azure VMware Solution, select the private cloud, and select **Manage** > Add-ons > Migration using HCX.
- 2. Under Connect with on-premise Using HCX keys, click Add and copy the activation key.





A separate key is required for each on-premises HCX Connector that is deployed.

3. Log into the on-premises VMware HCX Manager at "https://hcxmanagerIP:9443" using administrator credentials.



Use the password defined during the OVA deployment.

4. In the licensing, enter the key copied from step 3 and click Activate.



The on-premises HCX Connector should have internet access.

- 5. Under **Datacenter Location**, provide the nearest location for installing the VMware HCX Manager onpremises. Click **Continue**.
- 6. Under System Name, update the name and click Continue.
- 7. Click Yes, Continue.
- 8. Under **Connect your vCenter**, provide the fully qualified domain name (FQDN) or IP address of vCenter Server and the appropriate credentials and click **Continue**.



Use the FQDN to avoid connectivity issues later.

9. Under Configure SSO/PSC, provide the Platform Services Controller's FQDN or IP address and click

## Continue.



Enter the VMware vCenter Server FQDN or IP address.

- 10. Verify that the information entered is correct and click Restart.
- 11. After the services restart, vCenter Server is displayed as green on the page that appears. Both vCenter Server and SSO must have the appropriate configuration parameters, which should be the same as the previous page.



This process should take approximately 10 to 20 minutes and for the plug-in to be added to the vCenter Server.

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## Step 4: Pair on-premises VMware HCX Connector with Azure VMware Solution HCX Cloud Manager

After HCX Connector is installed in both on-premises and Azure VMware Solution, configure the onpremises VMware HCX Connector for Azure VMware Solution private cloud by adding the pairing. To configure the site pairing, complete the following steps:

 To create a site pair between the on-premises vCenter environment and Azure VMware Solution SDDC, log in to the on-premises vCenter Server and access the new HCX vSphere Web Client plugin.

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| Licensing             |                      |                                       |                        |                      |                           |                        |  |                             |               |     |  |

1. Under Infrastructure, click Add a Site Pairing.



Enter the Azure VMware Solution HCX Cloud Manager URL or IP address and the credentials for CloudAdmin role for accessing the private cloud.

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1. Click Connect.

i.

VMware HCX Connector must be able to route to HCX Cloud Manager IP over port 443.

1. After the pairing is created, the newly configured site pairing is available on the HCX Dashboard.

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## Step 5: Configure the network profile, compute profile, and service mesh

The VMware HCX Interconnect service appliance provides replication and vMotion-based migration capabilities over the internet and private connections to the target site. The interconnect provides encryption, traffic engineering, and VM mobility. To create an Interconnect service appliance, complete the followings steps:

1. Under Infrastructure, select Interconnect > Multi-Site Service Mesh > Compute Profiles > Create Compute Profile.



The compute profiles define the deployment parameters including the appliances that are deployed and which portion of the VMware data center are accessible to HCX service.

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After the compute profile is created, create the network profiles by selecting Multi-Site Service Mesh
 Network Profiles > Create Network Profile.

The network profile defines a range of IP address and networks that are used by HCX for its virtual appliances.



This step requires two or more IP addresses. These IP addresses are assigned from the management network to the Interconnect Appliances.

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- 1. At this time, the compute and network profiles have been successfully created.
- 2. Create the Service Mesh by selecting the **Service Mesh** tab within the **Interconnect** option and select the on-premises and Azure SDDC sites.
- 3. The Service Mesh specifies a local and remote compute and network profile pair.



As part of this process, the HCX appliances are deployed and automatically configured on both the source and target sites in order to create a secure transport fabric.

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1. This is the final step of configuration. This should take close to 30 minutes to complete the deployment. After the service mesh is configured, the environment is ready with the IPsec tunnels successfully created to migrate the workload VMs.

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#### Step 6: Migrate workloads

Workloads can be migrated bidirectionally between on-premises and Azure SDDCs using various VMware HCX migration technologies. VMs can be moved to and from VMware HCX-activated entities using multiple migration technologies such as HCX bulk migration, HCX vMotion, HCX Cold migration, HCX Replication Assisted vMotion (available with HCX Enterprise edition), and HCX OS Assisted Migration (available with the HCX Enterprise edition).

To learn more about various HCX migration mechanisms, see VMware HCX Migration Types.

## **Bulk migration**

This section details the bulk migration mechanism. During a bulk migration, the bulk migration capability of HCX uses vSphere Replication to migrate disk files while recreating the VM on the destination vSphere HCX instance.

To initiate bulk VM migrations, complete the following steps:

1. Access the Migrate tab under Services > Migration.

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- 1. Under **Remote Site Connection**, select the remote site connection and select the source and destination. In this example, the destination is Azure VMware Solution SDDC HCX endpoint.
- 2. Click **Select VMs for Migration**. This provides a list of all the on-premises VMs. Select the VMs based on the match:value expression and click **Add**.
- 3. In the **Transfer and Placement** section, update the mandatory fields (**Cluster**, **Storage**, **Destination**, and **Network**), including the migration profile, and click **Validate**.

|   |  |  | Select VMs for Migration |
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1. After the validation checks are complete, click **Go** to initiate the migration.

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During this migration, a placeholder disk is created on the specified Azure NetApp Files datastore within the target vCenter to enable replication of the source VM disk's data to the placeholder disks. HBR is triggered for a full sync to the target, and after the baseline is complete, an incremental sync is performed based on the recovery point objective (RPO) cycle. After the full/incremental sync is complete, switchover is triggered automatically unless a specific schedule is set.

1. After the migration is complete, validate the same by accessing the destination SDDC vCenter.

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For additional and detailed information about various migration options and on how to migrate workloads from on-premises to Azure VMware Solution using HCX, see VMware HCX User Guide.

To learn more about this process, feel free to watch the following video:

# Workload Migration using HCX

Here is a screenshot of HCX vMotion option.

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To learn more about this process, feel free to watch the following video:

# HCX vMotion

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Make sure sufficient bandwidth is available to handle the migration.

The target ANF datastore should have sufficient space to handle the migration.

# Conclusion

Whether you're targeting all-cloud or hybrid cloud and data residing on any type/vendor storage in onpremises, Azure NetApp Files and HCX provide excellent options to deploy and migrate the application workloads 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, bidirectional portability of workloads, and enterprise-grade capacity and performance. It is the same familiar process and procedures used to connect the storage and migrate VMs using VMware vSphere Replication, VMware vMotion, or even network file copy (NFC).

# Takeaways

The key points of this document include:

- You can now use Azure NetApp Files as a datastore on Azure VMware Solution SDDC.
- You can easily migrate data from on-premises to Azure NetApp Files datastore.
- You can easily grow and shrink the Azure NetApp Files datastore to meet the capacity and performance requirements during migration activity.

# 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/

• VMware HCX User Guide

https://docs.vmware.com/en/VMware-HCX/4.4/hcx-user-guide/GUID-BFD7E194-CFE5-4259-B74B-991B26A51758.html

# Region Availability – Supplemental NFS datastore for ANF

Learn more about the the Global Region support for Azure, AVS and ANF.



NFS datastore will be available in regions where both services (AVS and ANF) are available.

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.

# NetApp Capabilities for Google Cloud Platform GCVE

Learn more about the capabilities that NetApp brings to the Google Cloud Platform (GCP) Google Cloud VMware Engine (GCVE) - 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.

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

- Configuring GCVE in GCP
- NetApp Storage Options for GCVE
- NetApp / VMware Cloud Solutions

#### **Configuring GCVE in GCP**

As with on-premises, planning a cloud based virtualization environment is critical for a successful productionready 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.



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 for GCVE

NetApp storage can be utilized in several ways - either as guess connected or as a supplemental NFS datastore - within GCP GCVE.

Please visit Supported NetApp Storage Options for more information.

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)

#### **Solution Use Cases**

With NetApp and VMware cloud solutions, many use cases are simple to deploy in Azure AVS. se cases are defined for each of the VMware defined cloud areas:

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

Browse the NetApp solutions for Google Cloud GCVE

# Protecting Workloads on GCP / GCVE

#### Application Consistent Disaster Recovery with NetApp SnapCenter and Veeam Replication

Disaster recovery to cloud is a resilient and cost-effective way of protecting workloads against site outages and data corruption events such as ransomware. With NetApp SnapMirror, on-premises VMware workloads that use guest-connected storage can be replicated to NetApp Cloud Volumes ONTAP running in Google Cloud.

Authors: Suresh Thoppay, NetApp

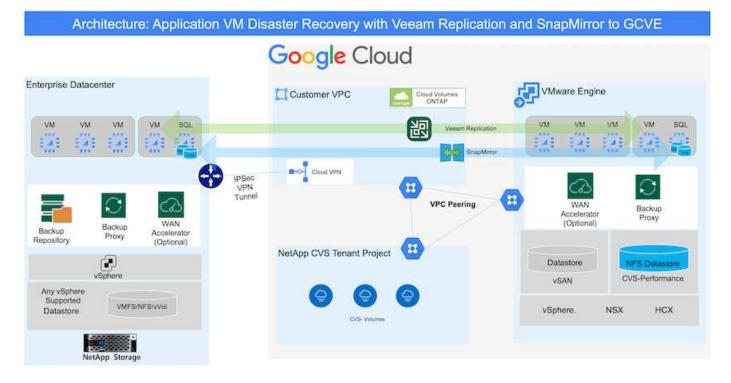
# Overview

Many customers are looking for an effective disaster recovery solution for their application VMs hosted on VMware vSphere. Many of them use their existing backup solution to perform recovery during diaster. Many times that solution increase the RTO and doesn't meet their expectations. To reduce the RPO and RTO, Veeam VM replication can be utilized even from on-prem to GCVE as long as network connectivity and environemnt with appropriate permissions are available.

NOTE: Veeam VM Replication doesn't protect VM guest connected storage devices like iSCSI or NFS mounts inside the guest VM. Need to protect those seperately.

For application consistent replication for SQL VM and to reduce the RTO, we used SnapCenter to orchestrate snapmirror operations of SQL database and log volumes.

This document provides a step-by-step approach for setting up and performing disaster recovery that uses NetApp SnapMirror, Veeam, and the Google Cloud VMware Engine (GCVE).



# Assumptions

This document focuses on in-guest storage for application data (also known as guest connected), and we assume that the on-premises environment is using SnapCenter for application-consistent backups.



This document applies to any third-party backup or recovery solution. Depending on the solution used in the environment, follow best practices to create backup policies that meet organizational SLAs.

For connectivity between the on-premises environment and the Google Cloud network, use the connectivity options like dedicated interconnect or Cloud VPN. Segments should be created based on the on-premises VLAN design.



There are multiple options for connecting on-premises datacenters to Google Cloud, which prevents us from outlining a specific workflow in this document. Refer to the Google Cloud documentation for the appropriate on-premises-to-Google connectivity method.

# **Deploying the DR Solution**

#### **Solution Deployment Overview**

- 1. Make sure that application data is backed up using SnapCenter with the necessary RPO requirements.
- 2. Provision Cloud Volumes ONTAP with the correct instance size using BlueXP within the appropriate subscription and virtual network.
  - a. Configure SnapMirror for the relevant application volumes.
  - b. Update the backup policies in SnapCenter to trigger SnapMirror updates after the scheduled jobs.
- 3. Install the Veeam software and start replicating virtual machines to Google Cloud VMware Engine instance.
- 4. During a disaster event, break the SnapMirror relationship using BlueXP and trigger failover of virtual machines with Veeam.
  - a. Reconnect the ISCSI LUNs and NFS mounts for the application VMs.
  - b. Bring up applications online.
- 5. Invoke failback to the protected site by reverse resyncing SnapMirror after the primary site has been recovered.

# **Deployment Details**

The first step is to configure Cloud Volumes ONTAP on Google Cloud (cvo) and replicate the desired volumes to Cloud Volumes ONTAP with the desired frequencies and snapshot retentions.

| ogle Cloud        |                    |                        |                   |
|-------------------|--------------------|------------------------|-------------------|
| VMware Engine     |                    | Customer VPC           |                   |
| VM VM VM          |                    | Cloud Volumes<br>ONTAP |                   |
|                   | Private Connection |                        | Compute<br>engine |
| Datastore<br>vSAN |                    | Persistent<br>disks    | Cloud<br>storage  |
| ·                 |                    | Hot data               | Cold data         |
| vSphere NSX       |                    | l                      |                   |

For sample step-by-step instructions on setting up SnapCenter and replicating the data, Refer to Setup Replication with SnapCenter

Review of SQL VM protection with SnapCenter

#### Configure GCVE hosts and CVO data access

Two important factors to consider when deploying the SDDC are the size of the SDDC cluster in the GCVE solution and how long to keep the SDDC in service. These two key considerations for a disaster recovery solution help reduce the overall operational costs. The SDDC can be as small as three hosts, all the way up to a multi-host cluster in a full-scale deployment.

NetApp Cloud Volume Service for NFS Datastore and Cloud Volumes ONTAP for SQL databases and log can be deployed to any VPC and GCVE should have private connection to that VPC to mount NFS datastore and have VM connect to iSCSI LUNs.

To configure GCVE SDDC, see Deploy and configure the Virtualization Environment on Google Cloud Platform (GCP). As a prerequisite, verify that the guest VMs residing on the GCVE hosts are able to consume data from Cloud Volumes ONTAP after connectivity has been established.

After Cloud Volumes ONTAP and GCVE have been configured properly, begin configuring Veeam to automate the recovery of on-premises workloads to GCVE (VMs with application VMDKs and VMs with in-guest storage) by using the Veeam Replication feature and by leveraging SnapMirror for application volumes copies to Cloud Volumes ONTAP.

Based on deployment scenario, the Veeam backup server, backup repository and backup proxy that needs to be deployed. For this use case, there is no need to deploy object store for Veeam and Scale-out repository also not required.

Refer to the Veeam documentation for the installation procedure For additional information, please refer Migration with Veeam Replication

#### Setup VM Replication with Veeam

Both on-premises vCenter and GCVE vCenter needs to be registered with Veeam. Setup vSphere VM Replication Job At the Guest Processing step of wizard, select disable application processing as we will be utilizing SnapCenter for application aware backup and recovery.

https://netapp.hosted.panopto.com/Panopto/Pages/Embed.aspx?id=8b7e4a9b-7de1-4d48-a8e2-b01200f00692

#### Failover of Microsoft SQL Server VM

https://netapp.hosted.panopto.com/Panopto/Pages/Embed.aspx?id=9762dc99-081b-41a2-ac68-b01200f00ac0

#### Benefits of this solution

- Uses the efficient and resilient replication of SnapMirror.
- Recovers to any available points in time with ONTAP snapshot retention.
- Full automation is available for all required steps to recover hundreds to thousands of VMs, from the storage, compute, network, and application validation steps.
- SnapCenter uses cloning mechanisms that do not change the replicated volume.
  - This avoids the risk of data corruption for volumes and snapshots.
  - Avoids replication interruptions during DR test workflows.
  - Leverages the DR data for workflows beyond DR, such as dev/test, security testing, patch and upgrade testing, and remediation testing.
- Veeam Replication allows changing VM IP addresses on DR site.

#### Application Disaster Recovery with SnapCenter, Cloud Volumes ONTAP and Veeam Replication

Disaster recovery to cloud is a resilient and cost-effective way of protecting workloads against site outages and data corruption events such as ransomware. With NetApp SnapMirror, on-premises VMware workloads that use guest-connected storage can be replicated to NetApp Cloud Volumes ONTAP running in Google Cloud.

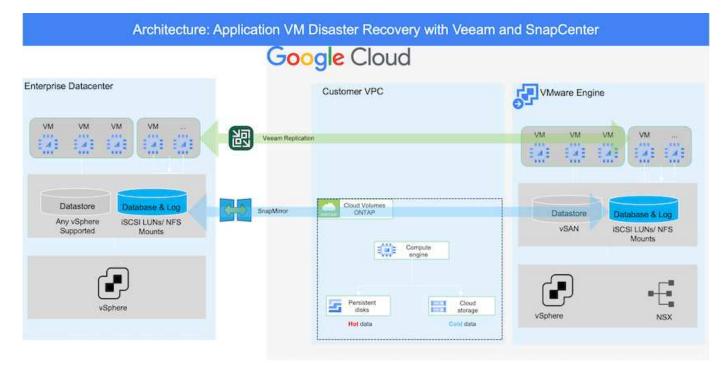
Authors: Suresh Thoppay, NetApp

# Overview

This covers application data; however, what about the actual VMs themselves. Disaster recovery should cover

all dependent components, including virtual machines, VMDKs, application data, and more. To accomplish this, SnapMirror along with Veeam can be used to seamlessly recover workloads replicated from on-premises to Cloud Volumes ONTAP while using vSAN storage for VM VMDKs.

This document provides a step-by-step approach for setting up and performing disaster recovery that uses NetApp SnapMirror, Veeam, and the Google Cloud VMware Engine (GCVE).



# Assumptions

This document focuses on in-guest storage for application data (also known as guest connected), and we assume that the on-premises environment is using SnapCenter for application-consistent backups.



This document applies to any third-party backup or recovery solution. Depending on the solution used in the environment, follow best practices to create backup policies that meet organizational SLAs.

For connectivity between the on-premises environment and the Google Cloud network, use the connectivity options like dedicated interconnect or Cloud VPN. Segments should be created based on the on-premises VLAN design.



There are multiple options for connecting on-premises datacenters to Google Cloud, which prevents us from outlining a specific workflow in this document. Refer to the Google Cloud documentation for the appropriate on-premises-to-Google connectivity method.

# **Deploying the DR Solution**

# **Solution Deployment Overview**

- 1. Make sure that application data is backed up using SnapCenter with the necessary RPO requirements.
- 2. Provision Cloud Volumes ONTAP with the correct instance size using Cloud manager within the appropriate subscription and virtual network.

- a. Configure SnapMirror for the relevant application volumes.
- b. Update the backup policies in SnapCenter to trigger SnapMirror updates after the scheduled jobs.
- 3. Install the Veeam software and start replicating virtual machines to Google Cloud VMware Engine instance.
- 4. During a disaster event, break the SnapMirror relationship using Cloud Manager and trigger failover of virtual machines with Veeam.
  - a. Reconnect the ISCSI LUNs and NFS mounts for the application VMs.
  - b. Bring up applications online.
- 5. Invoke failback to the protected site by reverse resyncing SnapMirror after the primary site has been recovered.

# **Deployment Details**

#### Configure CVO on Google Cloud and replicate volumes to CVO

The first step is to configure Cloud Volumes ONTAP on Google Cloud (cvo) and replicate the desired volumes to Cloud Volumes ONTAP with the desired frequencies and snapshot retentions.

|                   | : Cloud Volumes ONTA | P communicat | ion to GCV             | Æ                 |
|-------------------|----------------------|--------------|------------------------|-------------------|
| oogle Cloud       |                      |              |                        |                   |
| VMware Engine     |                      | Customer VPC |                        |                   |
|                   | Private Connection   | (Concession) | Cloud Volumes<br>ONTAP | Compute<br>engine |
| Datastore<br>vSAN |                      | 5            | Persistent<br>disks    | Cloud<br>storage  |
| vSphere NSX       |                      |              | Hot data               | Cold data         |

For sample step-by-step instructions on setting up SnapCenter and replicating the data, Refer to Setup Replication with SnapCenter

Setup Replication with SnapCenter

Two important factors to consider when deploying the SDDC are the size of the SDDC cluster in the GCVE solution and how long to keep the SDDC in service. These two key considerations for a disaster recovery solution help reduce the overall operational costs. The SDDC can be as small as three hosts, all the way up to a multi-host cluster in a full-scale deployment.

Cloud Volumes ONTAP can be deployed to any VPC and GCVE should have private connection to that VPC to have VM connect to iSCSI LUNs.

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#### **Install Veeam Components**

Based on deployment scenario, the Veeam backup server, backup repository and backup proxy that needs to be deployed. For this use case, there is no need to deploy object store for Veeam and Scale-out repository also not required.

Refer to the Veeam documentation for the installation procedure

#### Setup VM Replication with Veeam

Both on-premises vCenter and GCVE vCenter needs to be registered with Veeam. Setup vSphere VM Replication Job At the Guest Processing step of wizard, select disable application processing as we will be utilizing SnapCenter for application aware backup and recovery.

Setup vSphere VM Replication Job

#### Failover of Microsoft SQL Server VM

Failover of Microsoft SQL Server VM

#### Benefits of this solution

- Uses the efficient and resilient replication of SnapMirror.
- Recovers to any available points in time with ONTAP snapshot retention.
- Full automation is available for all required steps to recover hundreds to thousands of VMs, from the storage, compute, network, and application validation steps.
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  - Avoids replication interruptions during DR test workflows.

- Leverages the DR data for workflows beyond DR, such as dev/test, security testing, patch and upgrade testing, and remediation testing.
- Veeam Replication allows changing VM IP addresses on DR site.

# Migrating Workloads on GCP / GCVE

Migrate workloads to NetApp Cloud Volume Service datastore on Google Cloud VMware Engine using VMware HCX - Quickstart guide

One of the most common use cases for the Google Cloud VMware Engine and Cloud Volume Service datastore is the migration of VMware workloads. VMware HCX is a preferred option and provides various migration mechanisms to move on-premises virtual machines (VMs) and its data to Cloud Volume Service NFS datastores.

Author(s): NetApp Solutions Engineering

# Overview: Migrating virtual machines with VMware HCX, NetApp Cloud Volume Service datastores, and Google Cloud VMware Engine (GCVE)

VMware HCX is primarily a migration platform that is designed to simplify application migration, workload rebalancing, and even business continuity across clouds. It is included as part of Google Cloud VMware Engine Private Cloud and offers many ways to migrate workloads and can be used for disaster recovery (DR) operations.

This document provides step-by-step guidance for provisioning Cloud Volume Service datastore followed by downloading, deploying, and configuring VMware HCX, including all its main components in on-premises and the Google Cloud VMware Engine side including Interconnect, Network Extension, and WAN optimization for enabling various VM migration mechanisms.



VMware HCX works with any datastore type as the migration is at the VM level. Hence this document is applicable to existing NetApp customers and non-NetApp customers who are planning to deploy Cloud Volume Service with Google Cloud VMware Engine for a cost-effective VMware cloud deployment.

#### **High-level steps**

This list provides the high-level steps necessary to pair & Migrate the VMs to HCX Cloud Manager on the Google Cloud VMware Engine side from HCX Connector on-premises:

- 1. Prepare HCX through the Google VMware Engine portal.
- 2. Download and deploy the HCX Connector Open Virtualization Appliance (OVA) installer in the onpremises VMware vCenter Server.
- 3. Activate HCX with the license key.
- 4. Pair the on-premises VMware HCX Connector with Google Cloud VMware Engine HCX Cloud Manager.
- 5. Configure the network profile, compute profile, and service mesh.
- 6. (Optional) Perform network extension to avoid re-IP during migrations.
- 7. Validate the appliance status and ensure that migration is possible.
- 8. Migrate the VM workloads.

#### Prerequisites

Before you begin, make sure the following prerequisites are met. For more information, see this link. After the prerequisites, including connectivity, are in place, download HCX license key from the Google Cloud VMware Engine portal. After the OVA installer is downloaded, proceed with the installation process as described below.

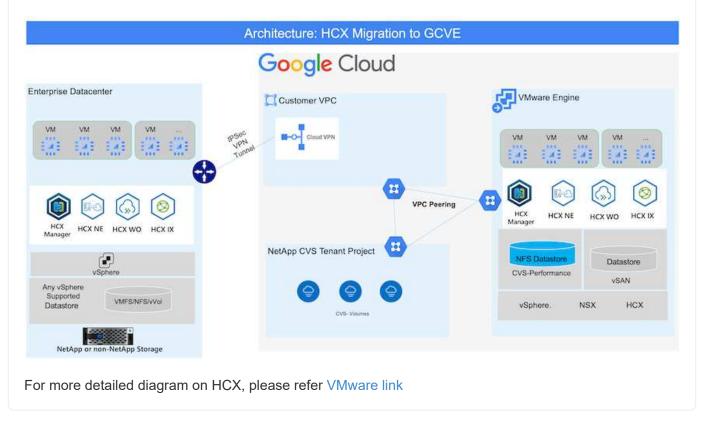


HCX advanced is the default option and VMware HCX Enterprise edition is also available through a support ticket and supported at no additional cost. Refer this link

- Use an existing Google Cloud VMware Engine software-defined data center (SDDC) or create a private cloud by using this NetApp link or this Google link.
- Migration of VMs and associated data from the on-premises VMware vSphere- enabled data center requires network connectivity from the data center to the SDDC environment. Before migrating workloads, set up a Cloud VPN or Cloud Interconnect connection between the on-premises environment and the respective private cloud.
- The network path from on-premises VMware vCenter Server environment to the Google Cloud VMware Engine private cloud must support the migration of VMs by using vMotion.
- Make sure the required firewall rules and ports are allowed for vMotion traffic between the onpremises vCenter Server and SDDC vCenter.
- Cloud Volume Service NFS volume should be mounted as a datastore in Google Cloud VMware Engine. Follow the steps detailed in this link to attach Cloud Volume Service datastores to Google Cloud VMware Engines hosts.

#### **High Level Architecture**

For testing purposes, the lab environment from on-premises used for this validation was connected through a Cloud VPN, which allows on-premises connectivity to Google Cloud VPC.



# **Solution Deployment**

Follow the series of steps to complete the deployment of this solution:

#### Step 1: Prepare HCX through the Google VMware Engine Portal

HCX Cloud Manager component automatically gets installed as you provision private cloud with VMware Engine. To prepare for site pairing, complete the following steps:

1. Log in to the Google VMware Engine Portal and sign-in to the HCX Cloud Manager.

You can login to HCX Console either by clicking on the HCX version link image::gcpd-hcx-image2.png[HCX Console access with link on GCVE resource] or clicking on HCX FQDN under vSphere Management Network tab. image::gcpd-hcx-image3.png[HCX Console access with FQDN link]

- 2. In HCX Cloud Manager, go to Administration > System Updates.
- Click Request download link and download the OVA file. image::gcpd-hcx-image4.png[Request download link]
- 4. Update HCX Cloud Manager to the latest version available from the HCX Cloud Manager UI.

For the on-premises Connector to connect to the HCX Manager in Google Cloud VMware Engine, make sure the appropriate firewall ports are open in the on-premises environment.

To download and install HCX Connector in the on-premises vCenter Server, complete the following steps:

- 1. Have the ova downloaded from the HCX Console on Google Cloud VMware Engine as stated in previous step.
- 2. After the OVA is downloaded, deploy it on to the on-premises VMware vSphere environment by using the **Deploy OVF Template** option.

| Deploy OVF Template         | Select an OVF template ×   |
|-----------------------------|--|
| 1 Select an OVF template    | Select an OVF template from remote URL or local file system<br>Enter a URL to download and install the OVF package from the internet, or browse to a location accessible from your computer, |
| 1 Select an OVP template    | such as a local hard drive, a network share, or a CD/DVD drive.  |
| 2 Select a name and folder  | OURL   |
| 3 Select a compute resource |  |
| 4 Review details            | Local file   |
| 5 Select storage            | UPLOAD FILES VMware-HCX-Connector-4.5.2.0-20914338.ova   |
| 6 Ready to complete         |  |
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|                             |  |
|                             | CANCEL   |
|                             |  |

3. Enter all the required information for the OVA deployment, click **Next**, and then click **Finish** to deploy the VMware HCX connector OVA.



Power on the virtual appliance manually.

For step-by-step instructions, see the VMware HCX User Guide.

After you deploy the VMware HCX Connector OVA on-premises and start the appliance, complete the following steps to activate HCX Connector. Generate the license key from the Google Cloud VMware Engine portal and activate it in VMware HCX Manager.

- From the VMware Engine portal, Click on Resources, select the private cloud, and click on download icon under HCX Manager Cloud Version. image::gcpd-hcx-image6.png[Download HCX License]
   Open Downloaded file and copy the License Key String.
- 2. Log into the on-premises VMware HCX Manager at "https://hcxmanagerIP:9443" using administrator credentials.



Use the hcxmanagerIP and password defined during the OVA deployment.

3. In the licensing, enter the key copied from step 3 and click Activate.



The on-premises HCX Connector should have internet access.

- 4. Under **Datacenter Location**, provide the nearest location for installing the VMware HCX Manager onpremises. Click **Continue**.
- 5. Under System Name, update the name and click Continue.
- 6. Click Yes, Continue.
- 7. Under **Connect your vCenter**, provide the fully qualified domain name (FQDN) or IP address of vCenter Server and the appropriate credentials and click **Continue**.



Use the FQDN to avoid connectivity issues later.

8. Under **Configure SSO/PSC**, provide the Platform Services Controller's(PSC) FQDN or IP address and click **Continue**.



For Embedded PSC, Enter the VMware vCenter Server FQDN or IP address.

- 9. Verify that the information entered is correct and click Restart.
- 10. After the services restart, vCenter Server is displayed as green on the page that appears. Both vCenter Server and SSO must have the appropriate configuration parameters, which should be the same as the previous page.



This process should take approximately 10 to 20 minutes and for the plug-in to be added to the vCenter Server.

| HCX-RT                   | P  |                               | (!)   | CPU                   | Free 1543 MHZ     | 26     |
|--------------------------|--|-------------------------------|-------|-----------------------|-------------------|--------|
| IP Address:              | 172.21.254.155   |                               |       | Used 552 MHZ          | Capacity 2095 MHZ |        |
| Version:                 | 4.5.2.0  |                               | 0     | Memory                | Free 2472 MB      | 79     |
| Uptime:<br>Current Time: | 13 days, 21 hours, 6 minutes<br>Thursday, 16 February 2023 | 05:59:00 PM UTC               | U     | Used 9535 MB          | Capacity 12008 MB |        |
|                          |  |                               | ~     | Storage               | Free 76           |        |
|                          |  |                               | ()    | Used 7.7G             | Capacity 84       | 9<br>G |
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| MANAGE                   |  | MANAGE                        |       | ANAGE                 |                   |        |

#### Step 4: Pair on-premises VMware HCX Connector with Google Cloud VMware Engine HCX Cloud Manager

After HCX Connector is deployed and configured on on-premises vCenter, establish connection to Cloud Manager by adding the pairing. To configure the site pairing, complete the following steps:

1. To create a site pair between the on-premises vCenter environment and Google Cloud VMware Engine SDDC, log in to the on-premises vCenter Server and access the new HCX vSphere Web Client plug-in.

| Shortcuts             |                      |                                       |                        |                      |                           |                        |  |               |     |  |
|-----------------------|----------------------|---------------------------------------|------------------------|----------------------|---------------------------|------------------------|--|---------------|-----|--|
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| Hosts and<br>Clusters | VMs and<br>Templates | Storage                               | Networking             | Content<br>Libraries | Global<br>Inventory Lists | Worktoad<br>Management | SnapCenter<br>Plug-in for<br>VMware<br>vSphere | Site Recovery | HCX |  |
| Monitoring            |                      |                                       |                        |                      |                           |                        |  |               |     |  |
| ()                    |                      | E.                                    | R                      |                      |                           | $\otimes$              |  |               |     |  |
| Task Console          | Event Console        | VM<br>Customization<br>Specifications | VM Storage<br>Policies | Host Profiles        | ONTAP tools               | Lifecycle<br>Manager   |  |               |     |  |
| Administratio         | n                    |                                       |                        |                      |                           |                        |  |               |     |  |
| Q                     |                      |                                       |                        |                      |                           |                        |  |               |     |  |
| Licensing             |                      |                                       |                        |                      |                           |                        |  |               |     |  |
|                       |                      |                                       |                        |                      |                           |                        |  |               |     |  |
|                       |                      |                                       |                        |                      |                           |                        |  |               |     |  |
|                       |                      |                                       |                        |                      |                           |                        |  |               |     |  |

2. Under Infrastructure, click Add a Site Pairing.



Enter the Google Cloud VMware Engine HCX Cloud Manager URL or IP address and the credentials for user with Cloud-Owner-Role privileges for accessing the private cloud.

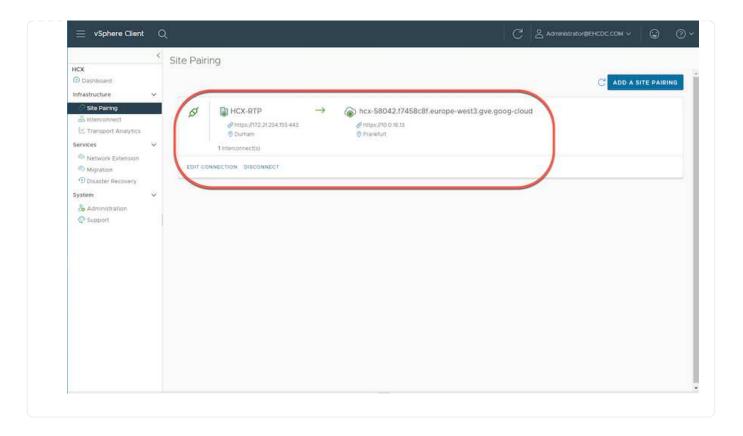
| Remote HCX URL | https://hcx-58042.f7458c8f.europe-west3.g  |         |
|----------------|--|---------|
| 2              | https://ficx-56642.1/456c61.edrope-west5.g | í       |
| Username       | cloudowner@gve.local                       | í       |
| Password       |  |         |
|                | CANCEL                                     | CONNECT |
|                |  |         |
|                |  |         |

# 3. Click Connect.



VMware HCX Connector must be able to route to HCX Cloud Manager IP over port 443.

4. After the pairing is created, the newly configured site pairing is available on the HCX Dashboard.



#### Step 5: Configure the network profile, compute profile, and service mesh

The VMware HCX Interconnect service appliance provides replication and vMotion-based migration capabilities over the internet and private connections to the target site. The interconnect provides encryption, traffic engineering, and VM mobility. To create an Interconnect service appliance, complete the followings steps:

1. Under Infrastructure, select Interconnect > Multi-Site Service Mesh > Compute Profiles > Create Compute Profile.



The compute profiles define the deployment parameters including the appliances that are deployed and which portion of the VMware data center are accessible to HCX service.

| 😑 vSphere Client   | Q   | k .  |   |   | @~  |
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| HCX Dashboard Infrastructure Ste Pairing Inferconnect E Transport Analytics                          | ~   | Interconnect<br>Muti-Site Service Mesh<br>Compute Profiles Service Mesh Network P  | rofiles : :Sectinel Management  |   | ILE |
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2. After the compute profile is created, create the network profiles by selecting Multi-Site Service Mesh
 > Network Profiles > Create Network Profile.

The network profile defines a range of IP address and networks that are used by HCX for its virtual appliances.



This step requires two or more IP addresses. These IP addresses are assigned from the management network to the Interconnect Appliances.

| vSphere Client   | 0        |  |                           |  |                              | CL                 | Administrator@EHCDC:      | ∞∞ ∽ 😳      | Ø       |
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- 3. At this time, the compute and network profiles have been successfully created.
- 4. Create the Service Mesh by selecting the **Service Mesh** tab within the **Interconnect** option and select the on-premises and GCVE SDDC sites.
- 5. The Service Mesh specifies a local and remote compute and network profile pair.

As part of this process, the HCX appliances are deployed and automatically configured on both the source and target sites in order to create a secure transport fabric.

|   | < | Interconnect   |                 |          |
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(i)

6. This is the final step of configuration. This should take close to 30 minutes to complete the deployment. After the service mesh is configured, the environment is ready with the IPsec tunnels successfully created to migrate the workload VMs.

|  |    | Intercon              | nect  |  |                |   |               |                 |                   |  |
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#### Step 6: Migrate workloads

Workloads can be migrated bidirectionally between on-premises and GCVE SDDCs using various VMware HCX migration technologies. VMs can be moved to and from VMware HCX-activated entities using multiple migration technologies such as HCX bulk migration, HCX vMotion, HCX Cold migration, HCX Replication Assisted vMotion (available with HCX Enterprise edition), and HCX OS Assisted Migration (available with the HCX Enterprise edition).

To learn more about various HCX migration mechanisms, see VMware HCX Migration Types.

The HCX-IX appliance uses the Mobility Agent service to perform vMotion, Cold, and Replication Assisted vMotion (RAV) migrations.



The HCX-IX appliance adds the Mobility Agent service as a host object in the vCenter Server. The processor, memory, storage and networking resources displayed on this object do not represent actual consumption on the physical hypervisor hosting the IX appliance.

#### **HCX vMotion**

This section describes the HCX vMotion mechanism. This migration technology uses the VMware vMotion protocol to migrate a VM to GCVE. The vMotion migration option is used for migrating the VM state of a single VM at a time. There is no service interruption during this migration method.



Network Extension should be in place (for the port group in which the VM is attached) in order to migrate the VM without the need to make an IP address change.

1. From the on-premises vSphere client, go to Inventory, right- click on the VM to be migrated, and select HCX Actions > Migrate to HCX Target Site.

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2. In the Migrate Virtual Machine wizard, select the Remote Site Connection (target GCVE).

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3. Update the mandatory fields (Cluster, Storage, and Destination Network), Click Validate.

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The vMotion transfer captures the VM active memory, its execution state, its IP address, and its MAC address. For more information about the requirements and limitations of HCX vMotion, see Understanding VMware HCX vMotion and Cold Migration.

5. You can monitor the progress and completion of the vMotion from the HCX > Migration dashboard.

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# Conclusion

Whether you're targeting all-cloud or hybrid cloud and data residing on any type/vendor storage in onpremises, Cloud Volume Service and HCX provide excellent options to deploy and migrate the application workloads while reducing the TCO by making the data requirements seamless to the application layer. Whatever the use case, choose Google Cloud VMware Engine along with Cloud Volume Service 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 used to connect the storage and migrate VMs using VMware vSphere Replication, VMware vMotion, or even network file copy (NFC).

#### Takeaways

The key points of this document include:

- You can now use Cloud Volume Service as a datastore on Google Cloud VMware Engine SDDC.
- You can easily migrate data from on-premises to Cloud Volume Service datastore.
- You can easily grow and shrink the Cloud Volume Service datastore to meet the capacity and performance requirements during migration activity.

# Videos from Google and VMware for reference

### From Google

- Deploy HCX Connector with GCVE
- Configure HCX ServiceMesh with GCVE
- Migrate VM with HCX to GCVE

#### From VMware

- HCX Connector deployment for GCVE
- HCX ServiceMesh configuration for GCVE
- HCX Workload Migration to GCVE

#### Where to find additional information

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

· Google Cloud VMware Engine documentation

https://cloud.google.com/vmware-engine/docs/overview

Cloud Volume Service documentation

https://cloud.google.com/architecture/partners/netapp-cloud-volumes

• VMware HCX User Guide

https://docs.vmware.com/en/VMware-HCX/index.html

# VM Migration to NetApp Cloud Volume Service NFS Datastore on Google Cloud VMware Engine using Veeam Replication feature

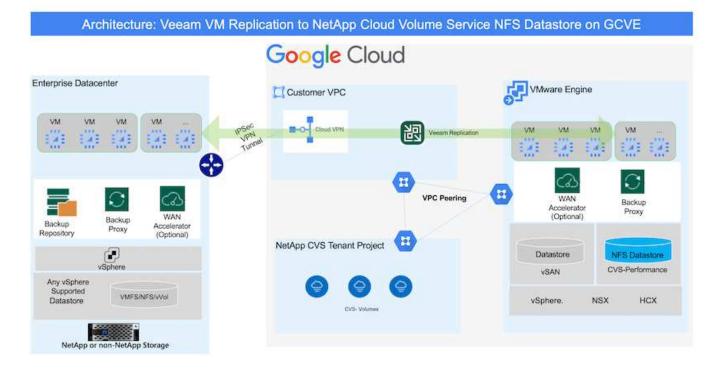
Customers who currently use Veeam for their data protection requirements continue using that solution to migrate the workloads to GCVE and enjoy the benefits of NetApp Cloud Volume Service NFS Datastores.

# Overview

Authors: Suresh Thoppay, NetApp

VM Workloads running on VMware vSphere can be migrated to Google Cloud VMware Engine (GCVE) utilizing Veeam Replication feature.

This document provides a step-by-step approach for setting up and performing VM migration that uses NetApp Cloud Volume Service, Veeam, and the Google Cloud VMware Engine (GCVE).



#### Assumptions

This document assumes you have either Google Cloud VPN or Cloud Interconnect or other networking option in place to establish network connectivity from existing vSphere servers to Google Cloud VMware Engine.



There are multiple options for connecting on-premises datacenters to Google Cloud, which prevents us from outlining a specific workflow in this document. Refer to the Google Cloud documentation for the appropriate on-premises-to-Google connectivity method.

# **Deploying the Migration Solution**

#### **Solution Deployment Overview**

- 1. Make sure NFS datastore from NetApp Cloud Volume Service is mounted on GCVE vCenter.
- 2. Ensure Veeam Backup Recovery is deployed on existing VMware vSphere environment
- 3. Create Replication Job to start replicating virtual machines to Google Cloud VMware Engine instance.
- 4. Perform Failover of Veeam Replication Job.
- 5. Perform Permanent Failover on Veeam.

#### **Deployment Details**

#### Make sure NFS datastore from NetApp Cloud Volume Service is mounted on GCVE vCenter

Login to GCVE vCenter and ensure NFS datastore with sufficient space is available. If not, Please refer Mount NetApp CVS as NFS datastore on GCVE

#### Ensure Veeam Backup Recovery is deployed on existing VMware vSphere environment

Please refer Veeam Replication Components documentation to install required components.

# Create Replication Job to start replicating virtual machines to Google Cloud VMware Engine instance.

Both on-premises vCenter and GCVE vCenter needs to be registered with Veeam. Setup vSphere VM Replication Job Here is a video explaining how to Configure Replication Job.



Replica VM can have different IP from the source VM and can also be connected to different port group. For more details, check the video above.

#### Perform Failover of Veeam Replication Job

To Migrate VMs, perform Perform Failover

#### Perform Permanent Failover on Veeam.

To treat GCVE as your new source environment, perform Permanent Failover

#### Benefits of this solution

- Existing Veeam backup infrastructure can be utilized for migration.
- Veeam Replication allows changing VM IP addresses on target site.
- Has ability to remap existing data replicated outside of Veeam (like replicated data from BlueXP)
- Has ability to specify different network portgroup on target site.
- Can specify the order of VMs to power on.
- Utilizes VMware Change Block Tracking to minimize the amount of data to send across WAN.
- Capability to execute pre and post scripts for replication.
- · Capability to execute pre and post scripts for snapshots.

# Region Availability – Supplemental NFS datastore for Google Cloud Platform (GCP)

Learn more about the the Global Region support for GCP, GCVE and CVS.



NFS datastore will be available in regions where both services (GCVE and CVS Performance) are available.

Supplemental NFS datastore for GCVE is supported with NetApp Cloud Volume Service.



Only CVS-Performance volumes can be used for GCVE NFS Datastore. For the available location, refer Global Region Map

Google Cloud VMware Engine is available at following locations image::gcve\_regions\_Mar2023.png[] To minimize latency, NetApp CVS Volume and GCVE where you intent to mount the volume should be in same availability zone.

Work with Google and NetApp Solution Architects for availability and TCO optimizations.

# Security overview - NetApp Cloud Volumes Service (CVS) in Google Cloud

Oliver Krause, Justin Parisi, NetApp

Security, particularly in the cloud where infrastructure is outside of the control of storage administrators, is paramount to trusting your data to service offerings provided by cloud providers. This document is an overview of the security offerings that NetApp Cloud Volumes Service provides in Google Cloud.

### Intended audience

This document's intended audience includes, but is not limited to, the following roles:

- Cloud providers
- Storage administrators
- Storage architects
- · Field resources
- Business decision makers

If you have questions about the content of this technical report, see the section "Contact us."

| Abbreviation    | Definition   |
|-----------------|--|
| CVS-SW          | Cloud Volumes Service, Service Type CVS                |
| CVS-Performance | Cloud Volume Service, Service Type CVS-<br>Performance |
| PSA             |  |

#### How Cloud Volumes Service in Google Cloud secures your data

Cloud Volumes Service in Google Cloud provides a multitude of ways to natively secure your data.

#### Secure architecture and tenancy model

Cloud Volumes Service provides a secure architecture in Google Cloud by segmenting the service management (control plane) and the data access (data plane) across different endpoints so that neither can impact the other (see the section "Cloud Volumes Service architecture"). It uses Google's private services access (PSA) framework to provide the service. This framework distinguishes between the service producer, which is provided and operated by NetApp, and the service consumer, which is a Virtual Private Cloud (VPC) in a customer project, hosting the clients that want to access Cloud Volumes Service file shares.

In this architecture, tenants (see the section "Tenancy model") are defined as Google Cloud projects that are completely isolated from each other unless explicitly connected by the user. Tenants allow complete isolation of data volumes, external name services, and other essential pieces of the solution from other tenants using the Cloud Volumes Service volume platform. Because the Cloud Volumes Service platform is connected through VPC peering, that isolation applies to it also. You can enable sharing of Cloud Volumes Service volumes between multiple projects by using a shared-VPC (see the section "Shared VPCs"). You can apply access controls to SMB shares and NFS exports to limit who or what can view or modify datasets.

# Strong identity management for the control plane

In the control plane where Cloud Volumes Service configuration takes place, identity management is managed by using Identity Access Management (IAM). IAM is a standard service that enables you to control authentication (logins) and authorization (permissions) to Google Cloud project instances. All configuration is performed with Cloud Volumes Service APIs over a secure HTTPS transport using TLS 1.2 encryption, and authentication is performed by using JWT tokens for added security. The Google console UI for Cloud Volumes Service translates user input into Cloud Volumes Service API calls.

# Security hardening - Limiting attack surfaces

Part of effective security is limiting the number of attack surfaces available in a service. Attack surfaces can include a variety of things, including data at-rest, in-flight transfers, logins, and the datasets themselves.

A managed service removes some of the attack surfaces inherently in its design. Infrastructure management, as described in the section "Service operation," is handled by a dedicated team and is automated to reduce the number of times a human actually touches configurations, which helps reduce the number of intentional and unintentional errors. Networking is fenced off so that only necessary services can access one another. Encryption is baked into the data storage and only the data plane needs security attention from Cloud Volumes Service administrators. By hiding most of the management behind an API interface, security is achieved by limiting the attack surfaces.

# Zero Trust model

Historically, IT security philosophy has been to trust but verify, and manifested as relying solely on external mechanisms (such as firewalls and intrusion detection systems) to mitigate threats. However, attacks and breaches evolved to bypass the verification in environments through phishing, social engineering, insider threats and other methods that provide the verification to enter networks and wreak havoc.

Zero Trust has become a new methodology in security, with the current mantra being "trust nothing while still verifying everything." Therefore, nothing is allowed access by default. This mantra is enforced in a variety of ways, including standard firewalls and intrusion detection systems (IDS) and also with the following methods:

- Strong authentication methods (such as AES-encrypted Kerberos or JWT tokens)
- Single strong sources of identities (such as Windows Active Directory, Lightweight Directory Access Protocol (LDAP), and Google IAM)
- Network segmentation and secure multitenancy (only tenants are allowed access by default)
- · Granular access controls with Least Privileged Access policies
- · Small exclusive lists of dedicated, trusted administrators with digital audit and paper trails

Cloud Volumes Service running in Google Cloud adheres to the Zero Trust model by implementing the "trust nothing, verify everything" stance.

# Encryption

Encrypt data at-rest (see the section "Data encryption at rest") by using XTS-AES-256 ciphers with NetApp Volume Encryption (NVE) and in-flight with "SMB encryption" or NFS Kerberos 5p support. Rest easy knowing cross-region replication transfers are protected by TLS 1.2 encryption (see the section "Cross-region replication"). In addition, Google networking also provides encrypted communications (see the section "Data encryption in transit") for an added layer of protection against attacks. For more information about transport encryption, see the section "Google Cloud network".

# Data protection and backups

Security isn't just about the prevention of attacks. It is also about how we recover from attacks if or when they occur. This strategy includes data protection and backups. Cloud Volumes Service provides methods to replicate to other regions in case of outages (see the section "Cross-region replication") or if a dataset is affected by a ransomware attack. It can also perform asynchronous backups of data to locations outside of the Cloud Volumes Service instance by using Cloud Volumes Service backup. With regular backups, mitigation of security events can take less time and save money and angst for administrators.

### Fast ransomware mitigation with industry leading Snapshot copies

In addition to data protection and backups, Cloud Volumes Service provides support for immutable Snapshot copies (see the section "Immutable Snapshot copies") of volumes that allow recovery from ransomware attacks (see the section "Service operation") within seconds of discovering the issue and with minimal disruption. Recovery time and effects depend on the Snapshot schedule, but you can create Snapshot copies that provide as little as one-hour deltas in ransomware attacks. Snapshot copies have a negligible effect on performance and capacity usage and are a low-risk, high-reward approach to protecting your datasets.

#### Security considerations and attack surfaces

The first step in understanding how to secure your data is identifying the risks and potential attack surfaces.

These include (but are not limited to) the following:

- · Administration and logins
- Data at rest
- Data in flight
- Network and firewalls
- · Ransomware, malware, and viruses

Understanding attack surfaces can help you to better secure your environments. Cloud Volumes Service in Google Cloud already considers many of these topics and implements security functionality by default, without any administrative interaction.

# **Ensuring secure logins**

When securing your critical infrastructure components, it is imperative to make sure that only approved users can log in and manage your environments. If bad actors breach your administrative credentials, then they have the keys to the castle and can do anything they want—change configurations, delete volumes and backups, create backdoors, or disable Snapshot schedules.

Cloud Volumes Service for Google Cloud provides protection against unauthorized administrative logins through the obfuscation of storage as a service (StaaS). Cloud Volumes Service is completely maintained by the cloud provider with no availability to login externally. All setup and configuration operations are fully automated, so a human administrator never has to interact with the systems except in very rare circumstances.

If login is required, Cloud Volumes Service in Google Cloud secures logins by maintaining a very short list of trusted administrators that have access to log in to the systems. This gatekeeping helps reduce the number of potential bad actors with access. Additionally, the Google Cloud networking hides the systems behind layers of network security and exposes only what is needed to the outside world. For information about the Google Cloud, Cloud Volumes Service architecture, see the section "Cloud Volumes Service architecture."

## Cluster administration and upgrades

Two areas with potential security risks include cluster administration (what happens if a bad actor has admin access) and upgrades (what happens if a software image is compromised).

### Storage administration protection

Storage provided as a service removes the added risk of exposure to administrators by removing that access to end users outside of the cloud data center. Instead, the only configuration done is for the data access plane by customers. Each tenant manages their own volumes, and no tenant can reach other Cloud Volumes Service instances. The service is managed by automation, with a very small list of trusted administrators given access to the systems through the processes covered in the section "Service operation."

The CVS-Performance service type offers cross-region replication as an option to provide data protection to a different region in the event of a region failure. In those cases, Cloud Volumes Service can be failed over to the unaffected region to maintain data access.

#### Service upgrades

Updates help protect vulnerable systems. Each update provides security enhancements and bug fixes that minimize attack surfaces. Software updates are downloaded from centralized repositories and are validated before the updates are allowed to verify that official images are used and that the upgrades are not compromised by bad actors.

With Cloud Volumes Service, updates are handled by the cloud provider teams, which removes risk exposure for administrator teams by providing experts well versed in configuration and upgrades that have automated and fully tested the process. Upgrades are nondisruptive, and Cloud Volumes Service maintains the latest updates for best overall results.

For information about the administrator team that performs these service upgrades, see the section "Service operation."

# Securing data at-rest

Data-at-rest encryption is important to protect sensitive data in the event of a disk that is stolen, returned, or repurposed. Data in Cloud Volumes Service is protected at rest by using software-based encryption.

- · Google-generated keys are used for CVS-SW.
- For CVS-Performance, the per-volume keys are stored in a key manager built into Cloud Volumes Service, which uses NetApp ONTAP CryptoMod to generate AES-256 encryption keys. CryptoMod is listed on the CMVP FIPS 140-2 validated modules list. See FIPS 140-2 Cert #4144.

Starting in November 2021, preview Customer-managed Encryption (CMEK) functionality was made available for CVS-Performance. This functionality allows you to encrypt the per-volume keys with per-project, per-region master-keys that are hosted in Google Key Management Service (KMS). KMS enables you to attach external key managers.

For details about how to configure KMS for CVS-Performance, see the Cloud Volumes Service documentation.

For more information about architecture, see the section "Cloud Volumes Service architecture."

# Securing data in-flight

In addition to securing data at rest, you must also be able to secure data when it is in flight between the Cloud Volumes Service instance and a client or replication target. Cloud Volumes Service provides encryption for in-

flight data over NAS protocols by using encryption methods such as SMB encryption using Kerberos, the signing/sealing of packets, and NFS Kerberos 5p for end-to-end encryption of data transfers.

Replication of Cloud Volumes Service volumes uses TLS 1.2, which takes advantage of AES-GCM encryption methods.

Most insecure in-flight protocols such as telnet, NDMP, and so on are disabled by default. DNS, however, is not encrypted by Cloud Volumes Service (no DNS Sec support) and should be encrypted by using external network encryption when possible. See the section "Data encryption in transit" for more information about securing data in-flight.

For information about NAS protocol encryption, see the section "NAS protocols."

# Users and groups for NAS permissions

Part of securing your data in the cloud involves proper user and group authentication, where the users accessing the data are verified as real users in the environment and the groups contain valid users. These users and groups provide initial share and export access, as well as permission validation for files and folders in the storage system.

Cloud Volumes Service uses standard Active Directory-based Windows user and group authentication for SMB shares and Windows-style permissions. The service can also leverage UNIX identity providers such as LDAP for UNIX users and groups for NFS exports, NFSv4 ID validation, Kerberos authentication, and NFSv4 ACLs.



Currently only Active Directory LDAP is supported with Cloud Volumes Service for LDAP functionality.

#### Detection, prevention and mitigation of ransomware, malware, and viruses

Ransomware, malware, and viruses are a persistent threat to administrators, and detection, prevention, and mitigation of those threats are always top of mind for enterprise organizations. A single ransomware event on a critical dataset can potentially cost millions of dollars, so it is beneficial to do what you can to minimize the risk.

Although Cloud Volumes Service currently doesn't include native detection or prevention measures, such as antivirus protection or automatic ransomware detection, there are ways to quickly recover from a ransomware event by enabling regular Snapshot schedules. Snapshot copies are immutable and read only pointers to changed blocks in the file system, are near instantaneous, have minimal impact on performance, and only use up space when data is changed or deleted. You can set schedules for Snapshot copies to match your desired acceptable recovery point objective (RPO)/recovery time objective (RTO) and can keep up to 1,024 Snapshot copies per volume.

Snapshot support is included at no additional cost (beyond data storage charges for changed blocks/data retained by Snapshot copies) with Cloud Volumes Service and, in the event of a ransomware attack, can be used to roll back to a Snapshot copy before the attack occurred. Snapshot restores take just seconds to complete, and you then can get back to serving data as normal. For more information, see The NetApp Solution for Ransomware.

Preventing ransomware from affecting your business requires a multilayered approach that includes one or more of the following:

- Endpoint protection
- · Protection against external threats through network firewalls
- · Detection of data anomalies

- Multiple backups (onsite and offsite) of critical datasets
- · Regular restore tests of backups
- Immutable read-only NetApp Snapshot copies
- Multifactor authentication for critical infrastructure
- · Security audits of system logins

This list is far from exhaustive but is a good blueprint to follow when dealing with the potential of ransomware attacks. Cloud Volumes Service in Google Cloud provides several ways to protect against ransomware events and reduce their effects.

#### Immutable Snapshot copies

Cloud Volumes Service natively provides immutable read-only Snapshot copies that are taken on a customizable schedule for quick point-in-time recovery in the event of data deletion or if an entire volume has been victimized by a ransomware attack. Snapshot restores to previous good Snapshot copies are fast and minimize data loss based on the retention period of your Snapshot schedules and RTO/RPO. The performance effect with Snapshot technology is negligible.

Because Snapshot copies in Cloud Volumes Service are read-only, they cannot be infected by ransomware unless the ransomware has proliferated into the dataset unnoticed and Snapshot copies have been taken of the data infected by ransomware. This is why you must also consider ransomware detection based on data anomalies. Cloud Volumes Service does not currently provide detection natively, but you can use external monitoring software.

#### **Backups and restores**

Cloud Volumes Service provides standard NAS client backup capabilities (such as backups over NFS or SMB).

- CVS-Performance offers cross-region volume replication to other CVS-Performance volumes. For more information, see volume replication in the Cloud Volumes Service documentation.
- CVS-SW offers service-native volume backup/restore capabilities. For more information, see cloud backup in the Cloud Volumes Service documentation.

Volume replication provides an exact copy of the source volume for fast failover in the case of a disaster, including ransomware events.

# **Cross-region replication**

CVS-Performance enables you to securely replicate volumes across Google Cloud regions for data protection and archive use cases by using TLS1.2 AES 256 GCM encryption on a NetApp-controlled backend service network using specific interfaces used for replication running on Google's network. A primary (source) volume contains the active production data and replicates to a secondary (destination) volume to provide an exact replica of the primary dataset.

Initial replication transfers all blocks, but updates only transmit the changed blocks in a primary volume. For instance, if a 1TB database that resides on a primary volume is replicated to the secondary volume, then 1TB of space is transferred on the initial replication. If that database has a few hundred rows (hypothetically, a few MB) that change between the initialization and the next update, only the blocks with the changed rows are replicated to the secondary (a few MB). This helps to make sure that the transfer times remain low and keeps replication charges down.

All permissions on files and folders are replicated to the secondary volume, but share access permissions

(such as export policies and rules or SMB shares and share ACLs) must be handled separately. In the case of a site failover, the destination site should leverage the same name services and Active Directory domain connections to provide consistent handling of user and group identities and permissions. You can use a secondary volume as a failover target in the event of a disaster by breaking the replication relationship, which converts the secondary volume to read-write.

Volume replicas are read-only, which provides an immutable copy of data offsite for quick recovery of data in instances where a virus has infected data or ransomware has encrypted the primary dataset. Read-only data won't be encrypted, but, if the primary volume is affected and replication occurs, the infected blocks also replicate. You can use older, non-affected Snapshot copies to recover, but SLAs might fall out of range of the promised RTO/RPO depending on how quickly an attack is detected.

In addition, you can prevent malicious administrative actions, such as volume deletions, Snapshot deletions, or Snapshot schedule changes, with cross-region replication (CRR) management in Google Cloud. This is done by creating custom roles that separate volume administrators, who can delete source volumes but not break mirrors and therefore cannot delete destination volumes, from CRR administrators, who cannot perform any volume operations. See Security Considerations in the Cloud Volumes Service documentation for permissions allowed by each administrator group.

# **Cloud Volumes Service backup**

Although Cloud Volumes Service provides high data durability, external events can cause data loss. In the event of a security event such as a virus or ransomware, backups and restores become critical for resumption of data access in a timely manner. An administrator might accidentally delete a Cloud Volumes Service volume. Or users simply want to retain backup versions of their data for many months and keeping the extra Snapshot copy space inside the volume becomes a cost challenge. Although Snapshot copies should be the preferred way to keep backup versions for the last few weeks to restore lost data from them, they are sitting inside the volume and are lost if the volume goes away.

For all these reasons, NetApp Cloud Volumes Service offers backup services through Cloud Volumes Service backup.

Cloud Volumes Service backup generates a copy of the volume on Google Cloud Storage (GCS). It only backs up the actual data stored within the volume, not the free space. It works as incremental forever, meaning it transfers the volume content once and from there on continues backing up changed data only. Compared to classical backup concepts with multiple full backups, it saves large amounts of backup storage, reducing cost. Because the monthly price of backup space is lower compared to a volume, it is an ideal place to keep backup versions longer.

Users can use a Cloud Volumes Service backup to restore any backup version to the same or a different volume within the same region. If the source volume is deleted, the backup data is retained and needs to be managed (for example, deleted) independently.

Cloud Volumes Service backup is built into Cloud Volumes Service as option. Users can decide which volumes to protect by activating Cloud Volumes Service backup on a per-volume basis. See the Cloud Volumes Service backup documentation for information about backups, the number of maximum backup versions supported, scheduling, and pricing.

All backup data of a project is stored within a GCS bucket, which is managed by the service and not visible to the user. Each project uses a different bucket. Currently, the buckets are in same region as the Cloud Volumes Service volumes, but more options are being discussed. Consult the documentation for the latest status.

Data transport from a Cloud Volumes Service bucket to GCS uses service-internal Google networks with HTTPS and TLS1.2. Data is encrypted at-rest with Google-managed keys.

To manage Cloud Volumes Service backup (creating, deleting, and restoring backups), a user must have the roles/netappcloudvolumes.admin role.

# Architecture

# Overview

Part of trusting a cloud solution is understanding the architecture and how it is secured. This section calls out different aspects of the Cloud Volumes Service architecture in Google to help alleviate potential concerns about how data is secured, as well as call out areas where additional configuration steps might be required to obtain the most secure deployment.

The general architecture of Cloud Volumes Service can be broken down into two main components: the control plane and the data plane.

# **Control plane**

The control plane in Cloud Volumes Service is the backend infrastructure managed by Cloud Volumes Service administrators and NetApp native automation software. This plane is completely transparent to end users and includes networking, storage hardware, software updates, and so on to help deliver value to a cloud-resident solution such as Cloud Volumes Service.

# Data plane

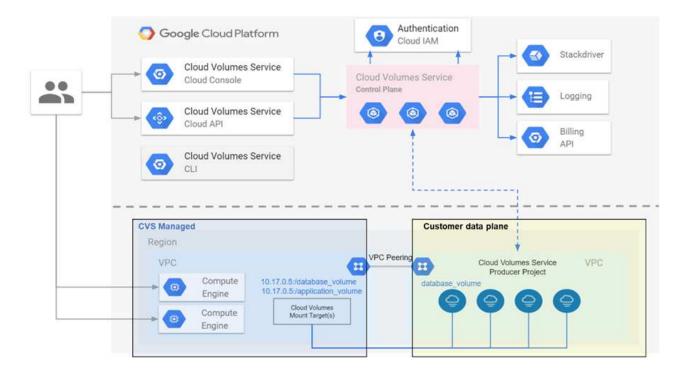
The data plane in Cloud Volumes Service includes the actual data volumes and the overall Cloud Volumes Service configuration (such as access control, Kerberos authentication, and so on). The data plane is entirely under the control of the end users and the consumers of the Cloud Volumes Service platform.

There are distinct differences in how each plane is secured and managed. The following sections cover these differences, starting with a Cloud Volumes Service architecture overview.

# **Cloud Volumes Service architecture**

In a manner similar to other Google Cloud native services such as CloudSQL, Google Cloud VMware Engine (GCVE), and FileStore, Cloud Volumes Service uses Google PSA to deliver the service. In PSA, services are built inside a service producer project, which uses VPC network peering to connect to the service consumer. The service producer is provided and operated by NetApp, and the service consumer is a VPC in a customer project, hosting the clients that want to access Cloud Volumes Service file shares.

The following figure, referenced from the architecture section of the Cloud Volumes Service documentation, shows a high-level view.



The part above the dotted line shows the control plane of the service, which controls the volume lifecycle. The part below the dotted line shows the data plane. The left blue box depicts the user VPC (service consumer), the right blue box is the service producer provided by NetApp. Both are connected through VPC peering.

# Tenancy model

In Cloud Volumes Service, individual projects are considered unique tenants. This means that manipulation of volumes, Snapshot copies, and so on are performed on a per- project basis. In other words, all volumes are owned by the project that they were created in and only that project can manage and access the data inside of them by default. This is considered the control plane view of the service.

# **Shared VPCs**

On the data plane view, Cloud Volumes Service can connect to a shared VPC. You can create volumes in the hosting project or in one of the service projects connected to the shared VPC. All projects (host or service) connected to that shared VPC are able to reach the volumes at the network layer (TCP/IP). Because all clients with network connectivity on the shared- VPC can potentially access the data through NAS protocols, access control on the individual volume (such as user/group access control lists (ACLs) and hostnames/IP addresses for NFS exports) must be used to control who can access the data.

You can connect Cloud Volumes Service to up to five VPCs per customer project. On the control plane, the project enables you to manage all created volumes, no matter which VPC they are connected to. On the data plane, VPCs are isolated from one another, and each volume can only be connected to one VPC.

Access to the individual volumes is controlled by protocol specific (NFS/SMB) access control mechanisms.

In other words, on the network layer, all project s connected to the shared VPC are able to see the volume, while, on the management side, the control plane only allows the owner project to see the volume.

# **VPC Service Controls**

VPC Service Controls establish an access control perimeter around Google Cloud services that are attached to

the internet and are accessible worldwide. These services provide access control through user identities but cannot restrict which network location requests originate from. VPC Service Controls close that gap by introducing the capabilities to restrict access to defined networks.

The Cloud Volumes Service data plane is not connected to the external internet but to private VPCs with welldefined network boundaries (perimeters). Within that network, each volume uses protocol-specific access control. Any external network connectivity is explicitly created by Google Cloud project administrators. The control plane, however, does not provide the same protections as the data plane and can be accessed by anyone from anywhere with valid credentials (JWT tokens).

In short, the Cloud Volumes Service data plane provides the capability of network access control, without the requirement to support VPC Service Controls and does not explicitly use VPC Service Controls.

# Packet sniffing/trace considerations

Packet captures can be useful for troubleshooting network issues or other problems (such as NAS permissions, LDAP connectivity, and so on), but can also be used maliciously to gain information about network IP addresses, MAC addresses, user and group names, and what level of security is being used on endpoints. Because of the way Google Cloud networking, VPCs, and firewall rules are configured, unwanted access to network packets should be difficult to obtain without user login credentials or JWT tokens into the cloud instances. Packet captures are only possible on endpoints (such as virtual machines (VMs)) and only possible on endpoints internal to the VPC unless a shared VPC and/or external network tunnel/IP forwarding is in use to explicitly allow external traffic to endpoints. There is no way to sniff traffic outside of the clients.

When shared VPCs are used, in-flight encryption with NFS Kerberos and/or SMB encryption can mask much of the information gleaned from traces. However, some traffic is still sent in plaintext, such as DNS and LDAP queries. The following figure shows a packet capture from a plaintext LDAP query originating from Cloud Volumes Service and the potential identifying information that is exposed. LDAP queries in Cloud Volumes Service currently do not support encryption or LDAP over SSL. CVS-Performance support LDAP signing, if requested by Active Directory. CVS-SW does not support LDAP signing.





unixUserPassword is queried by LDAP and is not sent in plaintext but instead in a salted hash. By default, Windows LDAP does not populate the unixUserPassword fields. This field is only required if you need to leverage Windows LDAP for interactive logins through LDAP to clients. Cloud Volumes Service does not support interactive LDAP logins to the instances.

The following figure shows a packet capture from an NFS Kerberos conversation next to a capture of NFS over AUTH\_SYS. Note how the information available in a trace differs between the two and how enabling in-flight encryption offers greater overall security for NAS traffic.

|            |  | IP addresses of the NFS client and  | d CVS instance               |                    | Genericized NFS  | coll/conty                        |  |  |  |
|------------|--|---|------------------------------|--------------------|--|-----------------------------------|--|--|--|
|            |  |   |                              |                    |  | calinepiy                         |  |  |  |
| No.        | Time   | Source  | Destination                  | Protocol           | Length Info  | ( · · · · · · · · · · · · · · · · |  |  |  |
| •          | 380 9.218014   | 10.193.67.225   | 10.193.67.219                | NFS                |  | (Reply In 381)                    |  |  |  |
|            | 381 9.218480   | 10.193.67.219   | 10.193.67.225                | NFS                | 426 V4 Reply   | (Call In 380)                     |  |  |  |
|            | 382 9.218641   | 10.193.67.225   | 10.193.67.219                | NFS                | 370 V4 Call  | (Reply In 397)                    |  |  |  |
|            | 397 9.369035   | 10.193.67.219   | 10.193.67.225                | NFS                | 458 V4 Reply   | (Call In 382)                     |  |  |  |
| >          | Frame 381: 426 bytes on w  | (ino (3408 hits) 4  | 26 bytes contured (          | (3408 bits)        |  |                                   |  |  |  |
|            | · · · · · ·  |   |                              |                    | . 2d (00, E0, E6, o  | 1.201.2d)                         |  |  |  |
|            | Ethernet II, Src: IntelCo  |   |                              | _                  | .20 (00:50:50:a0   | .20.20)                           |  |  |  |
|            | Internet Protocol Version  | •   | •                            |                    |  |                                   |  |  |  |
| >          | Transmission Control Prot  | cocol, Src Port: 204  | 49, Dst Port: 738,           | Seq: 6305, A       | ck: 6569, Len: 3   | 60                                |  |  |  |
| -> F       | Remote Procedure Call, Ty  | /pe:Reply XID:0xef5   | e998d                        |                    |  |                                   |  |  |  |
| <b>~</b> ( | GSS-Wrap   |   |                              | GSS wrapped NFS of | alls/replies with no other ider  | tifying information               |  |  |  |
|            | Length: 300  |   |                              |                    |  |                                   |  |  |  |
|            | GSS Data: 050407ff0000   | 000000000000000000000000000000000000000   | 1001d/3d208cf3031            |                    |  |                                   |  |  |  |
|            |  |   |                              |                    |  |                                   |  |  |  |
|            | <pre>&gt; krb5_blob: 050407ff000</pre>   | 00000000000000259134  | IS1ee10430298CT3031          |                    |  |                                   |  |  |  |
| × 1        | Network File System  |   |                              |                    |  |                                   |  |  |  |
|            | [Program Version: 4]   |   |                              |                    |  |                                   |  |  |  |
|            | [V4 Procedure: COMPOUN   | D (1)]  |                              |                    |  |                                   |  |  |  |
| No.        | Time         Source           33         0.958480         10.193.67.1           34         0.958784         10.193.67.1           35         0.959284         10.193.67.1  | 04 10.193.67.201  | NFS 306 V4 Cal               |                    | PEN StateID: 0x0481<br>ETATTR FH: 0x6c07918a<br>ETATTR   |                                   |  |  |  |
|            | <pre>&gt; Opcode: PUTFH (22)<br/>&gt; Opcode: SETATTR (34)<br/>&gt; Opcode: GETATTR (9)<br/>Status: NF54_OK (0)<br/>&gt; Attr mask[0]: 0x0010011a (Ty)<br/>&gt; reqd_attr: Type (1)<br/>&gt; reqd_attr: Change (3)<br/>&gt; reqd_attr: Size (4)<br/>&gt; reqd_attr: FSID (8)</pre> | File ID<br>2628   |                              | Access. Time Metad | ata. Time Modify. Mou  | nted on FileId)                   |  |  |  |
|            | v reco_attr: Mode (33)   | and the second | Teroph, share Tasket, take T | ceess) name_neess  | and the second sec | Petrnistion information           |  |  |  |
|            | > mode: 0644, Name: Unkno  | wn, Read permission for ow  | ner, Write permission for    | owner, Read permi  | ission for group, Read   |                                   |  |  |  |
|            | > reco_attr: NumLinks (35)   |   |                              |                    |  |                                   |  |  |  |
|            | <pre>v reco_attr: Owner (36)</pre>   | Owner and group ID strings  |                              |                    |  |                                   |  |  |  |
|            | > fattr4_owner: root@NTAP  | STORES AND ALL  |                              |                    |  |                                   |  |  |  |
|            | ✓ reco_attr: Owner_Group (37)  |   |                              |                    |  |                                   |  |  |  |
|            | <pre>&gt; fattr4_owner_group: root@NTAP.LOCAL &gt; reco_attr: Space_Used (45)</pre>  |   |                              |                    |  |                                   |  |  |  |
|            | > reco_attr: Space_osed (45) > reco_attr: Time_Access (45)   |   |                              |                    |  |                                   |  |  |  |
|            | > reco_attr: Time_Access (4)   |   |                              |                    |  |                                   |  |  |  |
|            | > reco_attr: Time_Modify (5)   |   |                              |                    |  |                                   |  |  |  |
|            | > reco_attr: Mounted_on_File   | 전화 모습 이 같이 있다.  |                              |                    |  |                                   |  |  |  |
|            |  | en a cara e arrende a cara de c   |                              |                    |  |                                   |  |  |  |

#### VM network interfaces

One trick attackers might attempt is to add a new network interface card (NIC) to a VM in promiscuous mode (port mirroring) or enable promiscuous mode on an existing NIC in order to sniff all traffic. In Google Cloud, adding a new NIC requires a VM to be shut down entirely, which creates alerts, so attackers cannot do this unnoticed.

In addition, NICs cannot be set to promiscuous mode at all and will trigger alerts in Google Cloud.

# **Control plane architecture**

All management actions to Cloud Volumes Service are done through API. Cloud Volumes Service management integrated into the GCP Cloud Console also uses the Cloud Volumes Service API.

# **Identity and Access Management**

Identity and Access Management (IAM) is a standard service that enables you to control authentication (logins) and authorization (permissions) to Google Cloud project instances. Google IAM provides a full audit trail of permissions authorization and removal. Currently Cloud Volumes Service does not provide control plane auditing.

# Authorization/permission overview

IAM offers built-in, granular permissions for Cloud Volumes Service. You can find a complete list of granular permissions here.

IAM also offers two predefined roles called netappcloudvolumes.admin and netappcloudvolumes.viewer. These roles can be assigned to specific users or service accounts.

Assign appropriate roles and permission to allow IAM users to manage Cloud Volumes Service.

Examples for using granular permissions include the following:

- Build a custom role with only get/list/create/update permissions so that users cannot delete volumes.
- Use a custom role with only snapshot.\* permissions to create a service account that is used to build application- consistent Snapshot integration.
- Build a custom role to delegate volumereplication.\* to specific users.

# Service accounts

To make Cloud Volumes Service API calls through scripts or Terraform, you must create a service account with the roles/netappcloudvolumes.admin role. You can use this service account to generate the JWT tokens required to authenticate Cloud Volumes Service API requests in two different ways:

- Generate a JSON key and use Google APIs to derive a JWT token from it. This is the simplest approach, but it involves manual secrets (the JSON key) management.
- Use Service account impersonation with roles/iam.serviceAccountTokenCreator. The code (script, Terraform, and so on.) runs with Application Default Credentials and impersonates the service account to gain its permissions. This approach reflects Google security best practices.

See Creating your service account and private key in the Google cloud documentation for more information.

# **Cloud Volumes Service API**

Cloud Volumes Service API uses a REST-based API by using HTTPS (TLSv1.2) as the underlying network transport. You can find the latest API definition here and information about how to use the API at Cloud Volumes APIs in the Google cloud documentation.

The API endpoint is operated and secured by NetApp using standard HTTPS (TLSv1.2) functionality.

# JWT tokens

Authentication to the API is performed with JWT bearer tokens (RFC-7519). Valid JWT tokens must be obtained by using Google Cloud IAM authentication. This must be done by fetching a token from IAM by providing a service account JSON key.

# Audit logging

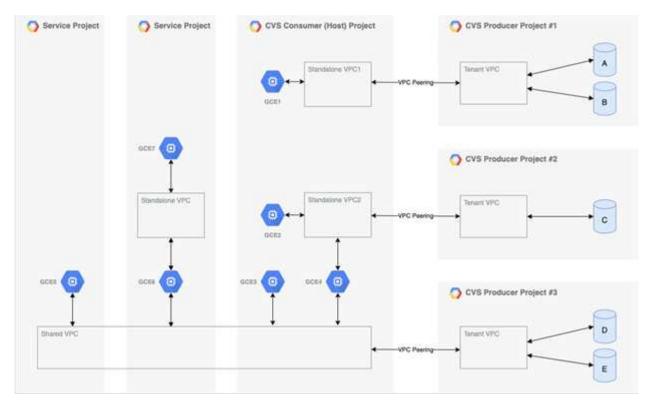
Currently, no user-accessible control plane audit logs are available.

# Data plane architecture

Cloud Volumes Service for Google Cloud leverages the Google Cloud private services access framework. In this framework, users can connect to the Cloud Volumes Service. This framework uses Service Networking and VPC peering constructs like other Google Cloud services, ensuring complete isolation between tenants.

For an architecture overview of Cloud Volumes Service for Google Cloud, see Architecture for Cloud Volumes Service.

User VPCs (standalone or shared) are peered to VPCs within Cloud Volumes Service managed tenant projects, which hosts the volumes.



The preceding figure shows a project (the CVS consumer project in the middle) with three VPC networks connected to Cloud Volumes Service and multiple Compute Engine VMs (GCE1-7) sharing volumes:

- VPC1 allows GCE1 to access volumes A and B.
- VPC2 allows GCE2 and GCE4 to access volume C.

• The third VPC network is a shared VPC, shared with two service projects. It allows GCE3, GCE4, GCE5, and GCE6 to access volumes D and E. Shared VPC networks are only supported for volumes of the CVS-Performance service type.



GCE7 cannot access any volume.

Data can be encrypted both in-transit (using Kerberos and/or SMB encryption) and at-rest in Cloud Volumes Service.

# Data encryption in transit

Data in transit can be encrypted at the NAS protocol layer, and the Google Cloud network itself is encrypted, as described in the following sections.

# **Google Cloud network**

Google Cloud encrypts traffic on the network level as described in Encryption in transit in the Google documentation. As mentioned in the section "Cloud Volumes Services architecture," Cloud Volumes Service is delivered out of a NetApp-controlled PSA producer project.

In case of CVS-SW, the producer tenant runs Google VMs to provide the service. Traffic between user VMs and Cloud Volumes Service VMs is encrypted automatically by Google.

Although the data path for CVS-Performance isn't fully encrypted on the network layer, NetApp and Google use a combination of IEEE 802.1AE encryption (MACSec), encapsulation (data encryption), and physically restricted networks to protect data in transit between the Cloud Volumes Service CVS-Performance service type and Google Cloud.

# **NAS** protocols

NFS and SMB NAS protocols provide optional transport encryption at the protocol layer.

# **SMB** encryption

SMB encryption provides end-to-end encryption of SMB data and protects data from eavesdropping occurrences on untrusted networks. You can enable encryption for both the client/server data connection (only available to SMB3.x capable clients) and the server/domain controller authentication.

When SMB encryption is enabled, clients that do not support encryption cannot access the share.

Cloud Volumes Service supports RC4-HMAC, AES-128-CTS-HMAC-SHA1, and AES-256-CTS-HMAC-SHA1 security ciphers for SMB encryption. SMB negotiates to the highest supported encryption type by the server.

# NFSv4.1 Kerberos

For NFSv4.1, CVS-Performance offers Kerberos authentication as described in RFC7530. You can enable Kerberos on a per-volume basis.

The current strongest available encryption type for Kerberos is AES-256-CTS-HMAC-SHA1. NetApp Cloud Volumes Service supports AES-256-CTS-HMAC-SHA1, AES-128-CTS-HMAC-SHA1, DES3, and DES for NFS. It also supports ARCFOUR-HMAC (RC4) for CIFS/SMB traffic, but not for NFS.

Kerberos provides three different security levels for NFS mounts that offer choices for how strong the Kerberos security should be.

As per RedHat's Common Mount Options documentation:

sec=krb5 uses Kerberos V5 instead of local UNIX UIDs and GIDs to authenticate users. sec=krb5i uses Kerberos V5 for user authentication and performs integrity checking of NFS operations using secure checksums to prevent data tampering. sec=krb5p uses Kerberos V5 for user authentication, integrity checking, and encrypts NFS traffic to prevent traffic sniffing. This is the most secure setting, but it also involves the most performance overhead.

As a general rule, the more the Kerberos security level has to do, the worse the performance is, as the client and server spend time encrypting and decrypting NFS operations for each packet sent. Many clients and NFS servers provide support for AES-NI offloading to the CPUs for a better overall experience, but the performance impact of Kerberos 5p (full end-to-end encryption) is significantly greater than the impact of Kerberos 5 (user authentication).

The following table shows differences in what each level does for security and performance.

| Security level | Security   | Performance   |
|----------------|--|---|
| NFSv3—sys      | <ul> <li>Least secure; plain text with<br/>numeric user IDs/group IDs</li> </ul>   | Best for most cases   |
|                | <ul> <li>Able to view UID, GID, client IP<br/>addresses, export paths, file<br/>names, permissions in packet<br/>captures</li> </ul>         |   |
| NFSv4.x—sys    | <ul> <li>More secure than NFSv3 (client<br/>IDs, name string/domain string<br/>matching) but still plain text</li> </ul>                     | <ul> <li>Good for sequential workloads<br/>(such as VMs, databases, large<br/>files)</li> </ul> |
|                | • Able to view UID, GID, client IP<br>addresses, name strings,<br>domain IDs, export paths, file<br>names, permissions in packet<br>captures | <ul> <li>Bad with high file count/high<br/>metadata (30-50% worse)</li> </ul>                   |

| Security level | Security   | Performance   |
|----------------|--|---|
| NFS—krb5       | <ul> <li>Kerberos encryption for<br/>credentials in every NFS<br/>packet—wraps UID/GID of<br/>users/groups in RPC calls in<br/>GSS wrapper</li> <li>User requesting access to<br/>mount needs a valid Kerberos<br/>ticket (either through<br/>username/password or manual<br/>key tab exchange); ticket<br/>expires after a specified time<br/>period and user must<br/>reauthenticate for access</li> <li>No encryption for NFS<br/>operations or ancillary<br/>protocols like<br/>mount/portmapper/nlm (can<br/>see export paths, IP addresses,<br/>file handles, permissions, file<br/>names, atime/mtime in packet<br/>captures)</li> </ul>  | <ul> <li>Best in most cases for<br/>Kerberos; worse than<br/>AUTH_SYS</li> </ul>  |
| NFS—krb5i      | <ul> <li>Kerberos encryption for<br/>credentials in every NFS<br/>packet—wraps UID/GID of<br/>users/groups in RPC calls in<br/>GSS wrapper</li> <li>User requesting access to<br/>mount needs a valid Kerberos<br/>ticket (either via<br/>username/password or manual<br/>key tab exchange); ticket<br/>expires after a specified time<br/>period and user must<br/>reauthenticate for access</li> <li>No encryption for NFS<br/>operations or ancillary<br/>protocols like<br/>mount/portmapper/nlm (can<br/>see export paths, IP addresses,<br/>file handles, permissions, file<br/>names, atime/mtime in packet<br/>captures)</li> <li>Kerberos GSS checksum is<br/>added to every packet to<br/>ensure nothing intercepts the<br/>packets. If checksums match,<br/>conversation is allowed.</li> </ul> | <ul> <li>Better than krb5p because the<br/>NFS payload is not encrypted;<br/>only added overhead compared<br/>to krb5 is the integrity<br/>checksum. Performance of<br/>krb5i won't be much worse than<br/>krb5 but will see some<br/>degradation.</li> </ul> |

| Security level | Security  | Performance   |
|----------------|---|---|
| NFS – krb5p    | <ul> <li>Kerberos encryption for<br/>credentials in every NFS<br/>packet—wraps UID/GID of<br/>users/groups in RPC calls in<br/>GSS wrapper</li> <li>User requesting access to<br/>mount needs a valid Kerberos<br/>ticket (either via<br/>username/password or manual<br/>keytab exchange); ticket<br/>expires after specified time<br/>period and user must<br/>reauthenticate for access</li> </ul> | <ul> <li>Worst performance of the security levels; krb5p has to encrypt/decrypt more.</li> <li>Better performance than krb5p with NFSv4.x for high file count workloads.</li> </ul> |
|                | <ul> <li>All of the NFS packet payloads<br/>are encrypted with the GSS<br/>wrapper (cannot see file<br/>handles, permissions, file<br/>names, atime/mtime in packet<br/>captures).</li> </ul>   |   |
|                | <ul> <li>Includes integrity check.</li> </ul>   |   |
|                | <ul> <li>NFS operation type is visible<br/>(FSINFO, ACCESS, GETATTR,<br/>and so on).</li> </ul>   |   |
|                | <ul> <li>Ancillary protocols (mount,<br/>portmap, nlm, and so on) are<br/>not encrypted - (can see export<br/>paths, IP addresses)</li> </ul>   |   |

In Cloud Volumes Service, a configured Active Directory server is used as Kerberos server and LDAP server (to lookup user identities from an RFC2307 compatible schema). No other Kerberos or LDAP servers are supported. NetApp highly recommends that you use LDAP for identity management in Cloud Volumes Service. For information on how NFS Kerberos is shown in packet captures, see the section "Packet sniffing/trace considerations."

# Data encryption at rest

All volumes in Cloud Volumes Service are encrypted-at-rest using AES-256 encryption, which means all user data written to media is encrypted and can only be decrypted with a per-volume key.

- For CVS-SW, Google-generated keys are used.
- For CVS-Performance, the per-volume keys are stored in a key manager built into the Cloud Volumes Service.

Starting in November 2021, preview customer-managed encryption keys (CMEK) functionality was made available. This enables you to encrypt the per-volume keys with a per-project, per-region master key that is hosted in Google Key Management Service (KMS). KMS enables you to attach external key managers.

For information about configuring KMS for CVS-Performance, see Setting up customer-managed encryption keys.

# Firewall

Cloud Volumes Service exposes multiple TCP ports to serve NFS and SMB shares:

- Ports required for NFS access
- Ports required for SMB access

Additionally, SMB, NFS with LDAP including Kerberos, and dual-protocol configurations require access to a Windows Active Directory domain. Active Directory connections must be configured on a per-region basis. Active Directory Domain controllers (DC) are identified by using DNS-based DC discovery using the specified DNS servers. Any of the DCs returned are used. The list of eligible DCs can be limited by specifying an Active Directory site.

Cloud Volumes Service reaches out with IP addresses from the CIDR range allocated with the gcloud compute address command while on-boarding the Cloud Volumes Service. You can use this CIDR as source addresses to configure inbound firewalls to your Active Directory domain controllers.

Active Directory Domain Controllers must expose ports to the Cloud Volumes Service CIDRs as mentioned here.

# NAS protocols

# NAS protocols overview

NAS protocols include NFS (v3 and v4.1) and SMB/CIFS (2.x and 3.x). These protocols are how CVS allows shared access to data across multiple NAS clients. In addition, Cloud Volumes Service can provide access to NFS and SMB/CIFS clients simultaneously (dual-protocol) while honoring all of the identity and permission settings on files and folders in the NAS shares. To maintain the highest possible data transfer security, Cloud Volumes Service supports protocol encryption in flight using SMB encryption and NFS Kerberos 5p.



Dual-protocol is available with CVS-Performance only.

# **Basics of NAS protocols**

NAS protocols are ways for multiple clients on a network to access the same data on a storage system, such as Cloud Volumes Service on GCP. NFS and SMB are the defined NAS protocols and operate on a client/server basis where Cloud Volumes Service acts as the server. Clients send access, read, and write requests to the server, and the server is responsible for coordinating the locking mechanisms for files, storing permissions and handling identity and authentication requests.

For example, the following general process is followed if a NAS client wants to create a new file in a folder.

1. The client asks the server for information about the directory (permissions, owner, group, file ID, available space, and so on); the server responds with the information if the requesting client and user have the

necessary permissions on the parent folder.

- 2. If the permissions on the directory allow access, the client then asks the server if the file name being created already exists in the file system. If the file name is already in use, creation fails. If the file name does not exist, the server lets the client know it can proceed.
- 3. The client issues a call to the server to create the file with the directory handle and file name and sets the access and modified times. The server issues a unique file ID to the file to make sure that no other files are created with the same file ID.
- 4. The client sends a call to check file attributes before the WRITE operation. If permissions allow it, the client then writes the new file. If locking is used by the protocol/application, the client asks the server for a lock to prevent other clients from accessing the file while locked to prevent data corruption.

# NFS

NFS is a distributed file system protocol that is an open IETF standard defined in Request for Comments (RFC) that allows anyone to implement the protocol.

Volumes in Cloud Volumes Service are shared out to NFS clients by exporting a path that is accessible to a client or set of clients. Permissions to mount these exports are defined by export policies and rules, which are configurable by Cloud Volumes Service administrators.

The NetApp NFS implementation is considered a gold standard for the protocol and is used in countless enterprise NAS environments. The following sections cover NFS and specific security features available in Cloud Volumes Service and how they are implemented.

# **Default local UNIX users and groups**

Cloud Volumes Service contains several default UNIX users and groups for various basic functionalities. These users and groups cannot currently be modified or deleted. New local users and groups cannot currently be added to Cloud Volumes Service. UNIX users and groups outside of the default users and groups need to be provided by an external LDAP name service.

The following table shows the default users and groups and their corresponding numeric IDs. NetApp recommends not creating new users or groups in LDAP or on the local clients that re-use these numeric IDs.

| Default users: numeric IDs | Default groups: numeric IDs |
|----------------------------|-----------------------------|
| • root:0                   | • root:0                    |
| • pcuser:65534             | • daemon:1                  |
| • nobody:65535             | • pcuser:65534              |
|                            | • nobody:65535              |
|                            |                             |



When using NFSv4.1, the root user might display as nobody when running directory listing commands on NFS clients. This is due to the client's ID domain mapping configuration. See the section called NFSv4.1 and the nobody user/group for details on this issue and how to resolve it.

# The root user

In Linux, the root account has access to all commands, files, and folders in a Linux-based file system. Because of the power of this account, security best practices often require the root user to be disabled or restricted in some fashion. In NFS exports, the power a root user has over the files and folders can be controlled in Cloud

Volumes Service through export policies and rules and a concept known as root squash.

Root squashing ensures that the root user accessing an NFS mount is squashed to the anonymous numeric user 65534 (see the section "The anonymous user") and is currently only available when using CVS-Performance by selecting Off for root access during export policy rule creation. If the root user is squashed to the anonymous user, it no longer has access to run chown or setuid/setgid commands (the sticky bit) on files or folders in the NFS mount, and files or folders created by the root user show the anon UID as the owner/group. In addition, NFSv4 ACLs cannot be modified by the root user. However, the root user still has access to chmod and deleted files that it does not have explicit permissions for. If you want to limit access to a root user's file and folder permissions, consider using a volume with NTFS ACLs, creating a Windows user named root, and applying the desired permissions to the files or folders.

# The anonymous user

The anonymous (anon) user ID specifies a UNIX user ID or username that is mapped to client requests that arrive without valid NFS credentials. This can include the root user when root squashing is used. The anon user in Cloud Volumes Service is 65534.

This UID is normally associated with the username nobody or nfsnobody in Linux environments. Cloud Volumes Service also uses 65534 as the local UNIX user' pcuser' (see the section "Default local UNIX users and groups"), which is also the default fallback user for Windows to UNIX name mappings when no valid matching UNIX user can be found in LDAP.

Because of the differences in usernames across Linux and Cloud Volumes Service for UID 65534, the name string for users mapped to 65534 might not match when using NFSv4.1. As a result, you might see nobody as the user on some files and folders. See the section "NFSv4.1 and the nobody user/group" for information about this issue and how to resolve it.

# Access control/exports

Initial export/share access for NFS mounts is controlled through host- based export policy rules contained within an export policy. A host IP, host name, subnet, netgroup, or domain is defined to allow access to mount the NFS share and the level of access allowed to the host. Export policy rule configuration options depend on the Cloud Volumes Service level.

For CVS-SW, the following options are available for export-policy configuration:

- Client match. Comma-separated list of IP addresses, comma-separated list of hostnames, subnets, netgroups, domain names.
- **RO/RW access rules.** Select read/write or read only to control level of access to export.CVS-Performance provides the following options:
- Client match. Comma-separated list of IP addresses, comma-separated list of hostnames, subnets, netgroups, domain names.
- RO/RW access rules. Select read/write or read only to control level of access to export.
- Root access (on/off). Configures root squash (see the section "The root user" for details).
- **Protocol type.** This limits access to the NFS mount to a specific protocol version. When specifying both NFSv3 and NFSv4.1 for the volume, either leave both blank or check both boxes.
- Kerberos security level (when Enable Kerberos is selected). Provides the options of krb5, krb5i, and/or krb5p for read-only or read-write access.

# Change ownership (chown) and change group (chgrp)

NFS on Cloud Volumes Service only allows the root user to run chown/chgrp on files and folders. Other users see an Operation not permitted error— even on files they own. If you use root squash (as covered in the section "The root user"), the root is squashed to a nonroot user and is not allowed access to chown and chgrp. There are currently no workarounds in Cloud Volumes Service to allow chown and chgrp for non-root users. If ownership changes are required, consider using dual protocol volumes and set the security style to NTFS to control permissions from the Windows side.

## **Permission management**

Cloud Volumes Service supports both mode bits (such as 644, 777, and so on for rwx) and NFSv4.1 ACLs to control permissions on NFS clients for volumes that use the UNIX security style. Standard permission management is used for these (such as chmod, chown, or nfs4\_setfacl) and work with any Linux client that supports them.

Additionally, when using dual protocol volumes set to NTFS, NFS clients can leverage Cloud Volumes Service name mapping to Windows users, which then are used to resolve the NTFS permissions. This requires an LDAP connection to Cloud Volumes Service to provide numeric-ID-to- username translations because Cloud Volumes Service requires a valid UNIX username to map properly to a Windows username.

# Providing granular ACLs for NFSv3

Mode bit permissions cover only owner, group, and everyone else in the semantics—meaning that there are no granular user access controls in place for basic NFSv3. Cloud Volumes Service does not support POSIX ACLs, nor extended attributes (such as chattr), so granular ACLs are only possible in the following scenarios with NFSv3:

- NTFS security style volumes (CIFS server required) with valid UNIX to Windows user mappings.
- NFSv4.1 ACLs applied using an admin client mounting NFSv4.1 to apply ACLs.

Both methods require an LDAP connection for UNIX identity management and a valid UNIX user and group information populated (see the section "LDAP") and are only available with CVS-Performance instances. To use NTFS security style volumes with NFS, you must use dual-protocol (SMB and NFSv3) or dual-protocol (SMB and NFSv4.1), even if no SMB connections are made. To use NFSv4.1 ACLs with NFSv3 mounts, you must select Both (NFSv3/NFSv4.1) as the protocol type.

Regular UNIX mode bits don't provide the same level of granularity in permissions that NTFS or NFSv4.x ACLs provide. The following table compares the permission granularity between NFSv3 mode bits and NFSv4.1 ACLs. For information about NFSv4.1 ACLs, see nfs4\_acl - NFSv4 Access Control Lists.

| NFSv3 mode bits   | NFSv4.1 ACLs  |
|---|---|
| <ul> <li>Set user ID on execution</li> <li>Set group ID on execution</li> <li>Save swapped text (not defined in POSIX)</li> <li>Read permission for owner</li> <li>Write permission for owner on a file; or look up (search) permission for owner in directory</li> <li>Read permission for group</li> <li>Write permission for group on a file; or look up (search) permission for group on a file; or look up (search) permission for group in directory</li> <li>Read permission for others</li> <li>Write permission for others</li> <li>Execute permission for others</li> <li>Execute permission for others in directory</li> </ul> | Access control entry (ACE) types (Allow/Deny/Audit)<br>* Inheritance flags<br>* directory-inherit<br>* file-inherit<br>* no-propagate-inherit<br>* inherit-only<br>Permissions<br>* read-data (files) / list-directory (directories)<br>* write-data (files) / create-file (directories)<br>* append-data (files) / create-subdirectory (directories)<br>* append-data (files) / create-subdirectory (directories)<br>* execute (files) / change-directory (directories)<br>* delete<br>* delete-child<br>* read-attributes<br>* write-attributes<br>* write-attributes<br>* write-named-attributes<br>* write-named-attributes<br>* write-named-attributes<br>* write-owner<br>* Synchronize |

Finally, NFS group membership (in both NFSv3 and NFSV4.x) is limited to a default maximum of 16 for AUTH\_SYS as per the RPC packet limits. NFS Kerberos provides up to 32 groups and NFSv4 ACLs remove the limitation by way of granular user and group ACLs (up to 1024 entries per ACE).

Additionally, Cloud Volumes Service provides extended group support to extend the maximum supported groups up to 32. This requires an LDAP connection to an LDAP server that contains valid UNIX user and group identities. For more information about configuring this, see Creating and managing NFS volumes in the Google documentation.

# NFSv3 user and group IDs

NFSv3 user and group IDs come across the wire as numeric IDs rather than names. Cloud Volumes Service does no username resolution for these numeric IDs with NFSv3, with UNIX security style volumes using just mode bits. When NFSv4.1 ACLs are present, a numeric ID lookup and/or name string lookup is needed to resolve the ACL properly—even when using NFSv3. With NTFS security style volumes, Cloud Volumes Service must resolve a numeric ID to a valid UNIX user and then map to a valid Windows user to negotiate access rights.

# Security limitations of NFSv3 user and group IDs

With NFSv3, the client and server never have to confirm that the user attempting a read or write with a numeric ID is a valid user; it is just implicitly trusted. This opens the file system up to potential breaches simply by spoofing any numeric ID. To prevent security holes like this, there are a few options available to Cloud Volumes Service.

• Implementing Kerberos for NFS forces users to authenticate with a username and password or keytab file to get a Kerberos ticket to allow access into a mount. Kerberos is available with CVS-Performance instances and only with NFSv4.1.

- Limiting the list of hosts in your export policy rules limits which NFSv3 clients have access to the Cloud Volumes Service volume.
- Using dual-protocol volumes and applying NTFS ACLs to the volume forces NFSv3 clients to resolve numeric IDs to valid UNIX usernames to authenticate properly to access mounts. This requires enabling LDAP and configuring UNIX user and group identities.
- Squashing the root user limits the damage a root user can do to an NFS mount but does not completely remove risk. For more information, see the section "The root user."

Ultimately, NFS security is limited to what the protocol version you are using offers. NFSv3, while more performant in general than NFSv4.1, does not provide the same level of security.

# NFSv4.1

NFSv4.1 provides greater security and reliability as compared to NFSv3, for the following reasons:

- · Integrated locking through a lease-based mechanism
- Stateful sessions
- All NFS functionality over a single port (2049)
- TCP only
- ID domain mapping
- Kerberos integration (NFSv3 can use Kerberos, but only for NFS, not for ancillary protocols such as NLM)

#### NFSv4.1 dependencies

Because of the additionally security features in NFSv4.1, there are some external dependencies involved that were not needed to use NFSv3 (similar to how SMB requires dependencies such as Active Directory).

# NFSv4.1 ACLs

Cloud Volumes Service offers support for NFSv4.x ACLs, which deliver distinct advantages over normal POSIX-style permissions, such as the following:

- · Granular control of user access to files and directories
- Better NFS security
- · Improved interoperability with CIFS/SMB
- Removal of the NFS limitation of 16 groups per user with AUTH\_SYS security
- ACLs bypass the need for group ID (GID) resolution, which effectively removes the GID limitNFSv4.1 ACLs are controlled from NFS clients—not from Cloud Volumes Service. To use NFSv4.1 ACLs, be sure your client's software version supports them and the proper NFS utilities are installed.

# Compatibility between NFSv4.1 ACLs and SMB clients

NFSv4 ACLs are different from Windows file-level ACLs (NTFS ACLs) but carry similar functionality. However, in multiprotocol NAS environments, if NFSv4.1 ACLs are present and you are using dual-protocol access (NFS and SMB on the same datasets), clients using SMB2.0 and later won't be able to view or manage ACLs from Windows security tabs.

## How NFSv4.1 ACLs work

For reference, the following terms are defined:

- · Access control list (ACL). A list of permissions entries.
- Access control entry (ACE). A permission entry in the list.

When a client sets an NFSv4.1 ACL on a file during a SETATTR operation, Cloud Volumes Service sets that ACL on the object, replacing any existing ACL. If there is no ACL on a file, then the mode permissions on the file are calculated from OWNER@, GROUP@, and EVERYONE@. If there are any existing SUID/SGID/STICKY bits on the file, they are not affected.

When a client gets an NFSv4.1 ACL on a file during the course of a GETATTR operation, Cloud Volumes Service reads the NFSv4.1 ACL associated with the object, constructs a list of ACEs, and returns the list to the client. If the file has an NT ACL or mode bits, then an ACL is constructed from mode bits and is returned to the client.

Access is denied if a DENY ACE is present in the ACL; access is granted if an ALLOW ACE exists. However, access is also denied if neither of the ACEs is present in the ACL.

A security descriptor consists of a security ACL (SACL) and a discretionary ACL (DACL). When NFSv4.1 interoperates with CIFS/SMB, the DACL is one-to-one mapped with NFSv4 and CIFS. The DACL consists of the ALLOW and the DENY ACEs.

If a basic chmod is run on a file or folder with NFSv4.1 ACLs set, existing user and group ACLs are preserved, but the default OWNER@, GROUP@, EVERYONE@ ACLs are modified.

A client using NFSv4.1 ACLs can set and view ACLs for files and directories on the system. When a new file or subdirectory is created in a directory that has an ACL, that object inherits all ACEs in the ACL that have been tagged with the appropriate inheritance flags.

If a file or directory has an NFSv4.1 ACL, that ACL is used to control access no matter which protocol is used to access the file or directory.

Files and directories inherit ACEs from NFSv4 ACLs on parent directories (possibly with appropriate modifications) as long as the ACEs have been tagged with the correct inheritance flags.

When a file or directory is created as the result of an NFSv4 request, the ACL on the resulting file or directory depends on whether the file creation request includes an ACL or only standard UNIX file access permissions. The ACL also depends on whether the parent directory has an ACL.

- If the request includes an ACL, that ACL is used.
- If the request includes only standard UNIX file access permissions and the parent directory does not have an ACL, the client file mode is used to set standard UNIX file access permissions.
- If the request includes only standard UNIX file access permissions and the parent directory has a noninheritable ACL, a default ACL based on the mode bits passed into the request is set on the new object.
- If the request includes only standard UNIX file access permissions but the parent directory has an ACL, the ACEs in the parent directory's ACL are inherited by the new file or directory as long as the ACEs have been tagged with the appropriate inheritance flags.

## **ACE** permissions

NFSv4.1 ACLs permissions uses a series of upper- and lower-case letter values (such as rxtncy) to control access. For more information about these letter values, see HOW TO: Use NFSv4 ACL.

## NFSv4.1 ACL behavior with umask and ACL inheritance

NFSv4 ACLs provide the ability to offer ACL inheritance. ACL inheritance means that files or folders created beneath objects with NFSv4.1 ACLs set can inherit the ACLs based on the configuration of the ACL inheritance flag.

Umask is used to control the permission level at which files and folders are created in a directory without administrator interaction. By default, Cloud Volumes Service allows umask to override inherited ACLs, which is expected behavior as per RFC 5661.

## **ACL** formatting

NFSv4.1 ACLs have specific formatting. The following example is an ACE set on a file:

A::ldapuser@domain.netapp.com:rwatTnNcCy

The preceding example follows the ACL format guidelines of:

```
type:flags:principal:permissions
```

A type of A means "allow." The inherit flags are not set in this case, because the principal is not a group and does not include inheritance. Also, because the ACE is not an AUDIT entry, there is no need to set the audit flags. For more information about NFSv4.1 ACLs, see http://linux.die.net/man/5/nfs4\_acl.

If the NFSv4.1 ACL is not set properly (or a name string cannot be resolved by the client and server), the ACL might not behave as expected, or the ACL change might fail to apply and throw an error.

Sample errors include:

```
Failed setxattr operation: Invalid argument
Scanning ACE string 'A:: user@rwaDxtTnNcCy' failed.
```

#### **Explicit DENY**

NFSv4.1 permissions can include explicit DENY attributes for OWNER, GROUP, and EVERYONE. That is because NFSv4.1 ACLs are default-deny, which means that if an ACL is not explicitly granted by an ACE, then it is denied. Explicit DENY attributes override any ACCESS ACEs, explicit or not.

DENY ACEs are set with an attribute tag of D.

In the example below, GROUP@ is allowed all read and execute permissions, but denied all write access.

```
sh-4.1$ nfs4_getfacl /mixed
A::ldapuser@domain.netapp.com:ratTnNcCy
A::OWNER@:rwaDxtTnNcCy
D::OWNER@:
A:g:GROUP@:rxtncy
D:g:GROUP@:waDTC
A::EVERYONE@:rxtncy
D::EVERYONE@:waDTC
```

DENY ACEs should be avoided whenever possible because they can be confusing and complicated; ALLOW ACLs that are not explicitly defined are implicitly denied. When DENY ACEs are set, users might be denied access when they expect to be granted access.

The preceding set of ACEs is equivalent to 755 in mode bits, which means:

- The owner has full rights.
- · Groups have read only.
- Others have read only.

However, even if permissions are adjusted to the 775 equivalent, access can be denied because of the explicit DENY set on EVERYONE.

## NFSv4.1 ID domain mapping dependencies

NFSv4.1 leverages ID domain mapping logic as a security layer to help verify that a user attempting access to an NFSv4.1 mount is indeed who they claim to be. In these cases, the username and group name coming from the NFSv4.1 client appends a name string and sends it to the Cloud Volumes Service instance. If that username/group name and ID string combination does not match, then the user and/or group is squashed to the default nobody user specified in the /etc/idmapd.conf file on the client.

This ID string is a requirement for proper permission adherence, especially when NFSv4.1 ACLs and/or Kerberos are in use. As a result, name service server dependencies such as LDAP servers are necessary to ensure consistency across clients and Cloud Volumes Service for proper user and group name identity resolution.

Cloud Volumes Service uses a static default ID domain name value of defaultv4iddomain.com. NFS clients default to the DNS domain name for its ID domain name settings, but you can manually adjust the ID domain name in /etc/idmapd.conf.

If LDAP is enabled in Cloud Volumes Service, then Cloud Volumes Service automates the NFS ID domain to change to what is configured for the search domain in DNS and clients won't need to be modified unless they use different DNS domain search names.

When Cloud Volumes Service can resolve a username or group name in local files or LDAP, the domain string is used and non-matching domain IDs squash to nobody. If Cloud Volumes Service cannot find a username or group name in local files or LDAP, the numeric ID value is used and the NFS client resolves the name properly (this is similar to NFSv3 behavior).

Without changing the client's NFSv4.1 ID domain to match what the Cloud Volumes Service volume is using, you see the following behavior:

- UNIX users and groups with local entries in Cloud Volumes Service (such as root, as defined in local UNIX users and groups) are squashed to the nobody value.
- UNIX users and groups with entries in LDAP (if Cloud Volumes Service is configured to use LDAP) squashes to nobody if DNS domains are different between NFS clients and Cloud Volumes Service.
- UNIX users and groups with no local entries or LDAP entries use the numeric ID value and resolve to the name specified on the NFS client. If no name exists on the client, only the numeric ID is shown.

The following shows the results of the preceding scenario:

```
# ls -la /mnt/home/prof1/nfs4/
total 8
drwxr-xr-x 2 nobody nobody 4096 Feb 3 12:07 .
drwxrwxrwx 7 root root 4096 Feb 3 12:06 ..
-rw-r--r-- 1 9835 9835 0 Feb 3 12:07 client-user-no-name
-rw-r--r-- 1 nobody nobody 0 Feb 3 12:07 ldap-user-file
-rw-r--r-- 1 nobody nobody 0 Feb 3 12:06 root-user-file
```

When the client and server ID domains match, this is how the same file listing looks:

```
# ls -la
total 8
drwxr-xr-x 2 root root 4096 Feb 3 12:07 .
drwxrwxrwx 7 root root 4096 Feb 3 12:06 ..
-rw-r--r- 1 9835 9835 0 Feb 3 12:07 client-user-no-name
-rw-r--r- 1 apache apache-group 0 Feb 3 12:07 ldap-user-file
-rw-r--r- 1 root root 0 Feb 3 12:06 root-user-file
```

For more information about this issue and how to resolve it, see the section "NFSv4.1 and the nobody user/group."

#### **Kerberos dependencies**

If you plan to use Kerberos with NFS, you must have the following with Cloud Volumes Service:

- Active Directory domain for Kerberos Distribution Center services (KDC)
- Active Directory domain with user and group attributes populated with UNIX information for LDAP functionality (NFS Kerberos in Cloud Volumes Service requires a user SPN to UNIX user mapping for proper functionality.)
- · LDAP enabled on the Cloud Volumes Service instance
- Active Directory domain for DNS services

#### NFSv4.1 and the nobody user/group

One of the most common issues seen with an NFSv4.1 configuration is when a file or folder is shown in a listing using ls as being owned by the user:group combination of nobody:nobody.

For example:

```
sh-4.2$ ls -la | grep prof1-file
-rw-r--r- 1 nobody nobody 0 Apr 24 13:25 prof1-file
```

And the numeric ID is 99.

```
sh-4.2$ ls -lan | grep prof1-file
-rw-r--r- 1 99 99 0 Apr 24 13:25 prof1-file
```

In some instances, the file might show the correct owner but nobody as the group.

```
sh-4.2$ ls -la | grep newfile1
-rw-r--r- 1 prof1 nobody 0 Oct 9 2019 newfile1
```

Who is nobody?

The nobody user in NFSv4.1 is different from the nfsnobody user. You can view how an NFS client sees each user by running the id command:

```
# id nobody
uid=99(nobody) gid=99(nobody) groups=99(nobody)
# id nfsnobody
uid=65534(nfsnobody) gid=65534(nfsnobody) groups=65534(nfsnobody)
```

With NFSv4.1, the nobody user is the default user defined by the idmapd.conf file and can be defined as any user you want to use.

```
# cat /etc/idmapd.conf | grep nobody
#Nobody-User = nobody
#Nobody-Group = nobody
```

Why does this happen?

Because security through name string mapping is a key tenet of NFSv4.1 operations, the default behavior when a name string does not match properly is to squash that user to one that won't normally have any access to files and folders owned by users and groups.

When you see nobody for the user and/or group in file listings, this generally means something in NFSv4.1 is misconfigured. Case sensitivity can come into play here.

For example, if user1@CVSDEMO.LOCAL (uid 1234, gid 1234) is accessing an export, then Cloud Volumes Service must be able to find user1@CVSDEMO.LOCAL (uid 1234, gid 1234). If the user in Cloud Volumes Service is USER1@CVSDEMO.LOCAL, then it won't match (uppercase USER1 versus lowercase user1). In

many cases, you can see the following in the messages file on the client:

May 19 13:14:29 centos7 nfsidmap[17481]: nss\_getpwnam: name 'root@defaultv4iddomain.com' does not map into domain 'CVSDEMO.LOCAL' May 19 13:15:05 centos7 nfsidmap[17534]: nss\_getpwnam: name 'nobody' does not map into domain 'CVSDEMO.LOCAL'

The client and server must both agree that a user is indeed who they are claiming to be, so you must check the following to ensure that the user that the client sees has the same information as the user that Cloud Volumes Service sees.

- NFSv4.x ID domain. Client: idmapd.conf file; Cloud Volumes Service uses defaultv4iddomain.com and cannot be changed manually. If using LDAP with NFSv4.1, Cloud Volumes Service changes the ID domain to what the DNS search domain is using, which is the same as the AD domain.
- User name and numeric IDs. This determines where the client is looking for user names and leverages the name service switch configuration—client: nsswitch.conf and/or local passwd and group files; Cloud Volumes Service does not allow modifications to this but automatically adds LDAP to the configuration when it is enabled.
- Group name and numeric IDs. This determines where the client is looking for group names and leverages the name service switch configuration—client: nsswitch.conf and/or local passwd and group files; Cloud Volumes Service does not allow modifications to this but automatically adds LDAP to the configuration when it is enabled.

In almost all cases, if you see nobody in user and group listings from clients, the issue is user or group name domain ID translation between Cloud Volumes Service and the NFS client. To avoid this scenario, use LDAP to resolve user and group information between clients and Cloud Volumes Service.

#### Viewing name ID strings for NFSv4.1 on clients

If you are using NFSv4.1, there is a name-string mapping that takes place during NFS operations, as previously described.

In addition to using /var/log/messages to find an issue with NFSv4 IDs, you can use the nfsidmap -l command on the NFS client to view which usernames have properly mapped to the NFSv4 domain.

For example, this is output of the command after a user that can be found by the client and Cloud Volumes Service accesses an NFSv4.x mount:

```
# nfsidmap -1
4 .id_resolver keys found:
    gid:daemon@CVSDEMO.LOCAL
    uid:nfs4@CVSDEMO.LOCAL
    gid:root@CVSDEMO.LOCAL
    uid:root@CVSDEMO.LOCAL
```

When a user that does not map properly into the NFSv4.1 ID domain (in this case, netapp-user) tries to access the same mount and touches a file, they are assigned nobody:nobody, as expected.

```
# su netapp-user
sh-4.2$ id
uid=482600012 (netapp-user), 2000 (secondary)
sh-4.2$ cd /mnt/nfs4/
sh-4.2$ touch newfile
sh-4.2$ ls -la
total 16
drwxrwxrwx 5 root root
                          4096 Jan 14 17:13 .
drwxr-xr-x. 8 root root
                           81 Jan 14 10:02 ..
-rw-r--r-- 1 nobody nobody
                             0 Jan 14 17:13 newfile
drwxrwxrwx 2 root
                   root 4096 Jan 13 13:20 qtree1
drwxrwxrwx 2 root
                    root 4096 Jan 13 13:13 gtree2
drwxr-xr-x 2 nfs4
                    daemon 4096 Jan 11 14:30 testdir
```

The nfsidmap -l output shows the user pcuser in the display but not netapp-user; this is the anonymous user in our export-policy rule (65534).

```
# nfsidmap -1
6 .id_resolver keys found:
    gid:pcuser@CVSDEMO.LOCAL
    uid:pcuser@CVSDEMO.LOCAL
    gid:daemon@CVSDEMO.LOCAL
    uid:nfs4@CVSDEMO.LOCAL
    gid:root@CVSDEMO.LOCAL
    uid:root@CVSDEMO.LOCAL
```

# SMB

SMB is a network file sharing protocol developed by Microsoft that provides centralized user/group authentication, permissions, locking, and file sharing to multiple SMB clients over an Ethernet network. Files and folders are presented to clients by way of shares, which can be configured with a variety of share properties and offers access control through share-level permissions. SMB can be presented to any client that offers support for the protocol, including Windows, Apple, and Linux clients.

Cloud Volumes Service provides support for the SMB 2.1 and 3.x versions of the protocol.

# Access control/SMB shares

- When a Windows username requests access to the Cloud Volumes Service volume, Cloud Volumes Service looks for a UNIX username using the methods configured by Cloud Volumes Service administrators.
- If an external UNIX identity provider (LDAP) is configured and Windows/UNIX usernames are identical, then Windows usernames will map 1:1 to UNIX usernames without any additional configuration needed. When LDAP is enabled, Active Directory is used to host those UNIX attributes for user and group objects.

- If Windows names and UNIX names do not match identically, then LDAP must be configured to allow Cloud Volumes Service to use the LDAP name mapping configuration (see the section "Using LDAP for asymmetric name mapping").
- If LDAP is not in use, then Windows SMB users map to a default local UNIX user named pcuser in Cloud Volumes Service. This means files written in Windows by users that map to the pcuser show UNIX ownership as pcuser in multiprotocol NAS environments. pcuser here is effectively the nobody user in Linux environments (UID 65534).

In deployments with SMB only, the pcuser mapping still occurs, but it won't matter, because Windows user and group ownership is correctly displayed and NFS access to the SMB-only volume is not allowed. In addition, SMB-only volumes do not support conversion to NFS or dual-protocol volumes after they are created.

Windows leverages Kerberos for username authentication with the Active Directory domain controllers, which requires a username/password exchange with the AD DCs, which is external to the Cloud Volumes Service instance. Kerberos authentication is used when the \\SERVERNAME UNC path is used by the SMB clients and the following is true:

- DNS A/AAAA entry exists for SERVERNAME
- A valid SPN for SMB/CIFS access exists for SERVERNAME

When a Cloud Volumes Service SMB volume is created, the machine account name is created as defined in the section "How Cloud Volumes Service shows up in Active Directory." That machine account name also becomes the SMB share access path because Cloud Volumes Service leverages Dynamic DNS (DDNS) to create the necessary A/AAAA and PTR entries in DNS and the necessary SPN entries on the machine account principal.



For PTR entries to be created, the reverse lookup zone for the Cloud Volumes Service instance IP address must exist on the DNS server.

For example, this Cloud Volumes Service volume uses the following UNC share path: \\cvs-east-433d.cvsdemo.local.

In Active Directory, these are the Cloud Volumes Service-generated SPN entries:

```
PS C:\> setspn /L CVS-EAST-433D
Registered ServicePrincipalNames for CN=CVS-EAST-433D,CN=Computers,DC=cvsdemo,DC=local:
HOST/cvs-east-433d.cvsdemo.local
HOST/CVS-EAST-433D
```

This is the DNS forward/reverse lookup result:

```
PS C:\> nslookup CVS-EAST-433D
Server: activedirectory. region. lab. internal
Address: 10. xx.0. xx
Name: CVS-EAST-433D.cvsdemo.local
Address: 10. xxx.0. x
PS C:\> nslookup 10. xxx.0. x
Server: activedirectory.region.lab.internal
Address: 10.xx.0.xx
Name: CVS-EAST-433D.CVSDEMO.LOCAL
Address: 10. xxx.0. x
```

Optionally, more access control can be applied by enabling/requiring SMB encryption for SMB shares in Cloud Volumes Service. If SMB encryption isn't supported by one of the endpoints, then access is not allowed.

#### Using SMB name aliases

In some cases, it might be a security concern for end users to know the machine account name in use for Cloud Volumes Service. In other cases, you might simply want to provide a simpler access path to your end users. In those cases, you can create SMB aliases.

If you want to create aliases for the SMB share path, you can leverage what is known as a CNAME record in DNS. For example, if you want to use the name \\CIFS to access shares instead of \\cvs-east-433d.cvsdemo.local, but you still want to use Kerberos authentication, a CNAME in DNS that points to the existing A/AAAA record and an additional SPN added to the existing machine account provides Kerberos access.

| ifs Properties   |     | ?      | Х    |
|--|-----|--------|------|
| Alias (CNAME) Security   |     |        |      |
| Alias name (uses parent domain if left blank):                                     |     |        |      |
| cifs   |     |        |      |
| Fully qualified domain name (FQDN):<br>cifs.cvsdemo.local                          |     |        |      |
|  |     |        |      |
| Eully qualified domain name (FQDN) for target host:<br>CVS-EAST-433D.CVSDEMO.LOCAL | -   | Browse | •    |
|  |     |        |      |
|  |     |        |      |
|  |     |        |      |
|  |     |        |      |
|  |     |        |      |
| OK Can   | cel | A      | oply |

This is the resulting DNS forward lookup result after adding a CNAME:

| PS C:\> nslookup cifs  |
|--|
| Server: ok-activedirectory.us-east4-a.c.cv-solution-architect- |
| lab.internal   |
| Address: 10. xx.0. xx  |
| Name: CVS-EAST-433D.cvsdemo.local                              |
| Address: 10. xxx.0. x  |
| Aliases: cifs.cvsdemo.local                                    |
|  |

This is the resulting SPN query after adding new SPNs:

#### PS C:\> setspn /L CVS-EAST-433D Registered ServicePrincipalNames for CN=CVS-EAST-433D,CN=Computers,DC=cvsdemo,DC=local: cifs/cifs.cvsdemo.local cifs/cifs HOST/cvs-east-433d.cvsdemo.local HOST/CVS-EAST-433D

In a packet capture, we can see the Session Setup Request using the SPN tied to the CNAME.

| 431 4.156722 |
|--------------|
| 32 4.156785  |
| 4.158108     |
| 35 4.160977  |
| 4.166224     |
| 8 4.166891   |
| 9 4.168063   |

```
realm: CVSDEMO.LOCAL

sname
name-type: kRB5-NT-SRV-INST (2)
sname-string: 2 items
SNameString: cifs
SNameString: cifs
enc-part
etype: eTYPE-ARCFOUR-HMAC-MD5 (23)
```

## **SMB** authentication dialects

Cloud Volumes Service supports the following dialects for SMB authentication:

- LM
- NTLM
- NTLMv2
- Kerberos

Kerberos authentication for SMB share access is the most secure level of authentication you can use. With AES and SMB encryption enabled, the security level is further increased.

Cloud Volumes Service also supports backward compatibility for LM and NTLM authentication. When Kerberos is misconfigured (such as when creating SMB aliases), share access falls back to weaker authentication methods (such as NTLMv2). Because these mechanisms are less secure, they are disabled in some Active Directory environments. If weaker authentication methods are disabled and Kerberos is not configured properly, share access fails because there is no valid authentication method to fall back to.

For information about configuring/viewing your supported authentication levels in Active Directory, see Network security: LAN Manager authentication level.

#### **Permission models**

#### **NTFS/File permissions**

NTFS permissions are the permissions applied to files and folders in file systems adhering to NTFS logic. You can apply NTFS permissions in Basic or Advanced and can be set to Allow or Deny for access control.

Basic permissions include the following:

Full Control

- Modify
- Read & Execute
- Read
- Write

When you set permissions for a user or group, referred to as an ACE, it resides in an ACL. NTFS permissions use the same read/write/execute basics as UNIX mode bits, but they can also extend to more granular and extended access controls (also known as Special Permissions), such as Take Ownership, Create Folders/Append Data, Write Attributes, and more.

Standard UNIX mode bits do not provide the same level of granularity as NTFS permissions (such as being able to set permissions for individual user and group objects in an ACL or setting extended attributes). However, NFSv4.1 ACLs do provide the same functionality as NTFS ACLs.

NTFS permissions are more specific than share permissions and can be used in conjunction with share permissions. With NTFS permission structures, the most restrictive applies. As such, explicit denials to a user or group overrides even Full Control when defining access rights.

NTFS permissions are controlled from Windows SMB clients.

# Share permissions

Share permissions are more general than NTFS permissions (Read/Change/Full Control only) and control the initial entry into an SMB share—similar to how NFS export policy rules work.

Although NFS export policy rules control access through host-based information such as IP addresses or host names, SMB share permissions can control access by using user and group ACEs in a share ACL. You can set share ACLs either from the Windows client or from the Cloud Volumes Service management UI.

By default, share ACLs and initial volume ACLs include Everyone with Full Control. The file ACLs should be changed but share permissions are overruled by the file permissions on objects in the share.

For instance, if a user is only allowed Read access to the Cloud Volumes Service volume file ACL, they are denied access to create files and folders even though the share ACL is set to Everyone with Full Control, as shown in the following figure.

| eneral Publish Share Permission   | ns Security  |                    | General Publish Share Permissions Sec   | curity                  |
|---|--|--------------------|---|-------------------------|
| aroup or user names:  |  | ~                  | Object name: \\CVS-EAST-433D\ecstation  | c-anory-ionamar         |
| Serveryone  |  |                    |   |                         |
| 2014 B  |  |                    | Group or user names:  |                         |
|   |  |                    | Lustin Parisi (parisi@custemo.local)  |                         |
|   |  |                    | Justin Parisi (parisi@cvsdemo.local)  |                         |
|   | A <u>d</u> d   | Remove             | To change permissions, click Edit.  | Edit                    |
| ermissions for Everyone   | Allow  | Deny               | Permissions for Justin Parisi   | Allow Deny              |
| Full Control  |  |                    | Full control  |                         |
| Change  | $\square$  |                    | Modify  |                         |
| Read  |  |                    | Read & execute  | ~                       |
|   |  |                    | List folder contents  | ~                       |
|   |  |                    | Read  | ~                       |
|   | OK Cancel  | Apply              | ОК  | Cancel Appl             |
|   | OK Cancel  |                    |   | Cancel Apple            |
| → • ↑ 💄 > Netwo   |  |                    | ע צ<br>Search   | ecstatic-angry-jonarnar |
| → • ↑ 💄 > Netwo   | ork > cifs > ecstat                                  |                    | レ Search<br>Date modified Ty  | ecstatic-angry-jonarnar |
| → • ↑ 💄 > Netwo   | ork > cifs > ecstat                                  |                    | ע צ<br>Search   | ecstatic-angry-jonarnar |
| →   | ork > cifs > ecstat                                  |                    | レ Search<br>Date modified Ty  | ecstatic-angry-jonarnar |
| <ul> <li>→ &lt; ↑ ↓ &gt; Netwo</li> <li>Quick access</li> <li>Desktop </li> <li>Downloads </li> <li>Documents </li> </ul>   | ork > cifs > ecstat<br>Name                          | tic-angry-jonarnar | ✓ ひ Search<br>Date modified Ty<br>This folder is empty.                       | ecstatic-angry-jonarnar |
| <ul> <li>→ ✓ ↑ ↓ &gt; Network</li> <li>Quick access</li> <li>Desktop *</li> <li>Downloads *</li> <li>Documents * Documents</li> </ul>   | ork > cifs > ecstat                                  | tic-angry-jonarnar | レ Search<br>Date modified Ty  | ecstatic-angry-jonarnar |
| <ul> <li>→ &lt; ↑ ↓ &gt; Netwo</li> <li>Quick access</li> <li>Desktop *</li> <li>Downloads *</li> <li>Documents *</li> <li>Documents *</li> <li>Pictures *</li> </ul>                                       | ork > cifs > ecstat<br>Name<br>estination Folder Acc | tic-angry-jonarnar | レン Search<br>Date modified Ty<br>This folder is empty.                        | ecstatic-angry-jonarnar |
| <ul> <li>→ ↑ ↓ &gt; Network</li> <li>A Quick access</li> <li>Desktop</li> <li>Doswnloads</li> <li>M Documents</li> </ul>  | ork > cifs > ecstat<br>Name<br>estination Folder Acc | tic-angry-jonarnar | レン Search<br>Date modified Ty<br>This folder is empty.                        | ecstatic-angry-jonarnar |
| <ul> <li>→ ↑ ↓ &gt; Network</li> <li>♦ Quick access</li> <li>Desktop</li> <li>Desktop</li> <li>Downloads</li> <li>Ø</li> <li>Documents</li> <li>Ø</li> <li>Pictures</li> <li>Ø</li> <li>System32</li> </ul> | ork > cifs > ecstat<br>Name<br>estination Folder Acc | tic-angry-jonarnar | ✓ ひ Search<br>Date modified Ty<br>This folder is empty.<br>X<br>m this action | ecstatic-angry-jonarnar |
| <ul> <li>Netwo</li> <li>Quick access</li> <li>Desktop</li> <li>Downloads</li> <li>Documents</li> <li>Pictures</li> <li>System32</li> <li>This PC</li> </ul>   | ork > cifs > ecstat<br>Name<br>estination Folder Acc | tic-angry-jonarnar | ✓ ひ Search<br>Date modified Ty<br>This folder is empty.<br>X<br>m this action | ecstatic-angry-jonarnar |
| <ul> <li>→ ↑ ↓ Netwo</li> <li>✓ Quick access</li> <li>✓ Desktop *</li> <li>✓ Downloads *</li> <li>✓ Documents *</li> <li>✓ Pictures *</li> </ul>  | ork > cifs > ecstat<br>Name<br>estination Folder Acc | tic-angry-jonarnar | ✓ ひ Search<br>Date modified Ty<br>This folder is empty.<br>X<br>m this action | ecstatic-angry-jonarnar |
| <ul> <li>Netwo</li> <li>Quick access</li> <li>Desktop</li> <li>Downloads</li> <li>Documents</li> <li>Pictures</li> <li>System32</li> <li>This PC</li> </ul>   | ork > cifs > ecstat<br>Name<br>estination Folder Acc | tic-angry-jonarnar | ✓ ひ Search<br>Date modified Ty<br>This folder is empty.<br>X<br>m this action | ecstatic-angry-jonarnar |

For best security results, do the following:

- Remove Everyone from the share and file ACLs and instead set share access for users or groups.
- Use groups for access control instead of individual users for ease of management and faster removal/addition of users to share ACLs through group management.
- Allow less restrictive, more general share access to the ACEs on the share permissions and lock down access to users and groups with file permissions for more granular access control.
- Avoid general use of explicit deny ACLs, because they override allow ACLs. Limit use of explicit deny ACLs for users or groups that need to be restricted from access to a file system quickly.
- Make sure that you pay attention to the ACL inheritance settings when modifying permissions; setting the inheritance flag at the top level of a directory or volume with high file counts means that each file below that

directory or volume has inherited permissions added to it, which can create unwanted behavior such as unintended access/denial and long churn of permission modification as each file is adjusted.

## SMB share security features

Snapshot directory visible: Unchecked

When you first create a volume with SMB access in Cloud Volumes Service, you are presented with a series of choices for securing that volume.

Some of these choices depend on the Cloud Volumes Service level (Performance or Software) and choices include:

• Make snapshot directory visible (available for both CVS-Performance and CVS-SW). This option controls whether or not SMB clients can access the Snapshot directory in an SMB share (\\server\share\~snapshot and/or Previous Versions tab). The default setting is Not Checked, which means that the volume defaults to hiding and disallowing access to the ~snapshot directory, and no Snapshot copies appear in the Previous Versions tab for the volume.

Snapshot directory visible: Checked

| vs-parisi (\\CVS-EAS | T-C2DB) Properties                                |             | 🤇 💄 cvs-pa | arisi (\\CVS-EAS  | T-C2DB) Properties                              |                |
|----------------------|---|-------------|------------|-------------------|---|----------------|
| General              | Network   | Security    | Ge         | eneral            | Network   | Security       |
| Previous Versions    | Customize Classification                          |             | Previo     | Previous Versions |   | Classification |
|                      | rsions come from shade<br>natically to your compu |             | Ð          |                   | sions come from shad<br>natically to your compu |                |
| der versions:        |   |             | Eolder v   | ersions:          |   |                |
| Name                 | Date mod  | dified      | Nan        | ne                | Date mo   | dified         |
| There are n          | o previous versions a                             | available   | ∽ To       | day (1)           |   |                |
| mere are m           | o previous versions e                             | IVANADIE    |            | cvs-parisi        | 2/1/2022  | 2 6:56 PM      |
|                      |   | ▼ Restore ▼ |            |                   | Open  | ▼ Restore      |
|                      | Open  | THESIDIE T  |            |                   |   |                |

Hiding Snapshot copies from end users might be desired for security reasons, performance reasons (hiding these folders from AV scans) or preference. Cloud Volumes Service Snapshots are read- only, so even if these Snapshots are visible, end users cannot delete or modify files in the Snapshot directory. File permissions on the files or folders at the time the Snapshot copy was taken apply. If a file or folder's permissions change between Snapshot copies, then the changes also apply to the files or folders in the Snapshot directory. Users and groups can gain access to these files or folders based on permissions. While deletes or modifications of files in the Snapshot directory are not possible, it is possible to copy files or folders out of the Snapshot

directory.

- Enable SMB encryption (available for both CVS-Performance and CVS-SW). SMB encryption is disabled on the SMB share by default (unchecked). Checking the box enables SMB encryption, which means traffic between the SMB client and server is encrypted in-flight with the highest supported encryption levels negotiated. Cloud Volumes Service supports up to AES-256 encryption for SMB. Enabling SMB encryption does carry a performance penalty that might or might not be noticeable to your SMB clients—roughly in the 10-20% range. NetApp strongly encourages testing to see if that performance penalty is acceptable.
- Hide SMB share (available for both CVS-Performance and CVS-SW). Setting this option hides the SMB share path from normal browsing. This means that clients that do not know the share path cannot see the shares when accessing the default UNC path (such as \\CVS-SMB). When the checkbox is selected, only clients that explicitly know the SMB share path or have the share path defined by a Group Policy Object can access it (security through obfuscation).
- Enable access-based enumeration (ABE) (CVS-SW only). This is similar to hiding the SMB share, except the shares or files are only hidden from users or groups that do not have permissions to access the objects. For instance, if Windows user joe is not allowed at least Read access through the permissions, then the Windows user joe cannot see the SMB share or files at all. This is disabled by default, and you can enable it by selecting the checkbox. For more information on ABE, see the NetApp Knowledge Base article How does Access Based Enumeration (ABE) work?
- Enable Continuously Available (CA) share support (CVS-Performance only). Continuously Available SMB shares provide a way to minimize application disruptions during failover events by replicating lock states across nodes in the Cloud Volumes Service backend system. This is not a security feature, but it does offer better overall resiliency. Currently, only SQL Server and FSLogix applications are supported for this functionality.

# Default hidden shares

When an SMB server is created in Cloud Volumes Service, there are hidden administrative shares (using the \$ naming convention) that are created in addition to the data volume SMB share. These include C\$ (namespace access) and IPC\$ (sharing named pipes for communication between programs, such as the remote procedure calls (RPC) used for Microsoft Management Console (MMC) access).

The IPC\$ share contains no share ACLs and cannot be modified—it is strictly used for RPC calls and Windows disallows anonymous access to these shares by default.

The C\$ share allows BUILTIN/Administrators access by default, but Cloud Volumes Service automation removes the share ACL and does not allow access to anyone because access to the C\$ share allows visibility into all mounted volumes in the Cloud Volumes Service file systems. As a result, attempts to navigate to \\SERVER\C\$ fail.

# Accounts with local/BUILTIN administrator/backup rights

Cloud Volumes Service SMB servers maintain similar functionality to regular Windows SMB servers in that there are local groups (such as BUILTIN\Administrators) that apply access rights to select domain users and groups.

When you specify a user to be added to Backup Users, the user is added to the BUILTIN\Backup Operators group in the Cloud Volumes Service instance that uses that Active Directory connection, which then gets the SeBackupPrivilege and SeRestorePrivilege.

When you add a user to Security Privilege Users, the user is given the SeSecurityPrivilege, which is useful in some application use cases, such as SQL Server on SMB shares.

# **Backup Users**

Provide a comma separated list of domain users or a domain group name that require elevated privileges to access volumes created by Cloud Volumes Service.

Accountnames administrator,cvs-svc

# Security Privilege Users

Provide a list of comma separated domain user accounts that require elevated privileges to manage security log for the Active Directory associated with Cloud Volumes Service.

Accountnames administrator,cvs-svc

You can view Cloud Volumes Service local group memberships through the MMC with the proper privileges. The following figure shows users that have been added by using the Cloud Volumes Service console.

| Backup Operato   | rs Propertie | 5              |   | ?       | ×   |
|------------------|--------------|----------------|---|---------|-----|
| General          |              |                |   |         |     |
| Back             | up Operators | 1              |   |         |     |
| Description:     | Backup C     | perators group |   |         |     |
| Members:         |              |                |   |         |     |
| CVSDEM<br>CVSDEM | O\cvs-svc    | Changes        | to a user's group<br>fective until the ne |         |     |
| A <u>d</u> d     | Remove       | user logs      |   | ext ume | ule |
|                  | OK           | Cancel         | Apply                                     | Н       | elp |

The following table shows the list of default BUILTIN groups and what users/groups are added by default.

| Local/BUILTIN group       | Default members      |
|---------------------------|----------------------|
| BUILTIN\Administrators*   | DOMAIN\Domain Admins |
| BUILTIN\Backup Operators* | None                 |
| BUILTIN\Guests            | DOMAIN\Domain Guests |
| BUILTIN\Power Users       | None                 |
| BUILTIN\Domain Users      | DOMAIN\Domain Users  |

\*Group membership controlled in Cloud Volumes Service Active Directory connection configuration.

You can view local users and groups (and group members) in the MMC window, but you cannot add or delete objects or change group memberships from this console. By default, only the Domain Admins group and Administrator are added to the BUILTIN\Administrators group in Cloud Volumes Service. Currently, you cannot modify this.

| Computer Management (CVS-EAST-C2DB) | Name Full Name        | Description<br>Built-in administrator account | Computer Management (CVS-EAST-C2DB<br>System Tools<br>Event Viewer<br>Shared Folders<br>Shared Folders<br>Shares<br>Shares<br>Stares<br>Stares<br>Stares<br>Compone Files<br>Stares<br>Groups<br>Groups | ) Name<br>希 <mark>Administrators</mark><br>愛 Users<br>愛 Guests<br>愛 Power Users<br>愛 Backup Operators | Description<br>Built-in Administrators group<br>All users<br>Built-in Guests Group<br>Restricted administrative privileges<br>Backup Operators group |
|-------------------------------------|-----------------------|---|---|---|--|
| Administrators                      | Properties            |   |   | ? ×   | 1  |
| General                             | ninistrators          |   |   |   |  |
| Description:                        | Built-in Ad           | ministrators grou                             | 0   |   |  |
| Administr                           | ator<br>IO\Domain Adr | Changes to                                    | o a user's group me   |   |  |
| A <u>a</u> d                        | Kemove                | user logs o                                   |   |   |  |
|                                     | OK                    | Cancel  | Apply   | Help  |  |

## **MMC/Computer Management access**

SMB access in Cloud Volumes Service provides connectivity to the Computer Management MMC, which allows you to view shares, manage share ACLs, ands view/manage SMB sessions and open files.

To use the MMC to view SMB shares and sessions in Cloud Volumes Service, the user logged in currently must be a domain administrator. Other users are allowed access to view or manage the SMB server from MMC and receive a You Do Not Have Permissions dialog box when attempting to view shares or sessions on the Cloud Volumes Service SMB instance.

To connect to the SMB server, open Computer Management, right click Computer Management and then select Connect To Another Computer. This opens the Select Computer dialog box where you can enter the SMB server name (found in the Cloud Volumes Service volume information).

When you view SMB shares with the proper permissions, you see all available shares in the Cloud Volumes Service instance that share the Active Directory connection. To control this behavior, set the Hide SMB Shares option on the Cloud Volumes Service volume instance.

Remember, only one Active Directory connection is allowed per region.

| File Action   Image: State S | 🜆 Computer Management  |  |               |                    |        |             | <br>× |
|--|--|--|---------------|--------------------|--------|-------------|-------|
| Somputer Management (CVS-EAST-C2DB)       Share Name       Folder Path       Type       # Client Connections       Description         Som Some       State Relation       CA       Windows       0       Shares       Sh  | <u>File Action View H</u> elp  |  |               |                    |        |             |       |
| <ul> <li>✓ <sup>1</sup><sup>1</sup>/<sub>2</sub> System Tools</li> <li>✓ <sup>1</sup>/<sub>2</sub> Task Scheduler</li> <li>✓ <sup>1</sup>/<sub>2</sub> Task Scheduler</li> <li>✓ <sup>1</sup>/<sub>2</sub> Task Scheduler</li> <li>✓ <sup>1</sup>/<sub>2</sub> Schared Folders</li> <li>✓ <sup>1</sup>/<sub>2</sub> Shares</li> <li>✓ <sup>1</sup>/<sub>2</sub> Sessions</li> <li>✓ <sup>1</sup>/<sub>2</sub> Sessions</li> <li>✓ <sup>1</sup>/<sub>2</sub> Sessions</li> <li>✓ <sup>1</sup>/<sub>2</sub> Deperformance</li> <li>✓ <sup>1</sup>/<sub>2</sub> Device Manager</li> <li>✓ <sup>1</sup>/<sub>2</sub> Services and Applications</li> </ul>  | 🗢 🔿 🙍 🖬 🙆 🖬 🐹  | - Ye                                   |               |                    |        |             |       |
| <ul> <li>&gt; (2) Tak Scheduler</li> <li>&gt; Event Viewer</li> <li>&gt; (2) Shared Folders</li> <li>(2) Shared Folders</li> <li>(2) Shares</li> <li>(2) Sessions</li> <li>(2) Open Files</li> <li>&gt; (2) Call Users and Groups</li> <li>&gt; (2) Pen Fromance</li> <li>(2) Device Manager</li> <li>&gt; (2) Storage</li> <li>&gt; (3) Services and Applications</li> </ul>  |  | S-10 No. 10 No. 10 No. 10 No. 10 No. 1 |               |                    |        | Description |       |
|  | <ul> <li>Task Scheduler</li> <li>Event Viewer</li> <li>Shared Folders</li> <li>Shares</li> <li>Sessions</li> <li>Open Files</li> <li>Local Users and Groups</li> <li>Performance</li> <li>Device Manager</li> <li>Storage</li> </ul> | 😥 cvs-parisi<br>😥 dgeyer-sm            | C:\cvs-parisi | Windows<br>Windows | 1<br>0 |             | ,     |

|  | 1 ×                       |  |                        |  |                                  | F                                   |
|--|---------------------------|--|------------------------|--|----------------------------------|-------------------------------------|
| <ul> <li>Computer Management (CVS-EAST-C2DB)</li> <li>System Tools</li> <li>Task Scheduler</li> <li>Event Viewer</li> <li>Shared Folders</li> <li>Shares</li> <li>Sessions</li> <li>Open Files</li> <li>Local Users and Groups</li> <li>Performance</li> <li>Device Manager</li> <li>Storage</li> <li>Services and Applications</li> </ul> | User<br>Sparisi<br>parisi | Computer<br>ok-activedi<br>ok-activedi | # Open Files<br>2<br>3 | Connected Time<br>01:19:15<br>01:01:08 | Idle Tim<br>00:00:00<br>00:39:58 | Actions<br>Sessions<br>More Actions |
|  | ¢                         |  |                        |  | ,                                |                                     |

The following table shows a list of supported/unsupported functionality for the MMC.

| Supported functions   | Unsupported functions   |
|---|---|
| View shares   | <ul> <li>Creating new local users/groups</li> </ul>             |
| <ul> <li>View active SMB sessions</li> </ul>  | <ul> <li>Managing/viewing existing local user/groups</li> </ul> |
| • View open files   | <ul> <li>View events or performance logs</li> </ul>             |
| <ul> <li>View local users and groups</li> </ul>   | Managing storage  |
| <ul> <li>View local group memberships</li> </ul>  | <ul> <li>Managing services and applications</li> </ul>          |
| <ul> <li>Enumerate the list of sessions, files, and tree<br/>connections in the system</li> </ul> |   |
| <ul> <li>Close open files in the system</li> </ul>  |   |
| Close open sessions   |   |
| Create/manage shares  |   |

# SMB server security information

The SMB server in Cloud Volumes Service uses a series of options that define security policies for SMB connections, including things such as Kerberos clock skew, ticket age, encryption, and more.

The following table contains a list of those options, what they do, the default configurations, and if they can be modified with Cloud Volumes Service. Some options do not apply to Cloud Volumes Service.

| Security option   | What it does  | Default value | Can change? |
|---|---|---------------|-------------|
| Maximum Kerberos Clock<br>Skew (minutes)                  | Maximum time skew<br>between Cloud Volumes<br>Service and domain<br>controllers. If the time<br>skew exceeds 5 minutes,<br>Kerberos authentication<br>fails. This is set to the<br>Active Directory default<br>value.   | 5             | No          |
| Kerberos Ticket Lifetime<br>(hours)                       | Maximum time a Kerberos<br>ticket remains valid before<br>requiring a renewal. If no<br>renewal occurs before the<br>10 hours, you must obtain<br>a new ticket. Cloud<br>Volumes Service performs<br>these renewals<br>automatically. 10 hours is<br>the Active Directory<br>default value. | 10            | No          |
| Maximum Kerberos Ticket<br>Renewal (days)                 | Maximum number of days<br>that a Kerberos ticket can<br>be renewed before a new<br>authorization request is<br>needed. Cloud Volumes<br>Service automatically<br>renews tickets for SMB<br>connections. Seven days<br>is the Active Directory<br>default value.                             | 7             | No          |
| Kerberos KDC Connection<br>Timeout (secs)                 | The number of seconds<br>before a KDC connection<br>times out.  | 3             | No          |
| Require Signing for<br>Incoming SMB Traffic               | Setting to require signing<br>for SMB traffic. If set to<br>true, clients that do not<br>support signing fail<br>connectivity.  | False         |             |
| Require Password<br>Complexity for Local User<br>Accounts | Used for passwords on<br>local SMB users. Cloud<br>Volumes Service does not<br>support local user<br>creation, so this option<br>does not apply to Cloud<br>Volumes Service.  | True          | No          |

| Security option  | What it does   | Default value  | Can change? |
|--|--|----------------|-------------|
| Use start_tls for Active<br>Directory LDAP<br>Connections    | Used to enable start TLS<br>connections for Active<br>Directory LDAP. Cloud<br>Volumes Service does not<br>currently support enabling<br>this.   | False          | No          |
| Is AES-128 and AES-256<br>Encryption for Kerberos<br>Enabled | This controls whether AES<br>encryption is used for<br>Active Directory<br>connections and is<br>controlled with the Enable<br>AES Encryption for Active<br>Directory Authentication<br>option when<br>creating/modifying the<br>Active Directory<br>connection.   | False          | Yes         |
| LM Compatibility Level                                       | Level of supported<br>authentication dialects for<br>Active Directory<br>connections. See the<br>section "SMB<br>authentication dialects" for<br>more information.   | ntlmv2-krb     | No          |
| Require SMB Encryption<br>for Incoming CIFS Traffic          | Requires SMB encryption<br>for all shares. This is not<br>used by Cloud Volumes<br>Service; instead, set<br>encryption on a per-<br>volume basis (see the<br>section "SMB share<br>security features").  | False          | No          |
| Client Session Security                                      | Sets signing and/or<br>sealing for LDAP<br>communication. This is<br>not currently set in Cloud<br>Volumes Service but<br>might be needed in future<br>releases to address .<br>Remediation for LDAP<br>authentication issues due<br>to the Windows patch is<br>covered in the section<br>"LDAP channel binding.". | None           | No          |
| SMB2 enable for DC connections                               | Uses SMB2 for DC connections. Enabled by default.  | System-default | No          |

| Security option   | What it does  | Default value | Can change? |
|---|---|---------------|-------------|
| LDAP Referral Chasing                                   | When using multiple<br>LDAP servers, referral<br>chasing allows the client<br>to refer to other LDAP<br>servers in the list when an<br>entry is not found in the<br>first server. This is<br>currently not supported by<br>Cloud Volumes Service. | False         | No          |
| Use LDAPS for Secure<br>Active Directory<br>Connections | Enables the use of LDAP<br>over SSL. Currently not<br>supported by Cloud<br>Volumes Service.  | False         | No          |
| Encryption is required for DC Connection                | Requires encryption for<br>successful DC<br>connections. Disabled by<br>default in Cloud Volumes<br>Service.  | False         | No          |

# Dual-protocol/multiprotocol

Cloud Volumes Service offers the ability to share the same datasets to both SMB and NFS clients while maintaining proper access permissions (dual-protocol). This is done by coordinating identity mapping between protocols and using a centralized backend LDAP server to provide the UNIX identities to Cloud Volumes Service. You can use Windows Active Directory to provide both Windows and UNIX users for ease of use.

# Access control

- Share access controls. Determine which clients and/or user and groups can access a NAS share. For NFS, export policies and rules control client access to exports. NFS exports are managed from the Cloud Volumes Service instance. SMB makes use of CIFS/SMB shares and share ACLs to provide more granular control at the user and group level. You can only configure share-level ACLs from SMB clients by using MMC/Computer Management with an account that has administrator rights on the Cloud Volumes Service instance (see the section "Accounts with local/BUILTIN administrator/backup rights.").
- File access controls. Control permissions at a file or folder level and are always managed from the NAS client. NFS clients can make use of traditional mode bits (rwx) or NFSv4 ACLs. SMB clients leverage NTFS permissions.

The access control for volumes that serve data to both NFS and SMB depends on the protocol in use. For information on permissions with dual protocol, see the section "Permission model."

# **User mapping**

When a client accesses a volume, Cloud Volumes Service attempts to map the incoming user to a valid user in the opposite direction. This is necessary for proper access to be determined across protocols and to ensure that the user requesting access is indeed who they claim to be.

For example, if a Windows user named joe attempts access to a volume with UNIX permissions through SMB,

then Cloud Volumes Service performs a search to find a corresponding UNIX user named joe. If one exists, then files that are written to an SMB share as Windows user joe appears as UNIX user joe from NFS clients.

Alternately, if a UNIX user named joe attempts access to a Cloud Volumes Service volume with Windows permissions, then the UNIX user must be able to map to a valid Windows user. Otherwise, access to the volume is denied.

Currently, only Active Directory is supported for external UNIX identity management with LDAP. For more information about configuring access to this service, see Creating an AD connection.

## **Permission model**

When using dual-protocol setups, Cloud Volumes Service makes use of security styles for volumes to determine the type of ACL. These security styles are set based on which NAS protocol is specified, or in the case of dual protocol, is a choice made at the time of Cloud Volumes Service volume creation.

- If you are only using NFS, Cloud Volumes Service volumes use UNIX permissions.
- If you are only using SMB, Cloud Volumes Service volumes use NTFS permissions.

If you are creating a dual-protocol volume, you can choose the ACL style at volume creation. This decision should be made based on the desired permissions management. If your users manage permissions from Windows/SMB clients, select NTFS. If your users prefer using NFS clients and chmod/chown, use UNIX security styles.

#### **Considerations for creating Active Directory connections**

Cloud Volumes Service provides the ability to connect your Cloud Volumes Service instance to an external Active Directory server for identity management for both SMB and UNIX users. Creating an Active Directory connection is required to use SMB in Cloud Volumes Service.

The configuration for this provides several options that require some consideration for security. The external Active Directory server can be an on-premises instance or cloud native. If you are using an on-premises Active Directory server, don't expose the domain to the external network (such as with a DMZ or an external IP address). Instead, use secure private tunnels or VPNs, one-way forest trusts, or dedicated network connections to the on-premises networks with Private Google Access. See the Google Cloud documentation for more information about best practices using Active Directory in Google Cloud.



CVS-SW requires Active Directory servers to be located in the same region. If a DC connection is attempted in CVS-SW to another region, the attempt fails. When using CVS-SW, be sure to create Active Directory sites that include the Active Directory DCs and then specify sites in Cloud Volumes Service to avoid cross-region DC connection attempts.

#### **Active Directory credentials**

When SMB or LDAP for NFS is enabled, Cloud Volumes Service interacts with the Active Directory controllers to create a machine account object to use for authentication. This is no different from how a Windows SMB client joins a domain and requires the same access rights to Organizational Units (OUs) in Active Directory.

In many cases, security groups do not allow the use of a Windows administrator account on external servers such as Cloud Volumes Service. In some cases, the Windows Administrator user is disabled entirely as a security best practice.

## Permissions needed to create SMB machine accounts

To add Cloud Volumes Service machine objects to an Active Directory, an account that either has administrative rights to the domain or has delegated permissions to create and modify machine account objects to a specified OU is required. You can do this with the Delegation of Control Wizard in Active Directory by creating a custom task that provides a user access to creation/deletion of computer objects with the following access permissions provided:

- Read/Write
- Create/Delete All Child Objects
- Read/Write All Properties
- Change/Reset Password

Doing this automatically adds a security ACL for the defined user to the OU in Active Directory and minimizes the access to the Active Directory environment. After a user has been delegated, that username and password can be provided as Active Directory Credentials in this window.



The username and password that is passed to the Active Directory domain leverages Kerberos encryption during the machine account object query and creation for added security.

#### Active Directory connection details

The Active Directory Connection Details provide fields for administrators to give specific Active Directory schema information for machine account placement, such as the following:

- Active Directory Connection Type. Used to specify whether the Active Directory connection in a region is used for volumes of either Cloud Volumes Service or CVS-Performance service type. If this is set incorrectly on an existing connection, it might not work properly when used or edited.
- **Domain.** The Active Directory domain name.
- Site. Limits Active Directory servers to a specific site for security and performance considerations. This is necessary when multiple Active Directory servers span regions because Cloud Volumes Service does not currently support allowing Active Directory authentication requests to Active Directory servers in a different region than the Cloud Volumes Service instance. (For instance, the Active Directory domain controller is in a region that only CVS-Performance supports but you want an SMB share in a CVS-SW instance.)
- DNS servers. DNS servers to use in name lookups.
- NetBIOS name (optional). If desired, the NetBIOS name for the server. This what is used when new machine accounts are created using the Active Directory connection. For instance, if the NetBIOS name is set to CVS-EAST then the machine account names will be CVS-EAST-{1234}. See the section "How Cloud Volumes Service shows up in Active Directory" for more information.
- **Organizational Unit (OU).** The specific OU to create the computer account. This is useful if you're delegating control to a user for machine accounts to a specific OU.
- **AES Encryption.** You can also check or uncheck the Enable AES Encryption for AD Authentication checkbox. Enabling AES encryption for Active Directory authentication provides extra security for Cloud Volumes Service to Active Directory communication during user and group lookups. Before enabling this option, check with your domain administrator to confirm that the Active Directory domain controllers support AES authentication.

()

By default, most Windows servers do not disable weaker ciphers (such as DES or RC4-HMAC), but if you choose to disable weaker ciphers, confirm Cloud Volumes Service Active Directory connection has been configured to enable AES. Otherwise, authentication failures occur. Enabling AES encryption doesn't disable weaker ciphers but instead adds support for AES ciphers to the Cloud Volumes Service SMB machine account.

# Kerberos realm details

This option does not apply to SMB servers. Rather, it is used when configuring NFS Kerberos for the Cloud Volumes Service system. When these details are populated, the NFS Kerberos realm is configured (similar to a krb5.conf file on Linux) and is used when NFS Kerberos is specified on the Cloud Volumes Service volume creation, as the Active Directory connection acts as the NFS Kerberos Distribution Center (KDC).



Non-Windows KDCs are currently unsupported for use with Cloud Volumes Service.

# Region

A region enables you to specify the location where the Active Directory connection resides. This region must be the same region as the Cloud Volumes Service volume.

 Local NFS Users with LDAP. In this section, there is also an option to Allow Local NFS Users with LDAP. This option must be left unselected if you want to extend your UNIX user group membership support beyond the 16-group limitation of NFS (extended groups). However, using extended groups requires a configured LDAP server for UNIX identities. If you don't have an LDAP server, leave this option unselected. If you have an LDAP server and want to also use local UNIX users (such as root), select this option.

## Backup users

This option enables you to specify Windows users that have backup permissions to the Cloud Volumes Service volume. Backup privileges (SeBackupPrivilege) are necessary for some applications to properly backup and restore data in NAS volumes. This user has a high level of access to data in the volume, so you should consider enabling auditing of that user access. After it is enabled, audit events display in Event Viewer > Windows Logs > Security.

| 🐻 Event Properties - Event 4674, Sec | curity-Auditing                       |            | ×   |
|--------------------------------------|---------------------------------------|------------|-----|
| General Details                      |                                       |            |     |
| Friendly View <u>X</u> ML View       | v                                     |            |     |
| SubjectUserName                      | e parisi                              |            |     |
| SubjectDomainNa                      | ame CVSDEMO                           |            |     |
| SubjectLogonId                       | 0x31de4904                            |            |     |
| ObjectServer                         | Security                              |            |     |
| ObjectType                           |                                       |            |     |
| ObjectName                           | -                                     |            | 4   |
| Handleld                             | 0x1174                                |            |     |
| AccessMask                           | 1048577                               |            |     |
| PrivilegeList                        | SeBackupPrivilege                     |            |     |
| ProcessId                            | 0x498                                 |            |     |
| ProcessName                          | C:\Windows\System32\wbem\WmiPrvSE.exe | ~          |     |
|                                      |                                       |            |     |
|                                      |                                       |            |     |
| Соду                                 |                                       | <u>C</u> I | ose |

# Security privilege users

This option enables you to specify Windows users that have security modification permissions to the Cloud Volumes Service volume. Security privileges (SeSecurityPrivilege) are necessary for some applications (such as SQL Server) to properly set permissions during installation. This privilege is needed to manage the security log. Although this privilege is not as powerful as SeBackupPrivilege, NetApp recommends auditing user access of users with this privilege level if needed.

For more information, see Special privileges assigned to new logon.

# How Cloud Volumes Service shows up in Active Directory

Cloud Volumes Service shows up in Active Directory as a normal machine account object. The naming conventions are as follows.

- CIFS/SMB and NFS Kerberos create separate machine account objects.
- NFS with LDAP enabled creates a machine account in Active Directory for Kerberos LDAP binds.
- Dual protocol volumes with LDAP share the CIFS/SMB machine account for LDAP and SMB.
- CIFS/SMB machine accounts use a naming convention of NAME-1234 (random four digit ID with hyphen appended to <10 character name) for the machine account. You can define NAME by the NetBIOS name setting on the Active Directory connection (see the section "Active Directory connection details").
- NFS Kerberos uses NFS-NAME-1234 as the naming convention (up to 15 characters). If more than 15 characters are used, the name is NFS-TRUNCATED-NAME-1234.

- NFS-only CVS-Performance instances with LDAP enabled create an SMB machine account for binding to the LDAP server with the same naming convention as CIFS/SMB instances.
- When an SMB machine account is created, default hidden admin shares (see the section "Default hidden shares") are also created (c\$, admin\$, ipc\$), but those shares have no ACLs assigned and are inaccessible.
- The machine account objects are placed in CN=Computers by default, but a you can specify a different OU when necessary. See the section "Permissions needed to create SMB machine accounts" for information about what access rights are needed to add/remove machine account objects for Cloud Volumes Service.

When Cloud Volumes Service adds the SMB machine account to Active Directory, the following fields are populated:

- cn (with the specified SMB server name)
- dNSHostName (with SMBserver.domain.com)
- msDS-SupportedEncryptionTypes (Allows DES\_CBC\_MD5, RC4\_HMAC\_MD5 if AES encryption is not enabled; if AES encryption is enabled, DES\_CBC\_MD5, RC4\_HMAC\_MD5, AES128\_CTS\_HMAC\_SHA1\_96, AES256\_CTS\_HMAC\_SHA1\_96 are allowed for Kerberos ticket exchange with the machine account for SMB)
- name (with the SMB server name)
- sAMAccountName (with SMBserver\$)
- servicePrincipalName (with host/smbserver.domain.com and host/smbserver SPNs for Kerberos)

If you want to disable weaker Kerberos encryption types (enctype) on the machine account, you can change the msDS-SupportedEncryptionTypes value on the machine account to one of the values in the following table to allow AES only.

| msDS-SupportedEncryptionTypes value | Enctype enabled  |
|-------------------------------------|--|
| 2                                   | DES_CBC_MD5  |
| 4                                   | RC4_HMAC   |
| 8                                   | AES128_CTS_HMAC_SHA1_96 only   |
| 16                                  | AES256_CTS_HMAC_SHA1_96 only   |
| 24                                  | AES128_CTS_HMAC_SHA1_96 and AES256_CTS_HMAC_SHA1_96                              |
| 30                                  | DES_CBC_MD5, RC4_HMAC,<br>AES128_CTS_HMAC_SHA1_96 and<br>AES256_CTS_HMAC_SHA1_96 |

To enable AES encryption for SMB machine accounts, click Enable AES Encryption for AD Authentication when creating the Active Directory connection.

To enable AES encryption for NFS Kerberos, see the Cloud Volumes Service documentation.

# Other NAS Infrastructure service dependencies (KDC, LDAP, and DNS)

When using Cloud Volumes Service for NAS shares, there might be external dependencies required for proper functionality. These dependencies are in play under specific circumstances. The following table shows various configuration options and what,

if any, dependencies are required.

| Configuration                   | Dependencies required   |
|---------------------------------|---|
| NFSv3 only                      | None  |
| NFSv3 Kerberos only             | Windows Active Directory:<br>* KDC<br>* DNS<br>* LDAP   |
| NFSv4.1 only                    | Client ID mapping configuration (/etc/idmap.conf)   |
| NFSv4.1 Kerberos only           | <ul> <li>Client ID mapping configuration (/etc/idmap.conf)</li> <li>Windows Active Directory:<br/>KDC<br/>DNS<br/>LDAP</li> </ul>                   |
| SMB only                        | Active Directory:<br>* KDC<br>* DNS   |
| Multiprotocol NAS (NFS and SMB) | <ul> <li>Client ID mapping configuration (NFSv4.1 only;<br/>/etc/idmap.conf)</li> <li>Windows Active Directory:<br/>KDC<br/>DNS<br/>LDAP</li> </ul> |

# Kerberos keytab rotation/password resets for machine account objects

With SMB machine accounts, Cloud Volumes Service schedules periodic password resets for the SMB machine account. These password resets occur using Kerberos encryption and operate on a schedule of every fourth Sunday at a random time between 11PM and 1AM. These password resets change the Kerberos key versions, rotate the keytabs stored on the Cloud Volumes Service system, and help maintain a greater level of security for SMB servers running in Cloud Volumes Service. Machine account passwords are randomized and are not known to administrators.

For NFS Kerberos machine accounts, password resets take place only when a new keytab is created/exchanged with the KDC. Currently, this is not possible to do in Cloud Volumes Service.

# Network ports for use with LDAP and Kerberos

When using LDAP and Kerberos, you should determine the network ports in use by these services. You can find a complete list of ports in use by Cloud Volumes Service in the Cloud Volumes Service documentation on security considerations.

# LDAP

Cloud Volumes Service acts as an LDAP client and uses standard LDAP search queries for user and group lookups for UNIX identities. LDAP is necessary if you intend to use users and groups outside the standard default users provided by Cloud Volumes Service. LDAP is also necessary if you plan on using NFS Kerberos

with user principals (such as user1@domain.com). Currently, only LDAP using Microsoft Active Directory is supported.

To use Active Directory as a UNIX LDAP server, you must populate the necessary UNIX attributes on users and groups you intend to use for UNIX identities. Cloud Volumes Service uses a default LDAP schema template that queries attributes based on RFC-2307-bis. As a result, the following table shows the bare minimum necessary Active Directory attributes to populate for users and groups and what each attribute is used for.

For more information about setting LDAP attributes in Active Directory, see Managing dual-protocol access.

| Attribute         | What it does  |
|-------------------|---|
| uid*              | Specifies the UNIX user name  |
| uidNumber*        | Specifies the UNIX user's numeric ID  |
| gidNumber*        | Specifies the UNIX user's primary group numeric ID  |
| objectClass*      | Specifies what type of object is being used; Cloud<br>Volumes Service requires "user" to be included in the<br>list of object classes (is included in most Active<br>Directory deployments by default). |
| name              | General information about the account (real name, phone number, and so on—also known as gecos)  |
| unixUserPassword  | No need to set this; not used in UNIX identity lookups<br>for NAS authentication. Setting this puts the<br>configured unixUserPassword value in plaintext.  |
| unixHomeDirectory | Defines path to UNIX home directories when a user<br>authenticates against LDAP from a Linux client. Set<br>this if you want to use LDAP for UNIX home directory<br>functionality.                      |
| loginShell        | Defines path to the bash/profile shell for Linux clients when a user authenticates against LDAP.  |

\*Denotes attribute is required for proper functionality with Cloud Volumes Service. Remaining attributes are for client-side use only.

| Attribute  | What it does   |
|------------|--|
| cn*        | Specifies the UNIX group name. When using Active<br>Directory for LDAP, this is set when the object is first<br>created, but it can be changed later. This name<br>cannot be the same as other objects. For instance, if<br>your UNIX user named user1 belongs to a group<br>named user1 on your Linux client, Windows doesn't<br>allow two objects with the same cn attribute. To work<br>around this, rename the Windows user to a unique<br>name (such as user1-UNIX); LDAP in Cloud Volumes<br>Service uses the uid attribute for UNIX user names. |
| gidNumber* | Specifies the UNIX group numeric ID.   |

| Attribute    | What it does   |
|--------------|--|
| objectClass* | Specifies what type of object is being used; Cloud<br>Volumes Service requires group to be included in the<br>list of object classes (this attribute is included in most<br>Active Directory deployments by default).  |
| memberUid    | Specifies which UNIX users are members of the UNIX group. With Active Directory LDAP in Cloud Volumes Service, this field is not necessary. The Cloud Volumes Service LDAP schema uses the Member field for group memberships.   |
| Member*      | Required for group memberships/secondary UNIX<br>groups. This field is populated by adding Windows<br>users to Windows groups. However, if the Windows<br>groups don't have UNIX attributes populated, they are<br>not included in the UNIX user's group membership<br>lists. Any groups that need to be available in NFS<br>must populate the required UNIX group attributes<br>listed in this table. |

\*Denotes attribute is required for proper functionality with Cloud Volumes Service. Remaining attributes are for client-side use only.

# LDAP bind information

To query users in LDAP, Cloud Volumes Service must bind (login) to the LDAP service. This login has readonly permissions and is used to query LDAP UNIX attributes for directory lookups. Currently, LDAP binds are possible only by using an SMB machine account.

You can only enable LDAP for CVS-Performance instances and use it for NFSv3, NFSv4.1, or dual-protocol volumes. An Active Directory connection must be established in the same region as the Cloud Volumes Service volume for successful deployment of the LDAP-enabled volume.

When LDAP is enabled, the following occurs in specific scenarios.

- If only NFSv3 or NFSv4.1 is used for the Cloud Volumes Service project, then a new machine account is created in the Active Directory domain controller, and the LDAP client in Cloud Volumes Service binds to Active Directory by using the machine account credentials. No SMB shares are created for the NFS volume and default hidden administrative shares (see the section "Default hidden shares") have share ACLs removed.
- If dual-protocol volumes are used for the Cloud Volumes Service project, then only the single machine account created for SMB access is used to bind the LDAP client in Cloud Volumes Service to Active Directory. No additional machine accounts are created.
- If dedicated SMB volumes are created separately (either before or after NFS volumes with LDAP are enabled), then the machine account for LDAP binds is shared with the SMB machine account.
- If NFS Kerberos is also enabled, two machine accounts are created—one for SMB shares and/or LDAP binds and one for NFS Kerberos authentication.

# **LDAP** queries

Although LDAP binds are encrypted, LDAP queries are passed over the wire in plaintext by using the common LDAP port 389. This well-known port cannot currently be changed in Cloud Volumes Service. As a result,

someone with access to packet sniffing in the network can see user and group names, numeric IDs, and group memberships.

However, Google Cloud VMs cannot sniff other VM's unicast traffic. Only VMs actively participating in LDAP traffic (that is, being able to bind) can see traffic from the LDAP server. For more information about packet sniffing in Cloud Volumes Service, see the section "Packet sniffing/trace considerations."

# LDAP client configuration defaults

When LDAP is enabled in a Cloud Volumes Service instance, an LDAP client configuration is created with specific configuration details by default. In some cases, options either do not apply to Cloud Volumes Service (not supported) or are not configurable.

| LDAP client option                    | What it does  | Default value   | Can change? |
|---------------------------------------|---|---|-------------|
| LDAP Server List                      | Sets LDAP server names<br>or IP addresses to use for<br>queries. This is not used<br>for Cloud Volumes<br>Service. Instead, Active<br>Directory Domain is used<br>to define LDAP servers.       | Not set   | No          |
| Active Directory Domain               | Sets the Active Directory<br>Domain to use for LDAP<br>queries. Cloud Volumes<br>Service leverages SRV<br>records for LDAP in DNS<br>to find LDAP servers in<br>the domain.                     | Set to the Active Directory<br>domain specified in the<br>Active Directory<br>connection. | No          |
| Preferred Active Directory<br>Servers | Sets the preferred Active<br>Directory servers to use<br>for LDAP. Not supported<br>by Cloud Volumes<br>Service. Instead, use<br>Active Directory sites to<br>control LDAP server<br>selection. | Not set.  | No          |
| Bind using SMB Server<br>Credentials  | Binds to LDAP by using<br>the SMB machine<br>account. Currently, the<br>only supported LDAP bind<br>method in Cloud Volumes<br>Service.   | True  | No          |
| Schema Template                       | The schema template used for LDAP queries.  | MS-AD-BIS   | No          |
| LDAP Server Port                      | The port number used for<br>LDAP queries. Cloud<br>Volumes Service currently<br>uses only the standard<br>LDAP port 389.<br>LDAPS/port 636 is not<br>currently supported.                       | 389   | No          |

| LDAP client option                   | What it does  | Default value  | Can change? |
|--------------------------------------|---|--|-------------|
| Is LDAPS Enabled                     | Controls whether LDAP<br>over Secure Sockets<br>Layer (SSL) is used for<br>queries and binds.<br>Currently not supported by<br>Cloud Volumes Service.   | False  | No          |
| Query Timeout (sec)                  | Timeout for queries. If<br>queries take longer than<br>the specified value,<br>queries fail.  | 3  | No          |
| Minimum Bind<br>Authentication Level | The minimum supported<br>bind level. Because Cloud<br>Volumes Service uses<br>machine accounts for<br>LDAP binds and Active<br>Directory does not support<br>anonymous binds by<br>default, this option does<br>not come into play for<br>security. | Anonymous  | No          |
| Bind DN                              | The user/distinguished<br>name (DN) used for binds<br>when simple bind is used.<br>Cloud Volumes Service<br>uses machine accounts<br>for LDAP binds and does<br>not currently support<br>simple bind<br>authentication.                             | Not set  | No          |
| Base DN                              | The base DN used for LDAP searches.   | The Windows domain use<br>for the Active Directory<br>connection, in DN format<br>(that is, DC=domain,<br>DC=local). | No          |
| Base search scope                    | The search scope for<br>base DN searches. Values<br>can include base,<br>onelevel, or subtree.<br>Cloud Volumes Service<br>only supports subtree<br>searches.   | Subtree  | No          |
| User DN                              | Defines the DN where<br>user searches start for<br>LDAP queries. Currently<br>not supported for Cloud<br>Volumes Service, so all<br>user searches start at the<br>base DN.  | Not set  | No          |

| LDAP client option                | What it does   | Default value | Can change? |
|-----------------------------------|--|---------------|-------------|
| User search scope                 | The search scope for user<br>DN searches. Values can<br>include base, onelevel, or<br>subtree. Cloud Volumes<br>Service does not support<br>setting the user search<br>scope.            | Subtree       | No          |
| Group DN                          | Defines the DN where<br>group searches start for<br>LDAP queries. Currently<br>not supported for Cloud<br>Volumes Service, so all<br>group searches start at<br>the base DN.             | Not set       | No          |
| Group search scope                | The search scope for<br>group DN searches.<br>Values can include base,<br>onelevel, or subtree.<br>Cloud Volumes Service<br>does not support setting<br>the group search scope.          | Subtree       | No          |
| Netgroup DN                       | Defines the DN where<br>netgroup searches start<br>for LDAP queries.<br>Currently not supported<br>for Cloud Volumes<br>Service, so all netgroup<br>searches start at the base<br>DN.    | Not set       | No          |
| Netgroup search scope             | The search scope for<br>netgroup DN searches.<br>Values can include base,<br>onelevel, or subtree.<br>Cloud Volumes Service<br>does not support setting<br>the netgroup search<br>scope. | Subtree       | No          |
| Use start_tls over LDAP           | Leverages Start TLS for<br>certificate based LDAP<br>connections over port 389.<br>Currently not supported by<br>Cloud Volumes Service.  | False         | No          |
| Enable netgroup-by-host<br>lookup | Enables netgroup lookups<br>by hostname rather than<br>expanding netgroups to<br>list all members. Currently<br>not supported by Cloud<br>Volumes Service.                               | False         | No          |

| LDAP client option               | What it does  | Default value | Can change? |
|----------------------------------|---|---------------|-------------|
| Netgroup-by-host DN              | Defines the DN where<br>netgroup-by-host<br>searches start for LDAP<br>queries. Netgroup-by-host<br>is currently not supported<br>for Cloud Volumes<br>Service.   | Not set       | No          |
| Netgroup-by-host search<br>scope | The search scope for<br>netgroup-by-host DN<br>searches. Values can<br>include base, onelevel or<br>subtree. Netgroup-by-host<br>is currently not supported<br>for Cloud Volumes<br>Service.  | Subtree       | No          |
| Client session security          | Defines what level of<br>session security is used<br>by LDAP (sign, seal, or<br>none). LDAP signing is<br>supported by CVS-<br>Performance, if requested<br>by Active Directory. CVS-<br>SW does not support<br>LDAP signing. For both<br>service types, sealing is<br>currently not supported. | None          | No          |
| LDAP referral chasing            | When using multiple<br>LDAP servers, referral<br>chasing allows the client<br>to refer to other LDAP<br>servers in the list when an<br>entry is not found in the<br>first server. This is<br>currently not supported by<br>Cloud Volumes Service.   | False         | No          |
| Group membership filter          | Provides a custom LDAP<br>search filter to be used<br>when looking up group<br>membership from an<br>LDAP server. Not<br>currently supported with<br>Cloud Volumes Service.   | Not set       | No          |

# Using LDAP for asymmetric name mapping

Cloud Volumes Service, by default, maps Windows users and UNIX users with identical usernames bidirectionally without special configuration. As long as Cloud Volumes Service can find a valid UNIX user (with LDAP), then 1:1 name mapping occurs. For instance, if Windows user johnsmith is used, then, if Cloud Volumes Service can find a UNIX user named johnsmith in LDAP, name mapping succeeds for that user, all files/folders created by johnsmith show the correct user ownership, and all ACLs affecting johnsmith are

honored regardless of the NAS protocol in use. This is known as symmetric name mapping.

Asymmetric name mapping is when the Windows user and UNIX user identity don't match. For instance, if Windows user johnsmith has a UNIX identity of jsmith, Cloud Volumes Service needs a way to be told about the variation. Because Cloud Volumes Service currently doesn't support creation of static name mapping rules, LDAP must be used to look up the identity of the users for both Windows and UNIX identities to ensure proper ownership of files and folders and expected permissions.

By default, Cloud Volumes Service includes LDAP in the ns-switch of the instance for the name map database, so that to provide name mapping functionality by using LDAP for asymmetric names, you only need to modify some of the user/group attributes to reflect what Cloud Volumes Service looks for.

The following table shows what attributes must be populated in LDAP for asymmetric name mapping functionality. In most cases, Active Directory is already configured to do this.

| Cloud Volumes Service attribute | What it does   | Value used by Cloud Volumes<br>Service for name mapping                            |
|---------------------------------|--|--|
| Windows to UNIX objectClass     | Specifies the type of object being<br>used. (That is, user, group,<br>posixAccount, and so on)                       | Must include user (can contain multiple other values, if desired.)                 |
| Windows to UNIX attribute       | that defines the Windows username<br>at creation. Cloud Volumes Service<br>uses this for Windows to UNIX<br>lookups. | No change needed here;<br>sAMAccountName is the same as<br>the Windows login name. |
| UID                             | Defines the UNIX username.   | Desired UNIX username.   |

Cloud Volumes Service currently does not use domain prefixes in LDAP lookups, so multiple domain LDAP environments do not function properly with LDAP namemap lookups.

The following example shows a user with the Windows name asymmetric, the UNIX name unix-user, and the behavior it follows when writing files from both SMB and NFS.

The following figure shows how LDAP attributes look from the Windows server.

asymmetric Properties

| Published ( | Certificates | Member Of       | Passwor | d Replication | Dial-in     | Object   |
|-------------|--------------|-----------------|---------|---------------|-------------|----------|
| Security    | Er           | vironment       | Sess    | sions I       | Remote o    | ontrol   |
| General     | Address      | Account         | Profile | Telephones    | Orga        | nization |
| Remote      | Desktop Se   | ervices Profile | С       | OM+           | Attribute I | Editor   |

# Attributes:

| Attribute            | Value                                     | 1 |
|----------------------|---|---|
| name                 | asymmetric                                |   |
| objectCategory       | CN=Person,CN=Schema,CN=Configuration,     |   |
| objectClass          | top; person; organizationalPerson; user   |   |
| objectGUID           | de489556-dd7b-43a3-98fa-2722f79d67ed      |   |
| objectSid            | S-1-5-21-3552729481-4032800560-2279794    |   |
| primaryGroupID       | 513 = ( GROUP_RID_USERS )                 |   |
| pwdLastSet           | 1/19/2017 1:56:34 PM Eastern Standard Tim |   |
| replPropertyMetaData | AttID Ver Loc.USN Org.DSA                 |   |
| sAMAccountName       | asymmetric                                |   |
| sAMAccountType       | 805306368 = ( NORMAL_USER_ACCOUN1         |   |
| uid                  | unix-user                                 |   |
| uidNumber            | 1207                                      |   |

From an NFS client, you can query the UNIX name but not the Windows name:

```
# id unix-user
uid=1207(unix-user) gid=1220(sharedgroup) groups=1220(sharedgroup)
# id asymmetric
id: asymmetric: no such user
```

When a file is written from NFS as unix-user, the following is the result from the NFS client:

```
sh-4.2$ pwd
/mnt/home/ntfssh-4.2$ touch unix-user-file
sh-4.2$ ls -la | grep unix-user
-rwx----- 1 unix-user sharedgroup 0 Feb 28 12:37 unix-user-nfs
sh-4.2$ id
uid=1207(unix-user) gid=1220(sharedgroup) groups=1220(sharedgroup)
```

From a Windows client, you can see that the owner of the file is set to the proper Windows user:

```
PS C:\ > Get-Acl \\demo\home\ntfs\unix-user-nfs | select Owner
Owner
-----
NTAP\asymmetric
```

Conversely, files created by the Windows user asymmetric from an SMB client show the proper UNIX owner, as shown in the following text.

SMB:

PS Z:\ntfs> echo TEXT > asymmetric-user-smb.txt

NFS:

```
sh-4.2$ ls -la | grep asymmetric-user-smb.txt
-rwx----- 1 unix-user sharedgroup 14 Feb 28 12:43 asymmetric-
user-smb.txt
sh-4.2$ cat asymmetric-user-smb.txt
TEXT
```

#### LDAP channel binding

Because of a vulnerability with Windows Active Directory domain controllers, Microsoft Security Advisory ADV190023 changes how DCs allow LDAP binds.

The impact for Cloud Volumes Service is the same as for any LDAP client. Cloud Volumes Service does not currently support channel binding. Because Cloud Volumes Service supports LDAP signing by default through negotiation, LDAP channel binding should not be an issue. If you do have issues binding to LDAP with channel binding enabled, follow the remediation steps in ADV190023 to allow LDAP binds from Cloud Volumes Service to succeed.

#### DNS

Active Directory and Kerberos both have dependencies on DNS for host name to IP/IP to host name resolution. DNS requires port 53 to be open. Cloud Volumes Service does not make any modifications to DNS records, nor does it currently support the use of dynamic DNS on network interfaces.

You can configure Active Directory DNS to restrict which servers can update DNS records. For more information, see Secure Windows DNS.

Note that resources within a Google project default to using Google Cloud DNS, which isn't connected with Active Directory DNS. Clients using Cloud DNS cannot resolve UNC paths returned by Cloud Volumes Service. Windows clients joined to the Active Directory domain are configured to use Active Directory DNS and can resolve such UNC paths.

To join a client to Active Directory, you must configure its DNS configuration to use Active Directory DNS.

Optionally, you can configure Cloud DNS to forward requests to Active Directory DNS. See Why can't my client resolve the SMB NetBIOS name? for more information.



Cloud Volumes Service does not currently support DNSSEC and DNS queries are performed in plaintext.

#### File access auditing

Currently not supported for Cloud Volumes Service.

#### **Antivirus protection**

You must perform antivirus scanning in Cloud Volumes Service at the client to a NAS share. There is currently no native antivirus integration with Cloud Volumes Service.

#### Service operation

The Cloud Volumes Service team manages the backend services in Google Cloud and uses multiple strategies to secure the platform and prevent unwanted access.

Each customer gets their own unique subnet that has access fenced off from other customers by default, and every tenant in Cloud Volumes Service gets their own namespace and VLAN for total data isolation. After a user is authenticated, the Service Delivery Engine (SDE) can only read configuration data specific to that tenant.

#### **Physical security**

With proper preapproval, only onsite engineers and NetApp-badged Field Support Engineers (FSEs) have access to the cage and racks for physical work. Storage and network management is not permitted. Only these onsite resources are able to perform hardware maintenance tasks.

For onsite engineers, a ticket is raised for the statement of work (SOW) that includes the rack ID and device location (RU) and all other details are included in the ticket. For NetApp FSEs, a site visitation ticket must be raised with the COLO and the ticket includes the visitor's details, date, and time for auditing purposes. The SOW for the FSE is communicated internally to NetApp.

# **Operations team**

The operations team for Cloud Volumes Service consists of Production Engineering and a Site Reliability Engineer (SRE) for Cloud Volume Services and NetApp Field Support Engineers and Partners for hardware. All operations team members are accredited for work in Google Cloud and detailed records of work are maintained for every ticket raised. In addition, there is a stringent change control and approval process in place to ensure each decision is appropriately scrutinized.

The SRE team manages the control plane and how the data is routed from UI requests to backend hardware and software in Cloud Volumes Service. The SRE team also manages system resources, such as volume and inode maximums. SREs are not allowed to interact with or have access to customer data. SREs also provide coordination with Return Material Authorizations (RMAs), such as new disk or memory replacement requests for the backend hardware.

#### **Customer responsibilities**

Customers of Cloud Volumes Service manage their organization's Active Directory and user role management as well as the volume and data operations. Customers can have administrative roles and can delegate permissions to other end users within the same Google Cloud project using the two predefined roles that NetApp and Google Cloud provide (Administrator and Viewer).

The administrator can peer any VPC within the customer project to Cloud Volumes Service that the customer determines to be appropriate. It is the responsibility of the customer to manage access to their Google Cloud marketplace subscription and to manage the VPCs that have access to the data plane.

# Malicious SRE protection

One concern that could arise is how does Cloud Volumes Service protect against scenarios in which there is a malicious SRE or when SRE credentials have been compromised?

Access to the production environment is with a limited number of SRE individuals only. Administrative privileges are further restricted to a handful of experienced administrators. All actions performed by anyone in the Cloud Volumes Service production environment are logged and any anomalies to the baseline or suspicious activities are detected by our security information and event management (SIEM) threat intelligence platform. As a result, malicious actions can be tracked and mitigated before too much damage is done to the Cloud Volumes Service backend.

#### Volume life cycle

Cloud Volumes Service manages only the objects within the service—not the data within the volumes. Only clients accessing the volumes can manage the data, the ACLs, file owners, and so on. The data in these volumes is encrypted at rest and access is limited to tenants of the Cloud Volumes Service instance.

The volume lifecycle for Cloud Volumes Service is create-update-delete. Volumes retain Snapshot copies of volumes until the volumes are deleted, and only validated Cloud Volumes Service administrators can delete volumes in Cloud Volumes Service. When a volume deletion is requested by an administrator, an additional step of entering the volume name is required to verify the deletion. After a volume is deleted, the volume is gone and cannot be recovered.

In cases where a Cloud Volumes Service contract is terminated, NetApp marks volumes for deletion after a specific time period. Before that time period expires, you can recover volumes at the customer's request.

# Certifications

Cloud Volumes Services for Google Cloud is currently certified to ISO/IEC 27001:2013 and ISO/IEC 27018:2019 standards. The service also recently received its SOC2 Type I attestation report. For information about the NetApp commitment to data security and privacy, see Compliance: Data security and data privacy.

#### GDPR

Our commitments to privacy and compliance with GDPR are available in a number of our customer contracts, such as our Customer Data Processing Addendum, which includes the Standard Contractual Clauses provided by the European Commission. We also make these commitments in our Privacy Policy, backed by the core values set out in our corporate Code of Conduct.

#### Additional information and contact information

To learn more about the information that is described in this document, review the following documents and/or websites:

· Google Cloud documentation for Cloud Volumes Service

https://cloud.google.com/architecture/partners/netapp-cloud-volumes/

· Google private service access

https://cloud.google.com/vpc/docs/private-services-access?hl=en\_US

NetApp product documentation

https://www.netapp.com/support-and-training/documentation/

Cryptographic Validation Module Program—NetApp CryptoMod

https://csrc.nist.gov/projects/cryptographic-module-validation-program/certificate/4144

The NetApp Solution for Ransomware

https://www.netapp.com/pdf.html?item=/media/16716-sb-3938pdf.pdf&v=202093745

• TR-4616: NFS Kerberos in ONTAP

https://www.netapp.com/pdf.html?item=/media/19384-tr-4616.pdf

#### Contact us

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Contact us at doccomments@netapp.com. Include TECHNICAL REPORT 4918 in the subject line.

# **BlueXP Backup and Recovery**

# BlueXP backup and recovery for VMs

#### 3-2-1 Data Protection for VMware with SnapCenter Plug-in and BlueXP backup and recovery for VMs

The 3-2-1 backup strategy is an industry accepted data protection method, providing a comprehensive approach to safeguarding valuable data. This strategy is reliable and ensures that even if some unexpected disaster strikes, there will still be a copy of the data available.

Author: Josh Powell - NetApp Solutions Engineering

# Overview

The strategy is comprised of three fundamental rules:

- 1. Keep at least three copies of your data. This ensures that even if one copy is lost or corrupted, you still have at least two remaining copies to fall back on.
- Store two backup copies on different storage media or devices. Diversifying storage media helps protect against device-specific or media-specific failures. If one device gets damaged or one type of media fails, the other backup copy remains unaffected.
- 3. Finally, ensure that at least one backup copy is offsite. Offsite storage serves as a fail-safe against localized disasters like fires or floods that could render onsite copies unusable.

This solution document covers a 3-2-1 backups solution using SnapCenter Plug-in for VMware vSphere (SCV) to create primary and secondary backups of our on-premises virtual machines and BlueXP backup and

recovery for virtual machines to backup a copy of our data to cloud storage or StorageGRID.

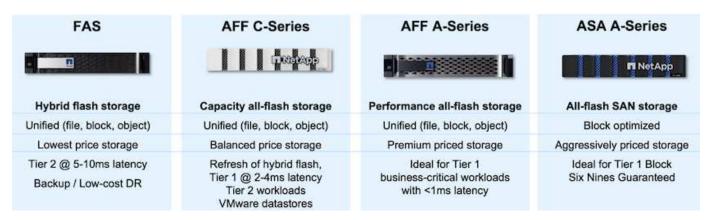
# **Use Cases**

This solution addresses the following use cases:

- Backup and restore of on-premises virtual machines and datastores using using SnapCenter Plug-in for VMware vSphere.
- Backup and restore of on-premises virtual machines and datastores, hosted on ONTAP clusters, and backed up to object storage using BlueXP backup and recovery for virtual machines.

# NetApp ONTAP Data Storage

ONTAP is NetApp's industry leading storage solution that offers unified storage whether you access over SAN or NAS protocols. The 3-2-1 backup strategy ensures on-premises data is protected on more than one media type and NetApp offers platforms ranging from high-speed flash to lower-cost media.



For more information on all of NetApp's hardware platform's check out NetApp Data Storage.

# SnapCenter Plug-in for VMware vSphere

The SnapCenter Plugin for VMware vSphere is a data protection offering which is tightly integrated with VMware vSphere and allows easy management of backup and restores for virtual machines. As part of that solution, SnapMirror provides a fast and reliable method to create a second immutable backup copy of virtual machine data on a secondary ONTAP storage cluster. With this architecture in place, virtual machine restore operations can easily be initiated from either the primary or secondary backup locations.

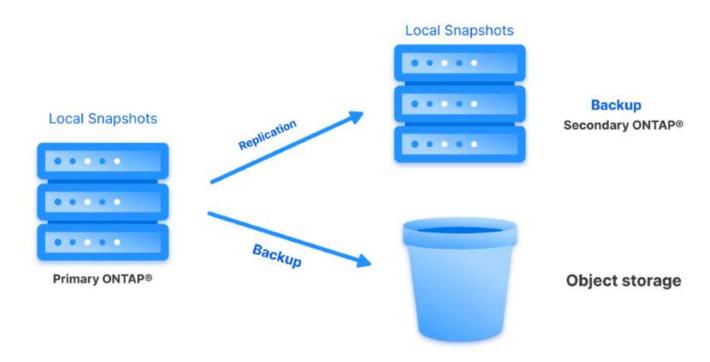
SCV is deployed as a linux virtual appliance using an OVA file. The plug-in now uses a remote plug-in architecture. The remote plug-in runs outside of the vCenter server and is hosted on the SCV virtual appliance.

For detailed information on SCV refer to SnapCenter Plug-in for VMware vSphere documentation.

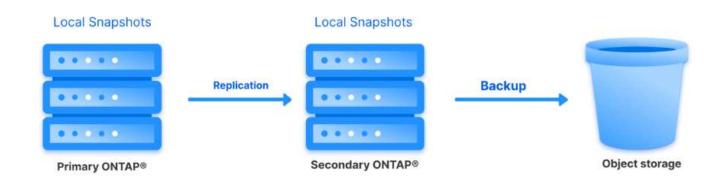
# BlueXP backup and recovery for virtual machines

BlueXP backup and recovery is a cloud based tool for data management that provides a single control plane for a wide range of backup and recovery operations across both on-premises and cloud environments. Part of the NetApp BlueXP backup and recovery suite is a feature that integrates with the SnapCenter Plugin for VMware vSphere (on-premises) to extend a copy of the data to object storage in the cloud. This establishes a third copy of the data offsite that is sourced from the primary or secondary storage backups. BlueXP backup and recovery makes it easy to set up storage policies that transfer copies of your data from either of these two on-prem locations. Choosing between the primary and secondary backups as the source in BlueXP Backup and Recovery will result in one of two topologies being implemented:

**Fan-out Topology** – When a backup is initiated by the SnapCenter Plug-in for VMware vSphere, a local snapshot is immediately taken. SCV then initiates a SnapMirror operation that replicates the most recent snapshot to the Secondary ONTAP cluster. In BlueXP Backup and Recovery, a policy specifies the primary ONTAP cluster as the source for a snapshot copy of the data to be transferred to object storage in your cloud provider of choice.



**Cascading Topology** – Creating the primary and secondary data copies using SCV is identical to the fan-out topology mentioned above. However, this time a policy is created in BlueXP Backup and Recovery specifying that the backup to object storage will originate from the secondary ONTAP cluster.



BlueXP backup and recovery can create backup copies of on-premises ONTAP snapshots to AWS Glacier, Azure Blob, and GCP Archive storage.







# AWS Glacier Azure GCP and Deep Glacier Blob Archive Archive Storage

In addition, you can use NetApp StorageGRID as the object storage backup target. For more on StorageGRID refer to the StorageGRID landing page.

#### **Solution Deployment Overview**

This list provides the high level steps necessary to configure this solution and execute backup and restore operations from SCV and BlueXP backup and recovery:

- 1. Configure SnapMirror relationship between the ONTAP clusters to be used for primary and secondary data copies.
- 2. Configure SnapCenter Plug-In for VMware vSphere.
  - a. Add Storage Systems
  - b. Create backup policies
  - c. Create resource groups
  - d. Run backup first backup jobs
- 3. Configure BlueXP backup and recovery for virtual machines
  - a. Add working environment
  - b. Discover SCV and vCenter appliances
  - c. Create backup policies
  - d. Activate backups
- 4. Restore virtual machines from primary and secondary storage using SCV.
- 5. Restore virtual machines from object storage using BlueXP backup and restore.

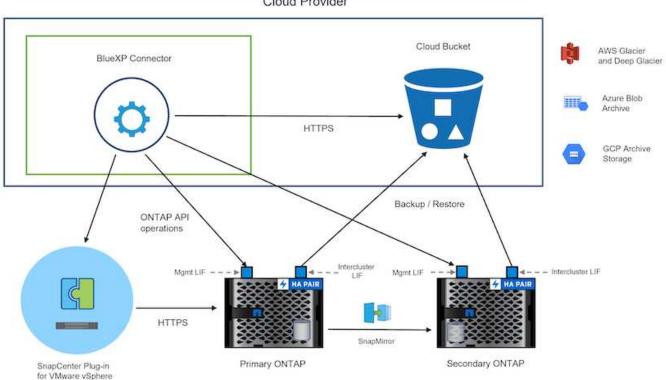
#### Prerequisites

The purpose of this solution is to demonstrate data protection of virtual machines running in VMware vSphere and located on NFS Datastores hosted by NetApp ONTAP. This solution assumes the following components are configured and ready for use:

- 1. ONTAP storage cluster with NFS or VMFS datastores connected to VMware vSphere. Both NFS and VMFS datastores are supported. NFS datastores were utilized for this solution.
- 2. Secondary ONTAP storage cluster with SnapMirror relationships established for volumes used for NFS datastores.
- 3. BlueXP connector installed for cloud provider used for object storage backups.
- 4. Virtual machines to be backed are on NFS datastores residing on the primary ONTAP storage cluster.
- 5. Network connectivity between the BlueXP connector and on-premises ONTAP storage cluster management interfaces.
- 6. Network connectivity between the BlueXP connector and on-premises SCV appliance VM and between the BlueXP connecter and vCenter.
- 7. Network connectivity between the on-premises ONTAP intercluster LIFs and the object storage service.
- 8. DNS configured for management SVM on primary and secondary ONTAP storage clusters. For more information refer to Configure DNS for host-name resolution.

#### **High Level Architecture**

The testing / validation of this solution was performed in a lab that may or may not match the final deployment environment.



Cloud Provider

# **Solution Deployment**

In this solution, we provide detailed instructions for deploying and validating a solution that utilizes SnapCenter Plug-in for VMware vSphere, along with BlueXP backup and recovery, to perform the backup and recovery of Windows and Linux virtual machines within a VMware vSphere cluster located in an on-premises data center. The virtual machines in this setup are stored on NFS datastores hosted by an ONTAP A300 storage cluster. Additionally, a separate ONTAP A300 storage cluster serves as a secondary destination for volumes replicated using SnapMirror. Furthermore, object storage hosted on Amazon Web Services and Azure Blob were employed as targets for a third copy of the data.

We will go over creating SnapMirror relationships for secondary copies of our backups managed by SCV and configuration of backup jobs in both SCV and BlueXP backup and recovery.

For detailed information on SnapCenter Plug-in for VMware vSphere refer to the SnapCenter Plug-in for VMware vSphere documentation.

For detailed information on BlueXP backup and recovery refer to the BlueXP backup and recovery documentation.

#### Establish SnapMirror relationships between ONTAP Clusters

SnapCenter Plug-in for VMware vSphere uses ONTAP SnapMirror technology to manage the transport of secondary SnapMirror and/or SnapVault copies to a secondary ONTAP Cluster.

SCV backup policies have the option of using SnapMirror or SnapVault relationships. The primary difference is that when using the SnapMirror option, the retention schedule configured for backups in the policy will be the same at the primary and secondary locations. SnapVault is designed for archiving and when using this option a separate retention schedule can be established with the SnapMirror relationship for the snapshot copies on the secondary ONTAP storage cluster.

Setting up SnapMirror relationships can be done in BlueXP where many of the steps are automated, or it can be done using System Manager and the ONTAP CLI. All of these methods are discussed below.

# Establish SnapMirror relationships with BlueXP

The following steps must be completed from the BlueXP web console:

Begin by logging into the BlueXP web console and navigating to the Canvas.

1. Drag and drop the source (primary) ONTAP storage system onto the destination (secondary) ONTAP storage system.

| My working environments                              | My estate                                  |  |  |
|--|--|--|--|
| ronment  |  |  |  |
|  |  | nta phd-a300e9u25                          |  |
|  | NTAPSelect<br>On-Premises ONTAP<br>1.31T/B | On-Premises ONTAP<br>173.74TiB<br>Capecity |  |
| $\sim$   | Capacity                                   |  | ots-demo<br>On-Premises ONTAP<br>3 TiB<br>Capacity |
| E13A300<br>On-Premises ONTAP<br>75.21TiB<br>Capacity |  |  |  |
|  |  |  | HA   |

2. From the menu that appears select **Replication**.



3. On the **Destination Peering Setup** page select the destination Intercluster LIFs to be used for the connection between storage systems.

| Replication Setup                |                                    | Destination                             | Peering Setup  |                     |  |
|----------------------------------|------------------------------------|---|--|---------------------|--|
| CVO_InterCluster_B               | Replication requires               | an initial connection between the two w | ald like to use for cluster peering setup<br>orking environments which is called a clu<br>lons, see Cloud Manager documentation.<br>zoneb-n2<br>praphcia300-02 : |                     | y intercluster_node_2  y ntaphci-a300-01 : a0a-181 |
| a0a-3510<br>172.21.254.212/24 up | a0a-3510<br>172.21.254.211/24   up | a0a-3484<br>172.21.228.21/24   up       | a0a-3484<br>172.21.228.22/24 up  | 10.61.181.193/24 up | 10.61.181.194/24 up                                |

4. On the **Destination Volume Name** page, first select the source volume and then fill out the destination volume name and select the destination SVM and aggregate. Click on **Next** to continue.

| F174700   |  | Select the volume that  | you want to replicate           |
|---|--|---|---------------------------------|
| 1 E13A300   |  |   |                                 |
| CDM01   |  | Data  | CONLINE                         |
| IFO<br>torage VM Name F502<br>leting Policy None<br>olume Type RW | CAPACITY<br>205 GB<br>Allocated<br>Disk Used | MFO<br>Storage VM Name F502<br>Thering Policy None<br>Volume Type RW  | CAPACITY                        |
| Demo  |  | Demo02_01   | CONLINE                         |
| FO<br>torage VM Name zonea<br>ering Policy None<br>olume Type RW  | 250 GB<br>Allocated                          | tHFO<br>Storage VM Name Demo<br>Tiering Policy None<br>Volume Type RW | CAPACITY<br>500 GB<br>Allocated |

# Destination Volume Name

Destination Volume Name

Demo\_copy

Destination Storage VM

EHC\_NFS

**Destination Aggregate** 

EHCAggr01

5. Choose the max transfer rate for replication to occur at.

|                 |                 | rate. An unlimited ra              | and the second se |
|-----------------|-----------------|------------------------------------|---|
|                 | act the perform | mance o <mark>f other appli</mark> | and the second se |
| negatively impa | act the perform | mance o <mark>f other appli</mark> | and the second se |

6. Choose the policy that will determine the retention schedule for secondary backups. This policy can be created beforehand (see the manual process below in the **Create a snapshot retention policy** step) or can be changed after the fact if desired.

| Replication Setup  | Replication Policy  |   |
|--|---|---|
| ↑ Previous Step  | Default Policies Additional Policies                                  |   |
| CloudBackupService-1674046623282 Original Policy Name: CloudBackupService-1674046623282 Creates a SnapiVault relationship which replicates Snapshot copies with the following labels to the destination volume: hourly (1), adia (15), weekly (4) (# of retained Snapshot copies in parenthesis) | CloudBackupService-1674047424679 Custom Policy - No Comment More info | CloudBackupService-1674047718637 Custom Policy - No Comment More info |

7. Finally, review all information and click on the **Go** button to start the replication setup process.

| ↑ Previous Step |         |                   | Review your selection and star  | t the replication process |                         |               |
|-----------------|---------|-------------------|---------------------------------|---------------------------|-------------------------|---------------|
|                 | Source  | Destination       | Source Volume Allocated Size:   | 250 GB                    | Destination Aggregate:  | EHCAggr01     |
|                 |         |                   | Source Volume Used Size:        | 1.79 GB                   | Destination Storage VM: | EHC_NFS       |
|                 | E13A300 | ntaphci-a300e9u25 | Source Thin Provisioning:       | Yes                       | Max Transfer Rate:      | 100 MB/s      |
|                 |         |                   | Destination Volume Allocated Si | ze: 250 GB                | SnapMirror Policy:      | Mirror        |
|                 |         | →                 | Destination Thin Provisioning:  | No                        | Replication Schedule:   | One-time copy |
|                 | Demo    | Demo_copy         |                                 |                           |                         |               |

# Establish SnapMirror relationships with System Manager and ONTAP CLI

All required steps for establishing SnapMirror relationships can be accomplished with System Manager or the ONTAP CLI. The following section provides detailed information for both methods:

#### Record the source and destination Intercluster logical interfaces

For the source and destination ONTAP clusters, you can retrieve the inter-cluster LIF information from System Manager or from the CLI.

1. In ONTAP System Manager, navigate to the Network Overview page and retrieve the IP addresses of Type: Intercluster that are configured to communicate with the AWS VPC where FSx is installed.

| Buckets        |                    |          |            |         |               |              |              |         |                   |                                   |      |
|----------------|--------------------|----------|------------|---------|---------------|--------------|--------------|---------|-------------------|-----------------------------------|------|
| Qtrees         |                    |          |            |         |               |              |              |         |                   |                                   |      |
| Quotas         | Network Interfaces | Portsets |            |         |               |              |              |         |                   |                                   |      |
| Storage VMs    | + Add              |          |            |         |               |              |              |         | Q Search 🔮 D      | ownload I Filter                  |      |
| Tiers          |                    |          |            |         |               |              |              |         | K Search ⊻ D      | awinioad - 9 Filder . @ 500W / Po | 00 4 |
| NETWORK        | Name               | Status   | Storage VM | IPspace | Address 🤤     | Current Node | Current Port | Portset | Protocols         | Туре                              | Th   |
| Overview       | veeam_/epo         | 0        | Backup     | Default | 10.61.181.179 | E13A300_1    | a0a-181      |         | SMB/CIPS, NFS, S3 | Data                              |      |
| Ethernet Ports | CM01               | 0        |            | Default | 10.61.181.180 | E13A300_1    | 202-181      |         |                   | Cluster/Node Mgmt                 |      |
| FC Ports       |                    | 54       |            |         |               |              |              |         |                   |                                   | 1    |
| EVENTS & JOBS  | HC_N3              | 0        |            | Default | 10.61.181.183 | E13A300_1    | a0a-181      |         |                   | Intercluster, Cluster, Node Mgmt  |      |
| PROTECTION .   | HC_N2              | 0        |            | Default | 10.61.181.184 | E13A300_2    | 181-60e      |         |                   | Intercluster, Cluster/Node Mgmt   |      |
| HOSTS          | lif_ora_sym_614    | 0        | ora_twm    | Default | 10.61.181.185 | E13A300_1    | a0a-181      |         | SMB/CIFS, NFS, FL | Data                              |      |

2. To retrieve the Intercluster IP addresses using the CLI run the following command:

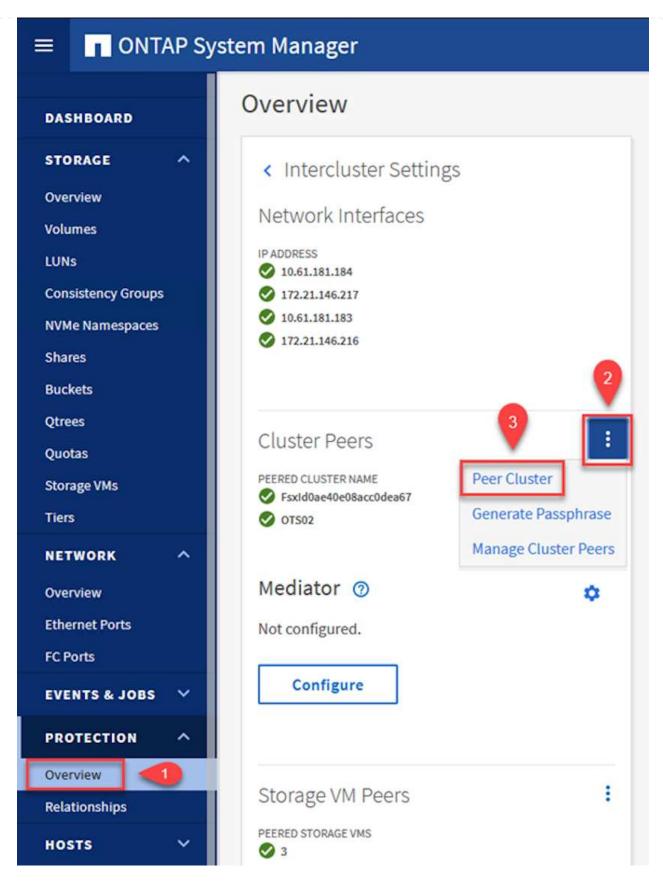
ONTAP-Dest::> network interface show -role intercluster

To establish cluster peering between ONTAP clusters, a unique passphrase entered at the initiating ONTAP cluster must be confirmed in the other peer cluster.

1. Set up peering on the destination ONTAP cluster using the cluster peer create command. When prompted, enter a unique passphrase that is used later on the source cluster to finalize the creation process.

```
ONTAP-Dest::> cluster peer create -address-family ipv4 -peer-addrs
source_intercluster_1, source_intercluster_2
Enter the passphrase:
Confirm the passphrase:
```

2. At the source cluster, you can establish the cluster peer relationship using either ONTAP System Manager or the CLI. From ONTAP System Manager, navigate to Protection > Overview and select Peer Cluster.



- 3. In the Peer Cluster dialog box, fill out the required information:
  - a. Enter the passphrase that was used to establish the peer cluster relationship on the destination ONTAP cluster.

- b. Select Yes to establish an encrypted relationship.
- c. Enter the intercluster LIF IP address(es) of the destination ONTAP cluster.
- d. Click Initiate Cluster Peering to finalize the process.

| Local  |     | •  | Rem             |
|--|-----|--|-----------------|
| STORAGE VM PERMISSIONS   |     | PASSPHRASE ⑦   |                 |
| All storage VMs (incl ×  |     | 1  |                 |
| Storage VMs created in the future also will be giv<br>permissions. | ven | It cannot be determined from the<br>this relationship was encrypted.<br>encrypted? |                 |
|  |     | To generate passphrase, La   |                 |
|  |     | Intercluster Network Interfac  | es IP Addresses |
|  |     | 3 172.30.15.42   |                 |
|  |     | 172.30.14.28   |                 |
|  |     |  | Cancel          |
|  |     | + Add  |                 |
| 4  |     |  |                 |

4. Verify the status of the cluster peer relationship from the destination ONTAP cluster with the following command:



The next step is to set up an SVM relationship between the destination and source storage virtual machines that contain the volumes that will be in SnapMirror relationships.

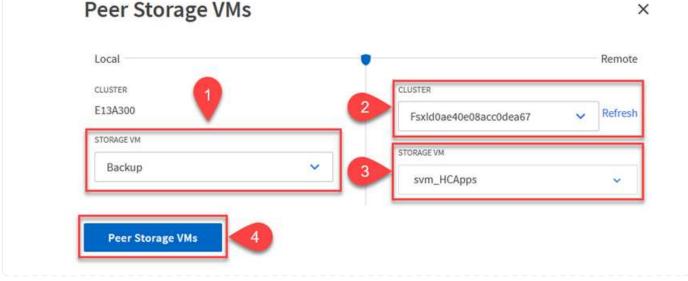
1. From the destination ONTAP cluster, use the following command from the CLI to create the SVM peer relationship:

```
ONTAP-Dest::> vserver peer create -vserver DestSVM -peer-vserver
Backup -peer-cluster OnPremSourceSVM -applications snapmirror
```

- 2. From the source ONTAP cluster, accept the peering relationship with either ONTAP System Manager or the CLI.
- 3. From ONTAP System Manager, go to Protection > Overview and select Peer Storage VMs under Storage VM Peers.



- 4. In the Peer Storage VM's dialog box, fill out the required fields:
  - The source storage VM
  - The destination cluster
  - The destination storage VM



5. Click Peer Storage VMs to complete the SVM peering process.

SnapCenter manages retention schedules for backups that exist as snapshot copies on the primary storage system. This is established when creating a policy in SnapCenter. SnapCenter does not manage retention policies for backups that are retained on secondary storage systems. These policies are managed separately through a SnapMirror policy created on the secondary FSx cluster and associated with the destination volumes that are in a SnapMirror relationship with the source volume.

When creating a SnapCenter policy, you have the option to specify a secondary policy label that is added to the SnapMirror label of each snapshot generated when a SnapCenter backup is taken.



On the secondary storage, these labels are matched to policy rules associated with the destination volume for the purpose of enforcing retention of snapshots.

The following example shows a SnapMirror label that is present on all snapshots generated as part of a policy used for daily backups of our SQL Server database and log volumes.

| Select secondary replication options | 6 |
|--------------------------------------|---|
| Select secondary replication options |   |

Update SnapMirror after creating a local Snapshot copy.

Update SnapVault after creating a local Snapshot copy.

| Secondary policy label | Custom Label 🔹 | 0 |
|------------------------|----------------|---|
|                        | sql-daily      |   |
| Error retry count      | 3 🗘 🚯          |   |

For more information on creating SnapCenter policies for a SQL Server database, see the SnapCenter documentation.

You must first create a SnapMirror policy with rules that dictate the number of snapshot copies to retain.

1. Create the SnapMirror Policy on the FSx cluster.

ONTAP-Dest::> snapmirror policy create -vserver DestSVM -policy PolicyName -type mirror-vault -restart always

2. Add rules to the policy with SnapMirror labels that match the secondary policy labels specified in the SnapCenter policies.

```
ONTAP-Dest::> snapmirror policy add-rule -vserver DestSVM -policy
PolicyName -snapmirror-label SnapMirrorLabelName -keep
#ofSnapshotsToRetain
```

The following script provides an example of a rule that could be added to a policy:

```
ONTAP-Dest::> snapmirror policy add-rule -vserver sql_svm_dest
-policy Async SnapCenter SQL -snapmirror-label sql-ondemand -keep 15
```



Create additional rules for each SnapMirror label and the number of snapshots to be retained (retention period).

#### **Create destination volumes**

To create a destination volume on ONTAP that will be the recipient of snapshot copies from our source volumes, run the following command on the destination ONTAP cluster:

```
ONTAP-Dest::> volume create -vserver DestSVM -volume DestVolName
-aggregate DestAggrName -size VolSize -type DP
```

#### Create the SnapMirror relationships between source and destination volumes

To create a SnapMirror relationship between a source and destination volume, run the following command on the destination ONTAP cluster:

```
ONTAP-Dest::> snapmirror create -source-path
OnPremSourceSVM:OnPremSourceVol -destination-path DestSVM:DestVol -type
XDP -policy PolicyName
```

#### Initialize the SnapMirror relationships

Initialize the SnapMirror relationship. This process initiates a new snapshot generated from the source volume and copies it to the destination volume.

To create a volume, run the following command on the destination ONTAP cluster:

ONTAP-Dest::> snapmirror initialize -destination-path DestSVM:DestVol

#### Configure the SnapCenter Plug-in for VMware vSphere

Once installed, the SnapCenter Plug-in for VMware vSphere can be accessed from the vCenter Server Appliance Management interface. SCV will manage backups for the NFS datastores mounted to the ESXi hosts and that contain the Windows and Linux VMs.

Review the Data protection workflow section of the SCV documentation for more information on the steps involved in configuring backups.

To configure backups of your virtual machines and datastores the following steps will need to be completed from the plug-in interface.

Discover the ONTAP storage clusters to be used for both primary and secondary backups.

1. In the SnapCenter Plug-in for VMware vSphere navigate to **Storage Systems** in the left-hand menu and click on the **Add** button.

SnapCenter Plug-in for VMware vSphere INSTANCE 10.61.181.201:8080 v

| 🚹 Dashboard          | Storage Systems |                     |  |
|----------------------|-----------------|---------------------|--|
| 📴 Settings           | 🛖 Add 🥒 Edit    | 🗙 Delete 🛛 🕞 Export |  |
| 🔃 Resource Groups    | Name            | Display Name        |  |
| Policies             | ⊟ 10.61.181.180 | E13A300             |  |
| Storage Systems      | Anthos          | Anthos              |  |
|                      | Backup          | Backup              |  |
| 🝺 Guest File Restore | Demo            | Demo                |  |
| >                    | 172.21.146.131  | FS02                |  |
| re -                 | 470 04140 466   | 2227 2222           |  |

2. Fill out the credentials and platform type for the primary ONTAP storage system and click on Add.

| Add | Storage | System |
|-----|---------|--------|
|-----|---------|--------|

| Platform               | All Flash FAS                       |               |
|------------------------|-------------------------------------|---------------|
| Authentication Method  | <ul> <li>Credentials</li> </ul>     | O Certificate |
| Username               | admin                               |               |
| Password               | •••••                               |               |
| Protocol               | HTTPS                               |               |
| Port                   | 443                                 |               |
| Timeout                | 60                                  | Seconds       |
| Preferred IP           | Preferred IP                        |               |
| Event Management Syste | em(EMS) & AutoSupport Setting       | g             |
| Log Snapcenter server  | events to syslog                    |               |
| Send AutoSupport Noti  | fication for failed operation to st | orage system  |

Policies specify the retention period, frequency and replication options for the backups managed by SCV.

Review the Create backup policies for VMs and datastores section of the documentation for more information.

To create backup policies complete the following steps:

1. In the SnapCenter Plug-in for VMware vSphere navigate to **Policies** in the left-hand menu and click on the **Create** button.

SnapCenter Plug-in for VMware vSphere INSTANCE 10.61.181.201:8080 v

| 🟠 Dashboard          | Policies              |              |
|----------------------|-----------------------|--------------|
| อ Settings           | 🕂 Create 🧪 Edit 🗙 Rem | ove 🕞 Export |
| 🔃 Resource Groups    | <i>▲Name</i>          | VM Co        |
| Policies             | Daily                 | No           |
| Storage Systems      | FCD                   | No           |
| itorage of stems     | Hourly                | No           |
| 👩 Guest File Restore | Monthly               | No           |
|                      | On Demand             | h1-          |

2. Specify a name for the policy, retention period, frequency and replication options, and snapshot label.

### New Backup Policy

| Name            | Daily   |
|-----------------|---|
| Description     | description   |
| Retention       | Days to keep 🔹 30 🖕 🚺   |
| Frequency       | Daily   |
| Replication     | 🗌 Update SnapMirror after backup 🕧                            |
|                 | 🗹 Update SnapVault after backup 🕧                             |
|                 | Snapshot label Daily  |
| Advanced $\vee$ | VM consistency ()   |
|                 | <ul> <li>Include datastores with independent disks</li> </ul> |
|                 | Scripts 👔   |
|                 | Enter script path   |

When creating a policy in the SnapCenter Plug-in you will see options for SnapMirror and SnapVault. If you choose SnapMirror, the retention schedule specified in the policy will be the same for both the primary and secondary snapshots. If you choose SnapVault, the retention schedule for the secondary snapshot will be based on a separate schedule implemented with the SnapMirror relationship. This is useful when you wish longer retention periods for secondary backups.

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Snapshot labels are useful in that they can be used to enact policies with a specific retention period for the SnapVault copies replicated to the secondary ONTAP cluster. When SCV is used with BlueXP Backup and Restore, the Snapshot label field must either be blank or <u>match</u> the label specified in the BlueXP backup policy.

3. Repeat the procedure for each policy required. For example, separate policies for daily, weekly, and monthly backups.

Resource groups contain the datastores and virtual machines to be included in a backup job, along with the associated policy and backup schedule.

Review the Create resource groups section of the documentation for more information.

To create resource groups complete the following steps.

1. In the SnapCenter Plug-in for VMware vSphere navigate to **Resource Groups** in the left-hand menu and click on the **Create** button.

| 🔄 Dashboard          | Resource Groups          |         |
|----------------------|--------------------------|---------|
| 👩 Settings           | 👍 Create 🥒 Edit 🗙 Delete | Run Now |
| ita Resource Groups  | Name                     | Des     |
| 8 Policies           | SMBC                     |         |
| Storage Systems      | Oracle_Servers           |         |
| Cuart File Partora   | Demo                     |         |
| 👩 Guest File Restore | SQL_Servers_Weekly       |         |

SpanCenter Plug-in for VMware vSphere INSTANCE 10, 61 191 201:8080 -

- 2. In the Create Resource Group wizard, enter a name and description for the group, as well as information required to receive notifications. Click on **Next**
- 3. On the next page select the datastores and virtual machines that wish to be included in the backup job and then click on **Next**.

### Create Resource Group

| 1. General info & notification   | Scope:          | Datastores                     | · .        |   |                   |
|----------------------------------|-----------------|--------------------------------|------------|---|-------------------|
| 2. Resource<br>3. Spanning disks | Datacenter:     | Datastores<br>Virtual Machines |            |   |                   |
| 4. Policies                      |                 | Tags                           | ntity name |   |                   |
| 5. Schedules                     | Available entit | Folders                        |            |   | Selected entities |
| 6. Summary                       | 🗐 Demo          |                                |            |   | INFS_SCV          |
|                                  | 🗐 DemoD         | S                              |            |   | SVERT             |
|                                  | 📒 destinat      | ion                            |            | * |                   |
|                                  | 🗐 esxi7-ho      | -01 Local                      |            | > |                   |
|                                  | 🗐 esxi7-ho      | -02 Local                      |            | < |                   |
|                                  | 🗐 esxi7-ho      | -03 Local                      |            | « |                   |
|                                  | 🖾 aavi7 ha      | 041.0001                       |            | 1 |                   |



You have the option to select specific VMs or entire datastores. Regardless of which you choose, the entire volume (and datastore) is backed up since the backup is the result of taking a snapshot of the underlying volume. In most cases, it is easiest to choose the entire datastore. However, if you wish to limit the list of available VMs when restoring, you can choose only a subset of VMs for backup.

4. Choose options for spanning datastores for VMs with VMDKs that reside on multiple datastores and then click on **Next**.

#### Create Resource Group

| 2. Resource       | This means that only the detectores directly added to the resource aroun and the primery detectors of VIII  |  |  |  |
|-------------------|---|--|--|--|
| 2. Resource       | This means that only the datastores directly added to the resource group and the primary datastore of VMs<br>directly added to the resource group will be backed up |  |  |  |
| 3. Spanning disks |   |  |  |  |
| 4. Policies       | <ul> <li>Always include all spanning datastores</li> </ul>  |  |  |  |
| 5. Schedules      | All datastores spanned by all included VMs are included in this backup  |  |  |  |
| 6. Summary        | Manually select the spanning datastores to be included  |  |  |  |
|                   | You will need to modify the list every time new VMs are added   |  |  |  |
|                   | There are no spanned entities in the selected virtual entities list.  |  |  |  |

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BlueXP backup and recovery does not currently support backing up VMs with VMDKs that span multiple datastores.

5. On the next page select the policies that will be associated with the resource group and click on **Next**.

#### Create Resource Group

| <ul> <li>1. General info &amp; notification</li> </ul> | + Cre | eate      |               |                        |                |
|--|-------|-----------|---------------|------------------------|----------------|
| 2. Resource  |       | Name 🔺    | VM Consistent | Include independent di | Schedule       |
| 3. Spanning disks                                      |       | Daily     | No            | No                     | Daily          |
| 4. Policies  |       | FCD       | No            | Yes                    | On Demand Only |
| 5. Schedules   |       | Monthly   | No            | No                     | Monthly        |
| 6. Summary   |       | On Demand | No            | No                     | On Demand Only |
|  |       | Weekly    | No            | No                     | Weekly         |

When backing up SCV managed snapshots to object storage using BlueXP backup and recovery, each resource group can only be associated with a single policy.

6. Select a schedule that will determine at what times the backups will run. Click on Next.

| Create Resource Gro                                    | up    |   |          |              |
|--|-------|---|----------|--------------|
| <ul> <li>4. General info &amp; notification</li> </ul> |       |   |          |              |
| <ul> <li>2. Resource</li> </ul>                        | Daily | • | Туре     | Daily        |
| <ul> <li>3. Spanning disks</li> </ul>                  |       |   | Every    | 1 Day(s)     |
| <ul> <li>4. Policies</li> </ul>                        |       |   | Starting | 06/23/2023   |
| 5. Schedules   |       |   |          |              |
| <ul> <li>6. Summary</li> </ul>                         |       |   | At       | 07 🗘 00 🗘 PM |

7. Finally, review the summary page and then on **Finish** to complete the resource group creation.

#### Run a backup job

In this final step, run a backup job and monitor its progress. At least one backup job must be successfully completed in SCV before resources can be discovered from BlueXP backup and recovery.

- 1. In the SnapCenter Plug-in for VMware vSphere navigate to **Resource Groups** in the left-hand menu.
- 2. To initiate a backup job, select the desired resource group and click the **Run Now** button.

#### SnapCenter Plug-in for VMware vSphere INSTANCE 10.61.181.201:8080 ~

| Dashboard            | Resource Groups          |           |           |  |
|----------------------|--------------------------|-----------|-----------|--|
| 😰 Settings           | 👍 Create 🥖 Edit 🗙 Delete | 📀 Run Now | Suspend   |  |
| Resource Groups      | Name                     |           | scription |  |
| Policies             | Win01                    |           |           |  |
| Storage Systems      | SMBC                     |           |           |  |
| 👩 Guest File Restore | Oracle_Servers           |           |           |  |
| ouest the Restore    | Demo                     |           |           |  |
| >>                   | SQL_Servers_Dally        |           |           |  |
|                      | SQL_Servers_Weekly       |           |           |  |

3. To monitor the backup job, navigate to **Dashboard** on the left hand menu. Under **Recent Job Activities** click on the Job ID number to monitor the job progress.

| Job Details : 2614                             | Ċ X                     |
|--|-------------------------|
| Validate Retention Settings                    |                         |
| Quiescing Applications                         |                         |
| 🤣 Retrieving Metadata                          |                         |
| Creating Snapshot copy                         |                         |
| Onquiescing Applications                       |                         |
| Registering Backup                             |                         |
| Backup Retention                               |                         |
| 🤣 Clean Backup Cache                           |                         |
| 🤣 Send EMS Messages                            |                         |
| (Job 2616)SnapVault Update                     |                         |
| Q Running, Start Time: 07/31/2023 07:24:40 PM. | ~                       |
|  | CLOSE DOWNLOAD JOB LOGS |

#### Configure Backups to Object Storage in BlueXP backup and recovery

For BlueXP to manage the data infrastructure effectively, it requires the prior installation of a Connector. The Connector executes the actions involved in discovering resources and managing data operations.

For more information on the BlueXP Connector refer to Learn about Connectors in the BlueXP documentation.

Once the connector is installed for the cloud provider being utilized, a graphic representation of the object storage will be viewable from the Canvas.

To configure BlueXP backup and recovery to backup data managed by SCV on-premises, complete the following steps:

The first step is to add the on-premises ONTAP storage systems to BlueXP

1. From the Canvas select **Add Working Environment** to begin.

| NetApp BlueXP             |        |
|---------------------------|--------|
| Canvas My working enviror | nments |
| + Add Working Environment |        |

2. Select **On-Premises** from the choice of locations and then click on the **Discover** button.

|           | Choose a Location |                                      |                       |             |  |  |  |
|-----------|-------------------|--------------------------------------|-----------------------|-------------|--|--|--|
|           | Microsoft Azure   | aws<br>Amazon Web Services<br>Select | Google Cloud Platform | On-Premises |  |  |  |
| On-Premis | ses ONTAP         |                                      |                       | Discover 🗸  |  |  |  |

3. Fill out the credentials for the ONTAP storage system and click the **Discover** button to add the working environment.

| 10.61.181.180 |         |  |
|---------------|---------|--|
| ·             |         |  |
| User Name     |         |  |
| admin         |         |  |
|               |         |  |
| Password      |         |  |
| •••••         | $\odot$ |  |

To discover the on-premises datastore and virtual machine resources, add info for the SCV data broker and credentials for the vCenter management appliance.

1. From the BlueXP left-hand menu selection **Protection > Backup and recovery > Virtual Machines** 

| 1  | NetApp BlueXP            |   |                  |
|----|--------------------------|---|------------------|
| 8  | Storage                  | • | ironment         |
| Q  | Health                   | • |                  |
| Ŧ  | Protection               | ¥ |                  |
|    | Backup and recovery      | 습 | Volumes          |
|    | Disaster recovery (Beta) | 쇼 | Applications     |
|    | Replication              | ☆ | Virtual Machines |
| ବ  | Governance               | • | Kubernetes       |
| 0  | Mobility                 | • | Job Monitoring   |
| •• | Extensions               | • | Reports          |

2. From the Virtual Machines main screen access the **Settings** drop down menu and select **SnapCenter Plug-in for VMware vSphere**.

| SnapCente | r Plug-i | n for VMware vSphere |
|-----------|----------|----------------------|
| Policies  |          |                      |
|           |          |                      |

3. Click on the **Register** button and then enter the IP address and port number for the SnapCenter Plugin appliance and the username and password for the vCenter management appliance. Click on the **Register** button to begin the discovery process.

| SnapCenter Plug-in for VMware vSphere | Username                    |
|---------------------------------------|-----------------------------|
| 10.61.181.201                         | administrator@vsphere.local |
|                                       |                             |
| Port                                  | Password                    |

4. The progress of jobs can be monitored from the Job Monitoring tab.

|                    | Job Name: Di                 | scover Virtual Resources<br>Job Id: 559167ba-8 | s from SnapCenter Plu<br>3876-45db-9131-b918a165d0a |                         | here           |              |
|--------------------|------------------------------|--|---|-------------------------|----------------|--------------|
|                    | ner<br>Type                  | Jul 31 2023, 9:18:22 pm<br>Start Time          | Jul 31 2023, 9:18:2<br>End Time                     | t6 pm 📀 s<br>Job St     | uccess<br>atus |              |
| ıb-Jobs(2)         |                              |  |   |                         |                | Collapse All |
| Job Name           | \$1                          | Job ID 🗘                                       | Start Time  | End Time                | Duration       | • 🗘          |
| Discover Virtual R | esources from SnapCenter Plu | 559167ba-8876-45db                             | Jul 31 2023, 9:18:22 pm                             | Jul 31 2023, 9:18:26 pm | 4 Seconds      |              |
| Discoveri          | ng Virtual Resources         | 99446761-f997-4c80-8                           | Jul 31 2023, 9:18:22 pm                             | Jul 31 2023, 9:18:24 pm | 2 Seconds      |              |
| Registerir         | g Datastores                 | b7ab4195-1ee5-40ff-9a                          | Jul 31 2023, 9:18:24 pm                             | Jul 31 2023, 9:18:26 pm | 2 Seconds      |              |

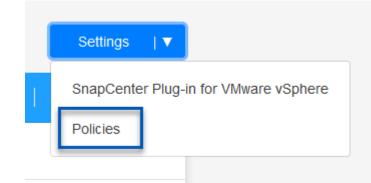
5. Once discovery is complete you will be able to view the datastores and virtual machines across all discovered SCV appliances.

image::bxp-scv-hybrid-23.png[View available resources]

In BlueXP backup and recovery for virtual machines, create policies to specify the retention period, backup source and the archival policy.

For more information on creating policies refer to Create a policy to back up datastores.

1. From the BlueXP backup and recovery for virtual machines main page, access the **Settings** drop down menu and select **Policies**.



- 2. Click on Create Policy to access the Create Policy for Hybrid Backup window.
  - a. Add a name for the policy
  - b. Select the desired retention period
  - c. Select if backups will be sourced from the primary or secondary on-premises ONTAP storage system
  - d. Optionally, specify after what period of time backups will be tiered to archival storage for additional cost savings.

| Policy Details  | Policy Name  |                         |
|---|--|-------------------------|
| and the angle of the state of the | 12 week - daily backups  |                         |
|   |  |                         |
| Retention 🚯   |  |                         |
|   | Daily  | ^                       |
|   | Backups to retain SnapMirror   | Label                   |
|   | 84 Daily   |                         |
|   |  |                         |
|   | D Weekly   | Setup Retention Weekly  |
|   | D Monthly  | Setup Retention Monthly |
|   | ⊖ Secondary  |                         |
| Archival Policy   | Backups reside in standard storage for frequently acc<br>you can tier backups to archival storage for further co |                         |
|   | Tier Backups to Archival   |                         |
|   | Archival After (Davs)  |                         |
|   | Cancel Create  |                         |
|   | <i>A</i> irror Label entered here is used to ic<br>The label name must match the label                           |                         |

The final step is to activate data protection for the individual datastores and virtual machines. The following steps outline how to activate backups to AWS.

For more information refer to Back up datastores to Amazon Web Services.

1. From the BlueXP backup and recovery for virtual machines main page, access the settings drop down for the datastore to be backed up and select **Activate Backup**.

| 6 Datastores |                 |                     |                              |                      |                       |                |
|--------------|-----------------|---------------------|------------------------------|----------------------|-----------------------|----------------|
| Filter By +  |                 |                     |                              |                      | Q 💿 VM Vi             | iew Settings   |
| Datastore    | 🗘 📔 Datastore 1 | lype 🗘   vCenter    | • •                          | Policy Name          | ≎ │ Protection Status | ; ≎            |
| NFS_SCV      | NFS             | vcsa7-hc            | .sddc.netapp.com             |                      | Unprotected           | •••            |
| OTS_DS01     | NFS             | 172.21.2            | 54.160                       | 1 Year Daily LTR     | Protected             | View Details   |
| SCV_WKLD     | NFS             | vcsa7-hc            | .sddc.netapp.com             | 1 Year Daily LTR     | Protected             |                |
|              |                 |                     |                              |                      |                       |                |
|              | Assign Policy   | (2) Add Working Env | ironments (3) s<br>Assign Po | Select Provider      | 4 Configure Provider  | 5 Review       |
| 21 Policies  | 1 Assign Policy | (2) Add Working Env | <u> </u>                     | blicy                |                       | 5 Review       |
| Pol          |                 |                     | Assign Po                    | blicy                | Source A              |                |
| Pol          | licy Name       | SnapMirror Label    | Assign Po                    | Dlicy<br>nt   Backup | Source A              | rchival Policy |

3. At the **Add Working Environments** page the datastore and working environment with a check mark should appear if the working environment has been previously discovered. If the working environment has not been previously discovered you can add it here. Click on **Next** to continue.

| Assign F   | Policy 2 Add Working Environm | select Provider           | (4) Configure Provider     | 5 Review |  |  |  |
|--|-------------------------------|---------------------------|----------------------------|----------|--|--|--|
| Add Working Environments Provide ONTAP cluster (working environment) details that you want Cloud Manager to discover. Working environment details will appear for all volumes that reside on the same cluster. You will need to enter multiple working environments when volumes reside on different clusters. |                               |                           |                            |          |  |  |  |
| SVM  | Volume                        | Working Environments when |                            | lers.    |  |  |  |
| EHC_NFS  | NFS_SCV                       | ⊘ OnPremW                 | orkingEnvironment-6MzE27u1 | Edit     |  |  |  |
|  |                               |                           |                            |          |  |  |  |

4. At the Select Provider page click on AWS and then click on the Next button to continue.

| Assign Policy       | Add Working Environments | 3 Select Provider (4) Configu | re Provider (5) Review |
|---------------------|--------------------------|-------------------------------|------------------------|
|                     | Selec                    | ot Provider                   |                        |
| aws                 |                          | ٥                             | StorageGRiD            |
| Amazon Web Services | Microsoft Azure          | Google Cloud Platform         | StorageGRID            |

 Fill out the provider specific credential information for AWS including the AWS access key and secret key, region, and archival tier to be used. Also, select the ONTAP IP space for the on-premises ONTAP storage system. Click on Next.

| Assign Policy                 | Add Working Environments                 | Select Provider                                | 4 Configure Provider                                  | 5 Review |
|-------------------------------|--|--|---|----------|
|                               | Config<br>Cloud Manager needs the follow | gure Provider<br>ing details to connect with t | he cloud provider.                                    |          |
| Provid                        | ler Information                          |  | Location and Connectivity                             |          |
| AWS Account                   |  | Region   |   |          |
|                               | •  | US East (                                      | N. Virginia)  | •        |
| AWS Access Key                |  |  | <sup>-</sup> Environment<br>rkingEnvironment-6MzE27u1 |          |
| Enter AWS Access Key Required |  | Default  |   | •        |
| AWS Secret Key                |  |  |   |          |
| Enter AWS Secret Key          |  | Archival Tie                                   | r   |          |
| Required                      |  | Glacier  |   | •        |

6. Finally, review the backup job details and click on the **Activate Backup** button to initiate data protection of the datastore.

AWS Access Key
Region
US East (N. Virginia)

Previous

### Restoring Virtual Machines in the case of data loss

storage.

Ensuring the safeguarding of your data is only one aspect of comprehensive data protection. Equally crucial is the ability to promptly restore data from any location in the event of data loss or a ransomware attack. This capability is vital for maintaining seamless business operations and meeting recovery point objectives.

NetApp offers a highly adaptable 3-2-1 strategy, providing customized control over retention schedules at the

i.

Policy

SVM

Volumes

Working Environment

Cloud Service Provider

Tier Backups to Archival

Backup Source

AWS Account

IP space

Select Provider

5 Year Daily LTR

EHC\_NFS

NFS\_SCV

Primary

Default

Activate Backup

No

At this point data transfer may not immediately begin. BlueXP backup and recovery scans for any outstanding snapshots every hour and then transfers them to object

AWS

Review



~

OnPremWorkingEnvironment-6MzE27u1



primary, secondary, and object storage locations. This strategy provides the flexibility to tailor data protection approaches to specific needs.

This section provides an overview of the data restoration process from both the SnapCenter Plug-in for VMware vSphere and BlueXP backup and recovery for virtual machines.

#### Restoring Virtual Machines from SnapCenter Plug-in for VMware vSphere

For this solution virtual machines were restored to original and alternate locations. Not all aspects of SCV's data restoration capabilities will be covered in this solution. For in depth information on all that SCV has to offer refer to the Restore VMs from backups in the product documentation.

Complete the following steps to restore a virtual machine restore from primary or secondary storage.

- 1. From the vCenter client navigate to **Inventory > Storage** and click on the datastore that contains the virtual machines you wish to restore.
- 2. From the **Configure** tab click on **Backups** to access the list of available backups.

| 8 E Q  | Summary Monitor Configure  | Permissions Piles Hosts VMs                         |   |                       |                      |         |        |                 |
|--|--|---|---|-----------------------|----------------------|---------|--------|-----------------|
| Vote314t: 100c metappicon     Alarm Definitione     Deteconter     Deteconter     Deteconter     Deteconter     Deteconter     Deteconter     Deteconter | Backups  |   |   |                       |                      |         |        |                 |
|  | Device Nacing  | Name Some   | Locanova                                    | Stat Tate             | Eind Titles          | Mounted | Policy | SM-app Stapping |
| destrution   | Currentwity with Husta   | 10x mm, may 07 31 2023, 11 24 30 0751. Compare      | I Pitting & Secondary                       | 2010202072436 PM      | 2/10/2003 F24 18 PM  | No      | Dwly   | his             |
|  | excN xechtose     ensitive doctaration     ensitive doctaration     ensitive doctaration     ensitive doctaration     ensitive doctaration     ensitive doctarat     ensitive doctarat     ensitive doctarat     ensitive doctarat | to any any at a 2021 of 20000. Careford             | 1 Premary & Secondary                       | 1002033 92800 AM      | T19/2023 B 38:02 AM  | No      | Detty  | No              |
|  |  | 10-, men, men, 00 10 2021, 04 30 00 0. Corpus       | I Primary & Secondary                       | 700/2022 9:29:00 AM   | 7130/2023 9/39/02 AM | 110     | Dwly   | 100             |
|  |  | 10. mms. m/s. 07-29-2023.09.33.005. Ormplete        | d Premary & Secondary                       | P29/2023 8 39:00 AM   | 109/2023/9/29/02 AM  | hip     | Daty   | No              |
|  |  | 101, million, mary, 07 28 2023, 26 28 00 8. Company | d Primary & Secondary                       | 7778/2023 9-39 00 AM  | 7/20/2023 9/38/02 AM | No      | Dwy    | No.             |
| exi7-bc-05 Local     exi7-bc-06 Local     Backets  | soc.mmi, may 07 23 2023, 30 25 50 76. Complete   | d Primary & Secondary                               | 1/2//2023 10:29:10 AM                       | 7/27/2023 10:25:52 XM | No                   | Dely    | Ani:   |                 |
|  | are mine, may \$2.77 2023, \$9.5728.06. Complete   | 8 Prenary & Secondary                               | 7/77/2022 WS7.28 AM                         | 727202395730 AM       | No                   | Dety    | No     |                 |
| 🗐 no   |  | southernet, may 27 21 2022, 00 39 20 05. Constant   | 8 Primary & Secondary                       | NA 60463 12000 AM     | WA 55/003 9 30/02 AM | tio     | Dwy    | 100             |
| ET NPS_SCV   |  | are more may 01/27/2022 00:34 h 2015. Consider      | <ul> <li>Primary &amp; Secondary</li> </ul> | 7/27/2023 8:34 71 644 | 7/27/2023 9:34 12 AM | No      | Dwy    | 1911            |

3. Click on a backup to access the list of VMs and then select a VM to restore. Click on **Restore**.

| SCV_DEMO : ACTIONS  |   |   |  |  |  |
|---|---|---|--|--|--|
| Summary Monitor Configur  | e Permissions File  | es Hosts                                | VMs  |  |  |
| Alarm Definitions<br>Scheduled Tasks<br>General<br>Device Backing<br>Connectivity with Hosts<br>Hardware Acceleration |   | o_daily_07-31-202<br>11 2023 19:24:36 G | 3_19.24.36.0755<br>MT-0400 (Eastern Daylight Time) |  |  |
| Capability sets<br>SnapCenter Plug-In for VMwa ✓<br>Resource Groups<br>Backups  | Mwa  The following entities are included in the backup:scv_demo_daily_07-31-2023_19.24.36.0755 Select an entity and click Restore to restore it.  RESTORE |   |  |  |  |
|   | Entity Name   | Quiesced                                | UUD  | Location   |  |
|   | SQLSRV-07   | No                                      | 5032d1f2-2591-7f7b-46e3-8dbd4a6b2fb4               | [SCV_DEMO] SQLSRV-07/SQLSRV-07.vmx               |  |
|   | scv_restore_test  | Yes                                     | 50323c8e-04a3-5acf-a2df-a6bc0ced0419               | [SCV_DEMO] scv_restore_test/scv_restore_test.vmx |  |
|   | SQLSRV-06   | No                                      | 50327515-8cce-5942-0f85-350ad39bce42               | [SCV_DEMO] SQLSRV-06/SQLSRV-06.vmx               |  |
|   | SQLSRV-08   | No                                      | 5032b2a9-e1af-c56a-6923-6dbd0eeb6327               | [SCV_DEMO] SQLSRV-08/SQLSRV-08.vmx               |  |
|   | SQLSRV-05   | No                                      | 50326625-dd29-af23-2fd5-fe04e0a57a69               | [SCV_DEMO] SQLSRV-05/SQLSRV-05.vmx               |  |
|   | SCV_DEMO  | No                                      | netfs://172.21.118.112///SCV_DEMO                  | SCV:/vol/SCV_DEMO                                |  |

 From the Restore wizard select to restore the entire virtual machine or a specific VMDK. Select to install to the original location or alternate location, provide VM name after restore, and destination datastore. Click Next.

| <ul> <li>✓ 1. Select scope</li> </ul>  | Restore scope                           | Entire virtual machine   |       |
|--|---|--|-------|
| 2. Select location   | Restart VM                              |  |       |
| 3. Summary   | Restore Location                        | Original Location  |       |
|  |   | (This will restore the entire VM to the original Hypervisor with the origi | inal  |
|  |   | settings. Existing VM will be unregistered and replaced with this VM.)     |       |
|  |   | Alternate Location   |       |
|  |   | (This will create a new VM on selected vCenter and Hypervisor with the     | he    |
|  |   | customized settings.)  |       |
|  | Destination vCenter Server              | 10.61.181.210 -  |       |
|  | Destination ESXi host                   | esxi7-hc-04.sddc.netapp.com  |       |
|  | Network                                 | Management 181   |       |
|  |   |  |       |
|  | VM name after restore                   | SQL_SRV_08_restored  |       |
|  |   |  |       |
|  |   |  |       |
| Choose to backup fr  | rom the primary or second               | BACK NEXT FINISH<br>ary storage location.                                  | CANCE |
| Choose to backup fr<br>Restore   | rom the primary or second               |  | CANCE |
|  |   |  | CANCE |
| Restore  | Destination datastore Lo                | ary storage location.  | CANCE |
| Restore <ul> <li>1. Select scope</li> </ul>                                      | Destination datastore Lo                | ary storage location.  | CANCE |
| <ul> <li>Restore</li> <li>1. Select scope</li> <li>2. Select location</li> </ul> | Destination datastore Lo<br>SCV_DEMO (f | ary storage location.  | CANCE |
| <ul> <li>Restore</li> <li>1. Select scope</li> <li>2. Select location</li> </ul> | Destination datastore Lo<br>SCV_DEMO (f | ary storage location.  | CANCE |
| <ul> <li>Restore</li> <li>1. Select scope</li> <li>2. Select location</li> </ul> | Destination datastore Lo<br>SCV_DEMO (f | ary storage location.  | CANCE |

#### Restoring Virtual Machines from BlueXP backup and recovery for virtual machines

BlueXP backup and recovery for virtual machines allows restores of virtual machines to their original location. Restore functions are accessed through the BlueXP web console.

For more information refer to Restore virtual machines data from the cloud.

To restore a virtual machine from BlueXP backup and recovery, complete the following steps.

1. Navigate to **Protection > Backup and recovery > Virtual Machines** and click on Virtual Machines to view the list of virtual machines available to be restored.

| Backup and recovery | Volumes | Restore          | Applications | Virtual I | Machines               | Kubernetes | Job Monitoring                | Reports |
|---------------------|---------|------------------|--------------|-----------|------------------------|------------|-------------------------------|---------|
|                     | 0       | 4<br>Working Env | ironments    |           | <b>6</b><br>Datastores | ð          | <b>14</b><br>Virtual Machines |         |

2. Access the settings drop down menu for the VM to be restored and select

| ter By 🕂        |                    |               |                         | Q                   | VM View           | Settings |
|-----------------|--------------------|---------------|-------------------------|---------------------|-------------------|----------|
| /irtual Machine | 🔅 🕴 Datastore Type | 0 vCenter     | ✓ Policy Name           | 0 Protection Status | Last Backup 🔅     |          |
| SQLSRV-08       | NFS                | vcsa7-hc.sddc | .netap                  | Unprotected         |                   |          |
| SQLSRV-04       | NFS                | vcsa7-hc.sddc | .netap 1 Year Daily LTR | Protected           | Jul 31, 2023, 7:2 | •••      |

3. Select the backup to restore from and click on Next.

| 17 Backup | S  |            |                  |  |
|-----------|--|------------|------------------|--|
|           | Backup Name                                | 🗧   Backuj | p Time           |  |
| <b>I</b>  | SQL_Servers_Daily_07-31-2023_19.23.39.0938 | Jul 31, 1  | 2023, 7:23:42 PM |  |
|           | SQL_Servers_Daily_07-31-2023_16.40.00.0661 | Jul 31, 3  | 2023, 4:40:03 PM |  |
|           | SQL_Servers_Daily_07-30-2023_16.40.00.0690 | Jul 30,    | 2023, 4:40:03 PM |  |

- 4. Review a summary of the backup job and click on **Restore** to start the restore process.
- 5. Monitor the progress of the restore job from the **Job Monitoring** tab.

| estore 17 files fr | om Cloud                             |                            | ame: Restore 17 files fro<br>d: ec567065-dcf4-4174-b7ef-b27e |                                 |                                 |                         |
|--------------------|--------------------------------------|----------------------------|--|---------------------------------|---------------------------------|-------------------------|
|                    | Restore Files<br>Job Type            | NFS_SQL<br>Restore Content | 17 Files<br>Content Files                                    | NFS_SQL<br>Restore to           | ) In Progress<br>Job Status     |                         |
|                    |                                      |                            |  |                                 |                                 | Expa                    |
| B                  | Restore Content                      |                            |  |                                 |                                 | ^                       |
| aws                | ots-demo<br>Working Environment Name | NAS_VOLS<br>SVM Name       | NFS_SQL<br>Volume Name                                       | SQL_Servers_Dail<br>Backup Name | y_07-31-2023 Jul 31 2<br>Backup | 023, 7:24:03 pm<br>Time |
| 5                  | Restore from                         |                            |  |                                 |                                 | ^                       |
| aws                | AWS                                  | us-east-1                  | 982589175402   | netapp-backup-d                 | 56250b0-24ad                    |                         |
|                    | Provider                             | Region                     | Account ID   | Bucket/Container                | Name                            |                         |

#### Conclusion

The 3-2-1 backup strategy, when implemented with SnapCenter Plug-in for VMware vSphere and BlueXP backup and recovery for virtual machines, offers a robust, reliable, and cost-effective solution for data protection. This strategy not only ensures data redundancy and accessibility but also provides the flexibility of restoring data from any location and from both on-premises ONTAP storage systems and cloud based object storage.

The use case presented in this documentation focuses on proven data protection technologies that highlight the integration between NetApp, VMware, and the leading cloud providers. The SnapCenter Plug-in for VMware vSphere provides seamless integration with VMware vSphere, allowing for efficient and centralized management of data protection operations. This integration streamlines the backup and recovery processes for virtual machines, enabling easy scheduling, monitoring, and flexible restore operations within the VMware ecosystem. BlueXP backup and recovery for virtual machines provides the one (1) in 3-2-1 by providing secure, air-gapped backups of virtual machine data to cloud based object storage. The intuitive interface and logical workflow provide a secure platform for long-term archival of critical data.

#### **Additional Information**

To learn more about the technologies presented in this solution refer to the following additional information.

- SnapCenter Plug-in for VMware vSphere documentation
- BlueXP documentation

### VMware Sovereign Cloud

#### VMware Resources for Sovereign Cloud

#### NetApp and VMware Sovereign Cloud

#### **Overview of VMware Sovereign Cloud**

The concept of sovereignty is emerging as a necessary component of cloud computing for many entities that process and maintain highly sensitive data, such as national and state governments, and highly regulated industries, such finance and healthcare. National governments are also looking to expand digital economic capability and reduce reliance on multi-national firms for their cloud services.

#### VMware Sovereign Cloud Initiative

VMware defines a sovereign cloud as one that:

- Protects and unlocks the value of critical data (e.g., national data, corporate data, and personal data) for both private and public sector organizations
- Delivers a national capability for the digital economy
- · Secures data with audited security controls
- · Ensures compliance with data privacy laws
- Improves control of data by providing both data residency and data sovereignty with full jurisdictional control

#### Partnering with a Trusted VMware Sovereign Cloud Service Provider

To ensure success, organizations must work with partners they trust and that are capable of hosting authentic and autonomous sovereign cloud platforms. VMware Cloud Providers recognized within the VMware Sovereign Cloud initiative commit to designing and operating cloud solutions based on modern, software-defined architectures that embody key principles and best practices outlined in the VMware Sovereign Cloud framework.

- Data Sovereignty and Jurisdictional Control All data is resident and subject to the exclusive control and authority of the nation state where that data was collected. Operations are fully managed within the jurisdiction
- **Data Access and Integrity** Cloud infrastructure is resilient and available in at least two data center locations within the jurisdiction with secure and private connectivity options available.
- **Data Security and Compliance** Information security management system controls are certified against an industry recognized global (or regional) standard and audited regularly.
- **Data Independence and Mobility** Support for modern application architectures to prevent vendor cloud lock-in and enable application portability and independence

For more information from VMware, please visit:

- VMware Sovereign Cloud Overview
- What is VMware Sovereign Cloud?
- Introducing the New VMware Sovereign Cloud Initiative
- VMware Sovereign Cloud Technical White Paper

#### Netpp with VMware Sovereign Cloud: Use Cases

NetApp provides support for VMware Sovereign Cloud concepts through the integration of several NetApp technologies.

Use the following link(s) to discover more about the NetApp technology integrations with VMware Sovereign Cloud:

NetApp StorageGRID as an Object Store Extension

#### NetApp StorageGRID as an Object Store Extension

NetApp has collaborated with VMware to integrate NetApp StorageGRID into VMware Cloud Director in support of the VMware Sovereign Cloud. This plug-in to VMware Cloud Director enables service providers to use StorageGRID as their object storage offering (regardless of use case) and allows StorageGRID management through the same VMware multi-tenant solution (VMware Cloud Director) used by service providers to manage other parts of their offering catalog.

Partners that deliver VMware Sovereign Clouds can choose NetApp StorageGRID to help them managed and maintain cloud environments with unstructured data. Its universal compatibility in its native support for industry-standard APIs, like Amazon S3 API, helps ensure smooth interoperability across diverse cloud environments, and unique innovations such as automated lifecycle management helps ensure more cost-effective safeguarding, storage, and long-term preservation of customers' unstructured data.

NetApp's Sovereign Cloud integration with Cloud Director providers customers with:

- Assurance that sensitive data, including metadata, remains under sovereign control while preventing access by foreign authorities that could violate data privacy laws.
- Increased security and compliance that protects applications and data from rapidly evolving attack vectors while maintaining continuous compliance with a trusted local. infrastructure, built-in frameworks, and local experts.
- Future-proofed infrastructure to react quickly to changing data privacy regulations, security threats, and geopolitics.
- The ability to unlock the value of data with secure data sharing and analysis to drive innovation without violating privacy laws. Data integrity is protected to ensure accurate insights.

For more information on the StorageGRID integration, check out the following:

NetApp Announcement

# NetApp Hybrid Multicloud with Red Hat OpenShift Container workloads

#### NetApp Hybrid Multicloud solutions for Red Hat OpenShift Container workloads

NetApp is seeing a significant increase in customers modernizing their legacy enterprise applications and building new applications using containers and orchestration platforms built around Kubernetes. Red Hat OpenShift Container Platform is one example that we see adopted by many of our customers.

#### Overview

As more and more customers begin adopting containers within their enterprises, NetApp is perfectly positioned to help serve the persistent storage needs of their stateful applications and classic data management needs such as data protection, data security, and data migration. However, these needs are met using different strategies, tools, and methods.

**NetApp ONTAP** based storage options listed below, deliver security, data protection, reliability, and flexibility for containers and Kubernetes deployments.

- Self-managed storage in on-premises:
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ONTAP feature highlights

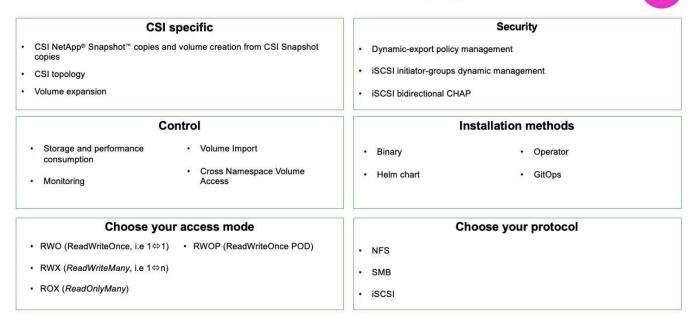
| Storage Administration  | Performance & Scalability  |  |  |
|---|--|--|--|
| Multi-tenancy     • ONTAP CLI & API       • FlexVol & FlexGroup     • System Manager & BlueXP       • LUN     • Quotas  | FlexCache     Inconnect, session trunking,<br>multipathing     FlexClone     Scale-out clusters  |  |  |
| Availability & Resilience   | Access Protocols   |  |  |
| Multi-AZ HA deployment<br>(MetroCluster)       • SnapMirror Business Continuity         SnapShot & SnapRestore       • SnapMirror Cloud         SnapMirror       • SnapMirror Cloud | NFS –v3, v4, v4.1, v4.2     iSCSI     SMB – v2, v3     Multi-protocol access   |  |  |
| Storage Efficiency  | Security & Compliance  |  |  |
| <ul> <li>Deduplication &amp; Compression</li> <li>Compaction</li> <li>Data Tiering (Fabric Pool)</li> </ul>   | <ul> <li>Fpolicy &amp; Vscan</li> <li>LDAP &amp; Kerberos</li> <li>Active Directory integration</li> <li>Certificate based authentication</li> </ul> |  |  |

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**NetApp Astra Trident** is a CSI Compliant Storage Orchestrator that enable quick and easy consumption of persistent storage backed by a variety of the above-mentioned NetApp storage options. It is an open-source software maintained and supported by NetApp.

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Business critical container workloads need more than just persistent volumes. Their data management requirements require protection and migration of the application kubernetes objects as well.

Application data includes kubernetes objects in addition to the user data: Some examples are as follows:

- kubernetes objects such as pods specs, PVCs, deployments, services
- custom config objects such as config maps and secrets
- persistent data such as Snapshot copies, backups, clones
- custom resources such as CRs and CRDs

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This reference documentation provides validation of migration and protection of container-based applications, deployed on RedHat OpenShift container platform, using NetApp Astra Control Center. In addition, the solution provides high-level details for the deployment and the use of Red Hat Advanced Cluster Management (ACM) for managing the container platforms. The document also highlights the details for the integration of NetApp storage with Red Hat OpenShift container platforms using Astra Trident CSI provisioner. Astra Control Center is deployed on the hub cluster and is used to manage the container applications and their persistent storage lifecycle. Finally, it provides a solution for replication and failover and fail-back for container workloads on managed Red Hat OpenShift clusters in AWS (ROSA) using Amazon FSx for NetApp ONTAP (FSxN) as persistent storage.

#### Value propositions of NetApp Hybrid Multicloud solutions for Red Hat OpenShift Container workloads

Most customers do not just start out building Kubernetes based environments without any existing infrastructure. Perhaps they are a traditional IT shop running most of their enterprise applications on virtual machines (in large VMware environments for example). Then they start building small container-based environments to satisfy the needs of their modern application development teams. These initiatives usually start small and begin to

become more pervasive as the teams learn these new technologies and skills, and begin to recognize the many benefits of adopting them.

The good news for customers is that NetApp can serve the needs of both environments. This set of solutions for hybrid multicloud with Red Hat OpenShift will empower NetApp customers to adopt modern cloud technologies and services without having to overhaul their entire infrastructure and organization. Whether customer applications and data are hosted on-premises, in cloud, run on virtual machines, or on containers, NetApp can provide consistent data management, protection, security, and portability. With these new solutions, the same value NetApp has delivered in on-premises data center environments for decades will be available across the enterprise entire data horizon, without requiring significant investment to retool, acquire new skills, or build new teams. NetApp is positioned well to help customers solve these business challenges regardless of what phase of their cloud journey they are in.

NetApp Hybrid Multi-Cloud with Red Hat Openshift:

- Gives customers validated designs and practices which demonstrate the best ways for customers to manage, protect, secure, and migrate their data and applications when using Red Hat OpenShift with NetApp based storage solutions.
- Present best practices for customers running Red Hat OpenShift with NetApp storage in VMware environments, bare metal infrastructure, or a combination of both.
- Demonstrate strategies and options for both on-prem and cloud environments, as well as hybrid environments where both are used.

#### Supported Solutions of NetApp Hybrid Multicloud for Red Hat OpenShift Container workloads

The solution tests and validates Migration & Centralized Data Protection with OpenShift container platform (OCP), OpenShift Advanced Cluster Manager (ACM), NetApp ONTAP, NetApp BlueXP and NetApp Astra Control Center (ACC).

For this solution, the following scenarios are tested and validated by NetApp. The solution is separated into multiple scenarios based on the following characteristics:

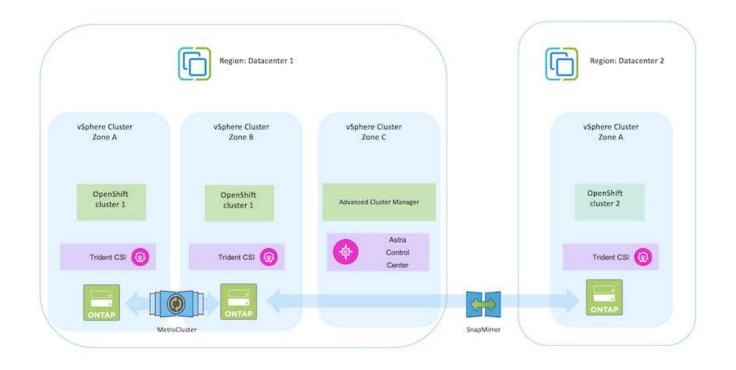
- on-premises
- cloud
  - self-managed OpenShift clusters and self-managed NetApp storage
  - $\circ\,$  provider-managed OpenShift clusters and provider-managed NetApp storage

#### We will be building out additional solutions and use cases in the future.

#### Scenario 1: Data protection and migration within the on-premises environment using ACC

#### On-premises: self-managed OpenShift clusters and self-managed NetApp storage

- Using ACC, create Snapshot copies, backups and restores for data protection.
- Using ACC, perform a SnapMirror replication of container applications.

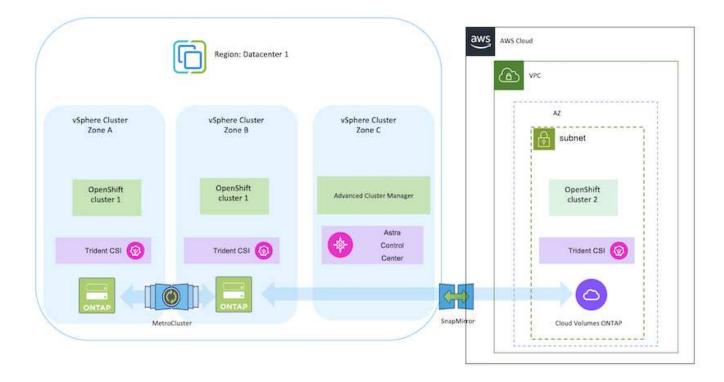


Scenario 2: Data protection and migration from the on-premises environment to AWS environment using ACC

## On-premises: Self-managed OpenShift cluster and self-managed storage AWS Cloud: Self-managed OpenShift cluster and self-managed storage

- Using ACC, perform backups and restores for data protection.
- Using ACC, perform a SnapMirror replication of container applications.

#### Scenario 2

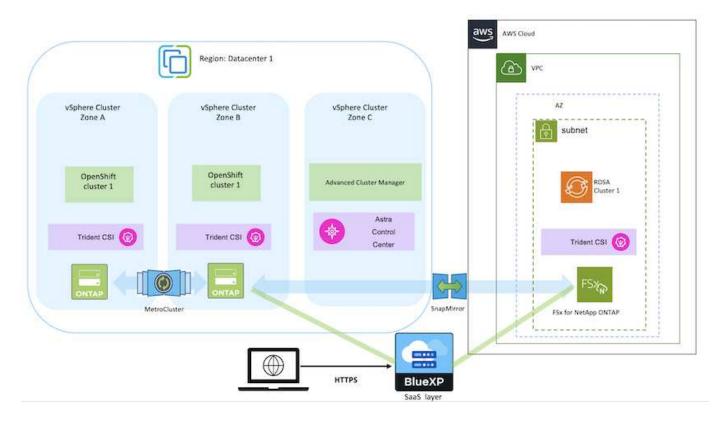


Scenario 3: Data protection and migration from the on-premises environment to AWS environment

#### On-premises: Self-managed OpenShift cluster and self-managed storage AWS Cloud: Provider-managed OpenShift cluster (ROSA) and provider-managed storage (FSxN)

- Using BlueXP, perform replication of persistent volumes (FSxN).
- Using OpenShift GitOps, recreate application metadata.

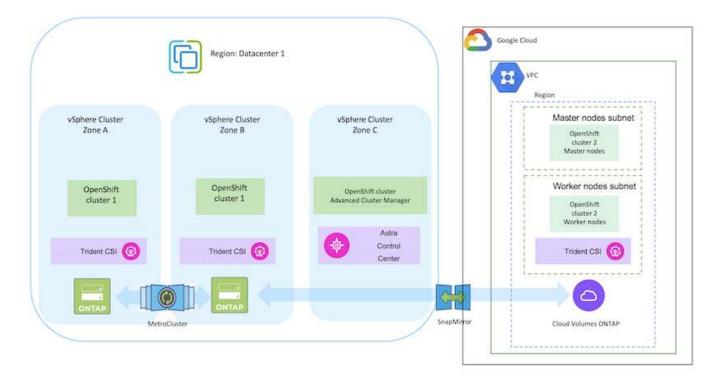
Scenario 3



## Scenario 4: Data protection and migration from the on-premises environment to GCP environment using ACC

#### On-premises: Self-managed OpenShift cluster and self-managed storage Google Cloud: Self-managed OpenShift cluster and self-managed storage

- Using ACC, perform backups and restores for data protection.
- Using ACC, perform a SnapMirror replication of container applications.



For considerations when using ONTAP in a MetroCluster configuration, refer here.

### Scenario 5: Data protection and migration from the on-premises environment to Azure environment using ACC

On-premises: Self-managed OpenShift cluster and self-managed storage Azure Cloud: Self-managed OpenShift cluster and self-managed storage

- Using ACC, perform backups and restores for data protection.
- Using ACC, perform a SnapMirror replication of container applications.

|                           |                           |   | Virtual Network   |
|---------------------------|---------------------------|---|---|
| vSphere Cluster<br>Zone A | vSphere Cluster<br>Zone B | vSphere Cluster<br>Zone C                     | Master nodes subnet<br>OpenShift<br>cluster<br>Master nodes |
| OpenShift<br>cluster 1    | OpenShift<br>cluster 1    | OpenShift cluster<br>Advanced Cluster Manager | Worker nodes subnet   |
| Trident CSI               | Trident CSI               | Astra<br>Control<br>Center                    | Trident CSI 🎯   |
|                           |                           |   |   |
| MetroCl                   | uster                     | SnapMin                                       | ror Cloud Volumes ONTAP                                     |

For considerations when using ONTAP in a MetroCluster configuration, refer here.

#### Versions of various components used in the solution validation

The solution tests and validates Migration & Centralized Data Protection with OpenShift container platform, OpenShift Advanced Cluster Manager, NetApp ONTAP, and NetApp Astra Control Center.

Scenarios 1, 2 and 3 of the solution were validated using the versions as shown in the table below:

| Component                          | Version  |
|------------------------------------|--|
| VMware                             | vSphere Client version 8.0.0.10200<br>VMware ESXi, 8.0.0, 20842819 |
| Hub Cluster                        | OpenShift 4.11.34  |
| Source and Destination<br>Clusters | OpenShift 4.12.9<br>on-premises and in AWS                         |
| NetApp Astra Trident               | Trident Server and Client 23.04.0                                  |
| NetApp Astra Control<br>Center     | ACC 22.11.0-82   |
| NetApp ONTAP                       | ONTAP 9.12.1   |
| AWS FSx for NetApp<br>ONTAP        | Single AZ  |

Scenario 4 of the solution was validated using the versions as shown in the table below:

| Component                          | Version  |  |
|------------------------------------|--|--|
| VMware                             | vSphere Client version 8.0.2.00000<br>VMware ESXi, 8.0.2, 22380479 |  |
| Hub Cluster                        | OpenShift 4.13.13  |  |
| Source and Destination<br>Clusters | OpenShift 4.13.12<br>on-premises and in Google Cloud               |  |
| NetApp Astra Trident               | Trident Server and Client 23.07.0                                  |  |
| NetApp Astra Control<br>Center     | ACC 23.07.0-25   |  |
| NetApp ONTAP                       | ONTAP 9.12.1   |  |
| Cloud Volumes ONTAP                | Single AZ, Single node,9.14.0                                      |  |

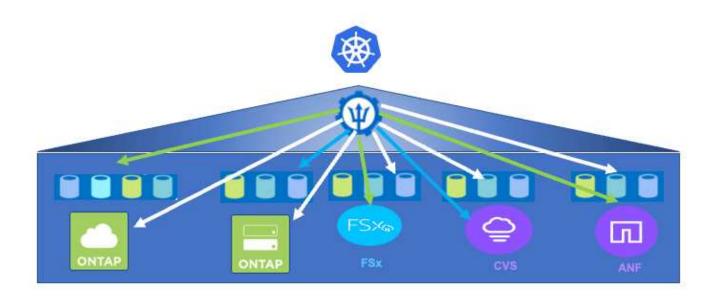
Scenario 5 of the solution was validated using the versions as shown in the table below:

| Component                          | Version  |
|------------------------------------|--|
| VMware                             | vSphere Client version 8.0.2.00000<br>VMware ESXi, 8.0.2, 22380479 |
| Source and Destination<br>Clusters | OpenShift 4.13.25<br>on-premises and in Azure                      |
| NetApp Astra Trident               | Trident Server and Client and Astra Control Provisioner 23.10.0    |
| NetApp Astra Control<br>Center     | ACC 23.10  |
| NetApp ONTAP                       | ONTAP 9.12.1   |
| Cloud Volumes ONTAP                | Single AZ, Single node,9.14.0                                      |

#### Supported NetApp Storage integrations with Red Hat Open Shift Containers

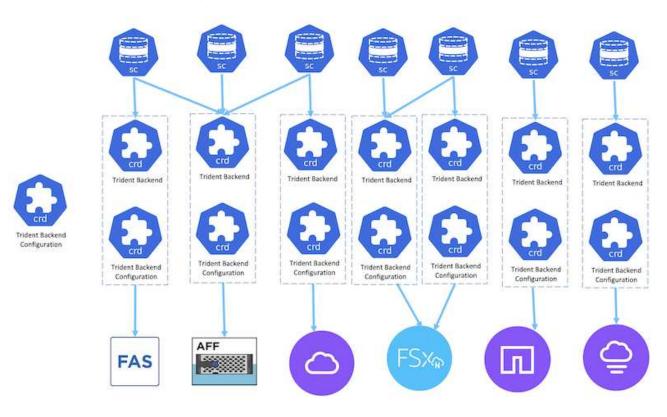
Whether the Red Hat Open Shift containers are running on VMware or in the hyperscalers, NetApp Astra Trident can be used as the CSI provisioner for the various types of backend NetApp storage that it supports.

The following diagram depicts the various backend NetApp storage that can be integrated with OpenShift clusters using NetApp Astra Trident.



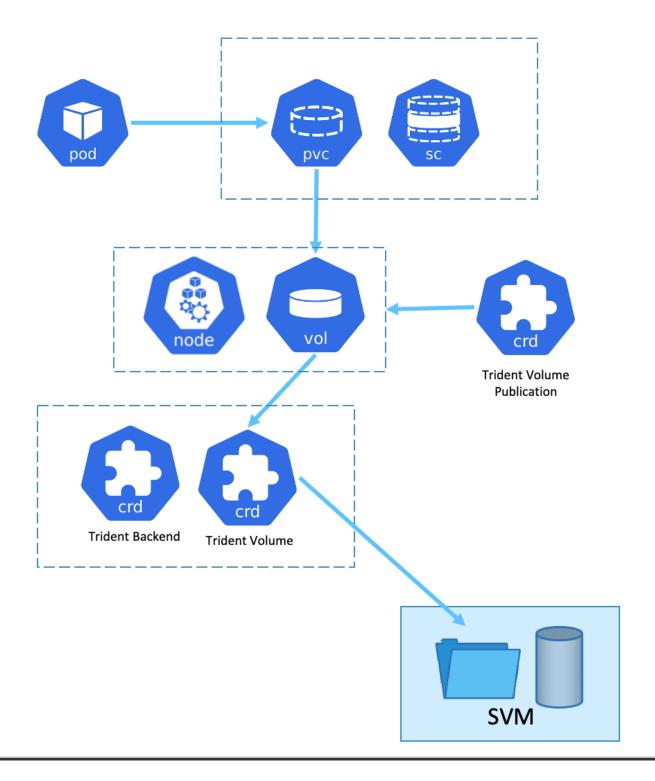
ONTAP Storage Virtual Machine (SVM) provides secure multi-tenancy. A Single OpenShift cluster can connect to single SVM or multiple SVMs or even to multiple ONTAP clusters. Storage class filters the backend storage based on parameters or by labels. Storage administrators define the parameters to connect to storage system using trident backend configuration. On successful connection establishment, it creates the trident backend and populates the information which the storage class can filter.

The relationship between the storageclass and backend is shown below.



Application owner requests persistent volume using storage class. The storage class filters the backend storage.

The relationship between the pod and backend storage is shown below.



#### **Container Storage Interface (CSI) Options**

On vSphere environments, customers can pick VMware CSI driver and/or Astra Trident CSI to integrate with ONTAP. With VMware CSI, the persistent volumes are consumed as local SCSI disks, whereas with Trident, it is consumed with network.

As VMware CSI does not support RWX access modes with ONTAP, applications need to use Trident CSI if

RWX mode is required. With FC based deployments, VMware CSI is preferred and SnapMirror Business Continuity (SMBC) provides zone level high availability.

## VMware CSI supports

- Core Block based datastores (FC, FCoE, iSCSI, NVMeoF)
- Core File based datastores (NFS v3, v4)
- vVol datastores (block and file)

## Trident has following drivers to support ONTAP

- ontap-san (dedicated volume)
- ontap-san-economy (shared volume)
- ontap-nas (dedicated volume)
- ontap-nas-economy (shared volume)
- ontap-nas-flexgroup (dedicated large scale volume)

For both VMware CSI and Astra Trident CSI, ONTAP supports nconnect, session trunking, kerberos, etc. for NFS and multipathing, chap authentication, etc. for block protocols.

In AWS, FSx for NetApp ONTAP (FSxN) can be deployed in single Availability Zone (AZ) or in Multi AZ. For production workloads that requires high availability, multi-AZ provides zonal level fault tolerance and has better NVMe read cache compared to single AZ. For more info, check AWS performance guidelines. To save cost on disaster recovery site, single AZ FSx ONTAP can be utilized. image::rhhc\_storage\_options\_fsxn\_options.png["Replication between Multi-AZ and Single-AZ"]

For number of SVMs that are supported by FSx ONTAP, refer managing FSx ONTAP storage virtual machine

# NetApp Hybrid Multicloud solutions for Red Hat OpenShift Container workloads

NetApp is seeing a significant increase in customers modernizing their legacy enterprise applications and building new applications using containers and orchestration platforms built around Kubernetes. Red Hat OpenShift Container Platform is one example that we see adopted by many of our customers.

## Overview

As more and more customers begin adopting containers within their enterprises, NetApp is perfectly positioned to help serve the persistent storage needs of their stateful applications and classic data management needs such as data protection, data security, and data migration. However, these needs are met using different strategies, tools, and methods.

**NetApp ONTAP** based storage options listed below, deliver security, data protection, reliability, and flexibility for containers and Kubernetes deployments.

- Self-managed storage in on-premises:
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| Performance & Scalability   |
|---|
| FlexCache     flexClone     flexClone |
| Access Protocols  |
| NFS –v3, v4, v4.1, v4.2     iSCSI     SMB – v2, v3     Multi-protocol access  |
| Security & Compliance   |
| <ul> <li>Fpolicy &amp; Vscan</li> <li>LDAP &amp; Kerberos</li> <li>Active Directory integration</li> <li>Certificate based authentication</li> </ul>  |
|   |

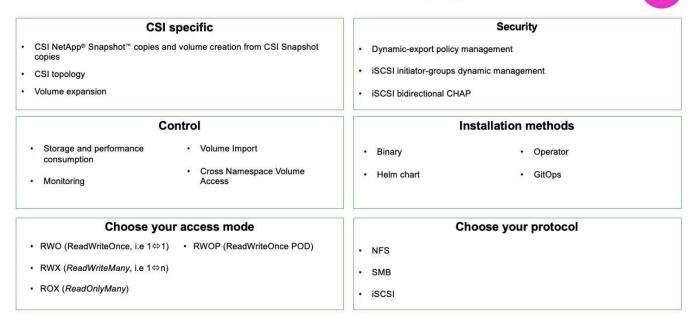
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# Astra Trident CSI feature highlights



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#### NetApp Solution with Red Hat OpenShift Container platform workloads on VMware

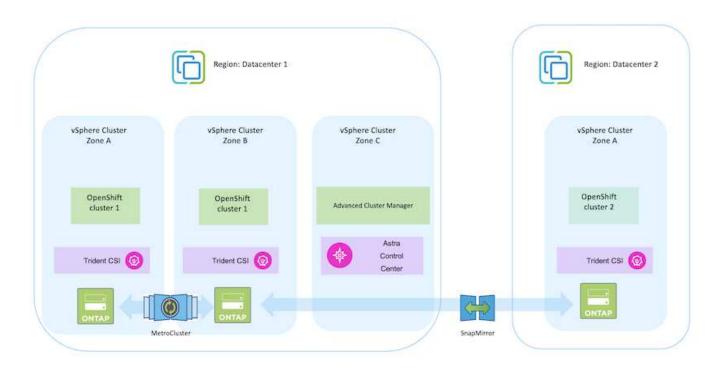
If customers have a need to run their modern containerized applications on infrastructure in their private data centers, they can do so. They should plan and deploy the Red Hat OpenShift container platform (OCP) for a successful production-ready environment for deploying their container workloads. Their OCP clusters can be deployed on VMware or bare metal. NetApp ONTAP storage delivers data protection, reliability, and flexibility for container deployments. Astra Trident serves as the dynamic storage provisioner to consume persistent ONTAP storage for customers' stateful applications. Astra Control Center can be used to orchestrate the many data management requirements of stateful applications such as data protection, migration, and business continuity.

With VMware vSphere, NetApp ONTAP tools provides a vCenter Plugin which can be utilized to provision datastores. Apply tags and use it with OpenShift for storing the node configuration and data. NVMe based storage provides lower latency and high performance.

This solution provides details for data protection and migration of container workloads using Astra Control Center. For this solution, the container workloads are deployed on Red Hat OpenShift clusters on vSphere within the on-premises environment.

NOTE: We will provide a solution for container workloads on OpenShift clusters on bare metal in the future.

### Data protection and migration solution for OpenShift Container workloads using Astra Control Center



## Deploy and configure the Red Hat OpenShift Container platform on VMware

This section describes a high-level workflow of how to set up and manage OpenShift clusters and manage stateful applications on them. It shows the use of NetApp ONTAP storage arrays with the help of Astra Trident to provide persistent volumes. Details are provided about the use of Astra Control Center to perform data protection and migration activities for the stateful applications.



There are several ways of deploying Red Hat OpenShift Container platform clusters. This highlevel description of the setup provides documentation links for the specific method that was used. You can refer to the other methods in the relevant links provided in the resources section.

Here is a diagram that depicts the clusters deployed on VMware in a data center.

|                           | Region: Datacenter 1      |                            | Region: Datacenter 2      |
|---------------------------|---------------------------|----------------------------|---------------------------|
| vSphere Cluster<br>Zone A | vSphere Cluster<br>Zone B | vSphere Cluster<br>Zone C  | vSphere Cluster<br>Zone A |
| OpenShift<br>cluster 1    | OpenShift<br>cluster 1    | Advanced Cluster Manager   | OpenShift<br>cluster 2    |
| Trident CSI               | Trident CSI               | Astra<br>Control<br>Center | Trident CSI               |
|                           |                           | s                          |                           |

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

### Deploy and configure a CentOS VM

( 🖓 )

- It is deployed in the VMware vSphere environment.
- This VM is used for deploying some components such as NetApp Astra Trident and NetApp Astra Control Center for the solution.
- A root user is configured on this VM during installation.

### Deploy and configure an OpenShift Container Platform cluster on VMware vSphere (Hub Cluster)

Refer to the instructions for the Assisted deployment method to deploy an OCP cluster.

Remember the following:

- Create ssh public and private key to provide to the installer. These keys will be used to login to the master and worker nodes if needed.

- Download the installer program from the assisted installer. This program is used to boot the VMs that you create in the VMware vSphere environment for the master and worker nodes.

- VMs should have the minimum CPU, memory, and hard disk requirement. (Refer to the vm create commands on this page for the master and the worker nodes which provide this information)

- The diskUUID should be enabled on all VMs.
- Create a minimum of 3 nodes for master and 3 nodes for worker.

- Once they are discovered by the installer, turn on the VMware vSphere integration toggle button.

This is installed using the Advanced Cluster Management Operator on the Hub Cluster. Refer to the instructions here.

### Install an internal Red Hat Quay registry on the Hub Cluster.

- An internal registry is required to push the Astra image. A Quay internal registry is installed using the Operator in the Hub cluster.
- Refer to the instructions here

#### Install two additional OCP clusters (Source and Destination)

- The additional clusters can be deployed using the ACM on the Hub Cluster.
- Refer to the instructions here.

#### Configure NetApp ONTAP storage

- Install an ONTAP cluster with connectivity to the OCP VMs in VMWare environment.
- · Create an SVM.
- Configure NAS data lif to access the storage in SVM.

#### Install NetApp Trident on the OCP clusters

- Install NetApp Trident on all three clusters: Hub, source, and destination clusters
- Refer to the instructions here.
- Create a storage backend for ontap-nas .
- Create a storage class for ontap-nas.
- Refer to instructions here.

#### Install NetApp Astra Control Center

- NetApp Astra Control Center is installed using the Astra Operator on the Hub Cluster.
- Refer to the instructions here.

#### Points to remember:

- \* Download NetApp Astra Control Center image from the support site.
- \* Push the image to an internal registry.
- \* Refer to instructions here.

#### **Deploy an Application on Source Cluster**

Use OpenShift GitOps to deploy an application. (eg. Postgres, Ghost)

After you add a cluster to Astra Control management, you can install apps on the cluster (outside of Astra Control) and then go to the Applications page in Astra Control to define the apps and their resources. Refer to Start managing apps section of Astra Control Center.

The next step is to use the Astra Control Center for Data protection and Data migration from the source to the destination cluster.

## Data protection using Astra

This page shows the data protection options for Red Hat OpenShift Container based applications running on VMware vSphere using Astra Control Center (ACC).

As users take their journey of modernizing their applications with Red Hat OpenShift, a data protection strategy should be in place to protect them from accidental deletion or any other human errors. Often a protection strategy is also required for regulatory or compliance purposes to protect their data from a diaster.

The requirements of data protection varies from reverting back to a point in time copy to automatically failing over to a different fault domain without any human intervention. Many customers pick ONTAP as their preferred storage platform for their Kubernetes applications because of its rich features like multitenancy, multi-protocol, high performance and capacity offerings, replication and caching for multi-site locations, security and flexibility.

Data protection in ONTAP can be achieved using ad-hoc or policy controlled

- Snapshot
- backup and restore

Both Snapshot copies and backups protect the following types of data:

- The application metadata that represents the state of the application
- Any persistent data volumes associated with the application
- Any resource artifacts belonging to the application

### Snapshot with ACC

A point in time copy of data can be captured using Snapshot with ACC. Protection policy defines the number of Snapshot copies to keep. Minimum schedule option available is hourly. Manual, on-demand Snapshot copies can be taken at any time and at shorter intervals than scheduled Snapshot copies. Snapshot copies are stored on the same provisioned volume as the app.

## **Configuring Snapshot with ACC**

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#### **Backup and Restore with ACC**

A backup is based on a Snapshot. ACC can take Snapshot copies using CSI and perform backup using the point in time Snapshot copy. The backup is stored in an external object store (any s3 compatible including ONTAP S3 at a different location). Protection policy can be configured for scheduled backups and the number of backup versions to keep. The minimum RPO is one hour.

#### Restoring an application from a backup using ACC

ACC restores application from the S3 bucket where the backups are store.

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#### Application specific execution hooks

In addition, execution hooks can be configured to run in conjunction with a data protection operation of a managed app. Even though storage array level data protection features are available, often additional steps are needed to make backups and restores, application consistent. The app-specific additional steps could be: - before or after a Snapshot copy is created.

- before or after a backup is created.
- after restoring from a Snapshot copy or backup.

Astra Control can execute these app-specific steps coded as custom scripts called execution hooks.

NetApp Verda GitHub project provides execution hooks for popular cloud-native applications to make protecting applications straightforward, robust, and easy to orchestrate. Feel free to contribute to that project if you have enough information for an application that is not in the repository.

Sample execution hook for pre-Snapshot of a redis application.

| DOK DETAILS 2                                       |              |  |            | 1   | EXECUTION HOOKS  |
|---|--------------|--|------------|-----|--|
| Operation<br>Pre-snapshot                           | ~            | Hook arguments (optional)<br>1 pre ×<br>Enter hook arguments |            | 2 0 | xecution hooks allow Astra<br>Control to execute your own<br>ustom scripts before or after a<br>napshot. |
| Hook name<br>redis-pre-snapshot                     |              |  |            | 5   | lead more in<br>Aanage application execution<br>tooks  |
| NTAINER IMAGES ?                                    |              |  |            |     |  |
| Apply to all container images                       |              |  |            |     |  |
| Use a regular expression to target container images | or the hook. |  |            |     |  |
| Container insage names to match :<br>redis          |              |  |            |     |  |
| RIPT P  |              |  |            |     |  |
| + Add   |              |  | \Xi Search |     |  |
| Name 4  |              |  |            |     |  |
| mariadb_mysqLsh                                     |              |  |            |     |  |
| postgresqLsh  |              |  |            |     |  |
| • redis_hook.sh                                     |              |  |            |     |  |
|   |              |  |            |     |  |

#### **Replication with ACC**

For regional protection or for a low RPO and RTO solution, an application can be replicated to another Kubernetes instance running at a different site, preferably in another region. ACC utilizes ONTAP async SnapMirror with RPO as low as 5 minutes. Replication is done by replicating to ONTAP and then a fail over creates the Kubernetes resources in the destination cluster.



Note that replication is different from the backup and restore where the backup goes to S3 and restore is performed from S3. Refer xref:./rhhc/ here to get additional details about the differences between the two types of data protection.

Refer here for SnapMirror setup instructions.

#### **SnapMirror with ACC**

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san-economy and nas-economy storage drivers do not support replication feature. Refer here for additional details.

#### Demo video:

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Demonstration video of disaster recovery with Astra Control Center

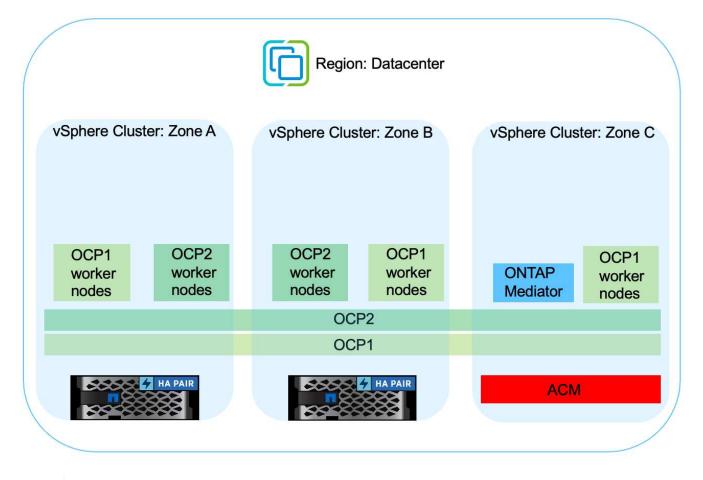
#### Data protection with Astra Control Center

#### **Business Continuity with MetroCluster**

Most of our hardware platform for ONTAP has high availability features to protect from device failures avoiding the need to perform diaster recovery. But to protect from fire or any other disaster and to continue the business with zero RPO and low RTO, often a MetroCluster solution is used.

Customers who currently have an ONTAP system can extend to MetroCluster by adding supported ONTAP systems within the distance limitations for providing zone level disaster recovery. Astra Trident, the CSI (Container Storage Interface) supports NetApp ONTAP including MetroCluster configuration as well as other options like Cloud Volumes ONTAP, Azure NetApp Files, AWS FSx for NetApp ONTAP, etc. Astra Trident provides five storage driver options for ONTAP and all are supported for MetroCluster configuration. Refer here for additional details about ONTAP storage drivers supported by Astra Trident.

The MetroCluster solution requires layer 2 network extension or capability to access the same network address from both fault domains. Once MetroCluster configuration is in place, the solution is transparent to application owners as all the volumes in the MetroCluster svm are protected and get the benefits of SyncMirror (zero RPO).



For Trident Backend Configuration (TBC), do not specify the dataLIF and SVM when using MetroCluster configuration. Specify SVM management IP for managementLIF and use vsadmin role credentials.

Details on Astra Control Center Data Protection features are available here

## Data migration using Astra Control Center

This page shows the data migration options for container workloads on Red Hat OpenShift clusters with Astra Control Center (ACC).

Kubernetes Applications are often required to be moved from one environment to another. To migrate an application along with its persistent data, NetApp ACC can be utilized.

### Data Migration between different Kubernetes environment

ACC supports various Kubernetes flavors including Google Anthos, Red Hat OpenShift, Tanzu Kubernetes Grid, Rancher Kubernetes Engine, Upstream Kubernetes, etc. For additional details, refer here.

To migrate application from one cluster to another, you can use one of the following features of ACC:

- replication
- backup and restore
- clone

**(Q**)

Refer to the data protection section for the replication and backup and restore options.

Refer here for additional details about cloning.



Astra Replication feature is only supported with Trident Container Storage Interface (CSI). However, replication is not supported by nas-economy & san-economy drivers.

### Performing data replication using ACC

| Deliboart  | i ghost 🔿  |                               |                        | e  | Adam •                                      |
|--|--|-------------------------------|------------------------|--|---|
| 🕹 Applications<br>🕃 Clusters<br>🛆 Closed Instances | -Approximation status  | C fully protected             | APPLICATION PROTECTION | Begination policy configured   | Stapher<br>Rack op<br>Clone<br>Austria      |
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## NetApp Hybrid Multicloud solutions for Red Hat OpenShift Container workloads

NetApp is seeing a significant increase in customers modernizing their legacy enterprise applications and building new applications using containers and orchestration platforms built around Kubernetes. Red Hat OpenShift Container Platform is one example that we see adopted by many of our customers.

### Overview

As more and more customers begin adopting containers within their enterprises, NetApp is perfectly positioned to help serve the persistent storage needs of their stateful applications and classic data management needs such as data protection, data security, and data migration. However, these needs are met using different strategies, tools, and methods.

**NetApp ONTAP** based storage options listed below, deliver security, data protection, reliability, and flexibility for containers and Kubernetes deployments.

- Self-managed storage in on-premises:
  - NetApp Fabric Attached Storage (FAS), NetApp All Flash FAS Arrays (AFF), NetApp All SAN Array (ASA) and ONTAP Select
- Provider-managed storage in on-premises:

- NetApp Keystone provides Storage as a Service (STaaS)
- Self-managed storage in the cloud:
  - NetApp Cloud Volumes ONTAP(CVO) provide self managed storage in the hyperscalers
- Provider-managed storage in the cloud:
  - Cloud Volumes Service for Google Cloud (CVS), Azure NetApp Files (ANF), Amazon FSx for NetApp ONTAP offer fully managed storage in the hyperscalers

| Storage Administration  | Performance & Scalability  |
|---|--|
| <ul> <li>Multi-tenancy</li> <li>ONTAP CLI &amp; API</li> <li>FlexVol &amp; FlexGroup</li> <li>System Manager &amp; BlueXP</li> <li>LUN</li> <li>Quotas</li> </ul> | FlexCache     flexCache     roonnect, session trunking,<br>multipathing     FlexClone     Scale-out clusters   |
| Availability & Resilience   | Access Protocols   |
| Multi-AZ HA deployment<br>(MetroCluster)     SnapShot & SnapRestore     SnapMirror Cloud     SnapMirror   | NFS –v3, v4, v4.1, v4.2     iSCSI     SMB – v2, v3     Multi-protocol access   |
| Storage Efficiency  | Security & Compliance  |
| <ul> <li>Deduplication &amp; Compression</li> <li>Compaction</li> <li>Data Tiering (Fabric Pool)</li> </ul>   | <ul> <li>Fpolicy &amp; Vscan</li> <li>LDAP &amp; Kerberos</li> <li>Active Directory integration</li> <li>Certificate based authentication</li> </ul> |

**NetApp BlueXP** enables you to manage all of your storage and data assets from a single control plane/interface.

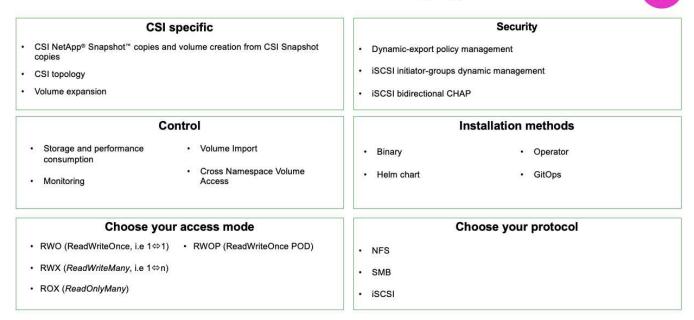
You can use BlueXP to create and administer cloud storage (for example, Cloud Volumes ONTAP and Azure NetApp Files), to move, protect, and analyze data, and to control many on-prem and edge storage devices.

**NetApp Astra Trident** is a CSI Compliant Storage Orchestrator that enable quick and easy consumption of persistent storage backed by a variety of the above-mentioned NetApp storage options. It is an open-source software maintained and supported by NetApp.

# **ONTAP** feature highlights

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# Astra Trident CSI feature highlights



Business critical container workloads need more than just persistent volumes. Their data management requirements require protection and migration of the application kubernetes objects as well.

Application data includes kubernetes objects in addition to the user data: Some examples are as follows:

- kubernetes objects such as pods specs, PVCs, deployments, services
- custom config objects such as config maps and secrets
- persistent data such as Snapshot copies, backups, clones
- custom resources such as CRs and CRDs

**NetApp Astra Control**, available as both fully-managed and self-managed software, provides orchestration for robust application data management. Refer to the Astra documentation for additional details on the Astra family of products.

This reference documentation provides validation of migration and protection of container-based applications, deployed on RedHat OpenShift container platform, using NetApp Astra Control Center. In addition, the solution provides high-level details for the deployment and the use of Red Hat Advanced Cluster Management (ACM) for managing the container platforms. The document also highlights the details for the integration of NetApp storage with Red Hat OpenShift container platforms using Astra Trident CSI provisioner. Astra Control Center is deployed on the hub cluster and is used to manage the container applications and their persistent storage lifecycle. Finally, it provides a solution for replication and failover and fail-back for container workloads on managed Red Hat OpenShift clusters in AWS (ROSA) using Amazon FSx for NetApp ONTAP (FSxN) as persistent storage.

### NetApp Solution with Red Hat OpenShift Container platform workloads in Hybrid Cloud

Customers may be at a point in their modernization journey when they are ready to move some select workloads or all workloads from their data centers to the cloud. They may choose to use self-managed OpenShift containers and self-managed NetApp storage in the cloud for various reasons. They should plan and deploy the Red Hat OpenShift container platform (OCP) in the cloud for a successful production-ready environment for

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migrating their container workloads from their data centers. Their OCP clusters can be deployed on VMware or Bare Metal in their data centers and on AWS, Azure or Google Cloud in the cloud environment.

NetApp Cloud Volumes ONTAP storage delivers data protection, reliability, and flexibility for container deployments in AWS, Azure and in Google Cloud. Astra Trident serves as the dynamic storage provisioner to consume the persistent Cloud Volumes ONTAP storage for customers' stateful applications. Astra Control Center can be used to orchestrate the many data management requirements of stateful applications such as data protection, migration, and business continuity.

### Data protection and migration solution for OpenShift Container workloads in a hybrid cloud using Astra Control Center

On-premises and AWS image::rhhc-self-managed-aws.png[]

On-premises and Google Cloud image::rhhc-self-managed-gcp.png[]

On-premises and Azure Cloud image::rhhc-self-managed-azure.png[]

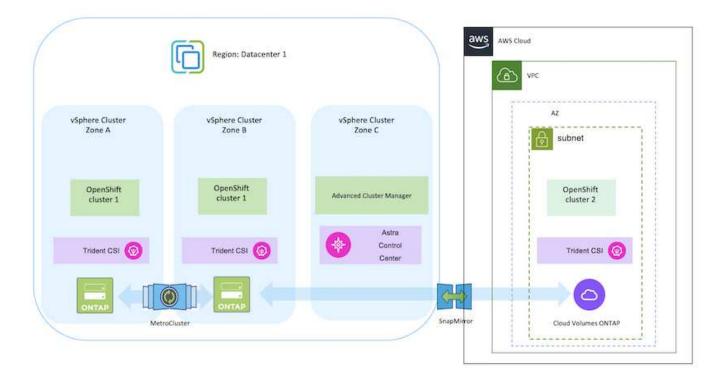
## Deploy and configure the Red Hat OpenShift Container platform on AWS

This section describes a high-level workflow of how to set up and manage OpenShift Clusters in AWS and deploy stateful applications on them. It shows the use of NetApp Cloud Volumes ONTAP storage with the help of Astra Trident to provide persistent volumes. Details are provided about the use of Astra Control Center to perform data protection and migration activities for the stateful applications.



There are several ways of deploying Red Hat OpenShift Container platform clusters on AWS. This high-level description of the setup provides documentation links for the specific method that was used. You can refer to the other methods in the relevant links provided in the resources section.

Here is a diagram that depicts the clusters deployed on AWS and connected to the data center using a VPN.



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

### Install an OCP cluster on AWS from the Advanced Cluster Management.

- Create a VPC with a site-to-site VPN connection (using pfsense) to connect to the on-premises network.
- · On-premises network has internet connectivity.
- Create 3 private subnets in 3 different AZs.
- Create a Route 53 private hosted zone and a DNS resolver for the VPC.

Create OpenShift Cluster on AWS from the Advanced Cluster Management (ACM) Wizard. Refer to instructions here.



You can also create the cluster in AWS from the OpenShift Hybrid Cloud console. Refer here for instructions.



When creating the cluster using the ACM, you have the ability to customize the installation by editing the yaml file after filling in the details in the form view. After the cluster is created, you can ssh login to the nodes of the cluster for troubleshooting or additional manual configuration. Use the ssh key you provided during installation and the username core to login.

- Install the connector in on-premises VMware environment. Refer to instructions here.
- Deploy a CVO instance in AWS using the connector. Refer to instructions here.



The connector can also be installed in the cloud environment. Refer here for additional information.

#### Install Astra Trident in the OCP Cluster

- Deploy Trident Operator using Helm. Refer to instructions here
- Create a backend and a storage class. Refer to instructions here.

#### Add the OCP cluster on AWS to the Astra Control Center.

Add the OCP cluster in AWS to Astra Control Center.

#### Using CSI Topology feature of Trident for multi-zone architectures

Cloud providers, today, enable Kubernetes/OpenShift cluster administrators to spawn nodes of the clusters that are zone based. Nodes can be located in different availability zones within a region, or across various regions. To facilitate the provisioning of volumes for workloads in a multi-zone architecture, Astra Trident uses CSI Topology. Using the CSI Topology feature, access to volumes can be limited to a subset of nodes, based on regions and availability zones. Refer here for additional details.

Kubernetes supports two volume binding modes:

- When **VolumeBindingMode is set to Immediate** (default), Astra Trident creates the volume without any topology awareness. Persistent Volumes are created without having any dependency on the requesting pod's scheduling requirements.

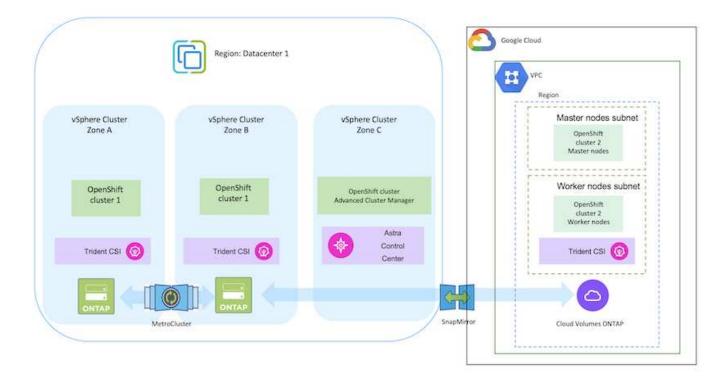
- When **VolumeBindingMode set to WaitForFirstConsumer**, the creation and binding of a Persistent Volume for a PVC is delayed until a pod that uses the PVC is scheduled and created. This way, volumes are created to meet the scheduling constraints that are enforced by topology requirements.

Astra Trident storage backends can be designed to selectively provision volumes based on availability zones (Topology-aware backend). For StorageClasses that make use of such a backend, a volume would only be created if requested by an application that is scheduled in a supported region/zone. (Topology-aware StorageClass) Refer here for additional details.

#### Deploy and configure the Red Hat OpenShift Container platform on GCP

This section describes a high-level workflow of how to set up and manage OpenShift Clusters in GCP and deploy stateful applications on them. It shows the use of NetApp Cloud Volumes ONTAP storage with the help of Astra Trident to provide persistent volumes. Details are provided about the use of Astra Control Center to perform data protection and migration activities for the stateful applications.

Here is a diagram that shows the clusters deployed on GCP and connected to the data center using a VPN.



There are several ways of deploying Red Hat OpenShift Container platform clusters in GCP. This high-level description of the setup provides documentation links for the specific method that was used. You can refer to the other methods in the relevant links provided in the resources section.

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

(i)

- Ensure that you have met all the prerequisites stated here.
- For the VPN connectivity between on-premises and GCP, a pfsense VM was created and configured. For instructions, see here.
  - The remote gateway address in pfsense can be configured only after you have created a VPN gateway in Google Cloud Platform.
  - The remote network IP addresses for the Phase 2 can be configured only after the OpenShift cluster installation program runs and creates the infrastructure components for the cluster.
  - The VPN in Google Cloud can only be configured after the infrastructure components for the cluster are created by the installation program.
- Now install the OpenShift cluster on GCP.
  - Obtain the installation program and the pull secret and deploy the cluster following the steps provided in the documentation here.
  - The installation creates a VPC network in Google Cloud Platform. It also creates a private zone in Cloud DNS and adds A records.
    - Use the CIDR block address of the VPC network to configure the pfsense and establish the VPN connection. Ensure firewalls are setup correctly.
    - Add A records in the DNS of the on-premises environment using the IP address in the A records of the Google Cloud DNS.
  - The installation of the cluster completes and will provide a kubeconfig file and username and password to login to the console of the cluster.

#### Deploy Cloud Volumes ONTAP in GCP using BlueXP.

- Install a connector in Google Cloud. Refer to instructions here.
- Deploy a CVO instance in Google Cloud using the connector. Refer to instructions here. https://docs.netapp.com/us-en/bluexp-cloud-volumes-ontap/task-getting-started-gcp.html

#### Install Astra Trident in the OCP Cluster in GCP

- There are many methods to deploy Astra Trident as shown here.
- For this project, Astra Trident was installed by deploying Astra Trident Operator manually using the instructions here.
- Create backend and a storage classes. Refer to instructions here.

#### Add the OCP cluster on GCP to the Astra Control Center.

- Create a separate KubeConfig file with a cluster role that contains the minimum permissions necessary for a cluster to be managed by Astra Control. The instructions can be found here.
- Add the cluster to Astra Control Center following the instructions here

### Using CSI Topology feature of Trident for multi-zone architectures

Cloud providers, today, enable Kubernetes/OpenShift cluster administrators to spawn nodes of the clusters that are zone based. Nodes can be located in different availability zones within a region, or across various regions. To facilitate the provisioning of volumes for workloads in a multi-zone architecture, Astra Trident uses CSI Topology. Using the CSI Topology feature, access to volumes can be limited to a subset of nodes, based on regions and availability zones. Refer here for additional details.

Kubernetes supports two volume binding modes:

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### **Demonstration Video**

OpenShift Cluster installation on Google Cloud Platform

### Importing OpenShift clusters into Astra Control Center

#### Deploy and configure the Red Hat OpenShift Container platform on Azure

This section describes a high-level workflow of how to set up and manage OpenShift Clusters in Azure and deploy stateful applications on them. It shows the use of NetApp Cloud Volumes ONTAP storage with the help of Astra Trident/Astra Control Provisioner to provide persistent volumes. Details are provided about the use of Astra Control Center to perform data protection and migration activities for the stateful applications.

Here is a diagram that shows the clusters deployed on Azure and connected to the data center using a VPN.

|                           | Region: Datacenter 1      |   | Virtual Network   |
|---------------------------|---------------------------|---|---|
| vSphere Cluster<br>Zone A | vSphere Cluster<br>Zone B | vSphere Cluster<br>Zone C                     | Master nodes subnet<br>OpenShift<br>cluster<br>Master nodes |
| OpenShift<br>cluster 1    | OpenShift<br>cluster 1    | OpenShift cluster<br>Advanced Cluster Manager | Worker nodes subnet   |
| Trident CSI               | Trident CSI               | Astra<br>Control<br>Center                    | Trident CSI   |
|                           |                           | SnapMirro                                     | Cloud Volumes ONTAP   |

There are several ways of deploying Red Hat OpenShift Container platform clusters in Azure. This high-level description of the setup provides documentation links for the specific method that was used. You can refer to the other methods in the relevant links provided in the resources section.

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

(i)

- Ensure that you have met all the prerequisites stated here.
- Create a VPN, subnets and network security groups and a private DNS zone. Create VPN gateway and site-to-site VPN Connection.
- For the VPN connectivity between on-premises and Azure, a pfsense VM was created and configured. For instructions, see here.
- Obtain the installation program and the pull secret and deploy the cluster following the steps provided in the documentation here.
- The installation of the cluster completes and will provide a kubeconfig file and username and password to login to the console of the cluster.

A sample install-config.yaml file is given below.

```
apiVersion: v1
baseDomain: sddc.netapp.com
compute:
- architecture: amd64
  hyperthreading: Enabled
  name: worker
  platform:
    azure:
      encryptionAtHost: false
      osDisk:
        diskSizeGB: 512
        diskType: "StandardSSD LRS"
      type: Standard D2s v3
      ultraSSDCapability: Disabled
      #zones:
      #- "1"
      #- "2"
      #- "3"
  replicas: 3
controlPlane:
  architecture: amd64
  hyperthreading: Enabled
  name: master
  platform:
    azure:
      encryptionAtHost: false
      osDisk:
        diskSizeGB: 1024
        diskType: Premium LRS
      type: Standard D8s v3
      ultraSSDCapability: Disabled
  replicas: 3
```

```
metadata:
  creationTimestamp: null
  name: azure-cluster
networking:
  clusterNetwork:
  - cidr: 10.128.0.0/14
    hostPrefix: 23
  machineNetwork:
  - cidr: 10.0.0/16
  networkType: OVNKubernetes
  serviceNetwork:
  - 172.30.0.0/16
platform:
  azure:
    baseDomainResourceGroupName: ocp-base-domain-rg
    cloudName: AzurePublicCloud
    computeSubnet: ocp-subnet2
    controlPlaneSubnet: ocp-subnet1
    defaultMachinePlatform:
      osDisk:
        diskSizeGB: 1024
        diskType: "StandardSSD LRS"
      ultraSSDCapability: Disabled
    networkResourceGroupName: ocp-nc-us-rg
    #outboundType: UserDefinedRouting
    region: northcentralus
    resourceGroupName: ocp-cluster-ncusrg
    virtualNetwork: ocp vnet ncus
publish: Internal
pullSecret:
```

#### Deploy Cloud Volumes ONTAP in Azure using BlueXP.

- Install a connector in in Azure. Refer to instructions here.
- Deploy a CVO instance in Azure using the connector. Refer to instructions link:https://docs.netapp.com/us-en/bluexp-cloud-volumes-ontap/task-getting-started-azure.html [here.]

#### Install Astra Control Provisioner in the OCP Cluster in Azure

- For this project, Astra Control Provisioner (ACP) was installed on all the clusters (on-prem cluster, onprem cluster where Astra Control Center is deployed and the cluster in Azure). Learn more about the Astra Control Provisioner here.
- Create backend and a storage classes. Refer to instructions here.

### Add the OCP cluster on Azure to the Astra Control Center.

- Create a separate KubeConfig file with a cluster role that contains the minimum permissions necessary for a cluster to be managed by Astra Control. The instructions can be found here.
- Add the cluster to Astra Control Center following the instructions here

### Using CSI Topology feature of Trident for multi-zone architectures

Cloud providers, today, enable Kubernetes/OpenShift cluster administrators to spawn nodes of the clusters that are zone based. Nodes can be located in different availability zones within a region, or across various regions. To facilitate the provisioning of volumes for workloads in a multi-zone architecture, Astra Trident uses CSI Topology. Using the CSI Topology feature, access to volumes can be limited to a subset of nodes, based on regions and availability zones. Refer here for additional details.

Kubernetes supports two volume binding modes:

- When **VolumeBindingMode is set to Immediate** (default), Astra Trident creates the volume without any topology awareness. Persistent Volumes are created without having any dependency on the requesting pod's scheduling requirements.

- When **VolumeBindingMode set to WaitForFirstConsumer**, the creation and binding of a Persistent Volume for a PVC is delayed until a pod that uses the PVC is scheduled and created. This way, volumes are created to meet the scheduling constraints that are enforced by topology requirements.

Astra Trident storage backends can be designed to selectively provision volumes based on availability zones (Topology-aware backend). For StorageClasses that make use of such a backend, a volume would only be created if requested by an application that is scheduled in a supported region/zone. (Topology-aware StorageClass) Refer here for additional details.

### **Demonstration Video**

Using Astra Control for Failover and Failback of applications

### Data protection using Astra Control Center

This page shows the data protection options for Red Hat OpenShift Container based applications running on VMware vSphere or in the cloud using Astra Control Center (ACC).

As users take their journey of modernizing their applications with Red Hat OpenShift, a data protection strategy should be in place to protect them from accidental deletion or any other human errors. Often a protection strategy is also required for regulatory or compliance purposes to protect their data from a diaster.

The requirements of data protection varies from reverting back to a point in time copy to automatically failing over to a different fault domain without any human intervention. Many customers pick ONTAP as their preferred storage platform for their Kubernetes applications because of its rich features like multitenancy, multi-protocol, high performance and capacity offerings, replication and caching for multi-site locations, security and flexibility.

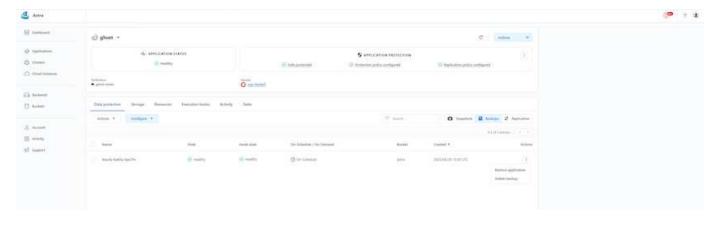
Customers may have a cloud environment setup as their data center extension, so that they can leverage the benefits of the cloud as well as be well positioned to move their workloads at a future time. For such customers, backing up of their OpenShift applications and their data to the cloud environment becomes an

inevitable choice. They can then restore the applications and the associated data either to an OpenShift cluster in the cloud or in their data center.

### Backup and Restore with ACC

Application owners can review and update the applications discovered by ACC. ACC can take Snapshot copies using CSI and perform backup using the point in time Snapshot copy. Backup destination can be an object store in the cloud environment. Protection policy can be configured for scheduled backups and the number of backup versions to keep. The minimum RPO is one hour.

### Restoring an application from a backup using ACC



### Application specific execution hooks

Even though storage array level data protection features are available, often additional steps are needed to make backups and restores application consistent. The app-specific additional steps could be:

- before or after a Snapshot copy is created.
- before or after a backup is created.
- after restoring from a Snapshot copy or backup.

Astra Control can execute these app-specific steps coded as custom scripts called execution hooks.

NetApp's open source project Verda provides execution hooks for popular cloud-native applications to make protecting applications straightforward, robust, and easy to orchestrate. Feel free to contribute to that project if you have enough information for an application that is not in the repository.

Sample execution hook for pre-Snapshot of a redis application.

| OK DETAILS 2  |  |          | EXECUTION HOOKS   |
|---|--|----------|---|
| re-snapshot   | Hook arguments (optional)<br>1 pre ×<br>Enter hook arguments | 1        | Execution hooks allow Astra<br>Control to execute your own<br>custom scripts before or after<br>snapshot. |
| ook name<br>edis-pre-snapshot                                     |  |          | Read more in<br>Manage application executio<br>hooks  |
| NTAINER IMAGES ?  |  |          |   |
| Apply to all container images                                     |  |          |   |
| lse a regular expression to target container images for the hook. |  |          |   |
| ontainer image names to match :<br>•dis                           |  |          |   |
| LIPT P  |  |          |   |
| + Add   |  | ₹ Search |   |
| Name 4  |  |          |   |
| mariadb_mysql.sh  |  |          |   |
| o postgresql.sh   |  |          |   |
| redis_hook.sh   |  |          |   |
|   |  |          |   |

### **Replication with ACC**

For regional protection or for a low RPO and RTO solution, an application can be replicated to another Kubernetes instance running at a different site, preferably in another region. ACC utilizes ONTAP async SnapMirror with RPO as low as 5 minutes.

Refer here for SnapMirror setup instructions.

#### SnapMirror with ACC

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| 2 Dations                                       | i ghost 🔿   |                              |  |  | e  | Adam •                               |
|---|---|------------------------------|--|--|--|--------------------------------------|
| ) Applications<br>Clusters<br>S Courd Instances | -4- APPLICATION STATUS  | <ul> <li>Esty pot</li> </ul> |  | S APPLICATION PROTECTION<br>Production polyly configured | (a) Replication policy configured  | trapher<br>Rack op<br>Cone<br>Nexton |
| Rackends.                                       | Boffottan<br>■ ghad runia   | O operations)                |  |  |  | Fail-over<br>Neverie replication     |
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| Account   | Configure +   |                              |  |  | O Staphots D Sach  | iope 2 Reptorte                      |
| Activity<br>Support                             | Source<br>ghost<br>@ huarby<br>@ huarby<br>@ photo sues<br>Athier ste |                              | Nution<br>Dat<br>unity<br>enternal<br>g served |  | Replication relationship<br>Status<br>Pression (Lauranee)<br>Scretoux<br>Replicate sugnitud revey 5 mean<br>C cop-charter?<br>Mass sync<br>Status (C) second<br>Status (C) second<br>St |                                      |

 $(\mathbf{i})$ 

san-economy and nas-economy storage drivers do not support replication feature. Refer here for additional details.

### Demo video:

Demonstration video of disaster recovery with Astra Control Center

Data protection with Astra Control Center

Details on Astra Control Center Data Protection features are available here

Disaster recovery (Failover and Failback using replication) with ACC

Using Astra Control for Failover and Failback of applications

#### Data migration using Astra Control Center

This page shows the data migration options for container workloads on Red Hat OpenShift clusters with Astra Control Center (ACC). Specifically, customers can use ACC to

- move some selected workloads or all workloads from their on-premises data centers to the cloud

- clone their apps to the cloud either for testing purposes or move from the data center to the cloud

#### **Data Migration**

To migrate application from one environment to another, you can use one of the following features of ACC:

replication

- backup and restore
- clone

Refer to the data protection section for the replication and backup and restore options.

Refer here for additional details about cloning.



Astra Replication feature is only supported with Trident Container Storage Interface (CSI). However, replication is not supported by nas-economy & san-economy drivers.

### Performing data replication using ACC

| 3 Dallboart                          | i ghost 🔿   |  |   | c   | Adam                            |
|--------------------------------------|---|--|---|---|---------------------------------|
| Applications                         | -Ip- APPLICATION STATUS                                   | (1) (1) (1) (1) (1) (1) (1) (1) (1) (1)  | APPLICATION PROTECTION                          | <ul> <li>Regisation policy configured</li> </ul>  | Staphet<br>Rack op              |
| S Coud Hotamore                      | Bellestan<br>• ghoù runa                                  | Channer<br>Channer<br>Sammer   | <ol> <li>Lingerpoi Bould (prephrint)</li> </ol> | <ul> <li>Within the point's considered</li> </ul>   | Cone<br>Aestore                 |
| à taounte                            | - processor   | O apression  |   |   | Fall-over<br>Reverse replicatio |
| ] Buckett                            | Data permantan Storage Resources Esteution hooks Activity | Tanks  |   |   | banange                         |
|                                      | Configure *   |  |   | o traphoto 🔒 Sach   | ape 2 August                    |
| 5 Account<br>3 Activity<br>3 Support |   |  |   | Replication relationship  |                                 |
| 2 support                            |   |  |   | STATUS<br>(a) matty   tatatoned<br>Schitzus<br>Replicate scapitor every 5 mon<br>C conclusion | wito.                           |
|                                      | ghoat<br>C inautry<br>C reautry                           | Contractors<br>ghott<br>@ heathy<br>@ heat |   | LAST SYNC<br>2002 DOLDS YMHS UTC<br>Sync duration 20 seconds                                  |                                 |
|                                      | Altheute  |  |   |   |                                 |

# NetApp Hybrid Multicloud solutions for Red Hat OpenShift Container workloads

NetApp is seeing a significant increase in customers modernizing their legacy enterprise applications and building new applications using containers and orchestration platforms built around Kubernetes. Red Hat OpenShift Container Platform is one example that we see adopted by many of our customers.

### Overview

As more and more customers begin adopting containers within their enterprises, NetApp is perfectly positioned to help serve the persistent storage needs of their stateful applications and classic data management needs such as data protection, data security, and data migration. However, these needs are met using different strategies, tools, and methods.

**NetApp ONTAP** based storage options listed below, deliver security, data protection, reliability, and flexibility for containers and Kubernetes deployments.

• Self-managed storage in on-premises:

- NetApp Fabric Attached Storage (FAS), NetApp All Flash FAS Arrays (AFF), NetApp All SAN Array (ASA) and ONTAP Select
- Provider-managed storage in on-premises:
  - NetApp Keystone provides Storage as a Service (STaaS)
- Self-managed storage in the cloud:
  - · NetApp Cloud Volumes ONTAP(CVO) provide self managed storage in the hyperscalers
- Provider-managed storage in the cloud:
  - Cloud Volumes Service for Google Cloud (CVS), Azure NetApp Files (ANF), Amazon FSx for NetApp ONTAP offer fully managed storage in the hyperscalers

| Storage Administration   | Performance & Scalability   |  |  |
|--|---|--|--|
| Multi-tenancy     ONTAP CLI & API     FlexVol & FlexGroup     System Manager & BlueXP     LUN     Quotas | FlexCache     flexClone     flexClone |  |  |
| Availability & Resilience  | Access Protocols  |  |  |
| Multi-AZ HA deployment<br>(MetroCluster)     SnapShot & SnapRestore     SnapMirror Cloud     SnapMirror  | • NFS -v3, v4, v4.1, v4.2     • iSCSI     • SMB - v2, v3     • Multi-protocol access  |  |  |
| Storage Efficiency   | Security & Compliance   |  |  |
| Deduplication & Compression     Thin provisioning  | Fpolicy & Vscan     LDAP & Kerberos   |  |  |
| Compaction     Data Tiering (Fabric Pool)  | Active Directory integration     Certificate based authentication   |  |  |

**NetApp BlueXP** enables you to manage all of your storage and data assets from a single control plane/interface.

You can use BlueXP to create and administer cloud storage (for example, Cloud Volumes ONTAP and Azure NetApp Files), to move, protect, and analyze data, and to control many on-prem and edge storage devices.

**NetApp Astra Trident** is a CSI Compliant Storage Orchestrator that enable quick and easy consumption of persistent storage backed by a variety of the above-mentioned NetApp storage options. It is an open-source software maintained and supported by NetApp.

# **ONTAP** feature highlights

# Astra Trident CSI feature highlights

| <ul> <li>CSI NetApp<sup>®</sup> Snapshot<sup>™</sup> copies and volume creation from CSI Snapshot copies</li> <li>CSI topology</li> <li>Volume expansion</li> </ul> | Security <ul> <li>Dynamic-export policy management</li> <li>iSCSI initiator-groups dynamic management</li> <li>iSCSI bidirectional CHAP</li> </ul> |  |  |  |  |
|---|--|--|--|--|--|
| Storage and performance volume Import<br>consumption     Monitoring     Cross Namespace Volume<br>Access  | Installation methods <ul> <li>Binary</li> <li>Operator</li> <li>Helm chart</li> <li>GitOps</li> </ul>  |  |  |  |  |
| Choose your access mode         • RWO (ReadWriteOnce, i.e 1⇔1)       • RWOP (ReadWriteOnce POD)         • RWX (ReadWriteMany, i.e 1⇔n)         • ROX (ReadOnlyMany) | Choose your protocol <ul> <li>NFS</li> <li>SMB</li> <li>iSCSI</li> </ul>   |  |  |  |  |

Business critical container workloads need more than just persistent volumes. Their data management requirements require protection and migration of the application kubernetes objects as well.

Application data includes kubernetes objects in addition to the user data: Some examples are as follows:

- kubernetes objects such as pods specs, PVCs, deployments, services
- custom config objects such as config maps and secrets
- persistent data such as Snapshot copies, backups, clones
- custom resources such as CRs and CRDs

**NetApp Astra Control**, available as both fully-managed and self-managed software, provides orchestration for robust application data management. Refer to the Astra documentation for additional details on the Astra family of products.

This reference documentation provides validation of migration and protection of container-based applications, deployed on RedHat OpenShift container platform, using NetApp Astra Control Center. In addition, the solution provides high-level details for the deployment and the use of Red Hat Advanced Cluster Management (ACM) for managing the container platforms. The document also highlights the details for the integration of NetApp storage with Red Hat OpenShift container platforms using Astra Trident CSI provisioner. Astra Control Center is deployed on the hub cluster and is used to manage the container applications and their persistent storage lifecycle. Finally, it provides a solution for replication and failover and fail-back for container workloads on managed Red Hat OpenShift clusters in AWS (ROSA) using Amazon FSx for NetApp ONTAP (FSxN) as persistent storage.

#### NetApp Solution with Managed Red Hat OpenShift Container platform workloads on AWS

Customers may be "born in the cloud" or may be at a point in their modernization journey when they are ready to move some select workloads or all workloads from their data centers to the cloud. They may choose to use provider-managed OpenShift containers and provider-managed NetApp storage in the cloud for running their workloads. They should plan and deploy the Managed Red Hat OpenShift container clusters (ROSA) in the cloud for a successful production-ready environment for their container workloads. When they are in AWS cloud, they could also deploy FSx for NetApp ONTAP for the storage needs.

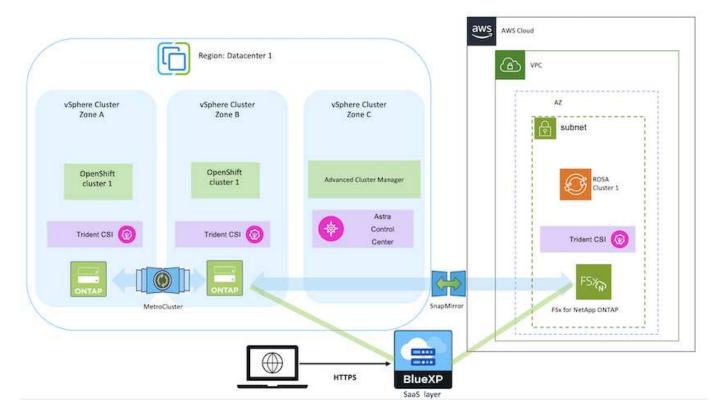
FSx for NetApp ONTAP delivers data protection, reliability, and flexibility for container deployments in AWS. Astra Trident serves as the dynamic storage provisioner to consume the persistent FSxN storage for customers' stateful applications.

As ROSA can be deployed in HA mode with control plane nodes spread across multiple availability zones, FSx ONTAP can also be provisioned with Multi-AZ option which provides high availability and protect against AZ failures.



There are no data transfer charges when accessing an Amazon FSx file system from the file system's preferred Availability Zone (AZ). For more info on pricing, refer here.

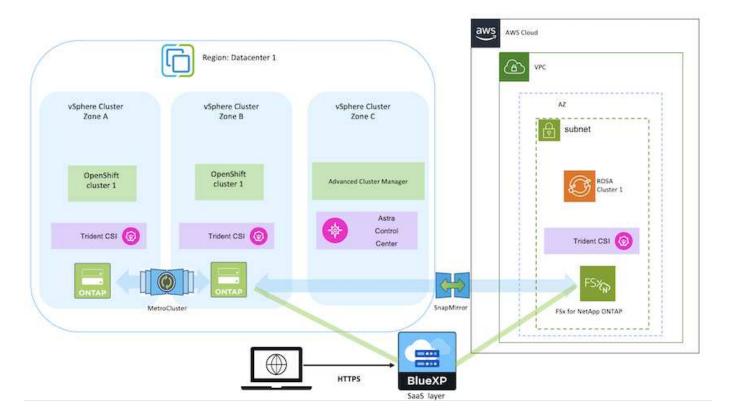
### Data protection and migration solution for OpenShift Container workloads



## Deploy and configure the Managed Red Hat OpenShift Container platform on AWS

This section describes a high-level workflow of setting up the Managed Red Hat OpenShift clusters on AWS(ROSA). It shows the use of Managed FSx for NetApp ONTAP (FSxN) as the storage backend by Astra Trident to provide persistent volumes. Details are provided about the deployment of FSxN on AWS using BlueXP. Also, details are provided about the use of BlueXP and OpenShift GitOps (Argo CD) to perform data protection and migration activities for the stateful applications on ROSA clusters.

Here is a diagram that depicts the ROSA clusters deployed on AWS and using FSxN as the backend storage.



This solution was verified by using two ROSA clusters in two VPCs in AWS. Each ROSA cluster was integrated with FSxN using Astra Trident. There are several ways of deploying ROSA clusters and FSxN in AWS. This high-level description of the setup provides documentation links for the specific method that was used. You can refer to the other methods in the relevant links provided in the resources section.

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

#### Install ROSA clusters

- Create two VPCs and set up VPC peering connectivity between the VPCs.
- Refer here for instructions to install ROSA clusters.

#### Install FSxN

(i)

- Install FSxN on the VPCs from BlueXP.
   Refer here for BlueXP account creation and to get started.
   Refer here for installing FSxN.
   Refer here for creating a connector in AWS to manage the FSxN.
- Deploy FSxN using AWS. Refer here for deployment using AWS console.

• Use Helm chart to install Trident on ROSA clusters. url for the Helm chart: https://netapp.github.io/trident-helm-chart

### Integration of FSxN with Astra Trident for ROSA clusters



OpenShift GitOps can be utilized to deploy Astra Trident CSI to all managed clusters as they get registered to ArgoCD using ApplicationSet.





- Refer here for details about creating backend and storage class.
- Make the storage class created for FsxN with Trident CSI as default from OpenShift Console. See screenshot below:

| C Administrator                            |    | StorageClasses           |                       |  | Crea           | ite StorageClas |  |
|--|----|--------------------------|-----------------------|--|----------------|-----------------|--|
| Home                                       | \$ | Name - Search by name_ / |                       |  |                |                 |  |
| Operators                                  | •  | Name                     | Provisioner 1         |  | Reclaim policy |                 |  |
| Workloads                                  | >  | Ste foxt-nas - Default   | csi.trident.netapp.io |  | Delete         | I               |  |
| Networking                                 | •  | <b>(1)</b> gp2           | kubernetes io/wws-ebs |  | Delete         | I               |  |
| <b>.</b>                                   | ~  | 🗊 gp2-csi                | ebs.csi.aws.com       |  | Delete         | I               |  |
| Storage                                    | Č  | 60 gp 3                  | ebs.cpl.aws.com       |  | Delete         | :               |  |
| PersistentVolumes<br>PersistentVolumeClain | ns | <b>69</b> (p3-cs)        | ebs.csi.aws.com       |  | Delete         | I               |  |

### Deploy an application using OpenShift GitOps (Argo CD)

- Install OpenShift GitOps operator on the cluster. Refer to instructions here.
- SetUp a new Argo CD instance for the cluster. Refer to instructions here.

Open the console of Argo CD and deploy an app. As an example, you can deploy a Jenkins App using Argo CD with a Helm Chart. When creating the application, the following details were provided: Project: default cluster: https://kubernetes.default.svc Namespace: Jenkins The url for the Helm Chart: https://charts.bitnami.com/bitnami

Helm Parameters: global.storageClass: fsxn-nas

#### **Data protection**

This page shows the data protection options for Managed Red Hat OpenShift on AWS (ROSA) clusters using Astra Control Service. Astra Control Service (ACS) provides an easy-to-use graphical user-interface with which you can add clusters, define applications running on them, and perform application aware data management activities. ACS functions can also be accessed using an API that allows for automation of workflows.

Powering Astra Control (ACS or ACC) is NetApp Astra Trident. Astra Trident integrates several types of Kubernetes clusters such as Red Hat OpenShift, EKS, AKS, SUSE Rancher, Anthos etc., with various flavors of NetApp ONTAP storage such as FAS/AFF, ONTAP Select, CVO, Google Cloud Volumes Service, Azure

NetApp Files and Amazon FSx for NetApp ONTAP.

This section provides details for the following data protection options using ACS:

- A video showing Backup and Restore of a ROSA application running in one region and restoring to another region.
- A video showing Snapshot and Restore of a ROSA application.
- Step-by-step details of installing a ROSA cluster, Amazon FSx for NetApp ONTAP, using NetApp Astra Trident to integrate with storage backend, installing a postgresql application on ROSA cluster, using ACS to create a snapshot of the application and restoring the application from it.
- A blog showing step-by-step details of creating and restoring from a snapshot for a mysql application on a ROSA cluster with FSx for ONTAP using ACS.

#### Backup/Restore from Backup

The following video shows the backup of a ROSA application running in one region and restoring to another region.

#### FSx NetApp ONTAP for Red Hat OpenShift Service on AWS

#### Snapshot/Restore from snapshot

The following video shows taking a snapshot of a ROSA application and restoring from the snapshot after.

Snapshot/Restore for Applications on Red Hat OpenShift Service on AWS (ROSA)clusters with Amazon FSx for NetApp ONTAP storage

#### Blog

• Using Astra Control Service for data management of apps on ROSA clusters with Amazon FSx storage

#### Step-by-Step Details to create snapshot and restore from it

#### **Prerequisite setup**

- AWS account
- Red Hat OpenShift account
- · IAM user with appropriate permissions to create and access ROSA cluster
- AWS CLI
- ROSA CLI
- OpenShift CLI(oc)
- · VPC with subnets and appropriate gateways and routes
- ROSA Cluster installed into the VPC
- · Amazon FSx for NetApp ONTAP created in the same VPC
- Access to the ROSA cluster from OpenShift Hybrid Cloud Console

#### **Next Steps**

1. Create an admin user and login to the cluster.

- 2. Create a kubeconfig file for the cluster.
- 3. Install Astra Trident on the cluster.
- 4. Create a backend, storage class and snapshot class configuration using the Trident CSI provisioner.
- 5. Deploy a postgresql application on the cluster.
- 6. Create a database and add a record.
- 7. Add the cluster into ACS.
- 8. Define the application in ACS.
- 9. Create a snapshot using ACS.
- 10. Delete the database in the postgresql application.
- 11. Restore from a snapshot using ACS.
- 12. Verify your app has been restored form the snapshot.

# 1. Create an admin user and login to the cluster

Access the ROSA cluster by creating an admin user with the following command : (You need to create an admin user only if you did not create one at the time of installation)

rosa create admin --cluster=<cluster-name>

The command will provide an output that will look like the following. Login to the cluster using the oc login command provided in the output.

W: It is recommended to add an identity provider to login to this cluster. See 'rosa create idp --help' for more information. I: Admin account has been added to cluster 'my-rosa-cluster'. It may take up to a minute for the account to become active. I: To login, run the following command: oc login https://api.my-rosa-cluster.abcd.p1.openshiftapps.com:6443 \ --username cluster-admin \ --password FWGYL-2mkJI-00000-00000



You can also login to the cluster using a token. If you already created an admin-user at the time of cluster creation, you can login to the cluster from the Red Hat OpenShift Hybrid Cloud console with the admin-user credentials. Then by clicking on the top right corner where it displays the name of the logged in user, you can obtain the oc login command (token login) for the command line.

# 2. Create a kubeconfig file for the cluster

Follow the procedures here to create a kubeconfig file for the ROSA cluster. This kubeconfig file will be used later when you add the cluster into ACS.

#### 3. Install Astra Trident on the cluster

Install Astra Trident (latest version) on the ROSA cluster. To do this, you can follow any one of the procedures

given here. To install Trident using helm from the console of the cluster, first create a project called Trident.

| ≡ ■ Red Ha<br>OpenS   | n <b>t</b><br>hift Service on AWS |        |   |           | = | <b>\$</b> 2 | Ð       | 0          | cluster-a | dmin <del>-</del> |
|-----------------------|-----------------------------------|--------|---|-----------|---|-------------|---------|------------|-----------|-------------------|
| Projects              |                                   |        |   |           |   |             |         |            | Create    | Project           |
| <b>Y</b> Filter • Nam | trident                           |        |   |           |   |             |         |            |           |                   |
| Name trident X C      | lear all filters                  |        |   |           |   |             |         |            |           |                   |
| Name I                | Display name                      | Status | I | Requester | I |             | Created | 1.1        |           |                   |
| PR trident            | trident                           | Active |   | rosaadmin |   |             | 🛛 Feb 1 | 2, 2024, 9 | 9:54 PM   | :                 |

Then from the Developer view, create a Helm chart repository. For the URL field use

'https://netapp.github.io/trident-helm-chart'. Then create a helm release for Trident operator.

| Project trident 👻   |
|---|
| Create Helm Chart Repository<br>Add helm chart repository.            |
| Configure via:      Form view      YAML view                          |
| Scope type  |
| <ul> <li>Namespaced scoped (ProjectHelmChartRepository)</li> </ul>    |
| Add Helm Chart Repository in the selected namespace.                  |
| Cluster scoped (HelmChartRepository)                                  |
| Add Helm Chart Repository at the cluster level and in all namespaces. |
| Name *  |
| trident   |
| A unique name for the Helm Chart repository.                          |
| Display name  |
| Astra Trident   |
| A display name for the Helm Chart repository.                         |
| Description   |
| NetApp Astra Trident  |
| A description for the Helm Chart repository.                          |
| Disable usage of the repo in the developer catalog.                   |
| URL *   |
| https://netapp.github.io/trident-helm-chart                           |
|   |

| Project: trident 🔹                                 |  |       |
|--|--|-------|
| Developer Catalog > Helm Cha                       | rts  |       |
| Helm Charts  |  |       |
|  | nage complex installations and upgrades. Clus<br>rs can try to configure their own custom Helm |       |
| All items  | All items  |       |
| CI/CD  | 0  |       |
| Languages  | Q Filter by keyword  | A-Z • |
| Other  |  |       |
| Chart Repositories                                 | Helm Chart   | 5)    |
| Astra Trident (1)                                  | TRIDENT  |       |
| <ul> <li>OpenShift Helm<br/>Charts (87)</li> </ul> | Trident Operator   |       |
|  | A Helm chart for deploying   |       |
| Source   | NetApp's Trident CSI storage   |       |
| Community (33)                                     | provisioner using the Trident  |       |
| Partner (42)                                       |  |       |
| Red Hat (12)                                       |  |       |

Verify all trident pods are running by going back to the Administrator view on the console and selecting pods in the trident project.

| <b>Red Hat</b><br>OpenShift Service                | on AWS                                    |                |         |            |                                      |      |
|--|---|----------------|---------|------------|--------------------------------------|------|
| 🏟 Administrator 👻                                  | Project: trident 🔹                        |                |         |            |                                      |      |
| Home >   | Pods                                      |                |         |            |                                      |      |
| Operators >  | ▼ Filter ▼ Name                           | Search by name | 1       |            |                                      |      |
| Workloads 🗸 🗸                                      | Name 1                                    | Status 1       | Ready 1 | Restarts 🗍 | Owner 1                              | Memo |
| Pods   | P trident-controller-<br>69cff44ddf-4dqnj | 2 Running      | 6/6     | 0          | RS trident-controller-<br>69cff44ddf | -    |
| Deployments<br>DeploymentConfigs                   | P trident-node-linux-<br>4b6fm            | 2 Running      | 2/2     | 0          | DS trident-node-linux                | -    |
| StatefulSets                                       | P trident-node-linux-<br>4sckw            | C Running      | 2/2     | 0          | DS trident-node-linux                | -    |
| Secrets<br>ConfigMaps                              | P trident-node-linux-<br>7I42w            | C Running      | 2/2     | 0          | DS trident-node-linux                |      |
| CronJobs   | P trident-node-linux-<br>dbhp4            | 2 Running      | 2/2     | 0          | OS trident-node-linux                | -    |
| Jobs<br>DaemonSets                                 | P trident-node-linux-<br>gj5km            | 2 Running      | 2/2     | 0          | OS trident-node-linux                |      |
| ReplicaSets  | P trident-node-linux-<br>r79c8            | 2 Running      | 2/2     | 0          | OS trident-node-linux                | -    |
| ReplicationControllers<br>HorizontalPodAutoscalers | P trident-node-linux-<br>tzwdp            | C Running      | 2/2     | 0          | DS trident-node-linux                | -    |
| PodDisruptionBudgets                               | P trident-node-linux-<br>vdvxt            | C Running      | 2/2     | 0          | DS trident-node-linux                |      |
| Networking >                                       | P trident-operator-<br>7f7fd45c68-6crcb   | C Running      | 1/1     | 0          | RS trident-operator-<br>7f7fd45c68   | -    |

# 4. Create a backend, storage class and snapshot class configuration using the Trident CSI provisioner

Use the yaml files shown below to create a trident backend object, storage class object and the Volumesnapshot object. Be sure to provide the credentials to your Amazon FSx for NetApp ONTAP file system you created, the management LIF and the vserver name of your file system in the configuration yaml for the backend. To get those details, go to the AWS console for Amazon FSx and select the file system, navigate to the Administration tab. Also, click on update to set the password for the fsxadmin user.



You can use the command line to create the objects or create them with the yaml files from the hybrid cloud console.

| ESx > File systems > fs-049f9a23aac951429   |   |  |
|---|---|--|
| fsx-for-rosa (fs-049f9a23aac951429)   |   |  |
| ▼ Summary   |   |  |
| File system ID<br>fs=049f9a23aac951429<br>Lifecycle state<br>Available<br>File system type<br>ONTAP<br>Deployment type<br>Single=AZ   | SSD storage capacity Update | Availability Zones<br>us-west-2b 🗇<br>Creation time<br>2024-02-12T20:15:23-05:00     |
| Network & security Monitoring & performance Administration Stora  | ge virtual machines Volumes Backups Updates Tags  |  |
| ONTAP administration  |   |  |
| Management endpoint - DNS name<br>management.fs-049f9a23aac951429.fsx.us-west-2.amazonaws.com 🗗<br>Inter-cluster endpoint - DNS name<br>intercluster.fs-049f9a23aac951429.fsx.us-west-2.amazonaws.com 🗗 | Management endpoint - IP address<br>10.49.9.135 🗗<br>Inter-cluster endpoint - IP address<br>10.49.9.49 🗗<br>10.49.9.251 🗗   | ONTAP administrator username<br>fsxadmin 🗗<br>ONTAP administrator password<br>Update |

#### **Trident Backend Configuration**

```
apiVersion: v1
kind: Secret
metadata:
 name: backend-tbc-ontap-nas-secret
type: Opaque
stringData:
 username: fsxadmin
 password: <password>
___
apiVersion: trident.netapp.io/v1
kind: TridentBackendConfig
metadata:
 name: ontap-nas
spec:
 version: 1
  storageDriverName: ontap-nas
  managementLIF: <management lif>
  backendName: ontap-nas
  svm: fsx
  credentials:
    name: backend-tbc-ontap-nas-secret
```

# Storage Class

```
apiVersion: storage.k8s.io/v1
kind: StorageClass
metadata:
   name: ontap-nas
provisioner: csi.trident.netapp.io
parameters:
   backendType: "ontap-nas"
   media: "ssd"
   provisioningType: "thin"
   snapshots: "true"
allowVolumeExpansion: true
```

#### snapshot class

```
apiVersion: snapshot.storage.k8s.io/v1
kind: VolumeSnapshotClass
metadata:
    name: trident-snapshotclass
driver: csi.trident.netapp.io
deletionPolicy: Delete
```

Verify that the backend, storage class and the trident-snapshotclass objects are created by issuing the commands shown below.

| NAME BAC        | CKEND NAME BACKEND UUI     | )            |                | PHASE     | STATI | S                    |       |
|-----------------|----------------------------|--------------|----------------|-----------|-------|----------------------|-------|
| ontap-nas ont   | tap-nas 8a5e4583-2da       | ac-46bb-b01e | -fa7c3816f121  | Bound     | Succe | ess                  |       |
| [ec2-user@ip-10 | 0-49-11-132 storage]\$ kut | pectl get so |                |           |       |                      |       |
| NAME            | PROVISIONER                | RECLAIMPOL   | ICY VOLUMEBI   | NDINGMODE |       | ALLOWVOLUMEEXPANSION | AGE   |
| gp2             | kubernetes.io/aws-ebs      | Delete       | WaitForF       | irstConsu | mer   | true                 | 3h23m |
| gp2-csi         | ebs.csi.aws.com            | Delete       | WaitForF       | irstConsu | mer   | true                 | 3h19m |
| gp3 (default)   | ebs.csi.aws.com            | Delete       | WaitForF       | irstConsu | mer   | true                 | 3h23m |
| gp3-csi         | ebs.csi.aws.com            | Delete       | WaitForF       | irstConsu | mer   | true                 | 3h19m |
| ontap-nas       | csi.trident.netapp.io      | Delete       | Immediat       | e         |       | true                 | 141m  |
| [ec2-user@ip-16 | 0-49-11-132 storage]\$ kui | pectl get Vo | lumesnapshotcl | ass       |       |                      |       |
| NAME            | DRIVER                     | DE           | LETIONPOLICY   | AGE       |       |                      |       |
| csi-aws-vsc     | ebs.csi.aws.com            | n De         | lete           | 3h19m     |       |                      |       |
| trident-snapsho | otclass csi.trident.net    | tapp.io De   | lete           | 6m56s     |       |                      |       |
| [ec2-user@ip-16 | 0-49-11-132 storage]\$ _   |              |                |           |       |                      |       |

At this time, an important modification you need to make is to set ontap-nas as the default storage class instead of gp3 so that the postgresql app you deploy later can use the default storage class. In the Openshift console of your cluster, under Storage select StorageClasses. Edit the annotation of the current default class to be false and add the annotation storageclass.kubernetes.io/is-default-class set to true for the ontap-nas storage class.

|                  |  |                | ··· A .     | <b>9</b> 00    | luster-admin <del>-</del> |
|------------------|--|----------------|-------------|----------------|---------------------------|
| StorageClasses   | Edit annotations<br>Key<br>storageclass.kubernetes.io/is | Value<br>false | •           | Cre            | eate StorageClass         |
| Name 1           | Add more   |                |             | Reclaim policy | / 1<br>I                  |
| SC gp2-csi       |  |                | Cancel Save | Delete         | 1                         |
| SC gp3 – Default | ebs.csi.av   | vs.com         |             | Delete         | 1                         |
| SC gp3-csi       | ebs.csi.av   | ws.com         |             | Delete         | 1                         |
| SC ontap-nas     | csitriden  | nt.netapp.io   |             | Delete         | 1                         |

| StorageClasses           |                       | Create StorageClass |
|--------------------------|-----------------------|---------------------|
| Name   Search by name  I |                       |                     |
| Name 1                   | Provisioner 💲         | Reclaim policy 1    |
| SG gp2                   | kubernetes.io/aws-ebs | Delete              |
| SC gp2-csi               | ebs.csi.aws.com       | Delete <b>1</b>     |
| SC gp3                   | ebs.csi.aws.com       | Delete #            |
| SC gp3-csi               | ebs.csi.aws.com       | Delete              |
| SC ontap-nas - Default   | csi.trident.netapp.io | Delete              |

# 5. Deploy a postgresql application on the cluster

You can deploy the application from the command line as follows:

helm install postgresql bitnami/postgresql -n postgresql --create-namespace

|                                      | 49-11-132 astra]\$ helm install postgresql bitnami/postgresql -n postgresqlcreate-namespace   |
|--------------------------------------|---|
| NAME: postgresql                     | ue Feb 13 14:46:16 2024   |
| NAMESPACE: posta                     |   |
| STATUS: deployed                     |   |
| REVISION: 1                          |   |
| TEST SUITE: None                     |   |
| NOTES:                               |   |
| CHART NAME: post<br>CHART VERSION: 1 |   |
| APP VERSION: 16.                     |   |
| Personal and a second second         | ient while the chart is being deployed **   |
| Statement and the second             |   |
| PostgreSQL can b                     | e accessed via port \$432 on the following DMS names from within your cluster:  |
| postgresql.p                         | ostgresql.svc.cluster.local - Read/Write connection   |
| To get the passw                     | word for "postgres" run:  |
| export POSTG                         | RES_PASSWORD=\$(kubect1 get secretnamespace postgresq1 postgresq1 -o jsonpath="{.data.postgres-password}"   base64 -d)  |
| To connect to yo                     | our database run the following command:   |
| kubectl run<br>PASSWORD-\$POSTGR     | postgresql-clientrmtty -irestart='Never'namespace postgresqlimage docker.io/bitnami/postgresql:16.2.0-debian-11-r1env="PG   |
|                                      | psqlhost postgresql -U postgres -d postgres -p 5432   |
|                                      | ou access the container using bash, make sure that you execute "/opt/bitnami/scripts/postgresql/entrypoint.sh /bin/bash" in order to avoid<br>local user with ID 1001} does not exist"  |
| To connect to yo                     | our database from outside the cluster execute the following commands:   |
|                                      | -forwardnamespace postgresql svc/postgresql 5432:5432 &<br>\$POSTGRES_PASSWORD" psqlhost 127.0.0.1 -U postgres -d postgres -p 5432  |
| case, old PVC w                      | afigured password will be ignored on new installation in case when previous PostgreSQL release was deleted through the helm command. In that<br>ill have an old password, and setting it through helm won't take effect. Deleting persistent volumes (PVs) will solve the issue.<br>49-11-132 astra]5 _ |
|                                      | If you do not see the application pods running, then there might be an error caused due to  |
|                                      |   |
|                                      | security context constraints.   |

image::rhhc-scc-error.png[]

(i)

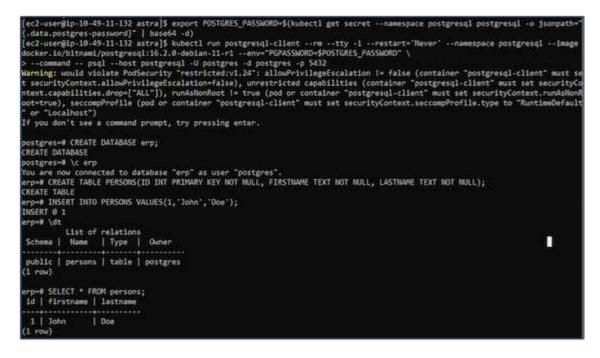
Fix the error by editing the runAsUser and fsGroup fields in statefuleset.apps/postgresql object with the uid that is in the output of the oc get project command as shown below. image::rhhc-scc-fix.png[]

postgresql app should be running and using persistent volumes backed by Amazon FSx for NetApp ONTAP storage.

| NAME         | READY | STATUS  | RESTARTS | AGE   |
|--------------|-------|---------|----------|-------|
| postgresql-0 | 1/1   | Running | 0        | 2m46s |

| [ec2-user@ip-10-49- | 11-132 st               | corage]\$ kubect1 get pvc -n postgresq1  |          |              |              |      |
|---------------------|-------------------------|--|----------|--------------|--------------|------|
| NAME                | STATUS                  | VOLUME                                   | CAPACITY | ACCESS MODES | STORAGECLASS | AGE  |
| data-postgresql-0   | Bound                   | pvc-dd09524a-de75-4825-9424-03a9b91195ca | 8Gi      | RWO          | ontap-nas    | 4m2s |
| [ec2-user@ip-10-49- | 11-13 <mark>2</mark> st | torage]\$                                |          |              |              |      |

6. Create a database and add a record



#### 7. Add the cluster into ACS

Log in to ACS. Select cluster and click on Add. Select other and upload or paste the kubeconfig file.

| Add cluster   |  |   |   |
|---|--|---|---|
| OVIDER  |  |   |   |
| Microsoft Azure   | Soogle Cloud Platform  | aws Amazon Web Services   | left Other  |
| IBECONFIG   |  |   |   |
| (i) Please ensure that the  | kubeconfig used for this cluster has a   | a long-lived token associated with it.  |   |
|   |  |   |   |
|   |  |   |   |
|   |  | kubeconfig credential. Follow these instr   | uctions 🖸 on how to create  |
| a dedicated admin-role kubect   | nfig.  | kubeconfig credential. Follow these <u>instr</u>                                      | uctions 🖸 on how to create  |
| a dedicated admin-role kubece<br>Upload file Paste or type  | nfig.  | kubeconfig credential. Follow these <u>instr</u><br>bmFc2SI6ImFzdHJhY29udHJvbC1z2XJ2a |   |
| a dedicated admin-role kubect<br>Upload file Paste or type<br>XJuZXR1cy5pby9zZXJ2aWN1Y<br>1cm51dGVzLm1vL3N1cnZpY2V<br>To1LCJzdWI101JzeXN02W06c  | nfig.<br>WNjb3VudC9zZXJ2aWN1LWFjY291bnQu<br>hY2NvdW50L3N1cn2pY2UtYWNjb3VudC  |   | WN1LWFjY291bnQ1LCJrdWJ<br>tCWFkNS0z2D15Nz&2N2N1N  |
| a dedicated admin-role kubeco<br>Upload file Paste or type<br>XJuZXRlcySpby9zZXJ2aWN1Y<br>lcm5ldGVzLmlvL3NlcnZpY2V<br>TciLC3zdW1i0iJzeXN02W06c<br>LkW-8ZDYOShQ5UolaSbJ-<br>0SId5r0EbvfcQ3tSf40VC72n | nfig.<br>WNjb3VudC9zZXJ2aWN1LWFjY291bnQu<br>hY2NvdWS0L3N1cnZpY2UtYWNjb3VudC<br>2Vydmlj2WFjY291bnQ62GVmYXVadDpb<br>M4BqYbN8cm0y0V81pF30G7tYA9XAIdw2 | bmFt2SI6ImFzdHJhY29udHJvbC1z2XJ2a<br>51aWQ101I4NzFhOTI4McOwMTEyLTRmYzA                | WN1LWFjY291bnQ1LCJrdWJ<br>tCWFkNS0z2DI5NzR2N2NiN<br>W50In0.M7-IRxcaKCe7S-<br>uqU63t8LLmeenCB1Cm9PaD |

Click **Next** and select ontap-nas as the default storage class for ACS. Click **Next**, review the details and **Add** the cluster.

| 🛱 Add clu     | ıster                            | STEP 2/3: STORAG      | E              |                      | ×                            |
|---------------|----------------------------------|-----------------------|----------------|----------------------|------------------------------|
| STORAGE       |                                  |                       |                |                      |                              |
| ✓ Assign a    | new default storage class        |                       |                |                      |                              |
| The following | storage classes are available on | the cluster.          |                |                      |                              |
| Set default   | Storage class                    | Storage provisioner   | Reclaim policy | Binding mode         | Eligibility                  |
| <u> </u>      | gp2                              | kubernetes.io/aws-ebs | Delete         | waitForFirstConsumer |                              |
|               | gp2-csi                          | ebs.csi.aws.com       | Delete         | WaitForFirstConsumer | 🕑 Eligible                   |
|               | gp3                              | ebs.csi.aws.com       | Delete         | WaitForFirstConsumer | <ul> <li>Eligible</li> </ul> |
|               | gp3-csi                          | ebs.csi.aws.com       | Delete         | WaitForFirstConsumer | ⊘ Eligible                   |
|               | ontap-nas Default                | csi.trident.netapp.io | Delete         | Immediate            | ⊘ Eligible                   |
|               |                                  | ← Back Ne             | ext →          |                      |                              |

#### 8. Define the application in ACS

Define the postgresql application in ACS. From the landing page, select **Applications**, **Define** and fill in the appropriate details. Click **Next** a couple of times, Review the details and click **Define**. The application gets added to ACS.

| Add cluster   |                                  | STEP 2/3: STORA       | GE             |                      | ×           |
|---------------|----------------------------------|-----------------------|----------------|----------------------|-------------|
| STORAGE       |                                  |                       |                |                      |             |
| ✓ Assign a    | new default storage class        |                       |                |                      |             |
| The following | storage classes are available on | the cluster.          |                |                      |             |
| Set default   | Storage class                    | Storage provisioner   | Reclaim policy | Binding mode         | Eligibility |
| U.            | gpz                              | kupernetes.io/aws-eps | Delete         | waitForFirstConsumer |             |
|               | gp2-csi                          | ebs.csi.aws.com       | Delete         | WaitForFirstConsumer | ⊘ Eligible  |
|               | gp3                              | ebs.csi.aws.com       | Delete         | WaitForFirstConsumer | ⊘ Eligible  |
|               | gp3-csi                          | ebs.csi.aws.com       | Delete         | WaitForFirstConsumer | Sligible    |
| . •           | ontap-nas Default                | csi.trident.netapp.io | Delete         | Immediate            | ⊘ Eligible  |
|               |                                  | ← Back                | Next →         |                      |             |

#### 9. Create a snapshot using ACS

There are many ways to create a snapshot in ACS. You can select the application and create a snapshot from the page that shows the details of the application. You can click on Create snapshot to create an on-demand snapshot or configure a protection policy.

Create an on-demand snapshot by simply clicking on **Create snapshot**, providing a name, reviewing the details, and clicking on **Snapshot**. The snapshot state changes to Healthy after the operation is completed.

| [2] Dashboard   | Data protection Storage Resources Exe       | ecution hooks Activity Tasks   |
|-----------------|---|--|
| Applications    | Actions  Configure protection policy        | 😇 Search   |
| Clusters        |   | 0–0 of 0 entries   |
| Cloud instances | Name State On-Schedule / O                  | Dn-Demand Created † Actions  |
| Buckets         |   |  |
| Account         |   | <b>D</b>   |
| Activity        |   |  |
| Support         |   | ' <b>t have any snapshots</b><br>ed a snapshot, it will be listed here |
| (     In NetApp |   | Create snapshot  |
|                 | O posticial                                 |  |
| [규] Dashboard   |   |  |
| Applications    | -√- APPLICATION STATUS                      | S APPLICATION PROTECTION   |
|                 | ⊘ Available ()                              | Partially protected 🔬 No scheduled protection policy                   |
| Cloud instances | Definition  postgresql                      | Cluster<br>S api-rosa-cluster1-nn5w-p1                                 |
| Buckets         | Data protection Storage Resources Exe       | ecution hooks Activity Tasks   |
| & Account       | Actions  Configure protection policy        | \Xi Search   |
|                 |   | 1–1 of 1 entries   |
| E Activity      | Name State                                  | On-Schedule / On-Demand Created † Actions                              |
| 🕄 Support       |   |  |
| (<) III NetApp  | postgresql-snapshot-20240213154610 😔 Health | hy On-Demand 2024/02/13 15:48 UTC                                      |

#### 10. Delete the database in the postgresql application

Log back into postgresql, list the available databases, delete the one you created previously and list again to ensure that the database has been deleted.

postgres=# \1 List of databases | ICU Locale | ICU Rules | Access priv | Owner | Encoding | Locale Provider | Collate | Name Ctype UTF8 libc en US.UTF-8 | en US.UTF-8 postgres erp postgres postgres UTF8 libc en US.UTF-8 | en US.UTF-8 1 template0 | postgres | UTF8 libc en\_US.UTF-8 | en\_US.UTF-8 | =c/postgres postgres=CTc UTF8 en\_US.UTF-8 | en\_US.UTF-8 template1 | postgres libc -c/postgres | postgres=CTc/ (4 rows) postgres=# DROP DATABASE erp; DROP DATABASE postgres=# \1 List of databases | Encoding | Locale Provider | | ICU Locale | ICU Rules | Name Owner Collate Ctype Access priv postgres | UTF8 libc en\_US.UTF-8 | en\_US.UTF-8 postgres template0 | postgres | UTF8 libc en\_US.UTF-8 | en\_US.UTF-8 | =c/postgres postgres=CTc template1 | postgres UTF8 libc en\_US.UTF-8 | en\_US.UTF-8 =c/postgres I postgres=CTc (3 rows)

# 11. Restore from a snapshot using ACS

To restore the application from a snapshot, go to ACS UI landing page, select the application and select Restore. You need to pick a snapshot or a backup from which to restore. (Typically, you would have multiple created based on a policy that you have configured). Make appropriate choices in the next couple of screens and then click on **Restore**. The application status moves from Restoring to Available after it has been restored from the snapshot.

| [㎡ Dashboard    | © postgresql ^                     |               |   | с (              | Actions 🗸        |
|-----------------|------------------------------------|---------------|---|------------------|------------------|
| Applications    |                                    |               |   |                  | Snapshot         |
| Clusters        | -M→ APPLICATION STATUS             |               | S APPLICATION PROT                        | ECTION           | Back up<br>Clone |
| Cloud instances |                                    | (i) Par       | tially protected 🕅 No s                   | cheduled protect | Restore          |
| Buckets         | Definition<br>postgresql           |               | Cluster<br>S api-rosa-cluster1-nn5w-p1-op | <u>D</u> ese     | Unmanage         |
| & Account       | Data protection Storage Resources  | Execution hoo | ks Activity Tasks                         |                  |                  |
| E Activity      | Actions   Configure protection po  | licy          | = Search                                  |                  |                  |
| 땅 Support       |                                    |               |   | 1–1 of 1 entr    | ies <>           |
|                 | Name                               | State         | On-Schedule / On-Demand                   | Created †        | Actions          |
| I NetApp        | postgresql-snapshot-20240213164912 | ⊘ Healthy     | On-Demand                                 | 2024/02/13 16    | 50 UTC (I)       |

| RESTORE TYPE   |                               |                                   |                      |
|--|-------------------------------|-----------------------------------|----------------------|
| Restore the application to new namespaces on any available | ble cluster or to original na | mespaces on the original cluster. |                      |
| Restore to new namespaces                                  |                               | Restore to original namespaces    |                      |
| RESTORE SOURCE   |                               |                                   |                      |
| Select a snapshot or backup to restore the application to  | a previous state.             |                                   |                      |
|  | Time range 🗸                  | Filter                            | Snapshots 🔒 Backups  |
| Application snapshot                                       | Snapshot state                | On-Schedule / On-Demand           | Created 1            |
| postgresql-snapshot-20240213164912                         | ⊘ Healthy                     | On-Demand                         | 2024/02/13 16:50 UTC |
|  |                               |                                   |                      |
|  |                               |                                   |                      |
|  | Ca                            | ncel Next →                       |                      |

| Ƙ Dashboard   | 🍥 postgresql \land                 |                |   | C Actions                             | ~       |
|---|------------------------------------|----------------|---|---------------------------------------|---------|
| <ul> <li>Applications</li> <li>Clusters</li> <li>Cloud instances</li> </ul> | - →- APPLICATION STATUS            | (i) <u>P</u>   | S APPLICATION PROT<br>artially protected A No | ECTION<br>scheduled protection policy | (1)     |
| Buckets   | Definition<br>postgresql           |                | Cluster<br>api-rosa-cluster1-nn5w-p1-o        | <b>p</b>                              |         |
| & Account   | Data protection Storage Resource   | s Execution ho | ooks Activity Tasks                           |                                       |         |
| E Activity  | Actions   Configure protection     | policy         | - Search                                      |                                       |         |
| Support   |                                    |                |   | 1–1 of 1 entries                      |         |
|   | Name                               | State          | On-Schedule / On-Demand                       | Created 1                             | Actions |
| In NetApp   | postgresql-snapshot-20240213164912 | ⊘ Healthy      | On-Demand                                     | 2024/02/13 16:50 UTC                  |         |

# 12. Verify your app has been restored from the snapshot

Login to the postgresql client and you should now see the table and the record in the table that you previously had. That's it. Just by clicking a button, your application has been restored to a previous state. That is how easy we make it for our customers with Astra Control.

| 2.0-debian-<br>Warning: wo<br>legeEscalat<br>pod or cont<br>text.seccom | 11-r1env<br>uld violate<br>ion=false),<br>ainer "post<br>pProfile.ty | PGPASSWOR<br>PodSecurity<br>unrestrict<br>grosql-clie<br>pe to "Runt | D=\$POSTGRES_PASSWOR<br>y "restricted:v1.2/<br>ed capabilities (co | RD"command<br>I": allowPrivi<br>ontainer "post<br>ityContext.run<br>:alhost") | psqlhost<br>legeEscalation<br>gresql-client* | postgresql -U<br>l= false (con<br>must set secu | postgres -d<br>tainer "post<br>rityContext. | ostgresqlimage docker.io/bitnami/postgresql:16,<br>postgres -p 5832<br>gresql-ciient" must set securityContext.allowPrivi<br>capabilities.drop=["ALL"]), runAsNonRoot != true (<br>container "postgresql-client" must set securityCon |
|---|--|--|--|---|--|---|---|---|
| postgres-#  | u  |  |  |   |  |   |   |   |
| Name  | Owner  | Encoding   | Locale Provider  | List of da<br>Collate   | tabases<br>Ctype                             | ICU Locale                                      | ICU Rules                                   | Access privileges   |
| erp<br>postgres<br>template0  | postgres<br>  postgres<br>  postgres<br>                             | UTF8<br>  UTF8<br>  UTF8<br>  UTF8<br>                               | libc<br>libc<br>libc   | en_US.UTF-8<br>en_US.UTF-8<br>en_US.UTF-8                                     | en_US.UTF-8<br>en_US.UTF-8<br>en_US.UTF-8    |   |   | <pre>*c/postgres + postgres=CTc/postgres</pre>  |
| templatel<br>(4 rows)   | postgres   | UTF8<br>   | libc   | en_US.UTF-8   | en_US.UTF-8<br>                              |   |   | -c/postgres +<br>postgres=CTc/postgres  |
| erp=# \dt<br>Schema   | connected<br>ist of rela<br>Name   Ty                                | tions  |  | stgres".  |  |   |   |   |
| erp=# SELEC<br>id   first<br>1   John<br>(1 row)                        | T * from PE<br>name   last<br>  Doe                                  |  |  |   |  |   |   | Activate Windows  |

#### **Data migration**

This page shows the data migration options for container workloads on Managed Red Hat OpenShift clusters using FSx for NetApp ONTAP for persistent storage.

#### Data Migration

Red Hat OpenShift service on AWS as well as FSx for NetApp ONTAP (FSxN) are part of their service portfolio by AWS. FSxN is available on Single AZ or Multi-AZ options.

Multi-Az option provides data protection from availability zone failure.

FSxN can be integrated with Astra Trident to provide persistent storage for applications on ROSA clusters.

#### Integration of FSxN with Trident using Helm chart

#### ROSA Cluster Integration with Amazon FSx for ONTAP

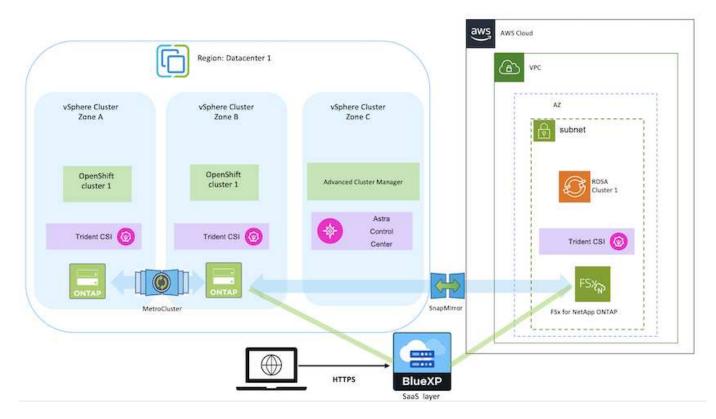
The migration of container applications involves:

- Persistent volumes: this can be accomplished using BlueXP. Another option is to use Astra Control Center to handle container application migrations from on-premises to the cloud environment. Automation can be used for the same purpose.
- Application metadata: this can be accomplished using OpenShift GitOps (Argo CD).

#### Failover and Fail-back of applications on ROSA cluster using FSxN for persistent storage

The following video is a demonstration of application failover and fail-back scenarios using BlueXP and Argo CD.

#### Failover and Fail-back of applications on ROSA cluster



# Data protection for Container Apps in OpenShift Container Platform using OpenShift API for Data Protection (OADP)

Author: Banu Sundhar, NetApp

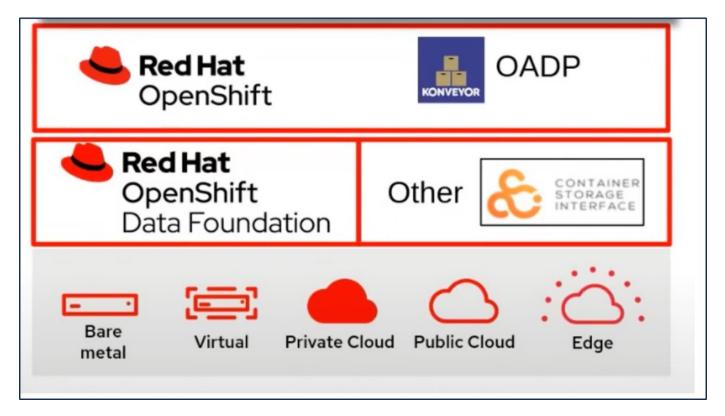
This section of the reference document provides details for creating backups of Container Apps using the OpenShift API for Data Protection (OADP) with Velero on NetApp ONTAP S3 or NetApp StorageGRID S3. The backups of namespace scoped resources including Persistent Volumes(PVs) of the app are created using CSI Astra Trident Snapshots.

The persistent storage for container apps can be backed by ONTAP storage integrated to the OpenShift Cluster using Astra Trident CSI. In this section we use OpenShift API for Data Protection (OADP) to perform backup of apps including its data volumes to

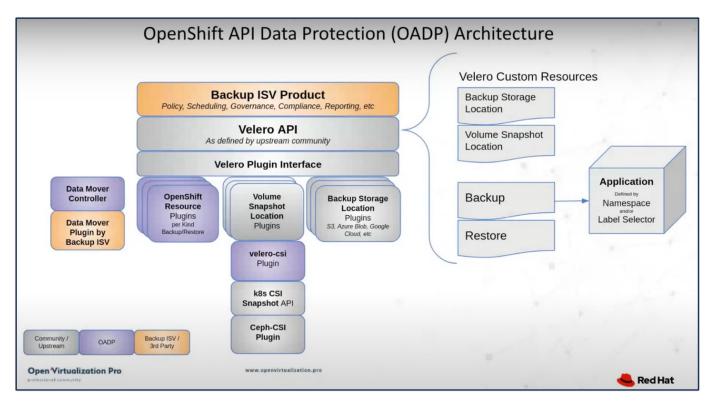
- ONTAP Object Storage
- StorageGrid

We then restore from the backup when needed. Please note that the app can be restored only to the cluster from where the backup was created.

OADP enables backup, restore, and disaster recovery of applications on an OpenShift cluster. Data that can be protected with OADP include Kubernetes resource objects, persistent volumes, and internal images.



Red Hat OpenShift has leveraged the solutions developed by the OpenSource communities for data protection. Velero is an open-source tool to safely backup and restore, perform disaster recovery, and migrate Kubernetes cluster resources and persistent volumes. To use Velero easily, OpenShift has developed the OADP operator and the Velero plugin to integrate with the CSI storage drivers. The core of the OADP APIs that are exposed are based on the Velero APIs. After installing the OADP operator and configuring it, the backup/restore operations that can be performed are based on the operations exposed by the Velero API.



OADP 1.3 is available from the operator hub of OpenShift cluster 4.12 and later. It has a built-in Data Mover that can move CSI volume snapshots to a remote object store. This provides portability and durability by

moving snapshots to an object storage location during backup. The snapshots are then available for restoration after disasters.

# The following are the versions of the various components used for the examples in this section

- OpenShift Cluster 4.14
- OADP Operator 1.13 provided by Red Hat
- Velero CLI 1.13 for Linux
- Astra Trident 24.02
- ONTAP 9.12
- postgresql installed using helm.

#### Astra Trident CSI OpenShift API for Data Protection (OADP) Velero

# Data protection for Container Apps in OpenShift Container Platform using OpenShift API for Data Protection (OADP)

Author: Banu Sundhar, NetApp

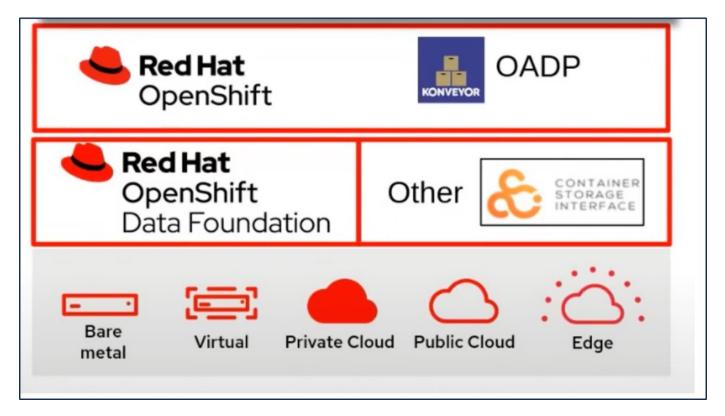
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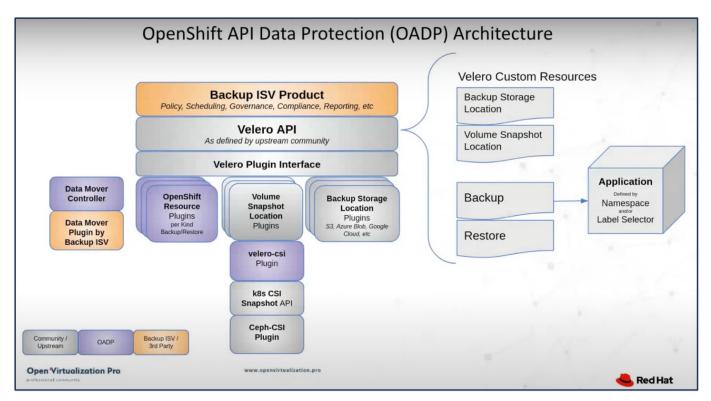
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#### Astra Trident CSI OpenShift API for Data Protection (OADP) Velero

# Installation of OpenShift API for Data Protection (OADP) Operator

This section outlines the installation of OpenShift API for Data Protection (OADP) Operator.

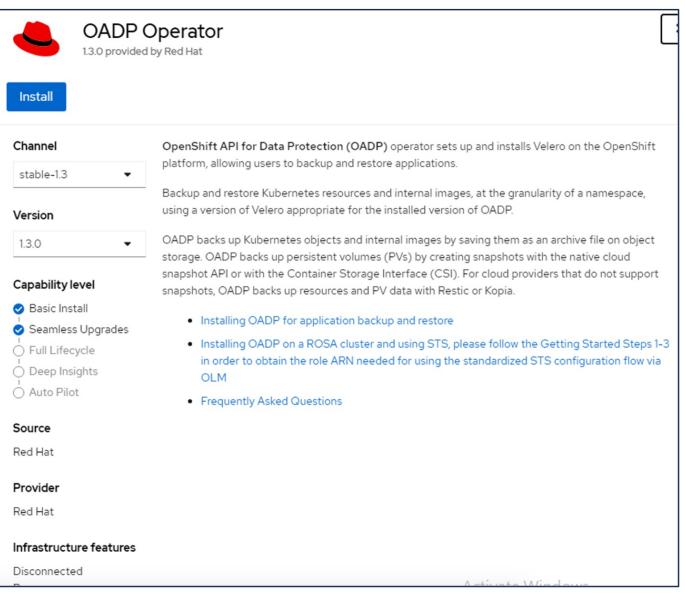
#### Prerequisites

- A Red Hat OpenShift cluster (later than version 4.12) installed on bare-metal infrastructure with RHCOS worker nodes
- A NetApp ONTAP cluster integrated with the cluster using Astra Trident
- A Trident backend configured with an SVM on ONTAP cluster
- · A StorageClass configured on the OpenShift cluster with Astra Trident as the provisioner
- Trident Snapshot class created on the cluster
- · Cluster-admin access to Red Hat OpenShift cluster
- Admin access to NetApp ONTAP cluster
- An application eg. postgresql deployed on the cluster
- An admin workstation with tridentctl and oc tools installed and added to \$PATH

#### Steps to install OADP Operator

1. Go to the Operator Hub of the cluster and select Red Hat OADP operator. In the Install page, use all the default selections and click install. On the next page, again use all the defaults and click Install. The OADP operator will be installed in the namespace openshift-adp.

| Home                     | >           | OperatorHub                                 |   |  |   |
|--------------------------|-------------|---|---|--|---|
| Operators                | *           | Discover Operators from the Kube            |   | y Red Hat. You can purchase commercial software through Red<br>tor capabilities will appear in the Developer Catalog providing a |   |
| OperatorHub              |             |   | ,   |  |   |
| -<br>Installed Operators |             | All Items<br>Al/Machine Learning            | All Items   |  |   |
| Workloads                | >           | Application Runtime<br>Big Data             | Q OADP ×  |  | _ |
| Virtualization           | >           | Cloud Provider<br>Database                  | Red Hat   | Community  |   |
| Networking               | <b>&gt;</b> | Developer Tools                             | OADP Operator   | OADP Operator  |   |
| Storage                  | >           | Development Tools<br>Drivers and plugins    | provided by Red Hat<br>OADP (OpenShift API for Data       | provided by Red Hat<br>OADP (OpenShift API for Data  |   |
| Builds                   | >           | Integration & Delivery<br>Logging & Tracing | Protection) operator sets up and installs Data Protection | Protection) operator sets up and<br>installs Velero on the OpenShift   |   |
| Observe                  | >           | Modernization & Migration                   |   |  |   |



| Project: A | Il Projects 🔻   |                              |  |                                     |
|------------|---|------------------------------|--|-------------------------------------|
| nstalle    | ed Operators  |                              |  |                                     |
|            | Operators are represented by (<br>and ClusterServiceVersion usi |                              | Namespace. For more information, see the Und | lerstanding Operators documentation |
| operator   |   |                              |  |                                     |
| Name •     | <ul> <li>Search by name</li> </ul>                              |                              |  |                                     |
| Name       | 1   | Namespace 1                  | Managed Namespaces  🕽                        | Status                              |
|            | OpenShift Virtualization  | NS openshift-cnv             | NS openshift-cnv                             | Succeeded                           |
|            | 4.14.4 provided by Red Hat                                      |                              |  | Up to date                          |
|            | OADP Operator   | NS openshift-adp             | NS openshift-adp                             | Succeeded                           |
| •          | 1.3.0 provided by Red Hat                                       |                              |  | Up to date                          |
| (4)        | Package Server  | NS openshift-operator-lifecy | cle- NS openshift-operator-lifecycle-        | Succeeded                           |
|            |   | manager                      | manager                                      |                                     |

# Prerequisites for Velero configuration with Ontap S3 details

After the installation of the operator succeeds, configure the instance of Velero. Velero can be configured to use S3 compatible Object Storage. Configure ONTAP S3 using the procedures shown in the Object Storage Management section of ONTAP documentation. You will need the following information from your ONTAP S3 configuration to integrate with Velero.

- A Logical Interface (LIF) that can be used to access S3
- · User credentials to access S3 that includes the access key and the secret access key
- · A bucket name in S3 for backups with access permissions for the user
- For secure access to the Object storage, TLS certificate should be installed on the Object Storage server.

#### Prerequisites for Velero configuration with StorageGrid S3 details

Velero can be configured to use S3 compatible Object Storage. You can configure StorageGrid S3 using the procedures shown in the StorageGrid documentation. You will need the following information from your StorageGrid S3 configuration to integrate with Velero.

- The endpoint that can be used to access S3
- User credentials to access S3 that includes the access key and the secret access key
- · A bucket name in S3 for backups with access permissions for the user
- For secure access to the Object storage, TLS certificate should be installed on the Object Storage server.

#### Steps to configure Velero

• First, create a secret for an ONTAP S3 user credential or StorageGrid Tenant user credentials. This will be used to configure Velero later. You can create a secret from the CLI or from the web console. To create a secret from the web console, select Secrets, then click on Key/Value Secret. Provide the values for the credential name, key and the value as shown. Be sure to use the Access Key Id and Secret Access Key of your S3 user. Name the secret appropriately. In the sample below, a secret with ONTAP S3 user credentials named ontap-s3-credentials is created.

| Installed Operators   | Project: openshift-adp 🔻                   |                        |                        |                   |
|-----------------------|--|------------------------|------------------------|-------------------|
| Workloads 🗸 🗸         | Secrets                                    |                        |                        | Create 👻          |
| Pods                  |  |                        |                        | Key/value secret  |
| Deployments           | ▼ Filter ▼ Name ▼ Search by name           | Size                   |                        | Image pull secret |
| DeploymentConfigs     | Name 1 Type 1                              | S 1                    | Created 1              | Source secret     |
| StatefulSets          | S builder-dockercfg-7g8ww kubernetes.io/do | ockercfg 1             | Apr 11, 2024, 10:52 AN | Webhook secret    |
| Secrets<br>ConfigMaps | S builder-token-rm4s kubernetes.io/se      | ervice-account-token 4 | Apr 11, 2024, 10:52 AN | From YAML         |

| Edit key/value sec  | ret  |
|---|--|
| Key/value secrets let you inject<br>variables.            | sensitive data into your application as files or environment |
| Secret name *   |  |
| ontap-s3-credentials                                      |  |
| Unique name of the new secret                             |  |
| Key *   |  |
| cloud   |  |
| Value   |  |
|   | Browse   |
| Drag and drop file with your val                          | e here or browse to upload it.                               |
| [default]<br>aws_access_key_id=<br>aws_secret_access_key= |  |
| <ul> <li>Add key/value</li> </ul>                         |  |
|   |  |
|   |  |

To create a secret named sg-s3-credentials from the CLI you can use the following command.

# oc create secret generic sg-s3-credentials --namespace openshift-adp --from-file cloud=cloud-credentials.txt Where credentials.txt file contains the Access Key Id and the Secret Access Key of the S3 user in the following format: [default] aws\_access\_key\_id=< Access Key ID of S3 user> aws\_secret\_access\_key=<Secret Access key of S3 user>

• Next, to configure Velero, select Installed Operators from the menu item under Operators, click on OADP operator, and then select the **DataProtectionApplication** tab.

| Home                               | <b>,</b> | Installed Operators                       |  |                                     |  |  |               |
|------------------------------------|----------|---|--|-------------------------------------|--|--|---------------|
| Operators                          | ~        | Installed Operators are represented by    | ClusterServiceVersions within this Names | pace. For more information, see the | Understanding Operators documentation 🗗. O | r create an Operator and ClusterServiceVer                   | sion using th |
| OperatorHub<br>Installed Operators |          | Operator SDK 🖉.     Name   Search by name |  |                                     |  |  |               |
| Workloads                          | >        | Name 1                                    | Managed Namespaces 1                     | Status                              | Last updated                               | Provided APIs  |               |
| Virtualization                     | >        | OADP Operator<br>1.3.0 provided by Red Ha | NS openshift-adp                         | Succeeded Up to date                | Apr 11, 2024, 10:53 AM                     | BackupRepository<br>Backup                                   | :             |
| Networking                         | >        |   |  |                                     |  | BackupStorageLocation<br>DeleteBackupRequest<br>View 11 more |               |

Click on Create DataProtectionApplication. In the form view, provide a name for the DataProtection Application or use the default name.

| Project: openshift-adp  | •                      |              |            |              |                                  |
|---|------------------------|--------------|------------|--------------|----------------------------------|
| Installed Operators > Operators > OADP Operator<br>13.0 provided by R |                        |              |            |              | Actions 👻                        |
| ServerStatusRequest   | VolumeSnapshotLocation | DataDownload | DataUpload | CloudStorage | DataProtectionApplication        |
| DataProtection  | Applications           |              |            |              | Create DataProtectionApplication |

Now go to the YAML view and replace the spec information as shown in the yaml file examples below.

Sample yaml file for configuring Velero with ONTAP S3 as the backupLocation

```
spec:
 backupLocations:
    - velero:
        config:
          insecureSkipTLSVerify: 'false' ->use this for https
communication with ONTAP S3
          profile: default
          region: us-east-1
          s3ForcePathStyle: 'true' ->This allows use of IP in s3URL
          s3Url: 'https://10.61.181.161' ->Ensure TLS certificate for S3
is configured
        credential:
          key: cloud
          name: ontap-s3-credentials -> previously created secret
        default: true
        objectStorage:
          bucket: velero -> Your bucket name previously created in S3 for
backups
          prefix: container-demo-backup ->The folder that will be created
in the bucket
          caCert: <base64 encoded CA Certificate installed on ONTAP
Cluster with the SVM Scope where the bucker exists>
        provider: aws
  configuration:
    nodeAgent:
      enable: true
      uploaderType: kopia
      #default Data Mover uses Kopia to move snapshots to Object Storage
    velero:
      defaultPlugins:
        - csi ->This plugin to use CSI snapshots
        - openshift
        - aws
        - kubevirt -> This plugin to use Velero with OIpenShift
Virtualization
```

Sample yaml file for configuring Velero with StorageGrid S3 as the backupLocation

```
spec:
 backupLocations:
    - velero:
        config:
          insecureSkipTLSVerify: 'true'
          profile: default
          region: us-east-1 ->region of your StorageGrid system
          s3ForcePathStyle: 'True'
          s3Url: 'https://172.21.254.25:10443' ->the IP used to access S3
        credential:
          key: cloud
          name: sg-s3-credentials ->secret created earlier
        default: true
        objectStorage:
          bucket: velero
          prefix: demobackup
        provider: aws
 configuration:
    nodeAgent:
      enable: true
      uploaderType: kopia
    velero:
      defaultPlugins:
        - csi
        - openshift
        - aws
        - kubevirt
```

The spec section in the yaml file should be configured appropriately for the following parameters similar to the example above

#### backupLocations

ONTAP S3 or StorageGrid S3 (with its credentials and other information as shown in the yaml) is configured as the default BackupLocation for velero.

#### snapshotLocations

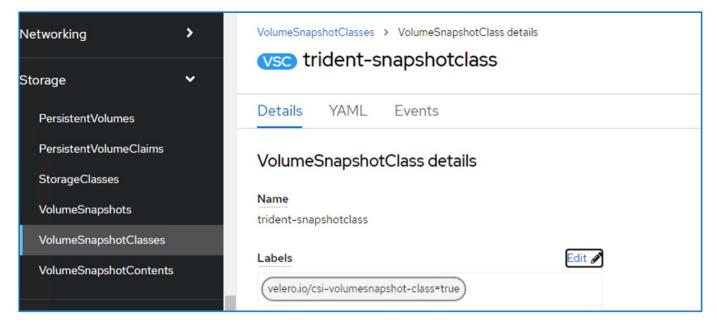
If you use Container Storage Interface (CSI) snapshots, you do not need to specify a snapshot location because you will create a VolumeSnapshotClass CR to register the CSI driver. In our example, you use Astra Trident CSI and you have previously created VolumeSnapShotClass CR using the Trident CSI driver.

#### **Enable CSI plugin**

Add csi to the defaultPlugins for Velero to back up persistent volumes with CSI snapshots. The Velero CSI plugins, to backup CSI backed PVCs, will choose the VolumeSnapshotClass in the cluster that has **velero.io/csi-volumesnapshot-class** label set on it. For this

- You must have the trident VolumeSnapshotClass created.
- · Edit the label of the trident-snapshotclass and set it to

velero.io/csi-volumesnapshot-class=true as shown below.



Ensure that the snapshots can persist even if the VolumeSnapshot objects are deleted. This can be done by setting the **deletionPolicy** to Retain. If not, deleting a namespace will completely lose all PVCs ever backed up in it.

```
apiVersion: snapshot.storage.k8s.io/v1
kind: VolumeSnapshotClass
metadata:
   name: trident-snapshotclass
driver: csi.trident.netapp.io
deletionPolicy: Retain
```

| VolumeSnapshotClasses > VolumeSnapshotClass details |        |
|---|--------|
| vsc trident-snapshotclass                           |        |
| Details YAML Events                                 |        |
| VolumeSnapshotClass details                         |        |
| Name  |        |
| trident-snapshotclass                               |        |
| Labels  | Edit 🖋 |
| velero.io/csi-volumesnapshot-class=true             |        |
| Annotations   |        |
| 1 annotation 🖋                                      |        |
| Driver  |        |
| csi.trident.netapp.io                               |        |
| Deletion policy                                     |        |
| Retain  |        |

Ensure that the DataProtectionApplication is created and is in condition:Reconciled.

| Proje <mark>ct:</mark> oj | pe <mark>nsh</mark> ift-adp 🝷  |                           |          |               |            |              |                     |               |
|---------------------------|--|---------------------------|----------|---------------|------------|--------------|---------------------|---------------|
| , c                       | erators > Operator details<br>OPDP Operator<br>3.2 provided by Red Hat |                           |          |               |            |              |                     | Actions 🔸     |
| Schedule                  | ServerStatusRequ   | est VolumeSnapshotl       | _ocation | DataDownload  | DataUpload | CloudStorage | DataProtection      | Application   |
| DataPr     Name           | Search by name   | ations                    |          |               |            |              | Create DataProtecti | onApplication |
| Name                      | 1  | Kind I                    | Status   | 1             | Labels I   | Last u       | pdated 1            |               |
|                           | elero-container-<br>ackup-ontap  | DataProtectionApplication | Conditio | n: Reconciled | No labels  | UL 🕲         | 15, 2024, 2:31 PM   | I             |

The OADP operator will create a corresponding BackupStorageLocation. This will be used when creating a backup.

| R 22 19 29  |                       |                              |   |   |                       |
|---|-----------------------|------------------------------|---|---|-----------------------|
| Installed Operators  Operator OADP Operator 1.3.2 provided by Red H |                       |                              |   |   | Actions 👻             |
| pRepository Backup  | BackupStorageLocation | DeleteBackupRequest          | DownloadRequest   | PodVolumeBackup   | PodVolumeRestor       |
| BackupStorageLc   | cations               |                              |   | Create  | BackupStorageLocation |
| an trac or  |                       | Status I                     | Labels 1  | Last updated  | BackupStorageLocation |
| Name 👻 Search by name   |                       | Status 1<br>Phase: Available | app.kubernetes.io/compo   | Last updated 1  |                       |
| Name  Search by name Name  Search by name Name                      | Kind 1                |                              |   | Last updated 1<br>inent=bsl ③ Jul 15, 2024, 2<br>intainer | 1                     |
| Name  Search by name Name  Search by name Name                      | Kind 1                |                              | app.kubernetes.io/compo   | Last updated 1<br>inent=bal                               | 1                     |
| Name  Search by name Name  Sume                                     | Kind 1                |                              | app.kubernetes.io/compo<br>app.kubernet=velero-co<br>app.kubernetes.io/m=oa | Last updated 1<br>inent=bal                               | 1                     |

# Creating on-demand backup for Apps in OpenShift Container Platform

This section outlines how to create on-demand backup for VMs in OpenShift Virtualization.

#### Steps to create a backup of an App

To create an on-demand backup of an app (app metadata and persistent volumes of the app), click on the **Backup** tab to create a Backup Custom Resource (CR). A sample yaml is provided to create the Backup CR. Using this yaml, the app and its persistent storage in the specified namespace will be backed up. Additional parameters can be set as shown in the documentation.

A snapshot of the persistent volumes and the app resources in the namespace specified will be created by the CSI. This snapshot will be stored in the backup location specified in the yaml. The backup will remain in the system for 30 days as specified in the ttl.

```
spec:
    csiSnapshotTimeout: 10m0s
    defaultVolumesToFsBackup: false
    includedNamespaces:
        - postgresql ->namespace of the app
    itemOperationTimeout: 4h0m0s
    snapshotMoveData: false
    storageLocation: velero-container-backup-ontap-1 -->this is the
    backupStorageLocation previously created when Velero is configured.
    ttl: 720h0m0s
```

Once the backup completes, its Phase will show as completed.

|         | OADP    | <ul> <li>Operate</li> <li>ovided by</li> </ul> |                |        |               |                |                   |                                | Actions 👻        |
|---------|---------|--|----------------|--------|---------------|----------------|-------------------|--------------------------------|------------------|
| Details | YA      | ML   | Subscription   | Events | All instances | BackupReposito | bry Backup        | BackupStorageLocation          | DeleteBackupRequ |
| Backu   | ups     |  |                |        |               |                |                   |                                | Create Backup    |
| Name    | • s     | earch by                                       | name           | 1      |               |                |                   |                                |                  |
| Name    | 1       |  | Kind           | 1      | Status        | I              | Labels 1          | Last updated                   | 1                |
| B ba    | ackup-p | ostgresq                                       | l-ontaps3 Back | up     | Phase         | Completed      | velero.io/sto =ve | elero-container 😵 Jul 16, 2024 | i, 10:01 AM      |

You can inspect the backup in the Object storage with the help of an S3 browser application. The path of the backup shows up in the configured bucket with the prefix name (velero/container-demo-backup). You can see the contents of the backup includes the volume snapshots, logs, and other metadata of the application.



In StorageGrid, you can also use the S3 console that is available from the Tenant Manager to view the backup objects.

| lame  | Size      | Туре      | Last Modified         | Storage Class |
|---|-----------|-----------|-----------------------|---------------|
|   |           |           |                       |               |
| backup-postgresql-ontaps3.tar.gz            | 384.66 KB | GZ File   | 7/16/2024 10:01:20 AM | STANDARD      |
| velero-backup.json                          | 3.30 KB   | JSON File | 7/16/2024 10:01:20 AM | STANDARD      |
| backup-postgresql-ontaps3-csi-volumesnap    | 731 bytes | GZ File   | 7/16/2024 10:01:19 AM | STANDARD      |
| backup-postgresql-ontaps3-csi-volumesnap    | 760 bytes | GZ File   | 7/16/2024 10:01:19 AM | STANDARD      |
| backup-postgresql-ontaps3-resource-list.jso | 823 bytes | GZ File   | 7/16/2024 10:01:19 AM | STANDARD      |
| backup-postgresql-ontaps3-itemoperations.j  | 378 bytes | GZ File   | 7/16/2024 10:01:19 AM | STANDARD      |
| backup-postgresql-ontaps3-volumesnapshot    | 29 bytes  | GZ File   | 7/16/2024 10:01:19 AM | STANDARD      |
| backup-postgresql-ontaps3-podvolumeback     | 29 bytes  | GZ File   | 7/16/2024 10:01:19 AM | STANDARD      |
| backup-postgresql-ontaps3-results.gz        | 49 bytes  | GZ File   | 7/16/2024 10:01:19 AM | STANDARD      |
| backup-postgresql-ontaps3-csi-volumesnap    | 429 bytes | GZ File   | 7/16/2024 10:01:19 AM | STANDARD      |
| hackun-nostaresal-ontans3-loas az           | 12 01 KB  | G7 File   | 7/16/2024 10:01:19 AM | STANDARD      |

#### Creating scheduled backups for Apps

To create backups on a schedule, you need to create a Schedule CR.

The schedule is simply a Cron expression allowing you to specify the time at which you want to create the backup. A sample yaml to create a Schedule CR is shown below.

```
apiVersion: velero.io/v1
kind: Schedule
metadata:
    name: schedule1
    namespace: openshift-adp
spec:
    schedule: 0 7 * * *
    template:
        includedNamespaces:
            - postgresql
        storageLocation: velero-container-backup-ontap-1
```

The Cron expression 0 7 \* \* \* means a backup will be created at 7:00 every day. The namespaces to be included in the backup and the storage location for the backup are also specified. So instead of a Backup CR, Schedule CR is used to create a backup at the specified time and frequency.

Once the schedule is created, it will be Enabled.

| Project: openshift-adp   | •              |                     |                        |                          |               |
|--|----------------|---------------------|------------------------|--------------------------|---------------|
| Installed Operators > Operator<br>OADP Operator<br>1.3.2 provided by Rev |                |                     |                        |                          | Actions 👻     |
|  | store Schedule | ServerStatusRequest | VolumeSnapshotLocation | DataDownload DataUpload  | CloudStorage  |
| <  |                |                     |                        |                          | )             |
| Schedules  |                |                     |                        | a                        | eate Schedule |
| Name 👻 Search by na  | me             |                     |                        |                          |               |
| Name 1   | Kind 1         | Status 1            | Labels 1               | Last updated             |               |
| S schedule1  | Schedule       | Phase: 🔮 En         | abled No labels        | 🕲 Jul 16, 2024, 10:32 AM | ŧ             |

Backups will be created according to this schedule, and can be viewed from the Backup tab.

| l | nstalled Operators > Op<br>OADP Opera<br>1.3.2 provided b | itor              |        |                                |  |                 | Actions 👻       |
|---|---|-------------------|--------|--------------------------------|--|-----------------|-----------------|
|   | All instances   | BackupRepository  | Backup | BackupStorageLocation          | DeleteBackupRequest                        | DownloadRequest | PodVolumeBackup |
|   | Backups   |                   |        |                                |  |                 | Create Backup   |
|   |   | wy name<br>Kind I | 7      | Status I                       | Labels I                                   | Last updated    | Create Backup   |
|   | Name   Search b   | Kind [            | Z      | Status I<br>Phase: O Completed | Labels 1<br>(velero.io/sto =velero-contair |                 |                 |

# Migrate an App from one cluster to another

Velero's backup and restore capabilities make it a valuable tool for migrating your data between clusters. This section describes how to migrate apps(s) from one cluster to another by creating a backup of the app in Object storage from one cluster and then restoring the app from the same object storage to another cluster.

#### **Prerequisites on Cluster 1**

- Astra Trident must be installed on the cluster.
- A trident backend and Storage class must be created.
- OADP operator must be installed on the cluster.
- The DataProtectionApplication should be configured.

Use the following spec to configure the DataProtectionApplication object.

```
spec:
  backupLocations:
    - velero:
        config:
          insecureSkipTLSVerify: 'false'
          profile: default
          region: us-east-1
          s3ForcePathStyle: 'true'
          s3Url: 'https://10.61.181.161'
        credential:
          key: cloud
          name: ontap-s3-credentials
        default: true
        objectStorage:
          bucket: velero
          caCert: <base-64 encoded tls certificate>
          prefix: container-backup
        provider: aws
  configuration:
    nodeAgent:
      enable: true
      uploaderType: kopia
    velero:
      defaultPlugins:
        - csi
        - openshift
        - aws
        - kubevirt
```

• Create an application on the cluster and take a backup of this application. As an example, install a postgres application.

| AME                    | STATUS   | ROLES      | 5            | AGE       | VERSION         |                |               |   |             |
|------------------------|----------|------------|--------------|-----------|-----------------|----------------|---------------|---|-------------|
| cp6-master1            | Ready    |            | plane,maste  |           | v1.27.15+614    | 7456           |               |   |             |
| cp6-master2            | Ready    | worker     |              | 3d12h     | v1.27.15+614    | 7456           |               |   |             |
| cp6-master3            | Ready    | control-   | plane,maste  | r 3d13h   | v1.27.15+614    | 7456           |               |   |             |
| cp6-worker1            | Ready    | worker     |              | 3d12h     | v1.27.15+614    | 7456           |               |   |             |
| cp6-worker2            | Ready    | worker     |              | 3d12h     | v1.27.15+614    | 7456           |               |   |             |
| cp6-worker3            | Ready    | control-   | plane, maste | r 3d12h   | v1.27.15+614    | 7456           |               |   |             |
| rootelocalhos          | t ~]# he | lm install | postgresql   | bitnami/  | postgresql -n p | ostgresqlcrea  | ate namespace | •^C   |             |
| root@localhos          | t ~]# oc | get pods   | -n postgres  | q1        |                 |                |               |   |             |
| AME                    | READY    | STATUS     | RESTARTS     | AGE       |                 |                |               |   |             |
| ostgresq1-0            | 1/1      | Running    | 0            | 4h53m     |                 |                |               |   |             |
| root@localhos          | t ~]# oc | get pvc -  | n postgresq  | 1         |                 |                |               |   |             |
| AME                    | ST       | ATUS VOL   | UME          |           |                 | CAPACITY       | ACCESS MODES  | STORAGECLASS AGE  |             |
| ata-postgresq          | 1-0 Bo   | and pvc    | -f7a3c772-0  | e61-49cb- | a3d0-7c7b2ec87d | c6 8Gi         | RWO           | ontap-nas 4h53m   |             |
| root@localhos          | t ~]# oc | get pv -n  | postgresql   |           |                 |                |               |   |             |
| WE                     |          |            |              | CAPACITY  | ACCESS MODES    | RECLAIM POLICY | STATUS        | CLAIM   | STORAGECLAS |
| EASON AGE              |          |            |              |           |                 |                |               |   |             |
| vc-2e9e982f-5<br>4h55m |          | -8eae-a589 | e0d9d819     | 1G1       | RWO             | Delete         | Bound         | trident/basic   | ontap-nas   |
| c-f7a3c772-0<br>4h53m  |          | -a3d0-7c7b | 2ec87dc6     | 8Gi       | RWO             | Delete         | Bound         | postgresq1¢datatpostgresq1v0<br>Go to Settings to activat |             |
| oot@localhos           | + ~1#    |            |              |           |                 |                |               |   |             |

• Use the following spec for the backup CR:

```
spec:
    csiSnapshotTimeout: 10m0s
    defaultVolumesToFsBackup: false
    includedNamespaces:
        - postgresql
    itemOperationTimeout: 4h0m0s
    snapshotMoveData: true
    storageLocation: velero-sample-1
    ttl: 720h0m0s
```

| Project: ope | nshift-adp   | •                     |                      |                   |                                      |                                   |
|--------------|--|-----------------------|----------------------|-------------------|--------------------------------------|-----------------------------------|
| OA           | ators > Operator<br>DP Operator<br>provided by Red |                       |                      |                   |                                      | Actions 👻                         |
| Repository   | Backup   | BackupStorageLocation | n DeleteBackupReques | t DownloadRequest | PodVolumeBackup                      | PodVolumeRes                      |
| Backups      | 6  |                       |                      |                   |                                      | Create Backup                     |
| Name 👻       | Search by nar                                      | me /                  |                      |                   |                                      |                                   |
| Name 1       |  |                       | Kind 1               |                   | Status                               |                                   |
| B backup     |  |                       | Backup               |                   | Activate Wind<br>Go to Settings to a | OWS<br>pleted<br>ctivate Windows. |

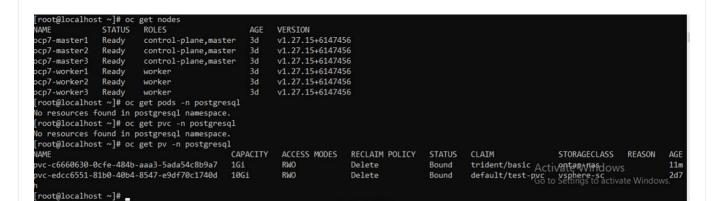
You can click on the **All instances** tab to see the different objects being created and moving through different phases to finally come to the backup **completed** phase.

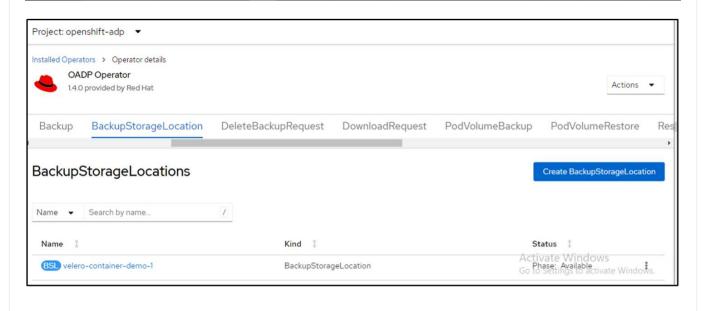
A backup of the resources in the namespace postgresql will be stored in the Object Storage location (ONTAP S3) specified in the backupLocation in the OADP spec.

#### **Prerequisites on Cluster 2**

- Astra Trident must be installed on cluster 2.
- The postgresql app must NOT be already installed in the postgresql namespace.
- OADP operator must be installed on cluster 2, and the BackupStorage Location must be pointing to the same object storage location where the backup was stored from the first cluster.
- The Backup CR must be visible from the second cluster.

| NAME                                | READY | STATUS  | RESTARTS | AGE  |
|-------------------------------------|-------|---------|----------|------|
| trident-controller-6799cfb77f-8rzvk | 6/6   | Running | 6        | 2d7h |
| trident-node-linux-7wvjz            | 2/2   | Running | 2        | 2d7h |
| trident-node-linux-8vvm2            | 2/2   | Running | 0        | 2d7h |
| trident-node-linux-bgs6f            | 2/2   | Running | 2        | 2d7h |
| trident-node-linux-njwb8            | 2/2   | Running | 0        | 2d7h |
| trident-node-linux-scqjl            | 2/2   | Running | 0        | 2d7h |
| trident-node-linux-swr69            | 2/2   | Running | 2        | 2d7h |
| trident-operator-b88b86fc8-7fk68    | 1/1   | Running | 1        | 2d7h |
| [root@localhost ~]# _               |       |         |          |      |





| Installed Operators > Operator details<br>OADP Operator<br>1.4.0 provided by Red Hat |                           |                                |                                       |                             | Actions 💌       |
|--|---------------------------|--------------------------------|---------------------------------------|-----------------------------|-----------------|
| Details YAML Subscrip  | tion Events               | All instances BackupRepository | BackupStorageLocation                 | DeleteBackupRequest         | DownloadRequest |
| Backups  |                           |                                |                                       |                             | Create Backup   |
| Name 🔹 Search by name  | $\overline{(\mathbf{Z})}$ |                                |                                       |                             |                 |
| Name 1   | Kind I                    | Status 1                       | Labels 1                              | Last updated 1              |                 |
| (B) backup   | Backup                    | Phase: 🔗 Complete              | ed velero.io/storage-locati=velero-sa | mpl 🕑 Jul 25, 2024, 8:39 PM |                 |

Restore the app on this cluster from the backup. Use the following yaml to create the Restore CR.

```
apiVersion: velero.io/v1
kind: Restore
apiVersion: velero.io/v1
metadata:
   name: restore
   namespace: openshift-adp
spec:
   backupName: backup
   restorePVs: true
```

When the restore is completed, you will see that the postgresql app is running on this cluster and is associated with the pvc and a corresponding pv. The state of the app is the same as when the backup was taken.

| Project: ope | nshift-adp 💌   |              |                     |                  |  |                              |
|--------------|--|--------------|---------------------|------------------|--|------------------------------|
| OA OA        | ators > Operator details<br>DP Operator<br>0 provided by Red Hat |              |                     |                  |  | Actions 👻                    |
| eLocation    | DeleteBackupRequest  | DownloadRequ | est PodVolumeBackup | PodVolumeRestore | Restore Sc   | hedule Server                |
| Restore      | S  |              |                     |                  |  | Create Restore               |
| Name 🔻       | Search by name   | Z            |                     |                  |  |                              |
| Name 1       |  |              | Kind                |                  | Status 1   |                              |
| R restore    |  |              | Restore             |                  | Activate Windo<br>Phase: Comp<br>Go to Settings to act | WS<br>leted<br>wate Windows. |

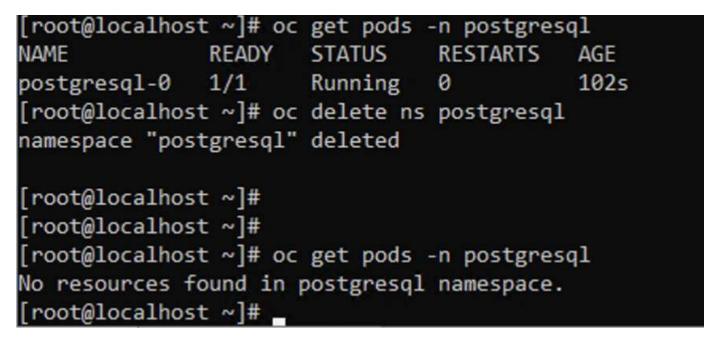
| OA       | tors > Operator details<br>DP Operator<br>provided by Red Hat |                 |                 |                  |         | Action   | is 🔻   |
|----------|---|-----------------|-----------------|------------------|---------|----------|--------|
| Location | DeleteBackupRequest   | DownloadRequest | PodVolumeBackup | PodVolumeRestore | Restore | Schedule | Serve  |
| Restore  | S   |                 |                 |                  |         | Create R | estore |
| Name •   | Search by name  | Ζ               |                 |                  |         | Create R | estore |

# Restore an App from a backup

This section describes how to restore apps(s) from a backup.

# Prerequisites

To restore from a backup, let us assume that the namespace where the app existed got accidentally deleted.



To restore from the backup that we just created, we need to create a Restore Custom Resource (CR). We need to provide it a name, provide the name of the backup that we want to restore from and set the restorePVs to true. Additional parameters can be set as shown in the documentation. Click on Create button.

| Pro   | iect: openshift-adp 🔹                     |                 |                  |         |          |                     |                 |
|-------|---|-----------------|------------------|---------|----------|---------------------|-----------------|
| Insta | OADP Operator<br>1.3.0 provided by Red Ha |                 |                  |         |          |                     | Actions 💌       |
| est   | DownloadRequest                           | PodVolumeBackup | PodVolumeRestore | Restore | Schedule | ServerStatusRequest | VolumeSnap<br>• |
| Re    | stores                                    |                 |                  |         |          | C                   | reate Restore   |

```
apiVersion: velero.io/v1
kind: Restore
apiVersion: velero.io/v1
metadata:
   name: restore
   namespace: openshift-adp
spec:
   backupName: backup-postgresql-ontaps3
   restorePVs: true
```

When the phase shows completed, you can see that the app has been restored to the state when the snapshot was taken. The app is restored to the same namespace.

| Proje  | ect: openshift-adp 🔻  |                 |                  |               |              |                     |                |
|--------|---|-----------------|------------------|---------------|--------------|---------------------|----------------|
| Instal | Ied Operators         > Operator de           OADP Operator         1.3.0 provided by Red Hat |                 |                  |               |              |                     | Actions 👻      |
| est    | DownloadRequest   | PodVolumeBackup | PodVolumeRestore | Restore       | Schedule     | ServerStatusRequest | : VolumeSr     |
| Re     | stores  |                 |                  |               |              |                     | Create Restore |
| Nan    | e Search by name  | 1               |                  |               |              |                     |                |
| Ν      | lame 🌐  | Kind 1          |                  | Status 🚦      | Labe         | is 1                |                |
| (      | restore1  | Restore         |                  | Phase: 🕑 Comp | oleted No la | bels                | :              |

| [root@localhos | t ~]#    |           |             |          |     |  |
|----------------|----------|-----------|-------------|----------|-----|--|
| [root@localhos | t ~]# oc | get pods  | -n postgre  | sql      |     |  |
| No resources f | ound in  | postgresq | l namespace | -        |     |  |
| [root@localhos | t ~]# oc | get pods  | -n postgre  | sql      |     |  |
| NAME           | READY    | STATUS    |             | RESTARTS | AGE |  |
| postgresql-0   | 0/1      | Container | rCreating   | 0        | 16s |  |
| [root@localhos | t ~]# oc | get pods  | -n postgre  | sql      |     |  |
| NAME           | READY    | STATUS    | RESTARTS    | AGE      |     |  |
| postgresql-0   | 0/1      | Running   | 0           | 22s      |     |  |
| [root@localhos | t ~]# oc | get pods  | -n postgre  | sql      |     |  |
| NAME           | READY    | STATUS    | RESTARTS    | AGE      |     |  |
| postgresql-0   | 0/1      | Running   | 0           | 29s      |     |  |
| [root@localhos | t ~]# oc | get pods  | -n postgre  | sql      |     |  |
| NAME           | READY    | STATUS    | RESTARTS    | AGE      |     |  |
| postgresql-0   | 1/1      | Running   | 0           | 37s      |     |  |
| [root@localhos | t ~]#    |           |             |          |     |  |

To restore the App to a different namespace, you can provide a namespaceMapping in the yaml definition of the Restore CR.

The following sample yaml file creates a Restore CR to restore an App and its persistent storage from the postgresql namespace, to the new namespace postgresql-restored.

```
apiVersion: velero.io/v1
kind: Restore
metadata:
   name: restore-to-different-ns
   namespace: openshift-adp
spec:
   backupName: backup-postgresql-ontaps3
   restorePVs: true
   includedNamespaces:
        postgresql
   namespaceMapping:
        postgresql: postgresql-restored
```

When the phase shows completed, you can see that the app has been restored to the state when the snapshot was taken. The App is restored to a different namespace as specified in the yaml.

| [root@localhos | t ~]# oc | get pods   | -n postgres | ql          |
|----------------|----------|------------|-------------|-------------|
| No resources f | ound in  | postgresql | namespace.  |             |
| [root@localhos | t ~]# oc | get pods   | -n postgres | ql-restored |
| NAME           | READY    | STATUS     | RESTARTS    | AGE         |
| postgresql-0   | 0/1      | Running    | 0           | 19s         |
| [root@localhos | t ~]# oc | get pods   | -n postgres | ql-restored |
| NAME           | READY    | STATUS     | RESTARTS    | AGE         |
| postgresql-0   | 0/1      | Running    | 0           | 22s         |
| [root@localhos | t ~]# oc | get pods   | -n postgres | ql-restored |
| NAME           | READY    | STATUS     | RESTARTS    | AGE         |
| postgresql-0   | 1/1      | Running    | 0           | 36s         |
| [root@localhos | t ~]#    |            |             |             |

Velero provides a generic ability to modify the resources during restore by specifying json patches. The json patches are applied to the resources before they are restored. The json patches are specified in a configmap and the configmap is referenced in the restore command. This feature enables you to restore using different storage class.

In the example below, the app, during deployment uses ontap-nas as the storage class for its persistent volumes. A backup of the app named backup-postgresql-ontaps3 is created.

| Project: postgresql 🔹  |        |   |
|--|--------|---|
| tata-postgresql-0 ⊗ ∞unit  |        |   |
| Details YAML Events VolumeSnapshots  |        |   |
| PersistentVolumeClaim details  |        |   |
|  |        |   |
| 8 GIB  |        |   |
| $\bigcirc$   |        |   |
| lame   |        | Status<br>© Bound                       |
| sta-postgresql-0   |        | Requested capacity                      |
| lamespece<br>139 postgresol  |        | 8 GiB                                   |
| nbels  | Edit 🖊 | Capacity<br>8 GiB                       |
| appluberretexiq/componentsprimary) (appluberretexiq/instancespostgress)) (appluberretexiq/inamespostgress)) (velexiq/backup-nomesbackup-postgress)-postgress) (velexiq/instancespostgress) |        | Used                                    |
| veteroiq/volume-anapahot-mame-vetero-date-poorgeood-0-74ph   |        | 13 MB                                   |
| unotations   |        | Access modes<br>ReadWriteOnce           |
| abel selector  |        | Volume mode<br>Filesystem               |
| la selector  |        | StorageClasses                          |
| Created at   |        | Storagecesses<br>ontap-nas-on-#300e9u25 |
| 3 Jul 16, 2024, 259 PM   |        | PersistentVolumes                       |
| Dunner<br>Na owner   |        |   |
|  |        |   |
|  |        |   |
|  |        |   |
| oject openshilt-adp 🔹  |        |   |
| talket Operators > Operator details<br>QADP Operator   |        |   |
| 132provided by Red Hat   |        |   |

| Details YAML Subscription E | Events All instances | BackupRepository | Backup | BackupStorageLocation | DeleteBackupRequest | DownloadRequest               | PodVolumeBackup            | PodVolumeRestore | Restore |
|-----------------------------|----------------------|------------------|--------|-----------------------|---------------------|-------------------------------|----------------------------|------------------|---------|
|                             |                      |                  |        |                       |                     |                               |                            |                  |         |
| Backups                     |                      |                  |        |                       |                     |                               |                            |                  | 0       |
| Nome   Search by name       | 1.                   |                  |        |                       |                     |                               |                            |                  |         |
| Name                        | Kind 1               |                  | 5      | itatus                | Labels 1            |                               | Lest updated               | 1                |         |
|                             |                      |                  |        | hase: 🛛 Completed     |                     | cati =velero-container-backup | o-onta.) @ Jul 16, 2024, 1 |                  |         |

Simulate a loss of the app by uninstalling the app.

To restore the VM using a different storage class, for example, ontap-nas-eco storage class, you need to do the following two steps:

#### Step 1

Create a config map (console) in the openshift-adp namespace as follows: Fill in the details as shown in the screenshot: Select namespace : openshift-adp Name: change-ontap-sc (can be any name) Key: change-ontap-sc-config.yaml: Value:

```
version: v1
resourceModifierRules:
- conditions:
    groupResource: persistentvolumeclaims
    resourceNameRegex: "data-postgresql*"
    namespaces:
    - postgresql
patches:
    operation: replace
    path: "/spec/storageClassName"
    value: "ontap-nas-eco"
```

| Edit ConfigMap   |   |
|--|---|
| Config maps hold key-value pairs that can be used in pods to read application configuration. |   |
| Configure via: 💿 Form view 🔿 YAML view   |   |
| Name *   |   |
| change-ontap-sc  |   |
| A unique name for the ConfigMap within the project   |   |
| Immutable  |   |
| Immutable, if set to true, ensures that data stored in the ConfigMap cannot be updated       |   |
| Data   |   |
| Data contains the configuration data that is in UTF-8 range                                  |   |
|  | Remove key/value  |
| Key *  |   |
| change-ontap-sc.yaml   |   |
| Value  |   |
|  | Browse  |
| Drag and drop file with your value here or browse to upload it.                              | with the second s |
| version: v1  |   |
| resourceModifierRules:   |   |
| - conditions:  |   |
| groupResource: persistentvolumeclaims<br>resourceNameRegex: "data-postgresgl*"               |   |
| namespaces:  |   |
| - postgresql   |   |
| patches:   |   |
| - operation: replace   |   |
| path: "/spec/storageClassName"   |   |
| value: "ontap-nas-eco"   |   |
|  |   |

The resulting config map object should look like this (CLI):

|   | st ~]# kubectl describe cm/change-ontap-sc -n openshift-adp<br>change-ontap-sc |
|---|--|
| Namespace:  |  |
| and the second se | <none></none>  |
| Annotations:  | 12.0 - 2.0 - 2.0 - 2.0   |
| Annocacions.  | (none)   |
| Data  |  |
| ====  |  |
| change-ontap-s  | sc.yaml:   |
|   |  |
| version: v1   |  |
| resourceModifi  | lerRules:  |
| - conditions:   |  |
| groupReso   | ource: persistentvolumeclaims  |
| resource  | lameRegex: "data-postgresql*"  |
| namespace   | 25:  |
| - postgre   | esql   |
| patches:  |  |
| - operation:  | replace  |
| path: "/sp  | pec/storageClassName"  |
| value: "or  | ntap-nas-eco"  |
| BinaryData  |  |
| ====  |  |
|   |  |
| Events: <none< td=""><th></th></none<>  |  |
| [root@localhos  | st ~]# _   |
|   |  |

This config map will apply the resource modifier rule when the restore is created. A patch will be applied to replace the storage class name to ontap-nas-eco for all persistent volume claims starting with rhel.

# Step 2

To restore the VM use the following command from the Velero CLI:

```
#velero restore create restore1 --from-backup backup1 --resource
-modifier-configmap change-storage-class-config -n openshift-adp
```

The app is restored in the same namespace with the persistent volume claims created using the storage class ontap-nas-eco.

| root@localhos<br>IAME | READY    | get pods<br>STATUS | -n postgre  | AGE                         |          |              |               |     |
|-----------------------|----------|--------------------|-------------|-----------------------------|----------|--------------|---------------|-----|
| ostgresq1-0           | 1/1      | Running            | 0           | 11m                         |          |              |               |     |
| root@localhos         | t ~]# oc | get pvc            | n postgres  | q1                          |          |              |               |     |
| IAME                  | ST       | ATUS VOI           | UME         |                             | CAPACITY | ACCESS MODES | STORAGECLASS  | AGE |
| lata-postgreso        | 1-0 Bo   | und pvo            | -33526ea4-3 | 37c2-4180-a9f6-fb47aea3b4e2 | 8Gi      | RWO          | ontap-nas-eco | 11m |
| root@localhos         | t ~]#    |                    |             |                             |          |              |               |     |

### Deleting backups and restores in using Velero

This section outlines how to delete backups and restores of Apps in OpenShift container platform using Velero.

#### List all backups

You can list all Backup CRs by using the OC CLI tool or the Velero CLI tool. Download the Velero CLI as given in the instructions in the Velero documentation.

| NAME                                 | AGE         |          |          |                     |           |         |                                 |               |
|--------------------------------------|-------------|----------|----------|---------------------|-----------|---------|---------------------------------|---------------|
| <pre>packup-postgresql-ontaps3</pre> | 23h         |          |          |                     |           |         |                                 |               |
| backup2                              | 26s         |          |          |                     |           |         |                                 |               |
| schedule1-20240717070005             | 6h42m       |          |          |                     |           |         |                                 |               |
| [root@localhost ~]# velero           | get backups | -n opens | hift-adp |                     |           |         |                                 |               |
| IAME                                 | STATUS      | ERRORS   | WARNINGS | CREATED             |           | EXPIRES | STORAGE LOCATION                | SELECTO       |
| backup-postgresql-ontaps3            | Completed   | 0        | 0        | 2024-07-16 10:01:08 | -0400 EDT | 29d     | velero-container-backup-ontap-1 | <none></none> |
| backup2                              | Completed   | 0        | 0        | 2024-07-17 09:42:32 | -0400 EDT | 29d     | velero-container-backup-ontap-1 | <none></none> |
| schedule1-20240717070005             | Completed   | 0        | 0        | 2024-07-17 03:00:05 | -0400 EDT | 29d     | velero-container-backup-ontap-1 | <none></none> |
| [root@localhost ~]#                  |             |          |          |                     |           |         |                                 |               |

#### Deleting a backup

You can delete a Backup CR without deleting the Object Storage data by using the OC CLI tool. The backup will be removed from the CLI/Console output. However, since the corresponding backup is not removed from the object storage, it will re-appear in the CLI/console output.

| [root@localhost ~]# oc del@ | ete backup backup2 -n openshift-adp |
|-----------------------------|-------------------------------------|
| backup.velero.io "backup2"  | deleted                             |
| [root@localhost ~]# oc get  | backups -n openshift-adp            |
| NAME                        | AGE                                 |
| backup-postgresql-ontaps3   | 23h                                 |
| schedule1-20240717070005    | 6h49m                               |
| [root@localhost ~]# oc get  | backups -n openshift-adp            |
| NAME                        | AGE                                 |
| backup-postgresql-ontaps3   | 23h                                 |
| backup2                     | 24s                                 |
| schedule1-20240717070005    | 6h50m                               |
| [root@localhost ~]#         |                                     |
|                             |                                     |

If you want to delete the Backup CR AND the associated object storage data, you can do so by using the Velero CLI tool.

| [root@localhost ~]# velero           | get backups  | -n opensk  | nift-adp     |                                |             |                                 |               |
|--------------------------------------|--------------|------------|--------------|--------------------------------|-------------|---------------------------------|---------------|
| NAME                                 | STATUS       | ERRORS     | WARNINGS     | CREATED                        | EXPIRES     | STORAGE LOCATION                | SELECTOR      |
| <pre>packup-postgresql-ontaps3</pre> | Completed    | 0          | 0            | 2024-07-16 10:01:08 -0400 EDT  | 29d         | velero-container-backup-ontap-1 | <none></none> |
| backup2                              | Completed    | 0          | 0            | 2024-07-17 09:42:32 -0400 EDT  | 29d         | velero-container-backup-ontap-1 | <none></none> |
| schedule1-20240717070005             | Completed    | 0          | 0            | 2024-07-17 03:00:05 -0400 EDT  | 29d         | velero-container-backup-ontap-1 | <none></none> |
| [root@localhost ~]# velero           | delete backu | ip backup2 | 2 -n openshi | lft-adp                        |             |                                 |               |
| Are you sure you want to co          | ntinue (Y/N) | ? Y        |              |                                |             |                                 |               |
| Request to delete backup "b          | ackup2" subm | nitted suc | cessfully.   |                                |             |                                 |               |
| The backup will be fully de          | leted after  | all assoc  | iated data   | (disk snapshots, backup files, | restores) a | are removed.                    |               |
| [root@localhost ~]# velero           | get backups  | -n opensk  | nift-adp     |                                |             |                                 |               |
| NAME                                 | STATUS       | ERRORS     | WARNINGS     | CREATED                        | EXPIRES     | STORAGE LOCATION                | SELECTOR      |
| backup-postgresql-ontaps3            | Completed    | 0          | 0            | 2024-07-16 10:01:08 -0400 EDT  | 29d         | velero-container-backup-ontap-1 | <none></none> |
| schedule1-20240717070005             | Completed    | 0          | 0            | 2024-07-17 03:00:05 -0400 EDT  | 29d         | velero-container-backup-ontap-1 | <none></none> |
| [root@localhost ~]#                  |              |            |              |                                |             |                                 |               |

# **Deleting the Restore**

You can delete the Restore CR Object by using either the OC CLI or the Velero CLI

| -   |  |              |                       |           |                     |           |        |          |                     |            |               |
|---|--|--------------|-----------------------|-----------|---------------------|-----------|--------|----------|---------------------|------------|---------------|
|   | alhost ~]# velero get restor   |              |                       |           |                     |           |        |          |                     |            |               |
| NAME  | BACKUP   | STATUS       | STARTED               |           | COMPLETED           |           | ERRORS | WARNINGS | CREATED             |            | SELECTOR      |
| restore   | backup-postgresql-ontaps3  | Completed    | 2024-07-16 14:59:22   | -0400 EDT | 2024-07-16 14:59:45 | -0400 EDT | 0      | 10       | 2024-07-16 14:59:22 | -0400 EDT  | <none></none> |
| restore1  | backup-postgresql-ontaps3  | Completed    | 2024-07-16 16:36:37   | -0400 EDT | 2024-07-16 16:36:59 | -0400 EDT | 0      | 9        | 2024-07-16 16:36:37 | -0400 EDT  | <none></none> |
| [root@localhost ~]# velero restore delete restore1 -n openshift-adp |  |              |                       |           |                     |           |        |          |                     |            |               |
| Are you sure you want to continue (Y/N)? Y                          |  |              |                       |           |                     |           |        |          |                     |            |               |
| Request to delete restore "restore1" submitted successfully.        |  |              |                       |           |                     |           |        |          |                     |            |               |
| The restor  | The restore will be fully deleted after all associated data (restore files in object storage) are removed. |              |                       |           |                     |           |        |          |                     |            |               |
| [root@localhost ~]# velero get restore -n openshift-adp             |  |              |                       |           |                     |           |        |          |                     |            |               |
| NAME  | BACKUP   | STATUS       | STARTED               |           | COMPLETED           |           | ERRORS | WARNINGS | CREATED             |            | SELECTOR      |
| restore   | backup-postgresql-ontaps3  | Completed    | 2024-07-16 14:59:22 - | 0400 EDT  | 2024-07-16 14:59:45 | -0400 EDT | 0      | 10       | 2024-07-16 14:59:22 | -0400 EDT  | <none></none> |
| [root@loca  | alhost ~]#   |              |                       |           |                     |           |        |          |                     |            |               |
| rootaloca   | root@localhost ~]# oc delete restore restore -n openshift-adp  |              |                       |           |                     |           |        |          |                     |            |               |
| restore.velero.io "restore" deleted                                 |  |              |                       |           |                     |           |        |          |                     |            |               |
| [root@localhost ~]# oc get restore -n openshift-adp                 |  |              |                       |           |                     |           |        |          |                     |            |               |
| No resources found in openshift-adp namespace.                      |  |              |                       |           |                     |           |        |          |                     |            |               |
| [root@loca  | alhost ~]# velero get restor   | e -n openshi | ft-adp                |           |                     |           |        |          |                     |            |               |
|   | alhost ~]# _   |              |                       |           |                     |           |        |          |                     | Activate \ | Nindows       |
|   |  |              |                       |           |                     |           |        |          |                     | Activate   | AIIIGOWS      |

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