

VMware Virtualization

NetApp Solutions

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NetApp Solutions for Virtualization with VMware by Broadcom

VMware vSphere with ONTAP

ONTAP has been a leading storage solution for VMware vSphere environments for almost two decades and continues to add innovative capabilities to simplify management while reducing costs. This document introduces the ONTAP solution for vSphere, including the latest product information and best practices, to streamline deployment, reduce risk, and simplify management.

For more information, visit VMware vSphere with ONTAP

VMware vSphere Foundation

NFS v3 Reference Guide for vSphere 8

VMware vSphere Foundation (VVF) is an enterprise-grade platform capable of delivering various virtualized workloads. Core to vSphere are VMware vCenter, the ESXi hypervisor, networking components, and various resource services. When combined with ONTAP, VMware-powered virtualized infrastructures exhibit remarkable flexibility, scalability, and capability.

Using NFS v3 with vSphere 8 and ONTAP Storage Systems

This document provides information on storage options available for VMware Cloud vSphere Foundation using the NetApp All-Flash Arrays. Supported storage options are covered with specific instruction for deploying NFS datastores. Additionally, VMware Live Site Recovery for Disaster Recovery of NFS datastores is demonstrated. Finally, NetApp's Autonomous Ransomware Protection for NFS storage is reviewed.

Use Cases

Use cases covered in this documentation:

- Storage options for customers seeking uniform environments across both private and public clouds.
- Deployment of virtual infrastructure for workloads.
- Scalable storage solution tailored to meet evolving needs, even when not aligned directly with compute resource requirements.
- Protect VMs and datastores using the SnapCenter Plug-in for VMware vSphere.
- Use of VMware Live Site Recovery for Disaster Recovery of NFS datastores.
- Ransomware detection strategy, including multiple layers of protection at ESXi host and guest VM levels.

Audience

This solution is intended for the following people:

• Solution architects looking for more flexible storage options for VMware environments that are designed to

maximize TCO.

- Solution architects looking for VVF storage options that provide data protection and disaster recovery options with the major cloud providers.
- Storage administrators wanting specific instruction on how to configure VVF with NFS storage.
- Storage administrators wanting specific instruction on how to protect VMs and datastores residing on ONTAP storage.

Technology Overview

The NFS v3 VVF Reference Guide for vSphere 8 is comprised of the following major components:

VMware vSphere Foundation

A central component of vSphere Foundation, VMware vCenter is a centralized management platform for providing configuration, control and administration of vSphere environments. vCenter acts as the base for managing virtualized infrastructures, allowing administrators to deploy, monitor and manage VMs, containers, and ESXi hosts within the virtual environment.

The VVF solution supports both native Kubernetes and virtual machine-based workloads. Key components include:

- VMware vSphere
- VMware vSAN
- Aria Standard
- VMware Tanzu Kubernetes Grid Service for vSphere
- vSphere Distributed Switch

For more information on VVF included components, refer to architecture and planning, refer to VMware vSphere Product Live Comparison.

VVF Storage Options

Central to a successful and powerful virtual environment is storage. Storage whether through VMware datastores or guest-connected use cases, unlocks the capabilities of your workloads as you can pick the best price per GB that delivers the most value while also reducing underutilization. ONTAP has been a leading storage solution for VMware vSphere environments for almost two decades and continues to add innovative capabilities to simplify management while reducing costs.

VMware storage options are typically organized as traditional storage and software defined storage offerings. Traditional storage models include local and networked storage while software-defined storage models include vSAN and VMware Virtual Volumes (vVols).



Refer to Introduction to Storage in vSphere Environment for more information on supported storage types for VMware vSphere Foundation.

NetApp ONTAP

There are numerous compelling reasons why tens of thousands of customers have chosen ONTAP as their primary storage solution for vSphere. These include the following:

- 1. **Unified Storage System:** ONTAP offers a unified storage system that supports both SAN and NAS protocols. This versatility allows for seamless integration of various storage technologies within a single solution.
- Robust Data Protection: ONTAP provides robust data protection capabilities through space-efficient snapshots. These snapshots enable efficient backup and recovery processes, ensuring the safety and integrity of application data.
- Comprehensive Management Tools: ONTAP offers a wealth of tools designed to assist in managing application data effectively. These tools streamline storage management tasks, enhancing operational efficiency and simplifying administration.
- 4. **Storage efficiency:** ONTAP includes several storage efficiency features, enabled by default, designed to optimized storage utilization, reduce costs and enhance overall system performance.

Using ONTAP with VMware affords great flexibility when it comes to given application needs. The following protocols are supported as VMware datastore with using ONTAP:

- * FCP
- * FCoE
- * NVMe/FC
- * NVMe/TCP
- * iSCSI
- * NFS v3
- * NFS v4.1

Using a storage system separate from the hypervisor allows you to offload many functions and maximize your investment in vSphere host systems. This approach not only makes sure your host resources are focused on application workloads, but it also avoids random performance effects on applications from storage operations.

Using ONTAP together with vSphere is a great combination that lets you reduce host hardware and VMware software expenses. You can also protect your data at lower cost with consistent high performance. Because virtualized workloads are mobile, you can explore different approaches using Storage vMotion to move VMs across VMFS, NFS, or vVols datastores, all on the same storage system.

NetApp All-Flash Arrays

NetApp AFF (All Flash FAS) is a product line of all-flash storage arrays. It is designed to deliver highperformance, low-latency storage solutions for enterprise workloads. The AFF series combines the benefits of flash technology with NetApp's data management capabilities, providing organizations with a powerful and efficient storage platform.

The AFF lineup is comprised of both A-Series and C-Series models.

The NetApp A-Series all-NVMe flash arrays are designed for high-performance workloads, offering ultra-low latency and high resiliency, making them suitable for mission-critical applications.



C-Series QLC flash arrays are aimed at higher-capacity use cases, delivering the speed of flash with the economy of hybrid flash.

AFF C250



AFF C400



Storage Protocol Support

The AFF support all standard protocols used for virtualization, both datastores and guest connected storage, including NFS, SMB, iSCSI, Fibre Channel (FC), Fibre Channel over Ethernet (FCoE), NVME over fabrics and S3. Customers are free to choose what works best for their workloads and applications.

NFS - NetApp AFF provides support for NFS, allowing for file-based access of VMware datastores. NFSconnected datastores from many ESXi hosts, far exceeds the limits imposed on VMFS file systems. Using NFS with vSphere provides some ease of use and storage efficiency visibility benefits. ONTAP includes file access features available for the NFS protocol. You can enable an NFS server and export volumes or qtrees.

For design guidance on NFS configurations, refer to the NAS storage management documentation.

iSCSI - NetApp AFF provides robust support for iSCSI, allowing block-level access to storage devices over IP

networks. It offers seamless integration with iSCSI initiators, enabling efficient provisioning and management of iSCSI LUNs. ONTAP's advanced features, such as multi-pathing, CHAP authentication, and ALUA support.

For design guidance on iSCSI configurations refer to the SAN Configuration reference documentation.

Fibre Channel - NetApp AFF offers comprehensive support for Fibre Channel (FC), a high-speed network technology commonly used in storage area networks (SANs). ONTAP seamlessly integrates with FC infrastructure, providing reliable and efficient block-level access to storage devices. It offers features like zoning, multi-pathing, and fabric login (FLOGI) to optimize performance, enhance security, and ensure seamless connectivity in FC environments.

For design guidance on Fibre Channel configurations refer to the SAN Configuration reference documentation.

NVMe over Fabrics - NetApp ONTAP support NVMe over fabrics. NVMe/FC enables the use of NVMe storage devices over Fibre Channel infrastructure, and NVMe/TCP over storage IP networks.

For design guidance on NVMe refer to NVMe configuration, support and limitations.

Active-active technology

NetApp All-Flash Arrays allows for active-active paths through both controllers, eliminating the need for the host operating system to wait for an active path to fail before activating the alternative path. This means that the host can utilize all available paths on all controllers, ensuring active paths are always present regardless of whether the system is in a steady state or undergoing a controller failover operation.

For more information, see Data Protection and disaster recovery documentation.

Storage guarantees

NetApp offers a unique set of storage guarantees with NetApp All-flash Arrays. The unique benefits include:

Storage efficiency guarantee: Achieve high performance while minimizing storage cost with the Storage Efficiency Guarantee. 4:1 for SAN workloads.

Ransomware recovery guarantee: Guaranteed data recovery in the event of a ransomware attack.

For detailed information see the NetApp AFF landing page.

NetApp ONTAP Tools for VMware vSphere

A powerful component of vCenter is the ability to integrate plug-ins or extensions that further enhance its functionality and provide additional features and capabilities. These plug-ins extend the management capabilities of vCenter and allow administrators to integrate 3rd party solutions, tools and services into their vSphere environment.

NetApp ONTAP tools for VMware is a comprehensive suite of tools designed to facilitate virtual machine lifecycle management within VMware environments via its vCenter Plug-in architecture. These tools seamlessly integrate with the VMware ecosystem, enabling efficient datastore provisioning and delivering essential protection for virtual machines. With ONTAP Tools for VMware vSphere, administrators can effortlessly manage storage lifecycle management tasks.

Comprehensive ONTAP tools 10 resources can be found ONTAP tools for VMware vSphere Documentation Resources.

View the ONTAP tools 10 deployment solution at Use ONTAP tools 10 to configure NFS datastores for vSphere 8

NetApp NFS Plug-in for VMware VAAI

The NetApp NFS Plug-in for VAAI (vStorage APIs for Array Integration) enhances storage operations by offloading certain tasks to the NetApp storage system, resulting in improved performance and efficiency. This includes operations such as full copy, block zeroing, and hardware-assisted locking. Additionally, the VAAI plugin optimizes storage utilization by reducing the amount of data transferred over the network during virtual machine provisioning and cloning operations.

The NetApp NFS Plug-in for VAAI can be downloaded from the NetApp support site and is uploaded and installed on ESXi hosts using ONTAP tools for VMware vSphere.

Refer to NetApp NFS Plug-in for VMware VAAI Documentation for more information.

SnapCenter Plug-in for VMware vSphere

The SnapCenter Plug-in for VMware vSphere (SCV) is a software solution from NetApp that offers comprehensive data protection for VMware vSphere environments. It is designed to simplify and streamline the process of protecting and managing virtual machines (VMs) and datastores. SCV uses storage based snapshot and replication to secondary arrays to meet lower recovery time objectives.

The SnapCenter Plug-in for VMware vSphere provides the following capabilities in a unified interface, integrated with the vSphere client:

Policy-Based Snapshots - SnapCenter allows you to define policies for creating and managing applicationconsistent snapshots of virtual machines (VMs) in VMware vSphere.

Automation - Automated snapshot creation and management based on defined policies help ensure consistent and efficient data protection.

VM-Level Protection - Granular protection at the VM level allows for efficient management and recovery of individual virtual machines.

Storage Efficiency Features - Integration with NetApp storage technologies provides storage efficiency features like deduplication and compression for snapshots, minimizing storage requirements.

The SnapCenter Plug-in orchestrates the quiescing of virtual machines in conjunction with hardware-based snapshots on NetApp storage arrays. SnapMirror technology is utilized to replicate copies of backups to secondary storage systems including in the cloud.

For more information refer to the SnapCenter Plug-in for VMware vSphere documentation.

BlueXP integration enables 3-2-1 backup strategies that extend copies of data to object storage in the cloud.

For more information on 3-2-1 backup strategies with BlueXP visit 3-2-1 Data Protection for VMware with SnapCenter Plug-in and BlueXP backup and recovery for VMs.

For step-by-step deployment instructions for the SnapCenter Plug-in, refer to the solution Use SnapCenter Plug-in for VMware vSphere to protect VMs on VCF Workload Domains.

Storage considerations

Leveraging ONTAP NFS datastores with VMware vSphere yields a high-performing, easy-to-manage, and scalable environment that provides VM-to-datastore ratios unattainable with block-based storage protocols. This architecture can result in a tenfold increase in datastore density, accompanied by a corresponding reduction in the number of datastores.

nConnect for NFS: Another benefit of using NFS is the ability to leverage the **nConnect** feature. nConnect enables multiple TCP connections for NFS v3 datastore volumes, thereby achieving higher throughput. This helps increase parallelism and for NFS datastores. Customers deploying datastores with NFS version 3 can increase the number of connections to the NFS server, maximizing the utilization of high-speed network interface cards.

For detailed information on nConnect, refer to NFS nConnect Feature with VMware and NetApp.

Session trunking for NFS: Starting from ONTAP 9.14.1, clients using NFSv4.1 can leverage session trunking to establish multiple connections to various LIFs on the NFS server. This enables faster data transfer and enhances resilience by utilizing multipathing. Trunking proves particularly beneficial when exporting FlexVol volumes to clients that support trunking, such as VMware and Linux clients, or when using NFS over RDMA, TCP, or pNFS protocols.

Refer to NFS trunking overview for more information.

FlexVol volumes: NetApp recommends using **FlexVol** volumes for most NFS datastores. While larger datastores can enhance storage efficiency and operational benefits, it is advisable to consider using at least four datastores (FlexVol volumes) to store VMs on a single ONTAP controller. Typically, administrators deploy datastores backed by FlexVol volumes with capacities ranging from 4TB to 8TB. This size strikes a good balance between performance, ease of management, and data protection. Administrators can start small and scale the datastore as needed (up to a maximum of 100TB). Smaller datastores facilitate faster recovery from backups or disasters and can be swiftly moved across the cluster. This approach allows for maximum performance utilization of hardware resources and enables datastores with different recovery policies.

FlexGroup volumes: For scenarios requiring a large datastore, NetApp recommends the use of **FlexGroup** volumes. FlexGroup volumes have virtually no capacity or file count constraints, enabling administrators to easily provision a massive single namespace. Using FlexGroup volumes does not entail additional maintenance or management overhead. Multiple datastores are not necessary for performance with FlexGroup volumes, as they scale inherently. By utilizing ONTAP and FlexGroup volumes with VMware vSphere, you can establish simple and scalable datastores that leverage the full power of the entire ONTAP cluster..

Ransomware protection

NetApp ONTAP data management software features a comprehensive suite of integrated technologies to help you protect, detect, and recover from ransomware attacks. The

NetApp SnapLock Compliance feature built into ONTAP prevents the deletion of data stored in an enabled volume using WORM (write once, read many) technology with

advanced data retention. After the retention period is established and the Snapshot copy is locked, not even a storage administrator with full system privileges or a member of the NetApp Support team can delete the Snapshot copy. But, more importantly, a hacker with compromised credentials can't delete the data.

NetApp guarantees that we will be able to recover your protected NetApp® Snapshot[™] copies on eligible arrays, and if we can't, we will compensate your organization.

More information about the Ransomware Recovery Guarantee, see: Ransomeware Recovery Guarantee.

Refer to the Autonomous Ransomware Protection overview for more in depth information.

See the full solution at the NetApps Solutions documentation center: Autonomous Ransomware Protection for NFS Storage

Disaster recovery considerations

NetApp provides the most secure storage on the planet. NetApp can help protect data and application

infrastructure, move data between on-premises storage and cloud, and help ensure data availability across clouds. ONTAP comes with powerful data protection and security technologies that help protect customers from disasters by proactively detecting threats and quickly recovering data and applications.

VMware Live Site Recovery, formerly known as VMware Site Recovery Manager, offers streamlined, policybased automation for protecting virtual machines within the vSphere web client. This solution leverages NetApp's advanced data management technologies through the Storage Replication Adapter as part of ONTAP Tools for VMware. By harnessing the capabilities of NetApp SnapMirror for array-based replication, VMware environments can benefit from one of ONTAP's most reliable and mature technologies. SnapMirror ensures secure and highly efficient data transfers by copying only the changed file system blocks, rather than entire VMs or datastores. Moreover, these blocks take advantage of space-saving techniques like deduplication, compression, and compaction. With the introduction of version-independent SnapMirror in modern ONTAP systems, you gain flexibility in selecting your source and destination clusters. SnapMirror has truly emerged as a powerful tool for disaster recovery, and when combined with Live Site Recovery, it offers enhanced scalability, performance, and cost savings compared to local storage alternatives.

For more information refer to the Overview of VMware Site Recovery Manager.

See the full solution at the NetApps Solutions documentation center: Autonomous Ransomware Protection for NFS Storage

BlueXP DRaaS (Disaster Recovery as a Service) for NFS is a cost-effective disaster recovery solution designed for VMware workloads running on on-premises ONTAP systems with NFS datastores. It leverages NetApp SnapMirror replication to protect against site outages and data corruption events, such as ransomware attacks. Integrated with the NetApp BlueXP console, this service enables easy management and automated discovery of VMware vCenters and ONTAP storage. Organizations can create and test disaster recovery plans, achieving a Recovery Point Objective (RPO) of up to 5 minutes through block-level replication. BlueXP DRaaS utilizes ONTAP's FlexClone technology for space-efficient testing without impacting production resources. The service orchestrates failover and failback processes, allowing protected virtual machines to be brought up on the designated disaster recovery site with minimal effort. Compared to other well-known alternatives, BlueXP DRaaS offers these capabilities at a fraction of the cost, making it an efficient solution for organizations to set up, test, and execute disaster recovery operations for their VMware environments using ONTAP storage systems.

See the full solution at the NetApps Solutions documentation center: DR using BlueXP DRaaS for NFS Datastores

Solutions Overview

Solutions covered in this documentation:

- NFS nConnect feature with NetApp and VMware. Click here for deployment steps.
 - Use ONTAP tools 10 to configure NFS datastores for vSphere 8. Click here for deployment steps.
 - Deploy and use the SnapCenter Plug-in for VMware vSphere to protect and restore VMs. Click here for deployment steps.
 - Disaster recovery of NFS Datastores with VMware Site Recovery Manager. Click here for deployment steps.
 - Autonomous Ransomware Protection for NFS storage. Click here for deployment steps.

NFS nConnect feature with NetApp and VMware

Starting with VMware vSphere 8.0 U1 (as Tech-preview), the nconnect feature enables multiple TCP connections for NFS v3 datastore volumes to achieve more throughput.

Customers using NFS datastore can now increase the number of connections to NFS server thus maximizing the utilization of high speed network interface cards.



The feature is generally available for NFS v3 with 8.0 U2, Refer storage section on Release notes of VMware vSphere 8.0 Update 2. NFS v4.1 support is added with vSphere 8.0 U3. for more info, check vSphere 8.0 Update 3 Release Notes

Use cases

- · Host more virtual machines per NFS datastore on the same host.
- Boost NFS datastore performance.
- Provide an option to offer service at a higher tier for VM and Container based applications.

Technical details

The purpose of nconnect is to provide multiple TCP connections per NFS datastore on a vSphere host. This helps increase parallelism and performance for NFS datastores. In ONTAP, when an NFS mount is established, a Connection ID (CID) iscreated. That CID provides up to 128 concurrent in-flight operations. When that number is exceeded by the client, ONTAP enacts a form of flow control until it can free up some available resources as other operations complete. These pauses usually are only a few microseconds, but over the course of millions of operations, those can add up and create performance issues. Nconnect can take the 128 limit and multiply it by the number of nconnect sessions on the client, which provides more concurrent operations per CID and can potentially add performance benefits. For additional details, please refer NFS best practice and implementation guide

Default NFS Datastore

To address the performance limitations of single connection of NFS datastore, additional datastores are mounted or additional hosts are added to increase the connection.

Without nConnect feature with NetApp and VMware



With nConnect NFS Datastore

Once the NFS datastore is created using ONTAP Tools or with other options, the number of connection per NFS datastore can be modified using vSphere CLI, PowerCLI, govc tool or other API options. To avoid performance concerns along with vMotion, keep the number of connections same for the NFS datastore on all vSphere hosts that are part of the vSphere Cluster.



With nConnect feature with NetApp and VMware

Pre-requisite

To utilize the nconnect feature, the following dependencies should be met.

ONTAP Version	vSphere Version	Comments
9.8 or above	8 Update 1	Tech preview with option to increase number of connections.
9.8 or above	8 Update 2	Generally available with option to increase and decrease the number of connections.
9.8 or above	8 Update 3	NFS 4.1 and multi-path support.

Update number of connection to NFS Datastore

A single TCP connection is used when a NFS datastore is created with ONTAP Tools or with vCenter. To increase the number of connections, vSphere CLI can be used. The reference command is shown below.

```
# Increase the number of connections while creating the NFS v3 datastore.
esxcli storage nfs add -H <NFS Server FQDN or IP> -v <datastore name> -s
<remote share> -c <number of connections>
# To specify the number of connections while mounting the NFS 4.1
datastore.
esxcli storage nfs41 add -H <NFS Server FQDN or IP> -v <datastore name> -s
<remote share> -c <number of connections>
# To utilize specific VMkernel adapters while mounting, use the -I switch
esxcli storage nfs41 add -I <NFS Server FQDN or IP>:vmk1 -I
<NFS Server FQDN or IP>:vmk2 -v <datastore name> -s <remote share> -c
<number of connections>
# To increase or decrease the number of connections for existing NFSv3
datastore.
esxcli storage nfs param set -v <datastore name> -c
<number of connections>
# For NFSv4.1 datastore
esxcli storage nfs41 param set -v <datastore_name> -c
<number of connections>
# To set VMkernel adapter for an existing NFS 4.1 datastore
esxcli storage nfs41 param set -I <NFS Server FQDN or IP>:vmk2 -v
<datastore name> -c <number of connections>
```

or use PowerCLI similar to shown below

```
$datastoreSys = Get-View (Get-VMHost hostO1.vsphere.local).ExtensionData
.ConfigManager.DatastoreSystem
$nfsSpec = New-Object VMware.Vim.HostNasVolumeSpec
$nfsSpec.RemoteHost = "nfs_server.ontap.local"
$nfsSpec.RemotePath = "/DSO1"
$nfsSpec.LocalPath = "DSO1"
$nfsSpec.LocalPath = "DSO1"
$nfsSpec.AccessMode = "readWrite"
$nfsSpec.Type = "NFS"
$nfsSpec.Connections = 4
$datastoreSys.CreateNasDatastore($nfsSpec)
```

Here is the example of increasing the number of connection with govc tool.

```
$env.GOVC URL = 'vcenter.vsphere.local'
$env.GOVC USERNAME = 'administrator@vsphere.local'
$env.GOVC PASSWORD = 'XXXXXXXXX'
$env.GOVC Datastore = 'DS01'
# $env.GOVC INSECURE = 1
$env.GOVC HOST = 'host01.vsphere.local'
# Increase number of connections while creating the datastore.
govc host.esxcli storage nfs add -H nfs server.ontap.local -v DS01 -s
/DS01 -c 2
# For NFS 4.1, replace nfs with nfs41
govc host.esxcli storage nfs41 add -H <NFS Server FQDN or IP> -v
<datastore name> -s <remote share> -c <number of connections>
# To utilize specific VMkernel adapters while mounting, use the -I switch
govc host.esxcli storage nfs41 add -I <NFS Server FQDN or IP>:vmk1 -I
<NFS Server FQDN or IP>:vmk2 -v <datastore name> -s <remote share> -c
<number of connections>
# To increase or decrease the connections for existing datastore.
govc host.esxcli storage nfs param set -v DS01 -c 4
# For NFSv4.1 datastore
govc host.esxcli storage nfs41 param set -v <datastore name> -c
<number of connections>
# View the connection info
govc host.esxcli storage nfs list
```

Refer VMware KB article 91497 for more information.

Design considerations

The maximum number of connections supported on ONTAP is depended on storage platform model. Look for exec_ctx on NFS best practice and implementation guide for more information.

As the number of connections per NFSv3 datastore is increased, the number of NFS datastores that can be mounted on that vSphere host decreases. The total number of connections supported per vSphere host is 256. Check VMware KB article 91481 for datastore limts per vSphere host.



vVol datastore does not support nConnect feature. But, protocol endpoints counts towards the connection limit. A protocol endpoint is created for each data lif of SVM when vVol datastore is created.

Use ONTAP tools 10 to configure NFS datastores for vSphere 8

ONTAP tools for VMware vSphere 10 features a next-generation architecture that enables native high availability and scalability for the VASA Provider (supporting iSCSI and NFS vVols). This simplifies the management of multiple VMware vCenter servers and ONTAP clusters.

In this scenario we will demonstrate how to deploy and use ONTAP tools for VMware vSphere 10 and

configure an NFS datastore for vSphere 8.

Solution Overview

This scenario covers the following high level steps:

- Create a storage virtual machine (SVM) with logical interfaces (LIFs) for NFS traffic.
- Create a distributed port group for the NFS network on the vSphere 8 cluster.
- Create a vmkernel adapter for NFS on the ESXi hosts in the vSphere 8 cluster.
- Deploy ONTAP tools 10 and register with the vSphere 8 cluster.
- · Create a new NFS datastore on the vSphere 8 cluster.

Architecture

The following diagram shows the architectural components of an ONTAP tools for VMware vSphere 10 implementation.



Prerequisites

This solution requires the following components and configurations:

- An ONTAP AFF storage system with physical data ports on ethernet switches dedicated to storage traffic.
- vSphere 8 cluster deployment is complete and the vSphere client is accessible.
- ONTAP tools for VMware vSphere 10 OVA template has been downloaded from the NetApp support site.

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

Refer to Best Practices For Running NFS with VMware vSphere for detailed information specific to VMware vSphere.

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

Comprehensive ONTAP tools 10 resources can be found ONTAP tools for VMware vSphere Documentation Resources.

Deployment Steps

To deploy ONTAP tools 10 and use it to create an NFS datastore on the VCF management domain, complete the following steps:

Create SVM and LIFs on ONTAP storage system

The following step is performed in ONTAP System Manager.

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

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

ONTAP System Manager					
DASHBOARD	Storage VMs				
INSIGHTS	+ Add				
STORAGE ^	Name				
Overview	EHC_ISCSI				
Volumes	EHC				
LUNS					
Consistency Groups	HMC_187				
NVMe Namespaces	HMC_3510				
Shares	HMC_iSCSI_3510				
Buckets					
Qtrees	infra_svm_a300				
Quotas	JS_EHC_iSCSI				
Storage VMs	OTVtest				
Tiers					

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

VCF_NFS	
IPSPACE	
Default	~
Access Protocol	
SMB/CIFS, NFS, S3	iSCSI FC NVMe
Enable SMB/CIFS	
Enable NFS	
Allow NF	S client access at least one rule to allow NFS clients to access volumes in this storage VM. 🧑
EXPORT PO Default	DLICY
Enable S2	



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

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

Парпстазоо-от					
SUBNET					
Without a subnet		~			
IP ADDRESS	SUBNET MASK		GATEWAY	BROADCAST DOMAIN AND PORT	
172.21.118.119	24		Add optional gateway	NFS_iSCSI	~
✓ Use the same sub	net mask, gateway, and l	broadcas	t domain for all of the followi	ng interfaces	
ntaphci-a300-02					
SUBNET					
Without a subnet		~			
IP ADDRESS	PORT				
172.21.118.120	a0a-3374	~			
bose whether to enab I click on Save to crea Storage VM A	le the Storage V ate the SVM. dministrat	M Adm	ninistration account (for multi-tenancy enviror	ımer
_					

Set up networking for NFS on ESXi hosts

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

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

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

]) B. E. Ø	,	Summary Monitor Configure	Permissions Ports Hosts
 		Switch Details	
DSwitch DS Actions - DSwitch		Manufacturer	VMware, Inc.
Mg Distributed Port Group Image: Settings VM Image: Settings	> > >	Mew Distributed Port Group Import Distributed Port Group Manage Distributed Port Groups Ports	4 4 1 40
Move To Rename Tags & Custom Attributes	>		\otimes
Add Permission Alarms	>	Tags II	Custom Attributes
🔀 Delete			

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

New Distributed Port Group	Set general properties of the new port group	
1 Name and location	Port binding	Static binding 🗸
2 Configure settings	Port allocation	Elastic 🗸 🛈
3 Ready to complete	Number of ports	8
	Network resource pool	(default) ~
	VLAN	
	VLAN type	VLAN ~
	VLAN ID	3374
	Advanced	
	Customize default policies configuration	
		CANCEL BACK

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



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

Distributed Port Group - Edit Settings | NFS 3374

General	Load balancing	Route based on originating virtual por $ \! \! \! \! \! \! \! \! \! \! \! \! \! \! \! \! \! $	
Advanced			
VLAN	Network failure detection	Link status only ~	
Security	Notify switches	Yes ~	
Traffic shaping	Failback	Yes ×	
Teaming and failover			
Monitoring	Failover order 🛈		
Miscellaneous	MOVE UP MOVE DOWN		
	Active uplinks		
	🗔 Uplink 1		
	🗔 Uplink 2		
	Standby uplinks		
	Unused uplinks		
			CANCEL
Repeat this process for	each ESXi host in the cluster.		

×

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

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

III I I I I I I I I I I I I I I I I I	esxisrm-05.sd summary Monitor	dc.net	app.	CON ermis	ן : Actions sions VMs	Datastores	Networks	Upda	ites
 ic vcenter-vlsr.sddc.netapp.com ic Datacenter ic SecondaryCluster esxisrm-05.sddc.netapp.com esxisrm-06.sddc.netapp.com esxisrm-07.sddc.netapp.com esxisrm-07.sddc.netapp.com esxisrm-08.sddc.netapp.com 	Storage Storage Adapters Storage Devices Host Cache Configuration Protocol Endpoints I/O Filters	• ^	VM ADE	Kerr		°S REFRESH ▼ Netwo @ N	ork Label Vigmt 3376	Ŧ	Sw
netapp-ontap-tools-for-vmware-vsphere-10.1	Networking Virtual switches VMkernel adapters Physical adapters TCP/IP configuration	Ť	:	»	wwk2	ima v شا v	/Motion 3373		

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



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

Add Networking	Select target device		
	Select a target device for the new	connection.	
1 Select connection type	Select an existing network		
	 Select an existing standard swite 	ch	
2 Select target device	O New standard switch		
3 Port properties	Quick Filter Enter value	le	
4 IPv4 settings	Name	NSX Port Group ID	Distributed Switch
	O 🕼 Mgmt 3376	2.57	DSwitch
5 Ready to complete	💿 🙈 NFS 3374	<u> </u>	DSwitch
	O 🕼 vMotion 3373	(DSwitch
	O 🏔 vSAN 3422	124 C	DSwitch
	Manage Columns		4 ite
			CANCEL DACK

- 4. On the **Port properties** page keep the defaults (no enabled services) and click on **Next** to continue.
- 5. On the **IPv4 settings** page fill in the **IP address**, **Subnet mask**, and provide a new Gateway IP address (only if required). Click on **Next** to continue.



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

Add Networking	Ready to comple	le	
1	Review your selections bef	ore finishing the wizard	
1 Select connection type	✓ Select target device		
2 Select target device	Distributed port group	NFS 3374	
3 Port properties	Distributed switch	DSwitch	
	✓ Port properties		
4 IPv4 settings	New port group	NFS 3374 (DSwitch)	
	MTU	9190	
5 Ready to complete	vMotion	Disabled	
	Provisioning	Disabled	
	Fault Tolerance logging	Disabled	
	Management	Disabled	
	vSphere Replication	Disabled	
	vSphere Replication NFC	Disabled	
	VSAN	Disabled	
	vSAN Witness	Disabled	
	vSphere Backup NFC	Disabled	
	NVMe over TCP	Disabled	
	NVMe over RDMA	Disabled	
	✓ IPv4 settings		
	IPv4 address	172.21.118.45 (static)	
	Subnet mask	255.255.255.0	
			CANCEL BACK
Dadiagos			
PACKAGES			

Deploy and use ONTAP tools 10 to configure storage

The following steps are performed on vSphere 8 cluster using the vSphere client and involve deploying OTV, configuring ONTAP tools Manager, and creating a vVols NFS datastore.

For the full documentation on deploying and using ONTAP tools for VMware vSphere 10 refer to Prepare to deploy ONTAP tools for VMware vSphere.

ONTAP tools for VMware vSphere 10 is deployed as a VM appliance and provides an integrated vCenter UI for managing ONTAP storage. ONTAP tools 10 features a new global management portal for managing connections to multiple vCenter servers and ONTAP storage backends.



In a non-HA deployment scenario, three available IP addresses are required. One IP address is allocated for the load balancer, another for the Kubernetes control plane, and the remaining one for the node. In an HA deployment, two additional IP addresses are necessary for the second and third nodes, in addition to the initial three. Prior to assignment, the host names should be associated to the IP addresses in DNS. It is important that all five IP addresses are on the same VLAN, which is chosen for the deployment.

Complete the following to Deploy ONTAP tools for VMware vSphere:

- 1. Obtain the ONTAP tools OVA image from the NetApp Support site and download to a local folder.
- 2. Log into the vCenter appliance for the vSphere 8 cluster.
- 3. From the vCenter appliance interface right-click on the management cluster and select **Deploy OVF Template...**

() P = Ø		 Summary 	daryCluster :4 Monitor Configure	Permissions
 vcenter-vlsr.sddc.netapp. Datacenter SecondaryCluster esxisrm-05.sc (esxisrm-06.sc]] Actions - SecondaryCluster	Cluster D	etails Total Processors:	8
esxisrm-07.sc esxisrm-08.sc vCLS-02eb4a	🔂 New Virtual Machine O New Resource Pool	0	Total vMotion Migrations: Fault Domains:	0
	한 Deploy OVF Template 답 New vApp.			

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



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

Deploy OVF Template	Select storage	
	Select the storage for the configuration and disk files	
1 Select an OVF template	Encrypt this virtual machine Select virtual disk format	
2 Select a name and folder	VM Storage Policy Datastore Default ~	
3 Select a compute resource	Storage	
4 Review details	Name T Compatibility T Capacity T Provisioned T Free T Second Second Se	T V
5 License agreements	Terms per page 10 v 1	> item
6 Configuration		
7. Soloct storage		
7 Select storage		
8 Select networks		
9 Customize template		
10 Ready to complete	Constant In 1994	
	Compatibility	
	CANCEL BACK NE	ΞХТ
the Select network page	the select the network used for management traffic.	

7.



8. On the Configuration page select the deployment configuration to be used. In this scenario the easy deployment method is used.



ONTAP Tools 10 features multiple deployment configurations including high-availability deployments using multiple nodes. For documentation on all deployment configurations, refer to Prepare to deploy ONTAP tools for VMware vSphere.

Deploy O <mark>VF Templa</mark> te	Configuration Select a deployment configuration	
1 Select an OVF template	Easy deployment (S)	Description
2 Select a name and folder	O Easy deployment (M)	Deploy local provisioner Non-HA Small single node instance of
	O Advanced deployment (S)	ONTAP tools
3 Select a compute resource	O Advanced deployment (M)	
4 Review details	O High-Availability deployment (S)	
5 License agreements	O High-Availability deployment (M)	
	O High-Availability deployment (L)	
6 Configuration	O Recovery	
7 Select storage		
8 Select networks		
9 Customize template		
10 Ready to complete		
	8 Items	
to ready to comprate	8 Items	
		CANCEL BACK NE

- 9. On the Customize template page fill out all required information:
 - Application username to be used to register the VASA provider and SRA in the vCenter Server.
 - Enable ASUP for automated support.
 - ASUP Proxy URL if required.
 - Administrator username and password.
 - NTP servers.
 - Maintenance user password to access management functions from the console.
 - Load Balancer IP.
 - Virtual IP for K8s control plane.
 - Primary VM to select the current VM as the primary (for HA configurations).
 - Hostname for the VM
 - Provide the required network properties fields.

Click on **Next** to continue.

epioy OVF Template	Customize template	
1 Select an OVF template	Customize the deployment properties o	f this software solution.
2 Select a name and folder	✓ System Configuration	8 settings
3 Select a compute resource	Application username(*)	Username to assign to the Application vsphere-services
4 Review details	Application password(*)	Password to assign to the Application
5 License agreements		Password ©
6 Configuration		
7 Select storage		Confirm Password
8 Select networks	Enable ASUP	Select this checkbox to enable ASUP
9 Customize template	ASUP Proxy URL	Proxy url (in case if egress is blocked in datacenter side), through which we can push the asup bundle.
	Administrator username(*)	Username to assign to the Administrator. Please use only a letter a the beginning. And only '@', '', '-', '!' special characters are supported
	Administrator password(*)	Password to assign to the Administrator

Deploy OVF Template

Select an OVF template
 Select a name and folder
 Select a compute resource
 Review details
 License agreements
 Configuration
 Select storage
 Select networks
 Select networks

faintenance user password(*)	Password to assign to maint user account		
	Password		0
	Confirm Password	•••••	0
eployment Configuration	3 settings		
oad balancer IP(*)	Load balancer IP (*) 172.21.120.57		
'irtual IP for K8s control plane(*)	Provide the virtual IP address for K8s control plane 172.21.120.58		
rimary VM	Maintain this field as s install the ONTAP too	selected to set the current	VM as primary and
ode Configuration	10 settings		1
lostName(*)	Specify the hostname	e for the VM	
P Address(*)	Specify the IP addres	s for the appliance	
	Specify the IDvC addr	ess on the deployed netwo	ork only when you

10. Review all information on the Ready to complete page and the click Finish to begin deploying the ONTAP tools appliance.

Connect Storage Backend and vCenter Server to ONTAP tools 10.

ONTAP tools manager is used to configure global settings for ONTAP Tools 10.

1. Access ONTAP tools Manager by navigating to https://loadBalanceIP:8443/virtualization/ui/ in a web browser and logging in with the administrative credentials provided during deployment.

2. On the **Getting Started** page click on **Go to Storage Backends**.

also do	winload support log bundles.
9	Storage Backends
9	Add, modify, and remove storage backends.
	Go to Storage Backends
_	Cantara
	vcenters
	Add, modify, and remove vCenters and associate storage backends with them.
	Go to vCenters
	Log Bundles
	Generate and download log bundles for support purposes.
	Go to Log Bundles

3. On the **Storage Backends** page, click on **ADD** to fill in the credentials of an ONTAP storage system to be registered with ONTAP tools 10.

	« Storage Bac	konds	490	
Storage Backend	Storage bac	.KCHUS	1	
VCenters	The ESXi hosts use Stor	age Backends for data storage.	0	
Log Bundles	Name	т Туре	T IP Address	or FQDN
En Certificates				
l Settings				Ţ
				This list is empty!

4. On the Add Storage Backend box, fill out the credentials for the ONTAP storage system.

33

lostname: *	172.16.9.25	
Jsername: *	admin	
Password: *		0
Port: *	443	

5. In the left hand menu click on **vCenters**, and then on on **ADD** to fill in the credentials of a vCenter server to be registered with ONTAP tools 10.

ONTAP tools Ma	nager			
Storage Backend	« vCenters			
VCenters	vCenters are central management	platforms that a low you to control hosts,	virtual machines and storage backends.	
Log Bundles	IP Address or FQDN	v Version	⊤ Status	y vCenter GUID
Certificates				\bigtriangledown
Settings				Y
			This	list is empty!

6. On the **Add vCenter** box, fill out the credentials for the ONTAP storage system.
| erver IP Address of FODIN. VO | center-visr.sddc.netapp.com |
|-------------------------------|---|
| Isername: * ac | d <mark>m</mark> inistrator@vsphere.local |
| assword: * | |
| ort: *44 | 43 |

7. From the vertical three-dot menu for the newly discovered vCenter server, select **Associate Storage Backend**.

ONTAP tools Manag	er					
«	VCe	enters	DD			
Storage Backend						
VCenters	vCent	ers are central management platforms t	hat allow yo	ou to control hosts, vi	rtual machines a	and storage backends.
Log Bundles		Associate Storage Backend	Ŧ	Version	Ŧ	Status
🛱 Certificates	1	Dissociate Stor Backend Modify		8.0.2		🔗 Healthy
-0		Remove				

8. On the **Associate Storage Backend** box, select the ONTAP storage system to associated with the vCenter server and click on **Associate** to complete the action.

Assoc <mark>ia</mark> te <mark>Storage</mark> Ba	ackend vcenter-vlsr.sddc.netapp.	com X
Storage Backend	ntaphci-a300e9u25	~
	CANCEL	ASSOCIATE
	CANCEL	ASSOCIATE

9. To verify the installation, log into the vSphere client and select **NetApp ONTAP tools** from the left hand menu.

ੀ Home	
Shortcuts	
2 Inventory	
Content Libraries	
Workload Management	
B Global Inventory Lists	
R Policies and Profiles	
Auto Deploy	
Hybrid Cloud Services	
Developer Center	
ð Administration	
Tasks	
Events	
Tags & Custom Attributes	
∋ Lifecycle Manager	
NetApp ONTAP tools	
ð NSX	
DVMware Aria Operations Configuration	
Skyline Health Diagnostics	

10. From the ONTAP tools dashboard you should see that a Storage Backend was associated with the vCenter Server.

TAPP ON TAP TOOIS INSTAN	CE 172.21.120.57:8443 ~							
≪ ∂ Overview	Overview							0
Storage Backends								
Settings	1		Storage Ba	ckends - Capacity				
Support	1						37.29 TB	31.34 TB
Reports ~	Storage Ba	ckend				USED AM	ID RESERVED	PHYSICAL AVAILABLE
Virtual Machines	, i i i i i i i i i i i i i i i i i i i							
Datastores			0%	20%	40%	60%	80%	100%
	VASA Provider Status:	Not Registered						
			VIEW ALL STOP	AGE BACKENDS (1)				

0		2
.3	2	1
~	-	-

Complete the following steps to deploy an ONTAP datastore, running on NFS, using ONTAP tools 10.

1. In the vSphere client, navigate to the storage inventory. From the **ACTIONS** menu, select **NetApp ONTAP tools > Create datastore**.

≡ vSphere Client Q Search in all environ	nents					C
Image: Constraint of the second se	C Datacenter Monitor Datacenter Details	Actions - Datacenter Actions - Datacenter Actions - Datacenter Actions - Datacenter Mew Cluster New Cluster New Virtual Machine Distributed Switch Mew Virtual Machine Deploy OVF Template Storage Edit Default VM Compatibility	s > >	VMs	5 Datastores Networks Updates Capacity and Usage Last updated at 10:47 AM CPU 10:19 GHz used Memory 65:23 GB used Storage	90.79 GHz free 100.98 GHz capacity 190.75 GB free 255.98 GB capacity 622.86 GB free
		Migrate VMs to Another Network Move To Rename Tags & Custom Attributes	>	6	177.11 GB used VIEW STATS	799.97 GB capacity
	Custom Attributes	Add Permission Alarms & Delete NetApp ONTAP tools Custom attributes assigned	>		ate datastore	

2. On the **Type** page of the Create Datastore wizard, click on the NFS radio button and then on **Next** to continue.

reate Datastore	Туре		
1 Туре	Destination:	Bt Datacenter	
2 Name and Protocol			
3 Storage	Datastore type:		
4 Storage Attributes			
5 Summary			
			CANCEL
			c'

3. On the **Name and Protocol** page, fill out the name, size and protocol for the datastore. Click on **Next**

to continue.					
Create Datastore	Name and Protocol				×
1 Туре	Datastore name:	NFS_DS1			
2 Name and Protocol	11244	248	1995		
3 Storage	Size:	2 Minimum supported size is 1 GB.	TB	<u>```</u>	
4 Storage Attributes	Protocol:	NFS 3	<u>~</u>		
5 Summary	 Advanced Options 				
	Datastore Cluster:		×		
				CANCEL BACK NEXT	
				5	5

4. On the **Storage** page select a Platform (filters storage system by type) and a storage VM for the volume. Optionally, select a custom export policy. Click on **Next** to continue.

Create Datastore	Storage					×
1 Type 2 Name and Protocol 3 Storage	Platform: * Storage VM: *	Performance (A) VCF_NFS ntaphci-a300e9u25 (172.16.9.25)	× ×			
4 Storage Attributes 5 Summary	 Advanced Options Custom Export Policy: 	Search or specify policy name Choose an existing policy or give a new name to th default policy.	/			
				CANCEL	ВАСК	NEKT

5. On the **Storage attributes** page select the storage aggregate to use, and optionally, advanced options such as space reservation and quality of service. Click on **Next** to continue.

Create Datastore	Storage Attributes	×
1 Туре	Specify the storage details for	provisioning the datastore.
2 Name and Protocol	Aggregate: *	EHCAggr02 (16.61 TB Free)
3 Storage	Volume:	A new volume will be created automatically.
4 Storage Attributes	 Advanced Options 	
5 Summary	Space Reserve: *	Thin
	Enable QoS	
		CANCEL BACK NEXT

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

Create Datastore	Summary		×
1 Туре	A new datastore will be cre	ated with these settings.	
2 Name and Protocol	Type Destination: Datastore type:	Datacenter NFS	
4 Storage Attributes	Name and Protocol		
5 Summary	Size: Protocol:	NFS_DS1 2 TB NFS 3	
	Storage	D-6	
	Platform: Storage VM:	VCF_NFS	
			CANCEL BACK FINISH
			C

Complete the following steps to resize an existing NFS datastore using ONTAP tools 10.

1. In the vSphere client, navigate to the storage inventory. From the **ACTIONS** menu, select **NetApp ONTAP tools > Resize datastore**.

	✓ I NFS_DS1	EACTIONS		
B B B C C	Summary Monitor	Actions - NFS_DS1	VMs	s
Datacenter NFS_DS1 vsanDatastore	Details	ਕਿ Browse Files 🖄 Register VM	8	Capacity and Usag Last updated at 12:14 PM Storage
) Configure Storage I/O Control		
		C Refresh Capacity Information		968 KB used
	s	Maintenance Mode	>	
	F	c Move To c Rename	:73-	
		Mount Datastore to Additional Hosts Unmount Datastore		VIEW STATS REFRESH
	Tags	Add Permission	>	
		NetApp ONTAP tools	>	

2. On the **Resize Datastore** wizard, fill in the new size of the datastore in GB and click on **Resize** to continue.

	lc							
volume Detai	IS							
Volume Name:			NFS_	_DS1				
Total Size:			2.1 T	В				
Used Size:	(0/)-		968	KB				
Shapshot Reserve	(%):		5					
i nin Provisionea:			Yes					
Size								
Current Datastore	Size:		2 TB					
New Datastore Siz	ze (GB): *	:	300	00	\$			
							CANCEL	RESIZE
1onitor the prog	ress of	the resize job	in the Rec	cent Tasks	s pane.		CANCEL	RESIZE
fonitor the prog	ress of	the resize job	in the Rec	cent Tasks	s pane.		CANCEL	RESIZE
fonitor the prog ✓ Recent Tas Task Name	ress of iks A	the resize job Marms Target	in the Rec	cent Tasks	s pane.	Ť	Details	RESIZE

Additional information

For a complete listing of ONTAP tools for VMware vSphere 10 resources refer to ONTAP tools for VMware vSphere Documentation Resources.

For more information on configuring ONTAP storage systems refer to the ONTAP 10 Documentation center.

Use VMware Site Recovery Manager for Disaster Recovery of NFS datastores

The utilization of ONTAP tools for VMware vSphere 10 and the Site Replication Adapter (SRA) in conjunction with VMware Site Recovery Manager (SRM) brings significant value to disaster recovery efforts. ONTAP tools 10 provide robust storage capabilities, including native high availability and scalability for the VASA Provider, supporting iSCSI and NFS vVols. This ensures data availability and simplifies the management of multiple VMware vCenter servers and ONTAP clusters. By using the SRA with VMware Site Recovery Manager, organizations can achieve seamless replication and failover of virtual machines and data between sites, enabling efficient disaster recovery processes. The combination

of ONTAP tools and the SRA empowers businesses to protect critical workloads, minimize downtime, and maintain business continuity in the face of unforeseen events or disasters.

ONTAP tools 10 simplifies storage management and efficiency features, enhances availability, and reduces storage costs and operational overhead, whether you are using SAN or NAS. It uses best practices for provisioning datastores and optimizes ESXi host settings for NFS and block storage environments. For all these benefits, NetApp recommends this plug-in when using vSphere with systems running ONTAP software.

The SRA is used together with SRM to manage the replication of VM data between production and disaster recovery sites for traditional VMFS and NFS datastores and also for the nondisruptive testing of DR replicas. It helps automate the tasks of discovery, recovery, and reprotection.

In this scenario we will demonstrate how to deploy and use VMWare Site Recovery manager to protect datastores and run both a test and final failover to a secondary site. Reprotection and failback are also discussed.

Scenario Overview

This scenario covers the following high level steps:

- Configure SRM with vCenter servers at primary and secondary sites.
- Install the SRA adapter for ONTAP tools for VMware vSphere 10 and register with vCenters.
- · Create SnapMirror relationships between source and destination ONTAP storage systems
- · Configure Site Recovery for SRM.
- · Conduct test and final failover.
- Discuss reprotection and failback.

Architecture

The following diagram shows a typical VMware Site Recovery architecture with ONTAP tools for VMware vSphere 10 configured in a 3-node high availability configuration.



Prerequisites

This scenario requires the following components and configurations:

- vSphere 8 clusters installed at both the primary and secondary locations with suitable networking for communications between environments.
- ONTAP storage systems at both the primary and secondary locations, with physical data ports on ethernet switches dedicated to NFS storage traffic.
- ONTAP tools for VMware vSphere 10 is installed and has both vCenter servers registered.
- VMware Site Replication Manager appliances have been installed for the primary and secondary sites.
 - Inventory mappings (network, folder, resource, storage policy) have been configured for SRM.

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

Refer to Best Practices For Running NFS with VMware vSphere for detailed information specific to VMware vSphere.

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

For NetApp documentation on using ONTAP storage with VMware SRM refer to VMware Site Recovery Manager with ONTAP

Deployment Steps

The following sections outline the deployment steps to implement and test a VMware Site Recovery Manager configuration with ONTAP storage system.

Create SnapMirror relationship between ONTAP storage systems

A SnapMirror relationship must be established between the source and destination ONTAP storage systems, for the datastore volumes to be protected.

Refer to ONTAP documentation starting HERE for complete information on creating SnapMirror relationships for ONTAP volumes.

Step-by-step instructions are outline in the following document, located HERE. These steps outline how to create cluster peer and SVM peer relationships and then SnapMirror relationships for each volume. These steps can be performed in ONTAP System Manager or using the ONTAP CLI.

Configure the SRM appliance

Complete the following steps to configure the SRM appliance and SRA adapter.

The following steps must be completed for both the primary and secondary sites.

1. In a web browser, navigate to https://<SRM_appliance_IP>:5480 and log in. Click on **Configure Appliance** to get started.

vmw SRM Appliance Manager	nent		С	; @ .	\$ ⊚	admin 🗸
Summary	Summarv					
Monitor Disks	,		RESTART	DOWNLOAD SU	PPORT BUNDLE	STOP
Access	Product	VMware Site Recovery Manager Appliance				
Certificates	Version	88.0				
Networking	Build	23263427				
Time						
Services		To start protecting virtual machines you must configure the Site Recovery Manager appliance and connect to a vCenter Server.				
Update		CONFIGURE A PLIANCE				
Syslog Forwarding		13				
Storage Replication Adapters						

2. On the **Platform Services Controller** page of the Configure Site Recovery Manager wizard, fill in the credentials of the vCenter server to which SRM will be registered. Click on **Next** to continue.

Configure Site Recovery Manager	Platform Se All fields are required	vrvices Controller		×
1 Platform Services Controller	PSC host name	vcenter-srm.sddc.netapp.com		
2 vCenter Server	PSC port	443		
3 Name and extension	User name	administrator@vsphere.local		
4 Ready to complete	Password		0	

- 3. On the **vCenter Server** page, view the connected vServer and click on **Next** to continue.
- 4. On the **Name and extension** page, fill in a name for the SRM site, an administrators email address, and the local host to be used by SRM. Click on **Next** to continue.

1 Platform Services Controller	Enter name and extension	In for Site Recovery Manager
2 vCenter Server	Site name	Site 2
2 Name and extension		A unique oisplay name for this site recovery manager site.
5 Name and extension	Administrator email	josh.powell@netapp.com
4 Ready to complete		An email address to use for system notifications.
	Local host	srm-site2.sddc.netapp.com v
		The address on the local host to be used by site recovery Manager.
	Extension ID	Custom extension ID (com.vmware.vcDr)
		The default extension ID is recommended for most configurations. For shared recovery site installatio which multiple sites connect to a shared recovery site, use a unique custom extension ID for each SR
	Extension ID	com.vmware.vcDr-
	Organization	
	Description	
	Description	
		CANCEL BACK

Complete the following steps to configure the SRA on the SRM appliance:

- 1. Download the SRA for ONTAP tools 10 at the NetApp support site and save the tar.gz file to a local folder.
- 2. From the SRM management appliance click on **Storage Replication Adapters** in the left hand menu and then on **New Adapter**.

vmw SRM Appliance Management
Summary Monitor Disks Access Certificates Networking Time Services Update Syslog Forwarding Storage Replication Adapters

3. Follow the steps outlined on the ONTAP tools 10 documentation site at Configure SRA on the SRM appliance. Once complete, the SRA can communicate with SRA using the provided IP address and credentials of the vCenter server.

Configure Site Recovery for SRM

Complete the following steps to configure Site Pairing, create Protection Groups,

The following step is completed in the vCenter client of the primary site.

1. In the vSphere client click on **Site Recovery** in the left hand menu. A new browser windows opens to the SRM management UI on the primary site.



2. On the **Site Recovery** page, click on **NEW SITE PAIR**.

Before you can use Site Recovery, you must configure the connection between the Site Recovery Manager server and vSphere Replication server instances on the protected and recovery sites. This is known as a site pair.



3. On the **Pair type** page of the **New Pair wizard**, verify that the local vCenter server is selected and select the **Pair type**. Click on **Next** to continue.

ew Pair	Pair type Select a local vCenter Server	
1 Pair type	VCenter Server	т
2 Peer vCenter Server	vcenter-vlsr.sddc.netapp.com	
3 Services		
4 Ready to complete	Pair type	
	 Pair with a peer vCenter Server located in a different SSO domain Pair with a peer vCenter Server located in the same SSO domain 	

 On the Peer vCenter page fill out the credentials of the vCenter at the secondary site and click on Find vCenter Instances. Verify the the vCenter instance has been discovered and click on Next to continue.

New Pair	Peer vCent	er Server			
1 Pair type	All fields are required t Enter the Platform	iniess marked (optional) Services Controller details for the p	eer vCenter Server.		
2 Peer vCenter Server	PSC host name	vcenter-srm.sddc.netapp.com			
3 Services	PSC port	443			
4 Ready to complete	User name	administrator@vsphere.local	<u> </u>		
	Password	•••••	0		
	FIND VCE	INTER SERVER INSTANCES			
	Select a vCenter Se	erver you want to pair.			
	vCenter Serv	/er			
	U Brycenter	-srm.sddc.netapp.com			
				CANCEL	BACK

5. On the **Services** page, check the box next the proposed site pairing. Click on **Next** to continue.

1 Dair type						
rall type		Service	↑ τ	vcenter-vlsr.sddc.netapp.com	т	vcenter-srm.sddc.netapp.com
2 Peer vCenter Server		(1) Site Recovery Mana	ger (com.vmware.vc	Site 1		Site 2
3 Services						
4 Ready to complete						
	X					
					CAN	CEL BACK N

7. The new Site Pair and its summary can be viewed on the Summary page.

uninary					RECONNECT BREAK SITE PAIR
	vCenter Server: vCenter Version: vCenter Host Name: Platform Services Controller:	vcenter-vlsr.sddc.netapp.com 2 8.0.2, 22385739 vcenter-vlsr.sddc.netapp.com:443 vcenter-vlsr.sddc.netapp.com:443	vcenter-srm.sddc.netapp.com [2] 8.0.2, 22365739 vcenter-srm.sddc.netapp.com.443 vcenter-srm.sddc.netapp.com.443		
Site Recovery N	lanager				EXPORT/IMPORT SRM CONFIGURATION
Protection Group	ps:0 📋 Recovery Plans:0				
Name		Site 1 RENAME		Site 2 RENAME	
Server		srm-site1.sddc.netapp.com:443 AC	TIONS Y	srm-site2.sddc.netapp.com:443 ACTIONS ~	
Version		8.8.0, 23263429		8.8.0, 23263429	
ID		com.vmware.vcDr		com.vmware.vcDr	
Logged in as		VSPHERE.LOCAL\Administrator		VSPHERE.LOCAL\Administrator	
	ion	✓ Connected		✓ Connected	

The following step is completed in the Site Recovery interface of the primary site.

1. In the Site Recovery interface navigate to **Configure > Array Based Replication > Array Pairs** in the left hand menu. Click on **ADD** to get started.

Site Pair Protection G	roups	Recovery Plans
Summary		Array Pairs
Issues		
Configure	~	
Array Based Replication	~	
Storage Replication Adapters		
Array Pairs		
Network Mappings		
Folder Mappings		
Resource Mappings		
Storage Policy Mappings		
Placeholder Datastores		
Advanced Settings	>	
Permissions		
Recovery Plans History		

2. On the **Storage replication adapter** page of the **Add Array Pair** wizard, verify the SRA adapter is present for the primary site and click on **Next** to continue.

1 Storage replication adapter		Storage Replication Adapter	↑ ¥ Status	y Vendor	▼ Version	▼ S	itretched Storage
2 Local array manager	•	NetApp Storage Replication	Ada 🗸 OK	NetApp	10.1	١	Not Support
3 Remote array manager							
4 Array pairs							
5 Ready to complete							

3. On the **Local array manager** page, enter a name for the array at the primary site, the FQDN of the storage system, the SVM IP addresses serving NFS, and optionally, the names of specific volumes to be discovered. Click on **Next** to continue.



4. On the **Remote array manager** fill out the same information as the last step for the ONTAP storage system at the secondary site.



5. On the Array pairs page, select the array pairs to enable and click on Next to continue.



The following step is completed in the Site Recovery interface of the primary site.

1. In the Site Recovery interface click on the **Protection Groups** tab and then on **New Protection Group** to get started.

Site Pair Protection Groups	Recovery Plans
Q Search	Protection Groups NEW PROTECTION GROU
Protection Groups	NEW PROTECTION GROUP
	Name ↑ ▼ Protection Status

2. On the **Name and direction** page of the **New Protection Group** wizard, provide a name for the group and choose the site direction for protection of the data.

lew Protection Group	Name and dir	ection	
	All fields are required unles	s marked (optional)	
1 Name and direction	Name:	SQL_Datastore	
2 Type		67 characters remaining	
3 Datastore groups	Description: (Optional)		
4 Recovery plan		4096 characters remaining	
5 Ready to complete	Direction:	• Site 1 \rightarrow Site 2 • Site 2 \rightarrow Site 1	
	Location:	Q. Search	
		Protection Groups	

3. On the **Type** page select the protection group type (datastore, VM, or vVol) and select the array pair. Click on **Next** to continue.



4. On the **Datastore groups** page, select the datastores to include in the protection group. VMs currently residing on the datastore are displayed for each datastore selected. Click on **Next** to continue.

New Protection Group	Datastore group	iS			
	Select the datastore groups	s to be part of this protection group	p. Datastore gr	oups contain datastores wi	hich must be
1 Name and direction	recovered together.			SELECT ALL	CLEAR SELECTION
2 Type	Datastore Group		T	Status	
	NFS_DS1			Add to this protection g	group
3 Datastore groups					
4. Recovery plan					
4 necovery plan					
5 Ready to complete					
	45/05/10/05/10/2				
	1 🖬			Items per page AUTO	A 1 datastore gro
	The following virtual machin	ies are in the selected datastore gi	roups:		
	Virtual Machine	T Datastore	Ť	Status	
	mi sousev-oi	NFS_DS1		Add to this protection gr	oup
	P act and an	LIED DOL			
	合 SQLSRV-03	NFS_DS1		Add to this protection gr	oup

5. On the **Recovery plan** page, optionally choose to add the protection group to a recovery plan. In this case, the recovery plan is not yet created so **Do not add to recovery plan** is selected. Click on **Next** to continue.



6. On the **Ready to complete** page, review the new protection group parameters and click on **Finish** to create the group.

New Protection Group

- 1 Name and direction
- 2 Type
- 3 Datastore groups
- 4 Recovery plan
- 5 Ready to complete

Ready to co	nplete	
Review your selected	I settings.	
Name	SQL_Datastore	
Description		

Protected site	Site 1
Recovery site	Site 2
Location	Protection Groups
Protection group type	Datastore groups (array-based replication)
Array pair	$ontap-source: NFS_Array1 \leftrightarrow ontap-destination: NFS_Array2 (nfs_array1 \leftrightarrow nfs_Array2)$
Datastore groups	NFS_DS1
Total virtual machines	3
Recovery plan	none

CANCEL

FINISH

BACK

×

The following step is completed in the Site Recovery interface of the primary site.

1. In the Site Recovery interface click on the **Recovery plan** tab and then on **New Recovery Plan** to get started.

Q Search R	ecovery Plans NEW RECOVERY PLAN
Recovery Plans	NEW RECOVERY PLAN

2. On the **Name and direction** page of the **Create Recovery Plan** wizard, provide a name for the recovery plan and choose the direction between source and destination sites. Click on **Next** to continue.

1 Name and direction		
I Name and direction	Name:	SQL Site 1-to-2
2 Protection Groups		65 characters remaining
3 Test Networks	Description: (Optional)	
Ready to complete		4096 characters remaining
	Direction:	Site 1 → Site 2
		\bigcirc Site 2 \rightarrow Site 1
	Location:	Q Search
		Recovery Plans
		CANCEL

3. On the **Protection groups** page, select the previously created protection groups to include in the recovery plan. Click on **Next** to continue.

eate Recovery Fidir			
1 Name and direction	All Selected (1)		
2 Protection Groups	SOL_Datastore	i T Description	
3 Test Networks			
4 Ready to complete			
		Items per page AUTO	∧ 1 group

4. On the **Test Networks** configure specific networks that will be used during the test of the plan. If no mapping exists or if no network is selected, an isolated test network will be created. Click on **Next** to continue.

2 Protection Groups	Recovery Network	Υ Υ	Test Network	
3 Test Networks	A Datacenter > DPortGroup	je-	Use site-level mapping	Cł
	🙆 Datacenter > Mgmt 3376		🚔 Mgmt 3376	E CI
4 Ready to complete	🚵 Datacenter > NFS 3374	E	ANFS 3374	io 📑
	🙆 Datacenter > VLAN 181	1	🧕 Use site-level mapping	CI
	Datacenter > VM Network	15	👰 Use site-level mapping	Cł
	🙆 Datacenter > vMotion 3373	1 1	👰 Use site-level mapping	CI
	A Datacenter > vSAN 3422	1=	Use site-level mapping	CI
				7.1
-V ^C Control Pred	VSENETEL/OCAL VSEM-c020200-C24		CANCEL	BACK
	V-DATE (00.11.000 dt0.2006-07-5). 4 ms		CANCEL	BACK

Disaster recovery operations with SRM

In this section various functions of using disaster recovery with SRM will be covered including, testing failover, performing failover, performing reprotection and failback.

Refer to Operational best practices for more information on using ONTAP storage with SRM disaster recovery operations.

The following step is completed in the Site Recovery interface.

1. In the Site Recovery interface click on the **Recovery plan** tab and then select a recovery plan. Click on the **Test** button to begin testing failover to the secondary site.

Site Pair Protection Groups	Recovery Plans		
Q. Search	Recovery Plans	RECOVERY PLAN NEW FOLDER	
Recovery Plans	NEW RECOVERY PLAN EDIT	MOVE DELETE TET CL	EANUP RUN ····
SQL Site 1-to-2	Name	c m	↑ ▼ Status
	SQL Site 1-to-2	0	→ Ready

2. You can view the progress of the test from the Site Recovery task pane as well the vCenter task pane.

Recent Tasks Alarms				
Task Name	Target T	Status	T Initiator T	Queued For
Test Recovery Plan	vcenter-visr.sddc.netapp.com		6 % VSPHERELOCAL\\SRM-d1369bbb-62c6_	11 ms
Create Recovery Plan	🚱 vcenter-vlsr.sddc.netapp.com	Completed	VSPHERE LOCAL\\SRM-d1369bbb-62c6	10 ms
Set virtual machine custom value	SQLSRV-02	 Completed 	VSPHERE.LOCAL\\SRM-d1369bbb-62c6_	4 ms
Set virtual machine custom value	SQLSRV-01	🗸 Completed	VSPHERE LOCAL\\SRM-d1369bbb-62c6	3 ms

3. SRM sends commands via the SRA to the secondary ONTAP storage system. A FlexClone of the most recent snapshot is created and mounted at the secondary vSphere cluster. The newly mounted datastore can be viewed in the storage inventory.

]) 🗗 🗏 🔮	Summary Monitor Confi	igure Permissions Files Hosts VMs
 vcenter-srm.sddc.netapp.com Datacenter 	Virtual Machines VM Temp	plates
STREADS1	Quick Filter 🗠 Enter value	2
vsanDatastore	Name	↑ State Status Provisioned Space
	SOLSRV-01	Powered Of Vormal 424.28 GB
	SOLSRV-02	Powered Of Vormal 244.28 GB
	口 ··· 奇 SOLSRV-03	Powered Of Vormal 244.28 GB

4. Once the test has completed, click on **Cleanup** to unmount the datastore and revert back to the original environment.

Site Pair Protection G	roups Recovery Plans	
Q Search	Recovery Plans NEW RECOVERY PLAN NEW FOL	DER
Recovery Plans	NEW RECOVERY PLAN EDIT MOVE DELETE TE	ST CLEATUP RUN
SQL Site 1-to-2	Name	
	SQL Site 1-to-2	S Test complete

Run Recovery Plan with SRM

Perform a full recovery and failover to the secondary site.

1. In the Site Recovery interface click on the **Recovery plan** tab and then select a recovery plan. Click on the **Run** button to begin failover to the secondary site.



Additional functions are possible in SRM once a failover has completed.

Reprotection: Once the recovery process is complete, the previously designated recovery site assumes the role of the new production site. However, it's important to note that the SnapMirror replication is disrupted during the recovery operation, leaving the new production site vulnerable to future disasters. To ensure continued protection, it is recommended to establish new protection for the new production site by replicating it to another site. In cases where the original production site remains functional, the VMware administrator can repurpose it as a new recovery site, effectively reversing the direction of protection. It's crucial to highlight that

re-protection is only feasible in non-catastrophic failures, necessitating the eventual recoverability of the original vCenter Servers, ESXi servers, SRM servers, and their respective databases. If these components are unavailable, the creation of a new protection group and a new recovery plan becomes necessary.

Failback: A failback operation is a reverse failover, returning operations to the original site. It's crucial to ensure that the original site has regained functionality before initiating the failback process. To ensure a smooth failback, it's recommended to conduct a test failover after completing the reprotection process and before executing the final failback. This practice serves as a verification step, confirming that the systems at the original site are fully capable of handling the operation. By following this approach, you can minimize risks and ensure a more reliable transition back to the original production environment.

Additional information

For NetApp documentation on using ONTAP storage with VMware SRM refer to VMware Site Recovery Manager with ONTAP

For information on configuring ONTAP storage systems refer to the ONTAP 9 Documentation center.

For information on configuring VCF refer to VMware Cloud Foundation Documentation.

Autonomous Ransomware Protection for NFS Storage

Detecting ransomware as early as possible is crucial in preventing its spread and avoiding costly downtime. An effective ransomware detection strategy must incorporate multiple layers of protection at ESXi host and guest VM levels. While multiple security measures are implemented to create a comprehensive defense against ransomware attacks, ONTAP enables adding more layers of protection to the overall defense approach. To name a few capabilities, it starts with Snapshots, Autonomous Ransomware Protection, tamperproof snapshots and so on.

Let's look at how the above-mentioned capabilities work with VMware to protect and recover the data against ransomware. To protect vSphere and guest VMs against attacks, it is essential to take several measures including segmenting, utilizing EDR/XDR/SIEM for endpoints and installing security updates and adhering to the appropriate hardening guidelines. Each virtual machine residing on a datastore also hosts a standard operating system. Ensure enterprise server anti-malware product suites are installed and regularly updated on them which is an essential component of multi-layered ransomware protection strategy. Along with this, enable Autonomous Ransomware Protection (ARP) on the NFS volume powering the datastore. ARP leverages built-in onbox ML that looks at volume workload activity plus data entropy to automatically detect ransomware. ARP is configurable through the ONTAP built-in management interface or system Manager and is enabled on a pervolume basis.

= 🗖	ONTAP Sy	stem Ma	inager	Search actions, objects, and pages Q,	0 O B
DASHBOA	IRD	Volun	nes		
INSIGHTS	8	+ Add	E Delete O Protect : More		Q Search T Fitter
Overview	~	-	Name Chinescon	Src_NFS_VoID1 All Volumes	Øtan i More
LUNS			NFSD502ARP	Overview Snapshot copies SnapMirror Back up to cloud Security File system Quota Reports	
NVMe namespaces Consistency groups	r groupe		nimpra SQLDatavol	Anti-ransomware	
Officers Objectais			Src,25G,Vol01	Disabled Disables Dis	
Storage VM Tiers	56		Sic_6C3L0502		
NETWORI	k ~		SHL_6CSL_0504 SHL_6CSL_0506		
PROTECTI	ion ~		SHE, NES, DS02		
HOSTS CLUSTER	\$		Sirc,NPS,DS04		
			Src, NF5, Vol01	Activate Wit	

With the new NetApp ARP/AI, which is currently in tech preview, there is no need for a learning mode. Instead, it can go straight to active mode with its AI-powered ransomware detection capability.

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With ONTAP One, all these feature sets are completely free. Access NetApp's robust suite of data protection, security and all the features that ONTAP offers without worrying about licensing barriers.

Once in active mode, it starts looking for the abnormal volume activity that might potentially be ransomware. If abnormal activity is detected, an automatic Snapshot copy is immediately taken, which provides a restoration point as close as possible to the file infection. ARP can detect changes in VM specific file extensions on an NFS volume located outside of the VM when a new extension is added to the encrypted volume or a file's extension is modified.

	ystem Manager	Search actions, objects, o	000		
DASHBOARD	Volumes				
INSIGHTS	+Add 😭 Delete 🔘 Potest 🗄 Mar	ŧ		Q search W Filter	
STORAGE	Name	Src_NF5_DS04 All Volumes		Ø tot 1 Mon	
Volumes	NF5ARPDemo02	Overview Snapshot copies SnapMire	or Back up to cloud Security File system	Quota Reports	
LUNs NVMe namespaces	NESDS02ARP				
Comistency groups	solDatavol	Anti-ransomware			
Shares Qtreez	Src.25G,Voi01	Enabled in active mode	() Pacar arti-rationmean	Diversi unversity settings	
Cuotai Coutai	Site_(SCSL,D05				
Tips	Src_6CSL_0602	Volume's workload characteristics		Configure uniting characteristics	
NETWORK	Src_ISCS1_DS04	Learned statistics	Surge statistics		
EVENTS & JOBS ~	Sirc NFS DS02	LARGEST PERCENT OF HIGH ENTROPY DATA	UNICEST PERCENT OF HIGH ENTRY	nijev gata	
PROTECTION ~	Src_NF5_DS03	1.00	₩. ©		
CLUSTER ~	Sk: NF5_DS04	HGHEST RATE OF FLE CREATION 16 Files/minute	HIGHEST ANTE OF HEE ORGANICH		

If a ransomware attack targets the virtual machine (VM) and alter files within the VM without making changes outside the VM, the Advanced Ransomware Protection (ARP) will still detect the threat if the default entropy of the VM is low, for example, for file types like .txt, .docx, or .mp4 files. Even though ARP creates a protective snapshot in this scenario, it does not generate a threat alert because the file extensions outside of the VM have not been tampered with. In such scenarios, the initial layers of defense would identify the anomaly, however ARP helps in creating a snapshot based on the entropy.

For detailed information, refer to "ARP and Virtual machines" section in ARP usecases and considerations.

Moving from files to backup data, ransomware attacks are now increasingly targeting backups and snapshot recovery points by trying to delete them before starting to encrypt files. However, with ONTAP, this can be prevented by creating tamperproof snapshots on primary or secondary systems with NetApp Snapshot[™] copy locking.

\equiv vSphere Client	Q, taxes it is a process								
SnopCenter Plug in for	VMware vSphere Instanc	± 172 21.964.0	Edit - Pol	NESDS04	~				
9 Deshboard	Policies		Lun Pol	11 55504	~				
G. Settings	Granter das Marros I		Name Psc.74F8D554				Film		
E Resource Groups	-Nome	Use Comm	Description	description.			Traphtrap	Brassmat Looking Parloo	
A Policier	Demostry_Hts	795	Frequency	Daly +			ts		
an Shirage Systems	DemiA25PX((PS	Yes.	Locking Period	Enable Snapshot Locking O		2	e .	1049	
and the second se	ÇençFit.	Mo		7 Dayy =				10my	
De covers ave sussesse		Noli	Retention	Days to keep - 7	. 0		96	7 Days	
5	Demolyse Section	766	Buildentes	S Lintels Constitute attai harman	1.5/7		<u>性</u>	-	
	Concept of the	Nes .	Heperation	Clinitate there's a far taking O				- Yoma	-81
				Snapshot label Durity					
			Advanced >	and the second					
			A Warning for	ONTAP 9.12.1 and below version	18 m				
		_				_			
Mincent Taska	Alaema								
tashina 🕈	lage y	- Hartes				Consol y	And Seal	Y Completion Take Y	-
Remove property	IP APE Denil 1909	Ocimient		CANCE	UPOATE	3.85	05/10/2014 3 36:56	A 05/10/2004 3 3656 A	
Result snauster	@ 165.04000.0004	Completion				1.01	- 06/19/2024; 3:34:05 M	A. 06/16/2024, 3:36.54.4	
Degeter Lintus machine	D ANDARSKA	S Compariso		WARDEL GOALS	ASSISTANT .	Time	08/10/034 - 3.54-45	A	
These Snapshot copies can't be deleted or changed by ransomware attackers or rogue administrators, so they're available even after an attack. If the datastore or specific virtual machines are affected, SnapCenter can recover virtual machine data in seconds, minimizing organization's downtime.

\equiv vSphere Clent 0 , Garmin et estrumini (- 9 0-
VSphere Client Q Correct ad according VSphere Client Q Correct ad according P C 10C_DerroVM_NFS C 6CS_DerroA C 0 40C3(_DerroAM_NFS C 6CS_DerroA C 0 40C3(_DerroAM_NFS C 6CS_DErroA C 0 40C3(_DerroAM_NFS C 6 40C5_DErroA C 10 50C Correct ad according C 10 50C Correct ad a	Virtual machine to be restored Backup name Restart virtual machine Restore Location ESXi host to be used to mount the backup	NFS_DemoA_VM01 NFSRamDemoR0_06-19-2024_13.26.52.0908 No Original Location vessi8-03.httpdt.local	2. Annual and column	
Demod20PVM03 Demod20PVM03 Demod20PVM04 Demod20PVM04 Demod20PVM03 SCVTPSDemo01 SCVTPSDemo01 SCVTPSDemo02 DusuARPDemo DusuARPDemo DusuARPDemo DusuARPDemo	This visual machine will be privered d	own during the process.	CANCEL	

The above demonstrates how ONTAP storage adds an additional layer to the existing techniques, enhancing futureproofing of the environment.

For additional information, view guidance for NetApp solutions for ransomware.

Now if all these needs to be orchestrated and integrated with SIEM tools, then offtap service like BlueXP ransomware protection can be used. It is a service designed to safeguard data from ransomware. This service offers protection for application-based workloads such as Oracle, MySQL, VM datastores, and file shares on on-premises NFS storage.

In this example, NFS datastore "Src_NFS_DS04" is protected using BlueXP ransomware protection.

-	NetApp BlueXP					<u>(</u>	Bilet Baards			-	• • •
	Ransomw	are protectio	0.	Dashboard	ż	Protection	Alerts	Recovery	Réports	Free trial (55 days left)	- view details 1 💌
۵											
٠	Vorkloads (10)								c	२ 🛓 Manage	protection strategies
¢	Workload C	туре ⊤≎	Connector \$	Importance V 2	Prot	ection st v 🗧	Oetection sta 7 0	Detection pol T C	Snapshot an	Raciup destine 3	
	Src_nfa_ds02	VM dwtaetone	GISABXPConn	Critical	0	Protected	Learning mode	rps-policy-primary	SnapCenter for VMw_	nelapp-backup-add	(BH pretection)
-	Drass_urc_test_3130	VM file share	GISABXPConn	Standard	0	At risk	None	None	None	n/a	Protect
	Nfsdx02argt_804	VM file share	GISABXPConn	Standard	Q	Prolected	Active	rps-policy-primary	None	netapp-backup-add	(Idit protection)
	Orass_srt_7027	VM file share	GISABXPConn	Standard	0	Atriak	None	None	None	netapp-backup-add	Frutect
	Src_nfx_vol01_7948	VM file share	GISA8XPConn	Standard	0	At risk	None	None	None	netapp-backup-add	Prutecl
	Src_n/s_ds03	VM datastore	SISABXPConn	Standard	0	At risk	None	None	SnapCenter for VMw	netapp-backup-add	Protect
	Src_nlg_ds04	VM datastore	GISABXPConn	Standard	0	Protected	Active	rps-policy-primary	SnapCenter for VMw	netapp-backup-add	(Lift protection)
	Teanvoic_oute	File share	GISABXPConn	Critical	0	Protected	Active	rps-policy-primary	IlluxXP backup and	netapp-backup-ba3	(101 ++11+11+*)
	Testvol_3787	File share	GISABOPConn	Standard	0	Protected	Learning mode	rps-policy-primary	None	netapp-backup-ba3	(fill protectus)
	Nfsarpdemo02_3419	File share	GISAEXPConn	Standard	0	Protected	Active	rps-policy-primary	None	netapp-backup-add	Edit protection

Ne	tApp BlueXP			Next Search	Datastore protected and N Alerts reported			
	Ransomware protection	Dashboar	d Protection	Alerts Re				
	1 Standard Importance	Protected Protection health Exit protection		⊘ o Alerta		Not marked for recovery liscovery		
	O Protection		UM datastore		Stor	990		
	These policies managed by SnapCenter for VMware w modified by apolying a detection policy to this workloa Pol_NFSDS04 Snapshot policy	ll not be d.	Location «Certer server Connector	um.acv.scvmUI Resou vvcsa8-01 hmcdc local GISABXPConn	Cluster id Working E Storage V Volume na Used size	add38d26-348c-1tet-8 hv name NYAP915_Sirc M name svm_NFS me Sirc_NFS_D504 29 GiB		
	(a) 1 Year Daily LTR Backup policy	÷						
	٠							

For detailed information on to configure BlueXP ransomware protection, refer to Setup BlueXP ransomware protection and Configure BlueXP ransomware protection settings.

It's time to walk through this with an example. In this walkthrough, the datastore "Src_NFS_DS04" is affected.

· م ۵ ۵ ۵	Src_NFS_DS04 j.actions	ons Films Hoebs VMs	Attack and VM affected						
- IR vicial-Othnosciocal - IB VCSA8-0001	The by a fuller same	NEW DALOFS UN OAD TATE			Q. :==	to the state address			
III ISODUND III NFSARFDemo02		I Name		Notifed +	7154 *	Fath			
III NESDS02ARP	shapshot	D 10,0m0/Miscontow	1 815	08/05/2024, 1 0.02.39 AM	File	(Src_NFS_0504) NFS_Demo8_VH0030_Dem Nationational			
III \$rc_8C9_0502	> EI NFS_DerroB_VM01	D 10, Demo/Macoreboard	(i) (ii) (iii) (ii	06/09/2024, 9 5131 AM	110	(SHL)P3_D(04)NF5_DemuR_VM0V50_Dem constanted			
III Src_ISCS(_DS04 III Src_NPS_DS01	S DI NFS_DerRU_VRUJ	D MS, Denue, VMON3624	8110 Volage 4.114.304 K	07/12/2024. 5 52:48 AM	2 in	ISIC_NPL_DEO4[NPL_Denic8_VM0UNPL_De VM05.362x008 vyxp			
SHC_NPS_DS02	> C1 NFS_Deno8_VM05	D NPS_Demill_VM010016	OUTLING 0.09 KB	08/05/2024,1 0.02/39 AM	794	(Sin_NPT_OSO4) NPT_Donull_VH05NPT_D VH053053009 Hag			
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						C & NFS, Denall, VMCLower	8.40.43	07/12/2024, %. 02.56 AM	Non-voluble M emory File
veskill-02-exx-histal-datasts		D APS_Denal_VXXLend	61.04 (08	OE/OB/2034, St OE/A5 AM	114	Sic_NPS_05041NPS_Denu8_VM0UNPS_D VM01vmut			
 vexoll-03-esc-nutat-datasta. 		D B NFS, Denolt, Millions	3.4 KB	08/08/2024.5 08:46 AM	Virtual Martinia	SHLARE, DIGHINES, Denue, VMOVARE, D			
		D B.N.S.Denel, VMC-INV	a 0 4.0	08/05/2024, 1 0/02/29 AH	FW.	(SHL_NPS_DS041NPS_Denuil_VMDUNP3_D VMOLVINENS			
		D MS_Dense_VAD.um/	#9 0.07 NB	28/09/2024.5: 3122 AM	The	(Soc_MP3_0504) NFS_Deno8_VM0VNFS_D VM0Lettel.org			
		 D. NPS, Denial, VMO(343) 	sends.org \$40.54.40	08/09/2024, 5: 31/22 AM	294	(Srt_NPE_DS04) MPS_Detcoll_VM00NPS_D VM01_3-ck.vmdk.arg			
		D M'S, Canuel, VMOL 3-14	vmsk.arg 10,485,760. 04.43	06/08/2024, 5: JHILAM	/ie	Sic_M2_DED4[1473_DenotE_VMDIAV3_D			
		D MS_Denall_VM0_3 er	dkarg 0.84,KB	08/09/2024, 8 21/22 AM	194	(Sec., M.R., 0504) NPR, Denuel, VM00/WS, De VM01, X vm04 and			
	Autiers per page <u>1000</u> -	e Managa Columny		1727 AM	_	Alert VALUE NO			

A Recent Tasks Alarma

ARP immediately triggered a snapshot on the volume upon detection.

5_DSQ4 All Volumes w Snapshot copies Snaphlirtor Back up to ch	oud Security File system	tApp Snapshot triggered suspected abnormal ac	d during " tivity
0			
		Q Search 🗢 Sho	avhde 🗸 📼 Filter
tame	Snapshot copy creation time	Snapshot restore size ()	
napmirror.e2ad5432-3537-11ef-bd57-00a0b0f6d346_21 9491296.2024-08-09_160500	Aug/9/2024 9:05 AM	50.5 Gill	
inti_ransomware_backup.2024-08-09_1326	Aug/9/2024 6:26 AM	44.5 GB	
IG,NFSDS04_08-09-2024_08-08-16-0981	Aug/9/2024 5:08 AM	27.8 G8	
NS_NFSD504_08-09-2024_07.54.46.0205	Aug/9/2024 4:55 AM	27.7 Gill-	
	Aug/9/2024 3:27 AM	27.6 G.B	
IG_NESD554_08-09-2024_06-27.18.0190	Aug/9/2024 3:27 AM	27.6 G/8	
IS_NFSD504_08-09-2024_05.00.28.0747	Aug/9/2024 2:00 AM	27.7 Gil	
Show	ng 1 - 7 of 7 Snapshot Copies		
	G_NFSDS04_08-09-2024_05.00.28:0747 Showi	G_NFSDS04_08-09-2024_05.00.28.0747 Aug/9/2024 2:00 AM Showing 1 - 7 of 7 Snapshot Copies	6_NFSD504_08-09-2024_05.00.28.0747 Aug/9/2824 2:00 AM 27.7 G8



Once the forensic analysis is complete, then the restores can be done quickly and seamlessly using SnapCenter or BlueXP ransomware protection. With SnapCenter, go to the affected virtual machines and select the appropriate snapshot to restore.

	B NFS_DemoB_VM01	P C C C	65 1 acm	🔤 🕺 withi	n the backup
22 E9 E 52 29 29 E 52 29 20	Summary Monitor Configur Settings v VM SDRS Rues Varie Dotions Aam Definitions Schoolaid Tarks Policias VM-ware EVC Durit Over Magpings StagCenter Page in for VM-wall v Resource Groups	Permissions E Rane BQ,N The Early Picket Munified Ni Polary Picket Polary Picket Polary Picket The fathoung entities are in Select as welty and cack lik Introduct (out) Have NFS_Dewell, VM0 NFS_Dewell, VM0 Sis_NFS_DS14	Unitation en 1909a - 66 06 20 10 2024 06 60 10 1909b - 190 East United in the East United	Network2 24_88.06.140.001 CAUT 0700 (Packs Daylight Time) 0017 0700 (Packs Daylight Time) 0017 0700 (Packs Daylight Time) 0012060-0010 (Packs Daylight Time) 00120600 (Packs Daylight Time) 00120600 (Packs	Location [Se_1475_000411475_0email_VM0024975_0email_VM001ema [Se_1478_00041475_0email_VM01475_0email_VM01ema [Se_1475_00041475_0email_VM015175_0email_VM01ema [Se_1475_00041475_0email_VM015175_0email_VM01ema [Se_1475_00041475_0email_VM015175_0email_VM01ema sem_1475_1vx02e_1475_0004
 ○ ISCSL_DemoC ○ ISCSL_TPS_Demo ○ ISCSL_TPS_Demo ○ NPS_DemoA ○ NPS_DemoB 					
AND REPORT PLANNED RANGE					

This section looks at how BlueXP ransomware protection orchestrates recovery from a ransomware incident wherein the VM files are encrypted.



If the VM is managed by SnapCenter, BlueXP ransomware protection restores the VM back to its previous state using the VM-consistent process.

- 1. Access BlueXP ransomware protection and an alert appears on the BlueXP ransomware protection Dashboard.
- 2. Click on the alert to review the incidents on that specific volume for the generated alert

I Ne	tApp BlueXP		(Q.	LuxXP Search	Protection View s the NF <u>S Vol</u>	specific to lume
ř.	Ransomware protection	Dashboard	Protection	Alerts	насовату корола	
ŝ	Protection > Src_NFS_DS04					
			Src,	_NFS_DS04		
	Standard Importance	Protected Protection health Edit protection		1 Alerta View glerts	Not marked for re Recovery	covery
	O Protection		VM datastore		Storage	
	These policies managed by SnapCenter for VMware will modified by applying a detection policy to this workload	not be L	ocation Center server Connector	um:scv:scvHULResou vvcsa8-01.hmodc.local GISABXPConn	Cluster id Working Env name Storage VM name Volume name Used state	add38d26-348c-11eF-8 NTAP915_Src svm_NFS Brc_NFS_D504 29 0/8
	1 Year Daily LTR Backup policy	~				

3. Mark the ransomware incident as ready for recovery (after incidents are neutralized) by selecting "Mark restore needed"

m N	etApp	BlueXP						•	. 191403	t Search			Mark the a	lert for
*	Alter	Ransomw	are p	rotection			Dashboard	Protection		Alerts	Recove	ry ;	restore n	eeded"
9									aler	12198		1. 		
•				0	Worklo	ad: Src_NFS_	DS04 Location: um	sov.sovmUI:Re	sou	Type: VM datastore	Connect	or: GISABXPConn		Mark restore needed
0	① Poter	1 ntial attack					4 hours ago First detected			29 GB impacted data			10 Impacted files	
4														
	cident (1) All selected											Q	🛓 Edit status
		incident ID	:	Volume	:	SVM 2	Working environment	а Туре	٠	Status	72	First detected	Evidence	Automated responses
		Inc1820		Src_NFS,	0504	nom_NFS	NTAP916_Src	Potential	ettack	D New		4 hours ago	1 new extensions detects	ed 2 Snapshot copies



÷.

4. Got to Recovery tab and review the workload information in the Recovery page and select the datastore volume that is in the "Restore needed" state and select Restore.

Image: Second	ietails (*
2 257 GIB 0 </th <th></th>	
Yorkloads (2) Workload 5 Location 5 Type ▼-5 Connector 5 Snapshot and backu., ▼-5 Recovery status ▼-5 Progress 2 Importance ▼-5 Total data 5 Act	
Workload \$ Location \$ Type # 5 Connector \$ Snepshot and backu # \$ Recovery status # \$ Progress \$ Importance # \$ Total data \$ Act	Q
	in .
Nfeds02arg_804 10.61.187/81 VM file share GISABXXPCorvi rv/a 😗 Restore needest rv/a Standard 228 GiB	estora)
Src_nh_ds04 unisourscumURResource.nu	estore

5. In this case, the restore scope is "By VM" (for SnapCenter for VMs, the restore scope is "By VM")

1 Net	NetApp BlueXP		Q. Bluet/P Search	Select "Restore needed to l	Select "Restore Point" and V needed to be restored		
é	Restore "Src_NFS_DS04"		1 Restore (2) Review				
ŝ.			Restore				
	Workload: Src_NFS_D3	04 Location: un:sov.sovmUL4	Resou VCenter: vvcsa8-01.hmcdc.	local Type: VM datastore Connector: GIS	A8XPConin		
		Restore scope VM-com Restore a	latent 9 VM block to its previous state and last trans	action using SnapCenter for VMware			
	Source				~		
	First attack reported August 8, 20	14, 153 PM					
	Restore points (6)				Q		
	Restore point		Ф. Туре	Date Date			
	RG_NFS0504_08-0	9-2024_08.08.16.0981	snapshot	August 9, 2024, 1:08 PM			
	0 RG_NF50504_08-0	9-2024_07.54,48.0205	snapshot	August 9, 2024, 12:54 PM			
	RG_NFSDS04_08-0	9-2024_06.27.18.0190	snapshot	August 9, 2024, 11:27 AM			
	O RG_NF\$0504_08-0	9-2024_05:00.28:0747	scapsbot	August 9, 2024, 10:00 AM			
			Nov1				

6. Choose the restore point to use to restore the data and select Destination and click on Restore.

n N	letApp Blu	eXP			Q BuildP Search		•	0	3
æ	Restore	"Src_NFS_DS04"			🕑 Restore 🛛 🛛 Review			×	
9					Review				
•	0	Src_NFS_DS04 Workload	umiticy set Location	mUli Resou	vvcsa8-01.hmode.loca vCenter	VM datastore Type	GISA8XPConn Connector		
4	olume (1)							q	4
	Source VM	•	Restore date	2 Destination	working environment	2 Destination SVM	Destination VM		•
	NFS_Demoil_\	VM02	August 9, 2024, 12:54 PM	NTAP915_5	ne	non, NFS	NFS_Demo8_VM02		
				P	Restore				

7. From the top menu, select Recovery to review the workload on the Recovery page where the status of the operation moves through the states. Once restore is complete, the VM files are restored as shown below.

	Src_NFS_DS04				veriny c	ine res	corea vin mes
	Summary Monitor Compare Permasions	Files.	Houts VMa				
E vvcsad-0thimcdc.socal - E VCSA8-0001	That up & home have						Q
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E NESDSOZARP	Avdevia C1 <		D. 10, Servive Contributer	3.50	07/02/014 814 #3.844	Play	(S-CMR, 2504) MR, Dennik, VMCDSJ, Dennik
0 SH_BC9_0502	D NFS_Demo8_VM03 D NFS_Demo8_VM03	0	() 10,2emi/W1.mprimer.	101	100/01/2024, 10:00:30 Ave	Phil	Sec. MS. (2004) MS. (Secular Million) Secular and
(1 SHL, NES, DEOT	 E MF5_Demoit_VM03 E MF5_Demoit_VM04 		() III. Service I introducer	10.00	00/03/2014 30:00-47 A	Pla-	(Sc.,MS_DEX)/MS_Demail_VM0250_Dem/W
[]] Sec, NFS, D503	> D NFS_Demo8_VMOS		D 53, 2enclyMicrohead	1148	10/0/2524 12:23 43-244	Phy.	(Sec.NPS,255(a)NPS,2amu8,VMC250,2ampV4
E SHLAPS, DEH			D. HULDHIELVICO 303485 (1940)	4794.254 m 10	OVER DATE AND ADDRESS OF	File:	The WE DOOR WE SHOULD BE WORKED BY STREET
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			0. Mrt., Densit, yMtD aux erm	0.0198	06/1/2024, 10:02:22/244	204	[54, M2, 2004] M2, Denall, MA22973, Octob 4.400
			L. APE, Denait, VM02 science	1.42.62	DEVENUESA, NUMBER AN	Personal Manual State	Inc. MPE, DEDKIMPE, Densel, VMCG7MPE, Densel
			D. MPS, Daniell, VMO2 yeard	0.04 #2	06/1/2024, 11:00.20 FW	P14	Dist, MPR, DANA[MPR, Dannak, VMO2/MPR, Garriell Md
		0	(B. HELDANIK, HELDAN	3.008	06/10104.101033764	WHAT MADINE	(Sec. WR. DECC) MR. Damak, VMCQNPS, Densiti 4
		0	D. Mrs. Densil, VMD2 vinces	0.00	00/08/2024, 10 10 20 AM	No.	[54,993,0004]993,0amid_VH001993[denot
		0	[] MR.Deval.Welland	0.03.48	DEPOSITION OF BOAM	PM.	(Sec.MS, USALMS, Denot, MG2MS, Denot
			D MR.Denst, VHDL, Schwarth	443.5.40	00703034.005.03794	Play	Drc.NPS,0554(NPS,Denol,VMCDNPS,Denol Ox ands
			& NPL Devolt, VMD2, Londo	5.957.840 #8	06/12/024, 10:05:52 PM	Virtual Doe	Dec. MR. DSOKI MR. Denull, VMCUMRS, Denult
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			E emeraliza	10.3.43	18/05/3024, 237-41 AM	which the	(Sec. NPS, (SSC4) NPS, (Sec. 8), VMC12-march 2.00
	· · · · · · · · · · · · · · · · · · ·	1	the los		(90900)), 0.01414/H	1990.000 Files	



The recovery can be performed from SnapCenter for VMware or SnapCenter plugin depending on the application.

The NetApp solution provides various effective tools for visibility, detection, and remediation, helping you to spot ransomware early, prevent this spread, and recover quickly, if necessary, to avoid costly downtime. Traditional layered defense solutions remain prevalent, as do third parties and partner solutions for visibility and detection. Effective remediation remains a crucial part of the response to any threat.

VMware Virtual Volumes with ONTAP

VMware Virtual Volumes (vVols) enables application-specific requirements to drive storage provisioning decisions while

leveraging the rich set of capabilities provided by storage arrays. The vSphere API for Storage Awareness (VASA) make it easy for a VM administrator to use whatever storage capabilities are needed to provision VMs without having to interact with their storage team. Prior to VASA, VM administrators could define VM storage policies, but had to work with their storage administrators to identify appropriate datastores, often by using documentation or naming conventions. With VASA, vCenter administrators with the appropriate permissions can define a range of storage capabilities which vCenter users can then use to provision VMs. The mapping between VM storage policy and datastore storage capability profile allows vCenter to display a list of compatible datastores for selection, as well as enabling other technologies like Aria (formerly known as vRealize) Automation or Tanzu Kubernetes Grid to automatically select storage from an assigned policy. This approach is known as storage policy based management. While storage capability profiles and policies may also be used with traditional datastores, our focus here is on vVols datastores. The VASA provider for ONTAP is included as part of ONTAP tools for VMware vSphere.

The advantages of having VASA Provider out of Storage Array, includes:

- Single Instance can manage multiple Storage Arrays.
- Release cycle doesn't have to depend on Storage OS release.
- Resources on Storage Array is much expensive.

Each vVol datastore is backed by Storage Container which is a logical entry in VASA provider to define the storage capacity. The Storage container with ONTAP tools is constructed with ONTAP volumes. The Storage Container can be expanded by adding ONTAP volumes within same SVM.

The Protocol Endpoint (PE) is mostly managed by ONTAP tools. In case of iSCSI based vVols, one PE is created for every ONTAP volume that is part of that storage container or vVol datastore. The PE for iSCSI is a small sized LUN (4MiB for 9.x and 2GiB for 10.x) that is presented to vSphere host and multipathing policies are applied to the PE.



vserver	path	size	
zoneb	/vol/Demo01_fv01/Demo01_fv01-vvolPE-1723681460207	2GB	
zoneb	/vol/Demo01 fv02/Demo01 fv02-vvolPE-1723681460217	2GB	
zoneb	/vol/TME01_iSCSI_01/vvolPE-1723727751956	4MB	
zoneb	/vol/TME01 iSCSI 02/vvolPE-1723727751970	4MB	
4 entri	es were displayed.		

For NFS, one PE is created for root filesystem export with every NFS data lif on SVM on which the storage



=	vSphere Client Q, Search in all environmente								9	•
> G.∳	€ - B 47P	TME02_NFS : Acre Summery Monitor Configure Alarm Defensione Scheduled Tanks	Prot	emission File Hosts ocol Endpoints	vine -					
0122 2000	iii Orivoso iii Teeo:acs iii Teeo:acs	General Connectivity with Hours Protocol Endocards Capability onti Datauit profiles NetApp ONTAP tools 3 SteapCenter Plugue for VMwcv	2	Name 17221227.227 18221227.227 17221224.277 17221234.227	•	1993 1973 1975 1975 1975	•	Image and NetApp cluttered Data ONTAP VP-40403664481545078668000000988883 RestApp cluttered Data ONTAP VP-4040366448154507866800000088883 NetApp cluttered Data ONTAP VP-4040366448154507866800000088883 RestApp cluttered Data ONTAP VP-4040366448154507866800000088883		•
5 位置目の		Resource Groues Backapt								

ONTAP tools manages the lifecycle of PE and also for vSphere host communication with vSphere cluster expansion and shrinkage. ONTAP tools API is available to integrate with existing automation tool.

Currently, ONTAP tools for VMware vSphere is available with two releases.

ONTAP tools 9.x

- When vVol support for NVMe/FC is required
- US Federal or EU regulatory requirements
- More use cases integrated with SnapCenter Plug-in for VMware vSphere

ONTAP tools 10.x

- · High Availablity
- Multi-tenancy
- Large Scale
- SnapMirror active sync support for VMFS datastore
- · Upcoming integration for certain use cases with SnapCenter Plug-in for VMware vSphere

Why vVols?

VMware Virtual Volumes (vVols) provides the following benefits:

- Simplified provisioning (No need to worry about Maximum LUN limits per vSphere host or need to create the NFS exports for each volume)
- Minimizes the number of iSCSI/FC paths (For block SCSI based vVol)
- Snapshots, Clones & other Storage operations are typically offloaded to storage array and performs much faster.
- Simplified data migrations for the VMs (No need to coordinate with other VM owners in same LUN)
- QoS policies applied at VM disk level rather than volume level.
- Operational simplicity (Storage vendors provide their differenciated features in VASA provider)
- Supports large scale of VMs.
- vVol replication support to migrate between vCenters.
- Storage Administrators has option to monitor at VM disk level.

Connectivity options

Dual fabric environment is typically recommended for the storage networks to address the high availability, performance and fault tolerance. The vVols are supported with iSCSI, FC, NFSv3 and NVMe/FC. NOTE: Refer Interoperability Matrix Tool (IMT) for supported ONTAP Tool version

The connectivity option remains consistent with VMFS datastore or NFS datastore options. A sample reference vSphere network is shown below for iSCSI and NFS.





Provisioning using ONTAP tools for VMware vSphere

The vVol datastore can be provisioned similar to VMFS or NFS datastore using ONTAP tools. If ONTAP tools plug-in is not available on vSphere client UI, refer the How to get started section below.

With ONTAP tools 9.13

1. Right click on vSphere cluster or host and select Provision Datastore under NetApp ONTAP tools.

2. Keep the type as vVols, provide name for the datastore and select the desired protocol

New Datastore	General			
1 General	Specify the details of the datast	ore to provision.		
2 Storage system	Provisioning destination:	Cluster01	BROWSE	
3 Storage attributes	Туре:			
4 Summary	Name:	TME01_ISCSI		
	Description:			
	Protocol:	○ NFS		
				CANCEL NEXT
New Datastore	General			
1 General	Specify the details of the datast	ore to provision.		
2 Storage system	Provisioning destination:	ClusterOl	BROWSE	
3 Storage attributes	Type:			
4 Summary	Name:	TME02_NFS		
	Description:			
	Protocol:	S NFS O ISCSI O FC / FCOE O NVMe/FC		
				CANCEL NEXT

3. Select the desired storage capability profile, pick the storage system and SVM.

General				
Storane system	Storage capability profiles:	Default profiles	â	
e atorage ayatem		Platinum AFF_C	8	
Storage attributes		Platinum ASA A		
		Platinum ASA C		
Summary		Create storage capability profile		
	Storage system:	ntaphci-a300e9u25 (172.16.9.25)	v	
	Storage VM:	zoneb	Ų.	

4. Create new ONTAP volumes or select existing one for the vVol datastore.

New Datastore 1 General 2 Storage system	Storage att Specify the storage Volumes: O Cr Create new volume	ributes details for provision eate new volumes s	ing the datastore.				
3 Storage attributes	Name		Size	Storage C	apability Profile	Aggregate	
4 Summary	TME01_ISC	SI_01	250 GB	Platinum	_AFF_A	EHCAggr01	
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			Platinum_AFF_	A ~	EHCAggr02 - (17109.63 Gi	Thin	
							ADD
					CANCEL	BACK	NEXT

ONTAP volumes can be viewed or change later from the datastore option.

=	vSphere Client Q, second of an and a second state								C & Adm	inistratoriji	VSPHERELOCAL ~	•	0~
0.0.0.00 0.0.0.0 × 0.0.0.0	VSphere Giert Q Speech is all processes	TMEO1_ISCSI Sorrmany Monitor Limit Aarm Darhitory Schwalawit Taxis General Connectionly with Hazas Prococol Endoperation Constelling with Hazas Prococol Endoperation Constelling sets Default profiles NetApp Contain Tools Contain Socrape StapCenter Plug-in for Viewa	ACTIONS gure Permassions CNITAP Store Sociage System Sociage System Sociage System Sociage System Sociage System Sociage System Theory of Colored Theory of Colored Theory of Colored Theory of Colored	ries age	Hors VM 17236-925 poneto HOVE STORAGE Approxim Declagator Eheclagator	Two Providence Vice They	*	News Minard (N)	C & Adam	inistrator d	NEPHENELOCAL V Timop Coastry Ports Patron APP A	•	0-
		Resource Groupe Backupt								-	ni ani biga 🔐 — 👘	1914	

5. Review the summary and click on Finish to create the vVol datastore.

lew Datastore	Summary							
	General							
1 General	vCenter server:	vVol-vc02.sddc.netapp.com						
2022430-000-000-000	Provisioning destination: Cluster01							
2 Storage system	Datastore name:	TME01_ISCSI						
3 Storane attributes	Datastore type:	vVols						
5 Storage attributes	Protocol:	ISCSI						
4 Summary	Storage capability profile:	Platinum_AFF_A						
	Storage system details							
	Storage system:	ntaphci-a300e9u25						
	SVM:	zoneb						
	Storage attributes							
	New FlexVol Name	New FlexVol Size	Aggregate	Storage Capability Profile				
	TME01_ISCSI_01	250 GB	EHCAggr01	Platinum_AFF_A				
	TME01 ISCSI 02	250 GB	EHCAggr02	Platinum_AFF_A				
		Page, page	Second Second					
			1800 - 1985 - 1995 - 1995 - 1995 - 1995 - 1995 - 1995 - 1995 - 1995 - 1995 - 1995 - 1995 - 1995 - 1995 - 1995 -					
	Click 'Finish' to provision this data	astore	SECOND PROPERTY					
	Click 'Finish' to provision this data	astore		CANCEL BACK FINIS				

6. Once vVol datastore is created, it can be consumed like any other datastore. Here is an example of assigning datastore based on VM storage policy to a VM that is getting created.

New Virtual Machine	Select storage						×
1 Select a creation type	Select the storage for the configural	tion and disk res Key Manag	files gement Server)				
2 Select a name and folder	Disable Storage DRS for this virtual	l machine	ients Policy ?				
3 Select a compute resource	Name	Ŧ	Storage Compatibility	Capacity Y	Provisioned Y	Free	т т
4 Select storage		· · · · · · · · · · · · · · · · · · ·	Compatible	500 GB	1 MB	500 GB	
			Incompatibl	499.75 GB	158.58 GB	341.17 GB	N
5 Select compatibility	Manage Columns				items ear e	ana 94 C	2 itoms
6 Select a guest OS	manage commis				items per p	ago 10 4	2 100115
7 Custonize hardware							
8 Ready to complete							
	Compatibility						
	Compatibility checks succeeded	d.					
						васк	NEXT

7. vVol details can be retrieved using web based CLI interface. The URL of the portal is same as VASA provider URL without the file name version.xml.

vSphere Client Q, Search is all analyzometry			C & Administration System DELLOCAL > C	∍ ⊙~
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The credential should match the info used during provision of ONTAP tools

← C SNot secure https://10.61.182.13:9083/jsp/login.jsp
Welcome to VASA Client Login
Username* administrator
Password *
Token *
• Login
▼ Where can I find Token
You can generate Token by logging into maint console. In main menu Select option 1) Application Configuration Select option 12) Generate Web-Cli Authentication token

or use updated password with ONTAP tools maintenance console.

Application Configuration Menu:

1) Display server status summary 2) Start Virtual Storage Console service 3) Stop Virtual Storage Console service 4) Start VASA Provider and SRA service 5) Stop VASA Provider and SRA service 6) Change 'administrator' user password 7) Re-generate certificates 8) Hard reset database 9) Change LOG level for Virtual Storage Console service 10) Change LOG level for VASA Provider and SRA service 11) Display TLS configuration 12) Generate Web-Cli Authentication token 13) Start ONTAP tools plug-in service 14) Stop ONTAP tools plug-in service 15) Start Log Integrity service 16) Stop Log Integrity service 17) Change database password b) Back x) Exit Enter your choice: 12 Starting token creation Your webcli auth token is :668826 This token is for one time use only. Its valid for 20 minutes.

Press ENTER to continue.

Select Web based CLI interface.

NetApp ONTAP tools for VMware vSphere - Control Panel:

Operation	Description					
Web based CLI interface	Web based access to the command line interface for administrative tasks					
Inventory	Listing of all objects and information currently known in Unified Virtual Appliance database					
Statistics	Listing of all counters and information regarding internal state					
Right Now	See what operations are in flight right now					
Logout	Logout					

 Build Release
 9.13P1

 Build Timestamp
 03/08/2024
 11:11:42 AM

 System up since
 Thu Aug 15
 02:23:18 UTC 2024

 Current time
 Thu Aug 15
 17:59:26 UTC 2024

Type the desired command from the Available command list. To list the vVol details along with underlying storage info, try vvol list -verbose=true

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For NFS based, the System Manager can be used to browse the datastore.

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With ONTAP tools 10.1

- 1. Right click on vSphere cluster or host and select Create Datastore (10.1) under NetApp ONTAP tools.
- 2. Select the datastore type as vVols.

Destination: Datastore type:	Cluster01	
Datastore type:		
	Unrs	
	○ VMF5 ● VVols	
		CANCEL NEXT
		vvois € VVois

If vVols option is not available, ensure the VASA provider is registered.



3. Provide the vVol datastore name and select the transport protocol.

Create Datastore	Name and Protoco	bl		×
1 Туре	Datastore name:	Demo01		
2 Name and Protocol	Protocol	isosi	0	
3 Storage		NFS 3		
4. Storage Attributes		Enders		
5 Summary				
			CANCEL	
			CANCEL	DACK NEXT

4. Select platform and Storage VM.



5. Create or use existing ONTAP volumes for the vVol datastore.

Create Datastore	Stora	ge Attribute	2S					3
1 Type 2 Name and Protocol 3 Storage	Create n to the di Volume	iew volumes or use atastore. s: O Cri NEW VOLUME	≥ the existing Fi	exVol volumes with f	volumes	equal to or greater	than 5 (iB to add storage
4 Storage Attributes		Name T	Size	Space Reserve	Ŧ	QoS Configured	т	Local Tier
5 Summary	E	Demo01_fv01	250 GB	Thin		No		EHCAggr01
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6. After vVol datastore is provisioned, it can be consumed similar to any other datastore.

7. ONTAP tools provide the VM and Datastore report.

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Data Protection of VMs on vVol datastore

Overview of data protection of VMs on vVol datastore can be found at protecting vVols.

1. Register the Storage system hosting the vVol datastore and any replication partners.

=	vSphere Client Q							(Administratoriji VSP	HERELOCAL ~	© ©
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2. Create a policy with required attributes.

New Backup Policy

Name	Daily
Description	description
Frequency	Daily
Locking Period	Enable Snapshot Locking 1
Retention	Days to keep
Replication	Update SnapMirror after backup ()
	Update SnapVault after backup (1)
	Snapshot label
Advanced $ \smallsetminus $	VM consistency (7)
	Include datastores with independent disks
	Scripts () Enter script path
	CANCEL ADD

3. Create a resource group and associate to policy (or Policies.)

Create Resource Group

n oonerar mile a nouncation	Scope:	Virtual Machines 🗸		
. Resource	Parent entity:	Datastores Virtual Machines	•	
J. Spanning disks		Tags Folders		
4. Policies		Q Enter available entity nam	ie	
5. Schedules	Available enti	ties	Selected entities	
5. Summary	TME01			
			3	
			>	
			<	
			×	
			BACK NEXT FINISH	CANCEL

NOTE: For vVol datastore, need to protect with VM, tag or folder. vVol datastore can't be included in the resource group.

4. Specific VM backup status can be viewed from its configure tab.

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	Resource Groups Backson								

5. VM can be restored from its primary or secondary location.

Refer SnapCenter plug-in documentation for additional use cases.

VM migration from traditional datastores to vVol datastore

To migrate VMs from other datastores to a vVol datastore, various options are available based on the scenario. It can vary from a simple storage vMotion operation to migration using HCX. Refer migrate vms to ONTAP datastore for more details.

×

VM migration between vVol datastores

For bulk migration of VMs between vVol datastores, please do check migrate vms to ONTAP datastore.

Sample Reference architecture

ONTAP tools for VMware vSphere and SCV can be installed on same vCenter it is managing or on different vCenter server. It is better to avoid to host on vVol datastore it is managing.



As many customers host their vCenter servers on different one rather than it is managing, similar approach is adviced for ONTAP tools & SCV too.



With ONTAP tools 10.x, a single instance can manage multiple vCenter environments. The storage systems are registered globally with cluster credentials and SVMs are assigned to each tenant vCenter servers.



Mix of dedicated and shared model is also supported.



How to get started

If ONTAP tools is not installed on your environment, please download from NetApp Support Site and follow the instructions available at using vVols with ONTAP.

Deployment Guide for VMFS

NetApp's storage solutions and offerings empower customers to fully capitalize on the advantages of a virtualized infrastructure. With NetApp solutions, customers can efficiently implement comprehensive data management software ensuring automation, efficiency, data protection and security capabilities to effectively meet demanding performance requirements. Combining ONTAP software with VMware vSphere allows to reduce host hardware and VMware licensing expenses, make sure data is protected at

lower cost, and provide consistent high performance.

Introduction

Virtualized workloads are mobile. Therefore, administrators use VMware Storage vMotion to move VMs across VMware Virtual Machine File System (VMFS), NFS, or vVols datastores, all residing on the same storage system and thus explore different storage approaches if using an All-Flash System or use the latest ASA models with SAN innovation for higher cost efficiency.

The key message here is that migrating to ONTAP improves customer experience and application performance while offering the flexibility to migrate data and applications between FCP, iSCSI, NVMe/FC and NVMe/TCP. For enterprises deeply invested in VMware vSphere, using ONTAP storage is a cost-effective option given the current market conditions, one that presents a unique opportunity. Enterprises today face new imperatives that a modern SAN approach can address simply and quickly. Here are some of the ways existing and new NetApp customers are adding value with ONTAP.

- Cost efficiency Integrated storage efficiency allows ONTAP to significantly reduce storage costs. NetApp ASA systems can run all storage efficiency capabilities in production with no performance impact. NetApp makes it simple to plan for these efficiency benefits with the most effective guarantee available.
- Data Protection SnapCenter software using snapshots provides advanced VM and application-level data protection for various enterprise applications deployed in a VM configuration.
- Security Use Snapshot copies to protect against malware and ransomware. Enhance protection by making Snapshot copies immutable using Snapshot locking and NetApp SnapLock® software.
- Cloud ONTAP provides a wide range of hybrid cloud options that enable enterprises to combine public and private clouds, offering flexibility and reducing infrastructure management overhead. Supplemental datastore support based on ONTAP offerings allow for the use of VMware Cloud on Azure, AWS and Google for TCO optimized deployment, data protection, and business continuity while avoiding vendor lock-in.
- Flexibility ONTAP is well-equipped to meet the rapidly changing needs of modern organizations. With ONTAP One, all these capabilities come standard with an ONTAP system at no extra cost.

Rightsize and optimize

With impending licensing changes, organizations are proactively addressing the potential increase in Total Cost of Ownership (TCO). They are strategically optimizing their VMware infrastructure through aggressive resource management and right-sizing to enhance resource utilization and streamline capacity planning. Through the effective use of specialized tools, organizations can efficiently identify and reclaim wasted resources, subsequently reducing core counts and overall licensing expenses. It's important to highlight that many organizations are already integrating these practices into their cloud assessments, demonstrating how these processes and tools effectively mitigate cost concerns in on-premises environments and eliminate unnecessary migration expenses to alternative hypervisors.

TCO Estimator

NetApp has created a simple TCO estimator which would act as the stepping stone in starting this optimisation journey. The TCO estimator uses RVtools or manual input methods to easily project how many hosts are required for the given deployment and calculate the savings to optimize the deployment using NetApp ONTAP storage systems. Keep in mind, this is the stepping stone.



The TCO estimator is only accessible to NetApp field teams and partners. Work with NetApp account teams to assess your existing environment.

Here is a screenshot from the TCO estimator.



Cloud Insights

Once the estimator shows the savings possible (which will be the case for any given organisation), then it's time to dive deep into analysing the workload IO profiles across virtual machines using real-time metrics. For this, NetApp provides Cloud Insights. By providing detailed analysis and recommendations for VM reclamation, Cloud Insights can help businesses make informed decisions about optimizing their VM environment. It can identify where resources can be reclaimed or hosts decommissioned with minimal impact on production, helping businesses navigate the changes brought about by Broadcom's acquisition of VMware in a thoughtful, strategic manner. In other words, Cloud Insight help businesses take the emotion out of the decision. Instead of reacting to the changes with panic or frustration, they can use the insights provided by Cloud Insights tool to make rational, strategic decisions that balance cost optimization with operational efficiency and productivity.

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Below are the screenshots from Cloud Insights.

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Conduct regular assessments to pinpoint underutilized resources, increase virtual machine density, and utilization within VMware clusters to control rising costs associated with new subscription licenses. Consider reducing the number of cores per CPU to 16 for new server purchases to align with changes in VMware licensing models.

With NetApp, right-size your virtualized environments and introduce cost-effective flash storage performance along with simplified data management and ransomware solutions to ensure organisations are prepared for new subscription model while optimizing the IT resources that are currently in place.

NetApp ONTAP Tools for VMware vSphere

To further enhance and simplify VMware integration, NetApp offers several offtap tools that can be used with NetApp ONTAP and VMware vSphere to efficiently manage virtualized environments. This section will focus on the ONTAP tools for VMware. ONTAP tools for VMware vSphere 10 provide a comprehensive set of tools for virtual machine lifecycle management, simplifying storage management, enhancing efficiency features, improving availability, and reducing storage costs and operational overhead. These tools seamlessly integrate with the VMware ecosystem, facilitating datastore provisioning and offering basic protection for virtual machines. The 10.x release of ONTAP tools for VMware vSphere comprises horizontally scalable, event-driven microservices deployed as an Open Virtual Appliance (OVA), following best practices for provisioning datastores and optimizing ESXi host settings for both block and NFS storage environments. Considering these benefits, OTV is recommended as a best practice to use with systems running ONTAP software.

Getting Started

Before deploying and configuring ONTAP tools for VMware, ensure the pre-requisites are met. Once done, deploy a single node configuration.



Three IP addresses are required for deployment - one IP address for load balancer, one IP address for the Kubernetes control plane and one for the node.

Steps

- 1. Log in to the vSphere server.
- 2. Navigate to the cluster or the host where you want to deploy the OVA.
- 3. Right-click the required location and select Deploy OVF template.
 - a. Enter the URL for the .ova file or browse to the folder where the .ova file is saved, and then select Next.

- 4. Select a name, folder, cluster / host for the virtual machine and select Next.
- 5. In the Configuration window, select Easy deployment(S), Easy deployment(M), or Advanced deployment(S) or Advanced deployment(M) configuration.



The easy deployment option is used in this walkthrough.

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	Select a deployment configuration		
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- 6. Choose the datastore to deploy the OVA and the source and destination network. Once done, select Next.
- 7. It's time to customize template > system configuration window.

epioy OVF Template	Customize template				
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After successful installation, the web console shows the state of ONTAP tools for VMware vSphere.

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API Docune	ntation is available at https://172.21.166.203:8443/
uotu3422n1	login: _

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The datastore creation wizard supports provisioning of VMFS, NFS and vVols datastores.

It's time to provision ISCSI based VMFS datastores for this walkthrough.

- 1. Log in to the vSphere client using https://vcenterip/ui
- 2. Right-click a Host or a Host Cluster or a Datastore, and then select NetApp ONTAP tools > Create Datastore.

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3. In the Type pane, select VMFS in Datastore Type.

Create Datastore	Type		×
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4. In the Name and Protocol pane, enter the datastore name, size, and protocol information. In the Advanced options section of the pane, select the Datastore cluster if you want to add this datastore to.

Create Datastore	Name and Protocol				×
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5. Select Platform and storage VM in the Storage pane. Provide the Custom initiator group name in the Advanced options section of the pane (optional). You can either choose an existing igroup for the datastore or create a new igroup with a custom name.

Create Datastore	Storage		×
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6. From the storage attributes pane, select Aggregate from the drop-down menu. Select Space Reserve, volume option, and Enable QoS options as required from the Advanced options section.

Create Datastore	Storage Attributes	2
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2 Name and Protocol	Aggregate: *	NTAP915_Src_01_VM_DISK_1 (147.9 GB Free)
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4 Storage Attributes	 Advanced Options 	
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7. Review the datastore details in the Summary pane and click Finish. The VMFS datastore is created and mounted on all the hosts.

Create Datastore	Summary				×	
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Refer to these links for vVol, FC, NVMe/TCP datastore provisioning.

VAAI Offloading

VAAI primitives are used in routine vSphere operations such as creating, cloning, migrating, starting, and stopping VMs. These operations can be executed through the vSphere client for simplicity or from the command line for scripting or to get more accurate timing. VAAI for SAN is natively supported by ESX. VAAI is always enabled on supported NetApp storage systems and provides native support for the following VAAI operations on SAN storage:

- · Copy offload
- Atomic Test & Set (ATS) locking
- Write Same
- · Out-of-space condition handling
- Space reclamation

```
[root@vesxi8-02:~] esxcli storage core device vaai status get -d=naa.600a09805a506576495d576a57553455
naa.600a09805a506576495d576a57553455
VAAI Flugin Name: VMW_VAAIP_NETAPP
ATS Status: supported
Clone Status: supported
Zero Status: supported
Delete Status: supported
```



Ensure that HardwareAcceleratedMove is enabled via the ESX advanced configuration options.



Ensure that the LUN has "space-allocation" enabled. If not enabled, enable the option and rescan all HBAs.

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These values are easily set using ONTAP tools for VMware vSphere. From the Overview dashboard, go to ESXi Host compliance card and Select Apply Recommended Settings option. In the Apply recommended host settings window, select the hosts and click Next to apply NetApp recommended host settings.

ESXi Host Compliance	
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APPLY RECOMMENDED SETTINGS VIEW ALL HOSTS (3)	Activate Windows

View detailed guidance for Recommended ESXi host and other ONTAP settings.

Data Protection

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Efficiently backing up VMs on VMFS datastore and rapidly recovering them are amongst the key advantages of ONTAP for vSphere. By integrating with vCenter, NetApp SnapCenter® software offers a wide range of backup and recovery features for VMs. It provides fast, space-efficient, crash-consistent, and VM-consistent backup and restore operations for VMs, Datastores, and VMDKs. It also works with SnapCenter Server to support application-based backup and restore operations in VMware environments using SnapCenter application-specific plug-ins. Leveraging Snapshot copies allows to make quick copies of the VM or datastore without any impact on performance and use NetApp SnapMirror® or NetApp SnapVault® technology for long-term, off-site data protection.

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The workflow is simple. Add primary storage systems and SVMs (and Secondary if SnapMirror/SnapVault is required).

High level steps for deployment and configuration:

- 1. Download SnapCenter for VMware Plug-in OVA
- 2. Log in with the vSphere Client credentials
- 3. Deploy OVF Template to start the VMware deploy wizard and complete the installation
- 4. To access the plug-in, select SnapCenter Plug-in for VMware vSphere from the Menu
- 5. Add Storage
- 6. Create backup policies
- 7. Create resource groups
- 8. Backup resource groups
- 9. Restore Entire virtual machine or particular virtual disk

Setting up SnapCenter Plug-in for VMware for VMs

To protect VMs and iSCSI datastores hosting them, SnapCenter Plug-in for VMware must be deployed. It's a simple OVF import.

The steps to deploy is as follows:

- 1. Download the Open Virtual Appliance (OVA) from NetApp Support Site.
- 2. Log in to the vCenter.
- 3. Within vCenter, right-click any inventory object such as a data center, folder, cluster, or host and select Deploy OVF template.
- 4. Select the right settings including storage, network and customise the template to update the vCenter and

its credentials. Once reviewed, click Finish.

- 5. Wait for the OVF import and deployment tasks to complete.
- 6. Once SnapCenter Plug-in for VMware is successfully deployed, it will be registered within vCenter. The same can be verified by accessing Administration > Client Plugins

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7. To access the plug-in, navigation to the left sidecar of the vCenter web client page, select SnapCenter Plug-in for VMware.

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Add storage, create policy and resource group

Adding storage system

Next step is to add the storage system. Cluster management endpoint or Storage virtual machine (SVM) administration endpoint IP should be added as a storage system to backup or restore VMs. Adding storage enables SnapCenter Plug-in for VMware to recognize and manage backup and restore operations in vCenter.

The process is straight forward.

- 1. From the left navigation, select SnapCenter Plug-in for VMware.
- 2. Select Storage Systems.
- 3. Select Add to add the "storage" details.
- 4. Use Credentials as the Authentication method and enter the username & its password and then click Add to save the settings.

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Create backup policy

A comprehensive backup strategy includes factors like when, what to back up and how long to keep backups. Snapshots can be trigged on an hourly or daily basis to back up entire datastores. This approach not only captures the datastores but also enables to back up and restore the VMs and VMDKs within those data stores.

Before backing up the VMs and datastores, a backup policy and resource group must be created. A backup policy includes settings such as the schedule and retention policy. Follow the below steps to create a backup policy.

- 1. In the left Navigator pane of SnapCenter Plug-in for VMware, click Policies.
- 2. On the Policies page, click Create to start the wizard.

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- 3. On the New Backup Policy page, enter the policy name.
- 4. Specify the retention, frequency settings and replication.



To replicate Snapshot copies to a mirror or vault secondary storage system, the relationships must be configured beforehand.



To enable VM-consistent backups, VMware tools must be installed and running. When VM consistency box is checked, the VMs are first quiesced, then VMware performs a VM consistent snapshot (excluding memory), and then SnapCenter Plug-in for VMware performs its backup operation, and then VM operations are resumed.

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Once the policy is created, next step is to create the resource group which will define the appropriate iSCSI datastores and VMs that should be backed up. After resource group is created, it's time for triggering backups.

Create Resource group

A resource group is the container for VMs and datastores that needs to be protected. The resources can be added or removed to resource groups at anytime.

Follow the below steps to create a resource group.

- 1. In the left Navigator pane of SnapCenter Plug-in for VMware, click Resource Groups.
- 2. On the Resource Groups page, click Create to start the wizard.

Another option to create resource group is by selecting the individual VM or datastore and creating a resource group respectively.

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3. On the Resources page, select the scope (virtual machines or datastores) and the datacenter.

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- 4. On the Spanning disks page, select an option for Virtual Machines with multiple VMDKs across multiple datastores
- 5. Next step is to associate a backup policy. Select an existing policy or create a new backup policy.
- 6. On the Schedules page, configure the backup schedule for each selected policy.

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7. Once the appropriate selections are made, click Finish.

This will create new resource group and add to the resource group list.

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Back up resource groups

Now it's time to trigger a backup. The backup operations are performed on all the resources defined in a resource group. If a resource group has a policy attached and a schedule configured, backups occur automatically according to the schedule.

1. In the left navigation of the vCenter web client page, select SnapCenter Plug-in for VMware > Resource Groups, then select the designated resource group. Select Run Now to start the ad-hoc backup.

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- 2. If the resource group has multiple policies configured, select the policy for the backup operation in the Backup Now dialog box.
- 3. Select OK to initiate the backup.

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Monitor the operation progress by selecting Recent Tasks at the bottom of the window or on the dashboard Job Monitor for more details.

Restore VMs from backup

SnapCenter Plug-in for VMware enables to restore virtual machines (VMs) to the vCenter. While restoring a VM, it can be restored to the original datastore mounted on the original ESXi host which will overwrite the existing content with the backup copy that is selected or a deleted/renamed VM can be restored from a backup copy (operation overwrites the data in the original virtual disks). To perform restore, follow the below steps:

- 1. In the VMware vSphere web client GUI, select Menu in the toolbar. Select Inventory and then Virtual Machines and Templates.
- 2. In the left navigation, Select the Virtual Machine, then select Configure tab, Select Backups under SnapCenter Plug-in for VMware. Click on the backup job from which the VM needs to be restored.

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3. Select the VM that needs to be restored from the backup.

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4. On the Select Scope page, select Entire Virtual Machine in the Restore scope field, then select Restore location, and then enter the destination ESXi information where the backup should be mounted. Enable Restart VM checkbox if the VM needs to be powered on after the restore operation.

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5. On the Select Location page, select the location for the primary location.

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6. Review the Summary page and then select Finish.

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Monitor the operation progress by selecting Recent Tasks at the bottom of the screen.

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Although the VMs are restored, they're not automatically added to their former resource groups. Therefore, add the restored VMs to the appropriate resource groups manually if protection of those VMs is required.

Now what if the original VM was deleted. It's a simple task with SnapCenter Plug-in for VMware. The restore operation for a deleted VM can be performed from the datastore level. Go to respective Datastore > Configure > Backups and select the deleted VM and select Restore.

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To summarize, when using ONTAP ASA storage to optimise TCO for a VMware deployment, use SnapCenter Plug-in for VMware as a simple and efficient method for backing up VMs. It enables to back up and restore VMs in a seamless and fast manner as snapshot backups take literally seconds to complete.

Refer to this solution guide and product documentation to learn about Snapcenter configuration, backup, restore from primary or secondary storage system or even from backups stored on object storage for long term retention.

To reduce storage costs, FabricPool volume tiering can be enabled to automatically move data for snapshot copies to a lower-cost storage tier. Snapshot copies typically use over 10% of allocated storage. While important for data protection and disaster recovery, these point-in-time copies are seldom used and are not an efficient use of high-performance storage. With the "Snapshot-Only" policy for FabricPool, you can easily free up space on high-performance storage. When this policy is enabled, inactive snapshot copy blocks in the volume that are not being used by the active file system are moved to the object tier and once read, the Snapshot copy is moved to the local tier to recover a VM or entire datastore. This object tier can be in the form of a private cloud (such as NetApp StorageGRID) or a public cloud (such as AWS or Azure).

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View detailed guidance for VMware vSphere with ONTAP.

Ransomware Protection

One of the most effective ways for ransomware attack protection is by implementing multi-layered security measures. Each virtual machine residing on a datastore hosts a standard operating system. Ensure enterprise server anti-malware product suites are installed and regularly updated on them which is an essential component of multi-layered ransomware protection strategy. Along with this, implement data protection leveraging NetApp snapshot technology to ensure rapid and reliable recovery from a ransomware attack.

Ransomware attacks are increasingly targeting backups and snapshot recovery points by trying to delete them before starting to encrypt files. However, with ONTAP this can be prevented by creating tamperproof snapshots on primary or secondary systems with NetApp Snapshot[™] copy locking in ONTAP. These Snapshot copies can't be deleted or changed by ransomware attackers or rogue administrators, so they're available even after an attack. You can recover virtual machine data in seconds, minimizing organization's downtime. Plus, you have the flexibility to choose the Snapshot schedule and lock duration that are right for your organization.

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As part of adding multiple layered approach, there is also a native built-in ONTAP solution for protecting unauthorized deletion of backup Snapshot copies. It is known as multiadmin verification or MAV which is available in ONTAP 9.11.1 and later. The ideal approach will be to use queries for MAV specific operations.

To learn more about MAV and how to configure its protection capabilities see the Multi-admin verification overview.

Migration

Many IT organizations are adopting a hybrid cloud-first approach as they undergo a transformation phase. Customers are assessing their current IT infrastructure and moving their workloads to the cloud based on this assessment and discovery. The reasons for migrating to the cloud vary and can include factors such as elasticity and burst, data center exit, data center consolidation, end-of-life scenarios, mergers, acquisitions, and more. Each organization's migration reasoning depends on their specific business priorities with cost optimization being the highest priority. Selecting the right cloud storage is crucial when moving to the hybrid cloud, as it unleashes the power of cloud deployment and elasticity. By integrating with 1P services powered by NetApp on each hyperscalar, organizations can realize a vSpherebased 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.

- View detailed guidance for Migrate Workloads to FSx for ONTAP datastore.
- View detailed guidance for Migrate workloads to Azure NetApp Files datastore.
- View detailed guidance for Migrate workloads to Google Cloud NetApp Volumes datastore.

Disaster Recovery

Disaster Recovery between on-premises sites

For more details, please visit DR using BlueXP DRaaS for VMFS Datastores

Disaster Recovery between on-premises and VMware Cloud in any hyperscalar

For those customers looking to use VMware Cloud on any hyperscalar as the disaster recovery target, ONTAP storage powered datastores (Azure NetApp Files, FSx for ONTAP, Google Cloud NetApp volumes) can be used to replicate data from on-premises using any validated third-party solution that provides VM replication capability. By adding ONTAP storage powered datastores, it will enable cost optimised disaster recovery on the destination with fewer amount of ESXi hosts. This also enables to decommission secondary site in the on-premises environment thus enabling significant cost savings.

- View detailed guidance for Disaster Recovery to FSx for ONTAP datastore.
- View detailed guidance for Disaster Recovery to Azure NetApp Files datastore.
- View detailed guidance for Disaster Recovery to Google Cloud NetApp Volumes datastore.

Conclusion

This solution demonstrates the optimal approach to using the ONTAP SAN technologies and Offtap tools to provide essential IT services for businesses both now and in the future. These advantages are particularly beneficial for virtualized environments running VMware vSphere in a SAN setup. With the flexibility and scalability of the NetApp storage systems, organizations can establish a foundation for updating and adjusting their infrastructure, allowing them to meet changing business needs over time. This system can handle current workloads and enhance infrastructure efficiency, thereby reducing operational costs and preparing for future workloads.

NetApp All-Flash SAN Array with VMware vSphere 8

For nearly two decades, NetApp ONTAP software has established itself as a premier storage solution for VMware vSphere environments, continually introducing innovative features that simplify management and decrease costs. NetApp is an established leader in the development of NAS and unified storage platforms that offer a wide range of protocol and connectivity support. Alongside this market segment, there are many customers who prefer the simplicity and cost benefits of block-based SAN storage platforms that are focused on doing one job well. NetApp's All-Flash SAN Array (ASA) delivers on that promise with simplicity at scale and with consistent management and automation features for all applications and cloud providers.

Solution Overview

Purpose of This Document

In this document we will cover the unique value of using NetApp ASA storage systems with VMware vSphere and provide a technology overview of the NetApp All-Flash SAN Array. In addition, we will look at additional tools for simplifying storage provisioning, data protection, and monitoring of your VMware and ONTAP datacenter.

Deployment sections of this document cover creating vVol datastores with ONTAP Tools for VMware vSphere, and observability for the modern datacenter with NetApp Cloud Insights.

Technology Overview

This solution includes innovative technologies from VMware and NetApp.

VMware vSphere 8.0

VMware vSphere is a virtualization platform that transforms physical resources into pools of compute, network and storage which can be used to satisfy customers' workload and application requirements. The main components of VMware vSphere include:

- **ESXi** VMware's hypervisor which enables the abstraction of compute processors, memory, network and other resources and makes them available to virtual machines and container workloads.
- vCenter VMware vCenter is a centralized management platform for interacting with compute resources, networking and storage as part of a virtual infrastructure. vCenter plays a crucial role in simplifying the administration of virtualized infrastructure.

New Improvements in vSphere 8.0

vSphere 8.0 introduces some new improvements including, but not limited to:

Scalability - vSphere 8.0 supports the latest Intel and AMD CPUs and has extended limits for vGPU devices, ESXi hosts, VMs per cluster, and VM DirectPath I/O devices.

Distributed Services Engine - Network offloading with NSX to Data Processing Units (DPUs).

Enhanced Device Efficiency - vSphere 8.0 boosts device management capabilities with features like device groups and Device Virtualization Extensions (DVX).

Improved Security - The inclusion of an SSH timeout and TPM Provision Policy strengthens the security framework.

Integration with Hybrid Cloud Services - This feature facilitates seamless transition between on-premises and cloud workloads.

Integrated Kubernetes Runtime - With the inclusion of Tanzu, vSphere 8.0 simplifies container orchestration.

For more information refer to the blog, What's New in vSphere 8?.

VMware Virtual Volumes (vVols)

vVols are a revolutionary new approach to storage management in vSphere clusters, providing simplified management and more granular control of storage resources. In a vVols datastore each virtual disk is a vVol and becomes a native LUN object on the storage system. The integration of the storage system and vSphere takes place through the **VMware API's for Storage Awareness (VASA)** provider and allows the storage system to be aware of the VM data and manage it accordingly. Storage policies, defined in the vCenter Client are used to allocate and manage storage resources.

vVols are a simplified approach to storage management and are preferred in some use cases.

For more information on vVols see the vVols Getting Started Guide.

NVMe over Fabrics

With the release of vSphere 8.0, NVMe is now supported end-to-end with full support for vVols with NVMe-TCP and NVMe-FC.

For detailed information on using NVMe with vSphere refer to About VMware NVMe Storage in the vSphere Storage documentation.

NetApp ONTAP

NetApp ONTAP software has been a leading storage solution for VMware vSphere environments for almost two decades and continues to add innovative capabilities to simplify management while reducing costs. Using ONTAP together with vSphere is a great combination that lets you reduce host hardware and VMware software expenses. You can also protect your data at lower cost with consistent high performance while taking advantage of native storage efficiencies.

Base ONTAP Features

NetApp Snapshot copies: Snapshot copies of a VM or datastore, ensuring no performance impact upon the creation or utilization of a Snapshot. These replicas can serve as restoration points for VMs or as a simple data safeguard. These array-based snapshots are different than VMware (consistency) snapshots. The most straightforward method to generate an ONTAP Snapshot copy is through the SnapCenter Plug-In for VMware vSphere, backing up VMs and datastores.

- **Storage Efficiency** ONTAP provides real-time and background deduplication and compression, zeroblock deduplication, and data compaction.
- Volume and LUN move Allows non-disruptive movement of volumes and LUNs supporting vSphere datastores and vVols within the ONTAP cluster to balance performance and capacity or support non-disruptive maintenance and upgrades.
- **Relocation of Volume and LUN** ONTAP allows non-disruptive movement of volumes and LUNs that host vSphere datastores and vVols within the ONTAP cluster. This aids in balancing performance and capacity, and allows for non-disruptive upgrades.
- Quality of Service QoS is a feature that enables the management of performance on an individual LUN, volume, or file. It can be used to limit an aggressive VM or to ensure that a critical VM receives sufficient performance resources.
- **Encryption** NetApp Volume Encryption and NetApp Aggregate Encryption. These options provide a straightforward software-based approach to encrypting data at rest, ensuring its protection.
- · Fabric Pool This feature tiers less frequently accessed data to a separate object store, freeing up

valuable flash storage. By operating at the block level, it efficiently identifies and tiers colder data, helping to optimize storage resources and reduce costs.

 Automation - Simplifies storage and data management tasks by utilizing ONTAP REST APIs for automation, and leveraging Ansible modules for seamless configuration management of ONTAP systems. Ansible modules offer a convenient solution for efficiently managing the configurations of ONTAP systems. The combination of these powerful tools enables the streamlining of workflows and enhancement of the overall management of storage infrastructure.

ONTAP Disaster Recovery Features

NetApp ONTAP provides robust disaster recovery solutions for VMware environments. These solutions leverage SnapMirror replication technologies between primary and secondary storage systems to allow failover and quick recovery in the case of failure.

Storage Replication Adapter:

The NetApp Storage Replication Adapter (SRA) is a software component that provides integration between NetApp storage systems and VMware Site Recovery Manager (SRM). It facilitates replication of virtual machine (VM) data across NetApp storage arrays, delivering robust data protection and disaster recovery capabilities. The SRA uses SnapMirror and SnapVault to achieve the replication of VM data across disparate storage systems or geographical locations.

The adapter provides asynchronous replication at the storage virtual machine (SVM) level using SnapMirror technology and extends support for both VMFS in SAN storage environments (iSCSI and FC) and NFS in NAS storage environments.



The NetApp SRA is installed as part of ONTAP Tools for VMware vSphere.

For information on the NetApp Storage Replication Adapter for SRM refer to VMware Site Recovery Manager with NetApp ONTAP.

SnapMirror Business Continuity:

SnapMirror is a NetApp data replication technology that provides synchronous replication of data between storage systems. It allows for the creation of multiple copies of data at different locations, providing the ability to recover data in case of a disaster or data loss event. SnapMirror provides flexibility in terms of replication

frequency and allows for the creation of point-in-time copies of data for backup and recovery purposes. SM-BC replicates data at the Consistency Group level.



For more information refer to SnapMirror Business Continuity overview.

NetApp MetroCluster:

NetApp MetroCluster is a high-availability and disaster recovery solution that provides synchronous data replication between two geographically dispersed NetApp storage systems. It is designed to ensure continuous data availability and protection in the event of a site-wide failure.

MetroCluster uses SyncMirror to synchronously replicate data just above the RAID level. SyncMirror is designed to efficiently transition between synchronous and asynchronous modes. This allows the primary storage cluster to continue operating in a non-replicated state in situations where the secondary site becomes temporarily inaccessible. SyncMirror will also replicate back to a RPO = 0 state when connectivity is restored.

MetroCluster can operate over IP based networks or using fibre channel.



For detailed information on MetroCluster architecture and configuration refer to the MetroCluster

ONTAP One Licensing Model

ONTAP One is a comprehensive licensing model that provides access to all features of ONTAP without requiring additional licenses. This includes data protection, disaster recovery, high availability, cloud integration, storage efficiency, performance, and security. Customers with NetApp storage systems licensed with Flash, Core plus Data Protection, or Premium are entitled to ONTAP One licensing, ensuring they can maximize the use of their storage systems.

ONTAP One licensing includes all of the following features:

NVMeoF – Enables the use of NVMe over Fabrics for front end client IO, both NVMe/FC and NVMe/TCP.

FlexClone – Enables rapid creation of space efficient cloning of data based on snapshots.

S3 – Enables the S3 protocol for front end client IO.

SnapRestore - Enables rapid recovery of data from snapshots.

Autonomous Ransomware Protection - Enables the automatic protection of NAS file shares when abnormal filesystem activity is detected.

Multi Tenant Key Manager - Enables the ability to have multiple key managers for different tenants on the system.

SnapLock - Enables the protection of data from modification, deletion or corruption on the system.

SnapMirror Cloud – Enables the replication of system volumes to object targets.

S3 SnapMirror – Enables the replication of ONTAP S3 objects to alternate S3 compatible targets.

NetApp All-Flash SAN Array

The NetApp All-Flash SAN Array (ASA) is a high-performance storage solution designed to meet the demanding requirements of modern data centers. It combines the speed and reliability of flash storage with NetApp's advanced data management features to deliver exceptional performance, scalability, and data protection.

The ASA lineup is comprised of both A-Series and C-Series models.

The NetApp A-Series all-NVMe flash arrays are designed for high-performance workloads, offering ultra-low latency and high resiliency, making them suitable for mission-critical applications.



C-Series QLC flash arrays are aimed at higher-capacity use cases, delivering the speed of flash with the economy of hybrid flash.



For detailed information see the NetApp ASA landing page.

NetApp ASA features

The NetApp All-Flash SAN Array includes the following features:

Performance - The All-Flash SAN Array leverages solid-state drives (SSDs), with an end-to-end NVMe architecture, to provide lightning-fast performance, significantly reducing latency and improving application response times. It delivers consistent high IOPS and low latency, making it suitable for latency-sensitive workloads such as databases, virtualization, and analytics.

Scalability - NetApp All-Flash SAN Arrays are built with a scale-out architecture, allowing organizations to seamlessly scale their storage infrastructure as their needs grow. With the ability to add additional storage nodes, organizations can expand capacity and performance without disruption, ensuring that their storage can keep up with increasing data demands.

Data Management - NetApp's Data ONTAP operating system powers the All-Flash SAN Array, providing a comprehensive suite of data management features. These include thin provisioning, deduplication, compression, and data compaction, which optimize storage utilization and reduce costs. Advanced data protection features like snapshots, replication, and encryption ensure the integrity and security of stored data.

Integration and Flexibility - The All-Flash SAN Array integrates with NetApp's broader ecosystem, enabling seamless integration with other NetApp storage solutions, such as hybrid cloud deployments with NetApp Cloud Volumes ONTAP. It also supports industry-standard protocols like Fibre Channel (FC) and iSCSI, enabling easy integration into existing SAN infrastructures.

Analytics and Automation - NetApp's management software, including NetApp Cloud Insights, provides

comprehensive monitoring, analytics, and automation capabilities. These tools enable administrators to gain insights into their storage environment, optimize performance, and automate routine tasks, simplifying storage management and improving operational efficiency.

Data Protection and Business Continuity - The All-Flash SAN Array offers built-in data protection features such as point-in-time snapshots, replication, and disaster recovery capabilities. These features ensure data availability and facilitate rapid recovery in the event of data loss or system failures.

Protocol Support

The ASA supports all standard SAN protocols including, iSCSI, Fibre Channel (FC), Fibre Channel over Ethernet (FCoE), and NVME over fabrics.

iSCSI - NetApp ASA provides robust support for iSCSI, allowing block-level access to storage devices over IP networks. It offers seamless integration with iSCSI initiators, enabling efficient provisioning and management of iSCSI LUNs. ONTAP's advanced features, such as multi-pathing, CHAP authentication, and ALUA support.

For design guidance on iSCSI configurations refer to .

Fibre Channel - NetApp ASA offers comprehensive support for Fibre Channel (FC), a high-speed network technology commonly used in storage area networks (SANs). ONTAP seamlessly integrates with FC infrastructure, providing reliable and efficient block-level access to storage devices. It offers features like zoning, multi-pathing, and fabric login (FLOGI) to optimize performance, enhance security, and ensure seamless connectivity in FC environments.

For design guidance on Fibre Channel configurations refer to the SAN Configuration reference documentation.

NVMe over Fabrics - NetApp ONTAP and ASA support NVMe over fabrics. NVMe/FC enables the use of NVMe storage devices over Fibre Channel infrastructure, and NVMe/TCP over storage IP networks.

For design guidance on NVMe refer to NVMe configuration, support and limitations.

Active-active technology

NetApp All-Flash SAN Arrays allows for active-active paths through both controllers, eliminating the need for the host operating system to wait for an active path to fail before activating the alternative path. This means that the host can utilize all available paths on all controllers, ensuring active paths are always present regardless of whether the system is in a steady state or undergoing a controller failover operation.

Furthermore, the NetApp ASA offers a distinctive feature that greatly enhances the speed of SAN failover. Each controller continuously replicates essential LUN metadata to its partner. As a result, each controller is prepared to take over data serving responsibilities in the event of a sudden failure of its partner. This readiness is possible because the controller already possesses the necessary information to start utilizing the drives that were previously managed by the failed controller.

With active-active pathing, both planned and unplanned takeovers have IO resumption times of 2-3 seconds.

For more information see TR-4968, NetApp All-SAS Array – Data Availability and Integrity with the NetApp ASA.

Storage guarantees

NetApp offers a unique set of storage guarantees with NetApp All-flash SAN Arrays. The unique benefits include:

Storage efficiency guarantee: Achieve high performance while minimizing storage cost with the Storage Efficiency Guarantee. 4:1 for SAN workloads.

6 Nines (99.9999%) data availability guarantee: Guarantees remediation for unplanned downtime in excess of 31.56 seconds per year.

Ransomware recovery guarantee: Guaranteed data recovery in the event of a ransomware attack.

See the NetApp ASA product portal for more information.

NetApp Plug-ins for VMware vSphere

NetApp storage services are tightly integrated with VMware vSphere through the use of the following plug-ins:

ONTAP Tools for VMware vSphere

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

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

ONTAP Tools includes the following components:

Virtual Storage Console (VSC): The VSC includes the interface integrated with the vSphere client where you can add storage controllers, provision datastores, monitor performance of datastores, and view and update ESXi host settings.

VASA Provider: The VMware vSphere APIs for Storage Awareness (VASA) Provider for ONTAP send information about storage used by VMware vSphere to the vCenter Server, enabling provisioning of VMware Virtual Volumes (vVols) datastores, creation and use of storage capability profiles, compliance verification, and performance monitoring.

Storage Replication Adapter (SRA): When enabled and used with VMware Site Recovery Manager (SRM), SRA facilitates the recovery of vCenter Server datastores and virtual machines in the event of a failure, allowing configuration of protected sites and recovery sites for disaster recovery.

For more information on NetApp ONTAP tools for VMware see ONTAP tools for VMware vSphere Documentation.

SnapCenter Plug-in for VMware vSphere

The SnapCenter Plug-in for VMware vSphere (SCV) is a software solution from NetApp that offers comprehensive data protection for VMware vSphere environments. It is designed to simplify and streamline the process of protecting and managing virtual machines (VMs) and datastores.

The SnapCenter Plug-in for VMware vSphere provides the following capabilities in a unified interface, integrated with the vSphere client:

Policy-Based Snapshots - SnapCenter allows you to define policies for creating and managing applicationconsistent snapshots of virtual machines (VMs) in VMware vSphere.

Automation - Automated snapshot creation and management based on defined policies help ensure

consistent and efficient data protection.

VM-Level Protection - Granular protection at the VM level allows for efficient management and recovery of individual virtual machines.

Storage Efficiency Features - Integration with NetApp storage technologies provides storage efficiency features like deduplication and compression for snapshots, minimizing storage requirements.

The SnapCenter Plug-in orchestrates the quiescing of virtual machines in conjunction with hardware-based snapshots on NetApp storage arrays. SnapMirror technology is utilized to replicate copies of backups to secondary storage systems including in the cloud.

For more information refer to the SnapCenter Plug-in for VMware vSphere documentation.

BlueXP integration enables 3-2-1 backup strategies that extend copies of data to object storage in the cloud.

For more information on 3-2-1 backup strategies with BlueXP visit 3-2-1 Data Protection for VMware with SnapCenter Plug-in and BlueXP backup and recovery for VMs.

NetApp Cloud Insights

NetApp Cloud Insights simplifies observation of on-prem and cloud infrastructure and provides analytics and troubleshooting capabilities to help solve complex problems. Cloud Insights works by collecting data from a data center environment and sending that data to the cloud. This is done with locally installed software called an Acquisition Unit and with specific collectors enabled for the assets in the data center.

The assets in Cloud Insights can be tagged with annotations that provide a method of organizing and classifying data. Dashboard can be created using a wide variety of widgets for displaying the data and Metric Queries can be created for detailed tabular views of data.

Cloud Insights comes with a large number of ready-made dashboards that help to zero in on specific types of problem areas and categories of data.

Cloud Insights is a heterogeneous tool designed to collect data from a wide range of devices. However, there is a library of templates, called ONTAP Essentials, that makes it easy for NetApp customers to get started quickly.

For detailed information on how to get started with Cloud Insights refer to the NetApp BlueXP and Cloud Insights landing page.

NetApp All-Flash SAN Array with VMware vSphere 8

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

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

Author: Josh Powell - NetApp Solutions Engineering

Managing Block Storage with ONTAP Tools for VMware vSphere

ONTAP Tools includes the following components:

Virtual Storage Console (VSC): The VSC includes the interface integrated with the vSphere client where you can add storage controllers, provision datastores, monitor performance of datastores, and view and update ESXi host settings.

VASA Provider: The VMware vSphere APIs for Storage Awareness (VASA) Provider for ONTAP send information about storage used by VMware vSphere to the vCenter Server, enabling provisioning of VMware Virtual Volumes (vVols) datastores, creation and use of storage capability profiles, compliance verification, and performance monitoring.

Storage Replication Adapter (SRA): When enabled and used with VMware Site Recovery Manager (SRM), SRA facilitates the recovery of vCenter Server datastores and virtual machines in the event of a failure, allowing configuration of protected sites and recovery sites for disaster recovery.

For more information on NetApp ONTAP tools for VMware see ONTAP tools for VMware vSphere Documentation.

Solution Deployment Overview

In this solution we will demonstrate the use of the ONTAP Tools for VMware vSphere to provision a VMware Virtual Volumes (vVol) datastores and create a virtual machine on a vVol datastore.

In a vVols datastore each virtual disk is a vVol and becomes a native LUN object on the storage system. The integration of the storage system and vSphere takes place through the VMware API's for Storage Awareness (VASA) provider (installed with ONTAP Tools) and allows the storage system to be aware of the VM data and manage it accordingly. Storage policies, defined in the vCenter Client are used to allocate and manage storage resources.

For detailed information on vVols with ONTAP refer to Virtual Volumes vVols) with ONTAP.

This solution covers the following high level steps:

- 1. Add a storage system in ONTAP Tools.
- 2. Create a storage capability profile in ONTAP Tools.
- 3. Create a vVols datastore in ONTAP Tools.
- 4. Create a VM storage policy in the vSphere client.
- 5. Create a new virtual machine on the vVol datastore.

Prerequisites

The following components were used in this solution:

- 1. NetApp All-Flash SAN Array A400 with ONTAP 9.13.
- 2. iSCSI SVM created on the ASA with network connectivity to the ESXi hosts.
- 3. ONTAP Tools for VMware vSphere 9.13 (VASA provider enabled by default).
- 4. vSphere 8.0 cluster (vCenter appliance, and ESXi hosts).

Solution Deployment

Create a vVols datastore in ONTAP Tools

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

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



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



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

Add Storage System

Any communication between ONTAP tools plug-in and the storage system should be mutually authenticated.				
vCenter server	10.61.181.205 ~			
Name or IP address:	10.192.102.103			
Username:	admin			
Password:	•••••			
Port:	443			
Advanced options 🔨				
ONTAP Cluster Certificate:	Automatically fetch 🔘 Manually upload			
	CANCEL			

Storage capability profiles describe the features provided by a storage array or storage system. They include quality of service definitions and are used to select storage systems that meet the parameters defined in the profile.

To create a storage capability profile in ONTAP Tools complete the following steps:

1. In ONTAP Tools select **Storage capability profile** from the left hand menu and then press **Create**.

\equiv vSphere Client (${\sf Q}$ Search in all environments
NetApp ONTAP tools INS	TANCE 10.61.181.154:8443 ~
Overview	Storage Capability Profiles
Storage Systems	CREATE
Storage capability profile	Name

2. In the **Create Storage Capability profile** wizard provide a name and description of the profile and click on **Next**.

reate Storage apability Profile	General	
	Specify a name an	d description for the storage capability profile. 💡
1 General		
2 Platform	Name:	Gold_ASA_iSCSI
	Description:	
3 Protocol		
4 Performance		
5 Storage attributes		
6 Summary		_

3. Select the platform type and to specify the storage system is to be an All-Flash SAN Array set **Asymmetric** to false.

Create Storage	Platform			
	Platform:	Performance		~
1 General	Asymmetric:			
2 Platform				
3 Protocol				
4 Performance				
5 Storage attributes				
6 Summary			CANCEL	BACK

4. Next, select choice of protocol or **Any** to allow all possible protocols. Click **Next** to continue.

Create Storage Capability Profile	Protocol			
supularity i rome	Protocol:	Any		~
1 General		Any		
2 Platform		FCP iSCSI NVMe/FC		
3 Protocol				
4 Performance				
5 Storage attributes				
6 Summary			CANCEL BAC	K NE

5. The **performance** page allows setting of quality of service in form of minimum and maximum IOPs allowed.

Create Storage Capability Profile	Performance					
	None (j					
1 General	QoS policy group	١				
2 Platform	Min IOPS:			_		
3 Protocol	Max IOPS:	6000		_		
4 Performance		Unlimited				
5 Storage attributes						
6 Summary			CANCEL	ВАСК	NEXT	

6. Complete the **storage attributes** page selecting storage efficiency, space reservation, encryption and any tiering policy as needed.

Create Storage Capability Profile	Storage attributes		
1 General	Deduplication:	Yes	<u>.</u>
2 Platform	Compression:	Yes	<u>~</u>
3 Protocol	Space reserve:	Thin	<u>~</u>
4 Performance	Encryption:	No	<u>~</u>
5 Storage attributes	Tiering policy (FabricPool):	None	<u>~</u>
6 Summary		CANCEL	BACK

7. Finally, review the summary and click on Finish to create the profile.



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

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

\equiv vSphere Client Q	Search in all environments	
NetApp ONTAP tools INSTAN	NCE 10.61.181.154:8443 ~	
Overview	ONTAP tools for VMware vSphere	
Storage Systems	Getting Started Traditional Dashboard vVols Dashboard	
Storage capability profile	ONTAP tools for VMware vSphere is a vCenter Server plug-in that provide	es end-to-end lifecycle management for virtual machines in VMware en
Storage Mapping		
Settings		
 Reports Datastore Report 	Add Storage System	Provision Datastore
Virtual Machine Report		
vVols Datastore Report	Add storage systems to ONTAP tools for VMware vSphere.	Create traditional or vVols datastores.
vVols Virtual Machine Report		
Log Integrity Report	ADD	PROVISION

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

New Datastore	General		
1 General	Specify the details of the datast	ore to provision. 🕗	
2 Storage system	Provisioning destination:	HMC Cluster	BROWSE
3 Storage attributes	Type:	NFS VMFS 💽 vVols	
4 Summary	Name:	ASA_VVOL	
	Description:		
	Protocol:	🔿 NFS 🧕 ISCSI 🔷 FC / FCoE 🔷 NVMe/FC	
			CANCEL NEXT

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

	Specify the storage capability pr	ofiles and the storage system you want to use.		
1 General				
2 Storage system	Storage capability profiles:	FAS_Default	^	
2 storage system		FAS_Max20		
3 Storage attributes		Gold_ASA_iSCSI		
		Gold_ASA	~	
4 Summary				
	Storage system:	HCG-NetApp-A400-E3U03 (10.192.102.103)	~	
	Storage VM:	svm1	~	
	96.11			

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

New Datastore 1 General 2 Storage system	Storage attr Specify the storage Volumes: • Create new volumes	ributes details for provi eate new volume	sioning the datastore.			
3 Storage attributes	Name	T S	ize	Storage Capability	Profile	Aggregate
4 Summary			FlexVo	ol volumes are no	ot added.	
	Name	Size(GB) () Storage c	apability profile	Aggregates	Space reserve
	ASA_VVOL	2000	Gold_AS	×	HCG_A400_E3u3b_NVI	ME - Thin
					CAN	NCEL BACK NEXT

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

New Datastore	Sammary			
1	General			
1 General	vCenter server:	10.61.181.205		
	Provisioning destination:	HMC Cluster		
2 Storage system	Datastore name:	ASA_VVOL		
3 Storage attributes	Datastore type:	vVols		
e eterage attributee	Protocol:	iSCSI		
4 Summary	Storage capability profile:	Gold_ASA		
	SVM:	svm1		
	Storage attributes			
	New FlexVol Name	New FlexVol Size	Aggregate	Storage Capability Profile
				CANCEL BACK F

Create a VM storage policy in the vSphere client

A VM storage policy is a set of rules and requirements that define how virtual machine (VM) data should be stored and managed. It specifies the desired storage characteristics, such as performance, availability, and data services, for a particular VM.

In this case, the task involves creating a VM storage policy to specify that a virtual machine will be generated on vVol datastores and to establish a one-to-one mapping with the previously generated storage capability profile.

To create a VM storage policy complete the following steps:

1. From the vSphere clients main menu select **Policies and Profiles**.



2. In the **Create VM Storage Policy** wizard, first fill out a name and description for the policy and click on **Next** to continue.

reate VM Storage Policy	Name and des	scription
1 Name and description	vCenter Server:	
2 Policy structure		
3 Storage compatibility	Name:	ASA_Gold
4 Review and finish	Description:	

3. On the **Policy structure** page select to enable rules for NetApp clustered data ontap vVol storage and click on **Next**.



4. On the next page specific to the policy structure chosen, select the storage capability profile that describes the storage system(s) to be used in the VM storage policy. Click on **Next** to continue.

reate VM Storage Policy	NetApp.clustered.Data	a.ONTAP.VP.vvol rules	
1 Name and description	Placement Replication Tag	gs	
2 Policy structure	ProfileName (j)	Gold_ASA	
3 NetApp.clustered.Data.ONTAP.VP. vvol rules			
 NetApp.clustered.Data.ONTAP.VP. vvol rules Storage compatibility 			

- 5. On the **Storage compatibility** page, review the list of vSAN datastores that match this policy and click **Next**.
- 6. Finally, review the policy to be implemented and click on **Finish** to create the policy.

Create a VM storage policy in the vSphere client

A VM storage policy is a set of rules and requirements that define how virtual machine (VM) data should be stored and managed. It specifies the desired storage characteristics, such as performance, availability, and data services, for a particular VM.

In this case, the task involves creating a VM storage policy to specify that a virtual machine will be generated
on vVol datastores and to establish a one-to-one mapping with the previously generated storage capability profile.

The final step is to create a virtual machine using the VM storage policies previously created:

1. From the **New Virtual Machine** wizard select **Create a new virtual machine** and select **Next** to continue.



- 2. Fill in a name and select a location for the virtual machine and click on Next.
- 3. On the **Select a compute resource** page select a destination and click on **Next**.

New Virtual Machine	Select a compute resource Select the destination compute resource for this operation
1 Select a creation type	Datacenter
2 Select a name and folder	
3 Select a compute resource	
4 Select storage	

4. On the **Select storage** page select a VM Storage Policy and the vVols datastore that will be the destination for the VM. Click on **Next**.

	Select the storage for the configuratio	n and disk files				
1 Select a creation type	VM Storage Policy	v bloc				
2 Select a name and folder	Disable Storage DRS for this virtual m	achine				
3 Select a compute resource	Name	T Storage Compatibility T	Capacity T	Provisioned T	Free T	
4 Select storage	I ■ ASA_VVOLS_1	Compatible	1.95 TB	9 MB	1.95 TB	
, secondary	O ASA400_ISCSI01	Incompatible	2 TB	185.32 GB	1.9 TB	
Select compatibility		Incompatible	800 GB	6.99 GB	793.01 GB	
	O destination	Incompatible	250 GB	32.66 MB	249.97 GB	
Select a guest OS	O B DRaaSTest	Incompatible	1 TB	133.27 GB	956.83 GB	
Customize hardware	O esxi-hc-01 local	Incompatible	349.25 GB	1.41 GB	347.84 GB	
Ready to complete	O esxi-hc-02 local	Incompatible	349.25 GB	1,41 GB	347.84 GB	
	O esxi-hc-03 local	Incompatible	349.25 GB	1,41 GB	347.84 GB	
	K Manage Columns	items per page	10 × 1-10	of 15 items	< 1 / 2	>
	Compatibility					
		Validating	g			

- 5. On the **Select compatibility** page choose the vSphere version(s) that the VM will be compatible with.
- 6. Select the guest OS family and version for the new VM and click on **Next**.
- 7. Fill out the **Customize hardware** page. Note that a separate VM storage policy can be selected for each hard disk (VMDK file).

	Configure the virtual machine	hardware			
1 Select a creation type	Virtual Hardware VM Op	ations Advanced Parameters			
2 Select a name and folder			А	DD NEW DEV	ICE ~
3 Select a compute resource	> CPU *	<u>4 ~</u> (j)			
4 Select storage	> Memory *	32 × GB ×			
4 Select storage	∽ New Hard disk *	150 GB ~			
5 Select compatibility					
6 Select a guest OS	Maximum Size	1.95 TB			
7 Customize hardware	VM storage policy	ASA_Gold ~			
8 Ready to complete	Location	Store with the virtual machine $$			
	Disk Provisioning	Thin Provision 👻			
	Sharing	Unspecified ~			
	Disk Mode	Dependent ~			
	Virtual Device Node	New SCSI controller SCSI(0:0) New H	ard disk \sim		
	> New SCSI controller	LSI Logic SAS			- :
	> New Network	VM Network			:
			CANCEL	ВАСК	NE

In summary, NetApp ONTAP Tools automates the process of creating vVol datastores on ONTAP storage systems. Storage capability profiles define not only the storage systems to be used for datastore creation but also dictate QoS policies that can be implemented on an individual VMDK basis. vVols provide a simplified storage management paradigm and tight integration between NetApp and VMware make this a practical solution for streamlined, efficient, and granular control over virtualized environments.

NetApp All-Flash SAN Array with VMware vSphere 8

NetApp Cloud Insights is a cloud-based infrastructure monitoring and analytics platform designed to provide comprehensive visibility and insights into the performance, health, and costs of IT infrastructures, both on-premises and in the cloud. Key features of NetApp Cloud Insights include real-time monitoring, customizable dashboards, predictive analytics, and cost optimization tools, allowing organizations to effectively manage and optimize their on-premises and cloud environments.

Author: Josh Powell - NetApp Solutions Engineering

Monitoring On-Premises Storage with NetApp Cloud Insights

NetApp Cloud Insights operates through Acquisition Unit software, which is set up with data collectors for assets such as VMware vSphere and NetApp ONTAP storage systems. These collectors gather data and transmit it to Cloud Insights. The platform then utilizes a variety of dashboards, widgets, and metric queries to organize the data into insightful analyses for users to interpret.



Solution Deployment Overview

This solution provides an introduction to monitoring on-premises VMware vSphere and ONTAP storage systems using NetApp Cloud Insights.

This list provides the high level steps covered in this solution:

- 1. Configure Data Collector for a vSphere cluster.
- 2. Configure Data Collector for an ONTAP storage system.
- 3. Use Annotation Rules to tag assets.
- 4. Explore and correlate assets.
- 5. Use a Top VM Latency dashboard to isolate noisy neighbors.
- 6. Identify opportunities to rightsize VMs.
- 7. Use queries to isolate and sort metrics.

Prerequisites

This solution uses the following components:

- 1. NetApp All-Flash SAN Array A400 with ONTAP 9.13.
- 2. VMware vSphere 8.0 cluster.
- 3. NetApp Cloud Insights account.

4. NetApp Cloud Insights Acquiition Unit software installed on a local VM with network connectivity to assets for data collection.

Solution Deployment

Configure Data Collectors

To configure Data Collectors for VMware vSphere and ONTAP storage systems complete the following steps:

1. Once logged into Cloud Insights, navigate to **Observability > Collectors > Data Collectors** and press the button to install a new Data Collector.

Observability 🗸	NetApp PCS Sandbox / Observ	vability / Collectors		
Fyplore		Data Collectors 9 7 Acc	uisition Units 🚺 3 Kube	ernetes Collectors
Liptore	Data Collectors (84)		+ Data Co	llector Bulk Actions 👻 \Xi
Alerts	Name 1	Status Type	Acquisit	ion Unit IP
om here search for	ONTAP and click on	ONTAP Data Manag	ement Softwa	re.
Choose a Data Colle	ctor to Monitor			
= ontap				
FSX for NetApp ONTA	NetApp Cloud Volumes ONTAP	NetApp ONTAP Data Management Software	NetApp ONTAP Select	
the Configure Co it and provide the n Complete Setur	ellector page fill out a credentials for the Of at the bottom of the	a name for the collecto NTAP storage system a page to complete the	or, specify the c . Click on Save e configuration.	orrect Acquisitio and Continue an
the Configure Co it and provide the n Complete Setu Select a Data C	ollector page fill out a credentials for the OI o at the bottom of the ollector	a name for the collector	or, specify the c . Click on Save e configuration.	orrect Acquisitio and Continue an Complete Setup
the Configure Co it and provide the n Complete Setur Select a Data C	ollector page fill out a credentials for the Of at the bottom of the ollector	a name for the collector	or, specify the c . Click on Save e configuration.	orrect Acquisitio and Continue an Complete Setup
the Configure Co it and provide the n Complete Setur Select a Data C I NetApp ONTAP Data Management S	ollector page fill out a credentials for the Of o at the bottom of the ollector	a name for the collector NTAP storage system page to complete the Configure Data Collector	or, specify the c . Click on Save e configuration.	orrect Acquisitio and Continue an Complete Setup
the Configure Co it and provide the n Complete Setur Select a Data Co NTAP Data Management S Add credentials and u	ollector page fill out a credentials for the Of o at the bottom of the ollector Software	a name for the collector NTAP storage system a page to complete the Configure Data Collector	or, specify the c . Click on Save e configuration.	orrect Acquisitio and Continue an Complete Setup
the Configure Co it and provide the n Complete Setur Select a Data C Not App ONTAP Data Management S Add credentials and r	ollector page fill out a credentials for the Of o at the bottom of the ollector software required settings	a name for the collector NTAP storage system a page to complete the Configure Data Collector Collector	or, specify the c . Click on Save e configuration.	orrect Acquisitio and Continue an Complete Setup
the Configure Co it and provide the n Complete Setur Select a Data C Name Itaphci-a300e9u25	ollector page fill out a credentials for the Of o at the bottom of the ollector software required settings	a name for the collector NTAP storage system a page to complete the Configure Data Collector Collector Acquisition Unit bxp-au01	or, specify the c . Click on Save e configuration.	orrect Acquisitio and Continue an Complete Setup
the Configure Co it and provide the n Complete Setur Select a Data Co NTAP Data Management S Add credentials and n Name @ ntaphci-a300e9u25	ollector page fill out a credentials for the Of o at the bottom of the ollector Software required settings	a name for the collector NTAP storage system a page to complete the Configure Data Collector Collector Acquisition Unit bxp-au01	or, specify the c . Click on Save e configuration.	orrect Acquisitio and Continue an Complete Setup
the Configure Co it and provide the n Complete Setur Select a Data C INTAP Data Management S Add credentials and r Name @ ntaphci-a300e9u25	ollector page fill out a credentials for the Of o at the bottom of the ollector software required settings	a name for the collector NTAP storage system page to complete the Configure Data Collector Collector Acquisition Unit bxp-au01	or, specify the c . Click on Save e configuration.	orrect Acquisitio and Continue an Complete Setup
the Configure Co it and provide the n Complete Setur Select a Data C INTAP Data Management S Add credentials and r Name @ ntaphci-a300e9u25 NetApp Management IP Ad 10.61.185.145	ollector page fill out a credentials for the Of o at the bottom of the ollector configure required settings	a name for the collector NTAP storage system a page to complete the Configure Data Collector Collector Acquisition Unit bxp-au01 User Name admin	or, specify the c . Click on Save e configuration.	orrect Acquisitio and Continue an Complete Setup
the Configure Co it and provide the n Complete Setur Select a Data Co Select a Data Co NTAP Data Management S Add credentials and n Name @ ntaphci-a300e9u25 NetApp Management IP Ad 10.61.185.145 Password	ollector page fill out a credentials for the Of o at the bottom of the ollector Software required settings	a name for the collector NTAP storage system a page to complete the Configure Data Collector Collector Acquisition Unit bxp-au01 User Name admin	or, specify the c . Click on Save e configuration.	orrect Acquisitio and Continue an Complete Setup

1. Once again, navigate to **Observability > Collectors > Data Collectors** and press the button to install a new Data Collector.

	sights					Q	٠	8
••• Observability	•	NetApp PCS Sandbox / Ob	servability / Collectors					
Explore			Data Collect	ors 07 Acquisition U	nits 🚺 3 Kubernetes Collectors	5		
		Data Collectors (84)			+ Data Collector Bulk /	Actions		Filter
Alerts		Name 1	Status	Туре	Acquisition Unit	IP		

2. From here search for **vSphere** and click on **VMware vSphere**.

	etApp Cloud I	nsights	
al	Observability		NetApp PCS Sandbox / Observability / Collectors / Add Data Collector
	Explore		Choose a Data Collector to Monitor
	Alerts		
	Collectors	29	vsphere
	Log Queries		

 On the Configure Collector page fill out a name for the collector, specify the correct Acquisition Unit and provide the credentials for the vCenter server. Click on Save and Continue and then Complete Setup at the bottom of the page to complete the configuration.

	ta Collector	Configure Data Collector
vsphere	Configure Collector	
Add credentials ar	nd required settings	Need He
Name 🕜		Acquisition Unit
VCSA7		bxp-au01
Virtual Center IP Addres	55	User Name
10.61.181.210		administrator@vsphere.local
Password		
Complete Setup	Test Connection	
VM Performance		Communication Dest
VM Performance	(min)	Communication Port
VM Performance	(min)	443
VM Performance Inventory Poll Interval	(min)	443 Choose 'Exclude' or 'Include' to Specify a List
VM Performance Inventory Poll Interval 20 Filter VMs by ESX_HOST	(min)	443 Choose 'Exclude' or 'Include' to Specify a List Exclude
VM Performance Inventory Poll Interval (20 Filter VMs by ESX_HOST Filter Device List (Common CLUSTER, and DATACEN	(min) w na Separated Values For Filtering By ESX_HOST, ITER Only)	Communication Port 443 Choose 'Exclude' or 'Include' to Specify a List Exclude Performance Poll Interval (sec)
VM Performance Inventory Poll Interval (20 Filter VMs by ESX_HOST Filter Device List (Comm CLUSTER, and DATACEN	(min) • na Separated Values For Filtering By ESX_HOST, ITER Only)	
VM Performance VM Performance Inventory Poll Interval (20 Filter VMs by ESX_HOST Filter Device List (Comm CLUSTER, and DATACEN Collect basic performance	(min) ma Separated Values For Filtering By ESX_HOST, ITER Only)	443 Choose 'Exclude' or 'Include' to Specify a List Exclude Performance Poll Interval (sec) 300

Add Annotations to assets

Annotations are a useful method of tagging assets so that they can be filtered and otherwise identified in the various views and metric queries available in Cloud Insights.

In this section, annotations will be added to virtual machine assets for filtering by **Data Center**.

1. In the left-hand menu, navigate to **Observability > Enrich > Annotation Rules** and click on the **+ Rule** button in the upper right to add a new rule.

al	Observability	•	NetApp PCS Sandbox / Observa	bility /
	Explore		Dashboard Groups (108)	+ <
			Q Search groups	
	Alerts		All Dashboards (3707)	-
	Collectors	11	My Dashboards (6)	
			Infrastructure Observability (2)	:
	Log Queries		01_Monitoring_CI_Course_Patrick	
	Enrich		Annotations	
			Annotation Rules	-
	Reporting	Z	Applications	÷
			Device Resolution	1
0	Kubernetes			

2. In the **Add Rule** dialog box fill in a name for the rule, locate a query to which the rule will be applied, the annotation field affected, and the value to be populated.

Add Rule					×
Name					
Add tags to Solut	tions Engine	ering VMs			
Query					
Solutions Engine	ering VMs				•
Annotation					
DataCenter					
Value					
Value Solutions Engine	ering				
Value Solutions Engine	eering			Cancel	Save
Value Solutions Engine	eering			Cancel	Save
Value Solutions Engine hally, in the upper e rule and apply t	right hand he annotatio	corner of the Annot on to the assets.	ation Rules pag	Cancel ge click on Run A	All Rules to r
Value Solutions Engine hally, in the upper e rule and apply t	eering right hand he annotatio	corner of the Annot on to the assets.	ation Rules pag	Gancel ge click on Run A	All Rules to r
Value Solutions Engine hally, in the upper e rule and apply the pp PCS Sandbox / Observability / Enrice	eering right hand o he annotatio	corner of the Annot on to the assets.	ation Rules pag	ge click on Run	All Rules to r
Value Solutions Engine Nally, in the upper e rule and apply the pp PCS Sandbox / Observability / Enrice Station rules (217)	ering right hand he annotatio h / Annotation Rules	corner of the Annot on to the assets.	ation Rules pag	ge click on Run A	All Rules to r

Explore and correlate assets

Cloud Insights draws logical conclusions about the assets that are running together on your storage systems and vsphere clusters.

This sections illustrates how to use dashboards to correlate assets.

1. In the left-hand menu, navigate to **Observability > Explore > All Dashboards**.

Observability	*	NetApp PCS Sandbox / Observal	bility / Collectors
Explore		Home Dashboard	
captoric		All Dashbonds	
Alerts		+ New Das	
		Metric Queries	S
Collectors	17	Infrastructure Insights NEW	S

2. Click on the **+ From Gallery** button to view a list of ready-made dashboards that can be imported.

	nsights			
0bservability	•	NetApp PCS Sandbox / Observability / Ex	lore / Dashboards	
Explore		Dashboard Groups (108) 🛛 🕂 ∢	All Dashboards (3,708)	+ From Gallery + Dashboard
		Q Search groups	Name 1	Owner
Alerts		All Dashboards (3708)	# Internal Volumes by IOPS Range (do not set as Home Page!)	Workneh Hilina
Collectors	17	My Dashboards (5)	# Internal Volumes by IOPS Range	Simon Wu

3. Choose a dashboard for FlexVol performance from the list and click on the **Add Dashboards** button at the bottom of the page.

 ONTAP FAS/AFF - Efficiency ONTAP FAS/AFF - FlexVol Performance ONTAP FAS/AFF - Node Operational/Optimal Points ONTAP FAS/AFF - PrePost Capacity Efficiencies
ONTAP FAS/AFF - FlexVol Performance ONTAP FAS/AFF - Node Operational/Optimal Points ONTAP FAS/AFF - PrePost Capacity Efficiencies
ONTAP FAS/AFF - Node Operational/Optimal Points ONTAP FAS/AFF - PrePost Capacity Efficiencies
ONTAP FAS/AFF - PrePost Capacity Efficiencies
Storage Admin - Which nodes are in high demand?
Storage Admin - Which pools are in high demand?
StorageGRID - Capacity Summary
StorageGRID - ILM Performance Monitoring
StorageGRID - MetaData Usage
StorageGRID - S3 Performance Monitoring
VMware Admin - ESX Hosts Overview
VMware Admin - Overview
VMware Admin - VM Performance
VMware Admin - Where are opportunities to right size?
VMware Admin - Where can I potentially reclaim waste?
VMware Admin - Where do I have VM Latency?
Additional Dashboards (13) These dashboards require additional data collectors to be installed. Add Mor
Add Dashboards Go Back

4. Once imported, open the dashboard. From here you can see various widgets with detailed performance data. Add a filter to view a single storage system and select a storage volume to drill into it's details.

	nsights		٩	🔅 😮 😫 Powell Josh 🔻
0bservability	•	NetApp PCS Sandbox / Observability / Dashboards / ONTAP FAS/AFF - FlexVol Performance (10)	① Last 24 Hours	• 🕕 🖉 Edit
Explore		Flexivol All	Storage ntapho-s300e9u25 X X	
Alerts		Drill Down		
Collectors	16	Select a storage or flexivol from above to focus on particular performance assets and characteristics.		
Log Queries				
Enrich		FlexVol IOPS Max Trend - Top 10 C 5m 🗄	Avg FlexVol Latency	C 5m :
Reporting		40x 20x	2	
G Kubernetes	٠	0 453 PM 7.40 PM 10.26 PM 113 AM (14 4.00 AM 6.46 AM 9.33 AM 12.20 PM Aug	0 4-53 PM 7-40 PM 10:26 PM 1:13 AM (14. 4:00 AM 6:46 AM Aug	9:33 AM 12:20 PM
Workload Security	•	ntaphci-a300e9u25:E ntaphci-a300e9u25:n ntaphci-a300e9u25:H ntaphci-a300e9u25:n HC_NFSRAGHU_DRO_ taphci-a300-01:vol0 MC_3510:Select_N1 taphci-a300-02:vol0	Ttaphci-a300e9u25:H Ttaphc	phci-a300e9u25:H _3510:Select_N2
ONTAP Essentials	•	Intaphici-a300e9u25:E ntaphici-a300e9u25:E ntaphici-a300e9u25:E ntaphici-a300e9u25:E MC_3510-Select_N2 HC_NFS/DS_0Mini HC_NFS/NSmounTe HC_NFS/NS_MMAR	Intaphic-a300e9u25:E Intaphic-a300e9u25:E Intaphic-a300e9u25:E Intaphic-a300e9u25:E HC_NFS:DevTest04 HC_NFS:NFSmountTe HC_NFS:DR_FSxN_n HC st01 Vol01 K K	aphci-a300e9u25:E _NFS:NFS_VMMAR Cl
Admin		ntaphci-a300e9u25:E ntaphci-a300e9u25:H	ntaphci-a300e9u25:H ntaphci-a300e9u25:E	

5. From this view you can see various metrics related to this storage volume and the top utilized and correlated virtual machines running on the volume.

Recommen	C Last 24 Hours	• 0	0 Edit
Display Metrics 💌		Hide Res	sources
	Resource		
	Top Correlated		91%
100 AM 10:00 AM 12:00 PM 2:00 PM	🗆 🍲 AuctionNoSQL0 🗇 🔓		58%
	Workload Contention		39%
\wedge	Additional Resources		
100 AM 10:00 AM 12:00 PM 2:00 PM	SedicitAsseta		

6. Clicking on the VM with the highest utilization drills into the metrics for that VM to view any potential issues.

		Dis	play Metrics 💌		Hide Resources
				Resource	
		1		Top Correlated	
٨		h		ntaphci-a3VMMARK_CI	91%
AM 6:00 AM	8:00 AM	10:00 AM 12:00 PM	M 2:00 PM	🔲 👜 esxi7-hc-0netapp.com	69%
		Total Read Wr	ite 🗊 📋	Workload Contention	
				🗌 🎯 AuctionWebB0	87%
		MC	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	AuctionNoSQL0	72%
			-0	Additional Resources	
AM 6:00 AM	8 00 AM	10:00 AM 12:00 PM	4 2:00 PM	Q Search Assets	

Use Cloud Insights to identify noisy neighbors

Cloud Insights features dashboards that can easily isolate peer VMs that are negatively impacting other VMs running on the same storage volume.

1. In this example access a dashboard available in the **Gallery** called **VMware Admin - Where do I** have VM Latency?

Dashboard Groups (108)	+ <	My Das	hboards (6)			+ From Gallery	+ Dashboard
Q Search groups			Name 1		Owner		
All Dashboards (3709)	*		All SAN Array Status (2)		Powell Josh		
My Dashboards (6)			Cloud Volumes ONTAP - FlexVol Performance (6)		Powell Josh		
Infractructure Observability (3)			ONTAP - Volume Workload Performance (Frontend) (7)		Powell Josh		
Masifacian Cl. Course Datrick	-		VMware Admin - Where are opportunities to right size? (37)		Powell Josh		
(15)	3		VMware Admin - Where can I potentially reclaim waste? (11)		Powell Josh		
02_Monitoring_CI_Course_Vish (5)	:		VMware Admin - Where do Lhave VM Latency? (9)	0	Powell Josh		
1_Str Dashboards (8)	:		(hn)				
			<u> </u>				

2. Next, filter by the **Data Center** annotation created in a previous step to view a subset of assets.

/ VMware Admin - Where do I have VM Latency? (9)						① Last 3 Hours		•
•	VirtualMachine All		Data Center	Solutions Engineering X	× •	diskLatency.total	2 ¥	All
! 5m	Avg Latency (all hypervisors)	C 5m	VM Count Wi	th Latency Concern	C 5m	Avg Latency (all VM	As)	

3. This dashboard shows a list of the top 10 VMs by average latency. From here click on the VM of concern to drill into its details.



4. The VMs potentially causing workload contention are listed and available. Drill into these VMs performance metrics to investigate any potential issues.

			D	isplay Metrics 🔻		Hide Resources
					Resource	
	~				Top Correlated	
					esxi7-hc-0netapp.com	9190
1:00 AM	11:15 AM	11:30 AM	11:45 AM	12:00 PM	ntaphci-a3VMMARK_CI	84%
					Workload Contention	
					AuctionNoSQL0	9296
					🗌 🎃 AuctionWebB0	5796
	~				Additional Resources	
MA 00:1	11:15 AM	11:30 AM	11:45 AM	12:00 PM	Q Search Assets	

View over and under utilized resources in Cloud Insights

By matching VM resources to actual workload requirements, resource utilization can be optimized, leading to cost savings on infrastructure and cloud services. Data in Cloud Insights can be customized to easily display over or under utilized VMs.

1. In this example access a dashboard available in the **Gallery** called **VMware Admin - Where are opportunities to right size?**

	Name †
	All SAN Array Status (2)
	Cloud Volumes ONTAP - FlexVol Performance (6)
	ONTAP - Volume Workload Performance (Frontend) (7)
*	VMware Admin - Where are opportunities to right size? (37)
	VMware Admin - Where of the otentially reclaim waste? (11)

2. First filter by all of the ESXi hosts in the cluster. You can then see ranking of the top and bottom VMs by memory and CPU utilization.



3. Tables allow sorting and provide more detail based on the columns of data chosen.

Memory Usage

C 5m :

121 items found

Virtual Machine	nemory (MiB)	memoryUt	Ļ
	768.0	81.64	í
	92.0	55.06	
ElasticAppB0	92.0	44.91	
AuctionAppA0	336.0	38.42	
Client0	480.0	37.98	
AuctionAppB0	336.0	37.83	
ElasticAppA0	92.0	35.63	
ElasticLB0	96.0	35.13	
user-cluster1-8872k-78c65dd794	92.0	32.47	
PrimeClient	48.0	30.30	Ļ
	4		F.

CPU Utilization

C 5m :

121 Items found

Virtual Machine	name	
hammerdb-01	hammerdb-01	-
DS3DB0	DS3DB0	
wc02-md-0-xwdgb-8cf48c96-qgn	wc02-md-0-xwdgb-8cf48c96-qg	
ElasticLB0	ElasticLBO	

4. Another dashboard called **VMware Admin - Where can I potentially reclaim waste?** shows powered off VM's sorted by their capacity use.

Data Center	All	•	Hypervisor	*essd7-hc* ×	X *	Name	AII	¥		
Powered Off VM	's	C 5m	Reclaimable	e Storage	C 5m	Powered Off V	'M CPU's	C 5m	Powered Off VM's Men	nory Allocation
18.00 33.61 VM's Capacity-Tota		33.61 TB Capacity - Total			8.54 % CPU's		12.30 Allocated Men			
Powered Off VM	's Capacity - Top 20				C 5m	Powered Off V	'M's			
OracleSn	_04				- 1	18 items found	d chine	capacity.tot	↓ processors	memory (!
OracleSn	_05					OracleSrv	04	6.433.25	4	32.768.0
OracleSn	_06					OracleStv	05	6 422 80		22 768 0
OracleSn	_07					OracleSer	05	0,402.00		22,700,0
PrimeClient	Old					Oracleor v_		0,432.60	*	52,100.0
rhel_se	rver					OracleSrv_	.07	6,432.78	4	32,768.0
SQL_Tem	late					OracleSrv_	.08	6,432.77	4	32,768.0
Win	022					PrimeClien	nt_Old	450.69	8	16,384.0
WinSrv	019					rhel_server	r	232.58	4	32,768.0
SnapCenter Se	rver					SQL_Temp	late	224.63	4	24,576.0
OcculeSe										

Use queries to isolate and sort metrics

The amount of data captured by Cloud Insights is quite comprehensive. Metric queries provide a powerful way to sort and organize large amounts of data in useful ways.

1. Navigate to **ONTAP Essentials > VMware** to access a comprehensive VMware metric query.

Observability	•
Kubernetes	•
Workload Security	•
ONTAP Essentials	
Overview	
Data Protection	
Security	
Alerts	
Infrastructure	
Networking	
Workloads	
VMwage	
	Observability Kubernetes Workload Security ONTAP Essentials Overview Data Protection Security Alerts Alerts Infrastructure Networking Workloads

2. In this view you are presented with multiple options for filtering and grouping the data at the top. All columns of data are customizable and additional columns can be easily added.

Filter by Attribute storageResources.storage.ven	dor NetApp X	× • × host.os	"vmware" ×	• • × + 0				
Filter by Metric +								
Group By Virtual Machine X	•							
Formatting: 🛩 Show Expanded Details Condition	onal Formatting Backgrou	und Color 🔻 🚺 5	how 😋 In Range as green					
281 items found								Bulk Actions
Table Row Grouping	Metrics & Attributes							
Virtual Machine	name † 🛛 🗄	powerState	capacity.used (GiB)	capacity.total (GiB)	capacityRatio.us	disklops.total (IO/s)	diskLatency.total	diskThroughp
01rfk8sprodclient	01rfk8sprodclient	On	49.38	69.86	70.68	1.21	8.13	0.01
02rfk8sprodserver	02rfk8sprodserver	On	63.64	74.06	85.93	22.80	4.13	0.11
03rfk8sprodmaster01	03rfk8sprodmaster01	On	65.13	77.21	84.36	26.64	5.64	0.20
04rfk8sprodmaster02	04rfk8sprodmaster02	On	63.89	76.27	83.77	26.82	5.14	0.16
05rfk8sprodmaster03	05rfk8sprodmaster03	On	63.77	75.58	84.38	28.23	4.63	0.17
AIQUM 9.11 (vApp)	AIQUM 9.11 (vApp)	On	152.00	152.00	100.00	23.24	0.19	0.41
AIQUM 9.12 (Linux)	AIQUM 9.12 (Linux)	On	55.28	100.00	55.28	0.01	11.83	0.00
AN-JumpHost01	AN-JumpHost01	On	90.00	90.00	100.00	1.39	0.19	0.01
AuctionAppA0	AuctionAppA0	On	9.38	16.00	58.62	1.21	0.44	0.12

Conclusion

This solution was designed as a primer to learn how to get started with NetApp Cloud Insights and show some of the powerful capabilities that this observability solution can provide. There are hundreds of dashboards and metric queries built into the product which makes it easy to get going immediately. The full version of Cloud Insights is available as a 30-day trial and the basic version is available free to NetApp customers.

Additional Information

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

- NetApp BlueXP and Cloud Insights landing page
- NetApp Cloud Insights documentation

VMware vSphere Metro Storage Cluster with SnapMirror active sync

VMware vSphere Metro Storage Cluster (vMSC) is a stretched cluster solution across

different fault domains to provide

- * Workload mobility across availability zones or sites.
- * downtime avoidance
- * disaster avoidance
- * fast recovery

This document provides the vMSC implementation details with SnapMirror active sync (SM-as) utilizing System Manager and ONTAP Tools. Further, it shows how the VM can be protected by replicating to third site and manage with SnapCenter Plugin for VMware vSphere.

SnapMirror active sync

General availability release 9.15.1 for symmetric configuration



SnapMirror active sync supports ASA, AFF and FAS storage arrays. It is recommended to use same type (Performance/Capacity models) on both fault domains. Currently, only block protocols like FC and iSCSI are supported. For further support guidelines, refer Interoperability Matrix Tool and Hardware Universe

vMSC supports two different deployment models named Uniform host access and Non-uniform host access. In Uniform host access configuration, every host on the cluster has access to LUN on both fault domains. It is typically used in different availability zones in same datacenter.





In Non-Uniform host access configuration, host has access only to local fault domain. It is typically used in different sites where running multiple cables across the fault domains are restrictive option.



In Non-Uniform host access mode, the VMs will be restarted in other fault domain by vSphere HA. Application availability will be impacted based on its design. Non-Uniform host access mode is supported only with ONTAP 9.15 onwards.

Prerequisites

- VMware vSphere hosts deployed with dual storage fabric (Two HBAs or Dual VLAN for iSCSI) per host.
- Storage Arrays are deployed with link aggregation for data ports (for iSCSI).
- Storage VM and LIFs are available
- Inter-Cluster latency round trip time must be less than 10 milliseconds.
- · ONTAP Mediator VM is deployed on different fault domain
- · Cluster Peer relationship is established
- SVM Peer relationship is established
- ONTAP Mediator registered to ONTAP cluster



If using self-signed certificate, the CA certificate can be retrieved from the <installation path>/ontap_mediator/server_config/ca.crt on mediator VM.

vMSC non-uniform host access with ONTAP System Manager UI.

Note: ONTAP Tools 10.2 or above can be used to provision stretched datastore with non-uniform host access mode without switching multiple user interfaces. This section is just for reference if ONTAP Tools is not used.

1. Note down one of the iSCSI data lif IP address from the local fault domain storage array.

Network interfaces Subnets										
+ Add							٩	Search 👤 Download \Xi Fi	lter 💿	Show/hide 🗸
Name	Status	Storage VM 🜲	IPspace	Address	Current node	Current p	Portset	Protocols	ту	Throughput
۹		Q zonea	۹	۹	Q	۹	۹	۹ _{iSCS}	۹	۹
iscsi02	\odot	zonea	Default	172.21.226.11	E13A300_1	a0a-3482		iSCSI	D	0
iscsi03	\odot	zonea	Default	172.21.225.12	E13A300_2	a0a-3481		iSCSI	D	0.33
iscsi04	\odot	zonea	Default	172.21.226.12	E13A300_2	a0a-3482		iSCSI	D	0.01
iscsi01	\odot	zonea	Default	172.21.225.11	E13A300_1	a0a-3481		iSCSI	D	0

2. On vSphere host iSCSI Storage Adapter, add that iSCSI IP under the Dynamic Discovery tab.

torage	~ *	tora	ge A	dapter	s											
Storage Adapters Storage Devices	-1.	ADD SC	FTWAR	IE ADAPTER	REFRES	H RESCAN STORA	GE RESCAN	ADAPTER #	Maka.							
Host Cache Configuration			Adapte	ei .	Model	La versione	¥.	Туре т	Stetue	¥ 1	dentifiev 🛛 🗡	Targets	Ŧ	Devices	Ŧ	Patria
Protocol Endpoints VO Filters			æ v	mhba65	ISCSI	Software Adapter		ISCSI	Online		scsi_vmk(ign.1998-01.com. vmware:dc01-esxi01.sddc. hetapp.com:473524194:6 5)					4
Storage Providers	. [Q T	G 9	mhbat	PEX4 olige	for 430TX/4408X/	MX IDE Contr	Block SCS	Unknown	E.		1		1		1
Virtual switches		0 1		mhba64	PEX4 oller	for 430TX/440BX/	MX IDE Contr	Block SCS	Unknown			0		0		0
VMkernel adapters Physical adapters		0	e v	Oedrim	PVSC	SI SCSI Controller		SCSI	Unknown		-	1		1		t
TCP/P configuration		Manar	e Colur	mans Expe	at =: []											14
/irtual Machines	× 1	- Consect	00000111	and Loose	-											
VM Startup/Shutdown Agent VM Settings		ropert	85	Devices	Paths	Dynamic Discover	y Static D	scovery P	letwork Port B	linding	Advanced Options					
		0UA	RE	MOVE AU	THENTICATIO	ON ADVANCED										
Default VM Compatibility		11-2-5														
Default VM Compatibility Swap File Location	- 51		19C/H 1	NUMER												



For Uniform access mode, need to provide the source and target fault domain iSCSI data lif address.

- 3. Repeat the above step on vSphere hosts for the other fault domain adding its local iSCSI data lif IP on Dynamic Discovery tab.
- 4. With proper network connectivity, four iSCSI connection should exist per vSphere host that has two iSCSI VMKernel nics and two iSCSI data lifs per storage controller.

E13A300::>	iscsi connecti Tpgroup	on show	-vser Conn	ver zonea -remot Local	e-address 172.21 Remote	.225.71 TCP Recv
Vserver	Name	TSIH	ID	Address	Address	Size
zonea	iscsi01	23	0	172.21.225.11	172.21.225.71	0
zonea	iscsi03	17	0	172.21.225.12	172.21.225.71	0
2 entries	were displayed.					
E13A300::>	iscsi connecti	on show	-vser	ver zonea -remot	e-address 172.21	.226.71
	Tpgroup		Conn	Local	Remote	TCP Recv
Vserver	Name	TSIH	ID	Address	Address	Size
zonea	iscsi02	24	0	172.21.226.11	172.21.226.71	0
zonea	iscsi04	16	A	172 21 226 12	172 21 226 71	0

5. Create LUN using ONTAP System Manager, setup SnapMirror with replication policy AutomatedFailOverDuplex, pick the host initiators and set host proximity.

6102				
RANK NO.		11		
zones		<u>v</u> .		
Group with	h related LLINA. 🕐			
Storage an	d optimization			
	100401211-00211400			
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Performance		~		
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er same	Program produce and the product a securit series CSI institution (2) Name April 1956 OS.com. institut.3 (s):19393088 rep: 1956-OS.com.and text.3143(19393088 rep: 1956-OS.com.and text.3143(1931888 rep: 1956-OS.com.and text.3143(195688 rep: 1956-OS.com.3143(1956888 rep: 1956-OS.com.3143(19568888 rep: 195688 rep: 1956888 rep: 195688 rep: 1956888 rep: 195688 rep	Description 2 - -	In products V In products V Hone Scores Scores Enviro Enviro Enviro	* Mar * * *
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6. On other fault domain storage array, create the SAN initiator group with its vSphere host initiators and set host proximity.

smas-dc02	All SAN initiator groups			
Overview	Mapped LUNs			
STORAGE VM Zoneb				
PROTOCOL Mixed (iSCSI	& FC)			
COMMENT				
PORTSET -				
CONNECTION STA	atus 🚯			
 Initiators 				
Nam	ne	De	Connection status ()	In proximity to
iqn.1	1998-01.com.vmware:dc02-esxi01.sddc.netap		<i>⊙</i> ок	zoneb
iqn.1	1998-01.com.vmware:dc02-esxi02.sddc.netap	-	⊘ок	zoneb

For Uniform access mode, the igroup can be replicated from source fault domain.

7. Map the replicated LUN with same mapping ID as in source fault domain.

 (\mathbf{i})

sm	as-dc02 All SAN initiator groups	🖉 Edit	🗊 Delete
0	verview Mapped LUNs		
-	Add O Map LUNs		₩ Filter
	Name		ID
	ds02		1
	ds01		0

8. On vCenter, right click on vSphere Cluster and select Rescan Storage option.

				LUI CIU.		in a light a
([])	Þ,		0	Summary	Monitor	Configure
~ 6	smas-vc	01.sddc.n	etapp.com	Service	s	× 1 0
~		uster01 dc01-es: dc02-es dc02-es Demo01 scv-6.0.	Actions - ClusterO1 Add Hosts Add Hosts New Virtual Machine New Resource Pool C Deploy OVF Template		re DRS re Availability ration tart al rovider re EVC ost Groups ost Rules	v v
		2	Storage Host Profiles	>	verrides 😫 New Da 🗒 Rescan	atastore Storage
			Edit Default VM Compa	tibility	g	~
			🖉 Assign vSAN Cluster Lic	ense	Cluster thority	
			Settings		efinitions	_
			Move To Rename Tags & Custom Attribute	es >	ed Tasks Cluster Servic al ores	ces 🗸
			Add Permission Alarms	>	PS	~
			Remove from Inventory		State	~
^	Recent	Tasks	VSAN	>		

9. On one of the vSphere host in the cluster, check the newly created device shows up with datastore showing Not Consumed.

Storage	×	Stora	ige Adapter	s													
Storage Adapters		ADD S	OFTWARE ADAPTER	- REFRESH RESCA	N STORAGE	RESCAN A	DAPTER	PENEVE.									
Storage Devices			Adapter	r Model		Ŧ	Type	¥ 3	stvis T	Identifie		Ŧ	Targeta 🔫	Devic	а. т	Patha	Ŧ
Protocol Endpoints VO Filters		•	⊕ vmhba65	ISCSI Software Ad	dapter		iscsi	c	nline	iscsi_v vmwar netapp 5)	mk(ign.1998-01. e.dc01-esxi01.sc .com:47352419	com, tdc, 4:6	4	2		8	
Storage Providers		0	G vmbbal	PIX4 for 430TX/4	4408X/MX IC	E Contr	Block	SCSI U	nknown	1			1	1		1	
Virtual switches	Ť	0	@ vmbba64	Plix4 for 430TX// ober	440BX/MX IC	Æ Contr	Block	SCSI U	nknown	5			0	0		0	
VMkernel adapters Physical adapters TCP/IP configuration		0	G vmhba0	PVSCSI SCSI Con	troller		scsi	U	nknown	Ż			1	1		1	
Virtual Machines	¥.	Mana	ge Columns Exp	ort -													Alterns
VM Startup/Shutdown Agent VM Settings Default VM Compatibilit	y	Propert	ies Devices	Paths Dynamic C	liscovery	Static Di	scovery	Networ	(Port Bindi	ng Ad	vanced Option:						
Swap File Location		0				Tana					Operational		Nardware				
System	× .	<u> </u>	Name	τ.	LON T	Түрө	π.	Capacity. T	Datasto	α. Τ	State	τ	Acceleration	π.	Drive Type	Ŧ	Тганаро
Licensing Host Profile			NETAPP ISCSFD 3038467724524	isk (naa.600a098038 1975577931)	0	disk		250.00 GB		501	Attached		Supported		Flash		ISCSI
Time Configuration		0	NETAPP (SCSI D	isk (nas 600s098038	t :	disk		300.00 GB	Not Co	orisume	Atlached		Supported		Flash		iscsi

10. On vCenter, right click on vSphere Cluster and select New Datastore option.

				LEI CIG.		. Hereite
([])	Þ,		\	Summary	Monitor	Configure
~ 6	smas-vc	01.sddc.n	etapp.com	Service	s	~ 1 0
		uster01 dc01-es: dc02-es dc02-es Demo01 scv-6.0.	Actions - Cluster01 Add Hosts Add Hosts New Virtual Machine New Resource Pool C Deploy OVF Template C New vApp		re DRS re Availability ration tart al ovider re EVC ost Groups ost Rules	v v
			Storage Host Profiles	>	New Da	atastore Storage
			Edit Default VM Compa	tibility	g	~
			🗇 Assign vSAN Cluster Lic	ense	Cluster	
			Settings		efinitions	
			Move To Rename Tags & Custom Attribut	es >	Cluster Servio al	ces 🗸
			Add Permission			~
			Alarms	,	es State	~
			Remove from Inventory X Delete		union	
^	Recent	Tasks	VSAN	>		

11. On Wizard, remember to provide the datastore name and select the device with right capacity & device id.

New Datastore	Nam	e and de	evice selection	on					×
1 Type	Specify	datastore n	name and a disk/L	UN for provis	ioning the datast	ore.			
2 Name and device selection	Name		D\$02						
3 VMFS version	(i) di	e datastore will sk/LUN that you sk/LUN.	I be accessible to all th u are interested in, it m	e hosts that are o ight not be acces	configured with acces sible to that host. Try	s to the selected disk/ changing the host or	LUN: If you do t configure acces	tot find the ssibility of that	×
4 Partition configuration	Select	a host	dc01-esxi01.sdd	ic.netapp.com	<u>v</u>				
5 Ready to complete			Select a host to view	wits accessible d	sicu/LUNs:				
		Name	٣	LUN T	Capacity Y	Hardware Acceleration	Drive Type	Y Sector Format	T VM Sut
	۲	NETAPP 600a098 45249755	iSCSI Disk (naa. 038303846772 577933)	1	300.00 G B	Supported	Flash	512e	No
	0	Local VM vmhba0:0	Iware Disk (mpx. CO:TO:LO)	0	100.00 G B	Not support ed	HDD	512n	Nc
	Man	age Columns	Export ~						2 items
						0	ANCEL	BACK	NEXT

12. Verify the datastore is mounted on all hosts on cluster across both fault domains.

Alarm Definitions Scheduled Tasks General	Con	nectivity and M	Aultip	athing									
Device Backing		Host		Ф. т	Detast	ice Mounted	Ŧ	Datastore Connectivity	T	Mount Point			т
onnectivity and Multipathing	•	dc01-esxi01.sd	dc.neta	pp.com	Moun	ted		Connected		/vmfs/volumes	/66b2d163-ce	443ad-3a67-005056	5b92d7e
rdware Acceleration	0	dc01-esxi02.sr	Stic mete	0.000	Moun	ted		Connected		/vmfs/volumes	/66b2d163-ce	(443ad-3a67-005056	5b92d7e
quability sets	0	dc02-esxi01.sr	idc.net/	00,000	Moun	ted		Connected		/vmfs/volumes	/66b2d163-ce	1443ad-3a67-005056	b92d7e
apCenter Plug-in for VMwa	0	dc02-esxi02-s	dd: net	100.001	Mosin	ted		Connected		/vmfs/volumes	/66b2d163-ce	1443ad-3a67-005058	sb92d7e
Resource Groups													
Backups	Man	age Columns											i i i i i i i i i
	Po Po Paths REEP	orage Array Type slicy wher Plugin	NM	N_SATP_ALUA									
		Runtime Name	+	Status	Ŧ	Target			1 T	LUN	Ŧ	Preferred	
	0	vmhba65.C0.T0.L1		Active		ign.1992-08.co 0d56:vs.28.172	m.netapp 21,225.11:	sn 3cb67894cf1f11ed819200. 3260	098a7	4		No.	
	0					ign.1992-08.co	minetapp	sn.3cb67894cftftled819200/	098a7	3		No	
	0	vmba65:C2:T0:L1		Active (I/Q)		Od56 vs.28:172	21.225.12	3260					
	0	vmhba65:C2:T0:L1		Active (I/O)		0d56 vs. 28 172 ign.1992-08.co 0d56 vs. 28 172	21.225.12 m.netapp 21.226.11	3260 sn.3cb67894cf1fRed819200i 3260	09847	1		No	

Alarm Definitions Scheduled Tasks Several	Con	nectivity and	Multip	athing								
Device Backing		Plast		÷	Datast	ore Mounted	Datastore Connectivity	*	Mount Point			
onnectivity and Multipathing	0	dc01-esxi01s	ddc.neta	00,000	Moun	ted	Connected		/vmts/volume	/66b2d163-ce	1443ad-3a67-0050561	292t17e
ardware Acceleration	0	□ _dc01-esxi02.1	idd:.nete	00.000	Moun	ted	Connected		/vmfs/volumes	/66b2d163-ce	(443ad-3a67-005056)	19207#
spoblity sets	9	_dc02-espi01.	scick: neta	RID.COM	Moun	ted	Connected		/vmfs/volume:	/66b2d163-ce	(443ad-3a67-005056)	92d7e
apCenter Plug-in for VMwzY	0	C dc02-05002	sddc neti	100.000	Moun	ted	Connected		/vmfs/volumes	/66b2d163-ce	(443ad-3a67-005056)	192d7e
Resource Groups												
lackups	Ma	nage Columns										-4.11
	P S P O Paths	ath Selection Policy torage Array Type olicy wher Plugin PESH \$144.0.2 01	Rou VMV NMF	nd Robin (VMwa N_SATP_ALUA	ие)							
		Buntivie Name		Status	٣	Target		÷.+	LUN	Ť	Preferred	
	0	vmbba65:C2:T0:L	<u>A</u>	Active (I/O)		ign.1992-08.com.net 46a21:vs.12:172.21.22	ipp:sn.133a93e1ce6o11edb100 5:21:3260	00a0985	1		No	
	0	vmhba65:C0.T01	3	Active		ign 1992-08.com net 46a21vs.12:172.21.22	ipp:sn:133a93etce6btledb100 5.22:3260	0040985	1		No	
							attent of the second state of the second	00-000			\$1.	
	0	vmhba65:C3:T0:L	4	Active (I/O)		46a21vs.12.172.21.22	spp:sn.133893e1cesb1%db100 5.21.3260	Operado	10		PHD	



The above screenshots shows Active I/O on single controller since we used AFF. For ASA, it will have Active IO on all paths.

13. When additional datastores are added, need to remember to expand the existing Consistency Group to have it consistent across the vSphere cluster.

PROTECTION POLICY AutomatedFailOverDuplex	transfer status Success	IS HEALTHY?
state ⊘ In sync	CONTAINED LUNS (SOURCE) /vol/ds01/ds01, /vol/ds02/ds0)2
E13A300 CONSISTENCY GROUP ds	CONSIST ds	-a300e9u25 ENCY GROUP
\odot		\odot
10,61.182.163 Mediator		

vMSC uniform host access mode with ONTAP Tools.

1. Ensure NetApp ONTAP Tools is deployed and registered to vCenter.

	${f Q}$ Search in all environment					
Shortcuts						
Inventories						
[]] Hosts and Clusters	Ms and Templates	Storage	2 Networking	Content Libraries	Global Inventory Lists	Workload Management
Monitoring						
Task Console	Event Console	C Customization Specifications	VM Storage Policies	Host Profiles	K	
Plugins						
NetApp ONTAP tools	SnapCenter Plug-in for VMware vSphere	Cloud Provider Services				
Administration						
Licensing						

If not, follow ONTAP Tools deployment and Add a vCenter server instance

2. Ensure ONTAP Storage systems are registered to ONTAP Tools. This includes both fault domain storage systems and third one for Asynchronous remote replication to use for VM protection with SnapCenter Plugin for VMware vSphere.

🚊 vSphere Client 🛛 Q 🖘													C	& Admin	REWRICKEVSPHERELOCAL ~		0
NetApp ONTAP tools instan	ice.	10.61.162.2	60:04	43-+													
e O Oservine		Stora	age	e Bac	kends												© *
🖬 Storage Backends		-400															
Protection wold clutter relationships				ana in	Spe	Taren +	CHILAP yesting	V	Sets 9	Capacity	14	NPE VAR			Supported Delation Typer O		
-O services		1 2		hipho-a.	danter	172 16 9 25	9.15.1		0 14atry	1	11110						
() feeport		11.0	1	13A300	Custer	17236-017	0.35.1		0	1.1	49.945						
(E) Reports v Virtual Machines		1.0		etas-pe.	Custer	entiab-dei.	9:57		0 Heating	1	6.7%						_
Datastores		Manag	# Crite	m14											Cloth Mrange N	0	(Spectre

If not, follow Add storage backend using vSphere client UI

3. Update hosts data to sync with ONTAP Tools and then, create a datastore.

() B		Ø	Summa	ry Monitor Cont	ons figure Pe
Smas- Smas- The second seco	<pre>/c01.sddc cluster01] dc01-e] dc02-e] dc02-e] dc02-e] dc02-e] bemo(] scv-6.0</pre>	Actions - ClusterOl Add Hosts New Virtual Machine New Resource Pool Peploy OVF Template Peploy OVF Template Import VMs Storage Host Profiles Edit Default VM Compatible Settings Move To Rename Tags & Custom Attributes Add Permission Alarms	s >	IS V ere DRS ere Availability Jaration V Start ral Provider are EVC lost Groups lost Rules Dverrides lost Rules Dverrides liters Options Profile Ng V I Cluster uthority Definitions led Tasks e Cluster Services V ral stores	Clust We ha autom
Task Name com.netapp. iscovery.labe	otv.hosts.	Remove from Inventory	2	Create datastor Mount datastor	re ho 07
Managa Colur		NetApp ONTAP tools	>	Update hosts d	lata

- 4. To enable SM-as, right click on vSphere cluster and pick Protect cluster on NetApp ONTAP Tools (refer above screenshot)
- 5. It will show existing datastores for that cluster along with SVM details. The default CG name is <vSphere Cluster name>_<SVM name>. Click on Add Relationship button.
| Protect the datastores of this cluste | r using SnapMirror replication. Learn more | 2 | |
|---------------------------------------|--|------------------------------------|---|
| Datastore type: * | VMFS | ~ | |
| Source storage VM: * | zonea | ~ | |
| | Cluster: E13A300
2 datastores | | |
| Consistency group name: * | Cluster01_zonea | | |
| SnapMirror settings | | | |
| ADD RELATIONSHIP | | | |
| Target storage VM | Policy | Uniform Host Configuration | Host proximity |
| No SnapMirror | relationship found. You can protect | datastores using one or more Snaph | /irror relationships. |
| | | | Objects per page <u>5</u> \checkmark 0 Object |
| | | | CANCEL PROTECT |

Protect Cluster | Cluster01

6. Pick the target SVM and set the policy to AutomatedFailOverDuplex for SM-as. There is a toggle switch for Uniform host configuration. Set the proximity for each host.

	E13A300 / zonea			
arget storage VM: *	zoneb		~	
	Cluster: ntaphci-a300e9u25			
olicy: *	AutomatedFailOverDuplex		~	
niform host configuration:				
lost proximity settings				
As part of protection, all datas	tores will be mounted on all hosts.			
S As part of protection, an autos	cores will be mounted on all nosts.			
SET PROXIMAL TO V				
SET PROXIMAL TO V	Ŧ	Proximal to		
SET PROXIMAL TO V	Ŧ	Proximal to		
SET PROXIMAL TO V Hosts dc01-esxi02.sddc.netapp.co	T .	Proximal to		
SET PROXIMAL TO V Hosts dc01-esxi02.sddc.netapp.co dc02-esxi01.sddc.netapp.co	T m m	Proximal to Source V Target V		

7. Verify the host promity info and other details. Add another relationship to third site with replication policy of Asynchronous if required. Then, click on Protect.

Protect Cluster Cluster01			
Protect the datastores of this cluster us	sing SnapMirror replication. Learn n	nore	
Datastore type: *	VMFS	~	
Source storage VM: *	zonea	~	
	Cluster: E13A300 2 datastores		
Consistency group name: *	Cluster01_zonea		
SnapMirror settings			
ADD RELATIONSHIP			
Target storage VM	Policy	Uniform Host Configuration	Host proximity
ntaphci-a300e9u25 / zoneb	AutomatedFailOverDuplex	Yes	Source (2), Target (2)
			Objects per page 5 \checkmark 1 Object
			CANCEL

NOTE: If plan to use SnapCenter Plug-in for VMware vSphere 6.0, the replication needs to be setup at volume level rather than at Consistency Group level.

8. With Uniform host access, the host has iSCSI connection to both fault domain storage arrays.

larm Definitions cheduled Tasks enerál	Connectivity and Mu	Itipathing				
evice Backing	Host	т	Datastore Mounted	T Datastore Connectivity	T Mount Point	
onnectivity and Multipathing	In dc02-esxi01.sddc.	netaco.com	Mounted	Connected	/vmfs/volumes/66aaa811-71dea46	7-813d-005056b92
irdware Acceleration	O dc01-esxi02.sddc	rietapo.com	Mounted	Connected	/vmfs/volumes/66aaa811-71dea46	7-8t3d-005056b92
pability sets	O dc02-esxi02.5ddc	netaoo.com	Mounted	Connected	/vmfs/volumes/66aaa811-71dea46	7-813d-005056692
apCenter Plug-in for VMwav	O C.dc01-esxi01.sddc.r	netaga.com	Mounted	Connected	/vmfs/volumes/66aaa8tl-71dea46	7-813d-005056692
lesporce Groups						
Derkumk						
Backups	Manage Columns					
App ONTAP tools >	Device V Multipathing Policies ACT Path Selection Policy Storage Array Type Policy	NETAPP ISCSI Disk TIONS ~ Round Robin (VM VMW_SATP_ALU	(naa,600a098038303846) ware) (A	7724524975577930		
App ONTAP tools >	Device ~ Muttipathing Policies ACT Path Selection Policy Storage Array Type Policy Owner Plugin Paths PEEPECH Device Device	NETAPP ISCSI Disk FIDNS ~ Round Robin (VM VMW_SATP_ALU NMP	(naa,600a098038303846) warei) (A	7724524975577031) -		
App ONTAP tools >	Device V Multipathing Policies ACT Path Selection Policy Storage Array Type Policy Owner Plugin Paths REFRESH DNAME CREATER	NETAPP ISCSI Disk TIONS - Round Robin (VM VMW_SATP_ALU NMP	(naa,600a098038303846) ware) (A	7724524975577931) -		T LUN
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NOTE: The above screenshot is from AFF. If ASA, ACTIVE I/O should be in all paths with proper network connections.

9. ONTAP Tools plugin also indicates the volume is protected or not.



10. For more details and to update the host proximity info, Host cluster relationships option under the ONTAP Tools can be utilized.

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VM protection with SnapCenter plug-in for VMware vSphere.

SnapCenter Plug-in for VMware vSphere (SCV) 6.0 or above supports SnapMirror active sync and also in combination with SnapMirror Async to replicate to third fault domain.







Supported use-cases include:

- * Backup and Restore the VM or Datastore from either of fault domains with SnapMirror active sync.
- * Restore resources from third fault domain.
- 1. Add all the ONTAP Storage Systems planned to use in SCV.

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2. Create Policy. Ensure Update SnapMirror after backup is checked for SM-as and also Update SnapVault after backup for Async replication to third fault domain.

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3. <u>Create Resource Group with desiered items that need to be protected, associate to policy and schedule.</u>

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4. Backups occur at scheduled time based on Policy associated to Resource Group. Jobs can be monitored from the Dashboard job monitor or from the backup info on those resources.

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5. VMs can be restored to same or alternate vCenter from the SVM on Primary fault domain or from one of the secondary locations.

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	(Secondary) svms2:vol_Datastore01_dest	
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6. Similar option is also available for Datastore mount operation.

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For assistance with additional operations with SCV, refer SnapCenter Plug-in for VMware vSphere documentation

VMware Cloud Foundation

VMware Cloud Foundation

VMware Cloud Foundation (VCF) is a set of technologies that provides a straightforward path to accessing a hybrid cloud experience. Within the VCF solution, support is provided for both native Kubernetes and virtual machine based workloads. Essential services like VMware vSphere, VMware vSAN, VMware NSX-T Data Center, and VMware vRealize Cloud Management are integral components of the VCF package. When combined, these services establish a software-defined infrastructure capable of managing compute, storage, networking, security, and cloud management. This collective infrastructure provides a hybrid experience, wherein the VCF framework extends the environment from onsite data center to Amazon Web Services (AWS), Azure, and Google Cloud.

Documentation resources

For detailed information on NetApp offerings for VMware Cloud Foundation, refer to the following four (4) part blog series:

- NetApp and VMware Cloud Foundation made easy Part 1: Getting started
- NetApp and VMware Cloud Foundation made easy Part 2: VCF and ONTAP principal storage

- NetApp and VMware Cloud Foundation made easy Part 3: VCF and Element principal storage
- NetApp and VMware Cloud Foundation made easy Part 4: ONTAP Tools for VMware and supplemental storage

VMware Cloud Foundation with NetApp All-Flash SAN Arrays

- VCF with NetApp ASA arrays, Introduction and Technology Overview
- Use Ontap Tools to deploy iSCSI datastores in a VCF management domain
- Use Ontap Tools to deploy vVols (iSCSI) datastores in a VI workload domain
- Configure NVMe over TCP datastores for use in a VI workload domain
- Deploy and use the SnapCenter Plug-in for VMware vSphere to protect and restore VMs in a VI workload domain

VMware Cloud Foundation with NetApp All-Flash AFF Arrays

- VCF with NetApp AFF arrays, Introduction and Technology Overview
- Use ONTAP with NFS as principal storage for VI workload domains
- Use ONTAP Tools to deploy NFS datastores in a VI workload domain

NetApp FlexPod solutions for VMware Cloud Foundation

- Expanding FlexPod hybrid cloud with VMware Cloud Foundation
- FlexPod as a Workload Domain for VMware Cloud Foundation
- FlexPod as a Workload Domain for VMware Cloud Foundation Design Guide

VMware Cloud Foundation with NetApp All-Flash SAN Arrays

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

Author: Josh Powell

This document provides information on storage options available for VMware Cloud Foundation using the NetApp All-Flash SAN Array. Supported storage options are covered with specific instruction for deploying iSCSI datastores as supplemental storage for management domains and both vVol (iSCSI) and NVMe/TCP datastores as supplemental datastores for workload domains. Also covered is data protection of VMs and datastores using SnapCenter for VMware vSphere.

Use Cases

Use cases covered in this documentation:

- Storage options for customers seeking uniform environments across both private and public clouds.
- Automated solution for deploying virtual infrastructure for workload domains.
- · Scalable storage solution tailored to meet evolving needs, even when not aligned directly with compute

resource requirements.

- Deploy supplemental storage to management and VI workload domains using ONTAP Tools for VMware vSphere.
- Protect VMs and datastores using the SnapCenter Plug-in for VMware vSphere.

Audience

This solution is intended for the following people:

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

Technology Overview

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

VMware Cloud Foundation

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

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

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



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

VCF Storage Options

VMware divides storage options for VCF into **principal** and **supplemental** storage. The VCF management domain must use vSAN as its principal storage. However, there are many supplemental storage options for the management domain and both principal and supplemental storage options available for VI workload domains.



Principal Storage for Workload Domains

Principal storage refers to any type of storage that can be directly connected to a VI workload domain during the setup process within SDDC Manager. Principal storage is deployed with SDDC manager as part of cluster creation orchestration and is the first datastore configured for a workload domain. It includes vSAN, vVols (VMFS), NFS and VMFS on Fibre Channel.

Supplemental Storage for Management and Workload Domains

Supplemental storage is the storage type that can be added to the management or workload domains at any time after the cluster has been created. Supplemental storage represents the widest range of supported storage options, all of which are supported on NetApp ASA arrays. Supplemental storage can be deployed using ONTAP Tools for VMware vSphere for most storage protocol types.

Additional documentation resources for VMware Cloud Foundation:

- * VMware Cloud Foundation Documentation
- * Supported Storage Types for VMware Cloud Foundation
- * Managing Storage in VMware Cloud Foundation

NetApp All-Flash SAN Arrays

The NetApp All-Flash SAN Array (ASA) is a high-performance storage solution designed to meet the demanding requirements of modern data centers. It combines the speed and reliability of flash storage with NetApp's advanced data management features to deliver exceptional performance, scalability, and data protection.

The ASA lineup is comprised of both A-Series and C-Series models.

The NetApp A-Series all-NVMe flash arrays are designed for high-performance workloads, offering ultra-low latency and high resiliency, making them suitable for mission-critical applications.



C-Series QLC flash arrays are aimed at higher-capacity use cases, delivering the speed of flash with the economy of hybrid flash.



For detailed information see the NetApp ASA landing page.

Storage Protocol Support

The ASA supports all standard SAN protocols including, iSCSI, Fibre Channel (FC), Fibre Channel over Ethernet (FCoE), and NVME over fabrics.

iSCSI - NetApp ASA provides robust support for iSCSI, allowing block-level access to storage devices over IP networks. It offers seamless integration with iSCSI initiators, enabling efficient provisioning and management of iSCSI LUNs. ONTAP's advanced features, such as multi-pathing, CHAP authentication, and ALUA support.

For design guidance on iSCSI configurations refer to the SAN Configuration reference documentation.

Fibre Channel - NetApp ASA offers comprehensive support for Fibre Channel (FC), a high-speed network technology commonly used in storage area networks (SANs). ONTAP seamlessly integrates with FC infrastructure, providing reliable and efficient block-level access to storage devices. It offers features like zoning, multi-pathing, and fabric login (FLOGI) to optimize performance, enhance security, and ensure seamless connectivity in FC environments.

For design guidance on Fibre Channel configurations refer to the SAN Configuration reference documentation.

NVMe over Fabrics - NetApp ONTAP and ASA support NVMe over fabrics. NVMe/FC enables the use of NVMe storage devices over Fibre Channel infrastructure, and NVMe/TCP over storage IP networks.

For design guidance on NVMe refer to NVMe configuration, support and limitations

Active-active technology

NetApp All-Flash SAN Arrays allows for active-active paths through both controllers, eliminating the need for the host operating system to wait for an active path to fail before activating the alternative path. This means that the host can utilize all available paths on all controllers, ensuring active paths are always present regardless of whether the system is in a steady state or undergoing a controller failover operation.

Furthermore, the NetApp ASA offers a distinctive feature that greatly enhances the speed of SAN failover. Each controller continuously replicates essential LUN metadata to its partner. As a result, each controller is prepared to take over data serving responsibilities in the event of a sudden failure of its partner. This readiness is possible because the controller already possesses the necessary information to start utilizing the drives that were previously managed by the failed controller.

With active-active pathing, both planned and unplanned takeovers have IO resumption times of 2-3 seconds.

For more information see TR-4968, NetApp All-SAS Array – Data Availability and Integrity with the NetApp ASA.

Storage guarantees

NetApp offers a unique set of storage guarantees with NetApp All-flash SAN Arrays. The unique benefits include:

Storage efficiency guarantee: Achieve high performance while minimizing storage cost with the Storage Efficiency Guarantee. 4:1 for SAN workloads.

6 Nines (99.9999%) data availability guarantee: Guarantees remediation for unplanned downtime in excess of 31.56 seconds per year.

Ransomware recovery guarantee: Guaranteed data recovery in the event of a ransomware attack.

See the NetApp ASA product portal for more information.

NetApp ONTAP Tools for VMware vSphere

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

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

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

SnapCenter Plug-in for VMware vSphere

The SnapCenter Plug-in for VMware vSphere (SCV) is a software solution from NetApp that offers comprehensive data protection for VMware vSphere environments. It is designed to simplify and streamline the process of protecting and managing virtual machines (VMs) and datastores. SCV uses storage based snapshot and replication to secondary arrays to meet lower recovery time objectives.

The SnapCenter Plug-in for VMware vSphere provides the following capabilities in a unified interface, integrated with the vSphere client:

Policy-Based Snapshots - SnapCenter allows you to define policies for creating and managing applicationconsistent snapshots of virtual machines (VMs) in VMware vSphere.

Automation - Automated snapshot creation and management based on defined policies help ensure consistent and efficient data protection.

VM-Level Protection - Granular protection at the VM level allows for efficient management and recovery of individual virtual machines.

Storage Efficiency Features - Integration with NetApp storage technologies provides storage efficiency features like deduplication and compression for snapshots, minimizing storage requirements.

The SnapCenter Plug-in orchestrates the quiescing of virtual machines in conjunction with hardware-based snapshots on NetApp storage arrays. SnapMirror technology is utilized to replicate copies of backups to secondary storage systems including in the cloud.

For more information refer to the SnapCenter Plug-in for VMware vSphere documentation.

BlueXP integration enables 3-2-1 backup strategies that extend copies of data to object storage in the cloud.

For more information on 3-2-1 backup strategies with BlueXP visit 3-2-1 Data Protection for VMware with SnapCenter Plug-in and BlueXP backup and recovery for VMs.

Solution Overview

The scenarios presented in this documentation will demonstrate how to use ONTAP storage systems as supplemental storage for management and workload domains. In addition, the SnapCenter Plug-in for VMware vSphere is used to protect VMs and datastores.

Scenarios covered in this documentation:

- Use Ontap Tools to deploy iSCSI datastores in a VCF management domain. Click here for deployment steps.
- Use Ontap Tools to deploy vVols (iSCSI) datastores in a VI workload domain. Click here for deployment steps.
- Configure NVMe over TCP datastores for use in a VI workload domain. Click here for deployment steps.
- Deploy and use the SnapCenter Plug-in for VMware vSphere to protect and restore VMs in a VI workload domain. Click here for deployment steps.

Use ONTAP Tools to configure supplemental storage for VCF Management Domains

In this scenario we will demonstrate how to deploy and use ONTAP Tools for VMware vSphere (OTV) to configure an iSCSI datastore for a VCF management domain.

Author: Josh Powell

Scenario Overview

This scenario covers the following high level steps:

- Create a storage virtual machine (SVM) with logical interfaces (LIFs) for iSCSI traffic.
- Create distributed port groups for iSCSI networks on the VCF management domain.
- Create vmkernel adapters for iSCSI on the ESXi hosts for the VCF management domain.
- Deploy ONTAP Tools on the VCF management domain.
- Create a new VMFS datastore on the VCF management domain.

Prerequisites

This scenario requires the following components and configurations:

- An ONTAP ASA storage system with physical data ports on ethernet switches dedicated to storage traffic.
- VCF management domain deployment is complete and the vSphere client is accessible.

NetApp recommends fully redundant network designs for iSCSI. The following diagram illustrates an example of a redundant configuration, providing fault tolerance for storage systems, switches, networks adapters and host systems. Refer to the NetApp SAN configuration reference for additional information.



NetApp ASA controller-1

NetApp ASA controller-2

For multipathing and failover across multiple paths, NetApp recommends having a minimum of two LIFs per storage node in separate ethernet networks for all SVMs in iSCSI configurations.

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

For additional information on using VMFS iSCSI datastores with VMware refer to vSphere VMFS Datastore - iSCSI Storage backend with ONTAP.



In situations where multiple VMkernel adapters are configured on the same IP network, it is recommended to use software iSCSI port binding on the ESXi hosts to ensure that load balancing across the adapters occurs. Refer to KB article Considerations for using software iSCSI port binding in ESX/ESXi (2038869).

Deployment Steps

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

Create SVM and LIFs on ONTAP storage system

The following step is is performed in ONTAP System Manager.

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

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

ONTAP System Manager						
DASHBOARD	Storage VMs					
INSIGHTS	+ Add					
STORAGE ^	Name					
Overview	EHC_ISCSI					
Volumes	EHC					
LUNS						
Consistency Groups	HMC_187					
NVMe Namespaces	HMC_3510					
Shares	HMC_iSCSI_3510					
Buckets						
Qtrees	infra_svm_a300					
Quotas	JS_EHC_iSCSI					
Storage VMs	OTVtest					
Tiers						

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

SVM_ISCSI			
PSPACE			
Default		~	
Access Protoco	ol		

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



For multipathing and failover across multiple paths, NetApp recommends having a minimum of two LIFs per storage node in separate Ethernet networks for all SVMs in iSCSI configurations.

IP ADDRESS	SUBNET MASK	GATEWAY	BROADCAST DOMAIN AND PORT
172.21.118.179	24	Add optional gateway	NFS_iSCSI
✓ Use the same su	bnet mask, gateway, and l	proadcast domain for all of the fo	llowing interfaces
IP ADDRESS	PORT		
172.21.119.179	a0a-3375 🗸		
ntaphci-a300-02	!		
PADDRESS	PORT		
172.21.118.180	a0a-3374 🗸		
P ADDRESS	PORT		
172.21.119.180	a0a-3375 🗸		
ose whether to en	able the Storage VN	I Administration account (for multi-tenancy environ
JICK OF JAVE LO C	reate the SVM.		
		~	
torage VM	Administrati	00	
Storage VM	Administrati	on	
Storage VM	Administrati	on	

Set up networking for iSCSI on ESXi hosts

The following steps are performed on the VCF management domain cluster using the vSphere client.

Complete the following to create a new distributed port group for each iSCSI network:

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

\equiv vSphere Client $$ Q $$ Search in a	all environments			
 Image: Second state of the second	<	vcf-m01-cl01-v Summary Monitor Switch Details	'dsO1 Aстю Configure Perm	NS
> 📾 vcf-m01-cl01-vds01 > 😡 vcf-wkld-vc01.sddc.netapp.com	Actions - vcf-m01-cl01-vds01	Manu	facturer	VMware
	Distributed Port Group	> 🖄 New Distribu	uted Port Group	AD
	Add and Manage Hosts. Edit Notes	Import Distr	ibuted Port Group tributed Port Groups	
	opgrade	Virtua	al machines	8

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

New Distributed Port Group	Configure settings		
1 Name and location	Port binding	Static binding	
2 Configure settings	Port allocation	Elastic 🗸 🛈	
3 Ready to complete	Number of ports	8	
	Network resource pool	(default) ~	
	VLAN		
	VLAN type	VLAN Y	
	VLAN ID	3374 0	
	Advanced		
	Customize default policies configuration		
		CANCEL BACK	NE

- 4. On the **Ready to complete** page, review the changes and click on **Finish** to create the new distributed port group.
- 5. Repeat this process to create a distributed port group for the second iSCSI network being used and ensure you have input the correct **VLAN ID**.
- 6. Once both port groups have been created, navigate to the first port group and select the action to **Edit settings...**.

(1) (2) (2) (2) (2) (2) (2) (2) (2) (2) (2	vcf-m01-cl01-vds01-pg-isc mary Monitor Configure Pe	Sİ-a ACTIONS
 vcf-m01-vc01.sddc.netapp.com 		
✓	istributed Port Group Details	
 Management Networks 		
 vcf-m01-cl01-vds01 	Port binding	Static binding
SDDC-DPortGroup-VM-Mgmt		
vcf-m01-cl01-vds-DVUplinks-19	Port allocation	Elastic
🗥 vcf-m01-cl01-vds0 <u>1-ng-iscsi-a</u>	VLAN ID	3374
🖄 vcf-m01-cl01-vds0 🕋 Actions - vcf-m01-cl01-vds01-pg-iscsi-a	Distributed switch	Contemporaries and second seco
🖄 vcf-m01-cl01-vds0 🖓 Edit Settings	Network protocol	122
🖄 vcf-m01-cl01-vds0	profile	
🖄 vcf-m01-cl01-vds0	Network resource	275
> 🕅 vcf-wkld-vc01.sddc.netapp.cor Restore Configuration	Hosts	4

7. On **Distributed Port Group - Edit Settings** page, navigate to **Teaming and failover** in the left-hand menu and click on **uplink2** to move it down to **Unused uplinks**.

Distributed Port Group	- Edit Settings vcf-m01-cl01-vc	ts01-pg-iscsi-a	×
General	Load balancing	Route based on originating virtual por ${}^{\!$	
Advanced VLAN	Network failure detection	Link status only	
Security	Notify switches	Yes >	
Traffic shaping	Failback	Yes ~	
Monitoring	Failover order 🛈		
Miscellaneous			
	© uplink1		
	Standby uplinks		
	Unused uplinks		
	🖫 uplink2		

8. Repeat this step for the second iSCSI port group. However, this time move **uplink1** down to **Unused uplinks**.

CANCEL

General	Load balancing	Route based on originating virtual por
Advanced		
VLAN	Network failure detection	Link status only \vee
Security	Notify switches	Yes ×
Traffic shaping	Failback	Yes 🗸
Teaming and failover		
Monitoring	Failover order (i)	
Miscellaneous	MOVE UP MOVE OWN	
	Active uplinks	
	uplink2	
	Standby uplinks	
	Unused uplinks	
	C uplink1	

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

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

\equiv vSphere Client $$ Q Search in all environments					
□ ₽ ≡ ◊	 Vcf-m01-esx0 Summary Monitor 	1.sddc	netapp re Perr	D.COM	CTIO <mark>NS</mark> Datastores Networks Updat
 	Storage Storage Adapters Storage Devices	× ^	VMke	ernel adapte	REFRESH
 vcf-m01-esx02.sddc.netapp.com vcf-m01-esx03.sddc.netapp.com vcf-m01-esx04.sddc.netapp.com 	Host Cache Configurati Protocol Endpoints I/O Filters	on	: >	De vmk0	Network Label Network
	Networking Virtual switches	~		>	vcf-m01-cl01-vds01-pg-vsan vcf-m01-cl01-vds01-pg-iscsi-a
	Physical adapters TCP/IP configuration		: > : >	> 😟 vmk10	

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



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

	Select a target device for the new connection.		
1 Select connection type	Select an existing network		
2 Select target device	Select an existing standard switch		
	O New standard switch		
3 Port properties	Quick Filter Enter value		
4 IPv4 settings	Name	NSX Port Group ID	Distributed Switch
	O SDDC-DPortGroup-VM-Mgmt	277	vcf-m01-cl01-vds01
5 Ready to complete	💽 🗥 vcf-m01-cl01-vds01-pg-iscsi-a		vcf-m01-cl01-vds01
	O kvcf-m01-cl01-vds01-pg-iscsi-b	344	vcf-m01-cl01-vds01
	○ A vcf-m01-cl01-vds01-pg-mgmt	100	vcf-m01-cl01-vds01
	○ K vcf-m01-cl01-vds01-pg-vmotion	344 	vcf-m01-cl01-vds01
	Vcf-m01-cl01-vds01-pg-vsan	(mm	vcf-m01-cl01-vds01

4. On the **Port properties** page keep the defaults and click on **Next** to continue.

Add Networking	Port properties				\times
	Specify VMkernel port settir	ngs.			
1 Select connection type	Network label	vcf-m01-ci01-vds01-pg-iscs	i-a (vcf-m01-cl01-vds01)		
2 Select target device	мти	Get MTU from switch ~	9000		
3 Port properties	TCP/IP stack	Default 🗸			
4 IPv4 settings	Available services				
	Enabled services	vMotion	vSphere Replication NFC	NVMe over RDMA	
5 Ready to complete		Provisioning	VSAN		
		Fault Tolerance logging	VSAN Witness		
		Management Sphere Replication	NVMe over TCP		

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

Add Networking	IPv4 settings		>
	Specify VMkernel IPv4 setting	gs.	
1 Select connection type	Obtain IPv4 settings auto	matically	
2 Select target device	 Use static IPv4 settings 		
3 Port properties	IPv4 address	172.21.118.114	
4 IPv4 settings	Subnet mask	255.255.255.0	
5 Ready to complete	Default gateway	Override default gateway for this adapter	
		172.21.166.1	
	DNS server addresses	10.61.185.231	

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



7. Repeat this process to create a VMkernel adapter for the second iSCSI network.

Deploy and use ONTAP Tools to configure storage

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

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

Complete the following to Deploy ONTAP tools for VMware vSphere:

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

\equiv vSphere Client C	${f \lambda}$ Search in all environ	ments	
	<	() vcf-m	01-cl01 Monitor
 vcf-m01-vc01.sddc.net vcf-m01-dc01 vcf-m01-cl01 	app.com	Cluster	Details
 vcf-m01-esx vcf-m01-esx vcf-m01-esx vcf-m01-esx vcf-m01-esx vcf-m01-esx 	 Actions - vcf-m01-cl01 Add Hosts New Virtual Mach New Resource Pc 	ine ool	Total Total Migra Fault
Image: stateImage: state <td>C Deploy OVE Tem</td> <td>plate</td> <td><u></u> 문 및</td>	C Deploy OVE Tem	plate	<u></u> 문 및

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



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

Deploy OVF Template	Sele	ect storage)
	Select	the storage for the co	onfiguration and dis	sk files				
1 Select an OVF template	Select	crypt this virtual machine virtual disk format	e (i) As defined in the	VM storage policy	~			
2 Select a name and folder	VM St	orage Policy able Storage DRS for th	Datastore Def is virtual machine	ault ~				
3 Select a compute resource		Name	T	Storage	Capacity T	Provisioned v	Free T	т^
4 Review details		vcf-m01-ci01-ds-vs	san01	Compatibility	999.97 GB	7.17 TB	225.72 GB	v
5 License agreements	0	vcf-m01-esx01-esx	-install-datastore	-	25.75 GB	4.56 GB	21.19 GB	v
6 Select storage	0	vcf-m01-esx02-es	x-install-datastore	-	25.75 GB	4.56 GB	21.19 GB	V
	0	vcf-m01-esx03-es	x-install-datastore	-	25.75 GB	4.56 GB	21.19 GB	V
7 Select networks	0	vcf-m01-esx04-es	x-install-datastore		25.75 GB	4.56 GB	21.19 GB	v
8 Customize template	<							``
9 Ready to complete	Mai	nage Columns				nems per pa	10 V	o neifis

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

Deploy OVF Template	Select networks		×
	Select a destination network for each	sou <mark>rce network.</mark>	
1 Select an OVF template			^
	Source Network	Destination Network	
2 Select a name and folder	nat	vcf-m01-cl01-vds01-pg-vsan	
3 Select a compute resource	Manage Columns	vcf-m01-cl01-vds01-pg-vsan	1 item
4 Review details	IP Allocation Settings	Browse	
5 License agreements	IP allocation:	Static - Manual	
6 Select storage	IP protocol:	IPv4 v	
7 Select networks			

- 8. On the Customize template page fill out all required information:
 - Password to be used for administrative access to OTV.
 - NTP server IP address.
 - OTV maintenance account password.
 - OTV Derby DB password.
 - Do not check the box to Enable VMware Cloud Foundation (VCF). VCF mode is not required for deploying supplemental storage.
 - FQDN or IP address of the vCenter appliance and provide credentials for vCenter.
 - Provide the required network properties fields.

Click on **Next** to continue.

Deploy OVF Template	Customize the deployment properties of the	his software solution.		
1 Select an OVF template	2 properties have invalid values			
2 Select a name and folder	✓ System Configuration	4 settings		
3 Select a compute resource4 Review details	Application User Password (*)	Password to assign to the administrator account.For sec reasons, it is recommended to use a password that is of thirty characters and contains a minimum of one upper, o one digit, and one special character.		
5 License agreements		Password	*******	0
6 Select storage 7 Select networks		Confirm Password	******	0
8 Customize template 9 Ready to complete	NTP Servers	A comma-separated Servers. If left blank, tools based time sy 172.21.166.1	list of hostnames or IP address VMware /nchronization will be used.	es of NTP
	Maintenance User Password (*)	Password to assign to	o maint user account.	
		Password	*******	0
		Confirm Password		0

	✓ Configure vCenter or Enable VCF	5 settings		
 Select an OVE template Select a name and folder 	Enable VMware Cloud Foundation (VCF)	vCenter server and use	er details are ignored wi	nen VCF is enabled.
3 Select a compute resource	vCenter Server Address (*)	Specify the IP address, to. 172.21.166.140	/hostname of an existing	vCenter to register
4 Review details	Port (*)	Specify the HTTPS por 443	rt of an existing vCenter	to register to.
6 Select storage	Username (*)	Specify the username administrator@vspher	of an existing vCenter to	o register to.
7 Select networks	Password (*)	Specify the password of	of an existing vCenter to	register to.
8 Customize template		Password		۵
9 Ready to complete		Confirm Password	•••••	0
	✓ Network Properties	8 settings		
	Host Name	Specify the hostname desired) vcf-m01-otv9	for the appliance. (Leavi	e blank if DHCP is
	IP Address	Specify the IP address	for the appliance. (Leav	e blank if DHCP is
			CANCEL	BACK

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

Complete the following to use OTV to configure a VMFS iSCSI datastore as supplemental storage on the management domain:

1. In the vSphere client navigate to the main menu and select **NetApp ONTAP Tools**.

	e
o onore	
品 Inven	tory
🗐 Conte	ent Libraries
% Work	load Management
🖫 Globa	al Inventory Lists
🖫 Polici	es and Profiles
지 Auto	Deploy
Hybrid	d Cloud Services
<>> Deve	loper Center
🖏 Admi	nistration
🗐 Tasks	
🔟 Event	ts
🛇 Tags	& Custom Attributes
<⊅ Lifecy	/cle Manager
NetA	pp ONTAP tools

2. Once in **ONTAP Tools**, from the Getting Started page (or from **Storage Systems**), click on **Add** to add a new storage system.
| VSphere Client Q | Search in all environments | | |
|---|--|---|---|
| App ONTAP tools INSTAN | NCE 172.21.166.139:8443 ~ | | |
| verview | ONTAP tools for VMware vSphere | | |
| orage Systems | Getting Started Traditional Dashboard vVols Dashboard | | |
| orage capability profile
orage Mapping | ONTAP tools for VMware vSphere is a vCenter Server plug-in that provides end-to-end lifecycl | e management for virtual machines in VMware | e environments using NetApp storage systems.
Next Steps |
| ttings | ₽+ | | 8 |
| Reports
Datastore Report
Virtual Machine Report | Add Storage System | Provision Datastore | View Dashboard
View and monitor the datastores in |
| vVols Datastore Report
vVols Virtual Machine | Add storage systems to ONTAP tools for VMware vSphere. Crea | te traditional or vVols datastores. | ONTAP tools for VMware vSphere. |
| Log Integrity Report | | PROVISION | Settings
Configure administrative settings such
as credentials, alarm thresholds. |
| | What's new?
September 4, 2023 | | Resources |
| | Qualified and supported with ONTAP 9.13.1 Supports and Interoperates with VMware vSphere 8.x releases Includes newer enhanced SCPs that efficiently map workloads to the newer All SAN Array platform based management | ONTAP tools for VMwa RBAC User Creator for ONTAP tools for VMwa | re vSphere Documentation Resources
Data ONTAP
rre vSphere REST API Documentation |

3. Provide the IP address and credentials of the ONTAP storage system and click on **Add**.

Any communication system should be m	between ONTAP tools plug-in and the storage utually authenticated.
vCenter server	vcf-m01-vc01.sddc.netapp.com ~
Name or IP address:	172.16.9.25
Jsername:	admin
Password:	
	442
Port:	443
Port: Advanced options >	
Port: Advanced options >	443
Port: Advanced options >	
Port: Advanced options >	
Port: Advanced options >	

4. Click on \boldsymbol{Yes} to authorize the cluster certificate and add the storage system.

Any communicat system should be	on between ONTAP tools plu mutually authenticated	ig-in and the storage
vCenter server	vcf-m01-vc01.sddc	netapp.com ~
Authorize Clu	ster Certificate	
Host 172.16.9.25 has	dentified itself with a self-	signed certificate.
Show certificate		
Do you want to trus	this certificate?	
	CANCEL SAV	E & ADD MORE ADD

In cases where it is preferred to use ONTAP storage to protect the VCF management VM's vMotion can be use to migrate the VM's to the newly created iSCSI datastore.

Complete the following steps to migrate the VCF management VM's to the iSCSI datastore.

- 1. From the vSphere Client navigate to the management domain cluster and click on the VMs tab.
- 2. Select the VMs to be migrated to the iSCSI datastore, right click and select Migrate...

\equiv vSphere Client $$ Q Search in all environments					C
 ✓ (C+m01-vc01.sddc.netapp.com) ✓ (C+m01-vc01.sddc.netapp.com) ✓ (C+m01-dc01) ✓ (C+m01-dc01) 	Image: Construction of the second	Permissions Hosts VM vApps	s Datastores Netwo	orks Updates	
 vcf-m01-esx01.sddc.netapp.com vcf-m01-esx02.sddc.netapp.com vcf-m01-esx03.sddc.netapp.com 	Name If the sector points	↑ State Status Powered O ✓ Norm	Provisioned Space al 616.52 GB	Used Space Host CPU 97.88 GB 5 GHz	Host Mem 31.63 GB
。 vcf-m01-esx04.sddc.netapp.com ぴ vcf-m01-nsx01a ぴ vcf-m01-otv9	Image: Construction Image: Construction Image: Construction Image: Construction Image: Construction Image: Construction Image: Construction Image: Construction	> Norm	al 106.33 GB al 1.79 TB	19.33 GB 2.52 GHz 237.82 GB 344 MHz	6.77 GB 15.98 GB
ጬ vcf-m01-sddcm01 ጬ vcf-m01-vc01 ጬ vcf-w01-nsx01	✓ III IIII IIIII ✓ IIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIII	> Norm	al 1.16 TB al 600.35 GB	143.81 GB 757 MHz 90.61 GB 7.99 GHz	13.98 GB 48.11 GB
	W # 60 vcf-wc VM Ves	> Norm	al 600.39 GB	94.6 GB 6.06 GHz	48.1 GB
vcf-wkld-vc01 S Vcf-wkld-vc01.sddc.netapp.com	Template	> Norm	al 600.45 GB al 1.82 TB	95.14 GB 7.16 GHz 126.69 GB 780 MHz	48.14 GB 28.02 GB

3. In the **Virtual Machines - Migrate** wizard, select **Change storage only** as the migration type and click on **Next** to continue.



4. On the Select storage page, select the iSCSi datastore and select Next to continue.

	5						
Migrate	Select the destination storage	e for the virtual mach	ine migration.				
	BATCH CONFIGURE CONF	IGURE PER DISK					
1 Select a migration type	Select virtual disk format	Same format as sour	ce 🗸				
	VM Storage Policy	Datastore Defaul	t 🛩				
2 Select storage	Disable Storage DRS for this	s virtual machine					
3 Ready to complete	Name	T	itorage Compatibility T	Capacity Y	Provisioned T	Free	T T
	🥌 🗐 mgmt_01_iscsi	-	-	З ТВ	1.46 GB	З ТВ	Ń
	O 🛢 vcf-m01-cl01-ds-vs	an01 -	2	999.97 GB	7.28 TB	52,38 GB	V
	<						>
	Manage Columns				ltems per p	age 10 V	2 item
	Compatibility						
	Compatibility	reeded					
	Compatibility	cceeded.					
	Compatibility	cceeded.					
	Compatibility	cceeded.					
	Compatibility	ceeded.					
	Compatibility	cceeded.					

- 5. Review the selections and click on **Finish** to start the migration.
- 6. The relocation status can be viewed from the **Recent Tasks** pane.

		The fast of the first field of t					6	
Task N	Name 1	Target	Ŧ	Status		٣	Details	т
Reloc	ate virtual machine	团 <u>vcf-w01-ns</u>	<u>×03</u>		38%	8	Migrating Virtual M ve state	achine acti
Reloc	ate virtual machine	vcf-wkld-vo	<u>c01</u>		42%	8	Migrating Virtual M ve state	achine acti
Reloc	ate virtual machine	<u>vcf-m01-ot</u> ر	<u>v9</u>		36%	8	Migrating Virtual M ve state	achine acti
Reloc	ate virtual machine	🗇 <u>vcf-m01-ns</u>	x01a	1	49%	8	Migrating Virtual M ve state	achine acti
Reloc	ate virtual machine	<u>vcf-w01-ns</u> ر	x02		47%	8	Migrating Virtual M ve state	achine acti
Reloc	ate virtual machine	<u>vcf-m01-sd</u>	dcm01		39%	8	Migrating Virtual M ve state	achine acti
Reloc	ate virtual machine	团 <u>vcf-w01-ns</u>	<u>×01</u>		42%	8	Migrating Virtual M ve state	achine acti
Reloc	ate virtual machine	@ <u>vcf-m01-vc</u>	01		44%	8	Migrating Virtual M ve state	achine acti

Additional information

For information on configuring ONTAP storage systems refer to the ONTAP 9 Documentation center.

For information on configuring VCF refer to VMware Cloud Foundation Documentation.

Video demo for this solution

iSCSI Datastores as Supplemental Storage for VCF Management Domains

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

In this scenario we will demonstrate how to deploy and use ONTAP Tools for VMware vSphere to configure a **vVols datastore** for a VCF workload domain.

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

Author: Josh Powell

Scenario Overview

This scenario covers the following high level steps:

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

Prerequisites

This scenario requires the following components and configurations:

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

NetApp recommends fully redundant network designs for iSCSI. The following diagram illustrates an example of a redundant configuration, providing fault tolerance for storage systems, switches, networks adapters and host systems. Refer to the NetApp SAN configuration reference for additional information.



NetApp ASA controller-1

NetApp ASA controller-2

For multipathing and failover across multiple paths, NetApp recommends having a minimum of two LIFs per storage node in separate ethernet networks for all SVMs in iSCSI configurations.

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



In situations where multiple VMkernel adapters are configured on the same IP network, it is recommended to use software iSCSI port binding on the ESXi hosts to ensure that load balancing across the adapters occurs. Refer to KB article Considerations for using software iSCSI port binding in ESX/ESXi (2038869).

For additional information on using VMFS iSCSI datastores with VMware refer to vSphere VMFS Datastore - iSCSI Storage backend with ONTAP.

Deployment Steps

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

Create SVM and LIFs on ONTAP storage system

The following step is performed in ONTAP System Manager.

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

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

ONTAP System Manager				
DASHBOARD	Storage VMs			
INSIGHTS	+ Add			
STORAGE ^	Name			
Overview	EHC_ISCSI			
Volumes	FHC			
LUNS				
Consistency Groups	HMC_187			
NVMe Namespaces	HMC_3510			
Shares	HMC_iSCSI_3510			
Buckets				
Qtrees	infra_svm_a300			
Quotas	JS_EHC_iSCSI			
Storage VMs	OTVtest			
Tiers				

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

SVM_ISCSI			
PSPACE			
Default		~	
Access Protoco	ol		

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



For multipathing and failover across multiple paths, NetApp recommends having a minimum of two LIFs per storage node in separate Ethernet networks for all SVMs in iSCSI configurations.

	E		
ntaphci-a300-01			
IP ADDRESS	SUBNET MASK	GATEWAY	BROADCAST DOMAIN AND PORT
172.21.118.179	24	Add optional gateway	NFS_ISCSI V
✓ Use the same su	bnet mask, gateway, and bro	oadcast domain for all of the fo	llowing interfaces
IP ADDRESS	PORT		
172.21.119.179	a0a-3375 🗸		
IP ADDRESS 172.21.118.180	PORT a0a-3374		
172.21.118.180	a0a-3374 💙		
IP ADDRESS	PORT		
172.21.119.180	a0a-3375 💙		
hoose whether to ena nd click on Save to cr	able the Storage VM A reate the SVM. Administratio	Administration account (for multi-tenancy environmen
Manage adminis	strator account		

Set up networking for iSCSI on ESXi hosts

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

Complete the following to create a new distributed port group for each iSCSI network:

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

	< _ vc	f-wkld-01-IT-INF-WK	LD-01-Vds-01
() B = Ø	Summa	ry Monitor Configure	Permissions Ports Host
 vcf-m01-vc01.sddc.netapp.com iii vcf-m01-dc01 vcf-wkld-vc01.sddc.netapp.com vcf-wkld-01-DC 	Swit	tch Details	
vcf-wkld-01-IT-INF-WKLD-01-vds-01		Manufacturer	VMware, Inc.
Crewide Contraction - vcf-w WKLD-01-vcf-w WKLD-01-vcs-	/kld-01-IT-INF-	Networks	3
vcf-wkld-01-IT-INF- Distributed	Port Group		4
> wcf-wkld-01-IT-INF-W Edit Notes.	anage Hosts Imj 	w Distributed Port Group port Distributed Port Group nage Distributed Port Groups	1 21
Upgrade Settings	>		

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

New Distributed Port	Configure settings		×
Group	Set general properties of the new port	t group.	
1 Name and location	Port binding	Static binding ~	
2 Configure settings	Port allocation	Elastic 🗸 🛈	
3 Ready to complete	Number of ports	8	0
1	Network resource pool	(default) ~	
	VLAN		
	VLAN type	VLAN ~	
	VLAN ID	3374	0
	Advanced		
	Customize default policies configurat	tion	
			CANCEL BACK NEXT
4. On the D eady to complet		e and click on Finish to	avante the mous
distributed port group.	e page, review the change	s and click on Finish to	create the new
5. Repeat this process to cre ensure you have input the	ate a distributed port group correct VLAN ID .	o for the second iSCSI n	etwork being used and
6. Once both port groups hav settings	ve been created, navigate t	o the first port group an	d select the action to Edit

	< 🗥 vcf	-wkld-01-i	iscsi-a	ACTIONS	
(]) ₱	Summary	Monitor	Configure	Permissions	Ports H
 vcf-m01-vc01.sddc.netapp.com vcf-m01-dc01 vcf-wkld-vc01.sddc.netapp.com vcf-wkld-01-DC 	Distri	buted Port	Group Deta	ails	vinding
vcf-wkld-01-IT-INF-WKLD-01-vds-01	A	2 Po	rt allocation	Flastic	
vcf-wkld-01-iscsi-a vcf-wkld-01-i		VL	AN ID	3374	
🗟 vcf-wkld-01-1 🛞 Edit Settings		Dis	tributed switch	WKLD-	wkld-01-IT-INF- 01-vds-01
Configuration		Ne	twork protocol	-	

7. On **Distributed Port Group - Edit Settings** page, navigate to **Teaming and failover** in the left-hand menu and click on **uplink2** to move it down to **Unused uplinks**.

Distributed Port Group	o - Edit Settings vcf-wkld-01-isc	:si-a	×
General	Load balancing	Route based on originating virtual por $ \sim $	
Advanced	Network failure detection	Link status only $$	
Security	Notify switches	Yes v	
Traffic shaping Teaming and failover	Failback	Yes ~	
Monitoring Miscellaneous	Failover order () MOVE UP MOVE DOWN Active uplinks uplink1 Standby uplinks Unused uplink2		

8. Repeat this step for the second iSCSI port group. However, this time move **uplink1** down to **Unused uplinks**.



General	Load balancing	Route based on originating virtual po
Advanced	Network failure detection	Link status only 🔗
VLAN		Section Augentines and all
Security	Notify switches	Yes 🗸
Traffic shaping	Failback	Yes 🗸
Teaming and failover		
Monitoring	Failover order (1)	
Miscellaneous	MOVE UP MOVEOWN	
	C uplink2	
	Standby uplinks	
	Unused uplinks	
	🗔 uplink1	

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

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

□ ₽ ≘ ◊	Summary Monito	x01.sddc	netapp	COM : AG	Datastores Networks Updates
 Vef-m01-vc01.sddc.netapp.com vcf-m01-dc01 vcf-m01-cl01 vcf-wkld-vc01.sddc.netapp.com 	Storage Storage Adapters Storage Devices	~ ^		nel adapte	rs Refresh
 Wcf-wkld-01-DC 	Host Cache Configu Protocol Endpoints I/O Filters	iration	÷ »	wmk0	Network Label T
vcf-wkld-esx02.sddc.netapp.com	Networking	~	: »	😇 vmk1	A vcf-wkld-01-IT-INF-WKLD-01-vd s-01-pg-vmotion
vcf-wkld-esx03.sddc.netapp.com	Virtual switches VMkernel adapters		i »	🖭 vmk2	A vcf-wkld-01-IT-INF-WKLD-01-vd s-01-pg-nfs
₿ vcf-w01-otv9	Physical adapters TCP/IP configuratio	ñ	: »	🕮 vmk10	論

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

Add Networking	Select connection type	×
	Select a connection type to create.	
1 Select connection type		
	VMkernel Network Adapter	
2 Select target device	The VMkernel TCP/IP stack handles traffic for ESXi services such as vSphere vMotion, iSCSI, NFS, FCoE, Fault	
	Tolerance, vSAN, host management and etc.	
3 Port properties		
	Virtual Machine Port Group for a Standard Switch	
4 IPv4 settings	A port group handles the virtual machine traffic on standard switch.	
5 Ready to complete	Physical Network Adapter	
	A physical network adapter handles the network traffic to other hosts on the network.	

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

Add Networking	Sciect target device		
	Select a target device for the new connection.		
1 Select connection type	 Select an existing network 		
2 Select target device	Select an existing standard switch		
3 Port properties	Quick Filter Enter value		
4 IPv4 settings	Name	NSX Port Group ID	Distributed Switch
	🕒 🙈 vcf-wkld-01-iscsi-a	<u>22</u> 27	vcf-wkld-01-IT-INF-WKLD-01-vds-0
5 Ready to complete	O kvcf-wkld-01-iscsi-b	e 0	vcf-wkld-01-IT-INF-WKLD-01-vds-0
	O & vcf-wkld-01-IT-INF-WKLD-01-vds-01-pg-mgmt	<u>जल</u> ी ी	vcf-wkld-01-IT-INF-WKLD-01-vds-0
	O Kcf-wkid-01-IT-INF-WKLD-01-vds-01-pg-nfs	<u>20</u> 3	vcf-wkld-01-IT-INF-WKLD-01-vds-0
	C & vcf-wkld-01-IT-INF-WKLD-01-vds-01-pg-vmotio	n —	vcf-wkld-01-IT-INF-WKLD-01-vds-
	Manage Columns		5 ite
			CANCEL BACK NE
			CANCEL BACK NE

4. On the **Port properties** page keep the defaults and click on **Next** to continue.

Add Networking	Port properties			
	Specify VMkernel port sett	ings.		
1 Select connection type	Network label	vcf-wkld-01-iscsi-a (vcf-wkl	d-01-IT-INF-WKLD-01-vds-01)	
2 Select target device	MTU	Get MTU from switch $ \checkmark $	9000	
3 Port properties	TCP/IP stack	_Default ~		
4 IPv4 settings	Available services			
	Enabled services	VMotion	vSphere Replication NFC	NVMe over RDMA
5 Ready to complete		Provisioning	VSAN	
		Fault Tolerance logging	VSAN Witness	
		Management	VSphere Backup NFC	
		VSphere Replication	NVMe over TCP	

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

Add Networking	IPv4 settings		×
1 Select connection type	Specify VMkernel IPv4 setting Obtain IPv4 settings auto Use static IPv4 settings	is. matically	
3 Port properties	IPv4 address	172.21.118.127	
4 IPv4 settings 5 Ready to complete	Subnet mask Default gateway	Override default gateway for this adapter	
		172.21.166.1	
	DNS server addresses	10.61.185.231	

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

Add Networking	Ready to comple	te	
	Review your selections bef	ore finishing the wizard	
1 Select connection type	✓ Select target device		
2 Select target device	Distributed port group	vcf-wkld-01-iscsi-a	
3 Port properties	Distributed switch	vcf-wkld-01-IT-INF-WKLD-01-vds-01	
	✓ Port properties		
4 IPv4 settings	New port group	vcf-wkld-01-iscsi-a (vcf-wkld-01-IT-INF-WKLD-01-vds-01)	
	MTU	9000	
5 Ready to complete	vMotion	Disabled	
	Provisioning	Disabled	
	Fault Tolerance logging	Disabled	
	Management	Disabled	
	vSphere Replication	Disabled	
	vSphere Replication NFC	Disabled	
	VSAN	Disabled	
	vSAN Witness	Disabled	
	vSphere Backup NFC	Disabled	
	NVMe over TCP	Disabled	
	NVMe over RDMA	Disabled	
	✓ IPv4 settings		
	IPv4 address	172.21.118.127 (static)	
	Subnet mask	255.255.255.0	
		CANCEL BACK	FINIS

7. Repeat this process to create a VMkernel adapter for the second iSCSI network.

Deploy and use ONTAP Tools to configure storage

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

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

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

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

Complete the following to Deploy ONTAP tools for VMware vSphere:

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

	< 🗊 vcf-r	n01-cl01
() ē e o	Summary	Monitor
 vcf-m01-vc01.sddc.netap vcf-m01-dc01 vcf-m01-cl01 	p.com Cluster	Details
 vcf-m01-esx vcf-m01-esx vcf-m01-esx vcf-m01-esx vcf-m01-esx vcf-m01-esx vcf-m01-nsx] Actions - vcf-m01-cl01 Add Hosts New Virtual Machine New Resource Pool	Total Total Migra Fault
🕃 vcf-m01-sdc	😚 Deploy OVF Template	<u>B</u>
🔂 vcf-m01-vcC		

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



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

Deploy OVF Template	Sele	ect storage						>
	Select	the storage for the co	nfiguration and dis	k files				
1 Select an OVF template	End Coloct	crypt this virtual machine	As defined in the	VM storage policy				
2 Select a name and folder	VM Ste	orage Policy able Storage DRS for thi	Datastore Def	ault ~				
3 Select a compute resource		Name	т	Storage	Capacity T	Provisioned T	Free T	т^
4 Review details		vcf-m01-cl01-ds-vs	anO1	- Compatibility	999.97 GB	7.17 TB	225.72 GB	v
5 License agreements	0	vcf-m01-esx01-esx	install-datastore		25.75 GB	4.56 GB	21.19 GB	v
	0	vcf-m01-esx02-esx	-install-datastore	.e.	25.75 GB	4.56 GB	21.19 GB	V
6 Select storage	0	vcf-m01-esx03-esx	-install-datastore	æ	25.75 GB	4.56 GB	21.19 GB	~
7 Select networks	0	vcf-m01-esx04-es>	-install-datastore		25.75 GB	4.56 GB	21.19 GB	v
8 Customize template	<						10	``
9 Ready to complete	Mar	age columns				items per pa	age 10 ~	o items

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

Deploy OVF Template	Select networks		×
1	Select a destination network for each	source network.	
1 Select an OVF template			^
2. Calent a same and falder	Source Network	Destination Network	
2. Select a name and rolder	nat	vcf-m01-cl01-vds01-pg-vsan	~
3 Select a compute resource	Manage Columns	vcf-m01-cl01-vds01-pg-vsan	1 item
		SDDC-DPortGroup-VM-Mgmt	
4 Review details	IP Allocation Settings	Browse	
5 License agreements	IP allocation:	Static - Manual	
3 License agreements	IP protocol:	IPv4 ~	
6 Select storage			
7 Select networks			

- 8. On the Customize template page fill out all required information:
 - Password to be used for administrative access to ONTAP Tools.
 - NTP server IP address.
 - ONTAP Tools maintenance account password.
 - ONTAP Tools Derby DB password.
 - Do not check the box to Enable VMware Cloud Foundation (VCF). VCF mode is not required for deploying supplemental storage.
 - FQDN or IP address of the vCenter appliance for the VI Workload Domain
 - Credentials for the vCenter appliance of the VI Workload Domain
 - Provide the required network properties fields.

Click on **Next** to continue.

	Customize the deployment properties of	This software solution.		
1 Select an OVF template	2 properties have invalid values			
2 Select a name and folder	✓ System Configuration	4 settings		
3 Select a compute resource	Application User Password (*)	Password to assign to	o the administrator accou	int.For security
4 Review details		thirty characters and	contains a minimum of or	ne upper, one low
5 License agreements		Password		0
6 Select storage		143511014		
7 Select networks		Confirm Password		0
8 Customize template	NTP Servers	A comma-separated	list of hostnames or IP ad	dresses of NTP
9 Pearly to complete	a land i shart shart shart sh	Servers. If left blank,	VMware	od.
5 Ready to complete		172.21.166.1		
	Maintenance User Password (*)	Password to assign to	o maint user account.	
		Password		۵
		Confirm Descurated	[]	
		Confirm Password	*******	
eploy OVF Template	Customize template	u settings	r details are innered who	n VCE is onabled
eploy OVF Template 1 Select an OVF template	Customize template Compose venter of Enable Venter Enable VMware Cloud Foundation (VCF) vCenter server and use	er details are ignored whe	n VCF is enabled.
eploy OVF Template 1 Select an OVF template 2 Select a name and folder	Customize template Customize template Enable VMware Cloud Foundation (VCF vCenter Server Address (*)) vCenter server and use Specify the IP address, to.	er details are ignored whe /hostname of an existing v	n VCF is enabled. vCenter to registe
eploy OVF Template 1 Select an OVF template 2 Select a name and folder 3 Select a compute resource	Customize template	vCenter server and use vCenter server and use Specify the IP address, to. cf-wkld-vc01.sddc.net	er details are ignored whe /hostname of an existing app.com	n VCF is enabled. vCenter to registe
eploy OVF Template 1 Select an OVF template 2 Select a name and folder 3 Select a compute resource 4 Review details	Customize template	Specify the IP address, to. Specify the HTTPS por 443	er details are ignored whe /hostname of an existing of app.com	en VCF is enabled. vCenter to registe o register to.
eploy OVF Template 1 Select an OVF template 2 Select a name and folder 3 Select a compute resource 4 Review details 5 License agreements	Customize template	vCenter server and use vCenter server and use Specify the IP address, to, cf-wkld-vc01.sddc.net Specify the HTTPS por 443 Specify the username e	er details are ignored whe /hostname of an existing of app.com t of an existing vCenter to of an existing vCenter to r	en VCF is enabled. vCenter to registe o register to. register to.
eploy OVF Template 1 Select an OVF template 2 Select a name and folder 3 Select a compute resource 4 Review details 5 License agreements 6 Select storage	Customize template	VCenter server and use VCenter server and use Specify the IP address, to, cf-wkkd-vc01.sddc.net Specify the HTTPS por 443 Specify the username e administrator@vspher Specify the parsword	Ar details are ignored whe Anostname of an existing of app.com t of an existing vCenter to of an existing vCenter to r re.local of an existing vCenter to r	en VCF is enabled. vCenter to registe o register to. register to.
eploy OVF Template 1 Select an OVF template 2 Select a name and folder 3 Select a compute resource 4 Review details 5 License agreements 6 Select storage 7 Select networks	Customize template	VCenter server and use VCenter server and use Specify the IP address, to, cf-wkld-vc01.sddc.net Specify the HTTPS por 443 Specify the username administrator@vspher Specify the password	Ar details are ignored when app.com	en VCF is enabled. vCenter to registe o register to. register to.
eploy OVF Template 1 Select an OVF template 2 Select a name and folder 3 Select a compute resource 4 Review details 5 License agreements 6 Select storage 7 Select networks 8 Customize template	Customize template	> vCenter server and use > Specify the IP address, to. cf-wkld-vc01.sddc.net Specify the HTTPS por 443 Specify the username e administrator@vspher Specify the password	er details are ignored whe /hostname of an existing a app.com t of an existing vCenter to r com of an existing vCenter to r re.local of an existing vCenter to r	en VCF is enabled. vCenter to registe o register to. register to. register to.
Perploy OVF Template 1 Select an OVF template 2 Select a name and folder 3 Select a compute resource 4 Review details 5 License agreements 6 Select storage 7 Select networks 8 Customize template 9 Ready to complete	Customize template	> vCenter server and use > Specify the IP address, to. cf-wkld-vc01.sddc.net Specify the HTTPS por 443 Specify the username e administrator@vspher Specify the password Password Confirm Password	er details are ignored whe	en VCF is enabled. vCenter to registe o register to. register to. @
 Perploy OVF Template 1 Select an OVF template 2 Select a name and folder 3 Select a compute resource 4 Review details 5 License agreements 6 Select storage 7 Select networks 8 Customize template 9 Ready to complete 	Customize template	Confirm Password VCenter server and use Confirm Password Confirm Password	er details are ignored whe /hostname of an existing of app.com t of an existing vCenter to of an existing vCenter to r e.local of an existing vCenter to r	en VCF is enabled. vCenter to register to register to. register to. (0)
 Peeploy OVF Template 1 Select an OVF template 2 Select a name and folder 3 Select a compute resource 4 Review details 5 License agreements 6 Select storage 7 Select networks 8 Customize template 9 Ready to complete 	Customize template Complete Center of Enable VC Enable VMware Cloud Foundation (VCF vCenter Server Address (*) Port (*) Username (*) Password (*) Vetwork Properties Host Name	Confirm Password Specify the bostname Specify the password	er details are ignored whe	en VCF is enabled. vCenter to register to register to. register to. (0) (0) (0) (0) (0) (0) (0) (0)
eploy OVF Template 1 Select an OVF template 2 Select a name and folder 3 Select a compute resource 4 Review details 5 License agreements 6 Select storage 7 Select networks 8 Customize template 9 Ready to complete	Customize template	> Settings) vCenter server and use	er details are ignored whe /hostname of an existing of app.com t of an existing vCenter to of an existing vCenter to r re.local of an existing vCenter to r e	en VCF is enabled. vCenter to register o register to. register to. () () () () () () () () () ()
eploy OVF Template 1 Select an OVF template 2 Select a name and folder 3 Select a compute resource 4 Review details 5 License agreements 6 Select storage 7 Select networks 8 Customize template 9 Ready to complete	Customize template	0 Settings 0 vCenter server and use 0 Specify the IP address, to, cf-wkld-vc01.sddc.net Specify the HTTPS por 443 Specify the HTTPS por 443 Specify the username - administrator@vsphei Specify the password Specify the password Confirm Password Specify the hostname - desired) vcf-w01-otv9 Specify the IP address desired) Specify the IP address	er details are ignored whe /hostname of an existing of app.com t of an existing vCenter to of an existing vCenter to r e.local of an existing vCenter to r for the appliance. (Leave l for the appliance. (Leave l	en VCF is enabled. vCenter to register o register to. register to. () () () () blank if DHCP is blank if DHCP is

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

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



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

vSphere Client Q Search in all environments NetApp ONTAP tools INSTANCE 172.21.166.139:8443 ~ **Plugin Instance** Version vCenter Server Overview 172.21.166.139:8443 9.13.0.36905 vcf-m01-vc01.sddc.netapp.com Storage Systems 172.21.166.149:8443 9.13.0.36905 vcf-wkld-vcO1.sddc.netapp.com Storage capability pr provide Storage Mapping Settings

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

\equiv vSphere Client C	${f \lambda}$ Search in all environments
NetApp ONTAP tools INST	ANCE 172.21.166.149:8443 ~
Overview	Storage Systems
Storage Systems	ADD REDISCOVER ALL
Storage capability profile	

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



vVol requires ONTAP cluster credentials rather than SVM credentials. For more information refer to Add storage systems In the ONTAP Tools documentation.

Add Storage System

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

vCenter server	vcf-m01-vc01.sddc.netapp.com ~
Name or IP address:	172.16.9.25
Username:	admin
Password:	•••••
Port:	443
Advanced options 🔨	
ONTAP Cluster Certificate:	• Automatically fetch 🦳 Manually upload
	CANCEL SAVE & ADD MORE ADD

Storage capability profiles describe the features provided by a storage array or storage system. They include quality of service definitions and are used to select storage systems that meet the parameters defined in the profile. One of the provided profiles can be used or new ones can be created.

To create a storage capability profile in ONTAP Tools complete the following steps:

1. In ONTAP Tools select **Storage capability profile** from the left-hand menu and then press **Create**.

\equiv vSphere Client C	Search in all environments
NetApp ONTAP tools INSTA	ANCE 172.21.166.149:8443 ~
Overview	Storage Capability Profiles
Storage Systems	CREATE
Storage capability profile	Name

2. In the **Create Storage Capability profile** wizard provide a name and description of the profile and click on **Next**.

Create Storage Capability Profile	General	
	Specify a name an	nd description for the storage capability profile. 🔊
1 General		
2 Platform	Name:	Gold_ASA_ISCSI
3 Protocol	Description:	
4 Performance		
5 Storage attributes		
6 Summary		

3. Select the platform type and to specify the storage system is to be an All-Flash SAN Array set **Asymmetric** to false.

Create Storage	Platform			
	Platform:	Performance		~
1 General	Asymmetric:			
2 Platform				
3 Protocol				
4 Performance				
5 Storage attributes				
6 Summary			CANCEL	BACK

4. Next, select choice of protocol or **Any** to allow all possible protocols. Click **Next** to continue.

Create Storage Capability Profile	Protocol			
apability rionic	Protocol:	Any	~	
1 General		Any		
2 Platform		FCP iSCSI NVMe/FC		
3 Protocol				
4 Performance				
5 Storage attributes				
6 Summary			CANCEL BACK	NE

5. The **performance** page allows setting of quality of service in form of minimum and maximum IOPs allowed.

Create Storage Capability Profile	Performance					
	None (j					
1 General	• QoS policy group	٩				
2 Platform	Min IOPS:			_		
3 Protocol	Max IOPS:	6000		_		
4 Performance		Unlimited				
5 Storage attributes						
6 Summary			CANCEL	ВАСК	NEXT	

6. Complete the **storage attributes** page selecting storage efficiency, space reservation, encryption and any tiering policy as needed.

Create Storage Capability Profile	Storage attributes		
1 General	Deduplication:	Yes	<u>.</u>
2 Platform	Compression:	Yes	<u>~</u>
3 Protocol	Space reserve:	Thin	<u>~</u>
4 Performance	Encryption:	No	<u>~</u>
5 Storage attributes	Tiering policy (FabricPool):	None	<u>~</u>
6 Summary		CANCEL	BACK

7. Finally, review the summary and click on Finish to create the profile.



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

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

\equiv vSphere Client $$ Q	Search in all environments	
NetApp ONTAP tools INSTAI	NCE 172.21.166.149:8443 ×	
Overview	ONTAP tools for VMware vSphere	
Storage Systems	Getting Started Traditional Dashboard vVols Dashboard	
Storage capability profile Storage Mapping	ONTAP tools for VMware vSphere is a vCenter Server plug-in that provides er	nd-to-end lifecycle management for virtual machines in VMware env
Settings	E +	
 Reports Datastore Report 	Add Storage System	Provision Datastore
Virtual Machine Report		
vVols Datastore Report vVols Virtual Machine Report	Add storage systems to ONTAP tools for VMware vSphere.	Create traditional or vVols datastores.
Log Integrity Report	ADD	PROVISION

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

New Datastore	General		
1 General	Specify the details of the dataste	pre to provision.	
2 Storage system	Provisioning destination:	IT-INF-WKLD-01	BROWSE
3 Storage attributes	Туре:	○ NFS ○ VMFS ③ vVols	
4 Summary	Name:	VCF_WKLD_02_VVOLS	
	Description:		
		<i>li</i> ,	
	Protocol:	🔿 NFS 🧕 ISCSI 🔷 FC / FCoE 🔷 NVMe/FC	
			CANCEL

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

	Specify the storage capability pr	ofiles and the storage system you want to use.		
1 General				
2 Storage system	Storage capability profiles:	AFF_Encrypted_Min50_ASA_A	^	
		FAS_Default		
3 Storage attributes		FAS_Max20		
d.		Custom profiles		
4 Summary		A3A_000_3C3	×	
	Storage system:	ntaphci-a300e9u25 (172.16.9.25)	~	
	Storage VM:	VCF_ISCSI	~	

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

New Datastore 1 General 2 Storage system	Storage attrik Specify the storage de Volumes: • Creat	Dutes :tails for provisionin te new volumes (ng the datastore.) Select volumes		
3 Storage attributes	Name	▼ Size	Storage Capability	Profile A	ggregate
4 Summary			FlexVol volumes are no	t added.	
	Name	Size(GB) (j)	Storage capability profile	Aggregates	Space reserve
	f_wkld_02_vvols	3000	ASA_Gold_iSCSI ~	EHCAggr02 - (27053.3 GE	~ Thin
				CANCI	EL BACK NEXT

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

		Wols		
	Datastore type:	vvois		
1 General	Protocol:	ISCSI		
2 Storage system	Storage capability profile:	ASA_GOID_ISCSI		
3 Storage attributes	Storage system details			
	Storage system:	ntaphci-a300e9u25		
4 Summary	SVM:	VCF_iSCSI		
	New FlexVol Name	New FlexVol Size	Aggregate	Storage Capability Profile
	vcf_wkld_02_vvols	3000 GB	EHCAggr02	ASA_Gold_iSCSI
	Click 'Finish' to provision this dat	astore.		

Additional information

For information on configuring ONTAP storage systems refer to the ONTAP 9 Documentation center.

For information on configuring VCF refer to VMware Cloud Foundation Documentation.

Configure NVMe/TCP supplemental storage for VCF Workload Domains

In this scenario we will demonstrate how to configure NVMe/TCP supplemental storage for a VCF workload domain.

Author: Josh Powell

Scenario Overview

This scenario covers the following high level steps:

- Create a storage virtual machine (SVM) with logical interfaces (LIFs) for NVMe/TCP traffic.
- Create distributed port groups for iSCSI networks on the VI workload domain.
- · Create vmkernel adapters for iSCSI on the ESXi hosts for the VI workload domain.
- Add NVMe/TCP adapters on ESXi hosts.
- Deploy NVMe/TCP datastore.

Prerequisites

This scenario requires the following components and configurations:

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

NetApp recommends fully redundant network designs for NVMe/TCP. The following diagram illustrates an

example of a redundant configuration, providing fault tolerance for storage systems, switches, networks adapters and host systems. Refer to the NetApp SAN configuration reference for additional information.



NetApp ASA controller-1

NetApp ASA controller-2

For multipathing and failover across multiple paths, NetApp recommends having a minimum of two LIFs per storage node in separate ethernet networks for all SVMs in NVMe/TCP configurations.

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

For additional information on NVMe design considerations for ONTAP storage systems, refer to NVMe configuration, support and limitations.

Deployment Steps

To create a VMFS datastore on a VCF workload domain using NVMe/TCP, complete the following steps.

Create SVM, LIFs and NVMe Namespace on ONTAP storage system

The following step is performed in ONTAP System Manager.

Complete the following steps to create an SVM together with multiple LIFs for NVMe/TCP traffic.

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

■ ONTAP Sy	stem Manager	
DASHBOARD	Storage VMs	
INSIGHTS	+ Add	
STORAGE ^	Name	
Overview	EHC_iSCSI	
Volumes	FHC	
LUNS		
Consistency Groups	HMC_187	
NVMe Namespaces	HMC_3510	
Shares	HMC_ISCSI_3510	
Buckets		
Qtrees	infra_svm_a300	
Quotas	JS_EHC_iSCSI	
Storage VMs	OTVtest	
Tiers		

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

TORAGE VM NAME			
VCF_NVMe			
PSPACE			
Default		~	
SMB/CIFS, NFS, S3 iSCSI FC	🔗 NVMe		

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



For multipathing and failover across multiple paths, NetApp recommends having a minimum of two LIFs per storage node in separate Ethernet networks for all SVMs in NVMe/TCP configurations.

ALL COLLEGE AND ADD ADD			BROADCACT DOLLARS AND DOOT	
IP ADDRESS	SUBNET MASK	GATEWAY	BROADCAST DOMAIN AND PORT	
172.21.118.189	24	Add optional gateway	NFS_iSCSI	~
🗹 Use the same	subnet mask, gateway, and l	broadcast domain for all of the follow	ving interfaces	
IP ADDRESS	PORT			
172.21.119.189	a0a-3375	~		
ntaphci-a300-	02			
IP ADDRESS	PORT			
172.21.118.190	a0a-3374	~		
IP ADDRESS	PORT			
172.21.119.190	a0a-3375	~		
Storage VM Admir	nistration			
Manage administrator acc	el			
Storage VI	M Administration			
------------	--------------------	--		
Manage adm	inistrator account			
Save	Cancel			

NVMe namespaces are analogous to LUNs for iSCSi or FC. The NVMe Namespace must be created before a VMFS datastore can be deployed from the vSphere Client. To create the NVMe namespace, the NVMe Qualified Name (NQN) must first be obtained from each ESXi host in the cluster. The NQN is used by ONTAP to provide access control for the namespace.

Complete the following steps to create an NVMe Namespace:

1. Open an SSH session with an ESXi host in the cluster to obtain its NQN. Use the following command from the CLI:

```
esxcli nvme info get
```

An output similar to the following should be displayed:

```
Host NQN: nqn.2014-08.com.netapp.sddc:nvme:vcf-wkld-esx01
```

- 2. Record the NQN for each ESXi host in the cluster
- 3. From ONTAP System Manager navigate to **NVMe Namespaces** in the left-hand menu and click on **+ Add** to start.

■ ONTAP Sy	ONTAP System Manager		
DASHBOARD	NVMe Namespaces		
INSIGHTS	+ ^ 1d		
STORAGE ^	Namespace Path		
Overview			
Volumes			
LUNS			
Consistency Groups			
NVMe Namespaces			
Shares			

4. On the **Add NVMe Namespace** page, fill in a name prefix, the number of namespaces to create, the size of the namespace, and the host operating system that will be accessing the namespace. In the

Host NQN section create a comma separated list of the NQN's previously collected from the ESXi hosts that will be accessing the namespaces.

Click on **More Options** to configure additional items such as the snapshot protection policy. Finally, click on **Save** to create the NVMe Namespace.



Set up networking and NVMe software adapters on ESXi hosts

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

Complete the following to create a new distributed port group for each NVMe/TCP network:

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

vSphere Client Q Search	h in all environments	<	wkld-01-IT-INF-WKL	D-01-vds-01 : ACTION
() Þ = <u>Ø</u>		Summary	Monitor Configure	Permissions Ports Hosts
 vcf-m01-vc01.sddc.netapp.com iii vcf-m01-dc01 vcf-wkld-vc01.sddc.netapp.com vcf-wkld-01-DC 	5 m	Switch	Details	
vcf-wkld-01-IT-INF-WkLD	-01-vds-01		Manufacturer	VMware, Inc.
🗒 vcf-wkld-01-IT-I-DV 🖾	Actions - vcf-wkld-01-IT-INF- WKLD-01-vds-01		Networks	3.0.0
vcf-wkld-01-IT-INF-	Distributed Port Group	>	(114)	4
> cf-wkld-01-IT-INF-W	Add and Manage Hosts Edit Notes	Impor	t Distinguted Port Group t Distinged Port Group ge Distributed Port Groups	1 21
	Settings	>		

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

New Distributed Port Group	Configure settings Set general properties of the new port group		
1 Name and location	Port binding	Static binding ~	
2 Configure settings	Port allocation	Elastic 🗸 🛈	
3 Ready to complete	Number of ports	8 🗘	
	Network resource pool	(default) ~	
	VLAN		
	VLAN type	VLAN ~	
	VLAN ID	3374	
	Advanced		
	Customize default policies configuration		
		CANCEL BACK	

- 4. On the **Ready to complete** page, review the changes and click on **Finish** to create the new distributed port group.
- 5. Repeat this process to create a distributed port group for the second NVMe/TCP network being used and ensure you have input the correct **VLAN ID**.
- 6. Once both port groups have been created, navigate to the first port group and select the action to **Edit settings...**.

<	vcf-wkld-0	01-nvme-a 🛛 🗄 🗛	CTIONS
() ð e Ø	Summary Moni	tor Configure Pe	ermission
> 😨 vcf-m01-vc01.sddc.netapp.com	1		
 vcf-wkld-vc01.sddc.netapp.com 	Distributed P	ort Group Details	
vcf-wkld-01-DC	-		
vcf-wkld-01-IT-INF-WKLD-01-vds-01	0		72,073
🖉 vcf-wkld-01-iscsi-a		Port binding	Stat
💮 vcf-wkld-01-iscsi-b	12T	Port allocation	Elas
vcf-wkld-01-IT-I-DVUplinks-10		VLAN ID	3374
vcf-wkld-01-IT-INF-WKLD-01-vds-01-pg-mgmt		Distributed switch	
A vcf-wkld-01-IT-INF-WKLD-01-vds-01-pg-vmotion			WKL
		Network protocol profile	
Actions - vcf-wkld-01-nv (A) Actions - vcf-wkld-01-nvme-a		Network resource	722
✓		pool	
vcf-wkld-01-IT		Hosts	4
A vcf-wkld-01-IT Ex Configuration		Virtual machines	0
Restore Configuration			

7. On **Distributed Port Group - Edit Settings** page, navigate to **Teaming and failover** in the left-hand menu and click on **uplink2** to move it down to **Unused uplinks**.

Distributed Port Group - Edit Settings | vcf-wkld-01-nvme-a

General	Load balancing	Route based on originating virtual por $^{\vee}$			
Advanced					
VLAN	Network failure detection	Link status only 💛			
Security	Notify switches	Yes 🗸			
Traffic shaping	Failback	Yes ~			
Teaming and failover					
Monitoring	Failover order (i)				
Miscellaneous	MOVE UP MOVE BOWN				
	Active uplinks				
	🗔 uplink1				
	Standby uplinks				
	Unused uplinks				
	C uplink2				
		<u>,</u>			

8. Repeat this step for the second NVMe/TCP port group. However, this time move **uplink1** down to

Distributed Port	Group - Edit Settings vcf-wk	ld-01-nvme-b
General	Load balancing	Route based on originating virtual por $^{\sim}$
Advanced		ys <u>terne a transformation and the second sec</u>
VLAN	Network failure detection	Link status only $$
Security	Notify switches	Yes 🗸
Traffic shaping	Failback	Vec V
Teaming and failover		
Monitoring	Failover order (1)	
Miscellaneous	MOVE UP MOVE DOWN	
	Active uplinks	
	uplink2	
	Standby uplinks	
	Unused uplinks	
	C uplink1	

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

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

Ξ vSphere Client ${\sf Q}$ Search in all environments					
₽ ≘ ♀	 Vcf-wkld-es Summary Monitor 	Configur	.netapp • Permi	.COM	Datastores Networks Updates
 	vc01.sddc.netapp.com storage v VMkernel adapters 01-dc01 Storage Adapters f-m01-cl01 Storage Devices vc01.sddc.netapp.com REFRESH	rs Refresh			
 vcf-wkld-01-DC IT-INF-WKLD-01 vcf-wkld-esx01.sddc.netapp.com 	Host Cache Configu Protocol Endpoints I/O Filters	ration	i »	wmk0	r Network Label T & vcf-wkid-01-IT-INF-WKLD-01-vd s-01-pg-mgmt
vcf-wkld-esx02.sddc.netapp.com	Networking	~	: »	🖭 vmk1	協 vcf-wkld-01-IT-INF-WKLD-01-vd s-01-pg-vmotion
vcf-wkld-esx03.sddc.netapp.com	VMkernel adapters		i »	🖭 vmk2	
₿ vcf-w01-otv9	Physical adapters TCP/IP configuratio	n	: »	🚥 vmk10	論

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

Add Networking	Select connection type	×
	Select a connection type to create.	
1 Select connection type		
	VMkernel Network Adapter	
2 Select target device	The VMkernel TCP/IP stack handles traffic for ESXi services such as vSphere vMotion, iSCSI, NFS, FCoE, Fault	
	Tolerance, vSAN, host management and etc.	
3 Port properties		
	Virtual Machine Port Group for a Standard Switch	
4 IPv4 settings	A port group handles the virtual machine traffic on standard switch.	
5 Ready to complete	Physical Network Adapter	
	A physical network adapter handles the network traffic to other hosts on the network.	

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



4. On the **Port properties** page click the box for **NVMe over TCP** and click on **Next** to continue.

Add Networking	Port properties			
1	Specify VMkernel port sett	ings.		
1 Select connection type	Network label	vcf-wkld-01-nvme-a (vcf-w	kld-01-IT-INF-WKLD-01-vds-01)
2 Select target device	мти	Get MTU from switch $ \smallsetminus $	9000	0
3 Port properties	TCP/IP stack	Default		
4 iPv4 settings	Available services			
5 Ready to complete	Enabled services	vMotion Provisioning Fault Tolerance logging Management vSphere Replication	VSphere Replication N VSAN VSAN Witness VSphere Backup NFC NVMe over TCP	FC 🗌 NVMe over RDMA

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

Add Networking	IPv4 settings	15.	×
1 Select connection type	 Obtain IPv4 settings autor 	matically	
2 Select target device	 Use static IPv4 settings 		
3 Port properties	IPv4 address	172.21.118.191	
4 IPv4 settings	Subnet mask	255.255.255.0	
5 Ready to complete	Default gateway	Override default gateway for this adapter	
		172.21.166.1	
	DNS server addresses	10.61.185.231	

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

Add Networking	Ready to comple	te
	Review your selections bef	ore finishing the wizard
1 Select connection type	✓ Select target device	
2 Select target device	Distributed port group	vcf-wkld-01-nvme-a
3 Port properties	Distributed switch	vcf-wkld-01-IT-INF-WKLD-01-vds-01
	✓ Port properties	
4 IPv4 settings	New port group	vcf-wkld-01-nvme-a (vcf-wkld-01-IT-INF-WKLD-01-vds-01)
	MTU	9000
5 Ready to complete	vMotion	Disabled
	Provisioning	Disabled
	Fault Tolerance logging	Disabled
	Management	Disabled
	vSphere Replication	Disabled
	vSphere Replication NFC	Disabled
	VSAN	Disabled
	vSAN Witness	Disabled
	vSphere Backup NFC	Disabled
	NVMe over TCP	Enabled
	NVMe over RDMA	Disabled
	✓ IPv4 settings	
	IPv4 address	172.21.118.191 (static)
	Subnet mask	255.255.255.0
		CANCEL BACK FIN

Each ESXi host in the workload domain cluster must have an NVMe over TCP software adapter installed for every established NVMe/TCP network dedicated to storage traffic.

To install NVMe over TCP adapters and discover the NVMe controllers, complete the following steps:

1. In the vSphere client navigate to one of the ESXi hosts in the workload domain cluster. From the **Configure** tab click on **Storage Adapters** in the menu and then, from the **Add Software Adapter** drop-down menu, select **Add NVMe over TCP adapter**.

() B = Ø	 vcf-wkld-es. Summary Monitor 	x01.sddc	e Permissions VMs Datastores
 vcf-m01-vc01.sddc.netapp.com vcf-wkld-vc01.sddc.netapp.com 	Storage	~ ^	Storage Adapters
 vcf-wkld-01-DC IT-INF-WKLD-01 vcf-wkld-esx01.sddc.netapp.com 	Storage Adapters Storage Devices Host Cache Configur Protocol Endpoints	ation	ADD SOFTWARE ADAPTER V REFRESH
 vcf-wkld-esx02.sddc.netapp.com vcf-wkld-esx03.sddc.netapp.com vcf-wkld-esx04.sddc.netapp.com 	I/O Filters Networking	~	Add NVMe over TCP adapter Add NVMe over TCP adapter 430 PIIX4 for 430
 ♂ OracleSrv_01 ♂ OracleSrv_02 ⑦ OracleSrv_03 	Virtual switches VMkernel adapters Physical adapters		O
OracleSrv_04	TCP/IP configuration		

2. In the Add Software NVMe over TCP adapter window, access the Physical Network Adapter dropdown menu and select the correct physical network adapter on which to enable the NVMe adapter.



- 3. Repeat this process for the second network assigned to NVMe over TCP traffic, assigning the correct physical adapter.
- 4. Select one of the newly installed NVMe over TCP adapters and, on the **Controllers** tab, select **Add Controller**.

(1) B = §	Summary Monitor	Configure	.neta • P	pp.com	ACT VMs	Datastores Networks Updates		
 >	Storage Storage Adapters	~ ^	Stor	age Adap software ada	ters	REFRESH RESCAN STORAGE RESCAN	ADAPTER	REMOV
V III IT-INF-WKLD-01	Host Cache Configuratio	m		Adapter	Ŧ	Model T	Туре	T
vcf-wkld-esx01.sddc.netapp.com	Protocol Endpoints		0	♦ vmhba65		iSCSI Software Adapter	iSCSI	
vcf-wkld-esx03.sddc.netapp.com	Networking		0	vmhba1		PIX4 for 430TX/440BX/MX IDE Controller	Block SCSI	
vcf-wkld-esx04.sddc.netapp.com	Networking	~	0	♦ vmhba64		PIIX4 for 430TX/440BX/MX IDE Controller	Block SCSI	
OracleSrv_01	Virtual switches		0	vmhba0		PVSCSI SCSI Controller	SCSI	
🗇 OracleSrv_02	VMkernel adapters		01	🔆 vmhba68		VMware NVMe over TCP Storage Adapter	NVME over	TCP
₫ OracleSrv_03	Physical adapters		0	G vmhba69		VMware NVMe over TCP Storage Adapter	NVME over	TCP
G OracleSrv_04	TCP/IP configuration						01202220000	10.000
GI SQLSRV-01	Virtual Machines	~						
G SQLSRV-02	VM Startup/Shutdown							
G SQLSRV-03	Agent VM Settings							
G SQLSRV-04	Default VM Compatibilit	У	Mar	age Columns	Export	~		
@ Win2022-8	Swap File Location							
	System	~	Prope	rties Devic	es	Paths Namespaces Controllers		
	Licensing		a sepa					
	Host Profile		ADD	CONTROLLER	REMO	VE:		
	Time Configuration		[m]	Name CM		Subsystem NON		
	Authentication Convicor			0				

5. In the **Add controller** window, select the **Automatically** tab and complete the following steps.

- Fill in an IP addresses for one of the SVM logical interfaces on the same network as the physical adapter assigned to this NVMe over TCP adapter.
- Click on the **Discover Controllers** button.
- From the list of discovered controllers, click the check box for the two controllers with network addresses aligned with this NVMe over TCP adapter.
- $\circ\,$ Click on the **OK** button to add the selected controllers.

Host	NQN		nqn.2014-08.com.netapp.sddc:nvme:vcf-wkld					
IP	1	1	172.21.118.189			Central d	liscovery control	er
		-	Enter IPv4 / IPv6 address					
Port	Number							
			Range more from 0			5		
Dige								
	st paramete	er	Header digest	Data digest				
DIS	SCOVER CON	er NTROLLE	Header digest	🗌 Data digest				
DIS Select	st paramete	ATROLLE Introller 1	Header digest	Data digest Transport Type	Ŧ	IP T	Port Number	
DIS Select	t which cor	er NTROLLE ntroller 1 T	Header digest	Data digest Data digest Transport Type sn. nvm	Ŧ	IP T 172.21.118.189	Port Number 4420	
Dis Select	t which cor	r NTROLLE Ntroller †	Header digest Header digest RS 2 co connect Subsystem NGN ngn.1992-08.com.netapp:s 64df3069fb6411eea55100 098b46a21:subsystem.VC _WKLD_04_NVMe_VCF_ KLD_04_NVMe	Transport Type Sn. nvm a F W	Ŧ	IP T 172.21.118.189	Port Number 4420	
Select	t which cor 65535	NTROLLE htroller f	Header digest Header	Transport Type sn. nvm a F W sn. nvm a nvm a	Ť	IP T 172.21.118.189 172.21.118.190	Port Number 4420 4420	

6. After a few seconds you should see the NVMe namespace appear on the Devices tab.

	Adapter T	Model T	Туре 🔻	Status 🕇	Identifier T	Targets	T De	evices T	Paths
C	vmhba65	iSCSI Software Adapter	ISCSI	Online	iscsi_vmk(iqn.1998-01.com.vm ware:vcf-wkld-esx01.sddc.net app.com:794177624:65)	4	2		8
C	🔆 vmhba1	PIIX4 for 430TX/440BX/MX IDE Controller	Block SCSI	Unknown	241	1	1		- 1
C	🔆 vmhba64	PIIX4 for 430TX/440BX/MX IDE Controller	Block SCSI	Unknown	-	0	0		0
DI	🔆 vmhba0	PVSCSI SCSI Controller	SCSI	Unknown	1	3	3		3
	🔆 vmhba68	VMware NVMe over TCP Storage Adapter	NVME over TCP	Online		1	1		1
	vmhba69	VMware NVMe over TCP Storage Adapter	NVME over TCP	Online	-	0	0		0
Mar		VMware NVMe over TCP Storage Adapter	NVME over TCP	Online		0	0		0
Mar ope	vmhba69 AT Devices RESH AT Devices	VMware NVMe over TCP Storage Adapter	NVME over TCP	Online	Operational	0	0		6
Mar ope	wmhba69 rage Columns) Export erties Devices RESH AT DEF Name	VMware NVMe over TCP Storage Adapter	VVME over TCP	Online T Datastore	Y Operational Y A	0 lardware ccceleration	0 •	Drive Type	0 6 7 Trans

 Repeat this procedure to create an NVMe over TCP adapter for the second network established for NVMe/TCP traffic. To create a VMFS datastore on the NVMe namespace, complete the following steps:

1. In the vSphere client navigate to one of the ESXi hosts in the workload domain cluster. From the **Actions** menu select **Storage > New Datastore...**.

	< 🛛 vcf-wklo	l-esx01.sddc.neta	ipp.com	ACTIONS	
	Summary Mo	onitor Configure P	ermissions V	Actions - vcf-wkld-	odates
	Host Detail	S		New Virtual Machine Deploy OVF Template New Resource Pool	nd Usage 2:04 PM
III-INF-WKLD-01 IIII-INF-WKLD-01 IIII-INF-WKLD-01 IIII-INF-WKLD-01 IIII-INF-WKLD-01 IIII-INF-WKLD-01 IIIIIIIIIIIIIIIIIIIIIIIIIIIIIIII		Hypervisor:	VMware ES	Et New vApp	
vcf-wkld-esx03.sddc.netapp.com	0	Model:	9 VMware7,1	뚭 Import VMs	
vcf-wkld-esx04.sddc.netapp.com		, locolor, i jper	U @ 2.30GH	Maintenance Mode	>
♂ OracleSrv_01 ♂ OracleSrv_02 ♂ OracleSrv_03		Logical Processors: NICs: Virtual Machines:	8 4 2	Connection Power	> >
라 OracleSrv_04 값 SQLSRV-01		State:	Connected	Certificates	>
SQLSRV-02		o partice		Storage	> 📑 New Datastore
SQLSRV-04	8			Stadd Networking	Rescan Storage

- 2. In the **New Datastore** wizard, select **VMFS** as the type. Click on **Next** to continue.
- 3. On the **Name and device selection** page, provide a name for the datastore and select the NVMe namespace from the list of available devices.



- 4. On the **VMFS version** page select the version of VMFS for the datastore.
- 5. On the **Partition configuration** page, make any desired changes to the default partition scheme. Click on **Next** to continue.



ck Filter 🗸 Enter value		0					
Name 1	State	Status	Cluster	Consumed CPU %	Consumed Memory %	HA State	Uptime
vcf-wkld-esx01.sddc.netapp.co m	2 Connected	V Normal	[]] <u>IT-INF-WKLD-0</u> 1	159	6 13%	 Connected (Se condary) 	19 days
Image: state	2 Connected	Vormal	([]) <u>IT-INF-WKLD-0</u> 1	99	6 15%	 Running (Prima ry) 	19 days
vcf-wkld-esx03.sddc.netapp.cc m	2 Connected	Vormal	([]] <u>IT-INF-WKLD-0</u> 1	99	6 21%	 Connected (Se condary) 	19 days
m vcf-wkld-esx04.sddc.netapp.co	2 Connected	Normal	([]) <u>IT-INF-WKLD-0</u> 1	119	6 4%	 Connected (Se condary) 	19 days
	k Filter Enter value Name 1 u	K Filter	k Filter	k Filter	K Filter Consumed CPU % Name 1 Status Cluster Consumed CPU % III Ust-Wkld-esx01 sddc.netapp.co Connected V Normal IIII Ust-Wkld-esx02 sddc.netapp.co Connected V Normal IIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIII	K Filter Consumed CPU % Consumed Memory % Name ↑ State Statu Ouster Consumed CPU % Consumed Memory % II	k Filter Consumed CFU % Consumed CFU % Consumed Memory % HA State Name 1 Statu Quiter Consumed CFU % Consumed Memory % HA State II Quiter Quiter Consumed CFU % Consumed CFU % Consumed Memory % HA State II Quit-Widd-esx01 sddc.netapp.co Connected ✓ Normal III_IT-INF-WKLD-0 9% 15% TS% Connected (Se condary) II Curd-widd-esx04 sddc.netapp.co Connected ✓ Normal III_IT-INF-WKLD-0 9% 21% ✓ Connected (Se condary) II Curd-widd-esx04 sddc.netapp.co Connected ✓ Normal III_IT-INF-WKLD-0 9% 21% ✓ Connected (Se condary) II Curd-widd-esx04 sddc.netapp.co Connected ✓ Normal III_IT-INF-WKLD-0 9% 21% ✓ Connected (Se condary)

Additional information

For information on configuring ONTAP storage systems refer to the ONTAP 9 Documentation center.

For information on configuring VCF refer to VMware Cloud Foundation Documentation.

Use SnapCenter Plug-in for VMware vSphere to protect VMs on VCF Workload Domains

In this scenario we will demonstrate how to deploy and use the SnapCenter Plug-in for VMware vSphere (SCV) to backup and restore VM's and datastores on a VCF workload domain. SCV uses ONTAP snapshot technology to take fast and efficient backup copies of the ONTAP storage volumes hosting vSphere datastores. SnapMirror and SnapVault technology are used to create secondary backups on a separate storage system and with retention policies that mimic the original volume or can be independent of the original volume for longer term retention.

iSCSI is used as the storage protocol for the VMFS datastore in this solution.

Author: Josh Powell

Scenario Overview

This scenario covers the following high level steps:

- Deploy the SnapCenter Plug-in for VMware vSphere (SCV) on the VI workload domain.
- Add storage systems to SCV.
- Create backup policies in SCV.
- Create Resource Groups in SCV.
- Use SCV to backup datastores or specific VMs.
- Use SCV to restores VMs to an alternate location in the cluster.
- Use SCV to restores files to a windows file system.

Prerequisites

This scenario requires the following components and configurations:

- An ONTAP ASA storage system with iSCSI VMFS datastores allocated to the workload domain cluster.
- A secondary ONTAP storage system configured to received secondary backups using SnapMirror.
- VCF management domain deployment is complete and the vSphere client is accessible.
- A VI workload domain has been previously deployed.
- Virtual machines are present on the cluster SCV is designated to protect.

For information on configuring iSCSI VMFS datastores as supplemental storage refer to **iSCSI as supplemental storage for Management Domains** in this documentation. The process for using OTV to deploy datastores is identical for management and workload domains.



In addition to replicating backups taken with SCV to secondary storage, offsite copies of data can be made to object storage on one of the three (3) leading cloud providers using NetApp BlueXP backup and recovery for VMs. For more information refer to the solution 3-2-1 Data Protection for VMware with SnapCenter Plug-in and BlueXP backup and recovery for VMs.



Deployment Steps

To deploy the SnapCenter Plug-in and use it to create backups, and restore VMs and datastores, complete the following steps:

Deploy and use SCV to protect data in a VI workload domain

Complete the following steps to deploy, configure, and use SCV to protect data in a VI workload domain:

The SnapCenter Plug-in is hosted on the VCF management domain but registered to the vCenter for the VI workload domain. One SCV instance is required for each vCenter instance and, keep in mind that, a Workload domain can include multiple clusters managed by a single vCenter instance.

Complete the following steps from the vCenter client to deploy SCV to the VI workload domain:

- 1. Download the OVA file for the SCV deployment from the download area of the NetApp support site **HERE**.
- 2. From the management domain vCenter Client, select to **Deploy OVF Template...**.

— vSphere Cl	ient Q Search in all environmer	rFl wef m01 cl01
	9	Summary Monitor
 vcf-m01-vc0 vcf-m01- 	01.sddc.netapp.com dc01	Services vSphere DRS
ver-m ver ver ver ver ver ver ver ver ver ver	f-mC f-mC f-mC f-mC f-mC f-mC f-mC f-mC f-mC f-mC f-mC	pere Availability juration kstart eral Provider
ि vet ि vet हो vet	f-mC & Deploy OVF Template f-mC f-mC Et New vAp	vare EVC Host Groups Host Rules
ස් vet සී vet	f-wC f-wC	Overrides Filters

3. In the **Deploy OVF Template** wizard, click on the **Local file** radio button and then select to upload the previously downloaded OVF template. Click on **Next** to continue.



- 4. On the **Select name and folder** page, provide a name for the SCV data broker VM and a folder on the management domain. Click on **Next** to continue.
- 5. On the **Select a compute resource** page, select the management domain cluster or specific ESXi host within the cluster to install the VM to.
- 6. Review information pertaining to the OVF template on the **Review details** page and agree to the licensing terms on the **Licensing agreements** page.
- 7. On the Select storage page choose the datastore which the VM will be installed to and select the virtual disk format and VM Storage Policy. In this solution, the VM will be installed on an iSCSI VMFS datastore located on an ONTAP storage system, as previously deployed in a separate section of this documentation. Click on Next to continue.

	Select the storage for the c	onfiguration and dis	sk files				
1 Select an OVF template	Encrypt this virtual maching	ie 🚺					
	Select virtual disk format	Thin Provision	~				
2 Select a name and folder	VM Storage Policy	Datastore Def	ault ~				
	Disable Storage DRS for the storage DRS for	his virtual machine					
3 Select a compute resource							
	Name	т	Storage Compatibility	Capacity T	Provisioned T	Free	T I
4 Review details	💿 🗐 mgmt_01_iscsi		-	3 TB	3.71 TB	2.5 TB	3
· · · · · · · · · · · · · · · · · · ·	O Svcf-m01-cl01-ds-v	rsan01		999.97 GB	49.16 GB	957.54 GB	
Cicense agreements	O 🗐 vcf-m01-esx01-es	x-install-datastore	550	25.75 GB	4.56 GB	21.19 GB	١
i Select storage	O 🗐 vcf-m01-esx02-es	sx-install-datastore	550	25.75 GB	4.56 GB	21.19 GB	1
Select networks	O vcf-m01-esx03-es	sx-install-datastore	77.0	25.75 GB	4.56 GB	21.19 GB	1
Customize template	O 🗐 vcf-m01-esx04-e	sx-install-datastore		25.75 GB	4.56 GB	21.19 GB	١
	<		1				>
9 Ready to complete	Manage Columns				Items per pa	age 10 v	6 iten
	Compatibility	ucceeded.					

8. On the **Select network** page, select the management network that is able to communicate with the workload domain vCenter appliance and both the primary and secondary ONTAP storage systems.



9. On the Customize template page fill out all information required for the deployment:

- FQDN or IP, and credentials for the workload domain vCenter appliance.
- Credentials for the SCV administrative account.
- Credentials for the SCV maintenance account.
- IPv4 Network Properties details (IPv6 can also be used).
- Date and Time settings.

Click on Next to continue.

Deploy OVF Template

- 1 Select an OVF template
- 2 Select a name and folder
- 3 Select a compute resource
- 4 Review details
- 5 License agreements
- 6 Select storage
- 7 Select networks
- 8 Customize template
- \checkmark 1. Register to existing vCenter 4 settings 1.1 vCenter Name(FQDN) or IP Address cf-wkld-vc01.sddc.netapp.com 1.2 vCenter username administrator@vcf.local 1.3 vCenter password Password 0 Confirm Password ******** 0 1.4 vCenter port 443 0 ✓ 2. Create SCV Credentials 2 settings 2.1 Username admin 2.2 Password Password 0 ••••• Confirm Password ••••• 0 ✓ 3. System Configuration 1 settings

×

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Deploy OVF Template

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

Customize template

Customize template

Customize the deployment properties of this software solution.

4.2 Setup IPv4 Network Properties	6 settings
4.2.1 IPv4 Address	IP address for the appliance. (Leave blank if DHCP is desired) 172.21.166.148
4.2.2 IPv4 Netmask	Subnet to use on the deployed network. (Leave blank if DHCP is desired) 255.255.255.0
4.2.3 IPv4 Gateway	Gateway on the deployed network. (Leave blank if DHCP is desired) 172.21,166,1
4.2.4 IPv4 Primary DNS	Primary DNS server's IP address. (Leave blank if DHCP is desired) 10.61.185,231
4.2.5 IPv4 Secondary DNS	Secondary DNS server's IP address. (optional - Leave blank if DHCP is desired) 10.61.186.231
4.2.6 IPv4 Search Domains (optional)	Comma separated list of search domain names to use when resolving host names. (Leave blank if DHCP is desired) netapp.com,sddc.netapp.com
3.3 Setup IPv6 Network Properties	6 settings
4.3.1 IPv6 Address	IP address for the appliance. (Leave blank if DHCP is desired)
4.3.2 IPv6 PrefixLen	Prefix length to use on the deployed network. (Leave blank if DHCP is desired)

✓ 5. Setup Date and Time	2 settings		
5.1 NTP servers (optional)	A comma-separated list of hostnames or IP addresses of NTP		
	Servers. If left blank, VMware tools based time synchronization will		
	be used.		
	172.21.166.1		
5.2 Time Zone setting	Sets the selected timezone setting for the VM		
	America/New_York 🗸		
	CANCEL BACK NE		

Once the SnapCenter Plug-in is installed complete the following steps to add storage systems to SCV:

1. SCV can be accessed from the main menu in the vSphere Client.

	ortcuts
品Inv	ventory
e cc ‰w	orkload Management
GI GI	obal Inventory Lists
围 Pc	licies and Profiles
	to Deploy
⊗ Ну	brid Cloud Services
De	eveloper Center
🍪 Ac	Iministration
創 Ta	sks
🗐 Ev	ents
🛇 Та	gs & Custom Attributes

2. At the top of the SCV UI interface, select the correct SCV instance that matches the vSphere cluster to be protected.

vSphere Clien	t Q Search in all environments
SnapCenter Plug-in f	or VMware vSphere INSTANCE 172.21.166.148:8080
🏠 Dashboard	Dashboard
o culture	

3. Navigate to **Storage Systems** in the left-hand menu and click on **Add** to get started.

SnapCenter Plug-in for	VMware vSphere	INSTANCE 172.21.166.148:8080
🔄 Dashboard	Storage Syste	ems
🝺 Settings	🐣 Add 🥖	Edit Y Delete - Export
🔃 Resource Groups	Name	Display Name
🍓 Policies	\cup	

4. On the **Add Storage System** form, fill in the IP address and credentials of the ONTAP storage system to be added, and click on **Add** to complete the action.

Add Storage System

	Contractor	0.0.0
Authentication Method	 Credentials 	() Certificate
Username	admin	
Password	•••••	
Protocol	HTTPS	
Port	443	
imeout	60	Seconds
Destand ID	Proformed IP	1
Preferred IP Event Management System	(EMS) & AutoSupport Setting	g
_ Preferred IP Event Management System _ Log Snapcenter server e _ Send AutoSupport Notific	(EMS) & AutoSupport Setting vents to syslog cation for failed operation to st	g torage system
_ Preferred IP Event Management System Log Snapcenter server e Send AutoSupport Notific	(EMS) & AutoSupport Setting vents to syslog cation for failed operation to st	g torage system
_ Preferred IP Event Management System Log Snapcenter server e Send AutoSupport Notific	(EMS) & AutoSupport Setting vents to syslog cation for failed operation to st	g torage system
Preferred IP Event Management System Log Snapcenter server e Send AutoSupport Notific	(EMS) & AutoSupport Setting vents to syslog cation for failed operation to st	g torage system
Preferred IP Event Management System Log Snapcenter server e Send AutoSupport Notific	(EMS) & AutoSupport Setting vents to syslog cation for failed operation to st	g torage system
Preferred IP Event Management System Log Snapcenter server e Send AutoSupport Notific	(EMS) & AutoSupport Setting vents to syslog ation for failed operation to st	g torage system

 \times

5. Repeat this procedure for any additional storage systems to be managed, including any systems to be used as secondary backup targets.

Q

For more information on creating SCV backup policies refer to Create backup policies for VMs and datastores.

Complete the following steps to create a new backup policy:

1. From the left-hand menu select **Policies** and click on **Create** to begin.

SnapCenter Plug-in for	VMwa	are vSphe	ere INSTA	NCE 172.21.16	56.148:8080 v
🟠 Dashboard	Po	olicies			
😰 Settings	í	👍 Create	/ Edit	X Remove	F→ Export
🔃 Resource Groups		Naga]		VM Consistency
🍓 Policies		\sim			8

2. On the **New Backup Policy** form, provide a **Name** and **Description** for the policy, the **Frequency** at which the backups will take place, and the **Retention** period which specifies how long the backup is retained.

Locking Period enables the ONTAP SnapLock feature to create tamper proof snapshots and allows configuration of the locking period.

For **Replication** Select to update the underlying SnapMirror or SnapVault relationships for the ONTAP storage volume.

SnapMirror and SnapVault replication are similar in that they both utilize ONTAP SnapMirror technology to asynchronously replicate storage volumes to a secondary storage system for increased protection and security. For SnapMirror relationships, the retention schedule specified in the SCV backup policy will govern retention for both the primary and secondary volume. With SnapVault relationships, a separate retention schedule can be established on the secondary storage system for longer term or differing retention schedules. In this case the snapshot label is specified in the SCV backup policy and in the policy associated with the secondary volume, to identify which volumes to apply the independent retention schedule to.

Choose any additional advanced options and click on Add to create the policy.

New Backup Policy

Name	Daily_Snapmirror
Description	description
Frequency	Daily
Locking Period	Enable Snapshot Locking ()
Retention	Days to keep 🔹 15 🔹 🤊
Replication	🕝 Update SnapMirror after backup 🕕
	Update SnapVault after backup 1
	Snapshot label
Advanced 🗸	VM consistency ()
	Include datastores with independent disks
	Scripts 1
	CANCEL ADD

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For more information on creating SCV Resource Groups refer to Create resource groups.

Complete the following steps to create a new resource group:

1. From the left-hand menu select **Resource Groups** and click on **Create** to begin.

SnapCenter Plug-in for	VMware vSpl	h in all enviro	NCE 172.21.	166.148:8080 ×
🔠 Dashboard	Resource	Groups		
😰 Settings	👍 Crea	te 🥒 Edit	🗙 Delete	🙆 Run Now 🧯
🛗 Resource Groups	Nac	η	- 50 C	Descrip
🍓 Policies				
🚐 Storage Systems				
👩 Guest File Restore				

- 2. On the **General info & notification** page, provide a name for for the resource group, notification settings, and any additional options for the naming of the snapshots.
- 3. On the **Resource** page select the datastores and VM's to be protected in the resource group. Click on **Next** to continue.



Even when only specific VMs are selected, the entire datastore is always backed up. This is because ONTAP takes snapshots of the volume hosting the datastore. However, note that selecting only specific VMs for backup limits the ability to restore to only those VMs.

1. General into & nouncation	Scope:	Virtual Machines 🐱			
2. Resource	Parent entity:	VCE WKLD 03 ISCSI			
3. Spanning disks					
4. Policies		Q Enter available entity name			
5. Schedules	Available enti	ties		Selected entities	
6. Summary	🔂 Oracles	Srv_01		B SQLSRV-01	
	🔂 Oracles	Srv_02		B SQLSRV-02	
	🔂 Oracles	Srv_03		B SQLSRV-03	
	🔂 Oracles	Srv_04		D SQLSRV-04	
			~		
			5		
			«		
				BACK NEXT FINISH CA	ANC

4. On the **Spanning disks** page select the option for how to handle VMs with VMDK's that span multiple datastores. Click on **Next** to continue.

Create Resource Group

 General info & notification 	 Always exclude all spanning datastores
2. Resource	This means that only the datastores directly added to the resource group and the primary datastore of VMs directly added to the resource group will be backed up
3. Spanning disks	
4. Policies	Always include all spanning datastores
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.

5. On the **Policies** page select a previously created policy or multiple policies that will be used with this resource group. Click on **Next** to continue.

2. Resource		Name	VM Consistent	Include independent di	Schedule
3. Spanning disks		Daily_Snapmirror	No	No	Daily
4. Policies					
5. Schedules					
6. Summary	_				
				BACK	FINISH CA

6. On the **Schedules** page establish for when the backup will run by configuring the recurrence and time of day. Click on **Next** to continue.

 1. General info & notification 			
 2. Resource 	Daily_Snapmi 👻	Туре	Daily
 3. Spanning disks 		Every	1 Day(s)
 4. Policies 		Starting	04/04/2024
5. Schedules		At	04 45 A PM
6. Summary			
			BACK NEXT FINISH CANC
Finally review the Summary	and click on Finis h	to creat	e the resource group.
Finally review the Summary	and click on Finis h	to creat	e the resource group.
Finally review the Summary	and click on Finish	to creat	e the resource group.
Finally review the Summary	and click on Finis h	to creat	e the resource group.
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Finally review the Summary	and click on Finis h	ı to creat	e the resource group.
Finally review the Summary	and click on Finish	to creat	e the resource group.
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Finally review the Summary	and click on Finish	to creat	e the resource group.
Finally review the Summary	and click on Finish	ı to creat	e the resource group.
Finally review the Summary	and click on Finish	to creat	e the resource group.

2. Resource	Humo	SQL_Servers
2 Company disks	Description	
A Policios	Send email	Never
5. Schedules	Latest Snapshot name	None 🕤
6. Summary	Custom snapshot format	None 💿
	Entities	SQLSRV-01, SQLSRV-02, SQLSRV-03, SQLSRV-04
	Spanning	False
	Policies	Name Frequency Snapshot Locking Period Daily_Snapmir Daily -
		BACK NEXT FINISH
th the resource group cre	eated click on the Run	BACK NEXT FINITH
th the resource group cre ≡ vSphere Client Q SnapCenter Plug-in for VMwa	eated click on the Run Search in all environment are vSphere INSTANCE 17	BACK NEXT FINITH Now button to run the first backup.
th the resource group cre vSphere Client Q SnapCenter Plug-in for VMwa Dashboard Re	eated click on the Run Search in all environment are vSphere INSTANCE 17 esource Groups	BACK NEXT FINITH Now button to run the first backup.
th the resource group cree vSphere Client Q SnapCenter Plug-in for VMwa Dashboard Re Settings	eated click on the Run Search in all environment are vSphere INSTANCE 17 esource Groups	BACK NEXT FINTH Now button to run the first backup.
th the resource group cree vSphere Client Q SnapCenter Plug-in for VMwa Dashboard Re Settings Kesource Groups	eated click on the Run Search in all environment are vSphere INSTANCE 17 esource Groups	EACK NEXT FINTH Now button to run the first backup.
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th the resource group cree VSphere Client Q SnapCenter Plug-in for VMwa Dashboard Re Settings Resource Groups Policies Storage Systems	eated click on the Run Search in all environment are vSphere INSTANCE 17 esource Groups Create / Edit X D Name SQL_Servers	EACK NEXT FINITH Now button to run the first backup. 22.21.166.148:8080 ~ elete Run for Suspend Resure C
th the resource group cree vSphere Client Q SnapCenter Plug-in for VMwa Dashboard Re Settings Resource Groups Policies Storage Systems Guest File Restore	eated click on the Run Search in all environment are vSphere INSTANCE 17 source Groups Create / Edit X D Name	BACK NEXT First backup. Suspend Resure Cription
💁 Dashboard	Dashboard	
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👩 Settings	Status Job Monitor Reports Getting Started	
🍓 Policies	RECENT JOB ACTIVITIES	Job Details : 6 O
📟 Storage Systems 👔 Guest File Restore	Backup Running [Job ID:s 1 min ago SOL_Servers	Backup of Resource Group 'SQL_Servers' with Policy 'Daily_Snapmirror'
>>		 (Job 7)Primary Backup of Resource Group 'SQL_Servers' with Policy 'Daily_Snapmirror' Retrieving Resource Group and Policy information
		Discovering Resources
		Validate retention Settings Quiescing Applications
	<u>See All</u>	 Retrieving Metadata Creating Snapshot copy
	CONFIGURATION @	Unquiescing Applications
	0 11 States Datastores	Registering Backup Running, Start Time: 04/04/2024 04:39:01 PM.

Use SCV to restore VMs, VMDKs and files

The SnapCenter Plug-in allows restores of VMs, VMDKs, files, and folders from primary or secondary backups.

VMs can be restored to the original host, or to an alternate host in the same vCenter Server, or to an alternate ESXi host managed by the same vCenter or any vCenter in linked mode.

vVol VMs can be restored to the original host.

VMDKs in traditional VMs can be restored to either the original or to an alternate datastore.

VMDKs in vVol VMs can be restored to the original datastore.

Individual files and folders in a guest file restore session can be restored, which attaches a backup copy of a virtual disk and then restores the selected files or folders.

Complete the following steps to restore VMs, VMDKs or individual folders.

Complete the following steps to restore a VM with SCV:

1. Navigate to the VM to be restored in the vSphere client, right click and navigate to **SnapCenter Plug**in for VMware vSphere. Select **Restore** from the sub-menu.

	<	🕆 OracleSr	/_04	⊳ ⊡ (🔁 🖓 🐼
	0	Summary Mor	itor (Configure	Permissions
 vcf-m01-vc01.sdc vcf-m01-dc01 	lc.netapp.com	Guest OS			Virtual Mad
 vcf-wkld-vcO1.sc vcf-wkld-01-E IT-INF-WK vcf-wkl vcf-wkl vcf-wkl vcf-wkl 	Actions - OracleSrv_04 Power Guest OS Snapshots Open Remote Console	> > >	Total and		(F)
vcf-wkl Oracles Oracles Concles	뎳 Migrate Clone	>	TE CONS	ole (j)	
Oracles Generation SQLSR'	Fault Tolerance	>	CONSO	LE	
값 SQLSR 값 SQLSR 값 SQLSR 값 Win20:	Template Compatibility Export System Logs	>	2	4 CPU(s), 22	2 MHz used
	🖗 Edit Settings			32 GB, 0 GB	memory active
	Move to folder Rename Edit Notes Tags & Custom Attributes	>	(of 2)	100 GB Thi VCF_WKLD vcf-wkld-01- (connected) Disconnected	in Provision () _03_iSCSI -IT-INF-WKLD-01-) 00:50:56:83:02: ed *9 - *
	Add Permission Alarms	>		ESXI 7.0 U2	and later (VM ver
Recent Tasks Task Name	Remove from Inventory Delete from Disk		鷓 (鷓 4 ☞ 4	Create Resour Add to Resour Attach Virtual	ce Group
	vSAN	>	(S+ [Detach Virtual	Disk(s)
	NetApp ONTAP tools	>	Stat F	Restore	



An alternative is to navigate to the datastore in inventory and then under the **Configure** tab go to **SnapCenter Plug-in for VMware vSphere > Backups**. From the chosen backup, select the VMs to be restored.

	_					C	Administra	itor@VCF.LOCAL ∨	٢	0
	Summary Monitor Configure	Permissions Files Hosts VMs								
 vcf-m01-vc01.sddc.netapp.com vcf-m01-dc01 vcf-wkld-vc01.sddc.netapp.com 	Alarm Definitions Scheduled Tasks General	Backups	G→ Export					Filter		
✓ I vcf-wkld-01-DC	Device Backing	Name	Status	Locations	Snapshot Loc	Created Time	Mounted	Policy	VMware S	in
vcf-wkld-esx01-esx-install-datastore	Connectivity and Multipathing	VCF_WKLD_ISCI_Datastore_04-12-2024_12.50.01.0083	Completed	Primary & Secondary	-	4/12/2024 12:50:06 PM	No	Hourly_SnapmIrror	No	^
vcf-wkld-esx02-esx-install-datastore	Hardware Acceleration	VCF_WKLD_ISCI_Datastore_04-12-2024_11.50.01.0083	Completed	Primary & Secondary		4/12/2024 11:50:06 AM	No	Hourly_Snapmtrror	No	
vcf-wkld-esx03-esx-install-datastore	Capability sets	VCF_WKLD_ISCI_Datastore_04-12-2024_10:50.01.0014	Completed	Primary & Secondary	-	4/12/2024 10:50:07 AM	No	Hourly_Snapmirror	No	
vcf-wkld-esx04-esx-install-datastore	SnapCenter Plug-in for VMwa V	VCF_WKLD_ISCI_Datastore_04-12-2024_09.50.01.0087	Completed	Primary & Secondary		4/12/2024 9:50:06 AM	No	Hourly_Snapmirror	No	
VCF_WKLD_01	Resource Groups	VCF_WKLD_ISCL_Datastore_04-12-2024_08.50.01.0050	Completed	Primary & Secondary	·	4/12/2024 8:50:06 AM	No	Hourly_Snapmirror	No	
VCF_WKLD_02_VVOLS	Backups	VCF_WKLD_ISCI_Datastore_04-12-2024_07.50.01.0237	Completed	Primary & Secondary		4/12/2024 7:50:07 AM	No	Hourly_Snapmirror	No	
VCF_WKLD_03_ISCSI		VCF_WKLD_ISCI_Datastore_04-12-2024_06.50.01.0068	Completed	Primary & Secondary	-	4/12/2024 6:50:06 AM	No	Hourly_Snapmirror	No	
A		VCF_WKLD_ISCL_Datastore_04-12-2024_05.50.01.0025	Completed	Primary & Secondary	*	4/12/2024 5:50:06 AM	No	Hourly_Snapmirror	No	
2	(4)	VCF_WKLD_ISCI_Datastore_04-12-2024_04-50.01.0062	Completed	Primary & Secondary	-	4/12/2024 4:50:06 AM	No	Hourly_Snapmtrror	No	
<u> </u>	-	VCF_WKLD_ISCI_Datastore_04-12-2024_03.50.01.0035	Completed	Primary & Secondary	-	4/12/2024 3:50:06 AM	No	Hourly_Snapmirror	No	
		VCF_WKLD_ISCI_Datastore_04-12-2024_02.50.01.0122	Completed	Primary & Secondary	-	4/12/2024 2:50:08 AM	No	Hourly_Snapmirror	No	
		VCF_WKLD_ISCL_Datastore_04-12-2024_01.50.01.0136	Completed	Primary & Secondary	~	4/12/2024 1:50:07 AM	No	Hourly_Snapmirror	No	
		VCF_WKLD_ISCI_Datastore_04-12-2024_00.50.01.0067	Completed	Primary & Secondary	-	4/12/2024 0:50:06 AM	No	Hourly_Snapmirror	No	
		VCF_WKLD_ISCI_Datastore_04-11-2024_23.50.01.0062	Completed	Primary & Secondary		4/11/2024 11:50:06 PM	No	Hourly_Snapmirror	No	
		VCF_WKLD_ISCI_Datastore_04-11-2024_22:50.01.0000	Completed	Primary & Secondary		4/11/2024 10:50:06 PM	No	Hourly_Snapmirror	No	- v
		<								

2. In the **Restore** wizard select the backup to be used. Click on **Next** to continue.

3. Select location	Search for Backups		N			
4. Summary	Available backups (This list shows primary ba	ickups. You can modify	the filter to display p	rimary and secondary backups	.)	
	Name	Backup Time	Mounted	Policy	VMware Snapshot	
	VCF_WKLD_ISCI	4/4/2024 4:50:0	No	Hourly_Snapmirror	No	^
	VCF_WKLD_ISCI	4/4/2024 4:45:1	No	Hourly_Snapmirror	No	
						~
				BACK NEXT	FINISH	ICE
			_	 1 		<u>D_</u>

- Restore scope Select to restore the entire virtual machine.
- Restart VM Choose whether to start the VM after the restore.
- **Restore Location** Choose to restore to the orginal location or to an alternate location. When choosing alternate location select the options from each of the fields:
 - Destination vCenter Server local vCenter or alternate vCenter in linked mode
 - Destination ESXi host
 - Network
 - VM name after restore
 - Select datastore:

1. Select backup	Restore scope	Entire virtual machine 🔹
2. Select scope	Restart VM	
3. Select location	Restore Location	Original Location
1. Summary		(This will restore the entire VM to the original Hypervisor with the original settings. Existing VM will be unregistered and replaced with this VM.)
		O Alternate Location
		(This will create a new VM on selected vCenter and Hypervisor with the customized settings.)
	Destination vCenter Server	172.21.166.143
	Destination ESXi host	vcf-wkld-esx04.sddc.netapp.com
	Network	vcf-wkld-01-IT-INF-WKLD-01-vds-01-pg-
	VM name after restore	OracleSrv_04_restored
	Select Datastore:	VCF_WKLD_03_ISCSI -
		BACK NEXT FINISH CANCEL

Click on **Next** to continue.

4. On the **Select location** page, choose to restore the VM from the primary or secondary ONTAP storage system. Click on **Next** to continue.

 1. Select backup 	Destination datastore	Locations
 2. Select scope 	VCF_WKLD_03_ISCSI	(Primary) VCF_ISCSI:VCF_WKLD_03_ISCSI
3. Select location		(Primary) VCF_iSCSI:VCF_WKLD_03_iSCSI
4. Summary		(Secondary) svm_iscsi:VCF_WKLD_03_iSCSI_dest
		<

5. Finally, review the **Summary** and click on **Finish** to start the restore job.

1. Select backup	/irtual machine to be restored	OracleSrv_04
2. Select scope	3ackup name	VCF_WKLD_iSCI_Datastore_04-04-2024_16.50.00.0940
3. Select location	Restart virtual machine	No
4. Summary	Restore Location	Alternate Location
t i	Destination vCenter Server	172.21.166.143
I I	ESXi host to be used to mount the backup	vcf-wkld-esx04.sddc.netapp.com
v	/M Network	vcf-wkld-01-IT-INF-WKLD-01-vds-01-pg-mgmt
I	Destination datastore	VCF_WKLD_03_iSCSI
Ň	/M name after restore	OracleSrv_04_restored
	Change IP address of the newly created V	M after restore operation to avoid IP conflict. BACK FINICH C

6. The restore job progress can be monitored from the **Recent Tasks** pane in the vSphere Client and from the job monitor in SCV.

	Dashboard					
👩 Settings 📆 Resource Groups	Status Job Monitor Reports Getting Started					
 Storage Systems Guest File Restore > 	RECENT JOB ACTIVITIES Restore Running (Job ID:15) VIC_WKLD_ISCL_Datastere Backup Successful (Job ID:15) Backup Successful (Job ID:15) Backup Successful (Job ID:12) 13 min ago VCF_WKLD_ISCL_Datastere Backup Successful (Job ID:12) 13 min ago ScL_Servera ScL_Serve	 Restoring backup with name: VCF_WI Preparing for Restore: Retrieving B Pre Restore Restore Restore 	KLD_ISCI_Datastore_04-04-2024_16.50.0 lackup meladata from Repository. 4:58:24 PM. CLOSE DOWNLOW	0.0940 OC	dup: 3	, c
	Resource Groups Backup Policies					
✓ Recent Tasks A	Resource Groups Backup Policies	Dahile	laitistar —	Queued	Start Time	1.
Recent Tasks A Task Name T NetApp Mount Datastore	Target T Status T Status T Status Sta	Details T Mount operation completed successful	Initiator T	Queued For T	Start Time	↓ • 8:27 F

ONTAP Tools allows full restore of VMDK's to their original location or the ability to attach a VMDK as a new disk to a host system. In this scenario a VMDK will be attached to a Windows host in order to access the file system.

To attach a VMDK from a backup, complete the following steps:

1. In the vSphere Client navigate to a VM and, from the **Actions** menu, select **SnapCenter Plug-in for VMware vSphere > Attach Virtual Disk(s)**.



2. In the **Attach Virtual Disk(s)** wizard, select the backup instance to be used and the particular VMDK to be attached.

Actip In last shows primary backups. In modify the filter to display primary and secondary backups.) Inter the inter to display primary and secondary backups.) Inter the inter to display primary and secondary backups.) Inter the inter to display primary and secondary backups.) Inter the inter to display primary and secondary backups.) Inter the inter to display primary and secondary backups.) Inter the inter to display primary and secondary backups.) Inter the inter to display primary and secondary backups. Inter the inter to display primary and secondary backups. Inter the inter to display primary and secondary backups. Inter the inter to display primary and secondary backups. Inter the inter to display primary and secondary backups. Inter the inter to display primary and secondary backups. Inter the inter to display primary and secondary backups and to display backups from both primary and secondary storage systems. Attach Virtual Disk(s)				ſ	Search for Backups		0	
Image in a straining function primary late according y decepted in the incomparison of the experiment of th	ackuj		riman, and secondary back	ine)			~	
Virtual disk Location Virtual disk Primary:VCF_ISCSI:VCF_WKLD_03_ISCSII SOLSRV-01/SOLSRV-01_1Vmdk VCF_WKLD_03_ISCSII SOLSRV-01/SOLSRV-01_1Vmdk Primary:VCF_ISCSI:VCF_WKLD_03_ISCSIVCF_VKLD_ISCI_Datastore_04-17-2024_09.50.01.023 More Hourly_Snapmirror No Immary:VCF_ISCSI:VCF_WkLD_0	lame		Backup Time	Mounted	Policy	VMware	Snapshot	
CF_WKLD_ISCI_Datastore_04-17-2024_08.50.01.0223 4/17/2024 8:50.01 AM No Hourly_Snapmirror No CF_WKLD_ISCI_Datastore_04-17-2024_07.50.01.0204 4/17/2024 7:50.00 AM No Hourly_Snapmirror No CF_WKLD_ISCI_Datastore_04-17-2024_06.50.01.0194 4/17/2024 7:50.00 AM No Hourly_Snapmirror No CF_WKLD_ISCI_Datastore_04-17-2024_06.50.01.0245 4/17/2024 6:50.00 AM No Hourly_Snapmirror No CF_WKLD_ISCI_Datastore_04-17-2024_06.50.01.0245 4/17/2024 5:50.01 AM No Hourly_Snapmirror No CF_WKLD_ISCI_Datastore_04-17-2024_06.50.01.0245 4/17/2024 4:50.01 AM No Hourly_Snapmirror No CF_WKLD_ISCI_Datastore_04-17-2024_06.50.01.0231 4/17/2024 4:50.01 AM No Hourly_Snapmirror No Select disks Location Primary.VCF_ISCSI:VCF_WKLD_03_JSCSI/VCF_WKLD_03.05Cl_Datastore_04-17-2024_09.50.01.0 Primary.VCF_ISCSI:VCF_WKLD_03_JSCSI:VCF_WKLD_ISCI_Datastore_04-17-2024_09.50.01.0 Image: VCF_ISCSI:VCF_WKLD_03_ISCSI:VCF_WKLD_03_ISCSI:VCF_WKLD_03.05Cl_Datastore_04-17-2024_09.50.01.0 VICF_WKLD_03_ISCSI/SOL/SRV-01/SOL/SRV-01_1.X Primary.VCF_ISCSI:VCF_WKLD_03_ISCSI:VCF_WKLD_03_ISCSI:VCF_WKLD_04.00.50.00.0 Image: VCF_ISCSI:VCF_WKLD_03_ISCSI:VCF_WKLD_04.00.50.00.0 Image: VCF_ISCSI:VCF_WKLD_03_ISCSI:VCF_WKLD_04.00.0.00.0 Image: VCF_ISCSI:VCF_	/CF_\	WKLD_ISCI_Datastore_04-17-2024_09.50.01.0218	4/17/2024 9:50:01 AM	No	Hourly_Snapmirror	No		
CCF_WKLD_ISCI_Datastore_04-17-2024_07.50.01.0204 4/17/2024 7:50.00 AM No Hourly_Snapmirror No CCF_WKLD_ISCI_Datastore_04-17-2024_06.50.01.0194 4/17/2024 6:50.00 AM No Hourly_Snapmirror No CCF_WKLD_ISCI_Datastore_04-17-2024_06.50.01.0245 4/17/2024 6:50.00 AM No Hourly_Snapmirror No CCF_WKLD_ISCI_Datastore_04-17-2024_06.50.01.0245 4/17/2024 6:50.01 AM No Hourly_Snapmirror No CCF_WKLD_ISCI_Datastore_04-17-2024_06.50.01.0231 4/17/2024 6:50.01 AM No Hourly_Snapmirror No Select disks Location No Hourly_Snapmirror No Virtual disk Location Primary-VCF_ISCSI:VCF_WKLD_03_ISCSI/VCF_WKLD_04:17-2024_09.50.01.0 VCF_WKLD_03_ISCSIJ SQLSRV-01/SQLSRV-01_1X Primary-VCF_ISCSI:VCF_WKLD_03_ISCSI/VCF_WKLD_0SCI_Datastore_04-17-2024_09.50.01.0 C CANCEL ITTACH C MCF_WKLD_03_ISCSIJ SQLSRV-01/SQLSRV-01_1X Primary-VCF_ISCSI:VCF_WKLD_03_ISCSI/VCF_WKLD_04:17-2024_09.50.01.0 Image: Construct Coreact Streact Struct Construct Construct Construct Cor	CF_	WKLD_ISCI_Datastore_04-17-2024_08.50.01.0223	4/17/2024 8:50:01 AM	No	Hourly_Snapmirror	No	_	
CF_WKLD_ISCL_Datastore_04-17-2024_06.50.01.0194 4/17/2024 6.50.00 AM No Hourly_Snapmirror No CF_WKLD_ISCL_Datastore_04-17-2024_05.50.01.0245 4/17/2024 5.50.01 AM No Hourly_Snapmirror No CF_WKLD_ISCL_Datastore_04-17-2024_05.50.01.0231 4/17/2024 5.50.01 AM No Hourly_Snapmirror No Select disks Image: CF_WKLD_03_ISCSIJSOLSRY-01/SOLSRY-01/Wdk Location Image: CF_UKLD_03_ISCSIJSOLSRY-01/SOLSRY-01/Wdk Primary:VCF_ISCSI:VCF_WKLD_03_ISCSI:VCF_WKLD_ISCI_Datastore_04-17-2024_09.50.01.0 V/CF_WKLD_03_ISCSIJSOLSRY-01/SOLSRY-01_/SOLSRY-01_IN Primary:VCF_ISCSI:VCF_WKLD_03_ISCSI:VCF_WKLD_ISCI_Datastore_04-17-2024_09.50.01.0 V/CF_WKLD_03_ISCSIJSOLSRY-01/SOLSRY-01_IN Primary:VCF_ISCSI:VCF_WKLD_03_ISCSI:VCF_WKLD_ISCI_Datastore_04-17-2024_09.50.01.0 Image: VCF_WKLD_03_ISCSIJSOLSRY-01/SOLSRY-01_SOLSRY-0	CF_\	WKLD_iSCI_Datastore_04-17-2024_07.50.01.0204	4/17/2024 7:50:00 AM	No	Hourly_Snapmirror	No		
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No

Primary/Secondary

Virtual disk

VCF_WKLD_03_is0

VCF_WKLD_03_iso

Mounted

Location

9.50.01.C 🗸

9.50.01.C 🗸

CLEAR

OK

CANCEL

- 3. After selecting all options, click on the **Attach** button to begin the restore process and attached the VMDK to the host.
- 4. Once the attach procedure is complete the disk can be accessed from the OS of the host system. In this case SCV attached the disk with its NTFS file system to the E: drive of our Windows SQL Server and the SQL database files on the file system are accessible through File Explorer.

	MSSQL 2019	> MSSQL15.MSSQLSERVER > MSSQ	L > DATA	~ Ū	Search DATA	
	^	Name	Date modified	Туре	Size	
Quick access		SOLHC01 01 mdf	4/16/2024 1-28 PM	SOL Server Databa	20.480.000	
Desktop	*	SOLHC01_02.ndf	4/16/2024 1:27 PM	SOL Server Databa	20 480 000	
🖶 Downloads	*	SOLHC01 03.ndf	4/16/2024 1:27 PM	SOL Server Databa	20 480.000	
Documents	*	🖓 SQLHC01 04.ndf	4/16/2024 1:27 PM	SQL Server Databa	20,480,000	
E Pictures	*	P SQLHC01_05.ndf	4/16/2024 1:27 PM	SQL Server Databa	20,480,000	
jpowell	*	P SQLHC01_06.ndf	4/16/2024 1:27 PM	SQL Server Databa	20,480,000	
→ iso share (\\10.61.184.87) (Z:)		🕼 SQLHC01_07.ndf	4/16/2024 1:27 PM	SQL Server Databa	20,480,000	
SOI Server Testing		📴 SQLHC01_08.ndf	4/16/2024 1:27 PM	SQL Server Databa	20,480,000	
Second rearing		📴 SQLHC01_09.ndf	4/16/2024 1:27 PM	SQL Server Databa	20,480,000	
This PC		🕞 SQLHC01_10.ndf	4/16/2024 1:27 PM	SQL Server Databa	20,480,000	
3D Objects						
🔜 Desktop						
Documents						
Downloads						
Music						
Fictures						
Videos						
Local Disk (C)						
MSSOL DATA (F)						
MSSQL_DATA (E:)	~					

ONTAP Tools features guest file system restores from a VMDK on Windows Server OSes. This is preformed centrally from the SnapCenter Plug-in interface.

For detailed information refer to Restore guest files and folders at the SCV documentation site.

To perform a guest file system restore for a Windows system, complete the following steps:

 The first step is to create Run As credentials to provide access to the Windows host system. In the vSphere Client navigate to the CSV plug-in interface and click on Guest File Restore in the main menu.

Dashboard	Guest File Restore
Settings	Guest Configuration
Policies	Guest Session Monitor •
	Run As Credentials

- 2. Under Run As Credentials click on the + icon to open the Run As Credentials window.
- 3. Fill in a name for the credentials record, an administrator username and password for the Windows system, and then click on the **Select VM** button to select an optional Proxy VM to be used for the restore.

Run As Cre	dentials	×
Run As Name	Administrator	6
Username	administrator	0
Password	******	0
Authentication Mode	Windows	
VM Name		Select VM
		200
		CANCEL SAVE

4. On the Proxy VM page provide a name for the VM and locate it by searching by ESXi host or by name. Once selected, click on **Save**.

Proxy VM	
VM Name	SQLSRV-01
Search by ESXi	Host
ESXi Host	vcf-wkld-esx04.sddc.netapp.com
Virtual Machine	SQLSRV-01
O Search by Virtu	al Machine name



X

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- 5. Click on Save again in the Run As Credentials window to complete saving the record.
- 6. Next, navigate to a VM in the inventory. From the **Actions** menu, or by right-clicking on the VM, select **SnapCenter Plug-in for VMware vSphere > Guest File Restore**.



7. On the **Restore Scope** page of the **Guest File Restore** wizard, select the backup to restore from, the particular VMDK, and the location (primary or secondary) to restore the VMDK from. Click on **Next** to continue.

	Backup Name	Start Time	End Time	
2. Guest Details	SQL Servers 04-16-2024 13.52.3	4/16/2024 1:52:34 PM	4/16/2024 1:52:40 PM	
3. Summary	VCF_WKLD_iSCI_Datastore_04-1	4/16/2024 1:50:01 PM	4/16/2024 1:50:08 PM	
	VMDK			
	[VCF_WKLD_03_ISCSI] SQLSRV-01/S	QLSRV-01.vmdk		,
	[VCF_WKLD_03_ISCSI] SQLSRV-01/S	QLSRV-01_1.vmdk		
	Locations			
	Primary:VCF_iSCSI:VCF_WKLD_03_i	SCSI:SQL_Servers_04-16-2024	_13.52.34.0329	2
	Secondary:svm_iscsi:VCF_WKLD_03	_iSCSI_dest:SQL_Servers_04-1	6-2024_13.52.34.0329	

8. On the **Guest Details** page, select to use **Guest VM** or **Use Gues File Restore proxy VM** for the restore. Also, fill out email notification settings here if desired. Click on **Next** to continue.

 I. Restore Scope 2. Guest Details 	⊙ Use Guest VM			
3. Summary	Guest File Restore opera	ation will attach disk to guest VN	ř.	
	Run As Name	Username	Authentication Mode	
	Administrator	administrator	WINDOWS	^
	OUse Guest File Restor	е ргоху VM		~
	Send email notificat	ion		
	Email send from:			
	Email send to:			
	Ernan Subject.	Guest File R	estore	
			BACK	FINISH CANCE
		EDIT	BACK	FINISH CANCE Storage
		EDIT	BACK	FINISH CANCE Storage
Finally, review the session.	• Summary page and	EDIT click on Finish to be	BACK NEXT	FINISH CANCE Storage VCF_WKLD
Finally, review the session. Back in the Snap(session under Gu	e Summary page and Center Plug-in interfac est Session Monitor	click on Finish to be e, navigate to Gues . Click on the icon u	EACK NEXT egin the Guest File Sy t File Restore again a nder Browse Files to	FINISH CANCER Storage VCF_WKLD vstem Restore and view the run continue.
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Finally, review the session. Back in the Snape session under Gu	e Summary page and Center Plug-in interfact est Session Monitor	click on Finish to be e, navigate to Gues . Click on the icon u	egin the Guest File Sy t File Restore again ander Browse Files to	FINISH CANCE Storage VCF_WKLD vstem Restore and view the run continue.

11. In the **Guest File Browse** wizard select the folder or files to restore and the file system location to restore them to. Finally, click on **Restore** to start the **Restore** process.

Disk Path

VCF_WK

Guest Session Monitor •

Run As Credentials

Proxy Credentials •

Source VM

Backup Name

Guest File Restore

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Time To Expi

G	E:\\MSSQL 2	2019	~	Enter Pa	ttern]
		Name		Size		
	MSSQL15.N	ISSQLSERVER				^
						~
	Name	Selected 0 Files / 1 Path	Directory	Size	Delete	
MSSC	QL 2019	E:\\MSSQL 2019			Û	^
						~
Pelee	t Destern 1					

Select address far	nily for UNC path:
Restore to path	\\172.21.166.16\c\$
	Provide UNC path to the guest where files will be restored. eg: \ \10.60.136.65\c\$
	Run As Credentials while triggering the Guest File Restore workflow will be used to connect to the UNC path
lf original file(s) ex	ist:
🗿 Always overwrite	
🔿 Always skip	
Disconnect Gue	est Session after successful restore
	CANCEL

Additional information

For information on configuring VCF refer to VMware Cloud Foundation Documentation.

For information on configuring ONTAP storage systems refer to the ONTAP 9 Documentation center.

For information on using the SnapCenter Plug-in for VMware vSphere refer to the SnapCenter Plug-in for VMware vSphere documentation.

VMware Cloud Foundation with NetApp AFF Arrays

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

Author: Josh Powell, Ravi BCB

This document provides information on storage options available for VMware Cloud Foundation using the NetApp All-Flash AFF storage system. Supported storage options are covered with specific instruction for

creating workload domains with NFS and vVol datastores as principal storage as well as a range of supplemental storage options.

Use Cases

Use cases covered in this documentation:

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

Audience

This solution is intended for the following people:

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

Technology Overview

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

VMware Cloud Foundation

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

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

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



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

VCF Storage Options

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



Principal Storage for Workload Domains

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

Supplemental Storage for Management and Workload Domains

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

Additional documentation resources for VMware Cloud Foundation:

- * VMware Cloud Foundation Documentation
- * Supported Storage Types for VMware Cloud Foundation
- * Managing Storage in VMware Cloud Foundation

NetApp All-Flash Storage Arrays

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

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

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

For more information on NetApp AFF A-Series storage arrays see the NetApp AFF A-Series landing page.

For more information on NetApp C-Series storage arrays see the NetApp AFF C-Series landing page.

NetApp ONTAP Tools for VMware vSphere

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

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

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

For more information on NetApp ONTAP tools see the ONTAP tools for VMware vSphere Documentation page.

Solution Overview

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

Scenarios covered in this documentation:

• Configure and use an NFS datastore as principal storage during VI Workload Domain deployment.

here for deployment steps.

• Install and demonstrate the use of ONTAP Tools to configure and mount NFS datastores as supplemental storage in VI Workload Domains. Click here for deployment steps.

NFS as principal storage for VI Workload Domains

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

Author: Josh Powell, Ravi BCB

Scenario Overview

This scenario covers the following high level steps:

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

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

Prerequisites

This scenario requires the following components and configurations:

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



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

For information on configuring ONTAP storage systems refer to the ONTAP 9 Documentation center.

For information on configuring VCF refer to VMware Cloud Foundation Documentation.

Deployment Steps

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

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

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

■ ONTAP Sy	stem Manager	
DASHBOARD INSIGHTS	Storage VMs + Add : More	
STORAGE ^	Name	FHC NES All Storage VMc
Overview	EHC_ISCSI	Eric_initio Antiology Mis
Volumes	EHC_NES	Overview Settings SnapMirror (I
Consistency Groups	HMC_187	
NVMe Namespaces	HMC_3510	NETWORK IP INTERFACES
Shares	HMC_ISCSI_3510	NFS 7
Buckets	infra_svm_a300	S 172,21,253,117
Qtrees Quotas	JS_EHC_ISCSI	Mi 172.21.253.118 N 172.21.253.116
Storage VMs	OTVtest	s# 172.21.253.112
Tiers	sum0	d 172.21.253.113
NETWORK 🗸	THE STREET	NI 172.21.118.163
EVENTS & JOBS 💙	zoneb	

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

network interface show -vserver <SVM NAME>

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

vmkping <IP Address>



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

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

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

■ ONTAP Sy	stem Manager	Search actions, objects, and p
DASHBOARD INSIGHTS	Storage VMs	
STORAGE ^	Name	EHC_NFS All Storage VMs
Overview Volumes	EHC_ISCSI	Compiler Catting Compliant (and a Depart) - File Comp
LUNS	EHC_NFS	Overview Settings Shapmirror (Local or Remote) File System
Consistency Groups	HMC_187	Pinned
NVMe Namespaces	HMC_3510	
Shares	HMC_ISCSI_3510	Export Policies
Qtrees	infra_svm_a300	default 41 Rules
Quotas	JS_EHC_ISCSI	JetStream_NFS_v02
Storage VMs	OTVtest	0.0.0.0/0 for Any
Tiers	svm0	JetStream_NFS_v03 © 0.0.0.0/0 for Anv
NETWORK V	Temp_3510_N1	

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

KLD_DM01	
Copy rules from existing policy	
svm0	•
XPORT POLICY	
default	~
RULES	
	No data
+ Add	

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

172.21.166.0/24			
ACCESS PROTOCOLS			
SMB/CIFS			
FlexCache			
NFS V NFSv3 V NFSv4			
ACCESS DETAILS			
Туре	Read-only Access	Read/Write Access	Superuser Access
All			
All (As anonymous user) (j)			
UNIX	\checkmark		
Kerberos 5			
Kerberos 5i			
Kerberos 5p			
NTLM			
			Cancel S
			5
When deploying a	VI Workload Domain, V	CF validates connect	tivity to the NFS Se

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

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

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



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

NAME		
VCF_WKLD_01		
CAPACITY		
5 🗘 TiB 🗸		
STORAGE VM		
EHC_NFS	~	
Export via NFS		

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

Access Permissions



+

- i - i

GRANT ACCESS TO HOST

default 🗸
JetStream_NFS_v04 Clients : 0.0.0.0/0 Access protocols : Any
NFSmountTest01 3 rules
NFSmountTestReno01 Clients : 0.0.0.0/0 Access protocols : Any
PerfTestVols Clients : 172.21.253.0/24 Access protocols : NFSv3, NFSv4, NFS
TestEnv_VPN Clients : 172.21.254.0/24 Access protocols : Any
VCF_WKLD 2 rules
WKLD_DM01 2 rules
Wkld01_NFS Clients : 172.21.252.205, 172.21.252.206, 172.21.252.207, 172.21.2

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

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

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

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

vmw Cloud Foundation	ŵ	
② Dashboard	«	Network Settings
o Solutions 品 Inventory G Workload Domains	~	View Network Pool details
Hosts Lifecycle Management	>	Network Pool Name
Administration	~	

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

a.	Network Settings			
🗇 Dashboard	Network Pool DNS Configuration	NTP Configuration		
18 Solutions	Create Network Pool			
🖧 inventory 🗸 🗸				
Workload Domains	Ensure that all required networks are selected bas	ed on their usage for workload domains.		
🗇 Hosts	Network Pool Name NFS_NPO	e e e e e e e e e e e e e e e e e e e		
Lifecycle Management >				
Administration ~	Network Type ()	19631 AMODOL		
G Network Settings	NFS Network Information		vMotion Network Information	
Storage Settings				
Recicensing	VLAN ID 😳	3374	VLAN ID	3423
IEI Single Sign On	100	0000	NTTI O	0000
聖 Proxy Settings	HIG O	9000	MIC U	
曲 Online Depot	Network ()	172 21 118 0	Network ()	172.21.157.0
@ Composable Infrastructure	Subnet Mask 😱	255 255 255 0	Subnet Mask 🕕	255.255.255.0
🕼 VMware Aria Suite	Delaute Colonia a		Data B Catavar	100.00.00.00
its Backup	Default Gateway (1)	1/2.21.08.1	Detault Gateway 🕡	1/2.21.807.1
€ _G VMware CEIP				
⊖ Security ~	Included IP Address Ranges	un ant able to add as tempois 🕫 monet	Included IP Address Ranges	unu are ant this to add at remain 70 reasons
Fin Password Management	from that pool.	Perior able to edit of remove in ranges	from that pool.	And are not table to enit or remove in validez
E Certificate Authority	TT 11 10 14 T		175 31 177 191 To 175 31	1077-1713
🖾 Developer Center	1/2/10/19 1/2/2/10/9	C REMOVE	1/2.21.107.121 10. 17.2.2	NEW VE
		A00	To	ADD
	CANCEL			

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

Commission Hosts

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

For more information see Commission Hosts in the VCF Administration Guide.

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

vmw Cloud Foundation	ស						⊘ ~ administrator@vcf.local
Dashboard	~	Hosts					
) Solutions ふ Inventory ④ Worldoed Domains	×	Capacity Utilization acr	ross Hosts	Memory	311.99 ⊂ਦ Total	Hosts	4 Total
Hosts Lifecycle Management		HI 07 CHZ Used	96.07 GHZ Free	02-22 GB Uted	189.76 (JB Free	4 Uned	0 Unatorned
Administration Gil Network Settings	÷	ALL HOSTS ASSIGNED HOSTS UNASS	IGNED HOSTS				

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

Checklist

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



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

	✓ Add Hosts				
1 Host Addition and Validation	You can either choose to add	host one at a time or do	wnload <u>JSON</u> ten	nplate and perform bulk com	mission.
2 Review	• Add new O Import				
	Host FQDN	vcf-wkld-esx02.sddc.n	etapp.com		
	Storage Type	🔿 vsan 💿 nfs	C VMFS or	n FC 🔘 vVol	
	Network Pool Name (j)	NFS_NP01	~		
	User Name	root			
	Password		0		ADD
	Password Hosts Added	× 0	<u>©</u>		dqa S
	Password Hosts Added Hosts added successfully. Add	d more or confirm fingerpr	Tint and validate ho	st	
	Password Hosts Added Hosts added successfully. Add REMOVE Confirm all Fin	d more or confirm fingerpriger Prints (1) Network Pool	Trint and validate ho	ost Confirm FingerPrint	VALIDATE ALL Validation Status
	Password Hosts Added Hosts added successfully. Add REMOVE Onfirm all Fin FODN FODN FODN FODN FODN FODN FODN FODN	d more or confirm fingerpringer Prints (1) Network Pool NFS_NP01 (1)	rint and validate ho IP Address 172.21.166.135	Confirm FingerPrint Confirm FingerPrint SHA256:CKbsinf E0G+I+z/ IpFUoFDI2tLuY FZ47WicVDp6v EQM	VALIDATE ALL Validation Status ©

- 4. Once all hosts to be validated have been added, click on the **Validate All** button to continue.
- 5. Assuming all hosts are validated, click on **Next** to continue.
| EMOVE | Confirm all Finger | Prints 🚺 | | | | VALIDATE ALL |
|-------|------------------------------------|--------------|----------------|--------|--|----------------------|
| | FQDN | Network Pool | IP Address | Confir | m FingerPrint | Validation
Status |
| 2 | vcf-wkld-
esx04.sddc.netapp.com | NFS_NP01 | 172.21.166.138 | 0 | SHA256:9Kg+9
nQaE4SQkOMs
QPON/
k5gZB9zyKN+6
CBPmXsvLBc | ⊘ Valid |
| 2 | vcf-wkld-
esx03.sddc.netapp.com | NFS_NP01 | 172.21.166.137 | 0 | SHA256:nPX4/
mei/
2zmLJHfmPwbk
6zhapoUxV2lO
wZDPFHz+zo | ⊘ Valid |
| 2 : | vcf-wkld-
esx02.sddc.netapp.com | NFS_NP01 | 172.21.166.136 | ۲ | SHA256:AMhyR
60OpTQIYYqO
DJhqVbj/M/
GvrQaqUy7Ce+
M4IWY | ⊘ Valid |
| 2 : | vcf-wkld-
esx01.sddc.netapp.com | NFS_NP01 | 172.21.166.135 | ۲ | SHA256:CKbsinf
EOG+I+z/
IpFUoFDI2tLuY
FZ47WicVDp6v
EQM | ⊘ Valid |

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

Commission Hosts	Review	
	Skip failed hosts during commissioning 🕦 🌑	On
1 Host Addition and Validation	 Validated Host(s) 	
2 Review	vcf-wkld-esx04.sddc.netapp.com	Network Pool Name: NFS_NP01
		IP Address: 172.21.166.138
		Storage Type: NFS
	vcf-wkld-esx03.sddc.netapp.com	Network Pool Name: NFS_NP01
		IP Address: 172.21.166.137
		Storage Type: NFS
	vcf-wkld-esx02.sddc.netapp.com	Network Pool Name: NFS_NP01
		IP Address: 172.21.166.136
		Storage Type: NFS
	vcf-wkld-esx01.sddc.netapp.com	Network Pool Name: NFS_NP01
		IP Address: 172.21.166.135
		Storage Type: NFS
		CANCEL BACK COMMISS

Deploy VI Workload Domain

+

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

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

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

VIIIW Cloud Foundation	ଜ					
Dashboard Solutions Inventory	×	SDDC Manager Dashbc				+WORKLOAD DOMAIN -
C Worldoard Domains		0 Solutions	÷×	CPU, Memory, Storage Usage	⊕ ×	Recent tasks
Lifecycle Management Administration	÷	Worldoad Management	\$ °	CPU	110:16 GHZ Total	3/4/24, 10:00 AM Commissioning host(s) vcf-widd-esxt
Q Network Settings Storage Settings		1 Workload Domains	4 ×	15-43 GHZ Used	94.73 GHZ Free	esx03 sddc netapp com,vcf-wkld-esx esx01 sddc netapp com to VMware c
12 Licensing		Management Domain VI Domain	\$ \$ \$	Top Domains in allocated CPU Usage	vcf-m01	2/22/24, 3:34 AM vSphere Lifecycle Manager Image Up
帶 Proxy Settings		Host Type and Usage	Φ×	Memory	311 98 GB Total 189,76 GB Free	Personality
Composable infrastruct Composable Aria Suite	ture	Host Types Hybrid Host All Flash Host	0 0	Top Domains in allocated Memory Usage	ect-möl	

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

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

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

VI Configuration	NFS Storage	
1 General Info	NFS Share Details	
2 Cluster	Datastore Name	VCF_WKLD_01
3 Compute	Folder (j)	/VCF_WKLD_01
4 Networking	NFS Server IP Address (j)	172.21.118.163
5 Host Selection		
6 NFS Storage		

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

1 General Info	✓ General	
2 Cluster	Virtual Infrastructure Name	vcf-wkld-01
	Organization Name	it-inf
3 Compute	SSO Domain Option	Joining Management SSO Domain
4 Networking	✓ Cluster	
5 Host Selection	Cluster Name	IT-INF-WKLD-01
6 MEC Starson	✓ Compute	
o NES Storage	vCenter IP Address	172.21.166.143
7 Switch Configuration	vCenter DNS Name	vci-wkld-vc01.sddc.netapp.com
8 License	vCenter Subnet Mask	255.255.255.0
9 Review	vCenter Default Gateway	172.21.166.1
	✓ Networking	
	NSX Manager Instance Option	Creating new NSX instance
	NSX Manager Cluster IP	172.21.166.147
	NSX Manager Cluster FQDN	vcf-w01-nsxcl01.sddc.netapp.com
	NSX Manager IP Addresses	172.21.166.144, 172.21.166.145, 172.21.166.146
		CANCEL

Install NetApp NFS Plug-in for VMware VAAI

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

For step-by-step instructions on deploying the NetApp NFS Plug-in for VMware VAAI following the instructions at Install NetApp NFS Plug-in for VMware VAAI.

Video demo for this solution

NFS Datastores as Principal Storage for VCF Workload Domains

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

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

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

Author: Josh Powell, Ravi BCB

Scenario Overview

This scenario covers the following high level steps:

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

Prerequisites

This scenario requires the following components and configurations:

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

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

Refer to Best Practices For Running NFS with VMware vSphere for detailed information specific to VMware vSphere.

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

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

Deployment Steps

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

Create SVM and LIFs on ONTAP storage system

The following step is performed in ONTAP System Manager.

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

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

	stem Manager
DASHBOARD	Storage VMs
INSIGHTS	+ Add
STORAGE ^	Name
Overview	EHC_ISCSI
Volumes	EHC
LUNs	
Consistency Groups	HMC_187
NVMe Namespaces	HMC_3510
Shares	HMC_iSCSI_3510
Buckets	
Qtrees	infra_svm_a300
Quotas	JS_EHC_iSCSI
Storage VMs	OTVtest
Tiers	

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

VCF_NFS	
IPSPACE	
Default	~
Access Protocol	
SMB/CIFS, NFS, S3	iSCSI FC NVMe
Enable SMB/CIFS	
Enable NFS	
Allow NF	S client access
EXPORT P Default	DLICY
Enable S3	



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

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

intaprici-a500-01				
SUBNET				
Without a subnet	~	•		
IP ADDRESS	SUBNET MASK	GATEWAY	BROADCAST DOMAIN AND PORT	
172.21.118.119	24	Add optional gateway	NFS_iSCSI	~
Use the same subn	et mask, gateway, and broad	dcast domain for all of the following	interfaces	
	et mask, gateway, and broad	deast domain for all of the following	interfaces	
ntaphci-a300-02				
SUBNET				
Without a subnet	~	•		
IP ADDRESS	PORT			
172.21.118.120	a0a-3374	•		
se whether to enabl	le the Storage VM A	Administration account (fo	r multi-tenancy environ	me
lick on Save to crea	ate the SVM.			
	due in istuatio			
	aministratio	n		
torage VM A				
torage VM A	ator account			

Set up networking for NFS on ESXi hosts

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

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

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

	< _ vc	f-wkld-01-IT-INF-WK	LD-01-Vds-01
() B = Ø	Summa	ry Monitor Configure	Permissions Ports Host
 • (cf-m01-vc01.sddc.netapp.com • (f-m01-dc01 • (cf-wkld-vc01.sddc.netapp.com • (f-wkld-01-DC 	Swit	tch Details	
vcf-wkld-01-IT-INF-WKLD-01-vds-01		Manufacturer	VMware, Inc.
Crewide Contraction - vcf-w WKLD-01-vcf-w WKLD-01-vcs-	/kld-01-IT-INF-	Networks	3
vcf-wkld-01-IT-INF- Distributed	Port Group		4
> wcf-wkld-01-IT-INF-W Edit Notes.	anage Hosts Imj 	w Distributed Port Group port Distributed Port Group nage Distributed Port Groups	1 21
Upgrade Settings	>		

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

Port binding Port allocation Number of ports Network resource pool	Static binding Elastic 8 C	
Port allocation Number of ports Network resource pool	Elastic ~ ①	
Number of ports Network resource pool	8 0	
Network resource pool		
	(default) V	
VLAN		
VLAN type	VLAN ~	
VLAN ID	3374 0	
Advanced		
Customize default policies configuration		
	CANCEL	
		ACK NG
	VLAN type VLAN ID Advanced Customize default policies configuration	VLAN type VLAN VLAN U 3374 C Advanced Customize default policies configuration

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



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

Advanced Network failure detection Link status only ~ VLAN Notify switches Yes ~ Security Notify switches Yes ~ Traffic shaping Failback Yes ~ Teaming and failover Yes ~ Yes ~ Monitoring Failover order () Yes ~ Moscellaneous MOVE UP MOVE DOWN Active uplinks I uplink1 Standby uplinks Unused uplinks	General	Load balancing	Route based on originating virtual por
VLAN Ink status only ~ Security Notify switches Yes ~ Traffic shaping Failback Yes ~ Teaming and failover Failback Yes ~ Monitoring Failover order ① Miscellaneous Move UP Move Down Active uplinks uplink1 Upused uplinks Unused uplinks	Advanced		
Security Notify switches Yes > Traffic shaping Failback Yes > Teaming and failover Yes > Movie or order () Miscellaneous Movie UP Movie UP Movie Down Active uplinks uplink1 Uplinks Uplinks	VLAN	Network failure detection	Link status only 👻
Traffic shaping Teaming and failover Monitoring Failover order ① Move UP	Security	Notify switches	Yes 🗸
Teaming and failover Monitoring Miscellaneous MOVE UP MOVE UP Move Down Active uplinks uplink1 Standby uplinks Unused uplinks	Traffic shaping	Failback	Yec v
Monitoring Failover order () Miscellaneous Move UP Move Down Active uplinks uplink2 uplink1 Standby uplinks Unused uplinks	Teaming and failover		
Miscellaneous MOVE UP MOVE DOWN Active uplinks Unused uplinks Unused uplinks	Monitoring	Failover order ()	
Active uplinks	Miscellaneous	MOVE UP MOVE DOWN	
uplink2 uplink1 Standby uplinks Unused uplinks		Active uplinks	
C uplink1 Standby uplinks Unused uplinks		🗔 uplink2	
Standby uplinks Unused uplinks		🗔 uplink1	
Unused uplinks		Standby uplinks	
		Unused uplinks	

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

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

Ξ vSphere Client ${\sf Q}$ Search in all environments					
	 Vcf-wkld-es Summary Monitor 	Configur	.netapp • Permi	.COM	Datastores Networks Updates
 Wcf-m01-vc01.sddc.netapp.com III vcf-m01-dc01 III vcf-m01-cl01 Vcf-wkld-vc01.sddc.netapp.com 	Storage Storage Adapters Storage Devices	Storage Adapters Storage Devices			rs Refresh
Verf-wkld-01-DC Verf-wkld-01-DC Verf-wkld-est01 sddc betabb com	Host Cache Configu Protocol Endpoints I/O Filters	ration	i »	wmk0	r Network Label T & vcf-wkid-01-IT-INF-WKLD-01-vd s-01-pg-mgmt
vcf-wkld-esx02.sddc.netapp.com	Networking	~	: »	🖭 vmk1	協 vcf-wkld-01-IT-INF-WKLD-01-vd s-01-pg-vmotion
vcf-wkld-esx03.sddc.netapp.com	VMkernel adapters		i »	🖭 vmk2	
₿ vcf-w01-otv9	Physical adapters TCP/IP configuratio	n	: »	🚥 vmk10	論

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

Add Networking	Select connection type	×
	Select a connection type to create.	
1 Select connection type		
	VMkernel Network Adapter	
2 Select target device	The VMkernel TCP/IP stack handles traffic for ESXi services such as vSphere vMotion, iSCSI, NFS, FCoE, Fault	
	Tolerance, vSAN, host management and etc.	
3 Port properties		
	Virtual Machine Port Group for a Standard Switch	
4 IPv4 settings	A port group handles the virtual machine traffic on standard switch.	
5 Ready to complete	Physical Network Adapter	
	A physical network adapter handles the network traffic to other hosts on the network.	

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

	Select a target device for the new connection.		
1 Select connection type	 Select an existing network 		
	Select an existing standard switch		
2 Select target device	New standard switch		
3 Port properties	Quick Filter Enter value		
4 IPv4 settings	Name	NSX Port Group ID	Distributed Switch
	O 🕼 vcf-wkld-01-iscsi-a	222	vcf-wkld-01-IT-INF-WKLD-01-vds
5 Ready to complete	C k vcf-wkld-01-iscsi-b	1944	vcf-wkld-01-IT-INF-WKLD-01-vds
	C & vcf-wkld-01-IT-INF-WKLD-01-vds-01-pg-mgmt	877	vcf-wkld-01-IT-INF-WKLD-01-vds
	O kright vcf-wkid-01-IT-INF-WKLD-01-vds-01-pg-nfs	844	vcf-wkld-01-IT-INF-WKLD-01-vds
	C & vcf-wkld-01-IT-INF-WKLD-01-vds-01-pg-vmotion	24	vcf-wkld-01-IT-INF-WKLD-01-vds
	🕒 🏔 vcf-wkld-01-nfs		vcf-wkld-01-IT-INF-WKLD-01-vds
	O I 🖾 vcf-wkld-01-nvme-a		vcf-wkld-01-IT-INF-WKLD-01-vds
	◯ 🖄 vcf-wkld-01-nvme-b		vcf-wkld-01-IT-INF-WKLD-01-vds
	Manage Columns		81

- 4. On the **Port properties** page keep the defaults (no enabled services) and click on **Next** to continue.
- 5. On the **IPv4 settings** page fill in the **IP address**, **Subnet mask**, and provide a new Gateway IP address (only if required). Click on **Next** to continue.

Add Networking	IPv4 settings				×
1 Select connection type	Specify VMkernel IPv4 setting	ηs.			
2 Select target device	 Obtain IPv4 settings auto Use static IPv4 settings 	matically			
3 Port properties	IPv4 address	172.21.118.145			
4 IPv4 settings	Subnet mask	255.255.255.0			
5 Ready to complete	Default gateway	Override default gateway for this adapter			
τ.		172.21.166.1			
	DNS server addresses	10.61.185.231			
			CANCEL	BACK	Ŧ
6. Review the your selections	on the Ready to co	mplete page and click on Fini	sh to crea	ate the	

337

Add Networking	Ready to comple	te	
1	Review your selections bef	ore finishing the wizard	
1 Select connection type	✓ Select target device		
2 Select target device	Distributed port group	vcf-wkld-01-nfs	
3 Port properties	Distributed switch	vcf-wkld-01-IT-INF-WKLD-01-vds-01	
	✓ Port properties		
4 IPv4 settings	New port group	vcf-wkld-01-nfs (vcf-wkld-01-IT-INF-WKLD-01-vds-01)	
	MTU	9000	
5 Ready to complete	vMotion	Disabled	
	Provisioning	Disabled	
	Fault Tolerance logging	Disabled	
	Management	Disabled	
	vSphere Replication	Disabled	
	vSphere Replication NFC	Disabled	
	VSAN	Disabled	
	vSAN Witness	Disabled	
	vSphere Backup NFC	Disabled	
	NVMe over TCP	Disabled	
		c.	EINU

Deploy and use ONTAP Tools to configure storage

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

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

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

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

Complete the following to Deploy ONTAP tools for VMware vSphere:

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

	< 🗊 vcf-m01-cl01
() ð e Ø	Summary Monitor
 vcf-m01-vc01.sddc.netapp.o vcf-m01-dc01 vcf-m01-cl01 	com Cluster Details
vcf-m01-esx [] A vcf-m01-esx vcf-m01-esx vcf-m01-esx vcf-m01-esx	Add Hosts Total New Virtual Machine New Resource Pool Fault
🔂 vcf-m01-sdc 🚭	Deploy OVF Template
🔂 vcf-m01-vcC	2 ^m

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



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

Deploy OVF Template	Sele	ect storage)
	Select	the storage for the co	onfiguration and dis	sk files				
1 Select an OVF template	Select	crypt this virtual machine virtual disk format	e (i) As defined in the	VM storage policy	~			
2 Select a name and folder		orage Policy able Storage DRS for th	Datastore Def is virtual machine	ault ~				
3 Select a compute resource		Name	T	Storage	Capacity T	Provisioned v	Free T	т ^
4 Review details		vcf-m01-ci01-ds-vs	sanO1	Compatibility	999.97 GB	7.17 TB	225.72 GB	v
5 License agreements	0	vcf-m01-esx01-esx	-install-datastore	-	25.75 GB	4.56 GB	21.19 GB	v
6 Select storage	0	vcf-m01-esx02-es	x-install-datastore	-	25.75 GB	4.56 GB	21.19 GB	V
	0	vcf-m01-esx03-es	x-install-datastore	-	25.75 GB	4.56 GB	21.19 GB	V
7 Select networks	0	vcf-m01-esx04-es	x-install-datastore		25.75 GB	4.56 GB	21.19 GB	v
8 Customize template	<							``
9 Ready to complete	Mai	nage Columns				nems per pa	age 10 V	o neifis

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

Select networks		×
Select a destination network for each	source network.	
		^
Source Network	Destination Network	
	vct-m01-cl01-vds01-pg-vsan	~
Manage Columns	vcf-m01-cl01-vds01-pg-vsan	1 item
	Browse	
IP Allocation Settings		
IP allocation:	Static - Manual	
IP protocol:	IPv4 ~	
	·	
	Select networks Select a destination network for each source Network nat Manage Columns IP Allocation Settings IP allocation: IP protocol:	Select networks Select a destination network for each source network. Source Network Destination Network nat vcf-m01-cl01-vds01-pg-vsan Manage Columns vcf-m01-cl01-vds01-pg-vsan IP Allocation Settings SDDC-DPortGroup-VM-Mgnt IP allocation: Static - Manual IP protocol: IPv4 v

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

Click on **Next** to continue.

	Customize the deployment properties of	this software solution.		
1 Select an OVF template	2 properties have invalid values	and software solution.		
2 Select a name and folder	✓ System Configuration	4 settings		
3 Select a compute resource	Application User Password (*)	Password to assign t reasons, it is recomm	o the administrator accounter accounter accounter and to use a password	unt.For security d that is of eight to
4 Review details		thirty characters and one digit, and one sp	contains a minimum of o pecial character.	ne upper, one low
5 License agreements		Password		0
6 Select storage		Confirm Dossword		
7 Select networks		Commin Password		
8 Customize template9 Ready to complete	NTP Servers	A comma-separated Servers. If left blank, tools based time s	list of hostnames or IP ac VMware ynchronization will be use	Idresses of NTP
		172.21.166.1		
	Maintenance User Password (*)	Password to assign t	o maint user account.	
		Password		۵
		Confirm Password	•••••	0
	Enable VMware Cloud Foundation (VCF	vCenter server and us	er details are ignored whe	en VCF is enabled
1 Select an OVF template	Enable VMware Cloud Foundation (VCF	vCenter server and us	er details are ignored whe	en VCF is enabled.
 Select an OVF template Select a name and folder Select a compute resource 	Configure Venter of Enable Venter of Enable Venter Cloud Foundation (VCF vCenter Server Address (*)	 Sectings vCenter server and us Specify the IP address to. 	er details are ignored whe	en VCF is enabled. vCenter to registe
 Select an OVF template Select a name and folder Select a compute resource 	Computer Vertice of Enable Vert Enable VMware Cloud Foundation (VCF vCenter Server Address (*)	vCenter server and us Specify the IP address to. cf-wkld-vc01.sddc.net	er details are ignored whe /hostname of an existing tapp.com	en VCF is enabled. vCenter to registe
 Select an OVF template Select a name and folder Select a compute resource Review details 	Computer Vertice of Enable Vert Enable VMware Cloud Foundation (VCF vCenter Server Address (*) Port (*)	vCenter server and us vCenter server and us Specify the IP address to. cf-wkld-vc01.sddc.net Specify the HTTPS por 443	r details are ignored whe /hostname of an existing tapp.com t of an existing vCenter to	en VCF is enabled. vCenter to registe o register to.
 Select an OVF template Select a name and folder Select a compute resource Review details License agreements Select storage 	Conlight Venter of Enable Venter (VCF) VCenter Server Address (*) Port (*) Username (*)	vCenter server and us vCenter server and us Specify the IP address to cf-wkld-vc01.sddc.net Specify the HTTPS por 443 Specify the username administrator@vsphe	r details are ignored whe	en VCF is enabled. vCenter to registe o register to. register to.
 Select an OVF template Select a name and folder Select a compute resource Review details License agreements Select storage Select networks 	Conlight Venter of Enable Venter of Enable Venter of Enable Venter of Enable Venter of Venter of Venter of Venter Server Address (*) Port (*) Username (*) Password (*)	vCenter server and us vCenter server and us Specify the IP address to cf-wkld-vc01.sddc.net Specify the HTTPS por 443 Specify the username administrator@vsphe Specify the password	Another details are ignored when the formation of an existing temp.com to f an existing vCenter to an existing vCenter to re.local of an existing vCenter to the temp.com to re.local of an existing vCenter to the temp.com temp.co	en VCF is enabled. vCenter to registe o register to. register to.
 Select an OVF template Select a name and folder Select a compute resource Review details License agreements Select storage Select networks Customize template 	Conlight Venter of Enable Venter of Enable Venter of Enable VMware Cloud Foundation (VCF vCenter Server Address (*) Port (*) Username (*) Password (*)	Specify the IP address to Cf-wkld-vc01.sddc.nel Specify the HTTPS por 443 Specify the username administrator@vsphe Specify the password Password	r details are ignored whe	en VCF is enabled. vCenter to registe o register to. register to.
 Select an OVF template Select a name and folder Select a compute resource Review details License agreements Select storage Select networks Customize template Ready to complete 	Conlight Center of Enable Vel Enable VMware Cloud Foundation (VCF vCenter Server Address (*) Port (*) Username (*) Password (*)	vCenter server and us vCenter server and us Specify the IP address to cf-wkld-vc01.sddc.net Specify the HTTPS por 443 Specify the username administrator@vsphe Specify the password Password Confirm Password	er details are ignored whe	en VCF is enabled. vCenter to register o register to. register to. ©
 Select an OVF template Select a name and folder Select a compute resource Select a compute resource License agreements License agreements Select storage Select networks Customize template Ready to complete 	Conlight Center of Enable Vel Enable VMware Cloud Foundation (VCF vCenter Server Address (*) Port (*) Username (*) Password (*) Vetwork Properties	Specify the IP address Co. Confirm Password Specify the Jackson Specify the HTTPS por 443 Specify the username administrator@vsphe Specify the password Password Sastings	er details are ignored whe	en VCF is enabled. vCenter to register o register to. register to. @
 Select an OVF template Select a name and folder Select a compute resource Review details License agreements Select storage Select networks Customize template Ready to complete 	 Conlight Verter of Enable Verter of Enable Verter of Enable VMware Cloud Foundation (VCF vCenter Server Address (*) Port (*) Username (*) Password (*) > Network Properties Host Name	Confirm Password Specify the hostname desired) vcertury	er details are ignored whe	en VCF is enabled. vCenter to register o register to. register to. () () () () () () () () () ()
 Select an OVF template Select a name and folder Select a compute resource Review details License agreements Select storage Select networks Customize template Ready to complete 	 Conlight Control of Fight Control of Control	Specify the IP address to. cf-wkld-vc01.sddc.nel Specify the ITTPS por 443 Specify the HTTPS por 443 Specify the username administrator@vsphe Specify the password Password Confirm Password 8 settings Specify the hostname desired) vcf-w01-otv9 Specify the IP address desired)	er details are ignored whe	en VCF is enabled. vCenter to registe o register to. register to. egister to. 0 0 0 0 0 0 0 0 0 0 0 0 0

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

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



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

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

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

\equiv vSphere Client C	$\boldsymbol{\zeta}$ Search in al	l environments			
NetApp ONTAP tools INSTANCE 172.21.166.149:8443 ~					
Overview	Storage	e Systems			
Storage Systems	ADD	REDISCOVER ALL			
Storage capability profile					

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

Add Storage System

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

vCenter server	vcf-m01-vc01.sddc.netapp.com ~
Name or IP address:	172.16.9.25
Username:	admin
Password:	•••••
Port:	443
Advanced options 🔨	
ONTAP Cluster Certificate:	 Automatically fetch O Manually upload
	CANCEL SAVE & ADD MORE ADD

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

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

\equiv vSphere Client $$ Q	Search in all environments	
NetApp ONTAP tools INSTAI	NCE 172.21.166.149:8443 ×	
Overview	ONTAP tools for VMware vSphere	
Storage Systems	Getting Started Traditional Dashboard vVols Dashboard	
Storage capability profile Storage Mapping	ONTAP tools for VMware vSphere is a vCenter Server plug-in that provides e	end-to-end lifecycle management for virtual machines in VMware envi
Settings	e + — — — — — — — — — — — — — — — — — — —	;
 Reports Datastore Report Virtual Machine Report 	Add Storage System	Provision Datastore
vVols Datastore Report vVols Virtual Machine Report	Add storage systems to ONTAP tools for VMware vSphere.	Create traditional or vVols datastores.
Log Integrity Report	ADD	PROVISION

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

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

New Datastore	General			
1 General	Specify the details of the datast	ore to provision.		
2 Storage system	Provisioning destination:	vcf-wkld-01-DC	BROWSE	
3 Storage attributes	Туре:	• NFS O VMFS O vVols		
4 Summary	Name:	VCF_WKLD_05_NFS		
	Size:	2TB	~	
	Protocol:	• NFS 3		
		Distribute datastore data across the ONT	AP cluster.	
		🕑 Use storage capability profile for provisio	ning	
	Advanced options >			
				CANCEL

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

New Datastore	Storage system		
1	Specify the storage capability p	rofiles and the storage system you want to use.	
1 General	Storage capability profile:	Platinum_AFF_A	~
2 Storage system			
	Storage system:	ntaphci-a300e9u25 (172.16.9.25)	×
3 Storage attributes			
	Storage VM:	VCF_NFS	×
4 Summary			

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

New Datastore	Storage attribu	tes	
1 General	Specify the storage det	ails for provisioning the datastore.	
2 Storage system	Aggregate:	EHCAggr02 - (25350.17 GB Free)	~
3 Storage attributes	Volumes:	Automatically creates a new volume.	
4 Summary	Advanced options >		

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

	General		
1 General	vCenter server:	vcf-wkld-vc01.sddc.netapp.com	
	Provisioning destination:	vcf-wkld-01-DC	
2 Storage system	Datastore name:	VCF_WKLD_05_NFS	
2 Storage attributes	Datastore size:	2 TB	
5 Storage attributes	Datastore type:	NFS	
4 Summary	Protocol:	NFS 3	
-	Datastore cluster:	None	
	Storage capability profile:	Platinum_AFF_A	
	Storage system details		
	Storage system:	ntaphci-a300e9u25	
	SVM:	VCF_NFS	
	Storage attributes		
	Aggregato	FHCAaar02	

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

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

\equiv vSphere Client Q	Search in all environments	
NetApp ONTAP tools INSTAI	NCE 172.21.166.149:8443 V	
Overview	ONTAP tools for VMware vSphere	
Storage Systems	Getting Started Traditional Dashboard vVols Dashboard	
Storage capability profile Storage Mapping Settings	ONTAP tools for VMware vSphere is a vCenter Server plug-in that provides	s end-to-end lifecycle management for virtual machines in VMware envi
 Reports Datastore Report Virtual Machine Report 	Add Storage System	Provision Datastore
vVols Datastore Report vVols Virtual Machine	Add storage systems to ONTAP tools for VMware vSphere.	Create traditional or vVols datastores.
Report Log Integrity Report	ADD	PROVISION

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

New Datastore	General		
	Specify the details of the datast	ore to provision. ?	
2 Storage system	Provisioning destination:	vcf-wkid-01-DC	BROWSE
3 Storage attributes	Туре:	NFS VMFS OVVols	
4 Summary	Name:	VCF_WKLD_06_VVOLS_NFS	
	Description:		
		1.	
	Protocol:	NFS O ISCSI O FC / FCoE O NVMe/FC	
			CANCEL NEXT

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

New Datastore	Storage system	rofiles and the storage system you want to use.	
1 General	Storage capability profile:	Platinum_AFF_A	
2 Storage system	Storage system:	ntaphci-a300e9u25 (172.16.9.25)	
3 Storage attributes	Storage VM:	VCF_NFS	
4 Summary			

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

Name	Size(GB)	Storage capabili	ty profile	Aggregate	rs S	pace reserve
vcf_wkld_06_vv	2000	Platinum_AFF_/	4 ~	EHCAggri	02 - (25404 GB i \vee 🔤	ADD
New Datastore 1 General 2 Storage system	Storage at specify the storage volumes:	tributes ge details for provisioning f Create new volumes S	he datastore. elect volumes			
3 Storage attributes	Name	T	Size	Storage	Capability Profile	Aggregate
4 Summary	vcf_wkłd	_06_vvols	2000 GB	Platinun	n_AFF_A	EHCAggr02 1-1 of 1 Item
	Name	Size(GB) ()	Storage capabili Platinum_AFF_	ty profile A v	Aggregates EHCAggr02 - (25407.15 G ∨	Space reserve Thin
	Default storage c	apability profile:	Platinum AFF .	Δ	~ CANCEI	BACK

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

	General			
1 General	vCenter server:	vcf-wkld-vc01.sddc.netap	p.com	
	Provisioning destination:	vcf-wkld-01-DC		
2 Storage system	Datastore name:	VCF_WKLD_06_VVOLS_	NFS	
3 Storage attributes	Datastore type:	vVols		
o otorage attributes	Protocol:	NFS		
4 Summary	Storage capability profile:	Platinum_AFF_A		
	SVM:	EHC_NFS		
	SVM:	EHC_NFS		
		No. The Met Circ	T with the	
	New FlexVol Name	New FlexVol Size	Aggregate	Storage Capability Profile
				CANCEL BACK

Additional information

For information on configuring ONTAP storage systems refer to the ONTAP 9 Documentation center.

For information on configuring VCF refer to VMware Cloud Foundation Documentation.

Migration of VMs

Migrate VMs to ONTAP Datastores

Author: Suresh Thoppay

VMware vSphere by Broadcom supports VMFS, NFS, and vVol datastores for hosting virtual machines. Customers have the option to create those datastores with hyper converged infrastructures or with centralized shared storage systems. Customers often see the value with hosting on ONTAP based storage systems to provide space efficient snapshots and clones of Virtual machines, flexiblity to choose various deployment models across the datacenters and clouds, operational efficiency with monitoring and alerting tools, security, governance and optional compliance tools to inspect VM data, etc,.

VMs hosted on ONTAP datastores can be protected using SnapCenter Plugin for VMware vSphere (SCV). SCV creates storage based snapshots and also replicates to remote ONTAP storage system. Restores can be performed either from Primary or Secondary storage systems.

Customers has flexibility to choose Cloud Insights or Aria Operations or combination of both or other third party tools that use ONTAP api to troubleshoot, performance monitoring, reporting and alert notification features.

Customers can easily provision datastore using ONTAP Tools vCenter Plug-in or its API and VMs can be migrated to ONTAP datastores even while it is powered on.



Some VMs which are deployed with external management tool like Aria Automation, Tanzu (or other Kubernetes flavors) are usually depends on VM storage policy. If migrating between the datastores within same VM storage policy, it should be of less impact for the applications. Check with Application owners to properly migrate those VMs to new datastore. vSphere 8 introduced vMotion notification to prepare application for the vMotion.

Network Requirements

It is assumed that dual storage network is already in place for the ONTAP datastore to provide connectivity, fault tolerance and performance boost.

Migration of VMs across the vSphere hosts are also handled by the VMKernel interface of the vSphere host. For hot migration (powered on VMs), VMKernel interface with vMotion enabled service is used and for cold migration (powered off VMs), VMKernel interface with Provisioning service enabled is consumed to move the data. If no valid interface was found, it will use the management interface to move the data which may not be desirable for certain use cases.

orage 🗸 🗸	VN	Ikerr	nel adapters										
Storage Adapters Storage Devices	AC	D NET	WORKING REFRESH	4									
lost Cache Configuration			Device T	Network Label	τ	Switch	τ	IP Address	т	TCP/IP Stack	т	Enabled Services	
Protocol Endpoints	1	>>	🖭 vmk0	🙆 Mgmt 181		DSwitch		10.61.181.213		Default		Management	
/O Filters	1	>>	🖭 vmk1	음) vSAN 3376		DSwitch		172.21.120.103		Default		VSAN	
tworking V	-	>>	😇 vmk2	Motion 3373		DSwitch		172.21.117.113		Default		vMotion +2	
/Mkernel adapters	1	>>	📖 vmk3	(船) iSCSI A - 1172		DSwitch		10.63.172.91		Default			
hysical adapters	1	>>	🖭 vmk4	(음) iSCSI B - 1172		DSwitch		10.63.172.92		Default			
DMA adapters	:	>>	🖭 vmk5	🛞 Data A - 3374		B DSwitch		172.21.118.123		Default			
CP/IP configuration		124		0		-		170 01 160 100		Default		Provisioning	

When you edit the VMKernel interface, here is the option to enable the required services.

vmk2 - Edit Settings	esxi-hc-03.sddc.netap	p.com		×
Port properties	TCP/IP stack	Default	*	
IPv4 settings	MTU (Bytes)	9000		
IPv6 settings				
	Available services			
	Enabled services	 ✓ vMotion Provisioning ✓ Fault Tolerance logging Management vSphere Replication 	VSphere Replication NFC VSAN VSAN Witness VSphere Backup NFC NVMe over TCP	NVMe over RDMA
Ensure at leaved vMotion and	ast two high-speed a Provisioning VMke	active uplink nics are	e available for the po	CANCEL OK

VM Migration Scenarios

vMotion is often used to migrate the VMs irrespective of its power state. Additional considerations and migration procedure for specific scenarios is available below.



Understand VM Conditions and Limitation of vSphere vMotion before proceeding with any VM migration options.

Follow the procedure below to migrate VMs to new Datastore using UI.

1. With vSphere Web Client, select the Datastore from the storage inventory and click on VMs tab.

	ents
 (1) (1) (2) (2) (2) (2) (2) (2) (2) (2) (2) (2	Summary Monitor Configure Permissions Files Hosts VMs
 vcsa-hc.sddc.netapp.com Datacenter 	Virtual Machines VM Templates

2. Select the VMs that needs to be migrated and right click to select Migrate option.



3. Choose option to change storage only, Click Next

4 Virtual Machines - Migrate	Change the virtual machines' compute resource, storage, or both.
	Change compute resource only
i Select a migration type	Migrate the virtual machines to another host or cluster.
2 Select storage	Change storage only
	Migrate the virtual machines' storage to a compatible datastore or datastore cluster.
3 Ready to complete	Change both compute resource and storage
	Migrate the virtual machines to a specific host or cluster and their storage to a specific datastore or datastore cluster
	Cross vCenter Server export
	Migrate the virtual machines to a vCenter Server not linked to the current SSO domain.
	CANCEL

4. Select the desired VM Storage Policy and pick the datastore that is compatible. Click Next.



4 Virtual Machines -	Ready to comp	lete	×
Migrate	Verify that the informat	ion is correct and click Finish to start the migration.	
1 Select a migration type	Migration Type	Change storage, Leave VM on the original compute resource	
2 Select storage	Virtual Machine Storage	Migrating 4 VMs ASA_VVOLS_1	
3 Ready to complete	Disk Format	NetApp Storage Thin Provision	
1			
		CANCEL BACK	FINISH
nigrate VMs using PowerC	LI, here is the sar	nple script.	

```
#Authenticate to vCenter
Connect-VIServer -server vcsa.sddc.netapp.local -force
# Get all VMs with filter applied for a specific datastore
$vm = Get-DataStore 'vSanDatastore' | Get-VM Har*
#Gather VM Disk info
$vmdisk = $vm | Get-HardDisk
#Gather the desired Storage Policy to set for the VMs. Policy should be
available with valid datastores.
$storagepolicy = Get-SPBMStoragePolicy 'NetApp Storage'
#set VM Storage Policy for VM config and its data disks.
$vm, $vmdisk | Get-SPBMEntityConfiguration | Set-
SPBMEntityConfiguration -StoragePolicy $storagepolicy
#Migrate VMs to Datastore specified by Policy
$vm | Move-VM -Datastore (Get-SPBMCompatibleStorage -StoragePolicy
$storagepolicy)
#Ensure VM Storage Policy remains compliant.
$vm, $vmdisk | Get-SPBMEntityConfiguration
```

Follow the procedure below to migrate VMs to new Datastore using UI.

1. With vSphere Web Client, select the Cluster from the Host and Cluster inventory and click on VMs tab.

\equiv vSphere Client Q Search in all environments	
(1) (3) (3)	Image: Vcf-m01-cl01 : ACTIONS Summary Monitor Configure Permissions Hosts VMs Datastores Networks Updates
 ✓ ✓ vcf-m01-vc01.sddc.netapp.com ✓ ✓ vcf-m01-dc01 	Virtual Machines VM Templates vApps
✓ []] vcf-m01-cl01	Quick Filter 😕 Enter value

2. Select the VMs that needs to be migrated and right click to select Migrate option.

gke-admin-ws-1-28-repeat	Actions - 4 Objects	32.78 GE
ि । । वि ake-admin-ws-asy	Power	> 46.51 GB
	Guest OS	>
🔽 🗏 🛱 <u>hammerdb-01</u>	Snapshots	> 16.31 GB
ammerdb-02		15.55 GB
ammerdb-03	VM Policies))
Mammerdb-04	Template	18.41 GB
	Template	

3. Choose option to change storage only, Click Next

4 Virtual Machines - Migrate	Select a migration type	
Migrate	Change the virtual machines' compute resource, storage, or both.	
1 Select a migration type	Change compute resource only	
	Migrate the virtual machines to another nost or cluster.	
2 Select storage	Change storage only Migrate the virtual machines' storage to a compatible datastore or datastore cluster.	
3 Ready to complete	Change both compute resource and storage	
1	Migrate the virtual machines to a specific host or cluster and their storage to a specific datastore or datastore cluster.	
	Cross vCenter Server export	
	Migrate the virtual machines to a vCenter Server not linked to the current SSO domain.	
	CANCEL	хт

4. Select the desired VM Storage Policy and pick the datastore that is compatible. Click Next.



4 Virtual Machines - Migrate	Ready to comp Verify that the informat	lete ion is correct and click Finish to start th	e migration.		×
1 Select a migration type	Migration Type Virtual Machine	Change storage, Leave VM on the o Migrating 4 VMs	riginal compute resource	e	
2 Select storage	Storage VM storage policy	ASA_VVOLS_1			
3 Ready to complete	Disk Format	Thin Provision			
			C/	ANCEL BACK	FINISH
			C/	ANCEL BACK	FINISH
```
#Authenticate to vCenter
Connect-VIServer -server vcsa.sddc.netapp.local -force
# Get all VMs with filter applied for a specific cluster
$vm = Get-Cluster 'vcf-m01-cl01' | Get-VM Aria*
#Gather VM Disk info
$vmdisk = $vm | Get-HardDisk
#Gather the desired Storage Policy to set for the VMs. Policy should be
available with valid datastores.
$storagepolicy = Get-SPBMStoragePolicy 'NetApp Storage'
#set VM Storage Policy for VM config and its data disks.
$vm, $vmdisk | Get-SPBMEntityConfiguration | Set-
SPBMEntityConfiguration -StoragePolicy $storagepolicy
#Migrate VMs to Datastore specified by Policy
$vm | Move-VM -Datastore (Get-SPBMCompatibleStorage -StoragePolicy
$storagepolicy)
#Ensure VM Storage Policy remains compliant.
$vm, $vmdisk | Get-SPBMEntityConfiguration
```



When Datastore Cluster is in use with fully automated storage DRS (Dynamic Resource Scheduling) and both (source & target) datastores are of same type (VMFS/NFS/vVol), Keep both datastores in same storage cluster and migrate VMs from source datastore by enabling maintenance mode on the source. Experience will be similar to how compute hosts are handled for maintenance.



Refer CPU Compatibility and vSphere Enhanced vMotion Compatibility when source and target hosts are of different CPU family or model.

Follow the procedure below to migrate VMs to new Datastore using UI.

1. With vSphere Web Client, select the Cluster from the Host and Cluster inventory and click on VMs tab.

<	D vcf-m01-cl01 : Actions
	Summary Monitor Configure Permissions Hosts VMs Datastores Networks Updates
 vcf-m01-vc01.sddc.netapp.com vcf-m01-dc01 	Virtual Machines VM Templates vApps
✓ []] vcf-m01-cl01	Quick Filter 🗸 Enter value

2. Select the VMs that needs to be migrated and right click to select Migrate option.

🔲 🗄 🔀 gke-admin-ws-1-28-repeat	Actions - 4 Objects	32.78 G
「」 「」 」 」 」 」 」 」 」 」 」 」 」 」 」 」 」 」 」	Power	> 46.51 G
	Guest OS	>
✓ #	Snapshots	> 16.31 GE
Ammerdb-02	🛱 Migrate	15.55 G
🔽 🗄 🗗 <u>hammerdb-03</u>	VM Policies	> 15.44 G
Mammerdb-04		18.41 GE
	Template	>

3. Choose option to change compute resource and storage, Click Next



4. Navigate and pick the right cluster to migrate.

4 Virtual Machines - Migrate	Select a compute resource × Select a cluster, host, vApp or resource pool to run the virtual machines.
1 Select a migration type 2 Select a compute resource 3 Select storage 4 Select networks 5 Select vMotion priority 6 Ready to complete	 © vcf-m01-vc01.sddc.netapp.com © vcf-wkld-vc01.sddc.netapp.com © vcf-wkld-01-DC > IT-INF-WKLD-01
	Compatibility Compatibility checks succeeded. CANCEL BACK NEXT

5. Select the desired VM Storage Policy and pick the datastore that is compatible. Click Next.



6. Pick the VM folder to place the target VMs.

4 Virtual Machines - Migrate	Select TOIGEr Select the destination virtual machine folder for the virtual machine migration. Select location for the virtual machine migration.	3
1 Select a migration type	✓ I vcf-wkld-01-DC	
2 Select a compute resource	Discovered virtual machine VCLS	
3 Select storage		
4 Select folder		
5 Select networks		
6 Select vMotion priority		
7 Ready to complete		
	✓ Compatibility checks succeeded.	
	CANCEL BACK	NEXT
elect the target port group).	



8. Review and click on Finish.

4 Virtual Machines -	Ready to comp	lete	×
Migrate	Verify that the informati	ion is correct and click Finish to start the migration.	
1. Coloct a ministrian tuna	Migration Type	Change storage. Leave VM on the original compute resource	
1 Select a higration type	Virtual Machine	Migrating 4 VMs	
2 Select storage	Storage	ASA_VVOLS_1	
	VM storage policy	NetApp Storage	
3 Ready to complete	Disk Format	Thin Provision	
		CANCEL BACI	FINISH
o migrate VMs using PowerCl	_I, here is the sar	nple script.	

```
#Authenticate to vCenter
Connect-VIServer -server vcsa.sddc.netapp.local -force
# Get all VMs with filter applied for a specific cluster
$vm = Get-Cluster 'vcf-m01-cl01' | Get-VM Aria*
#Gather VM Disk info
$vmdisk = $vm | Get-HardDisk
#Gather the desired Storage Policy to set for the VMs. Policy should be
available with valid datastores.
$storagepolicy = Get-SPBMStoragePolicy 'NetApp Storage'
#set VM Storage Policy for VM config and its data disks.
$vm, $vmdisk | Get-SPBMEntityConfiguration | Set-
SPBMEntityConfiguration -StoragePolicy $storagepolicy
#Migrate VMs to another cluster and Datastore specified by Policy
$vm | Move-VM -Destination (Get-Cluster 'Target Cluster') -Datastore
(Get-SPBMCompatibleStorage -StoragePolicy $storagepolicy)
#When Portgroup is specific to each cluster, replace the above command
with
$vm | Move-VM -Destination (Get-Cluster 'Target Cluster') -Datastore
(Get-SPBMCompatibleStorage -StoragePolicy $storagepolicy) -PortGroup
(Get-VirtualPortGroup 'VLAN 101')
#Ensure VM Storage Policy remains compliant.
$vm, $vmdisk | Get-SPBMEntityConfiguration
```

Follow the procedure below to migrate VMs to new vCenter server which is listed on same vSphere Client UI.



For additional requirements like source and target vCenter versions,etc., check vSphere documentation on requirements for vMotion between vCenter server instances

1. With vSphere Web Client, select the Cluster from the Host and Cluster inventory and click on VMs tab.

\equiv vSphere Client $$ Q $$ Search in all environments	
<pre></pre>	D VCF-M01-CI01 ACTIONS
(i) B) = 👳	Summary Monitor Configure Permissions Hosts VMs Datastores Networks Updates
	Virtual Machines VM Templates vApps
✓ [□] vcf-m01-cl01	Quick Filter 🗸 Enter value

2. Select the VMs that needs to be migrated and right click to select Migrate option.

gke-admin-ws-1-28-repeat	Actions - 4 Objects	32	.78 GE
□ □ □ □ □ □ □ □ □ □ □ □ □ □ □ □ □ □ □	Power	> 46	.51 GB
	Guest OS	>	
✓ I #	Snapshots	> 16.	31 GB
✓ III III hammerdb-02	🛱 Migrate	15.	55 GB
✓ III III hammerdb-03	VM Policies	> 15.	44 GB
Nammerdb-04		18.	41 GB
	Template	>	

3. Choose option to change compute resource and storage, Click Next



4. Select the target cluster in target vCenter server.

4 Virtual Machines - Migrate	Select a compute resource × Select a cluster, host, vApp or resource pool to run the virtual machines.
1 Select a migration type 2 Select a compute resource 3 Select storage 4 Select networks 5 Select vMotion priority 6 Ready to complete	 © vcf-m01-vc01.sddc.netapp.com © vcf-wkld-vc01.sddc.netapp.com © vcf-wkld-01-DC > IT-INF-WKLD-01
	Compatibility Compatibility checks succeeded.

5. Select the desired VM Storage Policy and pick the datastore that is compatible. Click Next.



6. Pick the VM folder to place the target VMs.

4 Virtual Machines - Migrate	Select folder Select the destination virtual machine folder for the virtual machine migration.	
1 Select a migration type	 vcf-wkld-01-DC 	
2 Select a compute resource	Discovered virtual machine CLS	
3 Select storage		
4 Select folder		
5 Select networks		
6 Select vMotion priority		
7 Ready to complete		
	✓ Compatibility checks succeeded.	
	CANCEL BACK	NEXT
elect the target port group		



8. Review the migration options and click Finish.

4 Virtual Machines - Migrate	Ready to comp Verify that the informat	lete ion is correct and click Finish to start the migration.		×
1 Select a migration type	Migration Type Virtual Machine	Change storage. Leave VM on the original compute Migrating 4 VMs	resource	
2 Select storage	Storage VM storage policy	ASA_VVOLS_1 NetApp Storage		
3 Ready to complete	Disk Format	Thin Provision		
			CANCEL	FINISH
To migrate VMs using PowerCLI	, here is the sar	nple script.		

```
#Authenticate to Source vCenter
$sourcevc = Connect-VIServer -server vcsa01.sddc.netapp.local -force
$targetvc = Connect-VIServer -server vcsa02.sddc.netapp.local -force
# Get all VMs with filter applied for a specific cluster
$vm = Get-Cluster 'vcf-m01-cl01' -server $sourcevc| Get-VM Win*
#Gather the desired Storage Policy to set for the VMs. Policy should be
available with valid datastores.
$storagepolicy = Get-SPBMStoragePolicy 'iSCSI' -server $targetvc
#Migrate VMs to target vCenter
$vm | Move-VM -Destination (Get-Cluster 'Target Cluster' -server
$targetvc) -Datastore (Get-SPBMCompatibleStorage -StoragePolicy
$storagepolicy -server $targetvc) -PortGroup (Get-VirtualPortGroup)
'VLAN 101' -server $targetvc)
$targetvm = Get-Cluster 'Target Cluster' -server $targetvc | Get-VM
Win*
#Gather VM Disk info
$targetvmdisk = $targetvm | Get-HardDisk
#set VM Storage Policy for VM config and its data disks.
$targetvm, $targetvmdisk | Get-SPBMEntityConfiguration | Set-
SPBMEntityConfiguration -StoragePolicy $storagepolicy
#Ensure VM Storage Policy remains compliant.
$targetvm, $targetvmdisk | Get-SPBMEntityConfiguration
```



This scenario assumes the communication exists between the vCenter servers. Otherwise check the across datacenter location scenario listed below. For prerequisites, check vSphere documentation on Advanced Cross vCenter vMotion

Follow the procedure below to migrate VMs to differnt vCenter server using UI.

1. With vSphere Web Client, select the source vCenter server and click on VMs tab.

vSphere Client Q Search in all environment	ns	C 🔘 a sthoppay@SDDC.NETAPP.COM ~
() () () () () () () () () () () () () (VCSa-hc.sddc.netapp.com : ACTIONS Summary Monitor Configure Permissions Datacenters Hosts & Clusters VMs Datastores Networks	Linked vCenter Server Systems Extensions Updates
 	Virtual Machines VM Templates vApps Quick Filter Enter value	

2. Select the VMs that needs to be migrated and right click to select Migrate option.

gke-admin-ws-1-28-repeat	Actions - 4 Objects	32.78 GE
🗍 🗄 gke-admin-ws-asv	Power	> 46.51 GB
	Guest OS	>
Mammerdb-01	Snapshots	> 16.31 GB
I hammerdb-02	බූ Migrate	15.55 GB
Mammerdb-03	VM Policies	15.44 GB
v lii na hammerdb-04	THE ORCES	18.41 GB
	Template	>

3. Choose option Cross vCenter Server export, Click Next



2 Select a target vCenter Server	vCepter Server address	ucf-wkid-uc01 side natann.com		
2 2 2 0 0	venter server address	vCenter Server FQDN or IP address		
3 Select a compute resource	Username	administrator@vcf.local		
4 Select storage		example/ildomain.local		
5 Select networks	Password		0	
6 Ready to complete	Save vCenter Server address (Password		
	LOGIN			



Migrate | SQLSRV-05 Select storage × Select the destination storage for the virtual machine migration. VM ORIGIN 1 Select a migration type BATCH CONFIGURE CONFIGURE PER DISK Thin Provision 2 Select a target vCenter Server Select virtual disk format VM Storage Policy NFS v 3 Select a compute resource Storage Compatibility **Y** Capacity **Y** Provisioned **Y** Free Name ٣ Ŧ 4 Select storage Compatible 5.93 GB 5 TB VCF_WKLD_01 VCF_WKLD_02_VVOLS Incompatible 2.93 TB 24 MB 2.93 TB VCF_WKLD_03_ISCSI 1.35 TB 2.59 TB Incompatible 3 18 6 Select networks 0 vcf-wkld-esx01-esx-install-datastore Incompatible 25.75 GB 3.68 GB 22.07 GB vcf-wkld-esx02-esx-install-datastore 25.75 GB 3.68 GB 22.07 GB Incompatible Manage Columns Items per page 10 $\, \sim \,$ 7 items Compatibility Compatibility checks succeeded. BACK NEXT CANCEL 8. Select the target VM folder. Select folder Migrate | SQLSRV-05 × Select the destination virtual machine folder for the virtual machine migration. VM ORIGIN 1 Select a migration type Select location for the virtual machine migration. ✓ ☐ vcf-wkld-01-DC 2 Select a target vCenter Server > 🗋 Discovered virtual machine 3 Select a compute resource > 🗋 Oracle SQL Server 4 Select storage > D vCLS 5 Select folder Compatibility checks succeeded. CANCEL BACK 9. Pick the VM portgroup for each network interface card mapping.

7. Select the target datastore based on the VM Storage Policy.



10. Review and click Finish to start the vMotion across the vCenter servers.



To migrate VMs using PowerCLI, here is the sample script.

```
#Authenticate to Source vCenter
$sourcevc = Connect-VIServer -server vcsa01.sddc.netapp.local -force
$targetvc = Connect-VIServer -server vcsa02.sddc.netapp.local -force
# Get all VMs with filter applied for a specific cluster
$vm = Get-Cluster 'Source Cluster' -server $sourcevc| Get-VM Win*
#Gather the desired Storage Policy to set for the VMs. Policy should be
available with valid datastores.
$storagepolicy = Get-SPBMStoragePolicy 'iSCSI' -server $targetvc
#Migrate VMs to target vCenter
$vm | Move-VM -Destination (Get-Cluster 'Target Cluster' -server
$targetvc) -Datastore (Get-SPBMCompatibleStorage -StoragePolicy
$storagepolicy -server $targetvc) -PortGroup (Get-VirtualPortGroup)
'VLAN 101' -server $targetvc)
$targetvm = Get-Cluster 'Target Cluster' -server $targetvc | Get-VM
Win*
#Gather VM Disk info
$targetvmdisk = $targetvm | Get-HardDisk
#set VM Storage Policy for VM config and its data disks.
$targetvm, $targetvmdisk | Get-SPBMEntityConfiguration | Set-
SPBMEntityConfiguration -StoragePolicy $storagepolicy
#Ensure VM Storage Policy remains compliant.
$targetvm, $targetvmdisk | Get-SPBMEntityConfiguration
```

Migration of VMs across datacenter locations

- When Layer 2 traffic is stretched across datacenters either by using NSX Federation or other options, follow the procedure for migrating VMs across vCenter servers.
- HCX provides various migration types including Replication Assisted vMotion across the datacenters to move VM without any downtime.
- Site Recovery Manager (SRM) is typically meant for Disaster Recovery purposes and also often used for planned migration utilizing storage array based replication.
- Continous Data Protection (CDP) products use vSphere API for IO (VAIO) to intercept the data and send a copy to remote location for near zero RPO solution.
- Backup and Recovery products can also be utilized. But often results in longer RTO.
- BlueXP Disaster Recovery as a Service (DRaaS) utilizes storage array based replication and automates certain tasks to recover the VMs at target site.

Migration of VMs in hybrid cloud environment

- Configure Hybrid Linked Mode and follow the procedure of Migration of VMs across vCenter servers in same SSO domain
- HCX provides various migration types including Replication Assisted vMotion across the datacenters to move VM while it is powered on.
 - TR 4942: Migrate Workloads to FSx ONTAP datastore using VMware HCX
 - TR-4940: Migrate workloads to Azure NetApp Files datastore using VMware HCX Quickstart guide
 - Migrate workloads to NetApp Cloud Volume Service datastore on Google Cloud VMware Engine using VMware HCX - Quickstart guide
- BlueXP Disaster Recovery as a Service (DRaaS) utilizes storage array based replication and automates certain tasks to recover the VMs at target site.
- With supported Continous Data Protection (CDP) products that use vSphere API for IO (VAIO) to intercept the data and send a copy to remote location for near zero RPO solution.



When the source VM resides on block vVol datastore, it can be replicated with SnapMirror to Amazon FSx for NetApp ONTAP or Cloud Volumes ONTAP (CVO) at other supported cloud providers and consume as iSCSI volume with cloud native VMs.

VM Template Migration Scenarios

VM Templates can be managed by vCenter Server or by a content library. Distribution of VM templates, OVF and OVA templates, other types of files are handled by publishing it in local content library and remote content libraries can subscribe to it.

- VM templates stored on vCenter inventory can be converted to VM and use the VM migration options.
- OVF and OVA templates, other types of files stored on content library can be cloned to other content libraries.
- Content library VM Templates can be hosted on any datastore and needs to be added into new content library.

1. In vSphere Web Client, right click on the VM template under VM and Templates folder view and select option to convert to VM.

	< B wi	in10-template	ACTIONS
[] þ 🖹 🕸	Summa	ry Monitor Confi	gure Permissions
	VM	Template Details	
		Guest OS	灯 Microsoft Wind
		VMware Tools	Not running, version:
		DNS Name (1)	DESKTOP-HGNBVPL
		IP Addresses	
		Encryption	Not encrypted
 > C SQL Server > Tanzu > Templates > ESXi-8.0-U1a > vdbench template > win10-template > win2019 template > win2022-template 	ື່ເອື້ New VM from Th ເວັ້ອ [®] Convert to Virtua ເວັ້ອ [®] Clone to Templa ເວັ້ອ [®] Clone to Library. Move to folder Rename Edit Notes Tags & Custom A	Attributes	Notes
	Add Permission Alarms		> No no
	Remove from Inv	ventory	
Recent Tasks Alarms	Delete from Disk	ε.	
Task Name	VSAN		>

1. In vSphere Web Client, select Content Libraries

A Home	_
Shortcuts	
윰 Inventory	
Content Libraries	
% Workload Management	
Global Inventory Lists	
Policies and Profiles	
Auto Deploy	
Hybrid Cloud Services	
V> Developer Center	
Administration	
曽 Tasks	
Events	
Tags & Custom Attributes	
☆ Lifecycle Manager	
SnapCenter Plug-in for VMware vSphere	
NetApp ONTAP tools	
Divider Services	
© NSX	
VMware Aria Operations Configuration	
Skyline Health Diagnostics	

- 2. Select the content library in which the item you like to clone
- 3. Right click on the item and click on Clone Item ..

vSphere Client O Search in alternation	iments	C &	10ppay@SDDC.NETAPP.COM ~ (2) (2)
	CL01 ACTIONS		
E CL01	Summary Templates Other Types Subscriptions		
OVF & OVA Templates	Guick Filter ~ Enter value		
VM Templates	Name ↑ Guest OS Stored Security Size: Compliant Size:	Last Modified Last Sync Content UUID Content Description	
	C NetAdo Yes Yes	MB CAV02/202 CL01 umrvapico 2 4, 508:57 P mrvapico 2 M y Item 1440 4 62:57 P content Iterar y Item 1440 442:86:57 F 6 66:55506 38:1511667 86:42167 86:42167 86:42167 86:42167	
	Tags > 82 Delete		
! If using	action menu, make sure cor	rect target object is listed to perform	n action.
4. Select the target co	ntent library and click on OK.		
Clone Librar	y Item NetApp ONTAP	-9.12.1.5	×
Name	NetApp ONTAP-9.12.1.5		
Notes			
Select a content libra	ary where to clone the library item.		
Name	Notes	Creation Date	
○ CL01		9/26/2023, 5:02:03 PM	
		4/1/2024 12:27:51 DM	
		C	ANCEL
5. Validate the item is	available on target content lil	orary.	



Here is the sample PowerCLI script to copy the content libary items from content library CL01 to CL02.

```
#Authenticate to vCenter Server(s)
$sourcevc = Connect-VIServer -server 'vcenter01.domain' -force
$targetvc = Connect-VIServer -server 'vcenter02.domain' -force
#Copy content library items from source vCenter content library CL01 to
target vCenter content library CL02.
Get-ContentLibaryItem -ContentLibary (Get-ContentLibary 'CL01' -Server
$sourcevc) | Where-Object { $_.ItemType -ne 'vm-template' } | Copy-
ContentLibaryItem -ContentLibrary (Get-ContentLibary 'CL02' -Server
$targetvc)
```

1. In vSphere Web Client, select the VM and right click to choose Clone as Template in Library

0000	C	
2) (1)-44401 (2) (1)-44402 (2) (1)-44403 (2) (1)-44403 (2) (1)-44403 (2) (1)-44403 (2) (1)-44403 (2) (1)-44403 (2) (1)-44403	Guest 05 Snaphers Coon Remote Consule (2), Majorie Coon	Virtual Machine Details Powr Status Ower 05 Powr 50 Virtual Machine
යි torreOl හි torreO2 හී SCV 4.5 Data Broker	Fault Telepania VM Policies	p ⁰ Cove to Tempine of Cove as Tempine to Like ay
3 SnapCenter Server 41 SOL_SERVER_01 35 SOLSERVER_01 41 SOLSERVER_02 42 SOLSERVER_02	Template Compatibility Export System Loge	Discription
30,597,01 30,597,04 30,597,04 30,597,04 30,597,04 30,597,04 30,597,08 30,597,08 30,597,08 30,597,08	48 Edit Sertings Move to foster Remeter Edit Nome	Um. O Migrania R. O Ditriescory active
D Veram Backap berke Vinnerkon-Templan Vinnerkon-Templan Vinnerkon-Center Serv WeelD WeelD WeelD	Add Permission Add Permission Alarms Barrole from Inventory	201) They Provide (0) 400 (Incl) 100 (Incl)
Becard Tanks Alarma	Delete from Diak	The GT and Jess Cold version Ph.



When VM template is selected to clone in libary, it can only store it as OVF & OVA template and not as VM template.

2. Confirm Template type is selected as VM Template and follow answering the wizard to complete the operation.

1 Basic information	Template type	VM Template		
Basic Information	Name	SQLSRV-01		
2 Location	Notes			
3 Select a compute resource				
4. Cale et electronic	Select a folder for the te	emplate		
4 Select storage	vcsa-hc.sddc.	netapp.com		
5 Ready to complete				
			CANCEL	N

Use Cases

Migration from third party storage systems (including vSAN) to ONTAP datastores.

• Based on where the ONTAP datastore is provisioned, pick the VM migration options from above.

Migration from previous version to latest version of vSphere.

• If in-place upgrade is not possible, can bring up new environment and use the migration options above.



In Cross vCenter migration option, import from target if export option is not available on source. For that procedure, check Import or Clone a Virtual Machine with Advanced Cross vCenter vMotion

• Migrate VMs from each vSphere Cluster to target workload domain.



To allow network communication with existing VMs on other clusters on source vCenter, either extend NSX segment by adding the source vcenter vSphere hosts to transport zone or use L2 bridge on edge to allow L2 communication in VLAN. Check NSX documentation of Configure an Edge VM for Bridging

Additional Resources

- vSphere Virtual Machine Migration
- What's New in vSphere 8 for vMotion
- vSphere vMotion Resources
- Tier-0 Gateway Configurations in NSX Federation
- HCX 4.8 User Guide
- VMware Site Recovery Manager Documentation
- BlueXP disaster recovery for VMware

Migrate VMs to Amazon EC2 using FSxN

Migrate VMs to Amazon EC2 using FSxN: Overview

Organizations are accelerating their migrations to cloud computing solutions on AWS, taking advantage of services such as Amazon Elastic Compute Cloud (Amazon EC2) instances and Amazon FSx for NetApp ONTAP (FSx for ONTAP) to modernize their IT infrastructures, achieve cost savings, and improve operational efficiency. These AWS offerings enable migrations that optimize total cost of ownership (TCO) through consumption-based pricing models, enterprise storage features, providing the flexibility and scalability to meet evolving global business demands.

Overview

For enterprises deeply invested in VMware vSphere, migrating to AWS is a cost-effective option given the current market conditions, one that presents a unique opportunity.

As these organizations transition to AWS, they seek to capitalize on the cloud's agility and cost benefits while preserving familiar feature sets, particularly when it comes to storage. Maintaining seamless operations with familiar storage protocols—especially iSCSI—processes, tools, and skillsets is crucial when migrating workloads or setting up disaster recovery solutions.

Using the AWS managed storage service FSx for ONTAP for retaining the enterprise storage capabilities, that too coming from any third-party vendor storage from on-premises, enterprises can unlock the power of AWS while minimizing disruption and maximizing their future investments.

This technical report covers how to migrate on-premises VMware vSphere VMs to an Amazon EC2 instance with data disks placed on FSx for ONTAP iSCSI LUNs using the MigrateOps "data-mobility-as-code" functionality of Cirrus Migrate Cloud (CMC).

Solution requirements

There are a number of challenges that VMware customers are currently looking to solve. These organizations want to:

- 1. Leverage enterprise storage capabilities, such as thin provisioning, storage efficiency technologies, zero footprint clones, integrated backups, block-level replication, and tiering. This helps optimize migration efforts and future proof deployment on AWS from Day 1.
- 2. Optimize storage deployments currently on AWS that use Amazon EC2 instances by incorporating FSx for ONTAP and the cost-optimizing features it provides.
- 3. Reduce the total cost of ownership (TCO) of using Amazon EC2 instances with block storage solutions by rightsizing Amazon EC2 instances to meet the required IOPS and throughput parameters. With block storage, Amazon EC2 disk operations have a cap on bandwidth and I/O rates. File storage with FSx for ONTAP uses network bandwidth. In other words, FSx for ONTAP has no VM-level I/O limits.

Technical components overview

FSx for ONTAP concepts

Amazon FSx for NetApp ONTAP is a fully managed AWS storage service that provides NetApp® ONTAP® file systems with all the familiar ONTAP data management features, performance, and APIs on AWS. Its high-performance storage supports multiple protocols (NFS, SMB, iSCSI), providing a single service for workloads using Windows, Linux, and macOS EC2 instances.

Since FSx for ONTAP is an ONTAP file system, it brings a host of familiar NetApp features and services with it, including SnapMirror® data replication technology, thin clones, and NetApp Snapshot[™] copies. By leveraging a low-cost capacity tier via data tiering, FSx for ONTAP is elastic and can reach a virtually unlimited scale. Plus, with signature NetApp storage efficiency technology, it reduces storage costs on AWS even further. For more, see Getting started with Amazon FSx for ONTAP.

File System

The central resource of FSx for ONTAP is its file system based on solid-state drive (SSD) storage. When provisioning an FSx for ONTAP file system, the user inputs a desired throughput and storage capacity, and selects an Amazon VPC where the file system will reside.

Users also have a choice between two built-in high-availability deployment models for the file system: Multi-Availability Zone (AZ) or single-AZ deployment. Each of these options offers its own level of durability and availability, which customers can select depending on their use case's business continuity requirements. Multi-AZ deployments consist of dual nodes that replicate seamlessly across two AZs. The more cost-optimized single-AZ deployment option structures the file system in two nodes split between two separate fault domains that both reside within a single AZ.

Storage Virtual Machines

Data in the FSx for ONTAP file system is accessed through a logical storage partition which is called a storage virtual machine (SVM). An SVM is actually its own file server equipped with its own data and admin access points. When accessing iSCSI LUNs on an FSx for ONTAP file system, the Amazon EC2 instance interfaces directly with the SVM using the SVM's iSCSI endpoint IP address.

While maintaining a single SVM in a cluster is possible, the option of running multiple SVMs in a cluster has a wide range of uses and benefits. Customers can determine the optimal number of SVMs to configure by considering their business needs, including their requirements for workload isolation.

Volumes

Data within an FSx for ONTAP SVM is stored and organized in structures known as volumes, which act as virtual containers. An individual volume can be configured with a single or multiple LUNs. The data stored in each volume consumes storage capacity in the file system. However, since FSx for ONTAP thinly provisions the volume, the volume only takes up storage capacity for the amount of data being stored.

The Cirrus Migrate Cloud MigrateOps concept

CMC is a transactable software-as-a-service (SaaS) offering from Cirrus Data Solutions, Inc. which is available via the AWS Marketplace. MigrateOps is a Data-Mobility-as-Code automation feature of CMC that allows you to declaratively manage your data mobility operations at scale using simple operation configurations in YAML. A MigrateOps configuration determines how you want your data mobility tasks to be executed. To learn more about MigrateOps, see About MigrateOps.

MigrateOps takes an automation-first approach, which is purpose-built to streamline the entire process, ensuring cloud-scale enterprise data mobility without operational disruptions. In addition to the already feature-rich functionalities that CMC offers for automation, MigrateOps further adds other automations that are often managed externally, such as:

- OS remediation
- · Application cutover and approval scheduling
- Zero-downtime cluster migration
- Public/Private cloud platform integration
- Virtualization platform integration
- Enterprise storage management integration
- SAN (iSCSI) configuration

With the above tasks fully automated, all the tedious steps in preparing the on-prem source VM (such as adding AWS agents and tools), creation of destination FSx LUNs, setting up iSCSI and Multipath/MPIO at the AWS destination instance, and all the tasks of stopping/starting application services are eliminated by simply specifying parameters in a YAML file.

FSx for ONTAP is used to provide the data LUNs and rightsize the Amazon EC2 instance type, while providing all the features that organizations previously had in their on-premises environments. The MigrateOps feature of CMC will be used to automate all the steps involved, including provisioning mapped iSCSI LUNs, turning this into a predictable, declarative operation.

Note: CMC requires a very thin agent to be installed on the source and destination virtual machine instances to ensure secure data transfer from the storage source storage to FSx for ONTAP.

Benefits of using Amazon FSx for NetApp ONTAP with EC2 instances

FSx for ONTAP storage for Amazon EC2 instances provides several benefits:

- High throughput and low latency storage that provide consistent high performance for the most demanding workloads
- Intelligent NVMe caching improves performance
- Adjustable capacity, throughput, and IOPs can be changed on the fly and quickly adapt to changing storage demands
- · Block-based data replication from on-premises ONTAP storage to AWS

- Multi-protocol accessibility, including for iSCSI, which is widely used in on-premises VMware deployments
- NetApp Snapshot™ technology and DR orchestrated by SnapMirror prevent data loss and speed up recovery
- Storage efficiency features that reduce storage footprint and costs, including thin provisioning, data deduplication, compression, and compaction
- Efficient replication reduces the time it takes to create backups from hours to just minutes, optimizing RTO
- Granular options for file back up and restores using NetApp SnapCenter®

Deploying Amazon EC2 instances with FSx ONTAP as the iSCSI-based storage layer delivers high performance, mission-critical data management features, and cost-reducing storage efficiency features that can transform your deployment on AWS.

Running a Flash Cache, multiple iSCSI sessions, and leveraging a working set size of 5%, it's possible for FSx for ONTAP to deliver IOPS of ~350K, providing performance levels to meet even the most intensive workloads.

Since only network bandwidth limits are applied against FSx for ONTAP, not block storage bandwidth limits, users can leverage small Amazon EC2 instance types while achieving the same performance rates as much larger instance types. Using such small instance types also keeps compute costs low, optimizing TCO.

The ability of FSx for ONTAP to serve multiple protocols is another advantage, one that helps standardize a single AWS storage service for a wide range of existing data and file services requirements. For enterprises deeply invested in VMware vSphere, migrating to AWS is a cost-effective option given the current market conditions, one that presents a unique opportunity.

Migrate VMs to Amazon EC2 using FSxN: Architecture and Pre-Requisites

This article shows the high-level architecture and deployment pre-requisites for completing the migration.

High level architecture

The diagram below illustrates the high-level architecture of migrating Virtual Machine Disk (VMDK) data on VMware to AWS using CMC MigrateOps:



How to migrate your VMware VMs to AWS using Amazon EC2 and FSx for ONTAP iSCSI

Prerequisites

Before starting the walkthrough steps, make sure the following prerequisites are met:

On AWS

- An AWS account. This includes permissions for subnets, VPC setup, routing tables, security rule migration, security groups, and other requirements for networking such as load balancing. As with any migration, the most effort and consideration should go into networking.
- Appropriate IAM roles that allow you to provision both FSx for ONTAP and Amazon EC2 instances.
- Route tables and security groups are allowed to communicate with FSx for ONTAP.
- Add an inbound rule to the appropriate security group (see below for more details) to allow for secure data transfer from your on-premises data center to AWS.
- A valid DNS that can resolve public internet domain names.
- Check that your DNS resolution is functional and allows you to resolve host names.
- For optimal performance and rightsizing, use performance data from your source environment to rightsize your FSx for ONTAP storage.
- Each MigrateOps session uses one EIP, hence the quota for EIP should be increased for more parallelism. Keep in mind, the default EIP quota is 5.
- (If Active Directory-based workloads are being migrated) A Windows Active Directory domain on Amazon EC2.

For Cirrus Migrate Cloud

- A Cirrus Data Cloud account at cloud.cirrusdata.com must be created before using CMC. Outbound communication with the CDN, Cirrus Data endpoints, and software repository via HTTPS must be allowed.
- Allow communication (outbound) with Cirrus Data Cloud services via HTTPS protocol (Port 443).
- For a host to be managed by the CMC project, the deployed CMC software must initiate a one-way outbound TCP connection to Cirrus Data Cloud.
- Allow TCP protocol, Port 443 access to portal-gateway.cloud.cirrusdata.com which is currently at 208.67.222.222.
- Allow HTTP POST requests (via HTTPS connection) with binary data payload (application/octet-stream). This is similar to a file upload.
- Ensure that portal-gateway.cloud.cirrusdata.com is resolvable by your DNS (or via OS host file).
- If you have strict rules for prohibiting product instances to make outbound connections, the "Management Relay" feature of CMC can be used where the outbound 443 connection is from a single, secured non-production host.

Note: No storage data is ever sent to the Cirrus Data Cloud endpoint. Only management metadata is sent, and this can be optionally masked so that no real host name, volume name, network IP are included.

For migrating data from on-premises storage repositories to AWS, MigrateOps automates the management of a Host-to-Host (H2H) connection. These are optimized, one-way, TCP-based network connections that CMC uses to facilitate remote migration. This process features always-on compression and encryption that can reduce the amount of traffic by up to eight times, depending on the nature of the data.

Note: CMC is designed so that no production data / I/O leaves the production network during the entire

migration phase. As a result, direct connectivity between the source and destination host is required.

Migrate VMs to Amazon EC2 using FSxN: Deployment Guide

This article describes the deployment procedure for this migration solutions.

Configure FSx for ONTAP and Cirrus Data for migration operations

This step-by-step deployment guide shows how to add FSx for ONTAP volume to a VPC. Since these steps are sequential in nature, make sure they are covered in order.

For the purposes of this demonstration, "DRaaSDemo" is the name of the file system created.



Once your AWS VPC is configured and FSx for ONTAP is provisioned based on your performance requirements, log in to cloud.cirrusdata.com and create a new project or access an existing project.

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Before creating the recipe for MigrationOps, AWS Cloud should be added as an integration. CMC provides built-in integration with FSx for ONTAP and AWS. The integration for FSx for ONTAP provides the following automated functionalities:

Prepare your FSx for ONTAP file system:

· Create new volumes and LUNs that match the source volumes

Note: A destination disk in the FSx for ONTAP FS model is a "LUN" that is created on a "Volume" that has enough capacity to contain the LUN plus a reasonable amount of overhead for facilitating snapshots and metadata. The CMC automation takes care of all these details to create the appropriate Volume and the LUN with optional user-defined parameters.

- · Create Host entity (called iGroups in FSx) with the Host Initiator IQN
- · Map newly created volumes to appropriate host entities using mappings
- · Create all other necessary configurations

Prepare Production Host for iSCSI connection:

- If necessary, install and configure iSCSI feature and set up Initiator.
- If necessary, install and configure multipath (MPIO for Windows) with proper vendor identifiers.
- · Adjust system settings, if necessary, according to vendor best practices, e.g. with udev settings on Linux.
- Create and manage iSCSI connections such as persistent/favorite iSCSI targets on Windows.

To configure CMC Integration for FSx for ONTAP and AWS, perform the following steps:

- 1. Log in to the Cirrus Data Cloud portal.
- 2. Go to the Project for which you want to enable the integration.
- 3. Navigate to Integrations \rightarrow Goodies.
- 4. Scroll to find FSx for NetApp ONTAP and click ADD INTEGRATION.



5. Provide a descriptive name (strictly for display purposes) and add the appropriate credentials.

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My Projects	FSXA	Name*	
CURRENT PROJECT NetApps-POC-Project	1 3748	Integration nerve	connection parameters set here once they are encrypted and stored
 Overview Data Migration 	Amazon FSx for NetApp ONTAP Fully managed shared storage built on NetApp's popular ONTAP file system	2. Credentials	
- Migration Hosts		Server Address *	
H2H Connections		Server Address to connect to	Password *
La Migration Sessions		Username	
💷 MigrateOps (1889)		3. Verify Connection From Host	
C Integrations		Deployment*	
- Goodles		Verbase Logging	
- Enabled		If emitted, all interactions between the integration and the vendor will be logged."	This should unly be used for traveleshooting purposes
Reports		Skip Windows MPIO Auto Configuration	
Settings		If enabled, Windows MPID configuration validation and remediation will not be don	e substatically during auto allocation. Only applicable to CMC v5.7.0+.
Help Center			Activate Mindows

6. Once the integration is created, during the creation of a new migration session, select Auto Allocate Destination Volumes to automatically allocate new volumes on FSx for ONTAP.

Note: New LUNs will be created with the same size as the source volume's size, unless "Migrate to Smaller Volumes" is enabled for the migration.

Note: If a host entity (iGroup) doesn't already exist, a new one will be created. All host iSCSI Initiator IQNs will be added to that new host entity.

Note: If an existing host entity with any of the iSCSI initiators already exists, it will be reused.

7. Once done, add the integration for AWS, following the steps on the screen.

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My Projects	Add Integration			
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Note: This integration is used while migrating virtual machines from on-premises storage to AWS along

with FSx for ONTAP integration.

Note: Use management relays to communicate with Cirrus Data Cloud if there is no direct outbound connection for production instances to be migrated.

With Integrations added, it's time to register hosts with the Project. Let's cover this with an example scenario.

Host registration scenario

Guest VMware VMs residing on vCenter in on-premises data center:

• Windows 2016 running with SQL Server with three VMDKs including OS and data disks. It is running an active database. The database is located on a data volume backed by two VMDKs.

Note: Since the source is a VMware environment and VMDKs are used, the Windows iSCSI Initiator software is not currently configured on this guest VM. To connect to our destination storage via iSCSI, both iSCSI and MPIO will have to be installed and configured. Cirrus Data Cloud integration will perform this installation automatically during the process.

Note: The Integration configured in the previous section automates the configuration of the new destination storage in creating the new disks, setting up the host entities and their IQNs, and even remediation of the application VM (host) for iSCSI and multipath configurations.

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This demonstration will migrate the application VMDKs from each VM to an automatically provisioned and mapped iSCSI volume from FSx for ONTAP. The OS VMDK in this case will be migrated to an Amazon EBS volume as Amazon EC2 instances support this Amazon EBS only as the boot disk.

Note: The scale factor with this migration approach is the network bandwidth and the pipe connecting onpremises to AWS VPC. Since each VM has 1:1 host session configured, the overall migration performance depends on two factors:

Network bandwidth

• Target instance type and ENI bandwidth

The migration steps are as follows:

1. Install CMC agent on each host (Windows and Linux) designated for the migration wave. This can be performed by executing a one-line installation command.

To do this, access Data Migration > Migration Hosts > Click on "Deploy Cirrus Migrate Cloud" and click to select "Windows".

Then, copy the *iex* command to the host and run it using PowerShell. Once the deployment of the agent is successful, the host will be added to the Project under "Migration hosts".

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2. Prepare the YAML for each virtual machine.

Note: It is a vital step to have a YAML for each VM that specifies the necessary recipe or blueprint for the migration task.

The YAML provides the operation name, notes (description) along with the recipe name as MIGRATEOPS_AWS_COMPUTE, the host name (system_name) and integration name (integration_name) and the source and destination configuration. Custom scripts can be specified as a before and after cutover action.

```
operations:
        name: Win2016 SQL server to AWS
    _
        notes: Migrate OS to AWS with EBS and Data to FSx for ONTAP
        recipe: MIGRATEOPS AWS COMPUTE
        config:
            system name: Win2016-123
            integration name: NimAWShybrid
            migrateops aws compute:
                region: us-west-2
                compute:
                    instance type: t3.medium
                    availability zone: us-west-2b
                network:
                    vpc id: vpc-05596abe79cb653b7
                    subnet id: subnet-070aeb9d6b1b804dd
                    security group names:
                        - default
                destination:
                    default volume params:
                        volume type: GP2
                    iscsi data storage:
                        integration name: DemoDRaaS
                        default volume params:
                            netapp:
                                qos policy name: ""
                migration:
                    session description: Migrate OS to AWS with EBS and
Data to FSx for ONTAP
                    qos level: MODERATE
                cutover:
                    stop applications:
                        - os shell:
                              script:
                                   - stop-service -name 'MSSQLSERVER'
-Force
                                   - Start-Sleep -Seconds 5
                                   - Set-Service -Name 'MSSQLSERVER'
```
-StartupType Disabled - write-output "SQL service stopped and disabled" - storage unmount: mountpoint: e - storage unmount: mountpoint: f after cutover: - os shell: script: - stop-service -name 'MSSQLSERVER' -Force - write-output "Waiting 90 seconds to mount disks..." > log.txt - Start-Sleep -Seconds 90 - write-output "Now re-mounting disks E and F for SQL..." >>log.txt - storage unmount: mountpoint: e - storage unmount: mountpoint: f - storage mount all: { } - os shell: script: - write-output "Waiting 60 seconds to restart SQL Services..." >>log.txt - Start-Sleep -Seconds 60 - stop-service -name 'MSSQLSERVER' -Force - Start-Sleep -Seconds 3 - write-output "Start SQL Services..." >>log.txt - Set-Service -Name 'MSSQLSERVER' -StartupType Automatic - start-service -name 'MSSQLSERVER' - write-output "SQL started" >>log.txt

- 3. Once the YAMLs are in place, create MigrateOps configuration. To do this, go to Data Migration > MigrateOps, click on "Start New Operation" and enter the configuration in valid YAML format.
- 4. Click "Create operation".

Note: To achieve parallelism, each host needs to have a YAML file specified and configured.

5. Unless the scheduled_start_time field is specified in the configuration, the operation will start immediately.

6. The operation will now execute and proceed. From the Cirrus Data Cloud UI, you can monitor the progress with detailed messages. These steps automatically include tasks that are normally done manually, such as performing auto allocation and creating migration sessions.

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My Projects	← BACK TO OPERATIONS
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Overview	OFFRATION TASKS CONFIDURATION MIGRATION SESSIONS
36 Data Migration	<u> </u>
5 Migration Hosts	
4 H2H Connections	0-0-0-0
4 Migration Sessions	Phase: Preparation
4 MigrateOps	Identify Storage Configuration
Integrations	1 Sinspect system storage configuration to identify existing source and destination volumes information.
Reports	
Settings	2 O Prepare Source Host ISCSI / MPIO Software
Help Center	Install and configure host isosi initiator and multipath software.
TeS Privacy Policy EULA AP1 © 2024 Circus Data Solutions Inc.	3 O Prepare AWS Account Verify and prepare all EC2 related resources for migration purposes in your AWS account. These include AMIs, security groups, key pairs, etc.

Note: During the host-to-host migration, an additional security group with a rule allowing Inbound 4996 port will be created, which will allow the required port for communication and it will be automatically deleted once the synchronization is complete.

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EC2 Dashboard X EC2 Global View Events	<u>EC2</u> > <u>Security Groups</u> > sg-05caf8s31272c71s3 sg-05caf8531272c7153 - (5 - Cirrus Data Cloud Secure Migration 1025 Cirrus Data Cloud Secu	e Migration 102	59			Actions ¥
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7. While this migration session is synchronizing, there is a future step in phase 3 (cutover) with the label "Approval Required." In a MigrateOps recipe, critical tasks (such as migration cutovers) require user approval before they can be executed. Project Operators or Administrators can approve these tasks from the UI. A future approval window can also be created.



- 8. Once approved, the MigrateOps operation continues with the cutover.
- 9. After a brief moment, the operation will be completed.

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My Projects	← BACK TO OPERATIONS
CURRENT PROJECT NetApps-POC-Project	NIMDRSQLN4 SQL server to AWS 10259 Compute Migration for MXS MMDBSGLM4 Created 2 hours ago by Niyaz Mahamed Time Elapsed: 00.35:10 Started 2 hours ago Ended 2 hours ago
Overview	OFFRATION TABLES CONFIGURATION MORATION SESSIONS
56 Data Migration	
🛶 Migration Hosts	
H2H Connections	
4 Migration Sessions	Phase: Preparation
4 MigrateOps 🕬	identify Storage Configuration
ල Integrations	1 V Inspect system storage configuration to identify existing source and destination volumes information.
Reports	
Settings	2 O Prepare Source Host ISCSI / MPIO Software
O Help Center	Install and configure host isosi initiator and multipath software.

Note: With the help of Cirrus Data cMotion[™] technology, the destination storage has been kept up-to-date with all the latest changes. Therefore, after approval is given, this entire final cutover process will take a very short time—less than a minute—to complete.

Post-migration verification

Let's look at the migrated Amazon EC2 instance running the Windows Server OS and the following steps that have completed:

1. Windows SQL Services are now started.

- 2. The database is back online and is using storage from the iSCSI Multipath device.
- 3. All new database records added during migration can be found in the newly migrated database.
- 4. The old storage is now offline.

Note: With just one click to submit the data mobility operation as code, and a click to approve the cutover, the VM has successfully migrated from on-premises VMware to an Amazon EC2 instance using FSx for ONTAP and its iSCSI capabilities.

Note: Due to AWS API limitation, the converted VMs would be shown as "Ubuntu." This is strictly a display issue and does not affect functionality of the migrated instance. An upcoming release will address this issue.

Note: The migrated Amazon EC2 instances can be accessed using the credentials that were used on the onpremises side.

Migrate VMs to Amazon EC2 using FSxN: Other Possibilities and Conclusion

This article highlight other possibilities for this migration solution as well as concluding the topic.

Other possibilities

The same approach can be extended to migrate VMs using in-guest storage on on-premises VMs. The OS VMDK can be migrated using CMC and the in-guest iSCSI LUNs can be replicated using SnapMirror. The process requires breaking the mirror and attaching the LUN to the newly migrated Amazon EC2 instance, as depicted in the diagram below.



Conclusion

This document has provided a complete walkthrough of using the MigrateOps feature of CMC to migrate data stored in on-premises VMware repositories to AWS using Amazon EC2 instances and FSx for ONTAP.

The following video demonstrates the migration process from start to finish:

Migrate VMware VMs to Amazon EC2

To check out the GUI and basic Amazon EBS to FSx for ONTAP local migration, please watch this five-minute demo video:



Migrating to any storage in scale with Cirrus Migrate Cloud

NetApp Hybrid Multicloud with VMware Solutions

VMware Hybrid Multicloud 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.

Introduction to automation for ONTAP and vSphere

This page describes the benefits of automating base ONTAP functionality in a VMware vSphere environment.

VMware automation

Automation has been an integral part of managing VMware environments since the first days of VMware ESX. The ability to deploy infrastructure as code and extend practices to private cloud operations helps to alleviate concerns surrounding scale, flexibility, self-provisioning, and efficiency.

Automation can be organized into the following categories:

Virtual infrastructure deployment

- Guest machine operations
- Cloud operations

(;

There are many options available to administrators with respect to automating their infrastructure. Whether through using native vSphere features such as Host Profiles or Customization Specifications for virtual machines to available APIs on the VMware software components, operating systems, and NetApp storage systems; there is significant documentation and guidance available.

Data ONTAP 8.0.1 and later supports certain VMware vSphere APIs for Array Integration (VAAI) features when the ESX host is running ESX 4.1 or later. VAAI is a set of APIs that enable communication between VMware vSphere ESXi hosts and storage devices. These features help offload operations from the ESX host to the storage system and increase network throughput. The ESX host enables the features automatically in the correct environment. You can determine the extent to which your system is using VAAI features by checking the statistics contained in the VAAI counters.

The most common starting point for automating the deployment of a VMware environment is provisioning block or file-based datastores. It is important to map out the requirements of the actual tasks prior to developing the corresponding automation.

For more information concerning the automation of VMware environments, see the following resources:

- The NetApp Pub. NetApp configuration management and automation.
- The Ansible Galaxy Community for VMware. A collection of Ansible resources for VMware.
- VMware {code} Resources. Resources needed to design solutions for the software-defined data center, including forums, design standards, sample code, and developer tools.

vSphere traditional block storage provisioning with ONTAP

VMware vSphere supports the following VMFS datastore options with ONTAP SAN protocol support indicated.

VMFS datastore options	ONTAP SAN protocol support
Fibre Channel (FC)	yes
Fibre Channel over Ethernet (FCoE)	yes
iSCSI	yes
iSCSI Extensions for RDMA (iSER)	no
NVMe over Fabric with FC (NVMe/FC)	yes
NVMe over Fabric with RDMA over Converged Ethernet (NVMe/RoCE)	no

NVMe over Fabric with RDMA over Converged Ethernet (NVMe/RoCE)

If iSER or NVMe/RoCE VMFS is required, check SANtricity-based storage systems.

vSphere VMFS datastore - Fibre Channel storage backend with ONTAP

This section covers the creation of a VMFS datastore with ONTAP Fibre Channel (FC)

storage.

What you need

- The basic skills necessary to manage a vSphere environment and ONTAP
- An ONTAP storage system (FAS/AFF/CVO/ONTAP Select/ASA) running {ontap_version}
- ONTAP credentials (SVM name, userID, and password)
- ONTAP WWPN of host, target, and SVM and LUN information
- The completed FC configuration worksheet
- vCenter Server credentials
- vSphere host(s) information
 - {vsphere_version}
- · Fabric switch(es)
 - · With connected ONTAP FC data ports and vSphere hosts
 - With the N_port ID virtualization (NPIV) feature enabled
 - Create a single initiator single target zone.
 - Create one zone for each initiator (single initiator zone).
 - For each zone, include a target that is the ONTAP FC logical interface (WWPN) for the SVMs. There should be at least two logical interfaces per node per SVM. Do not use the WWPN of the physical ports.
- An ONTAP Tool for VMware vSphere deployed, configured, and ready to consume.

Provisioning a VMFS datastore

To provision a VMFS datastore, complete the following steps:

- 1. Check compatability with the Interoperability Matrix Tool (IMT)
- 2. Verify that the FCP Configuration is supported.

ONTAP tasks

- 1. Verify that you have an ONTAP license for FCP.
 - a. Use the system license show command to check that FCP is listed.
 - b. Use licen se add -license-code <license code> to add the license.
- 2. Make sure that the FCP protocol is enabled on the SVM.
 - a. Verify the FCP on an existing SVM.
 - b. Configure the FCP on an existing SVM.
 - c. Create s new SVM with the FCP.
- 3. Make sure that FCP logical interfaces are available on an SVM.
 - a. Use Network Interface show to verify the FCP adapter.
 - b. When an SVM is created with the GUI, logical interfaces are a part of that process.
 - c. To rename network interfaces, use Network Interface modify.

4. Create and Map a LUN. Skip this step if you are using ONTAP tools for VMware vSphere.

VMware vSphere tasks

- 1. Verfiy that HBA drivers are installed. VMware supported HBAs have drivers deployed out of the box and should be visible in the Storage Adapter Information.
- 2. Provision a VMFS datastore with ONTAP Tools.

vSphere VMFS Datastore - Fibre Channel over Ethernet storage protocol with ONTAP

This section covers the creation of a VMFS datastore with the Fibre Channel over Ethernet (FCoE) transport protocol to ONTAP storage.

What you need

- · The basic skills necessary to manage a vSphere environment and ONTAP
- An ONTAP storage system (FAS/AFF/CVO/ONTAP Select) running {ontap_version}
- ONTAP credentials (SVM name, userID, and password)
- A supported FCoE combination
- A completed configuration worksheet
- vCenter Server credentials
- vSphere host(s) information
 - {vsphere_version}
- Fabric switch(es)
 - · With either ONTAP FC data ports or vSphere hosts connected
 - With the N_port ID virtualization (NPIV) feature enabled
 - Create a single initiator single target zone.
 - FC/FCoE zoning configured
- Network switch(es)
 - FCoE support
 - DCB support
 - Jumbo frames for FCoE
- · ONTAP Tool for VMware vSphere deployed, configured, and ready to consume

Provision a VMFS datastore

- Check compatibility with the Interoperability Matrix Tool (IMT).
- Verify that the FCoE configuration is supported.

ONTAP tasks

- 1. Verify the ONTAP license for FCP.
 - a. Use the system license show command to verify that the FCP is listed.
 - b. Use license add -license-code <license code> to add a license.

- 2. Verify that the FCP protocol is enabled on the SVM.
 - a. Verify the FCP on an existing SVM.
 - b. Configure the FCP on an existing SVM.
 - c. Create a new SVM with the FCP.
- 3. Verify that FCP logical interfaces are available on the SVM.
 - a. Use Network Interface show to verify the FCP adapter.
 - b. When the SVM is created with the GUI, logical interfaces are a part of that process.
 - c. To rename the network interface, use Network Interface modify.
- 4. Create and map a LUN; skip this step if you are using ONTAP tools for VMware vSphere.

VMware vSphere tasks

- 1. Verify that HBA drivers are installed. VMware-supported HBAs have drivers deployed out of the box and should be visible in the storage adapter information.
- 2. Provision a VMFS datastore with ONTAP Tools.

vSphere VMFS Datastore - iSCSI Storage backend with ONTAP

This section covers the creation of a VMFS datastore with ONTAP iSCSI storage.

For automated provisioning, use the following script: Ansible Playbook.

What you need

- The basic skills necessary to manage a vSphere environment and ONTAP.
- An ONTAP storage system (FAS/AFF/CVO/ONTAP Select/ASA) running {ontap_version}
- ONTAP credentials (SVM name, userID, and password)
- · ONTAP network port, SVM, and LUN information for iSCSI
- A completed iSCSI configuration worksheet
- vCenter Server credentials
- vSphere host(s) information
 - {vsphere_version}
- iSCSI VMKernel adapter IP information
- · Network switch(es)
 - · With ONTAP system network data ports and connected vSphere hosts
 - VLAN(s) configured for iSCSI
 - $\circ\,$ (Optional) link aggregation configured for ONTAP network data ports
- ONTAP Tool for VMware vSphere deployed, configured, and ready to consume

Steps

- 1. Check compatibility with the Interoperability Matrix Tool (IMT).
- 2. Verify that the iSCSI configuration is supported.

3. Complete the following ONTAP and vSphere tasks.

ONTAP tasks

- 1. Verify the ONTAP license for iSCSI.
 - a. Use the system license show command to check if iSCSI is listed.
 - b. Use license add -license-code <license code> to add the license.
- 2. Verify that the iSCSI protocol is enabled on the SVM.
- 3. Verify that iSCSI network logical interfaces are available on the SVM.



When an SVM is created using the GUI, iSCSI network interfaces are also created.

4. Use the Network interface command to view or make changes to the network interface.



Two iSCSI network interfaces per node are recommended.

- 5. Create an iSCSI network interface. You can use the default-data-blocks service policy.
- 6. Verify that the data-iscsi service is included in the service policy. You can use network interface service-policy show to verify.
- 7. Verify that jumbo frames are enabled.
- 8. Create and map the LUN. Skip this step if you are using ONTAP tools for VMware vSphere. Repeat this step for each LUN.

VMware vSphere tasks

- 1. Verify that at least one NIC is available for the iSCSI VLAN. Two NICs are preferred for better performance and fault tolerance.
- 2. Identify the number of physical NICs available on the vSphere host.
- 3. Configure the iSCSI initiator. A typical use case is a software iSCSI initiator.
- 4. Verify that the TCPIP stack for iSCSI is available.
- 5. Verify that iSCSI portgroups are available.
 - We typically use a single virtual switch with multiple uplink ports.
 - Use 1:1 adapter mapping.
- 6. Verify that iSCSI VMKernel adapters are enabled to match the number of NICs and that IPs are assigned.
- 7. Bind the iSCSI software adapter to the iSCSI VMKernel adapter(s).
- 8. Provision the VMFS datastore with ONTAP Tools. Repeat this step for all datastores.
- 9. Verify hardware acceleration support.

What's next?

After these the tasks are completed, the VMFS datastore is ready to consume for provisioning virtual machines.

Ansible Playbook

```
## Disclaimer: Sample script for reference purpose only.
- hosts: '{{ vsphere host }}'
 name: Play for vSphere iSCSI Configuration
 connection: local
 gather facts: false
 tasks:
    # Generate Session ID for vCenter
    - name: Generate a Session ID for vCenter
      uri:
        url: "https://{{ vcenter hostname }}/rest/com/vmware/cis/session"
        validate certs: false
        method: POST
        user: "{{ vcenter username }}"
       password: "{{ vcenter password }}"
        force basic auth: yes
        return content: yes
      register: vclogin
    # Generate Session ID for ONTAP tools with vCenter
    - name: Generate a Session ID for ONTAP tools with vCenter
      uri:
        url: "https://{{ ontap tools ip
}:8143/api/rest/2.0/security/user/login"
        validate certs: false
        method: POST
        return content: yes
        body format: json
        body:
          vcenterUserName: "{{ vcenter username }}"
          vcenterPassword: "{{ vcenter password }}"
      register: login
    # Get existing registered ONTAP Cluster info with ONTAP tools
    - name: Get ONTAP Cluster info from ONTAP tools
      uri:
        url: "https://{{ ontap tools ip
}}:8143/api/rest/2.0/storage/clusters"
        validate certs: false
        method: Get
        return content: yes
        headers:
          vmware-api-session-id: "{{ login.json.vmwareApiSessionId }}"
      register: clusterinfo
    - name: Get ONTAP Cluster ID
```

```
set fact:
        ontap_cluster_id: "{{ clusterinfo.json |
json query(clusteridquery) }}"
      vars:
        clusteridquery: "records[?ipAddress == '{{ netapp hostname }}' &&
type=='Cluster'].id | [0]"
    - name: Get ONTAP SVM ID
      set fact:
        ontap svm id: "{{ clusterinfo.json | json query(svmidquery) }}"
      vars:
        svmidquery: "records[?ipAddress == '{{ netapp hostname }}' &&
type=='SVM' && name == '{{ svm name }}'].id | [0]"
    - name: Get Aggregate detail
      uri:
        url: "https://{{ ontap_tools_ip
}}:8143/api/rest/2.0/storage/clusters/{{ ontap svm id }}/aggregates"
        validate certs: false
        method: GET
        return content: yes
        headers:
          vmware-api-session-id: "{{ login.json.vmwareApiSessionId }}"
          cluster-id: "{{ ontap svm id }}"
      when: ontap svm id != ''
      register: aggrinfo
    - name: Select Aggregate with max free capacity
      set fact:
        aggr name: "{{ aggrinfo.json | json query(aggrquery) }}"
      vars:
        aggrquery: "max by (records, & freeCapacity).name"
    - name: Convert datastore size in MB
      set fact:
        datastoreSizeInMB: "{{ iscsi datastore size |
human to bytes/1024/1024 | int }}"
    - name: Get vSphere Cluster Info
      uri:
        url: "https://{{ vcenter_hostname }}/api/vcenter/cluster?names={{
vsphere cluster }}"
        validate certs: false
        method: GET
        return content: yes
        body_format: json
```

```
headers:
          vmware-api-session-id: "{{ vclogin.json.value }}"
      when: vsphere cluster != ''
      register: vcenterclusterid
    - name: Create iSCSI VMFS-6 Datastore with ONTAP tools
      uri:
        url: "https://{{ ontap tools ip
} }:8143/api/rest/3.0/admin/datastore"
        validate certs: false
        method: POST
        return content: yes
        status code: [200]
        body format: json
        body:
          traditionalDatastoreRequest:
            name: "{{ iscsi datastore name }}"
            datastoreType: VMFS
            protocol: ISCSI
            spaceReserve: Thin
            clusterID: "{{ ontap_cluster_id }}"
            svmID: "{{ ontap svm id }}"
            targetMoref: ClusterComputeResource:{{
vcenterclusterid.json[0].cluster }}
            datastoreSizeInMB: "{{ datastoreSizeInMB | int }}"
            vmfsFileSystem: VMFS6
            aggrName: "{{ aggr name }}"
            existingFlexVolName: ""
            volumeStyle: FLEXVOL
            datastoreClusterMoref: ""
        headers:
          vmware-api-session-id: "{{ login.json.vmwareApiSessionId }}"
      when: ontap_cluster_id != '' and ontap_svm_id != '' and aggr_name !=
1.1
      register: result
      changed when: result.status == 200
```

vSphere VMFS Datastore - NVMe/FC with ONTAP

This section covers the creation of a VMFS datastore with ONTAP storage using NVMe/FC.

What you need

- · Basic skills needed to manage a vSphere environment and ONTAP.
- Basic understanding of NVMe/FC.

- An ONTAP Storage System (FAS/AFF/CVO/ONTAP Select/ASA) running {ontap_version}
- ONTAP credentials (SVM name, userID, and password)
- ONTAP WWPN for host, target, and SVMs and LUN information
- A completed FC configuration worksheet
- vCenter Server
- vSphere host(s) information ({vsphere_version})
- · Fabric switch(es)
 - With ONTAP FC data ports and vSphere hosts connected.
 - With the N_port ID virtualization (NPIV) feature enabled.
 - Create a single initiator target zone.
 - Create one zone for each initiator (single initiator zone).
 - For each zone, include a target that is the ONTAP FC logical interface (WWPN) for the SVMs. There should be at least two logical interfaces per node per SVM. DO not use the WWPN of physical ports.

Provision VMFS datastore

- 1. Check compatibility with the Interoperability Matrix Tool (IMT).
- 2. Verify that the NVMe/FC configuration is supported.

ONTAP tasks

- Verify the ONTAP license for FCP. Use the system license show command and check if NVMe_oF is listed. Use license add -license-code <license code> to add a license.
- 2. Verify that NVMe protocol is enabled on the SVM.
 - a. Configure SVMs for NVMe.
- 3. Verify that NVMe/FC Logical Interfaces are available on the SVMs.
 - a. Use Network Interface show to verify the FCP adapter.
 - b. When an SVM is created with the GUI, logical interfaces are as part of that process.
 - C. To rename the network interface, use the command Network Interface modify.
- 4. Create NVMe namespace and subsystem

VMware vSphere Tasks

- 1. Verify that HBA drivers are installed. VMware supported HBAs have the drivers deployed out of the box and should be visible at Storage Adapter Information
- 2. Perform vSphere Host NVMe driver installatioln and validation tasks
- 3. Create VMFS Datastore

vSphere traditional file storage provisioning with ONTAP

VMware vSphere supports following NFS protocols, both of which support ONTAP.

• NFS Version 3

• NFS Version 4.1

If you need help selecting the correct NFS version for vSphere, check this comparison of NFS client versions.

Reference

vSphere datastore and protocol features: NFS

vSphere NFS datastore - Version 3 with ONTAP

Creation of NFS version 3 datastore with ONTAP NAS storage.

What you need

- The basic skill necessary to manage a vSphere environment and ONTAP.
- An ONTAP storage system (FAS/AFF/CVO/ONTAP Select/Cloud Volume Service/Azure NetApp Files) running {ontap_version}
- ONTAP credentials (SVM name, userID, password)
- · ONTAP network port, SVM, and LUN information for NFS

• A completed NFS configuration worksheet

- vCenter Server credentials
- vSphere host(s) information for {vsphere_version}
- NFS VMKernel adapter IP information
- Network switch(es)
 - with ONTAP system network data ports and connected vSphere hosts
 - VLAN(s) configured for NFS
 - · (Optional) link aggregation configured for ONTAP network data ports
- ONTAP Tool for VMware vSphere deployed, configured, and ready to consume

Steps

- Check compatibility with the Interoperability Matrix Tool (IMT)
 - Verify that the NFS configuration is supported.
- Complete the following ONTAP and vSphere tasks.

ONTAP tasks

- 1. Verify the ONTAP license for NFS.
 - a. Use the system license show command and check that NFS is listed.
 - b. Use license add -license-code <license code> to add a license.
- 2. Follow the NFS configuration workflow.

VMware vSphere Tasks

Follow the workflow for NFS client configuration for vSphere.

Reference

vSphere datastore and protocol features: NFS

What's next?

After these tasks are completed, the NFS datastore is ready to consume for provisioning virtual machines.

vSphere NFS Datastore - Version 4.1 with ONTAP

This section describes the creation of an NFS version 4.1 datastore with ONTAP NAS storage.

What you need

- The basic skills necessary to manage a vSphere environment and ONTAP
- ONTAP Storage System (FAS/AFF/CVO/ONTAP Select/Cloud Volume Service/Azure NetApp Files) running {ontap_version}
- · ONTAP credentials (SVM name, userID, password)
- · ONTAP network port, SVM, and LUN information for NFS
- A completed NFS configuration worksheet
- vCenter Server credentials
- vSphere host(s) information {vsphere_version}
- NFS VMKernel adapter IP information
- Network switch(es)
 - with ONTAP system network data ports, vSphere hosts, and connected
 - VLAN(s) configured for NFS
 - · (Optional) link aggregation configured for ONTAP network data ports
- ONTAP Tools for VMware vSphere deployed, configured, and ready to consume

Steps

- Check compatability with the Interoperability Matrix Tool (IMT).
 - Verify that the NFS configuration is supported.
- Complete the ONTAP and vSphere Tasks provided below.

ONTAP tasks

- 1. Verify ONTAP license for NFS
 - a. Use the system license show command to check whether NFS is listed.
 - b. Use license add -license-code <license code> to add a license.
- 2. Follow the NFS configuration workflow

VMware vSphere tasks

Follow the NFS Client Configuration for vSphere workflow.

What's next?

After these tasks are completed, the NFS datastore is ready to consume for provisioning virtual machines.

Virtual Desktops

Virtual Desktop Services (VDS)

TR-4861: Hybrid Cloud VDI with Virtual Desktop Service

Suresh Thoppay, NetApp

The NetApp Virtual Desktop Service (VDS) orchestrates Remote Desktop Services (RDS) in major public clouds as well as on private clouds. VDS supports Windows Virtual Desktop (WVD) on Microsoft Azure. VDS automates many tasks that must be performed after deployment of WVD or RDS, including setting up SMB file shares (for user profiles, shared data, and the user home drive), enabling Windows features, application and agent installation, firewall, and policies, and so on.

Users consume VDS for dedicated desktops, shared desktops, and remote applications. VDS provides scripted events for automating application management for desktops and reduces the number of images to manage.

VDS provides a single management portal for handling deployments across public and private cloud environments.

Customer Value

The remote workforce explosion of 2020 has changed requirements for business continuity. IT departments are faced with new challenges to rapidly provision virtual desktops and thus require provisioning agility, remote management, and the TCO advantages of a hybrid cloud that makes it easy to provision on-premises and cloud resources. They need a hybrid-cloud solution that:

- · Addresses the post-COVID workspace reality to enable flexible work models with global dynamics
- Enables shift work by simplifying and accelerating the deployment of work environments for all employees, from task workers to power users
- · Mobilizes your workforce by providing rich, secure VDI resources regardless of the physical location
- · Simplifies hybrid-cloud deployment
- · Automates and simplifies risk reduction management

Use Cases

Hybrid VDI with NetApp VDS allows service providers and enterprise virtual desktop administrators to easily expand resources to other cloud environment without affecting their users. Having on-premises resources provides better control of resources and offers wide selection of choices (compute, GPU, storage, and network) to meet demand. This solution applies to the following use cases:

- · Bursting into the cloud for surges in demand for remote desktops and applications
- Reducing TCO for long running remote desktops and applications by hosting them on-premises with flash storage and GPU resources
- · Ease of management of remote desktops and applications across cloud environments
- Experience remote desktops and applications by using a software-as-a- service model with on-premises resources

Target Audience

The target audience for the solution includes the following groups:

- EUC/VDI architects who wants to understand the requirements for a hybrid VDS
- · NetApp partners who would like to assist customers with their remote desktop and application needs
- Existing NetApp HCI customers who want to address remote desktop and application demands

NetApp Virtual Desktop Service Overview

NetApp offers many cloud services, including the rapid provisioning of virtual desktop with WVD or remote applications and rapid integration with Azure NetApp Files.

Traditionally, it takes weeks to provision and deliver remote desktop services to customers. Apart from provisioning, it can be difficult to manage applications, user profiles, shared data, and group policy objects to enforce policies. Firewall rules can increase complexity and require a separate skillset and tools.

With Microsoft Azure Windows Virtual Desktop service, Microsoft takes care of maintenance for Remote Desktop Services components, allowing customers to focus on provisioning workspaces in the cloud. Customers must provision and manage the complete stack which requires special skills to manage VDI environments.

With NetApp VDS, customers can rapidly deploy virtual desktops without worrying about where to install the architecture components like brokers, gateways, agents, and so on. Customers who require complete control of their environment can work with a professional services team to achieve their goals. Customers consume VDS as a service and thus can focus on their key business challenges.

NetApp VDS is a software-as-a-service offering for centrally managing multiple deployments across AWS, Azure, GCP, or private cloud environments. Microsoft Windows Virtual Desktop is available only on Microsoft Azure. NetApp VDS orchestrates Microsoft Remote Desktop Services in other environments.

Microsoft offers multisession on Windows 10 exclusively for Windows Virtual Desktop environments on Azure. Authentication and identity are handled by the virtual desktop technology; WVD requires Azure Active Directory synced (with AD Connect) to Active Directory and session VMs joined to Active Directory. RDS requires Active Directory for user identity and authentication and VM domain join and management.

A sample deployment topology is shown in the following figure.



Each deployment is associated with an active directory domain and provides clients with an access entry point for workspaces and applications. A service provider or enterprise that has multiple active directory domains typically has more deployments. A single Active Directory domain that spans multiple regions typically has a single deployment with multiple sites.

For WVD in Azure, Microsoft provides a platform-as-a-service that is consumed by NetApp VDS. For other environments, NetApp VDS orchestrates the deployment and configuration of Microsoft Remote Desktop Services. NetApp VDS supports both WVD Classic and WVD ARM and can also be used to upgrade existing versions.

Each deployment has its own platform services, which consists of Cloud Workspace Manager (REST API endpoint), an HTML 5 Gateway (connect to VMs from a VDS management portal), RDS Gateways (Access point for clients), and a Domain Controller. The following figure depicts the VDS Control Plane architecture for RDS implementation.



For RDS implementations, NetApp VDS can be readily accessed from Windows and browsers using client software that can be customized to include customer logo and images. Based on user credentials, it provides user access to approved workspaces and applications. There is no need to configure the gateway details.

The following figure shows the NetApp VDS client.

NetApp | Virtual Desktop Service

INETAPP[®] Virtual Desktop Service

X

Demo01@eng		
Password	Contraction Notice	
•••••		
Save Username		
Workspace	Applications	

In the Azure WVD implementation, Microsoft handles the access entry point for the clients and can be consumed by a Microsoft WVD client available natively for various OSs. It can also be accessed from a webbased portal. The configuration of client software must be handled by the Group Policy Object (GPO) or in other ways preferred by customers.

The following figure depicts the VDS Control Plane architecture for Azure WVD implementations.



In addition to the deployment and configuration of required components, NetApp VDS also handles user management, application management, resource scaling, and optimization.

NetApp VDS can create users or grant existing user accounts access to cloud workspace or application services. The portal can also be used for password resets and the delegation of administrating a subset of components. Helpdesk administrators or Level-3 technicians can shadow user sessions for troubleshooting or connect to servers from within the portal.

NetApp VDS can use image templates that you create, or it can use existing ones from the marketplace for cloud-based provisioning. To reduce the number of images to manage, you can use a base image, and any additional applications that you require can be provisioned using the provided framework to include any command-line tools like Chocolatey, MSIX app attach, PowerShell, and so on. Even custom scripts can be used as part of machine lifecycle events.

NetApp HCI Overview

NetApp HCI is a hybrid cloud infrastructure that consists of a mix of storage nodes and compute nodes. It is available as either a two-rack unit or single-rack unit, depending on the model. The installation and configuration required to deploy VMs are automated with the NetApp Deployment Engine (NDE). Compute clusters are managed with VMware vCenter, and storage clusters are managed with the vCenter Plug-in deployed with NDE. A management VM called the mNode is deployed as part of the NDE.

NetApp HCI handles the following functions:

- Version upgrades
- Pushing events to vCenter
- vCenter Plug-In management
- A VPN tunnel for support
- The NetApp Active IQ Digital Advisor (also known as Digital Advisor) collector
- The extension of NetApp Cloud Services to on the premises, enabling a hybrid cloud infrastructure. The following figure depicts HCl components.

Int	tegrated Da	ata Servic	es		Data I	abric Se	rvices		Third	-Party Ser	vices	7
High Availability	Replication	Data Assurance	Data Reduction	ONTAP File Services	StorageGRID Object Services	Backup & Recovery	Replication	Data Protection	Backup & Recovery	X Orchestration	B Disaster Recovery	letApp Dep
				v	Mware v	Cente	9.5 -					loymen
	N	letApp Sc	lidFire Ele	mentO	S			VMwa	re ESXi			t Eng
mNode	Net/	<mark>Sto</mark> App Solid	<mark>rage Node</mark> Fire All-Fla	es ash Stor	age		NetAp	Compu p Architect	ted and	e Designed		line

Storage Nodes

Storage nodes are available as either a half-width or full-width rack unit. A minimum of four storage nodes is required at first, and a cluster can expand to up to 40 nodes. A storage cluster can be shared across multiple compute clusters. All the storage nodes contain a cache controller to improve write performance. A single node provides either 50K or 100K IOPS at a 4K block size.

NetApp HCI storage nodes run NetApp Element software, which provides minimum, maximum, and burst QoS limits. The storage cluster supports a mix of storage nodes, although one storage node cannot exceed one-third of total capacity.

Compute Nodes



NetApp supports its storage connected to any compute servers listed in the VMware Compatability Guide.

Compute nodes are available in half-width, full-width, and two rack-unit sizes. The NetApp HCI H410C and H610C are based on scalable Intel Skylake processors. The H615C is based on second-generation scalable Intel Cascade Lake processors. There are two compute models that contain GPUs: the H610C contains two NVIDIA M10 cards and the H615C contains three NVIDIA T4 cards.



The NVIDIA T4 has 40 RT cores that provide the computation power needed to deliver real-time ray tracing. The same server model used by designers and engineers can now also be used by artists to create photorealistic imagery that features light bouncing off surfaces just as it would in real life. This RTX-capable GPU produces real-time ray tracing performance of up to five Giga Rays per second. The NVIDIA T4, when combined with Quadro Virtual Data Center Workstation (Quadro vDWS) software, enables artists to create photorealistic designs with accurate shadows, reflections, and refractions on any device from any location.

Tensor cores enable you to run deep learning inferencing workloads. When running these workloads, an NVIDIA T4 powered with Quadro vDWS can perform up to 25 times faster than a VM driven by a CPU-only server. A NetApp H615C with three NVIDIA T4 cards in one rack unit is an ideal solution for graphics and compute-intensive workloads.

The following figure lists NVIDIA GPU cards and compares their features.

NVIDIA GP	Us Recommended	d for Virtualizatio	n	Available on NetApp HCI H615C	Available on NetApp HCI H610C	
	V1005	RTX 8000	RTX 6000	T4	M10	P6
GPU	1 NVIDIA Velta	1 NVIDIA Turing	1 NVIDIA Turing	1 NVIDIA Turing	4 NVIDIA Maxwell	1 NVIDIA Pascal
CUDA Cores	5,120	4,608	4,608	2,560	2,560 (640 per GPU)	2,048
Tensor Cores	640	576	576	320	-	-
RT Cores		72	72	40	20	
Guaranteed QoS (GPU Scheduler)	7	7	7	1	1 4 01	1
Live Migration	1	1	1	1	1	1
Multi-vGPU	1	1	1	1	1	1
Memory Size	32/16 GB HBM2	48 GB GDDR6	24 GB GDDR6	16 GB GDDR6	32 GB GDDR5 (8 GB per GPU)	16 GB GODR5
vGPU Profiles	1 GB, 2 GB, 4 GB, 8 GB, 16 GB, 32 GB	1 GB, 2 GB, 3 GB, 4 GB, 6 GB, 8 GB, 12 GB, 16 GB, 24 GB, 48 GB	1 GB, 2 GB, 3 GB, 4 GB, 6 GB, 8 GB, 12 GB, 24 GB	1 GB, 2 GB, 4 GB, 8 GB, 16 GB	0.5 GB, 1 GB, 2 GB, 4 GB, 8 GB	1 GB, 2 GB, 4 GB, 8 GB, 16 GB
Form Factor	PCIe 3.0 dual slot and SXM2	PCIe 3.0 dual slot	PCIe 3.0 dual slot	PCIe 3.0 single slot	PCIe 3.0 dual slot	MXM [blade servers]
Power	250 W /300 W (SXM2)	250 W	250 W	70 W	225 W	90 W
Thermal	passivo	passive	passive	passivo	passive	bare board
vGPU Software Support	Quadro vDWS, GRID vPC, GRID vApps, vComputeServer	Quadro vDWS, GRID vPC, GRID vApps, vComputeServer	Quadro vDWS, GRID vPC, GRID vApps, vComputeServer	Quadro vOWS, GRID vPC, GRID vApps, vComputeServer	Quadro vDWS, GRID vPC, GRID vApps	Quadro vDWS, GRID vPC, GRID vApps, vComputeServer
Use Case	Ultra-high-end rendering, simulation, 3D design with Quadro vOWS: ideal upgrade path for V100	High-end rendering, 3D design and creative workflows with Quadro vDW5	Mid-range to high-end rendering, 3D design and creative workflows with Quadro vDWS	Entry-level to highend 3D design and engineering workflows with Quadro vOWS. High-density, low power GPU acceleration for knowledge workers with NVIDIA GRID software.	Knowledge workers using modern productivity apps and Windows 10 requiring best density and total cost of ownership ITCOI, multimonitor support with NVIDIA GRID vPC/vApps	For customers requiring GPUs in a blade server form factor; ideal upgrade path for M6

The M10 GPU remains the best TCO solution for knowledge-worker use cases. However, the T4 makes a great alternative when IT wants to standardize on a GPU that can be used across multiple use cases, such as virtual workstations, graphics performance, real-time interactive rendering, and inferencing. With the T4, IT can take advantage of the same GPU resources to run mixed workloads—for example, running VDI during the day and repurposing the resources to run compute workloads at night.

The H610C compute node is two rack units in size; the H615C is one rack unit in size and consumes less power. The H615C supports H.264 and H.265 (High Efficiency Video Coding [HEVC]) 4:4:4 encoding and decoding. It also supports the increasingly mainstrean VP9 decoder; even the WebM container package served by YouTube uses the VP9 codec for video.

The number of nodes in a compute cluster is dictated by VMware; currently, it is 96 with VMware vSphere 7.0 Update 1. Mixing different models of compute nodes in a cluster is supported when Enhanced vMotion Compatibility (EVC) is enabled.

NVIDIA Licensing

When using an H610C or H615C, the license for the GPU must be procured from NVIDIA partners that are authorized to resell the licenses. You can find NVIDIA partners with the partner locator. Search for competencies such as virtual GPU (vGPU) or Tesla.

NVIDIA vGPU software is available in four editions:

- NVIDIA GRID Virtual PC (GRID vPC)
- NVIDIA GRID Virtual Applications (GRID vApps)
- NVIDIA Quadro Virtual Data Center Workstation (Quadro vDWS)
- NVIDIA Virtual ComputeServer (vComputeServer)

GRID Virtual PC

This product is ideal for users who want a virtual desktop that provides a great user experience for Microsoft Windows applications, browsers, high-definition video, and multi-monitor support. The NVIDIA GRID Virtual PC delivers a native experience in a virtual environment, allowing you to run all your PC applications at full performance.

GRID Virtual Applications

GRID vApps are for organizations deploying a Remote Desktop Session Host (RDSH) or other app-streaming or session-based solutions. Designed to deliver Microsoft Windows applications at full performance, Windows Server-hosted RDSH desktops are also supported by GRID vApps.

Quadro Virtual Data Center Workstation

This edition is ideal for mainstream and high-end designers who use powerful 3D content creation applications like Dassault CATIA, SOLIDWORKS, 3Dexcite, Siemens NX, PTC Creo, Schlumberger Petrel, or Autodesk Maya. NVIDIA Quadro vDWS allows users to access their professional graphics applications with full features and performance anywhere on any device.

NVIDIA Virtual ComputeServer

Many organizations run compute-intensive server workloads such as artificial intelligence (AI), deep learning (DL), and data science. For these use cases, NVIDIA vComputeServer software virtualizes the NVIDIA GPU, which accelerates compute-intensive server workloads with features such as error correction code, page retirement, peer-to-peer over NVLink, and multi-vGPU.



A Quadro vDWS license enables you to use GRID vPC and NVIDIA vComputeServer.

Deployment

NetApp VDS can be deployed to Microsoft Azure using a setup app available based on the required codebase. The current release is available here and the preview release of the upcoming product is available here.

See this video for deployment instructions.



Hybrid Cloud Environment

NetApp Virtual Desktop Service can be extended to on-premises when connectivity exists between on-premises resources and cloud resources. Enterprises can establish the link to Microsoft Azure using Express Route or a site-to-site IPsec VPN connection. You can also create links to other clouds in a similar way either using a dedicated link or with an IPsec VPN tunnel.

For the solution validation, we used the environment depicted in the following figure.



On-premises, we had multiple VLANs for management, remote-desktop-session hosts, and so on. They were on the 172.21.146-150.0/24 subnet and routed to the corporate network using the Microsoft Remote Routing Access Service. We also performed the following tasks:

- 1. We noted the public IP of the Microsoft Routing and Remote Access Server (RRAS; identified with IPchicken.com).
- 2. We created a Virtual Network Gateway resource (route-based VPN) on Azure Subscription.
- 3. We created the connection providing the local network gateway address for the public IP of the Microsoft RRAS server.
- 4. We completed VPN configuration on RRAS to create a virtual interface using pre-shared authentication that was provided while creating the VPN gateway. If configured correctly, the VPN should be in the connected state. Instead of Microsoft RRAS, you can also use pfSense or other relevant tools to create the site-to-site IPsec VPN tunnel. Since it is route-based, the tunnel redirects traffic based on the specific subnets configured.

Microsoft Azure Active Directory provides identity authentication based on oAuth. Enterprise client authentications typically require NTLM or Kerberos-based authentication. Microsoft Azure Active Directory Domain Services perform password hash sync between Azure Active Directory and on-prem domain controllers using ADConnect.

For this Hybrid VDS solution validation, we initially deployed to Microsoft Azure and added an additional site with vSphere. The advantage with this approach is that platform services were deployed to Microsoft Azure and were then readily backed up using the portal. Services can then be easily accessed from anywhere, even if the site-site VPN link is down.

To add another site, we used a tool called DCConfig. The shortcut to that application is available on the desktop of the cloud workspace manager (CWMgr) VM. After this application is launched, navigate to the DataCenter Sites tab, add the new datacenter site, and fill in the required info as shown below. The URL points to the vCenter IP. Make sure that the CWMgr VM can communicate with vCenter before adding the

configuration.



Make sure that vSphere PowerCLI 5.1 on CloudWorkspace manager is installed to enable communication with VMware vSphere environment.

The following figure depicts on- premises datacenter site configuration.

atal	Center Accounts	Email Datab	aseConnection	Exclude Da	ataCenter Sites	Product Keys Stati	c IpAddress Drive	Mapping
				Add New Dat	aCeriter Site	DataCenter Site		
-	DataCenter	Туре	ls	DataCenter Site	9	DataCenter Site Sit	te 2	Cancel Edit Save
	Site		Primary	Detail		M	spitere	Load hypervisor lest
	Site 1	AZUFERM			Edit	-General Settings-	-	
	Site Z	vspriere	- Lui		conc	Local VM Account		Hypervisor Account
						Usermanse Admin	nistrator	Username Administrator@vsphere
						Password		Pessword
						URL	https://172.21.146.1	50/sdk/
						Vm Name Prefix		Is Primary Hypervisor? O Yes O N
						Max Concurrent	20	Must Set IpAddress Of VM: O Yes O !
						Subnet Mask	255.255.255.0	
	elete Datacenter Site	s), select it and n	gnt cack to dea	te		Default Gateway	172.21.148.250	
						DNS		
						Primary DNS:	10.67.78.11	Ť.
						Secondary DNS:		
						Set DNS Address:	🔾 Yes 💿 No	
						VSphere		
						Data Cente	er NetApp-HCI-Datac	enter 🗸
						Clust	er	
						Resource Poo	ol	
						Host Nam	ne	
						VM Fold	er VDS	~
							11.0	
						Max VMs In Datastore	e <mark>-1</mark>	
						Max VMs In Datastore Min HD Free Space I Datastore GB	e -1 In -1	
						Max VMs In Datastore Min HD Free Space I Datastore GB Min Ram Free G	e -1 In -1 8 -1	

Note that there are filtering options available for compute resource based on the specific cluster, host name, or free RAM space. Filtering options for storage resource includes the minimum free space on datastores or the maximum VMs per datastore. Datastores can be excluded using regular expressions. Click Save button to save the configuration.

To validate the configuration, click the Test button or click Load Hypervisor and check any dropdown under the vSphere section. It should be populated with appropriate values. It is a best practice to keep the primary hypervisor set to yes for the default provisioning site.

The VM templates created on VMware vSphere are consumed as provisioning collections on VDS. Provisioning collections come in two forms: shared and VDI. The shared provisioning collection type is used for remote desktop services for which a single resource policy is applied to all servers. The VDI type is used for WVD instances for which the resource policy is individually assigned. The servers in a provisioning collection can be assigned one of the following three roles:

- TSDATA. Combination of Terminal Services and Data server role.
- TS. Terminal Services (Session Host).
- **DATA.** File Server or Database Server. When you define the server role, you must pick the VM template and storage (datastore). The datastore chosen can be restricted to a specific datastore or you can use the least-used option in which the datastore is chosen based on data usage.

Each deployment has VM resource defaults for the cloud resource allocation based on Active Users, Fixed, Server Load, or User Count.

Single server load test with Login VSI

The NetApp Virtual Desktop Service uses the Microsoft Remote Desktop Protocol to access virtual desktop sessions and applications, and the Login VSI tool determines the maximum number of users that can be hosted on a specific server model. Login VSI simulates user login at specific intervals and performs user operations like opening documents, reading and composing mails, working with Excel and PowerPoint, printing documents, compressing files, and taking random breaks. It then measures response times. User response time is low when server utilization is low and increases when more user sessions are added. Login VSI determines the baseline based on initial user login sessions and it reports the maximum user session when the user response exceeds 2 seconds from the baseline.

NetApp Virtual Desktop Service utilizes Microsoft Remote Desktop Protocol to access the Virtual Desktop session and Applications. To determine the maximum number of users that can be hosted on a specific server model, we used the Login VSI tool. Login VSI simulates user login at specific intervals and performs user operations like opening documents, reading and composing mails, working with Excel and PowerPoint, printing documents, compressing files, taking random breaks, and so on. It also measures response times. User response time is low when server utilization is low and increases when more user sessions are added. Login VSI determines the baseline based on the initial user login sessions and it reports maximum user sessions when the user response exceeds 2sec from the baseline.

Model	Count	Description
NetApp HCI H610C	4	Three in a cluster for launchers, AD, DHCP, and so on. One server for load testing.
NetApp HCI H615C	1	2x24C Intel Xeon Gold 6282 @2.1GHz. 1.5TB RAM.

The following table contains the hardware used for this validation.

The following table contains the software used for this validation.

Product	Description
NetApp VDS 5.4	Orchestration
VM Template Windows 2019 1809	Server OS for RDSH
Login VSI	4.1.32.1
VMware vSphere 6.7 Update 3	Hypervisor

Product Description

VMware vCenter 6.7 Update 3f VMware management tool

The Login VSI test results are as follows:

Model	VM configuration	Login VSI baseline	Login VSI Max
H610C	8 vCPU, 48GB RAM, 75GB disk, 8Q vGPU profile	799	178
H615C	12 vCPU, 128GB RAM, 75GB disk	763	272

Considering sub-NUMA boundaries and hyperthreading, the eight VMs chosen for VM testing and configuration depended on the cores available on the host.

We used 10 launcher VMs on the H610C, which used the RDP protocol to connect to the user session. The following figure depicts the Login VSI connection information.

ntem32 WindowsPowerShell w nmectorWagperScript pa 11 ko Connectors /RDPConnect.exe Reference vir ky clocelworkspa warning /rdusecredentials true /r	I.0'powershell.exe executionpolic ahost (usename)@domain) (pai /werver METX v) cloudrokapao ce.app /vlgatewayusefogn (user dbycaselocal false ./vlgatewaymo	viceo y bypass file " (VSISHARE), VSI, Briaries second) "\\USIOSHCEUC Demo\'VSIShare e app /uer/sitemane)@(doman) /password mame)@(Soman) /idgatewayusepasaword
ptem32/WindowsPowerShellw/ prinectorWagperSorgit p1*1" loo /Correctors/BDPConnect exit piteway vlyrds vfy cloudworkapa warning /idusecredientials true /i	1.0 powentheli exe +wecutionpolic ahoit (usename)@(domain) (pa /verver MST x/y clouden) (pa ex.app./rdgatewayusefogin (user dbypassiocal false/rdgatewaymo	cy bypass file " (VSISHARE) _ VSI_Brusies second) "\LVSIDSHOELD Demo\VSIShare e app \ueer \ueerseman\@ (donam) / baseword mame)@ (donam) //dgatewayusepassword
atten 32: Windows/PowerShell w nnectorWapperScript.ps1" loc Connectors/RDPConnect.exe" jateway viy rds.vty.cloudworkapa warning./rdusecredentials.true./r	I.0-powershell.exe -executionpolic ahoit (username)@(domain) (par /server M6TX vly cloudworkspac ce.app./rdgatewayusefogin (user dbypasslocal false /rdgatewaymo	cy bypass file " (VSISHARE), VSI_Binaries sexond) "\'LVSIDS HCIEUC Demo\'VSIShare te app /user (username)@fdomain) /bassword mame)@fdomain) /rdgatewayuserpassword
Connection MDPConnect exer ateway vity ds. vty cloudworkspo warning /rdusecredentials true /r	/server MSTX v/y cloudworkspac ce app /rdgatewayusefogn (user dbypassiocal false /rdgatewayno	e app Aser (username)@(domain) /password mame)@(domain) /rdgatewayuserpassword
warning Adusecredentials true A	dovpassiocal false /rdgatewavmo	
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	wokspace app nt/4}	wokspace app nt/4}

The following figure displays the Login VSI response time versus the active sessions for the H610C.



The following figure displays the Login VSI response time versus active sessions for the H615C.



The performance metrics from Cloud Insights during H615C Login VSI testing for the vSphere host and VMs are shown in the following figure.



Management Portal

NetApp VDS Cloud Workspace Management Suite portal is available here and the upcoming version is available here.

The portal allows centralized management for various VDS deployments including one that has sites defined for on-premises, administrative users, the application catalog, and scripted events. The portal is also used by administrative users for the manual provisioning of applications if required and to connect to any machines for troubleshooting.

Service providers can use this portal to add their own channel partners and allow them to manage their own clients.

User Management

NetApp VDS uses Azure Active Directory for identity authentication and Azure Active Directory Domain Services for NTLM/Kerberos authentication. The ADConnect tool can be used to sync an on-prem Active Directory domain with Azure Active Directory.

New users can be added from the portal, or you can enable cloud workspace for existing users. Permissions for workspaces and application services can be controlled by individual users or by groups. From the management portal, administrative users can be defined to control permissions for the portal, workspaces, and so on.

The following figure depicts user management in NetApp VDS.



Each workspace resides in its own Active Directory organization unit (OU) under the Cloud Workspace OU as shown in the following figure.



For more info, see this video on user permissions and user management in NetApp VDS.

When an Active Directory group is defined as a CRAUserGroup using an API call for the datacenter, all the users in that group are imported into the CloudWorkspace for management using the UI. As the cloud workspace is enabled for the user, VDS creates user home folders, settings permissions, user properties updates, and so on.

If VDI User Enabled is checked, VDS creates a single-session RDS machine dedicated to that user. It prompts for the template and the datastore to provision.

VDI User Enabled	Mobile Drive Enabled
Hypervisor Template	
Windows20192899ver1 *	
Storage Type	
D502 *	
Account Expiration Enabled	Local Drive Access Enabled
Force Password Reset at Next Login	Wake On Demand Enabled
Multi-factor Auth Enabled	
Update	

Workspace Management

A workspace consists of a desktop environment; this can be shared remote desktop sessions hosted on-premises or on any supported cloud environment. With Microsoft Azure, the desktop environment can be persistent with Windows Virtual Desktops. Each workspace is associated with a specific organization or client. Options available when creating a new workspace can be seen in the following figure.

	New	Workspace	
	Client & Settings Choose Appl	ications Add Users	Review & Provision
Select a Client Add	Workspace Setti Company Name Primary Notification	n Email	Application Settings Enable Remote App Enable App Locker Enable Application Usage Tracking Device Settings Disable Printing Access Enable Workspace User Data Storage Security Settings Require Complex User Password Enable MFA for All Users Permit Access To Task Manager
			Cancel Continue



Each workspace is associated with specific deployment.

Workspaces contain associated apps and app services, shared data folders, servers, and a WVD instance. Each workspace can control security options like enforcing password complexity, multifactor authentication, file audits, and so on.

Workspaces can control the workload schedule to power on extra servers, limit the number of users per server, or set the schedule for the resources available for given period (always on/off). Resources can also be configured to wake up on demand.

The workspace can override the deployment VM resource defaults if required. For WVD, WVD host pools (which contains session hosts and app groups) and WVD workspaces can also be managed from the cloud workspace management suite portal. For more info on the WVD host pool, see this video.

Application Management

Task workers can quickly launch an application from the list of applications made available to them. App services publish applications from the Remote Desktop Services session hosts. With WVD, App Groups provide similar functionality from multi-session Windows 10 host pools.

For office workers to power users, the applications that they require can be provisioned manually using a service board, or they can be auto-provisioned using the scripted events feature in NetApp VDS.

For more information, see the NetApp Application Entitlement page.
ONTAP features for Virtual Desktop Service

The following ONTAP features make it attractive choice for use with a virtual desktop service.

• **Scale-out filesystem.** ONTAP FlexGroup volumes can grow to more than 20PB in size and can contain more than 400 billion files within a single namespace. The cluster can contain up to 24 storage nodes, each with a flexible the number of network interface cards depending on the model used.

User's virtual desktops, home folders, user profile containers, shared data, and so on can grow based on demand with no concern for filesystem limitations.

- File system analytics. You can use the XCP tool to gain insights into shared data. With ONTAP 9.8+ and ActiveIQ Unified Manager, you can easily query and retrieve file metadata information and identify cold data.
- **Cloud tiering.** You can migrage cold data to an object store in the cloud or to any S3-compatible storage in your datacenter.
- **File versions.** Users can recover files protected by NetApp ONTAP Snapshot copies. ONTAP Snapshot copies are very space efficient because they only record changed blocks.
- **Global namespace.** ONTAP FlexCache technology allows remote caching of file storage making it easier to manage shared data across locations containing ONTAP storage systems.
- Secure multi-tenancy support. A single physical storage cluster can be presented as multiple virtual storage arrays each with its own volumes, storage protocols, logical network interfaces, identity and authentication domain, management users, and so on. Therefore, you can share the storage array across multiple business units or environments, such as test, development, and production.

To guarantee performance, you can use adaptive QoS to set performance levels based on used or allocated space, and you can control storage capacity by using quotas.

• VMware integration. ONTAP tools for VMware vSphere provides a vCenter plug-in to provision datastores, implement vSphere host best practices, and monitor ONTAP resources.

ONTAP supports vStorage APIs for Array Integration (VAAI) for offloading SCSI/file operations to the storage array. ONTAP also supports vStorage APIs for Storage Awareness (VASA) and Virtual Volumes support for both block and file protocols.

The Snapcenter Plug-in for VMware vSphere provides an easy way to back up and restore virtual machines using the Snapshot feature on a storage array.

ActivelQ Unified Manager provides end-to-end storage network visibility in a vSphere environment. Administrators can easily identify any latency issues that might occur on virtual desktop environments hosted on ONTAP.

- Security compliance. With ActiveIQ Unified Manager, you can monitor multiple ONTAP systems with alerts for any policy violations.
- **Multi-protocol support.** ONTAP supports block (iSCSI, FC, FCoE, and NVMe/FC), file (NFSv3, NFSv4.1, SMB2.x, and SMB3.x), and object (S3) storage protocols.
- Automation support. ONTAP provides REST API, Ansible, and PowerShell modules to automate tasks with the VDS Management Portal.

Data Management

As a part of deployment, you can choose the file-services method to host the user profile, shared data, and the home drive folder. The available options are File Server, Azure Files, or Azure NetApp Files. However, after deployment, you can modify this choice with the Command Center tool to point to any SMB share. There are various advantages to hosting with NetApp ONTAP. To learn how to change the SMB share, see Change Data Layer.

Global File Cache

When users are spread across multiple sites within a global namespace, Global File Cache can help reduce latency for frequently accessed data. Global File Cache deployment can be automated using a provisioning collection and scripted events. Global File Cache handles the read and write caches locally and maintains file locks across locations. Global File Cache can work with any SMB file servers, including Azure NetApp Files.



Global File Cache requires the following:

- Management server (License Management Server)
- Core

• Edge with enough disk capacity to cache the data

To download the software and to calculate the disk cache capacity for Edge, see the GFC documentation.

For our validation, we deployed the core and management resources on the same VM at Azure and edge resources on NetApp HCI. Please note that the core is where high-volume data access is required and the edge is a subset of the core. After the software is installed, you must activate the license activated before use. To do so, complete the following steps:

1. Under the License Configuration section, use the link Click Here to complete the license activation. Then register the core.

Global File Cacl	he Configuration Console				-	P	×
NetA	pp.						
System Overview	System Configuration GFC Configurat	on Policy Configuratio	e				
License Manager	Legacy Licensing						
License Cor	nfeuration						
Associate	e this instance with a License Manager Serve	н					
Ue	ense Server Public IP Address/DNS name	GFC-COI.Demovds.com					
	Customer Id	<customer from<="" id="" td=""><td>License></td><td></td><td></td><td></td><td></td></customer>	License>				
	Intended Server Role	Core dge					
			Register				
License Ser	ver Configuration						
8ir	nd this LMS Server to Azure Inventory (or) Ve	rify License Information		Click Here			

2. Provide the service account to be used for the Global File Cache. For the required permissions for this account, see the GFC documentation.

NetApp

ction	Service Account	
tryice Account. ackend File Servers lobal Exclusion List erver Exclusion List erver Exclusion List effectable File Handling re-Population dvanced Options	Configure Core instance Service Account Domain Name DEMOVDS User Name DEMOVDS(svc_gfc Password Password	Αρρίγ

3. Add a new backend file server and provide the file server name or IP.

Global File Cache Configuration Cons	ole	- 🗆 X
NetApp		
System Overview System Configuration	on GFC Configuration Policy Configuration	
Section	Backend File Servers	
Service Account Backend File Servers Global Exclusion List Server Exclusion List Remote Inclusion List Selectable File Handling Pre-Population Advanced Options	Add New Backend Generic 5MB ~ New Backend Settings NetBIOS / FQDN	Add
	Configured Backend Servers	
	Backend Server Local Path 327.0.0.1 netappsv-093d.deipoxds.com <	
	:Deletit	

4. On the edge, the cache drive must have the drive letter D. If it does not, use diskpart.exe to select the volume and change drive letter. Register with the license server as edge.

ystem Overview System Configuration GFC Configuration	Policy Configuration			
System Information Software Version 1.0.0.21 System Name GFC-E01 IP Addresses 172.21.148.22 Server Uptime 0 Day(s) 14 Hour(s) 05 Minute(s) License Expiry Activated through License Server. Cluster Configuration No Configured Roles	Initial Configuration I. Licensing Ucense Configuration 2. Edge Configuration Steps Associate this Edge with Core instance 3. Core Configuration Steps Service Account	Perform Perform		
Feature Status Edge Service Configured Pre-population Service Running	SAME Server's Configuration			

If core auto-configuration is enabled, core information is retrieved from the license management server automatically.

Global File Cache Configuration	n Console					 6	×
NetApp ystem Overview System Config GFC Core GFC Edge	guration GPC Configuration Policy Con	iguration					
Section	Core Instances						
Fore Instances Pre-Population	Core Auto Configuration						
Advanced Options Throttling	Associate this Edge instance with	a Core					
Cache Cleaner	Cloud Fabric ID						
	FQDN / IP Address						
	Enabled SSL						
	User Name		(Optional)				
	Password		(Optional)	Add			
	Cloud Fabric ID	FQDN/IP Address	SSL-	inabled	2		
	GFC-CO1	10.67.64.10	0				
	e			3			
				Delete			

From any client machine, the administrators that used to access the share on the file server can access it with GFC edge using UNC Path \\<edge server name>\FASTDATA\<core server name>\<backend file server name>\<share name>. Administrators can include this path in user logonscript or GPO for users drive mapping at the edge location.

To provide transparent access for users across the globe, an administrator can setup the Microsoft Distributed

Filesystem (DFS) with links pointing to file server shares and to edge locations.



When users log in with Active Directory credentials based on the subnets associated with the site, the appropriate link is utilized by the DFS client to access the data.

Active Directory Sites and Services (DemoVDS-AD0)	Name	Site	Location	Tune	Description
 Sites Inter-Site Transports IP Subnets 10.67.64.0/20 III 172.21.146.0/24 III 172.21.146.0/24 III 172.21.148.0/24 I	10.67.64.0/20 172.21.146.0/24 172.21.147.0/24 172.21.148.0/24 172.21.148.0/24 172.21.149.0/24	Azure-US-East RTP RTP RTP RTP RTP	Location	subnet Subnet Subnet Subnet Subnet	waxiipten

File icons change depending on whether a file is cached; files that are not cached have a grey X on the lower left corner of the icon. After a user in an edge location accesses a file, that file is cached, and the icon changes.

·	> Net	work > demovds.com > DFS > CW	-M6TX > Data		
10:11		Name	Date modified	Туре	Size
Quick access		Department	10/1/2020 5:28 PM	File folder	
Desktop	1	Outlook	10/12/2020 3:05 PM	File folder	
Downloads	1	Outlook Files	10/12/2020 6:07 PM	File folder	
Documents	1	Output	10/12/2020 3:12 PM	File folder	
Fictures	1	WindowsPowerShell	10/11/2020 6:24 PM	File folder	
This BC		FSLogix	10/11/2020 9:11 PM	Registration Entries	2.63
inis PC		GFC-1-0-0-21-Release	10/11/2020 10:05	Application	26,869 KB
is Network		PDF1.pdf	6/22/2016 9:31 PM	PDF File	1,101 KB
	_	DF2.pdf	6/22/2016 9:31 PM	PDF File	1,066 KB
		Spreadsheet.xlsx	6/22/2016 9:31 PM	XLSX File	298 Kill
		UserEdit.doc	6/22/2016 9:31 PM	DOC File	1,061 KB
		UserEdit1.doc	10/12/2020 3:13 PM	DOC File	1,061 KB
		UserEdit2.doc	10/12/2020 3:01 PM	DOC File	1,063.KB
		UserMindmap.mm	6/22/2016 9:31 PM	5.65.1 File	06 KB
		UserPresentation.ppt	6/22/2016 9:31 PM	PPT File	3,071 KB

When a file is open and another user is trying to open the same file from an edge location, the user is prompted with the following selection:

File In Use	?	\times
WSL2 on WVD.docx is locked for editin	g.	
Do you want to:		
Open a Read Only copy		
Create a local copy and merge yo	our changes lat	er
O Receive notification when the or	riginal copy is a	vailable
0	K Ca	incel

If the user selects the option to receive a notification when the original copy is available, the user is notified as follows:



For more information, see this video on Talon and Azure NetApp Files Deployment.

SaaS Backup

NetApp VDS provides data protection for Salesforce and Microsoft Office 365, including Exchange, SharePoint, and Microsoft OneDrive. The following figure shows how NetApp VDS provides SaaS Backup for these data services.



For a demonstration of Microsoft Office 365 data protection, see this video.

For a demonstration of Salesforce data protection, see this video.

Operation management

With NetApp VDS, administrators can delegate tasks to others. They can connect to deployed servers to troubleshoot, view logs, and run audit reports. While assisting customers, helpdesk or level-3 technicians can shadow user sessions, view process lists, and kill processes if required.

For information on VDS logfiles, see the Troubleshooting Failed VDA Actions page.

For more information on the required minimum permissions, see the VDA Components and Permissions page.

If you would like to manually clone a server, see the Cloning Virtual Machines page.

To automatically increase the VM disk size, see the Auto-Increase Disk Space Feature page.

To identify the gateway address to manually configure the client, see the End User Requirements page.

Cloud Insights

NetApp Cloud Insights is a web-based monitoring tool that gives you complete visibility into infrastructure and applications running on NetApp and other third-party infrastructure components. Cloud Insights supports both private cloud and public clouds for monitoring, troubleshooting, and optimizing resources.

Only the acquisition unit VM (can be Windows or Linux) must be installed on a private cloud to collect metrics from data collectors without the need for agents. Agent-based data collectors allow you to pull custom metrics from Windows Performance Monitor or any input agents that Telegraf supports.

The following figure depicts the Cloud Insights VDS dashboard.

ne.	State II (task of Second Roots United	Cont	Ø ini	e of traces 20 too	relationaria O la		O 161 *		0.00
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	Research Laboration 	D so.	Non-sign Average XD Non	0 m 1	Wangari (1975)	di ina i	Storing Throughant		(7 in 1
	Tar-CFU Conserver		The Heaver's Consumers Sector Provide 14 Subscription of the Sector Subscription of the Sector Sector Provide 14 Sector Pr			2 m	The Modern Find Field (Merroy) Tools-TENSTING Tools-TENSTING Nation TENSTING Nation TEN		

For more info on NetApp Cloud Insights, see this video.

Tools and Logs

This page discusses the DCConfig Tool, TestVdc Tools, and log files.

DCConfig Tool

The DCCconfig tool supports the following hypervisor options for adding a site:

-DataCenter Site-				
DataCenter Site	Site 3	Cancel New	Save	
Hypervisor	Select Hypervisor $ \smallsetminus $	Load Hypervisor	Test	
	Select Hypervisor			-
	Aws			
	AzureClassic			
	AzureRM			
	ComputeEngine			
	HyperV			
	ProfitBricks			
	vCloud			
	vCloudRest			
	vSphere			
	XenServer			

taContor	Accounts	Email	DatabaseConnection	Exclude	DataContor Sitor	Product Kove	Static InAddross	Drive Mappin
acenter	Accounts	Linan	Databaseconnection	LACIUGE	DataCenter Sites	Product Keys	Static IpAddress	bitte mappin
					Savo			
					Jave			
	Des	cription		DriveLette	r			
	Shared Data	1	P					
	FTP		F					
<u>۲</u>	User Home		Н					

Workspace-specific drive-letter mapping for shared data can be handled using GPO. Professional Services or the support team can use the advanced tab to customize settings like Active Directory OU names, the option to enable or disable deployment of FSLogix, various timeout values, and so on.

n Configuration		
ogram: CollimationationService	Ψ.	Add New Property Save
GroupHame	FriendlyName	Value
Server Creation	Update Vitiliame When Recover dl rom Cache	
Server Creation	Update/TewsalRoles	8
Server Creation	waitAfterRebootMin	
Server Creation	WaltAtteringervisorCreateNin	1
Server Creation	waitAfterSysPrepMin	30
Server Creation	WaltAfterSysPrepFar2008ServertMM	30
Server Creation	GF1 Agent Path	
Server Creation	Automated Cloning Enabled	8
Server Creation	CompaniesOU	Cloud Workspace Companies
Server Creation	sectal ThisPrint v11	8
Server Creation	ServersOt	Cloud Workspace Servers
Server Creation	install Fix.ogis	
Server Creation	Use Default OUs	12
Server Creation	Max Threads	50
Server Creation	Wait for DHS to Update Minutes	5
Check Vdc Sools Wirston	Run Every X Minutes	15
Daily Actions	Exabled	2
Daily Actions	Puri at Startup	8
Generate Reports	Time Of Day	b6:00
Daily Maletenance	Dabled	8
Dally Malintenarice	Time Of Day	00/01
Weekly Maintenance	Enabled	2
Weekly Maintenance	Time Of Day	00:01
Weekly Matchenance	Day	Tunday
AutomaticResourceAdocation	Enabled	R
Resignie Allanation	the Data Center Defaulty	Ð
Ema@eports	IncludeEmailAttachment	
Server HeartDeat	Briterval Minutes	15

Command Center (Previously known as TestVdc Tools)

To launch Command Center and the required role, see the Command Center Overview.

You can perform the following operations:

• Change the SMB Path for a workspace.

Tests Operations Advanced Hypervisor Command Change Data/Home/Pro Folders Load Data Company Code M6TX Data \(NetAppSvr-093d.demovds.com\cw-m6bx\Data Is Windows Server Home \(NetAppSvr-093d.demovds.com\cw-m6bx\Pro Is Windows Server Pro \(NetAppSvr-093d.demovds.com\cw-m6bx\Pro Is Windows Server Vew All Logs Execute Command Ceer Log	lestVdcTools	5.4.20252.1903	- 🗆
Command Change Data/Home/Pro Folders Load Data Company Code M6TX Data \\NetAppSvr-093d.demovds.com\cw-m6tx\Data Is Windows Server Home \\NetAppSvr-093d.demovds.com\cw-m6tx\Home Is Windows Server Pro \\NetAppSvr-093d.demovds.com\cw-m6tx\Pro Is Windows Server Vew Al Logs Execute Command Ceer Log	Tests Or	erations Advanced Hypervisor	
Company Code M6TX Data \\NetAppSvr-093d.demovds.com\cw-m6bx\Data Is Windows Server Home \\NetAppSvr-093d.demovds.com\cw-m6bx\Home Is Windows Server Pro \\NetAppSvr-093d.demovds.com\cw-m6bx\Pro Is Windows Server Pro \\NetAppSvr-093d.demovds.com\cw-m6bx\Pro Is Windows Server	Comm	and Change Data/Home/Pro Folders	 ✓ Load Data
Data [\NetAppSvr-093d.demovds.com\cw-m6b\]Data		Company Code M6TX	~
Home [\NetAppSvr-093d.demovds.com\cw-m6bx\Home Is Windows Server Pro [\NetAppSvr-093d.demovds.com\cw-m6bx\Pro Is Windows Server Is Is Windows Server Is Windows Server Execute Command Is Windows Server Is Windows Server	Data	\\NetAppSvr-093d.demovds.com\cw-m6tx\Data	Is Windows Server
Pro \\NetAppSvr-093d.demovds.com\cw-m6tx\Pro Is Windows Server Execute Command Clear Log	Home	\\NetAppSvr-093d.demovds.com\cw-m6tx\Home	Is Windows Server
Execute Command	Pro	\\NetAppSvr-093d.demovds.com\cw-m6tx\Pro	Is Windows Server
View All Logs			
	View All	Execute Command	Clear Los

• Change the site for provisioning collection.

ests	Operations	Advance	d Hyperv	isor					
Co	ommand [Edit Provi	sioning C	ollectio	n		~	Lo	ad Data
	Provisior	ning Colle	ction 🚺	indows	2019		~	~	
		Des	cription	On vS	ohere Site 2				
		Sha	e Drive	Р	~				
	Minim	num Cach	elevel	1					
		nerating	System	Winda	We Server 2010	9	1		
	0	peraulig	Jystem	windo	ws Server 201	9 0			
		Collectio	on Type	Share	d v				
	Data Cent	er Site	Role		Template				Storag
•	Site 2	~	TSData	~	Windows2019	9		~	DS01
•		×		~		-		~	
<									;
				Eve	nute Command				
				Exe	ute command	a			
				Exe					

Log Files

Name	Date modified	Туре	Size
CwAgent	9/19/2020 12:35 PM	File folder	
CWAutomationService	9/19/2020 12:34 PM	File folder	
	9/19/2020 12:53 PM	File folder	
CwVmAutomationService	9/19/2020 12:34 PM	File folder	
TestVdcTools	9/22/2020 8:20 PM	File folder	
🕌 report	9/19/2020 12:18 PM	Executable Jar File	705 KB

Check automation logs for more info.

GPU considerations

GPUs are typically used for graphic visualization (rendering) by performing repetitive arithmetic calculations. This repetitive compute capability is often used for AI and deep learning use cases.

For graphic intensive applications, Microsoft Azure offers the NV series based on the NVIDIA Tesla M60 card with one to four GPUs per VM. Each NVIDIA Tesla M60 card includes two Maxwell-based GPUs, each with 8GB of GDDR5 memory for a total of 16GB.



An NVIDIA license is included with the NV series.

TechPower	rUp GPU-Z 2.36	.0	3 -		
Graphics Card	Sensors Adva	anced Valida	tion	iii 0 ≡	
Name	NVI	DIA Tesla M60)	Lookup	
GPU	GM204	Revision	FF		
Technology	28 nm	Die Size	398 mm ²		
Release Date	Aug 30, 2015	Transistors	5200M	NVIDIA	
BIOS Version	84	.04.85.00.03			
Subvendor	NVIDIA	Device	ID 10DE 13	3F2 - 10DE 115E	
ROPs/TMUs	64 / 128	Bus Interface		PCI ?	
Shaders	2048 Unifie	d Direc	tX Support	12 (12_1)	
Pixel Fillrate	75.4 GPixel/s	Texture	Fillrate 1	50.8 GTexel/s	
Memory Type	GDDR5 (H	ynix)	Bus Width	256 bit	
Memory Size	8192 MB	Ban	dwidth	160.4 GB/s	
Driver Version	27.21	.14.5257 (NVI	DIA 452.57)	/ 2016	
Driver Date	Oct 22, 202	0 Digital	Signature	WHQL	
GPU Clock	557 MHz N	Memory 1253	MHz Bo	post 1178 MHz	
Default Clock	557 MHz N	Memory 1253	MHz Bo	post 1178 MHz	
NVIDIA SLI	Disabled				
Computing	OpenCL		DirectComput	te 🗹 Direct ML	
Technologies	Vulkan	Ray Tracing	PhysX	OpenGL 4.6	
NVIDIA Tesla M	160	~		Close	

With NetApp HCI, the H615C GPU contains three NVIDIA Tesla T4 cards. Each NVIDIA Tesla T4 card has a Touring-based GPU with 16GB of GDDR6 memory. When used in a VMware vSphere environment, virtual machines are able to share the GPU, with each VM having dedicated frame buffer memory. Ray tracing is available with the GPUs on the NetApp HCI H615C to produce realistic images including light reflections. Please note that you need to have an NVIDIA license server with a license for GPU features.

4	TechPowerUp GPU-Z 2.36.0	
---	--------------------------	--

Graphics Card	Sensors Adva	nced Validat	ion	® ∂ ≡
Name	NVIDIA GRID T4-8Q			Lookup
GPU	TU104 Revision A1			
Technology	12 nm	Die Size	545 mm ²	
Release Date	Sep 13, 2018	Transistors	13600M	NVIDIA
BIOS Version	0.0	00.00.00.00		
Subvendor	NVIDIA	Device I	D 10DE 1E	B8 - 10DE 130F
ROPs/TMUs	8 / 160	Bus Interface	1	PCI ?
Shaders	2560 Unifie	d Direct	X Support	12 (12_2)
Pixel Fillrate	4.7 GPixel/s Texture Fillrate			03.6 GTexel/s
Memory Type	GDDR	5 1	Bus Width	256 bit
Memory Size	8192 MB	Band	lwidth	Unknown
Driver Version	27.21	.14.5257 (NVIE	DIA 452.57)	/ 2016
Driver Date	Oct 22, 2020	Digital S	Signature	WHQL
GPU Clock	585 MHz N	1emory 0 M	Hz Sha	ider N/A
Default Clock	585 MHz N	1emory 0 M	Hz Sha	ider N/A
NVIDIA SLI		Disab	led	
Computing	Ø OpenCL ☑		irectComput	e DirectML
Technologies	Vulkan V	Ray Tracing	PhysX	OpenGL 4.6
NVIDIA GRID T	'4-8Q	~		Close

×

To use the GPU, you must install the appropriate driver, which can be downloaded from the NVIDIA license portal. In an Azure environment, the NVIDIA driver is available as GPU driver extension. Next, the group policies in the following screenshot must be updated to use GPU hardware for remote desktop service sessions. You should prioritize H.264 graphics mode and enable encoder functionality.

2 🚾 🗟 🖬 🖬 🐨 🖓				
Microsoft account Microsoft Secondary Authentication Microsoft Secondary Authentication Microsoft User Experience Virtualiza NetMeeting OneDrive Online Assistance OOBE Portable Operating System Presentation Settings Push To Install Push To Install Remote Desktop Services RD Licensing Prefication Compatibility Connections Device and Resource Redires Licensing Priofiles RD Connection Broker Security Session Time Limits Temporary folders RSS Feeds Search Security Center Shutdown Options Smart Card	Setting RemoteFX for Windows Server 2008 R2 Limit maximum color depth Enforce Removal of Remote Desktop Wallpaper Use hardware graphics adapters for all Remote Desktop Services sessions Limit maximum display resolution Limit maximum display resolution Remove Windows Security item from Shut Down dialog Remove Windows Security item from Start menu Use advanced RemoteFX graphics for Remote Desktop Connections Configure H264/AVC Hardware encoding for Remote Desktop Connections Configure H264/AVC hardware encoding for Remote Desktop Connections Configure M264/AVC hardware encoding for Remote Desktop Connections Configure image quality for RemoteFX data Configure image quality for RemoteFX datats Sata program on connection Always show desktop on connection Allow desktop composition for remote desktop sessions Do not allow font smoothing	State Not configured Not configured Enabled Not configured Not configured Not configured Not configured Enabled Not configured Not configured	Comment No No No No No No No No No No No No No	

Validate GPU performance monitoring with Task Manager or by using the nvidia-smi CLI when running WebGL samples. Make sure that GPU, memory, and encoder resources are being consumed.



To make sure that the virtual machine is deployed to the NetApp HCI H615C with Virtual Desktop Service, define a site with the vCenter cluster resource that has H615C hosts. The VM template must have the required vGPU profile attached.

For shared multi-session environments, consider allocating multiple homogenous vGPU profiles. However, for high end professional graphics application, it is better to have each VM dedicated to a user to keep VMs isolated.

The GPU processor can be controlled by a QoS policy, and each vGPU profile can have dedicated frame buffers. However, the encoder and decoder are shared for each card. The placement of a vGPU profile on a GPU card is controlled by the vSphere host GPU assignment policy, which can emphasize performance (spread VMs) or consolidation (group VMs).

Solutions for Industry

Graphics workstations are typically used in industries such as manufacturing, healthcare, energy, media and entertainment, education, architecture, and so on. Mobility is often limited for graphics-intensive applications.

To address the issue of mobility, Virtual Desktop Services provide a desktop environment for all types of workers, from task workers to expert users, using hardware resources in the cloud or with NetApp HCI, including options for flexible GPU configurations. VDS enables users to access their work environment from anywhere with laptops, tablets, and other mobile devices.

To run manufacturing workloads with software like ANSYS Fluent, ANSYS Mechanical, Autodesk AutoCAD, Autodesk Inventor, Autodesk 3ds Max, Dassault Systèmes SOLIDWORKS, Dassault Systèmes CATIA, PTC Creo, Siemens PLM NX, and so on, the GPUs available on various clouds (as of Jan 2021) are listed in the following table.

GPU Model	Microsoft Azure	Google Compute (GCP)	Amazon Web Services (AWS)	On-Premises (NetApp HCI)
NVIDIA M60	Yes	Yes	Yes	No
NVIDIA T4	No	Yes	Yes	Yes
NVIDIA P100	No	Yes	No	No
NVIDIA P4	No	Yes	No	No

Shared desktop sessions with other users and dedicated personal desktops are also available. Virtual desktops can have one to four GPUs or can utilize partial GPUs with NetApp HCI. The NVIDIA T4 is a versatile GPU card that can address the demands of a wide spectrum of user workloads.

Each GPU card on NetApp HCI H615C has 16GB of frame buffer memory and three cards per server. The number of users that can be hosted on single H615C server depends on the user workload.

Users/Server	Light (4GB)	Medium (8GB)	Heavy (16GB)
H615C	12	6	3

To determine the user type, run the GPU profiler tool while users are working with applications performing typical tasks. The GPU profiler captures memory demands, the number of displays, and the resolution that users require. You can then pick the vGPU profile that satisfies your requirements.

Virtual desktops with GPUs can support a display resolution of up to 8K, and the utility nView can split a single monitor into regions to work with different datasets.

With ONTAP file storage, you can realize the following benefits:

- A single namespace that can grow up to 20PB of storage with 400 billion of files, without much administrative input
- A namespace that can span the globe with a Global File Cache
- · Secure multitenancy with managed NetApp storage
- The migration of cold data to object stores using NetApp FabricPool
- · Quick file statistics with file system analytics
- · Scaling a storage cluster up to 24 nodes increasing capacity and performance
- · The ability to control storage space using quotas and guaranteed performance with QoS limits
- · Securing data with encryption
- · Meeting broad requirements for data protection and compliance
- · Delivering flexible business continuity options

Conclusion

The NetApp Virtual Desktop Service provides an easy-to-consume virtual desktop and application environment with a sharp focus on business challenges. By extending VDS with the on-premises ONTAP environment, you can use powerful NetApp features in a VDS environment, including rapid clone, in-line deduplication, compaction, thin provisioning, and compression. These features save storage costs and improve performance with all-flash storage. With VMware vSphere hypervisor, which minimizes server-provisioning time by using Virtual Volumes and vSphere API for Array integration. Using the hybrid cloud, customers can pick the right environment for their demanding workloads and save money. The desktop session running on-premises can access cloud resources based on policy.

Where to Find Additional Information

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

- NetApp Cloud
- NetApp VDS Product Documentation
- Connect your on-premises network to Azure with VPN Gateway
- Azure Portal
- Microsoft Windows Virtual Desktop
- Azure NetApp Files Registration

VMware Horizon

NVA-1132-DESIGN: VMware end-user computing with NetApp HCI

Suresh Thoppay, NetApp

VMware end-user computing with NetApp HCI is a prevalidated, best-practice data center architecture for deploying virtual desktop workloads at an enterprise scale. This document describes the architectural design and best practices for deploying the solution at production scale in a reliable and risk-free manner.

NVA-1132-DESIGN: VMware end-user computing with NetApp HCI

NVA-1129-DESIGN: VMware end-user computing with NetApp HCI and NVIDIA GPUs

Suresh Thoppay, NetApp

VMware end-user computing with NetApp HCI is a prevalidated, best-practice data center architecture for deploying virtual desktop workloads at an enterprise scale. This document describes the architectural design and best practices for deploying the solution at production scale in a reliable and risk-free manner.

NVA-1129-DESIGN: VMware end-user computing with NetApp HCI and NVIDIA GPUs

NVA-1129-DEPLOY: VMware end-user Computing with NetApp HCI and NVIDIA GPUs

Suresh Thoppay, NetApp

VMware end-user Computing with NetApp HCI is a prevalidated, best-practice, data center architecture for deploying virtual desktop workloads at an enterprise scale. This document describes how to deploy the solution at production scale in a reliable and risk-free manner

NVA-1129-DEPLOY: VMware end-user Computing with NetApp HCI and NVIDIA GPUs

NetApp HCI for virtual desktop infrastructure with VMware Horizon 7 - Empower your power users with 3D Graphics

Suresh Thoppay, NetApp

TR-4792 provides guidance on using the NetApp H615C compute node for 3D graphics workloads in a VMware Horizon environment powered by NVIDIA graphics processing units (GPUs) and virtualization software. It also provides the results from the preliminary testing of SPECviewperf 13 for the H615C.

NetApp HCI for virtual desktop infrastructure with VMware Horizon 7 - Empower your power users with 3D Graphics

FlexPod desktop virtualization solutions

Learn more about FlexPod virtualization solutions by reviewing the FlexPod design guides

Demos and Tutorials

Virtualization Videos and Demos

See the following videos and demos highlighting specific features of the hybrid cloud, virtualization, and container solutions.

NetApp ONTAP Tools for VMware vSphere

ONTAP Tools for VMware - Overview

VMware iSCSI Datastore Provisioning with ONTAP

VMware NFS Datastore Provisioning with ONTAP

SnapCenter Plug-in for VMware vSphere

NetApp SnapCenter software is an easy-to-use enterprise platform to securely coordinate and manage data protection across applications, databases, and file systems.

The SnapCenter Plug-in for VMware vSphere allows you to perform backup, restore, and attach operations for VMs and backup and mount operations for datastores that are registered with SnapCenter directly within VMware vCenter.

For more information about NetApp SnapCenter Plug-in for VMware vSphere, see the NetApp SnapCenter Plug-in for VMware vSphere Overview.

SnapCenter Plug-in for VMware vSphere - Solution Pre-Requisites

SnapCenter Plug-in for VMware vSphere - Deployment

SnapCenter Plug-in for VMware vSphere - Backup Workflow

SnapCenter Plug-in for VMware vSphere - Restore Workflow

SnapCenter - SQL Restore Workflow

3-2-1 Data Protection Solutions

3-2-1 data protection solutions combine on-premises primary and secondary backups, using SnapMirror technology, with replicated copies to object storage using BlueXP backup and recovery.

3-2-1 Data Protection for VMFS Datastores with SnapCenter Plug-in for VMware vSphere and BlueXP Backup and Recovery for Virtual Machines

VMware Cloud on AWS with AWS FSx for NetApp ONTAP

Windows Guest Connected Storage with FSx ONTAP using iSCSI

Linux Guest Connected Storage with FSx ONTAP using NFS

VMware Cloud on AWS TCO savings with Amazon FSx for NetApp ONTAP

VMware Cloud on AWS supplemental datastore w/ Amazon FSx for NetApp ONTAP

VMware HCX Deployment and Configuration Setup for VMC

vMotion Migration Demonstration with VMware HCX for VMC and FSxN

Cold Migration Demonstration with VMware HCX for VMC and FSxN

Azure VMware Solution supplemental datastore overview with Azure NetApp Files

Azure VMware Solution DR with Cloud Volumes ONTAP, SnapCenter and JetStream

Cold Migration Demonstration with VMware HCX for AVS and ANF

vMotion Demonstration with VMware HCX for AVS and ANF

Bulk Migration Demonstration with VMware HCX for AVS and ANF

VMware Cloud Foundation with NetApp ONTAP

NFS Datastores as Principal Storage for VCF Workload Domains

iSCSI Datastores as Supplemental Storage for VCF Management Domains

NetApp with VMware Tanzu

VMware Tanzu enables customers to deploy, administer, and manage their Kubernetes environment through vSphere or the VMware Cloud Foundation. This portfolio of products from VMware allows customer to manage all their relevant Kubernetes clusters from a single control plane by choosing the VMware Tanzu edition that best suits their needs.

For more information about VMware Tanzu, see the VMware Tanzu Overview. This review covers use cases, available additions, and more about VMware Tanzu.



How to use vVols with NetApp and VMware Tanzu Basic, part 1



How to use vVols with NetApp and VMware Tanzu Basic, part 2



How to use vVols with NetApp and VMware Tanzu Basic, part 3

NetApp Cloud Insights is comprehensive monitoring and analytics platform designed to provide visibility and control over your on-premises and cloud infrastructure.

NetApp Cloud Insights - Observability for the Modern Datacenter

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