

VMware vSphere Foundation

NetApp Solutions

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VMware vSphere Foundation

NFS Reference Guide for vSphere 8

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:

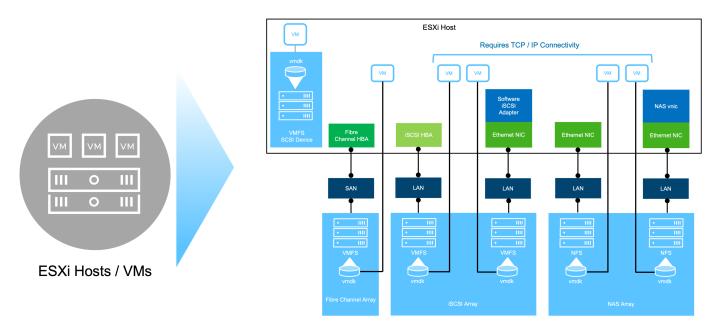
- VMware vSphere
- VMware vSAN
- Aria Standard
- VMware Tanzu Kubernetes Grid Service for vSphere
- vSphere Distributed Switch

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.
- 3. **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.

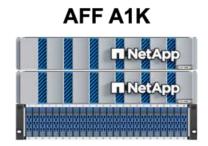
The NetApp A-Series all-NVMe flash arrays are designed for high-performance workloads, offering ultra-low latency and high resiliency, making them suitable for mission-critical applications.





T NetApp

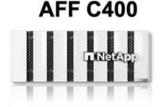
AFF A90



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







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

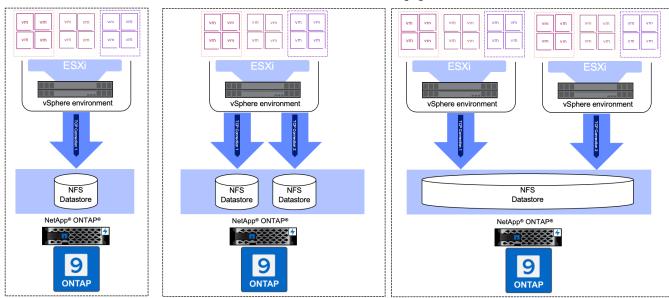
- Host more virtual machines per NFS datastore on the same host.
- Boost NFS datastore performance.
- Provide an option to offer service at a higher tier for VM and Container based applications.

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.

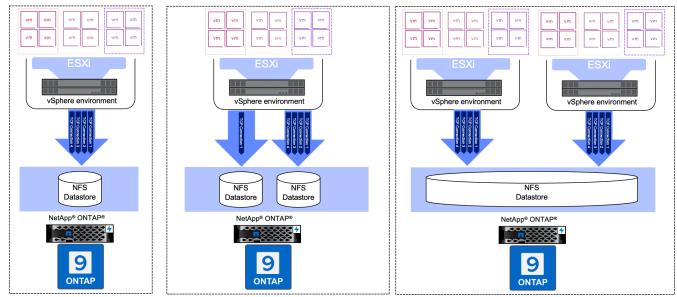


Without nConnect feature with NetApp and VMware

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.

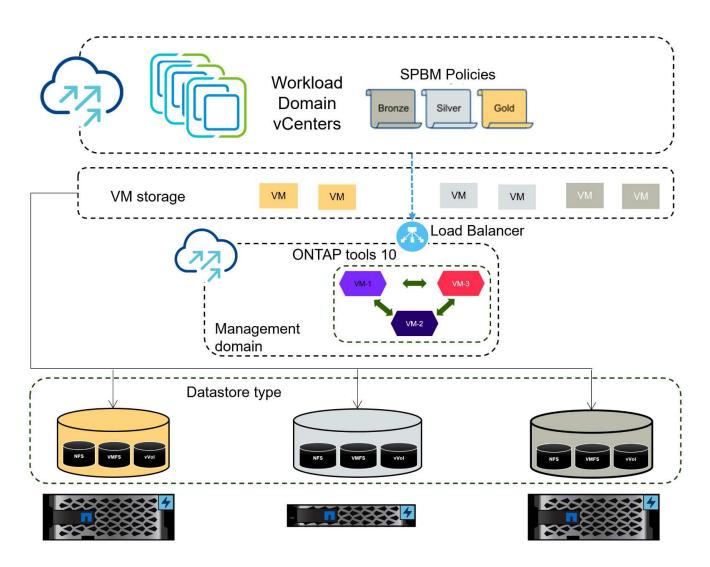
Solution Overview

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	infra_svm_a300			
Qtrees				
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	
	S client access at least one rule to allow NFS clients to access volumes in this storage VM. 🧑
EXPORT PO	
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.

SUBJET Without a subnet IP ADDRESS SUBNET MASK GATEWAY BROADCAST DOMAIN AND PORT 172.21.118.119 24 Add optional gateway NFS_iSCSI If 2.21.118.119 24 Add optional gateway NFS_iSCSI If 2.21.118.119 24 Add optional gateway NFS_iSCSI If 2.21.118.119 24 Net subnet NFS_iSCSI SUBNET Image: Subnet subnet in the following interfaces Nthout a subnet Image: Subnet in the subnet i	ntaphci-a300-01			
IP ADDRESS SUBNET MASK GATEWAY BROADCAST DOMAIN AND PORT 172.21.118.119 24 Add optional gateway NFS_iSCSI If Use the same subnet mask, gateway, and broadcast domain for all of the following interfaces ntaphci-a300-02 SUBNET Without a subnet • IP ADDRESS PORT 172.21.118.120 Observe the enable the Storage VM Administration account (for multi-tenancy environmedication on Save to create the SVM. Storage VM Administration	SUBNET			
IT2.21.118.119 24 Add optional gateway NFS_iSCSI IT2.21.118.119 IVse the same subnet mask, gateway, and broadcast domain for all of the following interfaces ntaphci-a300-02 SUBNET IVADDRESS PORT IT2.21.118.120 PORT IT2.21.118.120 Observe the same subnet the Storage VM Administration account (for multi-tenancy environmedication on Save to create the SVM. Storage VM Administration	Without a subnet		~	
Vse the same subnet mask, gateway, and broadcast domain for all of the following interfaces ntaphci-a300-02 SUBNET Without a subnet PORT 172.21.118.120 PORT 172.21.118.120 PORT Storage VM Administration account (for multi-tenancy environmedick on Save to create the SVM.	IP ADDRESS	SUBNET MASK	GATEWAY	BROADCAST DOMAIN AND PORT
ntaphci-a300-02 SUBNET Without a subnet IP ADDRESS PORT 172.21.118.120 a0a-3374 we see whether to enable the Storage VM Administration account (for multi-tenancy environmedick on Save to create the SVM.	172.21.118.119	24	Add optional gateway	NFS_iSCSI
SUBNET Without a subnet IP ADDRESS PORT 172.21.118.120 a0a-3374 se whether to enable the Storage VM Administration account (for multi-tenancy environm lick on Save to create the SVM. torage VM Administration	✓ Use the same subne	et mask, gateway, and broa	adcast domain for all of the following	interfaces
Without a subnet IP ADDRESS IT2.21.118.120 a0a-3374 a0a-3374 a0a-3374 a0a-3374 conset whether to enable the Storage VM Administration account (for multi-tenancy environmedick on Save to create the SVM. Storage VM Administration account (for multi-tenancy environmedick on Save to create the SVM.	ntaphci-a300-02			
IP ADDRESS PORT 172.21.118.120 a0a-3374 se whether to enable the Storage VM Administration account (for multi-tenancy environm lick on Save to create the SVM. torage VM Administration	SUBNET			
172.21.118.120 a0a-3374 se whether to enable the Storage VM Administration account (for multi-tenancy environm lick on Save to create the SVM. torage VM Administration	Without a subnet		~	
se whether to enable the Storage VM Administration account (for multi-tenancy environm lick on Save to create the SVM.	IP ADDRESS	PORT		
torage VM Administration	172.21.118.120	a0a-3374	~	
	lick on Save to crea	te the SVM.		r multi-tenancy environm
Manage administrator account	torage vin A			

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:

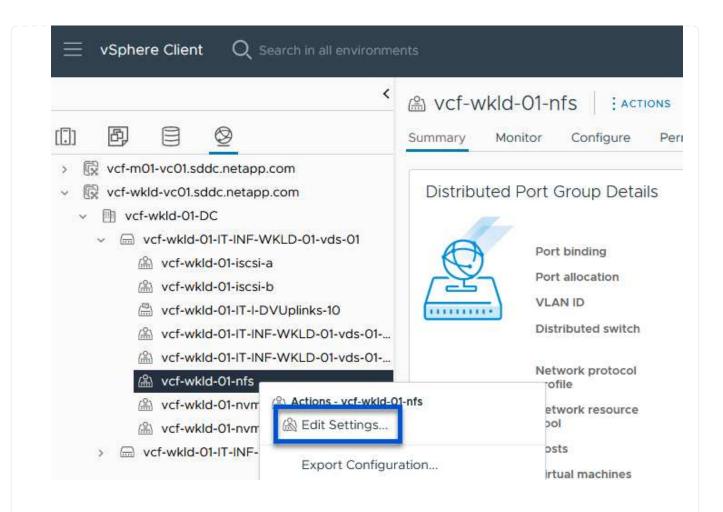
1. From the vSphere client , navigate to **Inventory > Networking** for the workload domain. Navigate to the existing Distributed Switch and choose the action to create **New Distributed Port Group...**.

mmary Monitor Configure Permissions Ports Hosts Switch Details Manufacturer VMware, Inc. Manufacturer VMware, Inc. w Distributed Port Group 4 port Distributed Port Group 4 nage Distributed Port Groups 1 Ports 40
w Distributed Port Group 8.0.0 port Distributed Port Group 4 nage Distributed Port Groups 1
w Distributed Port Group 4 port Distributed Port Group 4 nage Distributed Port Groups 1
×
Tags II Custom Attributes
T

- 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. 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

	Load balancing	Route based on originating virtual por $ \sim $
Advanced VLAN	Network failure detection	Link status only $$
Security	Notify switches	Yes ~
Traffic shaping Teaming and failover	Failback	Yes \vee
Monitoring Miscellaneous	Failover order (1) MOVE UP MOVE DOWN Active uplinks Uplink 1 Uplink 2 Standby uplinks Unused uplinks	
		CANCEL

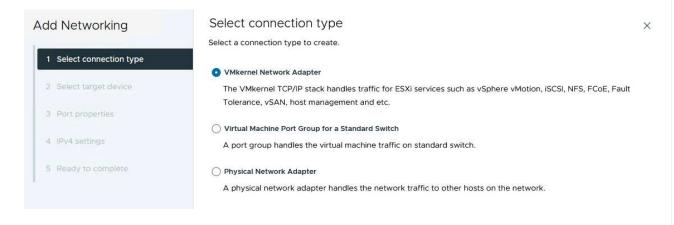
×

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.

· · · · · · · · · · · · · · · · · · ·	esxisrm-05.sdo	d <mark>c.net</mark> a _{Configure}	5.9		ACTIONS	Datastores Networks	Update
 	Storage v Adapters Storage Devices Host Cache Configuration				2	REFRESH	
	Protocol Endpoints I/O Filters Networking Virtual switches	•	: : :	» » »	Devid www.k0 www.k1 www.k2	▼ Network Label	Ŧ

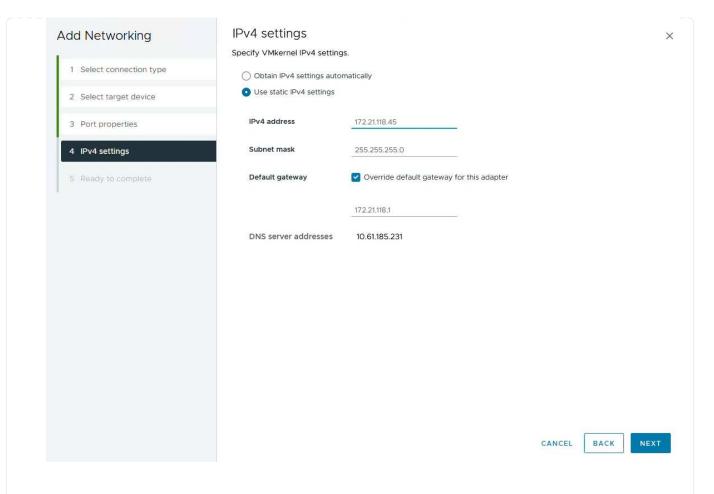
2. On the **Select connection type** window choose **VMkernel Network Adapter** and click on **Next** to continue.



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	v connection.	
1 Select connection type	 Select an existing network 		
	 Select an existing standard swit 	tch	
2 Select target device	O New standard switch		
3 Port properties	Quick FilterEnter val	ue	
4 IPv4 settings	Name	NSX Port Group ID	Distributed Switch
	〇 倫 Mgmt 3376	2.57	DSwitch
5 Ready to complete	🔘 🙈 NFS 3374	· #	DSwitch
	〇	100	DSwitch
	〇 (044	DSwitch
	Manage Columns		4 ites

- 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		
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)	
E. Deaduite complete	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
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 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...**

() þ e Ø			laryCluster : A Nonitor Configure	Permissions
 vcenter-vlsr.sddc.netapp Datacenter SecondaryCluster esxisrm-05.sc esxisrm-06.sc 	o.com []] Actions - SecondaryCluster [] Add Hosts		Total Processors:	8
esxisrm-07.sc esxisrm-08.sc vCLS-02eb4a	New Virtual Machine	0	Total vMotion Migrations: – Fault Domains:	0
과 vCLS-02eb4a	Deploy OVF Template			

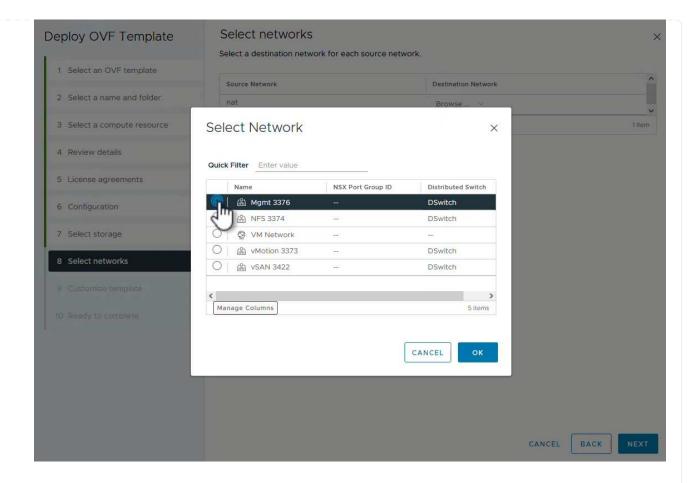
4. In the **Deploy OVF Template** wizard click the **Local file** radio button and select the ONTAP tools OVA file downloaded in the previous step.



- 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	Compatibility Compatibility Compatibility Provisioned Pree T	T
5 License agreements		> 1 item
6 Configuration		
7 Select storage		
8 Select networks		
9 Customize template		
10 Ready to complete		
	Compatibility	
	<u></u>	
	CANCEL BACK N	IEXT
the Select network page	e 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 and prerequisites, refer to Prerequisites for deploying ONTAP tools for VMware vSphere.

	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)	
6 Configuration	O High-Availability deployment (L)	
6 Conliguration	O Recovery	
7 Select storage		
8 Select networks		
9 Customize template		
10 Ready to complete		
	8 Items	

- 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.

eploy OVF Template	Customize template	
1 Select an OVF template	Customize the deployment properties o	t 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 O
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 as 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

aintenance 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		
Primary VM	Maintain this field as s install the ONTAP too	selected to set the current	VM as primary and
ode Configuration	10 settings		
lostName(*)	Specify the hostname	e for the VM	
P Address(*)	Specify the IP addres	s for the appliance	
	Specify the IPv6 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.

 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.

ONTAP tools Manager	
admin	
LOGIN	

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

also do	2 tools Manager allows you to manage ONTAP Storage Backends and associate them with vCenters. You convolve a support log bundles.
P	Storage Backends
9	Add, modify, and remove storage backends.
	Go to Storage Backends
_	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	APD	
Storage Backend	Storage bac	.KCHUS	- They	
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 or FQDN: * vo	center-vlsr.sddc.netapp.com
Jsername: * 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	jer					
«		enters	DD			
Storage Backend			0			
VCenters	vCente	ers are central management platforms t	hat allow you	u to control hosts, vi	rtual machines a	ind storage backends.
Log Bundles		Associate Storage Backend	т	Version	Ŧ	Status
		Dissociate Store Backend				
En Certificates		Modify		8.0.2		Healthy

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.

A Home	
& Shortcuts	
品 Inventory	
Content Libraries	
🖗 Workload Management	
Global Inventory Lists	
Policies and Profiles	
지 Auto Deploy	
Hybrid Cloud Services	
Developer Center	
8 Administration	
Tasks	
Events	
Tags & Custom Attributes	
🖓 Lifecycle Manager	
NetApp ONTAP tools	
D 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.

App ONTAP tools INSTAN	CE 172.21.120.57:8443 ~							
«	Overview							0
Storage Backends								
Settings	1		Storage Ba	ckends - Capacity				
Support							37.29 TB	31.34 TB
Reports ~	Storage Bac	kend				USED AM	ND 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		-
.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 environme	ents				C
Center-visr.sddc.netapp.com Center-visr.sddc.netapp.com Center Center Center Center	Datacenter Monitor Summary Monitor Datacenter Details Hosts Virtue Cluste Netwo Datas	Distributed Switch 얇 New Virtual Machine 양 Deploy OVF Template	s > >	S Datastores Networks Updates Capacity and Usage Last updated at 10:47 AM CPU 10.19 GHz used Memory 65.23 GB used Storage 177.11 GB used	90.79 GHz free 90.79 GHz free 100.98 GHz capacity 190.75 GB free 255.98 GB capacity 622.86 GB free 799.97 GB capacity
F	Custom Attributes	Add Permission Alarms	>	VIEW STATS	

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

1 Type Destination: Ill Datacenter 2 Name and Protocol Datastore type: Ill NFS 3 Storage VMFS 4 Storage Attributes VMFS	
2 Name and Protocol Datastore type: NFS Storage VMFS 4 Storage Attributes	
3 Storage O VMES	
5 Summany	
a annihity	
	CANCEL NEX
	S.

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	11244-00	248	1995		
3 Storage	Size:	2 Minimum supported size is 1 GB.	ТВ	<u> </u>	
4 Storage Attributes	Protocol:	NFS 3	<u>~</u>		
5 Summary	Advanced Options				
	Datastore Cluster:		×		
				CANCEL BACK NEXT	
				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	Platform: * Storage VM: *	Performance (A) VCF_NFS	~			
3 Storage 4 Storage Attributes 5 Summary	 Advanced Options 	ntaphci-a300e9u25 (172.16.9.25)				
5 Summary	Custom Export Policy:	Search or specify policy name Choose an existing policy or give a new name to the default policy.	ме ne			
				CANCEL	BACK	NICT

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	
3 Storage4 Storage Attributes	Name and Protocol		
5 Summary	Size: Protocol:	NFS_DS1 2 TB NFS 3	
	Storage Platform:	D-6	
	Platform: Storage VM:	Performance (A) 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**.

	▲ INFS_DS1	ACTIONS		
	Summary Monitor		VMs	5
Venter-visi-state.inetapp.com Datacenter InFS_DS1 VsanDatastore	Details	C Browse Files 말 Register VM	B	Capacity and Usage Last updated at 12:14 PM Storage
		Configure Storage I/O Control		
	Vi	C Refresh Capacity Information		968 KB used
	VI	Maintenance Mode >	×.	
	Fc	Move To Rename	:73-	
		Mount Datastore to Additional Hosts		VIEW STATS REFRESH
	Tags	Tags & Custom Attributes		
		Add Permission Alarms	×.	
		NetApp ONTAP tools		elete datastore

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

	ils							
Volume Name:				D.04				
Total Size:			NFS_ 2.1 TE					
Used Size:			2.1 TE 968 K					
Snapshot Reserve	e (%):		5					
Thin Provisioned:			Yes					
Size								
Current Datastore	e Size:		2 TB					
New Datastore Si	ze (GB): *	E	300	D	$\hat{\mathbf{v}}$			
							CANCE	LRESIZE
Nonitor the proc	gress of	the resize jol	o in the Rec	ent Task	s pane.		CANCE	LRESIZE
Nonitor the proc		the resize jol	o in the Rec	ent Task	s pane.		CANCE	L RESIZE
			o in the Rec	ent Task	s pane.	Ţ	CANCE	L 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.

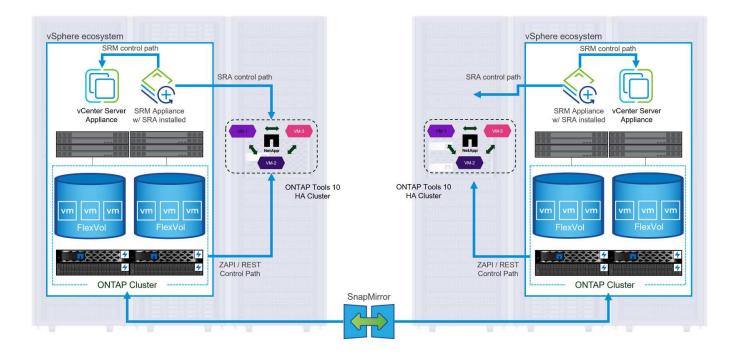
Scenario Overview

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 Managen	nent		C	¢ (© ۵	admin 🗸
Summary	Summary					
Monitor Disks	,		RESTART	DOWNLOAD	SUPPORT BUNDLE	STOP
Access	Product	VMware Site Recovery Manager Appliance				
Certificates	Version	8.8.0				
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		4				
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		rvices 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		n for Site Recovery Manager
2 vCenter Server	Site name	Site 2
		A unique display name for this Site Recovery Manager site.
3 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 \vee
		The address on the local host to be used by Site Recovery Manager.
	Extension ID	 Default extension ID (com.vmware.vcDr)
		O Custom extension ID The default extension ID is recommended for most configurations. For shared recovery site installation
		which multiple sites connect to a shared recovery site, use a unique custom extension ID for each SRM
	Extension ID	com.vmware.vcDr-
	Organization	
		·
	Description	
		CANCEL BACK N

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 Managemen	t
Summary Monitor Disks Access Certificates Networking Time Services Update Syslog Forwarding	Storage Replication Adapters
Storage Replication Adapters	

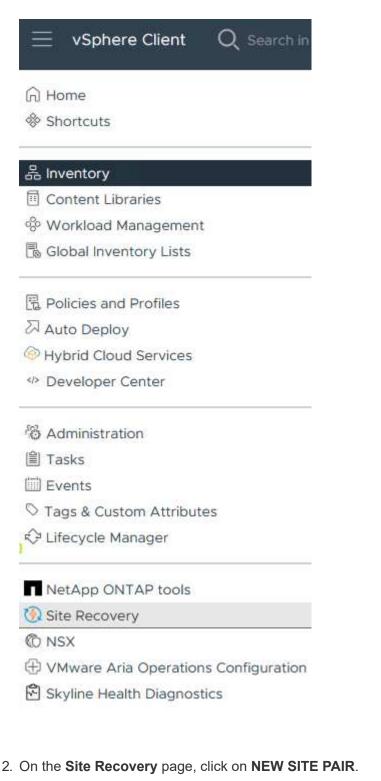
3. Follow the steps outlined on the ONTAP tools 10 documentation site at Configure SRA on the SRM appliance. Once complete, the SRA can communicate with SRA using the provided IP address and credentials of the vCenter server.

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.



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	-
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	
		CANCEL

 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			
1 Pair type		inless marked (optional) Services Controller details for the per	er 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		
	Password		0	
	FIND VCE	NTER SERVER INSTANCES		
	Select a vCenter Se	erver you want to pair.		
	vCenter Serv	/er		
	💽 📴 vcenter	-srm.sddc.netapp.com		

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

1 Pair type		Service	1 τ	vcenter-vlsr.sddc.netapp.com	T V	center-srm.sddc.netapp.co	on
2 Peer vCenter Server		🛞 Site Recovery Man	ager (com.vmware.vc	Site 1	S	ite 2	
3 Services							
4 Ready to complete							
	<						
					CANC	EL BACK	N
							5

- 6. On the **Ready to complete** page, review the proposed configuration and then click on the **Finish** button to create the Site Pairing
- 7. The new Site Pair and its summary can be viewed on the Summary page.

			RECONNECT BREAK SITE PAIR
#	vCenter Host Name:	vcenter-visr.sddc.netapp.com vcenter-srm.sddc.netapp.com ? 8.0.2, 22385739 8.0.2, 22385739 8.0.2, 22385739 vcenter-visr.sddc.netapp.com.443 vcenter-srm.sddc.netapp.com.443 vcenter-srm.sddc.netapp.com.443 vcenter-visr.sddc.netapp.com.443 vcenter-srm.sddc.netapp.com.443 vcenter-srm.sddc.netapp.com.443	
Site Recovery M	lanager		EXPORT/IMPORT SRM CONFIGURATION
Protection Group	os:0 🖹 Recovery Plans:0		
Name		Site 1 RENAME	Site 2 RENAME
Server		srm-site1.sddc.netapp.com:443 ACTIONS ~	srm-site2.sddc.netapp.com:443 ACTIONS ~
Version		8.8.0, 23263429	8.8.0, 23263429
ID		com.vmware.vcDr	com.vmware.vcDr
		VSPHERE LOCAL\Administrator	VSPHERE.LOCAL\Administrator
Logged in as		✓ Connected	✓ Connected

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

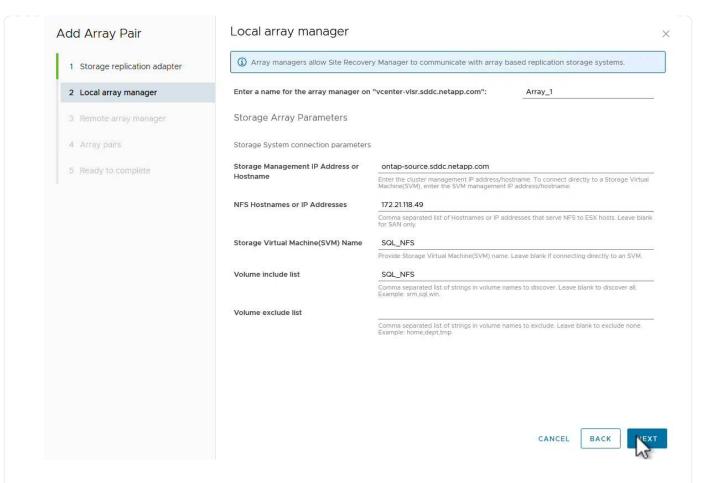
1. In the Site Recovery interface navigate to **Configure > Array Based Replication > Array Pairs** in the left hand menu. Click on **ADD** to get started.

bups	Recovery Plans
	Array Pairs
	AD Tray Pair
~	
\sim	
>	
	~

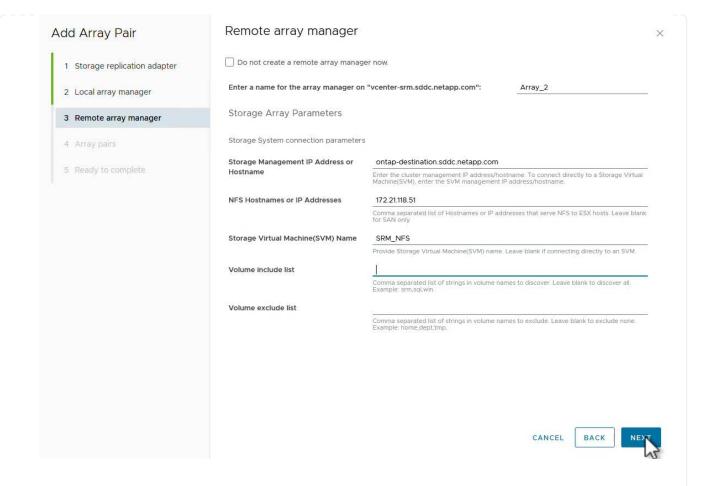
2. On the **Storage replication adapter** page of the **Add Array Pair** wizard, verify the SRA adapter is present for the primary site and click on **Next** to continue.

dd Array P <mark>a</mark> ir	Select a sto	prage replication adapter (SRA):					
1 Storage replication adapter		Storage Replication Adapter 🔹 🕈 🔻	Status 🔻	Vendor	version	▼ Stretched Storage	
2 Local array manager	• •	NetApp Storage Replication Ada	√ ок	NetApp	10.1	Not Sup	port.
3 Remote array manager							
4 Array pairs							
5 Ready to complete							
						ge AUTO A	

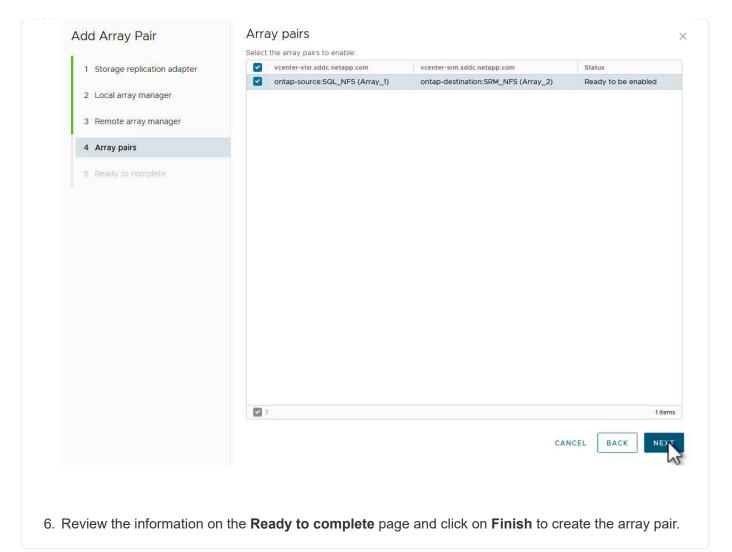
3. On the **Local array manager** page, enter a name for the array at the primary site, the FQDN of the storage system, the SVM IP addresses serving NFS, and optionally, the names of specific volumes to be discovered. Click on **Next** to continue.



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.

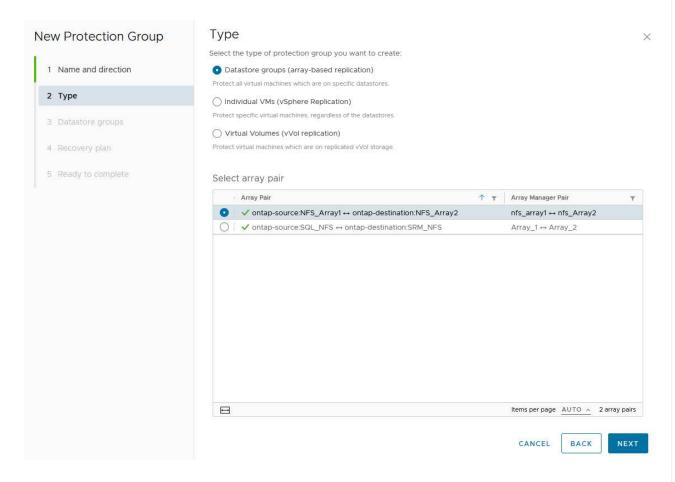
1. In the Site Recovery interface click on the **Protection Groups** tab and then on **New Protection Group** to get started.

Site Pair Protection Groups	Recovery Plans
Q Search	Protection Groups NEW PROTECTION GROUP
Protection Groups	NEW PROTECTION GROUP
	Name T 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.

ew Protection Group	Name and dir	rection	
	All fields are required unles	ss 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	8
Ready to complete	Direction:	• Site 1 \rightarrow Site 2 • Site 2 \rightarrow Site 1	
	Location:	Q Search	
		Protection Groups	
		CANCEL	NEX

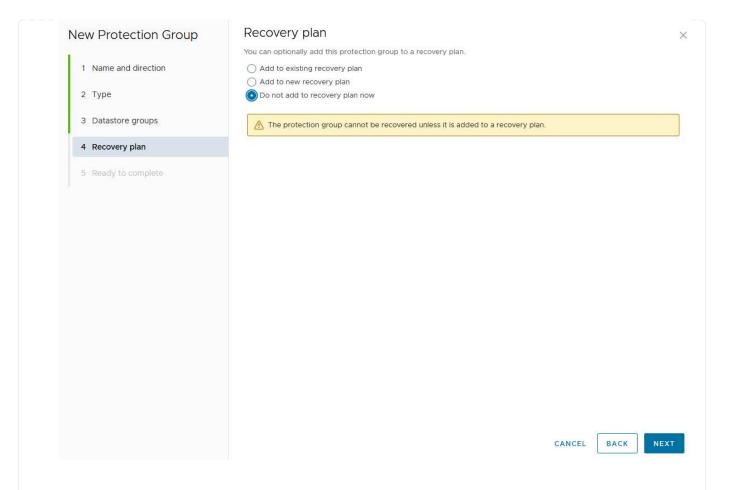
3. On the **Type** page select the protection group type (datastore, VM, or vVol) and select the array pair. Click on **Next** to continue.



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.

Name and direction	recovered together:	to be part of this protection group	Datastore gr	oups contain datastores wit	ich must bo
Туре					
Гуре				SELECT ALL	CLEAR SELECTIO
	Datastore Group		٣	Status	
Datastore groups	NFS_DS1			Add to this protection g	roup
Recovery plan					
i Ready to complete					
	1 🖽			Items per page AUTO	 1 datastore grou
					_
	The following virtual machine	s are in the selected datastore gro	ups:		
	Virtual Machine	T Datastore		Status	
			T	Status	
	D SQLSRV-01	NFS_DS1	T	Add to this protection gro	pup
	団 SQLSRV-01	· · · · · · · · · · · · · · · · · · ·	T		

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

eady to comple	
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.

Site Pair VProtection Groups	Recovery Plans	
Q Search	Recovery 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		
	Name:	SQL Site 1-to-2
2 Protection Groups		oo characters remaining
3 Test Networks	Description: (Optional)	
4 Ready to complete		4096 characters remaining
	Direction:	Site 1 → Site 2
		\bigcirc Site 2 \rightarrow Site 1
	Location:	Q Search
		Recovery Plans
		CANCEL N

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

	Name	↑ T Description	
2 Protection Groups	SOL_Datastore	T. T. Description	
3 Test Networks			
4 Ready to complete			
	1	items per page AUTO ^ 1	grou

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.

	If "Use site-level mapping" is selected				
2 Protection Groups	Recovery Network	↑ т	Test Network		
3 Test Networks	A Datacenter > DPortGroup	10-	🔮 Use site-level mapping		CHANG
4 Ready to complete	🗟 Datacenter > Mgmt 3376	1	🖀 Mgmt 3376	ΈΞ	CHANG
4 Ready to complete	🗟 Datacenter > NFS 3374		🚇 NFS 3374	t e	CHANG
	🚔 Datacenter > VLAN 181	15			CHANG
	Datacenter > VM Network	15			CHANG
	A Datacenter > vMotion 3373	==	👰 Use site-level mapping		CHAN
	A Datacenter > vSAN 3422	E=	👰 Use site-level mapping		CHAN
					7 netwo

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	NEW RECOVERY PLAN NEW FOLDER	
Recove <mark>r</mark> y Plans	NEW RECOVERY PLAN	EDIT MOVE DELETE TEST	CLEANUP RUN
SOL Site 1-to-2	Name	21	↑ ▼ 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.

Task Name		TODES		Chattan		ALTRACE CONTRACTOR	0
Task Name	T	Target	1	Status	T	Initiator T	Queued For
Test Recovery Plan		vcenter-visr.sddc.netapp.com			6 %	VSPHERE.LOCAL\\SRM-d1369bbb-62c6	11 ms
Create Recovery Plan		vcenter-visr.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.

i de <u>e</u>	Summary Monitor C	Configure Permissions Fi	les Hosts	VMs
 vcenter-srm.sddc.netapp.com Datacenter 	Virtual Machines VM T	emplates		J
VFS_DS1 VsanDatastore	Quick Filter - Enter v	value		
	Name	↑ State	Status	Provisioned Space
	SQLSRV-01	Powered Of f	🗸 Normal	424.28 GB
	□	Powered Of f	🗸 Normal	244.28 GB
			V Normal	244.28 GB

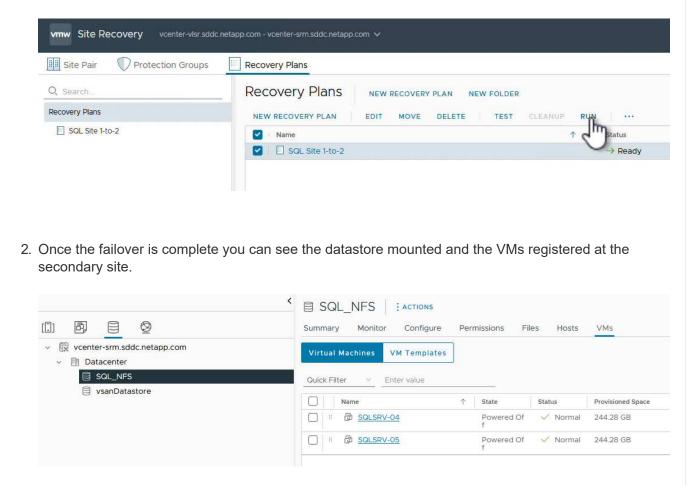
4. Once the test has completed, click on **Cleanup** to unmount the datastore and revert back to the original environment.

Site Pair Protection G	roups Recovery Plans	
Q Search	Recovery Plans NEW RECOVERY PLAN NEW FO	LDER
Recovery Plans	NEW RECOVERY PLAN EDIT MOVE DELETE T	EST CLEATUP RUN
SQL Site 1-to-2	Name	C → T Status
	SQL Site 1-to-2	Stest 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.

	AP Sy	stem Manager	Search actions, objects, and pages Q	② ◇ €
DASHBOARD		Volumes		Q Saarch 🐨 Filter
STORAGE Overview Volumes UUNe UUNe Consistency groups Shares Otroos Otroos Chuotas Storage VMs Tiers NETWORK		Name Name Uname_pm NrFSARPDemoD2 NrFSD502ARP nimpra SQLDatavol Src_25G_VolD1 Src_25G_VolD1 Src_25G_VolD Src_25G_D05 Src_36CSI_D502 Src_56CSI_D504	Src_NFS_Vol01 All Volumes Overview Snapshot copies SnapMirror Back up to cloud Security File system Quota Reports Anti-ransomware Minimum Disabled Totable arti-lamammare if you're running applications us this NAS volume.	Q search ♥ riter
EVENTS & JOBS ~ PROTECTION ~ HOSTS ~	*	SHC, 56CSI, DSD6 SHC, NFS, DSD2 SHC, NFS, DSD3 SHC, NFS, DSD4 SHC, NFS, Vel01	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.

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.

(;)

(;)

	AP Sys	stem Manager	Search actions, objects,	and pages Q	∂ ↔ €
DASHBOARD		Volumes			
INSIGHTS		+Add @ Delete O Protect E #	Alem .		Q search V Filter
STORAGE	^	Name	Src_NFS_DS04 All Volumes		Ø tat i Mon
Volumes		NFSARPDemo02	Overview Snapshot copies SnapMire	or Back up to cloud Security File system	Quota Reports
LUNs NVMe namespaces		NESDSOZARP			2.200 (1.
Consistency groups		SQLDatavol	Anti-ransomware		
Shares Otroos		Src. 25G, Voi01	Enabled in active mode	() Pause anti-canonimicane	Diamet unversity settings
Quotas		Site_(SCSL_D05			
Storage VMs Ders		Sre_6CSI_0502			
NETWORK	4	Src_ISCS1_0504	Volume's workload characteristics		Configure workload characteristics
EVENTS & JOBS		SircusCSUDS06	Learned statistics 🕦 Learned PERCENT OF HIGH ENTROPY (2013)	Surge statistics United Philosoft of wide but	NDPY DATA
PROTECTION	*	Src_NF5_D502 Src_NF5_D503		83 50	
HOSTS	*	SIC,NFS,DS04	HIGHEST RATE OF FILE CREATION	HEHE! WIT OF HE OKATON	6
CLUSTER	¥.		16 files/minute	21 21	

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.

	VMware vSphere IniSTAIn		Edit - Pol	NFSDS04	×					
Te Dashboard	Policies									
D-Settings	+ Caste / Las	× Pernove []	Name	PROVERDERA				Film:		
E Resource Groups	-News	Vie Cours	Description	description.			Breakford?		Bracenul Looking Relico	
B Policies	Demoscia_tra	795	Frequency	Daly +			No			
in through Systems	Dem(AdSPS(IPS	100	Locking Period	Enable Snapshot Locking G			No		1Dey	
	Cent/Fill	No		7 Days +			No		104	
Count Me Restore		ND	Retention	Days to keep - 17	0		394		70eye	
50.	Demolyschick	Web .	Replication	Update Snaphhror after backup O	84		(WE)		70m	
	Section	THE	nayara and	Update ShapVault after tackup O		_	No.	_	10est	
				Snapshol label Daily						
			Advanced >							
		_	🔺 Warning for	ONTAP 9.12.1 and below version	× 4					
Hiscont Tasks	Allorma	-								
fies T	Sugar: 7	Batal				Connel y	Inst time	+ *	Completion Table	
ove properties	IP ACL DUILD VIDE	O Complete		CANCEL	UPDATE	2.05	-06/10/2014 3	136.56 A	05/18/2024 3 36 56 A	
	@ 165.Denot.10024	Completion				1.01	- 06/19/2024,1	AMOSAL	08/14/2024.3:36:56.4	

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.

= vSphere Clent Q				- 0 0
B B C IDC_DerroVM_N/S G IDC_DerroVM_N/S G IDC_DerroVM_N/S G IDCS_DerroA G IDCS_DerroA G IDCS_DErroA G IDCS_DErroA G IDCS_DErroA MSS_DerroA MSS_DerroA MSS_DerroA MSS_DerroA G INS_DerroA G INS_DErroA	KICC Downs A Vision Control Select backup Select b	NFS_DemoA_VM01 NFSRamDemoR0_06-19-2024_13.26.52.0908 No Original Location he vesui0-03.hmodc.local	×	
OpencuRPFVMO3 DemouRPFVMO3 DemouRPFVMO3 DemouRPFVMO3 SolverouRPFVMO3 SolverouRPFVMO3 SolverouRPFVMO3 SolverouRPFVMO3 SolverouRPFVMO3 SolverouRPFVMO3 DuuAPPOence DuuAPPOence DuuAPPOence DuuMAPPOence DuuMAPPOence	(Managa Carama) (Figure)	overled down during the process. BACK. HERT FINESH	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.

@ Ransomw	are protectio	0	Dashboard		Protection	Alerts	Recovery	Reports	Free trial (55 days left)	- view details 1
forkloads (10)									Q 🛓 Manage	protection strate
Workload C	Type T C	Connector C	Importance V 🗘	Prot	ection st 🔻 🕻	Ontection sta 7 0	Outection pol T 2	Snapshot an	Backup destina 2	
Sec_nfa_dis02	VM datastone	GISABXPConn	Critical	0	Protected	Learning mode	rps-policy-primary	SnapCenter for VMw_	netapp-backup-add	(241244666
Drass_pro_test_3130	VM file share	GISABXPConn	Statidard	0	At risk	None	None	None	n/a	Protect
Nfsde02arg_804	VM file share	GISABXPConn	Standard	Q	Profected	Active	rps-policy-primary	Norse	netapp-backup-add	(Talk protecto
Orana_srt_7027	VM file share	GISABXPConn	Standard	0	ALTINK	None	None	None	netapp-backup-add	Frutect
Src_ntx_vol01_7948	VM file share	GISABXPConn	Standard	0	At risk	None	None	None	netapp-backup-add	Prutect
Src_n/s_ds03	VM datastore	GISABXPConn	Standard	0	At risk	None	None	ShapCenter for VMw_	netapp-backup-add	Putert
Sirc_nta_ds04	VM datastore	GISABXPConn	Standard	0	Protected	Active	rps-policy-primary	SnapCenter for VMw	netapp-backup-add	(Leganstern
Sec_nfs_ds04 Textrac_cutu	File share	GISABXPConn	Critical	0	Protected	Active	rps-policy-primary	IllueXP backup and	netapip-backup-ba3	(101 ++1+01)
Testvol_3787	File share	GISABXPConn	Standard	0	Protected	Learning mode	rps-policy-primary	None	netapp-backup-ba3	(Edit protection
Nfsarpdamo02_3419	File share	GISAEXPConn	Standard	0	Protected	Active	ros-policy-primary	None	netapp-backup-add	(Tan protecto

Nel	App BlueXP		(9)	Nuex# Source		otected and No reported
8	Ransomware protection	Dashbo	oard Protection	Alerts R	7e	
	Standard Importance	Protected Prutection healt Edit protection		💮 0 Alerta	Not mark Receivery	ed for recovery
	O Protection		VM datastore		Storage	
	These policies managed by SnapCenter for VMware a modified by applying a detection policy to this worklo Pol_NFSDS04 Snapshot policy		Location «Center server Connector	um sovsowith Resou vvcsa8-01 hmodo local GISABXPConn	Cluster id Working Env name Storage VM name Volume name Used size	add30d20-3486-1161-8 NTAP918_Src svm_36*5 Src_845_D504 29 Gill
	(i) 1 Year Daily LTR Backup policy	~				
	*					

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

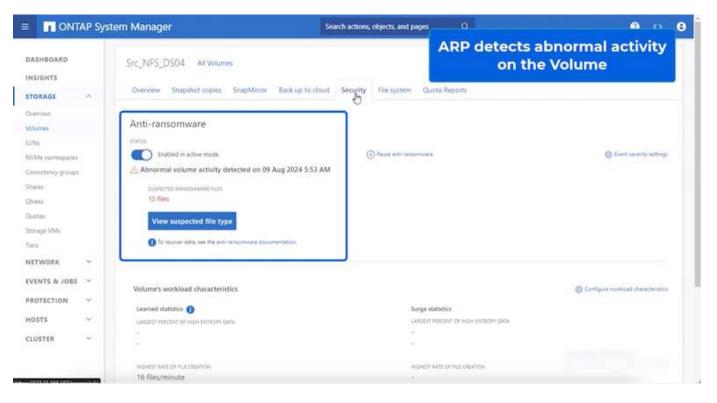
It's time to walk through this with an example. In this walkthrough, the datastore "Src_NFS_DS04" is affected.

· 0 8 8 8	Src_NFS_DS04 _acrows Summary Monitor Configure Permiss	ions	Films Hosts VMs	and the second s	ck and		nsomware ected
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			D. MrS, Osmud, VMOL 3-Rat Visite ang	10,485,310. 04 kB	08/08/2024, 5: 3111 AM	.the	TW_NF3_DEXEMPS_Dence_VMDVNF3_D VMD1_3 fail_mmB_wg
		0	[] NFS_Dermit_VM01_3 ends arg	0.84 KB	08/09/2024, 8 21:22 AM	TH:	(Sec_NPE_0504) NPE_Demole_VMDUVPS_D VM01_XVP04 and
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A Recent Tasks Alarma

ARP immediately triggered a snapshot on the volume upon detection.

ASHBOARD NSIGHTS TORAGE		C_NFS_DS04 All Volumes		etApp Snapshot triggered during suspected abnormal activity
tverviewe Shumes		+ add		Cl. Search 🛛 🗢 Showhide 🛩 🖙 Pitter
ins.		Name	Snapshot copy creation time	Snapshot restore size 🕕
Whe namespaces onsistency groups		snapmirror.e2ad5432-3537-11ef-bd57-00a0b8f6d346_21 59491296.2026-08-09_160500	Aug/9/2024 9:05 AM	50.5 Gill
hares		Anti_ransomware_backup.2024-08-09_1326	Aug/9/2024 6:26 AM	44.5 G-8
treel.		RG_NFSDS04_08-09-2024_08-08.16-0981	Aug/9/2024 5:08 AM	27.8 G/8
torage VMs		RG_NFSD504_08-09-2024_07.54.48.0205	Aug/9/2024 4:55 AM	27.7 Gi8
ers			Aug/9/2024 3:27 AM	27.6 G·B
ETWORK	<u>e</u>	RG_NFSD504_08-09-2024_06-27.18.0190	Aug/9/2024 3:27 AM	27.6 G48
VENTS & JOBS	~	RIS_NFSD504_08-09-2024_05.00.28.0747	Aug/9/2024 2:00 AM	27.7 Gib
ROTECTION	e			
OSTS	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~			
LUSTER	- C		ng 1 - 7 of 7 Snapshot Copies	



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.

vSphere Client Q Search in	@ NFS_DemoB_VM01	P de	65 1 ACD		VM to be restored *** © n the backup
圆 🖶 😵	Summary Monitor Configur	e Permisions I	Dutastores	Network	
VCIAB-011mmcdc.local WCISAB-0001 WVCISAB-0001 WVCISAB-0001 WVCISAB-001mmcdc.local VerseB-021mmcdc.local VerseB-021mmcdc.local WISSB-021mmcdc.local WISSB-021mmcdc.local VerseB-021mmcdc.local VerseB-021mmcdc.l	Settings × VM SDRS Rules VAID Options Amm Definitions Schooling Tasks Parkoss VMeware EVC Guern Over Megacings ShapCenter Parg in for VMewa v	Time Stamp Fo Jup Munched Na Policy Pol_3 Where anapshat Ins Entities	00 2024 05 08 19 750504 cluded in the back	24_08.08 16-0981 CMIT-0700 (Paudic Daylight Time) NO FRC_NIFSCOSE4_08-05-2024_08.08.16.0981	
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(2) 10C_DemoVM03 (2) 10C_DemoVM04	Backups	NFS Deniel VMI2	Tes	50121540-4678-4114-2121-77095905403402F	Dis. NPS. 0004 NPS. Denut. V002NPS, Denut. V002 ms
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() 10C_DemoVM06		NPS_Demolt_VM05	799	\$212x662-e052-246-787a-4aa43e301620	[Stc.]491_DS04[495_Danu8_VMD31975_Deno8_VM03.cms
E 10C DemoVM07		NPS_Dense_VM05	Yes.	5712a048-ex25-0433-20c4-0/3137x651/1	[54_NFS_DS04] NFS_Denu8_VM05NFS_Denu8_VM05 vmv
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(D NPS_Demo8_VM02		(1)			octivate windows

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

1 Ne	tApp BlueXP		(Q.	LucXP Search	Protection View specific to the NFS Volume
2	Ransomware protection	Dashboard	Protection	Alerts	чиссинту мереть
	Protection > Sec_NFS_D504				
			Src.	_NFS_DS04	
	Standard Impertance	Protected Protection health Edit protection		1 Alerta View glerts	Not marked for recovery Recovery
	O Protection	6	VM datastore		E Storage
	These policies managed by SnapCenter for VMware will o modified by applying a detection policy to this workload.	YC	cation enter server enector	um:scv:scvHULResou vvcsa8-01.hmodc.local GISABXPConn	Chuster Id add38d26-348o-11eF-8 Working Env name NTAP915_Brc Storage VM name wm_NPS Volume name Sirc_NPS_DS04 Used Size 29 Gi8
	Year Daily LTR Backup policy	~			

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

	BlueXP						e searce			lark the ale	
0	North Street Street	are prote	ction		Dashboard	Protection	Alerts	Recovery	6	'restore ne	eded"
Alt	rts > alert2398					ale	rt2198		<u>k</u>		
			Worklos	ad: Src_NF6_	DS04 Location: um:s		Type: VM datastore	Connecto	: GISABXPConn		Mark restore readed
O 1 Poter	1 ntial ettack				4 hours ago first detected		29 GB imported data			10 Impoched files	
icident (1) All selected									٩	🚽 Edit status
	Incident ID	:)	/olume 2	SVM C	Working environment	Туре С	Status	71	First detected	Evidence 2	Automated responses
	Inc1820	1	Irc_NFS_DS04	nvm_NFS	NTAP915_Src	Potential attack	C. New		4 hours ago	1 new extensions detected	2 Snapshot copies



The alert can be dismissed if the incident turns out to be false positive.

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.

	Ranso	mware protection		Dashboard	Protection	Alerts Recove	ry Repo	rts Free trial	(55 days left) -	view details (*
	2 Restore	257 Gi8 Data		۹	O MB Data		O Resto	O MB Data			
A	orkloads (2)									Q	
	Workload 2	Location \$	туре ⊤ ≎	Connector :	Snepshot and backu 🐨 🕯	Recovery status 🔍 🗘	Progress 2 In	nportance 🔻 3	Total data 0	Action	
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	Src_nfa_ds04	um scy scymUl:Resource.nu	VM datastore	GISABXPConn	SnapCenter for VMware	 Restore needed 	n/4 51	tandard	29 Gill	Restore	ß

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

n NetAp	PP BlueXP		Q (BlueXP Search	Select "Restore needed to	Point" and VM
	Restore "Src_NFS_DS04"		Restore (2) Review		
7			Restore		
	Workload: Src_	NFS_DS04 Location: um:scv:scvmUI	Resou VCenter: vvcsa8-01.hmcdc.	local Type: VM datastore Connector: Gi	SABXPConn
, ,			nsiateot e a VM block to its previous state and last trans	action using SnapCenter for VMware	
	Source				~
	First attack, reported Jugs	NE 8, 2024, 153 PM			
	Restore points (6)				Q
	Restore pol	nt ()	\$ Type	0 Date	
		04_08-09-2024_08.08.16.0981	mapshot	August 9, 2024, 1:08 PM	
		04_08-09-2024_07.54.48.0205	snapshot	August 9, 2024, 12:54 PM	
		04_08-09-2024_06.27.18.0190	anapshot	August 9, 2024, 11:27 AM	
	O RG_NESOS	04_08-09-2024_05.00.28.0747	enapshot	August 9, 2024, 10-00 AM	
			Not		

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

IN	etApp Blu	eXP				Q BuickP Search		•	0 0	9
ŧ.	Restore	"Src_NFS_DS04	1			G Restore 🛛 Review			×	
,						Review				
Ð	8	Src_NFS_DS04 Workload		um.scy.scvmQl Location	Resou	vycsa8-91.hmodc.loca vCenter	VM datastore Type	GISA8XPConn Connector		
	olume (1)								a	4
	Source VM		Restore date		2 Destinatio	in working environment	2 Destination SVM	Destination VM		•
	NFS_Demd6_)	VM02	August 9, 2024,	12:54 PM	NTAP915_	.Src	sum_NFS	NFS_Demo8_VM02		
						Previous				

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 Tectore						tored VM files
	Summary Mointor Company Permasions	Files.	HORES VMB				
vcsat-0thredeseat Vcsat-0thredeseat Vcsat-0thredeseat	That is a hant have						C Insert in the other management
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E NESOSOJARE	> D anapatos		D 10,5empletures	3.50	07/020514 81443.8M	Pla	[5-, 103, 2554] MS, Densil, MG250, Service:
SHL/6C9L0502 SHL/6C9L0502 SHL/6C9L0504	NFS_Demoli_VM02 NFS_Demoli_VM02	0	() 50,2emphil.sopplased	100	10/10/2024 10:00:20 244	Piel.	15-C, MS, (2004) MP3, Demuk, VMC(200, Demu594) and
II SHLAFS_DEDT	 b) NFS_Demoit_VM03 b) NFS_Demoit_VM04 		13 HL Service Laterstrated	140	06/38/2024 30:30-47 A W	file .	(S-C,MR_DBDR) MR_Demail_VM02SD_DemANN) set#
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III SHENPS, DEM			D. HER, Devolt, VHD-202405 comp.	4794.354 m 1	07/22123-112-01-04	File .	The MPL DECEMPL Dames, VACUMPL, Dames, California, Dames, California, Californ
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vesile-02-eck-install-detailore vesile-03-eck-install-datastore			Q MEDINE, VMID an err	0.01918	06713024, 101232744	200	[51,101,0054]101,5amal,94021013,0amal, 4.400
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		0	D. HULDHINE, VHDJ VIIKER	0.40	06/08/2024, 10 10 20 AM	No.	[54,973,0504]101,0amil_VHG1075,0amil_
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			12 vmvav-2xe	10.9.41	18/05/30A-13747 AM	-yeldon Pile	(Sec. MPS, 1954) MPS, 20008, VMC01-0009-2240
	V Hannaharana 2000	10	10. mm 100.		(h1 + 2011), 1 (1 / 1 + 1)	1900-00	



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

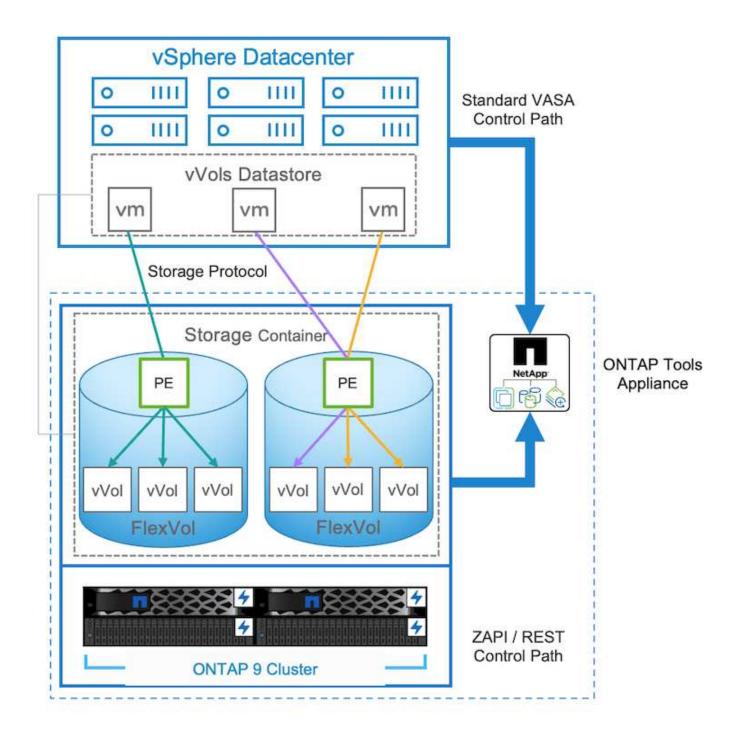
leveraging the rich set of capabilities provided by storage arrays. The vSphere API for Storage Awareness (VASA) make it easy for a VM administrator to use whatever storage capabilities are needed to provision VMs without having to interact with their storage team. Prior to VASA, VM administrators could 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.

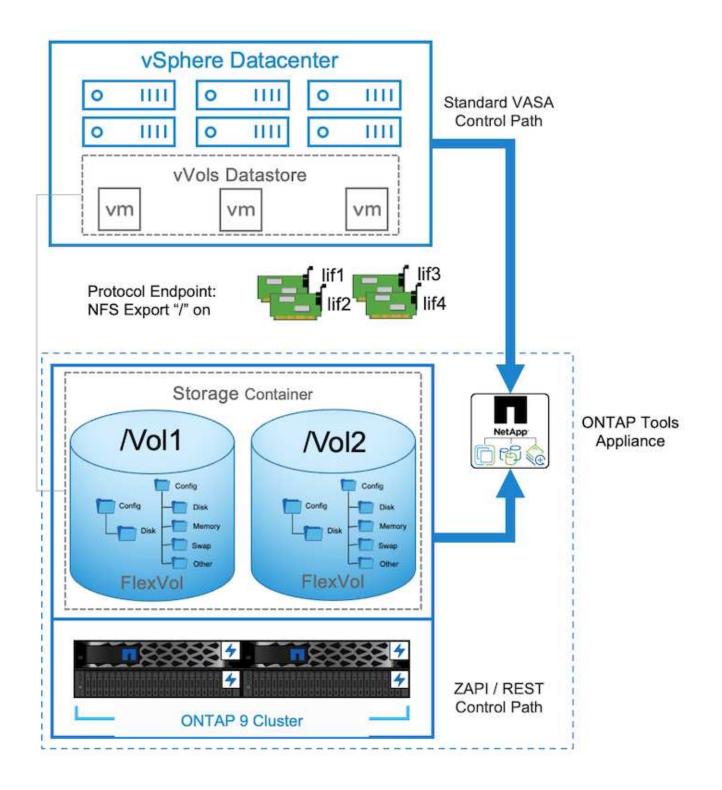
Each vVol datastore is backed by Storage Container which is a logical entry in VASA provider to define the storage capacity. The Storage container with ONTAP tools is constructed with ONTAP volumes. The Storage Container can be expanded by adding ONTAP volumes within same SVM.

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.



server	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 entrie	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, dearch is all environmente					C & Administrations/VSPHERELOCAL ~	٢	۰.
	I TMEO2_NFS	ova. • Permissiona Film No	its VML				
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E THEOLOGY	General	Nate	e hoe	T Stronge	a+4y		
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0	SnapCenter Plug-in for VMwzv						
	Resource Groups						
10 18 12	Backups						

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?

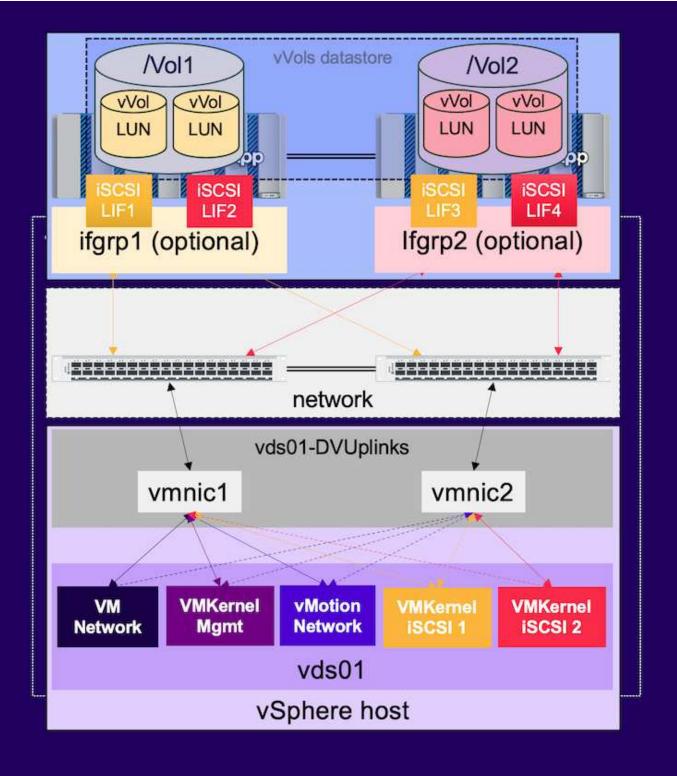
VMware Virtual Volumes (vVols) provides the following benefits:

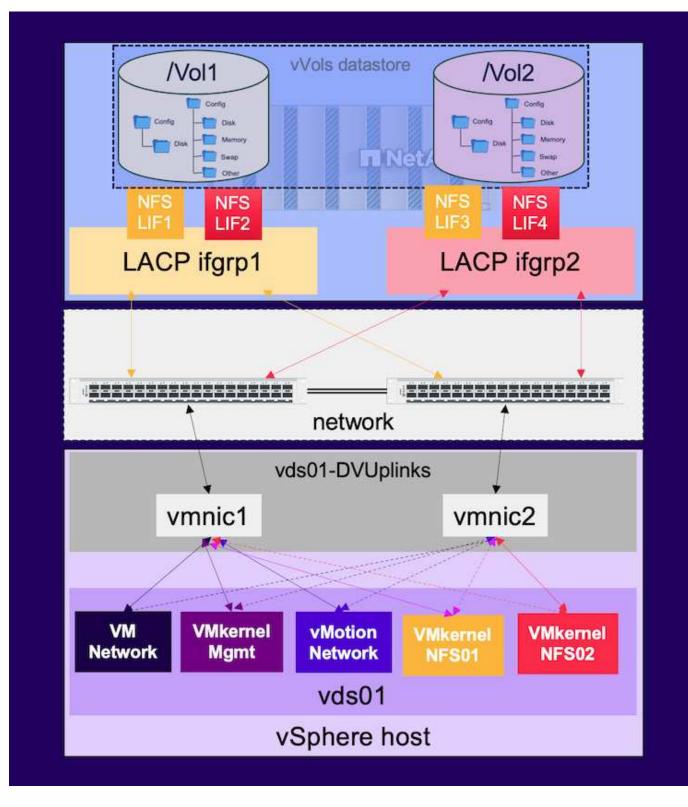
- Simplified provisioning (No need to worry about Maximum LUN limits per vSphere host or need to create the NFS exports for each volume)
- Minimizes the number of iSCSI/FC paths (For block SCSI based vVol)
- Snapshots, Clones & other Storage operations are typically offloaded to storage array and performs 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:	Cluster01	BROWSE	
3 Storage attributes	Type:			
4 Summary	Name:	TME02_NFS		
	Description:			
	Protocol:	SNFS O ISCSI O FC / FCOE O NVMe/FC		
				CANCEL

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

General				
2 Storage system	Storage capability profiles:	Default profiles Platinum_AFF_A	â	
		Platinum_AFF_C		
3 Storage attributes		Platinum_ASA_A		
		Platinum_ASA_C		
4 Summary		Create storage capability profile		
	Storage system:	ntaphci-a300e9u25 (172.16.9.25)	v	
	Storage VM:	zoneb	U.	

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

ew Datastore 1 General 2 Storage system		details for provision				
3 Storage attributes	Name	Ŧ	Size	Storage C	apability Profile	Aggregate
4 Summary	TME01_ISC	SI_01	250 GB	Platinum		EHCAggr01
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						1 - 2 of 2 items
	Name	Size(GB) ()	Storage capabilit	y profile	Aggregates	Space reserve
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						ADD
					CANCE	L BACK NEXT

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

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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		
	Provisioning destination:	Cluster01		
2 Storage system	Datastore name:	TME01_ISCSI		
3 Storage attributes	Datastore type:	vVols		
s storage attributes	Protocol:	ISCSI		
1 Summary	Storage capability profile:	Platinum_AFF_A		
	Storage system details			
	Storage system:	ntaphci-a300e9u25		
	Storage system: SVM:	ntaphci-a300e9u25 zoneb		
			Aggregate	Storage Capability Profile
	SVM: Storage attributes	zoneb	Aggregate EHCAggr01	Storage Capability Profile Platinum_AFF_A
	SVM: Storage attributes New FlexVol Name	zonéb New FlexVol Size		

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 configura Encrypt this virtual machine (Requiver the second		ement Server)				
2 Select a name and folder	Disable Storage DRS for this virtua		ients Policy ?				
3 Select a compute resource	Name	Ŧ	Storage Compatibility	Capacity Y	Provisioned Y	Free	T T
4 Select storage	I TME01_ISCSI		Compatible	500 GB	1 MB	500 GB	
			Incompatibl e	499.75 GB	158.58 GB	341.17 GB	X
5 Select compatibility	Manage Columns				items per p	ago 10 V	2 itoms
6 Select a guest OS							
7 Customize hardware							
8 Ready to complete							
	Compatibility						
	✓ Compatibility checks succeede	d.					
						заск	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.

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The credential should match the info used during provision of ONTAP tools

← C Not 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.

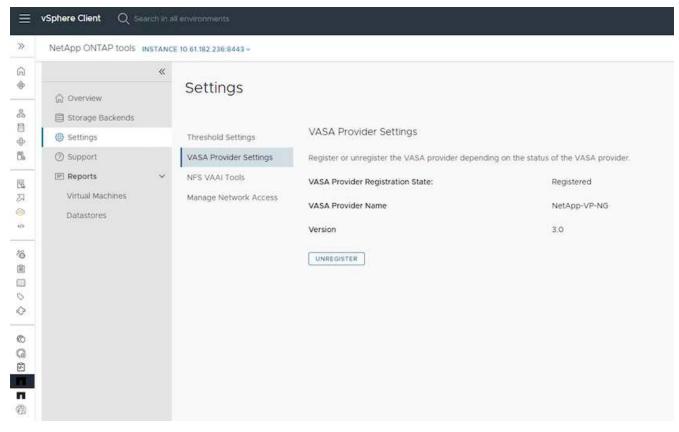
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With ONTAP tools 10.1

- 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.

Create Datastore	Туре		×
1 Type	Destination:	Cluster01	
2 Name and Protocol	Datastore type:	○ NFS	
3 Storage		VMFS vvols	
# Storage Attributes			
5 Summary			
			CANCEL NEXT

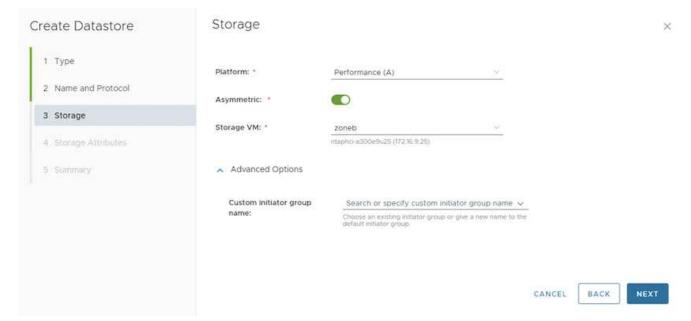
If vVols option is not available, ensure the VASA provider is registered.



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:	iSCSI	0	
3 Storage	101000	NFS 3 ISCSI		
4 Storage Attributes		Baddel		
5 Summary				
			CANCEL	BACK

4. Select platform and Storage VM.



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

Create Datastore	Storage Attributes	
1 Type 2 Name and Protocol	Create new volumes or use the existing FlexVol volumes with free size equal to or greater than to the datastore.	5 GB to add stora
	Volumes: O Create new volumes O Use existing volumes	
3 Storage	ADD NEW VOLUME	
4 Storage Attributes	Name T Size T Space Reserve T GoS Configured T	Local Tier
5 Summary		
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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.

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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 ()
Retention	Days to keep
Replication	🕑 Update SnapMirror after backup 🕧
	Update SnapVault after backup (1)
	Snapshot label
Advanced $ \smallsetminus $	VM consistency 🕧
	Include datastores with independent disks
	Scripts () Enter script path
	CANCEL ADD

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

 \times

Create Resource Group

1. General info & notification	Scope:	Virtual Machines 🗸		
2. Resource	Parent entity:	Datastores Virtual Machines	•	
3. Spanning disks		Tags Folders		
I. Policies		Q Enter available entity nam	•	
5. Schedules	Available enti	ties	Selected entities	
6. Summary	TME01			
			>	
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			BACK NEXT FIN	SH 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.

	@ TME01 D C C @		Janastories Netwo	sis Shapshots	Updates				
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	Resource Groups								
	Backups								

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

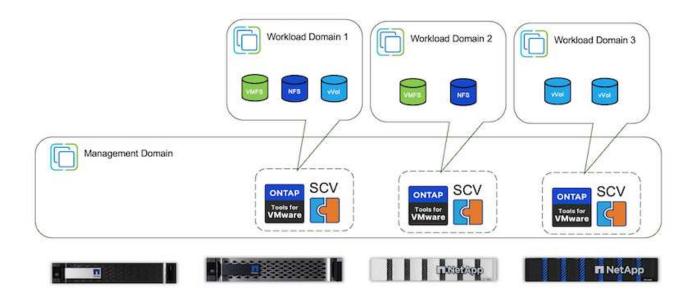
For bulk migration of VMs between vVol datastores, please check migrate vms to ONTAP datastore.

Sample Reference architecture

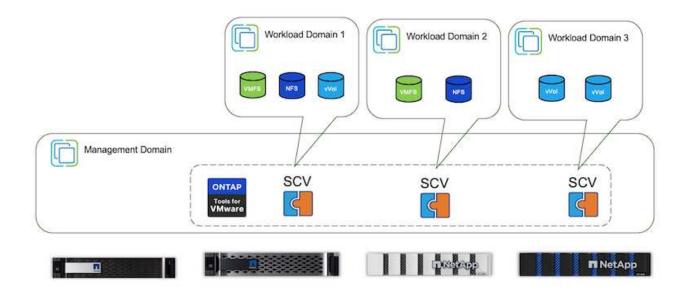
ONTAP tools for VMware vSphere and SCV can be installed on same vCenter it is managing or on different vCenter server. It is better to avoid to host on vVol datastore it is managing.



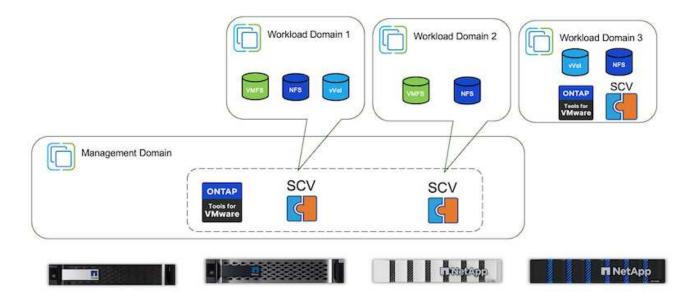
As many customers host their vCenter servers on different one rather than it is managing, similar approach is adviced for ONTAP tools & SCV too.



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.

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.

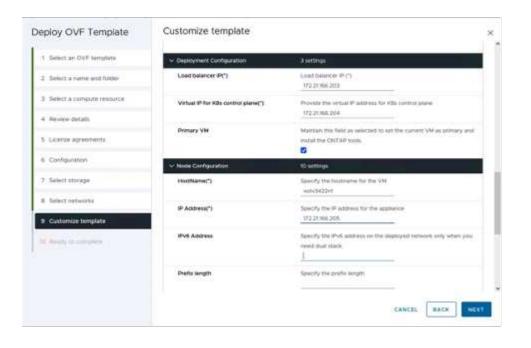


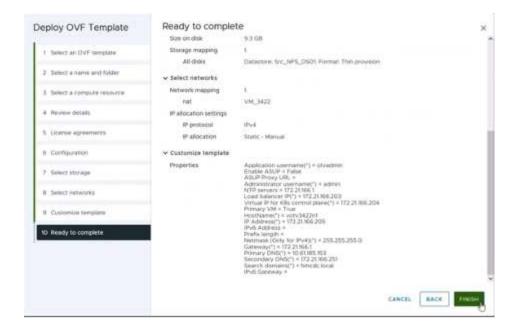
The easy deployment option is used in this walkthrough.

Deploy OVF Template	Configuration		3
	Select a deployment configuration		
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	O Advanced displayment (5)	ONTAP tools	
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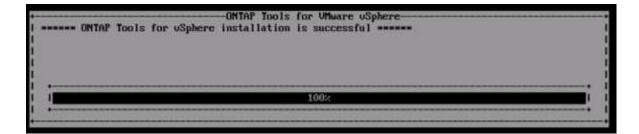
- 6. Choose the datastore to deploy the OVA and the source and destination network. Once done, select Next.
- 7. It's time to customize template > system configuration window.

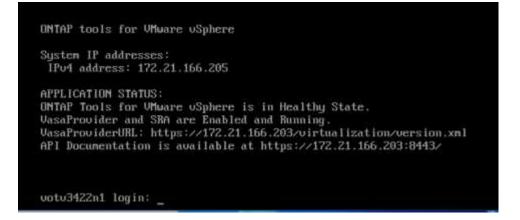
1. Select an OVF template	Administrator username(*)	Unername to assign to the Administrator Please use only a letter as the beginning. And only $(\Phi_{i_{1}}^{i_{1}}, \nabla_{i_{1}}^{i_{1}}, \nabla_{i_{2}}^{i_{1}}, \nabla_{i_{2}}^{i_{2}})$ special characters are subsiriled admin			
2 Select a name and folder					
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4 Review details		Password		0	
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8 Configuration		Confirm Passworth		Ø	
7 Select storage	NTP servers	A common requesting fait of Accelerations or IP addresses of ACP servers. If left black, VMvans Coch based Invia synchronization will be used (72.21.56.1			
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District to constitue		Pastword		0	
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After successful installation, the web console shows the state of ONTAP tools for VMware vSphere.



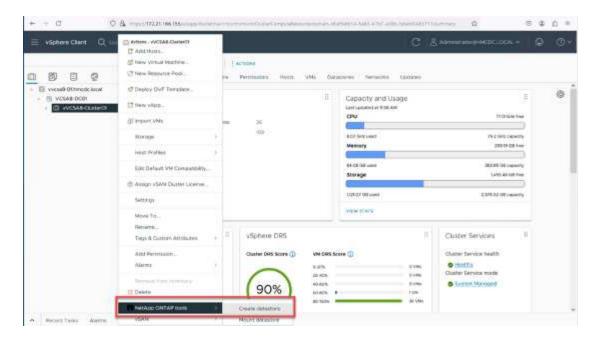


The datastore creation wizard supports provisioning of VMFS, NFS and vVols datastores.

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.

 (\mathbf{i})



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

Create Datastore	Туре		×
1 See 2 Sector Stationed 2 Sector Stationed 2 Sector Stationed 3 Sector Stationed	facturature: Defauture type	© WCHE-Control ∵Hra © Hra © Hra	
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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				×
t type	Datastore name	DenoD5_BC9			
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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		×
1 Type : 2 Name and Protocol 3 Storage	Platform: * Storage VH; *	Any - svm_BCB - starting_te_str2206.955	
4 (Incidentification) (1 (Incidentification)	 Advanced Options Curters initiator group name: 	Lanch in good) curtors folding goals have a Original execution being goal in goe a new some state article states goals.	
			CANCEL BACK NEXT

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.

reate Datastore	Storage Attributes	
1 Туре	Specify the storage details for	provisioning the datastore
2 Name and Protocol	Aggregate: *	NTAP915_Src_01_VM_DISK_1 (147.9 GB Free)
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4 Storage Attributes	Advanced Options	
	Space Reserve: *	Thes -
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		CANCEL BACK NEXT

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					ċ.
	Datastore type:	VMFS				1
1 Type						
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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 Plugin 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	
NFS	O Compliant (3)
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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

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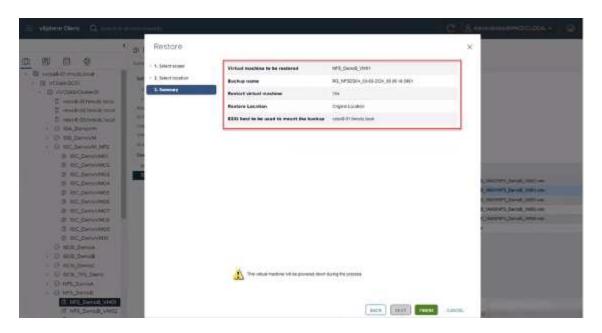
4. On the Select Scope page, select Entire Virtual Machine in the Restore scope field, then select Restore location, and then enter the destination ESXi information where the backup should be mounted. Enable Restart VM checkbox if the VM needs to be powered on after the restore operation.

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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.

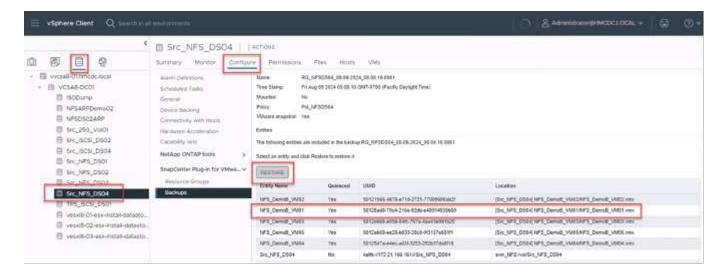


Monitor the operation progress by selecting Recent Tasks at the bottom of the screen.



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.



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 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 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 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

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.

Author: Josh Powell - NetApp Solutions Engineering

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

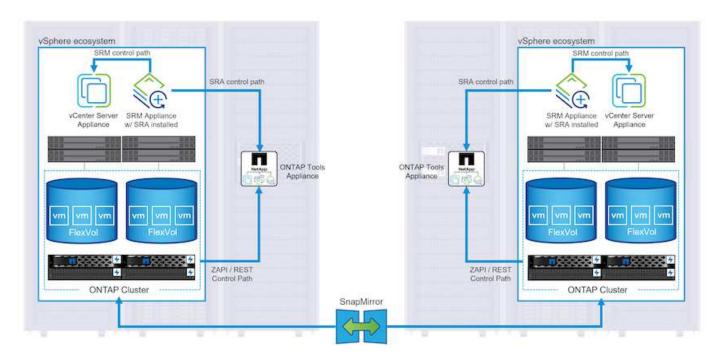
NetApp ONTAP provides robust disaster recovery solutions for VMware environments. These solutions leverage SnapMirror replication technologies between primary and secondary storage systems to allow failover

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.

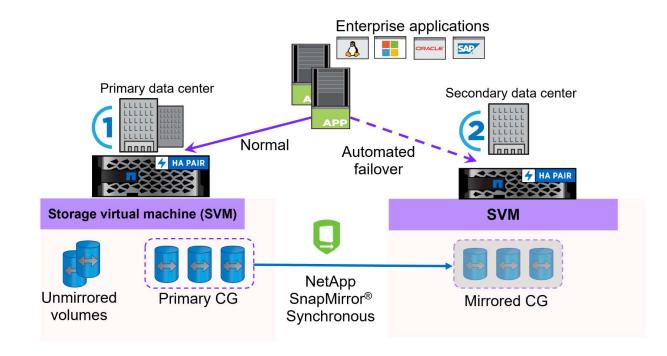


The NetApp SRA is installed as part of ONTAP Tools for VMware vSphere.

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.



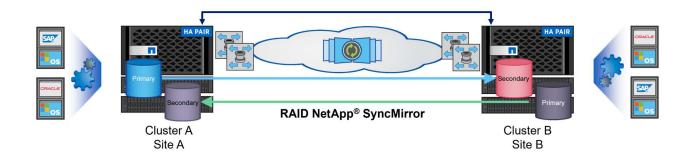
For more information refer to SnapMirror Business Continuity overview.

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 documentation site.

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.

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Author: Josh Powell - NetApp Solutions Engineering

Managing Block Storage with ONTAP Tools for VMware vSphere

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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:

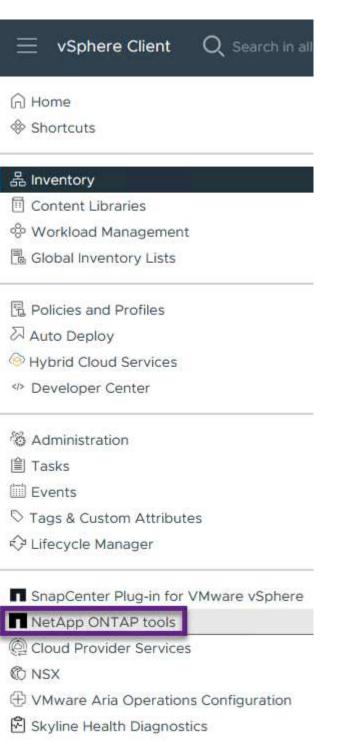
- 1. NetApp All-Flash SAN Array A400 with ONTAP 9.13.
- 2. iSCSI SVM created on the ASA with network connectivity to the ESXi hosts.
- 3. ONTAP Tools for VMware vSphere 9.13 (VASA provider enabled by default).
- 4. vSphere 8.0 cluster (vCenter appliance, and ESXi hosts).

Solution Deployment

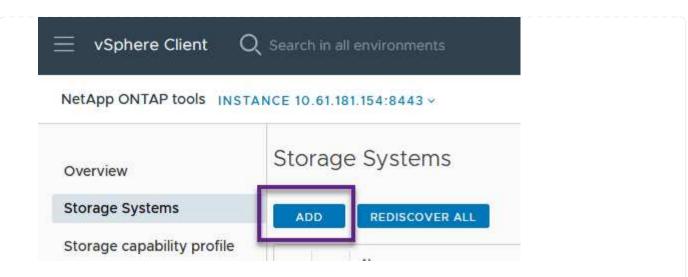
Create a vVols datastore in ONTAP Tools

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 betw system should be mutual 	een ONTAP tools plug-in and the storage y 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 C	${f \lambda}$ Search in all environments
NetApp ONTAP tools INST	ANCE 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	Name:	Gold_ASA_ISCSI
2 Platform		
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			
Capability Profile	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	

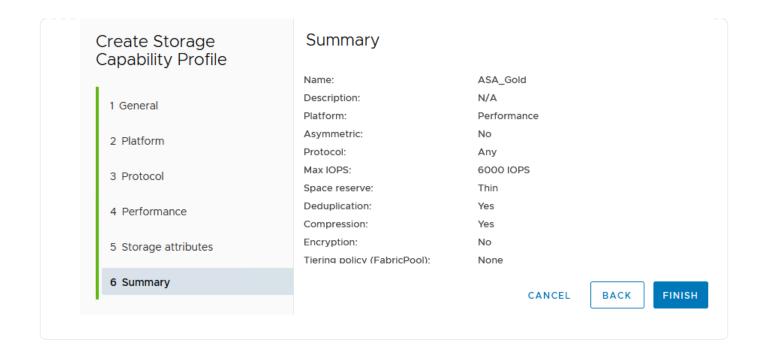
5. The **performance** page allows setting of quality of service in form of minimum and maximum IOPs allowed.

Create Storage Capability Profile	Performance					
	None					
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	
	Capability Profile 1 General 2 Platform 3 Protocol 4 Performance 5 Storage attributes	Capability Profile None (1) 1 General 2 Platform 3 Protocol 4 Performance 5 Storage attributes	Capability Profile 1 General 2 Platform 3 Protocol 4 Performance 5 Storage attributes	Capability Profile 1 General 2 Platform 3 Protocol 4 Performance 5 Storage attributes 6 Summary	Capability Profile 1 General 2 Platform 3 Protocol 4 Performance 5 Storage attributes 6 Summary	Capability Profile 1 General 2 Platform 3 Protocol 4 Performance 5 Storage attributes 6 Summary

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	v .
5 Storage attributes	Tiering policy (FabricPool):	None	v .
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 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	Туре:	NFS VMFS 💽 vVols	
4 Summary	Name:	ASA_VVOL	
	Description:		
	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:	FAS_Default	^	
		FAS_Max20 Custom profiles		
3 Storage attributes		Gold_ASA_ISCSI		
4 Summary		Gold_ASA	~	
	Storage system:	HCG-NetApp-A400-E3U03 (10.192.102.103)	~	
	Storage VM:	svm1	~	

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: O Cre Create new volumes	details for provisio eate new volumes						
3 Storage attributes	Name	⊤ Size	Storage Capability	Profile	Aggregate			
4 Summary	FlexVol volumes are not added.							
	Name	Size(GB) (j	Storage capability profile	Aggregates	Space reserve			
	ASA_VVOL	2000	Gold_ASA ~	HCG_A400_E3u3b_NVM	IE - Thin ADD			
				CAN				

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

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

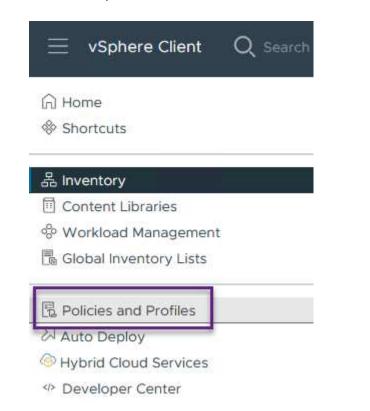
Create a VM storage policy in the vSphere client

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:

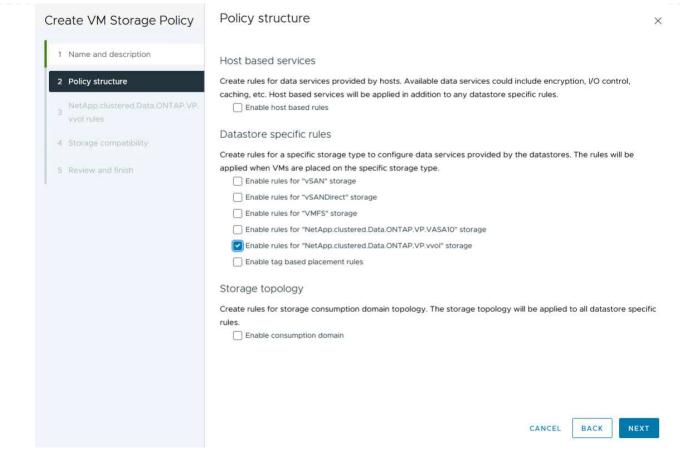
1. From the vSphere clients main menu select **Policies and Profiles**.



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.

create VM Storage Policy	NetApp.clustered.Data	ONTAP.VP.vvol rules	
1 Name and description	Placement Replication Tag	5	
2 Policy structure	ProfileName (j)	Gold_ASA	
3 NetApp.clustered.Data.ONTAP.VP. 3 vvol rules			
4 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

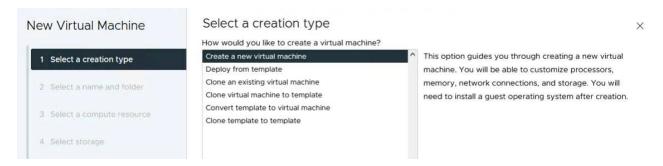
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on vVol datastores and to establish a one-to-one mapping with the previously generated storage capability profile.

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 Im HMC Cluster
2 Select a name and folder	> III HMC Cluster
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 configuration	n and disk files				
1 Select a creation type	Encrypt this virtual machine (i) VM Storage Policy ASA_G	v blog				
2 Select a name and folder	Disable Storage DRS for this virtual ma					
3 Select a compute resource	Name	T Storage T Compatibility T	Capacity T	Provisioned T	Free T	
4 Select storage	I ASA_VVOLS_1	Compatible	1.95 TB	9 MB	1.95 TB	
- Select storage	O B ASA400_ISCSI01	Incompatible	2 TB	185.32 GB	1.9 TB	
Select compatibility	O DemoDS	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 🗐 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	
	Manage Columns	Items per page	10 ~ 1 - 10	of 15 items	< 1 / 2	>
	Compatibility					
	Compatibility					
		Validating	J			

- 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).

1 Select a creation type	Configure the virtual machine		
Select a creation type	Virtual Hardware VM Op	tions Advanced Parameters	
2 Select a name and folder			ADD NEW DEVICE -
3 Select a compute resource	> CPU *	<u>4 ~</u> (1)	
A. Colorit element	> Memory *	32 × GB ×	
4 Select storage	∽ New Hard disk *	150 GB ~	1
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 Hard dis	<u>к ~</u>
	> New SCSI controller	LSI Logic SAS	:
	> New Network	VM Network 🐇 🔄 Connected	1
			CANCEL BACK 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.

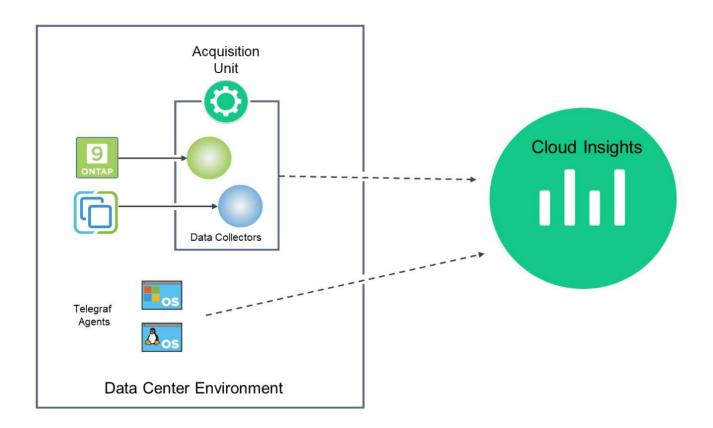
NetApp All-Flash SAN Array with VMware vSphere 8

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 Acqusition 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.

NetApp Cloud Insights				Q 🍄
Observability -	NetApp PCS Sandbox / Observa	ability / Collectors		
Explore		Data Collectors 07 A	cquisition Units 🚺 3 Kub	ernetes Collectors
Liptore	Data Collectors (84)		+ Data C	ollector Bulk Actions 🔻 \Xi F
Alerts	Name 1	Status Type	Acquisi	tion Unit IP
om here search for C	DNTAP and click on	ONTAP Data Mana	gement Softwa	re.
Choose a Data Collect	or to Monitor			
= ontap				1
FSX	NetApp		NetApp	
FSx for NetApp ONTAP	Cloud Volumes ONTAP	ONTAP Data Management Software	ONTAP Select	
n the Configure Coll hit and provide the cr en Complete Setup	edentials for the ON	ITAP storage systen	n. Click on Save	and Continue an
nit and provide the cr	redentials for the ON at the bottom of the	ITAP storage systen	n. Click on Save	and Continue an
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it and provide the cr en Complete Setup Select a Data Coll NetApp ONTAP Data Management Sof Add credentials and red Name @ ntaphci-a300e9u25	ector tware quired settings	ITAP storage system page to complete th Configure Data Collector Collector Acquisition Unit bxp-au01	n. Click on Save le configuration.	e and Continue an Complete Setup
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it and provide the cr en Complete Setup Select a Data Coll NetApp ONTAP Data Management Sof Add credentials and red Name @ ntaphci-a300e9u25 NetApp Management IP Addre 10.61.185.145	ector tware quired settings	ITAP storage system page to complete th Configure Data Collector Collector Acquisition Unit bxp-au01	n. Click on Save le configuration.	e and Continue an Complete Setup
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In the complete Setup Select a Data Coll NetApp ONTAP Data Management Sof Add credentials and red Name Intaphci-a300e9u25 NetApp Management IP Addred 10.61.185.145 Password Internet IP Addred Internet IP Addred Intaphci-a300e9u25	ector tware quired settings	ITAP storage system page to complete th Configure Data Collector Collector Acquisition Unit bxp-au01 User Name admin	n. Click on Save le configuration.	e and Continue an Complete Setup

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

NetApp Cloud	Insights					Q	\$ 3
••• Observability	•	NetApp PCS Sandbox / Obs	ervability / Collectors	5			
Explore			Data Collec	ctors 07 Acquisition	Units \rm 3 Kubernetes Col	ectors	
Alerts		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**.

RetApp Cloud	Insights	
0 Observability		NetApp PCS Sandbox / Observability / Collectors / Add Data Collector
Explore		Choose a Data Collector to Monitor = vsphere
Alerts		vmware
Collectors	29	vsphere
Log Queries		6)

 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.

VCSA7	Acquisition Unit
Name VCSA7 Virtual Center IP Address 10.61.181.210 Password Complete Setup Test Connection	bxp-au01
VCSA7 Virtual Center IP Address 10.61.181.210 Password Complete Setup Test Connection	bxp-au01
VCSA7 Virtual Center IP Address 10.61.181.210 Password Complete Setup Test Connection	User Name
10.61.181.210 Password •••••••• Complete Setup Test Connection	
Password Complete Setup Test Connection	administrator@vsphere.local
Complete Setup Test Connection	
Complete Setup Test Connection	
Collecting: Vinventory VM Performance	
Inventory Poll Interval (min)	Communication Port
20	443
Filter VMs by	Choose 'Exclude' or 'Include' to Specify a List
ESX_HOST 👻	Exclude
Filter Device List (Comma Separated Values For Filtering By ESX_HOST, CLUSTER, and DATACENTER Only)	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	1
	Reporting	Ø	Applications	÷
			Device Resolution	3
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				
Sciences	eering			Cancel	Save
Sciences	eering			Cancel	Save
Solutions Engine	right hand	corner of the Annot on to the assets.	ation Rules pag		All Rules to r
Solutions Engine	right hand		ation Rules pag		All Rules to r
Solutions Engine nally, in the upper e rule and apply t	right hand he annotatio		ation Rules pag		Q 🏠 🚱 🕒 PC C Rules running
	right hand he annotatio		ation Rules pag		Q 🌣 🙆 🔒 🛚

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	
capitore		All Dashbords	
Alerts		+ New Das	
		Metric Queries	St
Collectors	17	Infrastructure Insights NEW	SI

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 / E	plore / Dashboards	
Explore		Dashboard Groups (108) 🛛 🕂 🔍	All Dashboards (3,708)	+ From Gallery + Dashboard
		Q. Search groups	Name Î	Owner V
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.

(\Box)	ONTAP FAS/AFF - Cluster Capacity		
0	ONTAP FAS/AFF - Efficiency		
~	ONTAP FAS/AFF - FlexVol Performance		
	ONTAP FAS/AFF - Node Operational/Optimal Points		
	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		
0	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?		
	dditional Dashboards (13) e dashboards require additional data collectors to be installed. Add Mor		
Add D	ashboards 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.

NetApp Cloud	nong-no			🔍 🌣 🕜 😫 Powell Jash
0bservability	-	NetApp PCS Sandbox / Observability / Dashboards / ONTAP FAS/AFF - FlexVol Performance (10)	0	Last 24 Hours 🔹 🕕 🖉 Edit
Explore		FlexVol All Data Center All	Storage ntaphci-a000e9u25 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	Ø	40%	2	
3 Kubernetes	•	0 453 PM 7x40 PM 1026 PM 113 AM(14, 4x00 AM 6x46 AM 933 AM Aug	0 453 PM 7x0 PM 1026 PM 113 AM (14. Auto	4:00 AM 6:46 AM 9:33 AM 12:20 PM
Workload Security		ntaphci-a300e9u25:E ntaphci-a300e9u25:n ntaphci-a300e9u25:H ntaphci-a300e9 HC NFSRAGHU_DRO_taphci-a300-01:vol0 MC 3510:Select.N1 taphci-a300-02:v DEST TEST 0		ntaphci-a300e9u25:H III ntaphci-a300e9u25:H MC_3510:Select_N1 MC_3510:Select_N2
		ntaphci-a300e9u25:H ntaphci-a300e9u25:E ntaphci-a300e9u	u25:E ntaphci-a300e9u25:E ntaphci-a300e9u25:E ntaphci-a300e9u25:E	ntaphci-a300e9u25:E ntaphci-a300e9u25:E HC_NFS:DRO_FSxN_n HC_NFS:NFS_VMMAR
ONTAP Essentials		st01 K_CI C	st01 V	Vol01 K CI

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		Ø Edit
Display Metrics 💌		Hide Res	ources
	Resource		
	Top Correlated		91%
:00 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	Search Asseis		

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

	Display Me	trics 💌		Hide Resources
			Resource	
l.			Top Correlated	
a ah			ntaphci-a3VMMARK_CI	91%
AM 6:00 AM 8:00 AM 10:0	0 AM 12:00 PM	2:00 PM	🗌 👜 esxi7-hc-0netapp.com	69%
E.	Total Read Write	₫	Workload Contention	
			🗌 🎰 AuctionWebB0	87%
^	1	3	AuctionNoSQL0	72%
			Additional Resources	
AM 6:00 AM 8:00 AM 10:0	0 AM 12:00 PM	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.

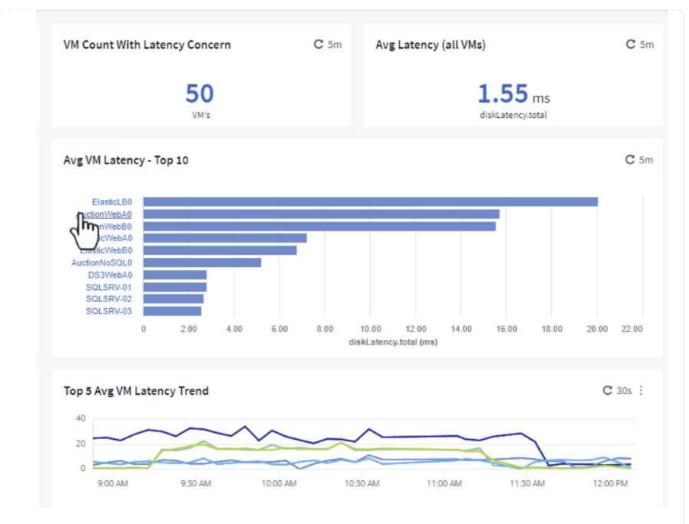
1. In this example access a dashboard available in the **Gallery** called **VMware Admin - Where do I** have VM Latency?

ashboard Groups (108)	+ <	My D	ashl	poards (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		
Infrastructure Observability (2)				ONTAP - Volume Workload Performance (Frontend) (7)		Powell Josh		
11 Monitoring CI Course Patrick	-			VMware Admin - Where are opportunities to right size? (37)		Powell Josh		
(15)	-			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)	ō	Powell Josh		
1_Str Dashboards (8)	:			Jun				
4 100				\cup				

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

*	VirtualMachine Al		Data Center	Solutions Engineering X	××	diskLatency.total	2 🔻	All

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	
					AuctionWebA0	
	_				Top Correlated	
					🗌 🍿 esxi7-hc-0netapp.com	91%
11:00 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	
1:00 AM	11:15 AM	11:30 AM	11:45 AM	12:00 PM	Q Search Assets	

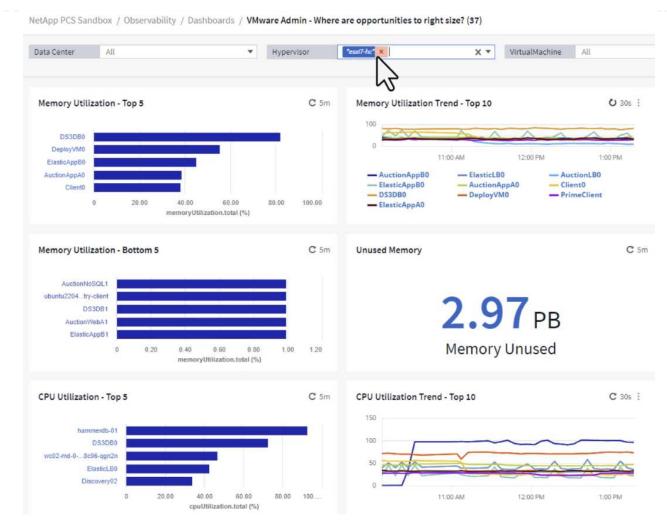
View over and under utilized resources in Cloud Insights

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 1
	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	
	768.0	81.64	
	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	

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
ElasticL80	ElasticLB0

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 *sxi7-hc* ×	X *	Name All	*		
Powered Off VM's	C 5m	Reclaimable Storage	C 5m	Powered Off VM CPU's	C 5m	Powered Off VM's Men	nory Allocation
18.00		33.61 TI Capacity-Total	В	8.54 %			2.30 % ocated Memory
Powered Off VM's Capacity - Top 20			C 5m	Powered Off VM's			
OracleSiv_04				18 items found Virtual Machine	capacity.	ot ↓ processors	memory (M
OracleSrv_05				OracleSrv_04	6,433.25	4	32,768.0
OracleSrv_06							
OracleSrv_07				OracleSrv_05	6,432.89	4	32,768.0
OracleSrv_08				OracleSrv_06	6,432.80	4	32,768.0
PrimeClient_Old				OracleSrv_07	6,432.78	4	32,768.0
sou_Template				OracleSrv_08	6,432.77	4	32,768.0
Win2022				PrimeClient_Old	450.69	8	16,384.0
WinSrv2019				rhel_server	232.58	4	32,768.0
SnapCenter Server				SQL_Template	224.63	4	24,576.0
OracleSrv_01				Sec_rempine	224.03	7	a-4,010.0

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.

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

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.vendo	n NetApp X	× 💌 × host.os	"vmware" ×	• × + 0				
Filter by Metric +								
Group By Virtual Machine X 💌								
Formatting: 🛩 Show Expanded Details Condition	al Formatting Backgrou	ind Color 👻 🚺 👘 Sl	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	diskThroughpu
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
AuctionAppA1	AuctionAppA1	On	6.44	16.00	40.26	0.00	3.00	0.00

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

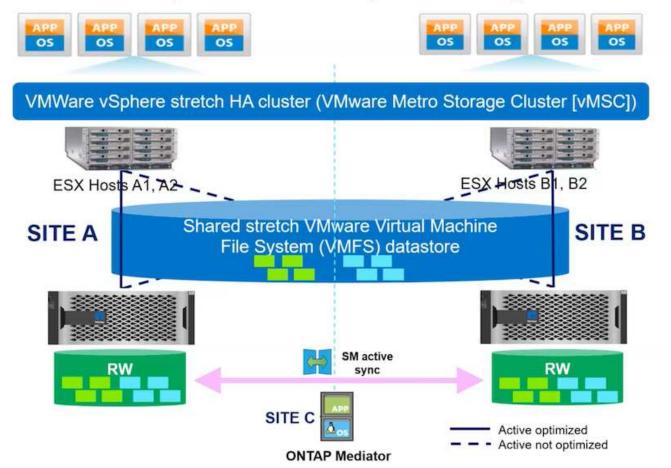
different fault domains to provide

- * 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.

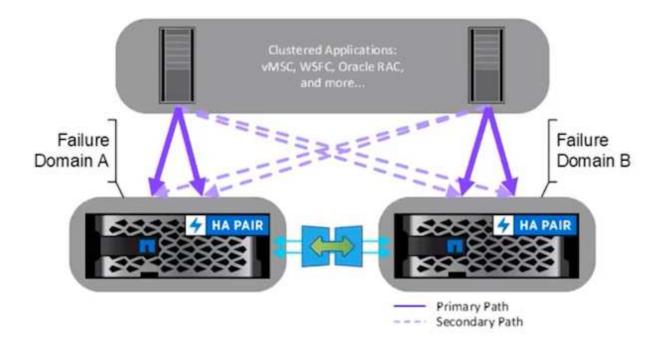
SnapMirror active sync

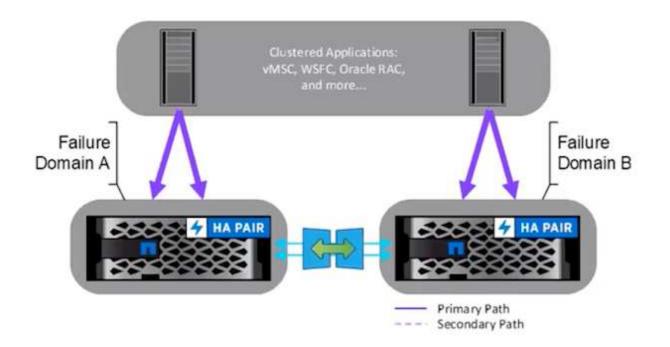
General availability release 9.15.1 for symmetric configuration



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							Q s	earch 🛓 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	۹	Q	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 🗸 🗸	Stora	ge Adapters							
Storage Adapters	ADD SO	FTWARE ADAPTER -	REFRESH RESCAN STORAGE RESCAN A	DAFTER FEMO	12.				
Storage Devices		Adapter •	Model ¥	Туре т	Status 🐨	identifier 🔻	Targets	Devices v	Paths 9
Host Cache Configuration		G vmhba65	ISCSI Software Adapter	ISCSI	Online	iscsi_vmk(ign.1998-01.com	4	Devices T	4
Protocol Endpoints	× 1	G Withbaos	ISCSI Software Adapter	1965F	Onane	vmware:dc01-esxi01.sddc.	372		
VO Filters						netapp.com:473524194:6 5)			
Storage Providers	0	G ymhbat	PEX4 for 430TX/4408X/MX IDE Contr	Block SCSI	Unknown	-			1
letworking 🗸		d. analoni	olier	0000 000	LONG PROPERTY		3		
Virtual switches	0	G vmhba64	PEX4 for 430TX/440BX/MX IDE Contr	Block SCSI	Unknown	- T)	0	0	0
		147 (MAR) / 201	ollor						
VMkernel adapters	0	@ vmhba0	PVSCSI SCSI Controller	SCSI	Unknown	-	1	1	1
Physical adapters									
TCP/IP configuration	Manag	e Columna Export -	1						14.000
/irtual Machines 🛛 🗸 🗸		to the terminal processor							
VM Startup/Shutdown	Property	es Devices A	Aths Dynamic Discovery Static Dis	Automatica State	vork Port Eindin	g Advanced Options			
Agent VM Settings	Property	es veviles e	and Dynamic Uncovery State of	covery ives	TOTAL POPULATION	A WARRINGS CAUSES			
Default VM Compatibility	OCA	REMOVE AUTH	ENTICATION ADVANCED						
Swap File Location	8								
country and the encountry	64	172.21.225.11:3260							3
ystem 🗸									



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::>	Tpgroup		Conn	Local	Remote	TCP Recv
					Address	
					172.21.225.71	
zonea	iscsi03	17	0	172.21.225.12	172.21.225.71	e
2 entries	were displayed.					
	· iscsi connecti	ion show			te-address 172.22 Remote	
E13A300::>	iscsi connecti Tpgroup	ion show	Conn	Local		TCP Recv
E13A300::> Vserver	iscsi connecti Tpgroup Name	ion show TSIH	Conn ID	Local Address	Remote	TCP Recv Size

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

8402	
totage in	
zones	(a)
Group with related LLINA ()	
storage and optimization	
Construction Construction Pro-	
1 300 Gill 🛩	
mentance investigation	
Performance	~
Charles of the university tool	
Apply the performance limits enforcement to each U.M. Forces	iction. Here instry will be applied to the action set of (1.5%).
Protection	
Freder Graphett copen doord	
Shaha ShqirAmp (Golal privenime)	
Automated FailOverDuplex	V Dive legacy primer (1)
Source	Destination
ELIA200	1.014
transfer we	traphol a000etha23 🐱 Rativish
25/100	troitide ste
memory and ()	Joodi A
#	- Destination settings
	(i) this obtained transition creates an agreeup top address applications bands in the additionation adjusted and theat operage to the ready constraint and the agreeup to the ready.
lost information	
EST APPROVALATION	441108668
stMeans 🗸	VMean
egt samma) being visible group) here visible group samg entiting infattur groups	
inter teltatore	
N/YOF BOP WAR	
(5) (SCN initiation (2)	
(j) 6CSI initiatives (2)	
(2) (6CS) initiators (2)	Discolar M Ville
 Nova 	Description V V Mar Description in productly to
* News	Description in proximity to
Nama ign1956-0Lean-indtat31e37889868	Description in producity to
Name ups1956-05.com.indtat.51eC10070688 ups1956-05.com.indtat.64550466018	Description in productly to
Name Ny 1994 O'Loss indhats1x010019988 Ny 1994 O'Loss indhats14050486014 Ny 1996 O'Loss indhats24050486014 Ny 1996 O'Loss indhats240504860144	Description in proceeding to 1 Name ~ 1 Name
Name Name Ny 1954 O'Loom indhat514(1939968) Ny 1954 O'Loom indhat514(1939968) Ny 1956 O'Loom indhat63450(466078 Ny 1956 O'Loom indhat63450(466078 Ny 1956 O'Loom indhat63145) Ny 1956 O'Loom indhat631451212	Description In proximity to 1 Name No - Manual No
Name Name Name No. No.	Description In proximity to 1 Name No - Manual No

6. On other fault domain storage array, create the SAN initiator group with its vSphere host initiators and set host proximity.

Overview Mapped LU	JNs			
STORAGE VM zoneb				
TYPE				
VMware				
PROTOCOL				
Mixed (iSCSI & FC)				
COMMENT				
PORTSET				
-				
CONNECTION STATUS				
⊘ OK				
 Initiators 				
Name		De	Connection status ()	In proximity to
iqn.1998-01.com.	vmware:dc02-esxi01.sddc.netap	÷	⊘ ок	zoneb
iqn.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.

smas-dc02 All SAN initiator groups

 (\mathbf{i})

smas-dc02 All SAN initiator groups	🖉 Edit 🛛 🔟 Delete
Overview Mapped LUNs	
+ Add	≂ Filter
Name	ID
ds02	1
ds01	0

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

	2	Summary	Monitor	Configu	re		
smas-vc01.sddc.n	etapp.com	Services	1.9	~	(
 RTP Cluster01 	[]] Actions - Cluster01		re DRS		1		
dc01-es:	다 Add Hosts 다 New Virtual Machine		re Availability ation	~	ſ		
🕄 dc02-es	C New Resource Pool		tart				
Demo01	🛠 Deploy OVF Template		al ovider				
🔂 scv-6.0.	gå New vApp		re EVC				
	ត្រី Import VMs		ost Groups ost Rules				
)	Storage	> errides > 📴 New Datastore					
	Host Profiles	>					
	Edit Default VM Compatil	oility	g	~			
	🗇 Assign vSAN Cluster Lice	1156	Cluster	- 1			
	Settings		thority efinitions				
	Move To		ed Tasks Cluster Services				
	Rename Tags & Custom Attributes	s >	al ores				
	Add Permission		ores	~			
	Alarms	>	25				
	Remove from Inventory		State	ř			
	Are senses a more		uration				

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

Storage	×	Stora	ge Adapte	ers													
Storage Adapters	-1	ADD SI	FTWARE ADAPT	N- REFRESH RES	CAN STORAGE	RESCAN	ADAPTER	PENERS.									
Storage Devices			Adapter	T Model		т	Type	+ 3	atus T	Identifie	C	Ŧ	Targeta	+ D	vices =	Patr	т <i>и</i>
Host Cache Configuration Protocol Endpoints VO Filters		• 1	∲ vmhba65	ISCSI Software	Adapter		ISCSI	c	nline	vmwar	mk(ign.1998-01 e:dc01-esxi01.s .com:4735241	ddc.	4	2		8	
Storage Providers	÷.	0	G vmbbal	PIX4 for 4301 other	K/44DBX/MX	IDE Contr	Block	SCSI U	nknown	10			1	51		1	
Networking Virtual switches	Ť	0	@ vmhba64		K/440EX/MX	IDE Contr	Block	SCSI U	nknown	Ξ.			0	0		0	
VMkernel adapters Physical adapters TCP/IP configuration		0	Ģ vmhba0	PVSCSI SCSI C	ontroller		SCSI	U	nknawn	2			1	1		1	
Virtual Machines VM Startub/Shutdown	×			(v troq													Altern
Agent VM Settings Default VM Compatibility Swap File Location		REFRE		Paths Dynami DCTADH BEIMME	c Discovery	Static Di	scovery	Networ	k Port Bindir	ig Ad	vanced Option	5					
System	×	0	None	1.00	LUN	т Туре	× .	Copacity T	Datasto	e ar	Operational State	τ	Hardware Acceleration	×	Drive Ty	n r	Transp
Licensing Host Profile			NETAPP (SCS) 30384677245	Disk (nas.600a098038 24975577931)	0	disk		250.00 GB	自己	501	Attached		Supported		Flash		iscsi
Time Configuration		0		Disk (nas 600a098038 249755779331	6 t)	disk		300.00 GB	Not Co	nsume	Attached		Supported		Flash		iscsi

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

	2	Summary	Monitor	Configu	re		
 Smas-vc01.sddc.ne RTP 	etapp.com	Service	5	~	(
 Cluster01 	[]] Actions - Cluster01		re DRS	- 1	1		
dc01-es:	📑 Add Hosts		re Availability	- 1	8		
dc01-es:	🔂 New Virtual Machine		ration	~			
dc02-es dc02-es	C New Resource Pool		tart				
⊕ Demo01 ⊕ scv-6.0.	St Deploy OVF Template		al ovider				
<u></u> scv•o.o.−	₿å New vApp		re EVC ost Groups				
	র্দ্রি Import VMs		ost Rules				
1	Storage	> Verrides New Datastore					
	Host Profiles	>					
	Edit Default VM Compati	bility	g	~			
	🗇 Assign vSAN Cluster Lice	ense	Cluster	- 1			
	Settings		thority efinitions	- 1			
	Move To		ed Tasks Cluster Service	s 🗸			
	Rename		al	207 - 54 A			
	Tags & Custom Attribute	s >	ores				
	Add Permission			~			
	Alarms	>	es				
	Remove from Inventory		State	~			
	🔀 Delete		iuntine				
Recent Tasks	VSAN	>					

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

lew Datastore	Name	and de	vice selection	on						3
1 Type	Specify	datastore n	ame and a disk/L	UN for provision	oning the datast	ore.				
2 Name and device selection	Name		D502	-						
3 VMFS version	(i) dist					s to the selected disk/l changing the host or				×
4 Partition configuration	Select a	a host	dc01-esxi01.sdc	ic.netapp.com	¥.,					
			Select a host to view	wits accessible dis	ke/LUNs:					
 Ready to complete. 		Name	Ŧ	LUN T	Capacity Y	Hardware Acceleration	Drive Type		Sector Format	
	•	NETAPP i 600a0980 45249755	SCSI Disk (naa. 038303846772 577933)	1	300.00 G B	Supported	Flash	5 B	512e	1
	0.1	Local VMv vmhba0:0	ware Disk (mpx. :0:T0:L0)	0	100.00 G B	Not support ed	HDD	-	512n	
	Mana	ge Columns	Export ~							2 item

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

Alarm Definitions Scheduled Tasks General	Connectivity and Multipathing												
Device Backing		Host		* *	Detest	ice Mounted	Ŧ	Datastore Connectivity	τ.	Mount Point			т
onnectivity and Multipathing	•	dc01-esxi01.sd	dc.neta	pp.com	Moun	ted		Connected		/vmfs/volumes	/66b2d163-ce	1443ad-3a67-005050	5b92d7e
rdware Acceleration	0	dc01-esxi02.sc	Rec mete	000.000	Moun	ted		Connected		/vmfs/volumes	/66b2d163-ce	(443ad-3a67-005056	5b92d7e
quability sets	0	dc02-esxi01.sc	(dc.net/	000,000	Moun	ted		Connected				1443ad-3a67-005056	
apCenter Plug-in for VMwa	0	dc02-esxi02.s	dd: net	abb com	Moun	ted		Connected		/vmfs/volumes	/66b2d163-ce	1443ad-3a67-005054	5b92d7e
Resource Groups													
Backups	Manage Columns 4 dom												
	Storage Array Type VMW_SATP_ALUA Policy Owner Plugin NMP Paths PREPESH CHARGE DISASE												
		Runtime Name	+	Status	τ	Target			1 T	LON	Ŧ	Preferred	
	0	vmhba65.C0.T0.L1		Active		ign.1992-08.cc 0d56:vs.28.172		sn 3cb67894c1111ed819200a 3260	09887	3		No.	
	100					ion.1992-08.cc	m.netapp	sn.3cp67894cftffled819200a	098a7	1		No	
	0	vmba65:C2:T0:L1		Active (I/O)		Od56 vs.28:172	21.225.12	3260					
	0	vmhba65:C2:T0:L1		Active (I/CI)		Od56 vs.28 172	minetapp	sn.3cb67894cf1f1led819200a	098#7	1		No	

Alarm Definitions Scheduled Tasks General	Connectivity and Multipathing												
Device Backing		Plast		Ф. т	Datasto	re Mounted 🛛 🔻	Datastore Connectivity	τ.	Mount Point			Ť	
Connectivity and Multipathing	01	dc01-esxi01.sd	dc neter	20.020	Mount	ed	Connected		/vmts/volumes/6	6b2d163-cet	443ad-3a67-005056b5	92d7e	
Hardware Acceleration	0	dc01-esxi02.sd			Mount		Connected				443ad-3a67-005056b5		
Capoblity sets	0	dc02-esxi01.sd		Contraction of the local division of the loc	Mount	138	Connected			and the second	443ad-3a67-005056b9		
SnapCenter Plug-in for VMwz∽	0	dc02-esxi02 sc	idc net	ipp com	Mount	ba	Connected		/vmts/volumes/6	6b2d163-cet	443ad-3a67-005056b5	92d7e	
Resource Groups Backups	Manage Columns												
	Multipathing Policies ACTIONS~ Path Selection Policy Round Robin (VMware) Storage Array Type VMW_SATP_ALUA Policy Owner Plugin Path Impressive												
		Buritivie Name		Status	Ξ¥.	Target		Ŧ	LUN	Ψ	Preferred		
	0 1	vmhba65:C2:T0:L1		Active (I/O)		ign 1992-08 com rietepp 46a21.vs 12:172:21:225:21	sn.133a93e1ce6b11edb10000a09 3260	985	1		No		
	0	vmhba65:C0.T011		Active		ign 1992-08.com netapp 46a21/vs.12:172.21.225.22	sn:133a93e1ce6b11edb10000a09 3260	089	1		No		
	0	vmbba65:C2:T0:L1		Active (I/O)		ign 1992-08.com.netapp 46a21.vs.12:172-21.226-21	sn.133a93etce6bthedb10000a09	696	1		No		
						#04141.V1.14.17.2.21.2.20.21	3400						



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/ds02	
E13A300 CONSISTENCY GROUP ds	maphci-a300e9u25 CONSISTENCY GROUP ds	
\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.

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

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 same											C &	Administrator@VSPHERELOCAL ~	0	
IntApp ONTAP tools Instance	IC 10.61.163	1,2401	9443-+											
الله Q Overview		raç	ge Bac	kends										0
🖬 ütorage Backends	ADO	×												
Protection ····· rost clutter relationships			Nano y	Ter	Laren +	Owfair wergen	 State 9	Capacity	19	Arts wear		Supported Detailors Types O		
Ø seniegi		8	Micho-a.	dianty.	172 16 9 25	9.25.1	0 14atty	1	13765					
() feeport		$ \mathbf{x} $	E13A300	Cutter	172363312	0.951	0	1	49.94%					
(E) Reports v Virtual Machines	1	£	ontas-pe.	Cutter	entilo-del.	9.51	0 (matty	1	8.7%					
Datastores	3444	44.C	staning									Opension and the	1.11	1.550

If not, follow Add storage backend using vSphere client UI

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

Image: Signal State Sta		<		uster01 : ACTIONS	
Image: Cluster of the cluster of th	<u>.</u> 9	Ø	Summa	ry Monitor Configur	e Pe
Rename Tags & Custom Attributes e Cluster Services ral Add Permission Add Permission stores Alarms Alarms Create datastore Task Name Remove from Inventory Create datastore Com.netapp.otv.hosts Delete Mount datastore	 RTP Cluster01 dc01-e dc01-e dc02-e dc02-e Democ 	Add Hosts New Virtual Machine New Resource Pool Deploy OVF Template Deploy OVF Template New vApp Import VMs Storage Host Profiles Edit Default VM Compatible Settings	> sility	ere DRS ere Availability Jration Start Start ral Provider are EVC lost Groups lost Rules Dverrides Iters Options Profile ng LCluster uthority	Cluste We hav automa 1. C No
Recent Tasks Remove from Inventory Task Name Remove from Inventory com.netapp.otv.hosts Delete		Rename Tags & Custom Attributes	>	led Tasks e Cluster Services 🛛 🗡 ral	
com.netapp.otv.hosts. Create datastore Mount datastore	✓ Recent Tasks	Alarms	>		
iscovery label 07	com.netapp.otv.hosts.				host
vSAN > Protect cluster	iscovery.iabel	VSAN	>	Protect cluster	07

- 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 cluster	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 o	datastores using one or more SnapN	lirror relationships.
			Objects per page <u>5</u> ^V 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.

ource storage VM: *	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			
SET PROXIMAL TO ~				
	T	Proximal to		
SET PROXIMAL TO ~	T	Proximal to		
SET PROXIMAL TO ~	T	Proximal to Source v		°
SET PROXIMAL TO ~	T			(

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

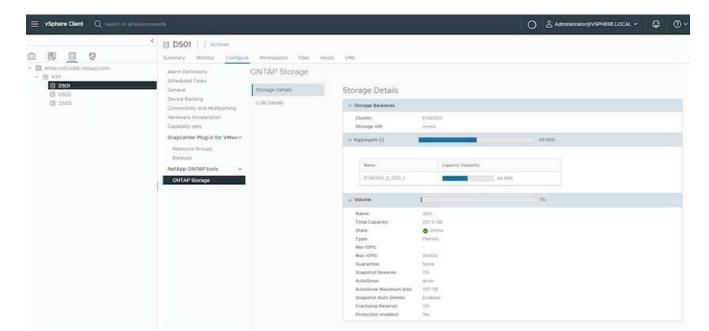
NOTE: If plan to use SnapCenter Plug-in for VMware vSphere 6.0, the replication needs to be setup at volume level rather than at Consistency Group level.

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

Alarm Definitions Scheduled Tasks Seneral	Connectivity and Mul	tipathing					
Device Backing	Host	т	Datastore Mounted	T Datastore Connectivity	T Mount Point		
Connectivity and Multipathing	COL H dc02-esxi01.sddc.n	netaco.com	Mounted	Connected	/vmfs/volumes/66aaa811-71dea4	467-813d-005056	5b92d1
lardware Acceleration	O addot-esxi02.sddc.n	netapo.com	Mounted	Connected	/vmfs/volumes/66aaa811-71dea4	467-813d-005056	5b92d
Capability sets	O Coresxi02.5ddc.r	netaoo.com	Mounted	Connected	/vmfs/volumes/66aaa811-71dea4	467-813d-005056	5692d
napCenter Plug-in for VMwav	O C dc01-esxi01.sddc.ne	etago.com	Mounted	Connected	/vmfs/volumes/66aaa811-71dea4	467-813d-005056	5b92d
Resource Groups							
Backups	Manage Columns						
	Manage Columns						- 4
etApp ONTAP tools >	V Multipathing Policies ACT Path Selection Policy P	IONS - Round Robin (VMv		57724524975577930			
etApp ONTAP tools >	✓ Multipathing Policies ACTI Path Selection Policy Policy Storage Array Type Policy Owner Plugin N Paths	IONS -	ware)	57724524975577 <u>939</u> -			
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etApp ONTAP tools >	✓ Multipathing Policies ACTI Path Selection Policy Policy Storage Array Type V Policy Owner Plugin N Paths REFRESH ENANCE DISANCE	IONS ~ Round Robin (VMv VMW_SATP_ALU/ NMP	vare) A Taryet	57724524975577030) - 	3a70d58-ys_28:172-21225.12:3260	7 U	
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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.

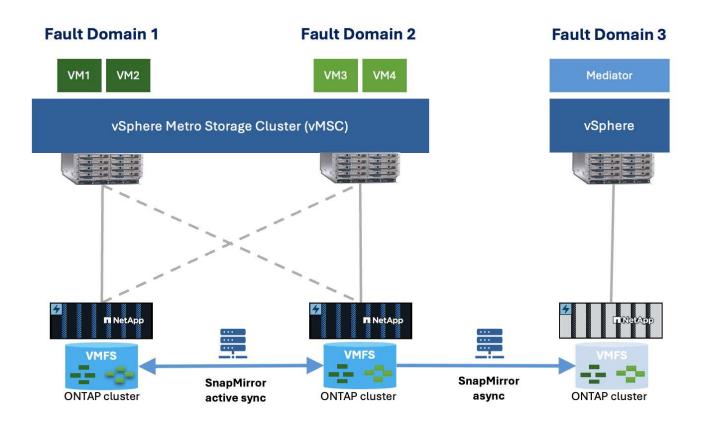


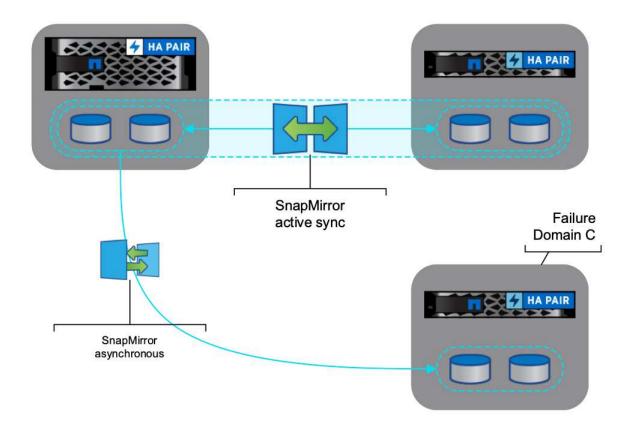
10. For more details and to update the host proximity info, Host cluster relationships option under the ONTAP Tools can be utilized.

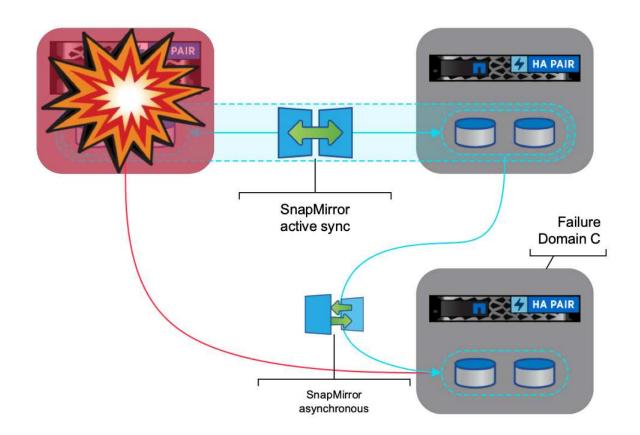
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VM protection with SnapCenter plug-in for VMware vSphere.

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.

Destination datastore	Locations	
Datastore01	(Primary) 172.21.228.10:Datastore01	
	(Primary) 172.21.228 10:Datastore01	
	(Secondary) svms2:vol_Datastore01_dest	
	(Secondary) zoneb:Datastore01_dest	

BACK NEXT FINISH CANCEL

6. Similar option is also available for Datastore mount operation.

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	Datastore02		Primary:172.21.228.10:Datastore01:VM_Backup_08-11-2024_16.00.02.0270 Secondary:svms2:vol_Datastore01_dest:VM_Backup_08-11-2024_16.00.02.0270 Secondary:zoneb:Datastore01_dest:VM_Backup_08-11-2024_16.00.02.0270	
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			CANCEL	MOUNT

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

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