



# NetApp All-Flash SAN Array with VMware vSphere 8

NetApp Solutions

NetApp  
July 31, 2024

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# 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.

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## **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, zero-

block 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

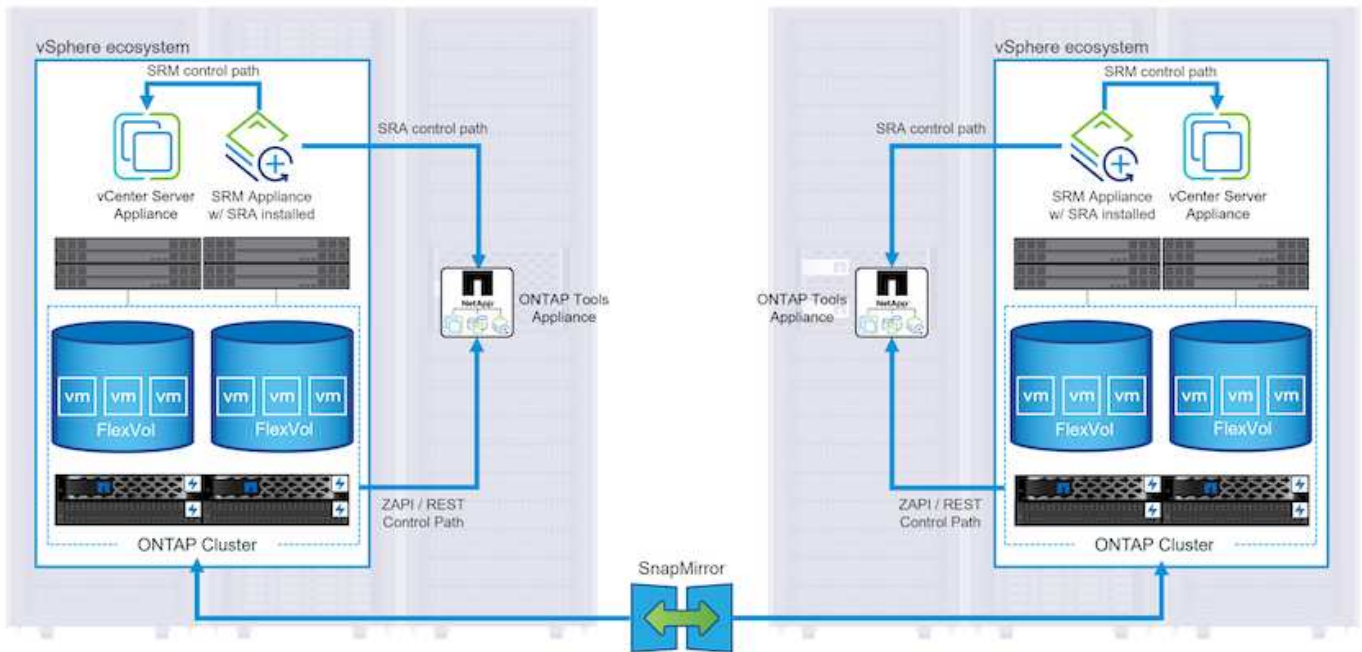
NetApp ONTAP provides robust disaster recovery solutions for VMware environments. These solutions leverage SnapMirror replication technologies between primary and secondary storage systems to allow failover and quick recovery in the case of failure.

### 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.

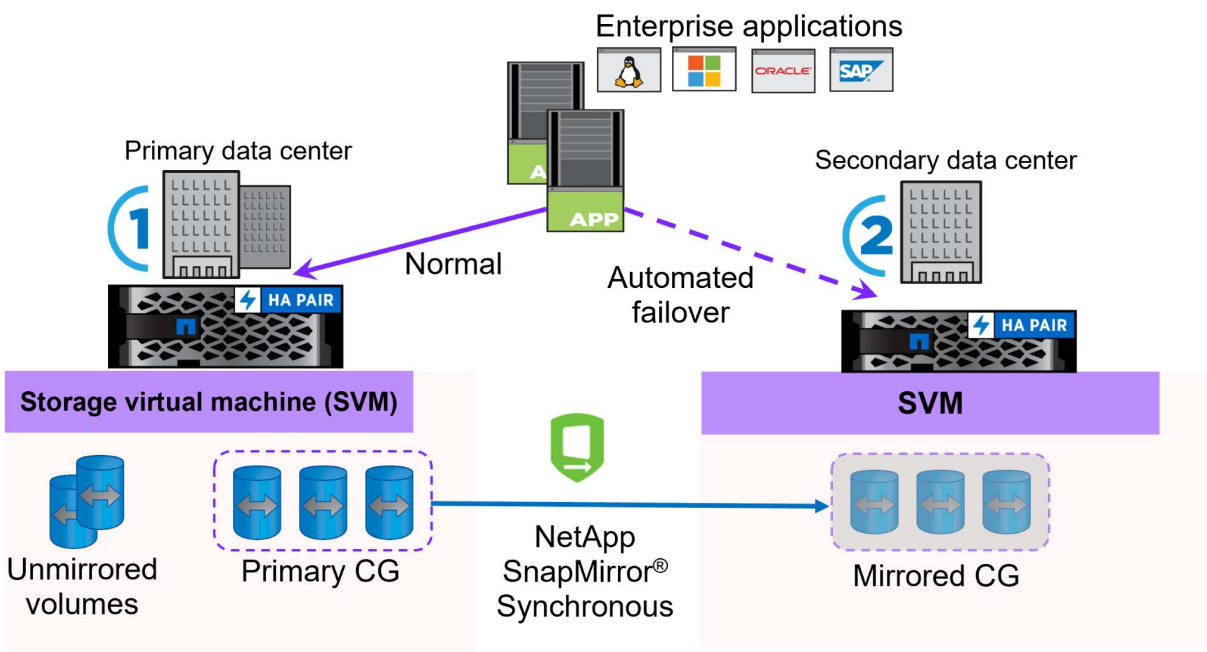
The NetApp SRA is installed as part of ONTAP Tools for VMware vSphere.



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.



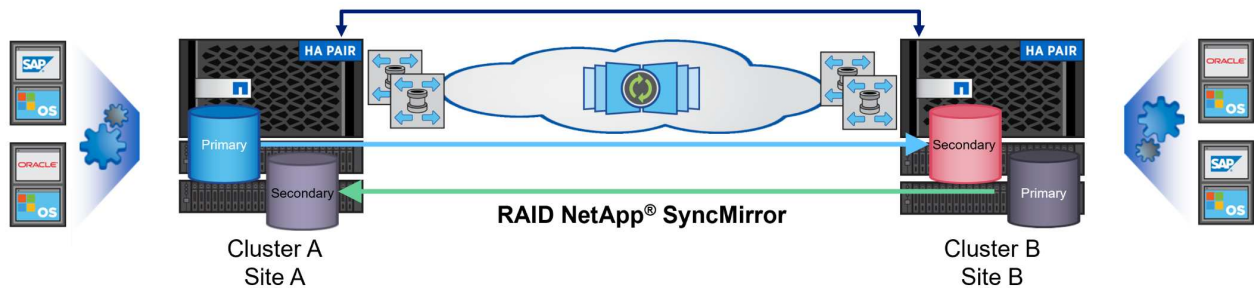
For more information refer to SnapMirror [Business Continuity overview](#).

### 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.

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## 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 application-consistent 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](#).

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## 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

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Author: Josh Powell - NetApp Solutions Engineering

### Managing Block Storage with ONTAP Tools for VMware vSphere

ONTAP Tools includes the following components:

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

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

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

For more information on NetApp ONTAP tools for VMware see [ONTAP tools for VMware vSphere Documentation](#).

### Solution Deployment Overview

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

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

For detailed information on vVols with ONTAP refer to [Virtual Volumes \(vVols\) with ONTAP](#).

This solution covers the following high level steps:

1. Add a storage system in ONTAP Tools.
2. Create a storage capability profile in ONTAP Tools.
3. Create a vVols datastore in ONTAP Tools.

4. Create a VM storage policy in the vSphere client.
5. Create a new virtual machine on the vVol datastore.

### **Prerequisites**

The following components were used in this solution:

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

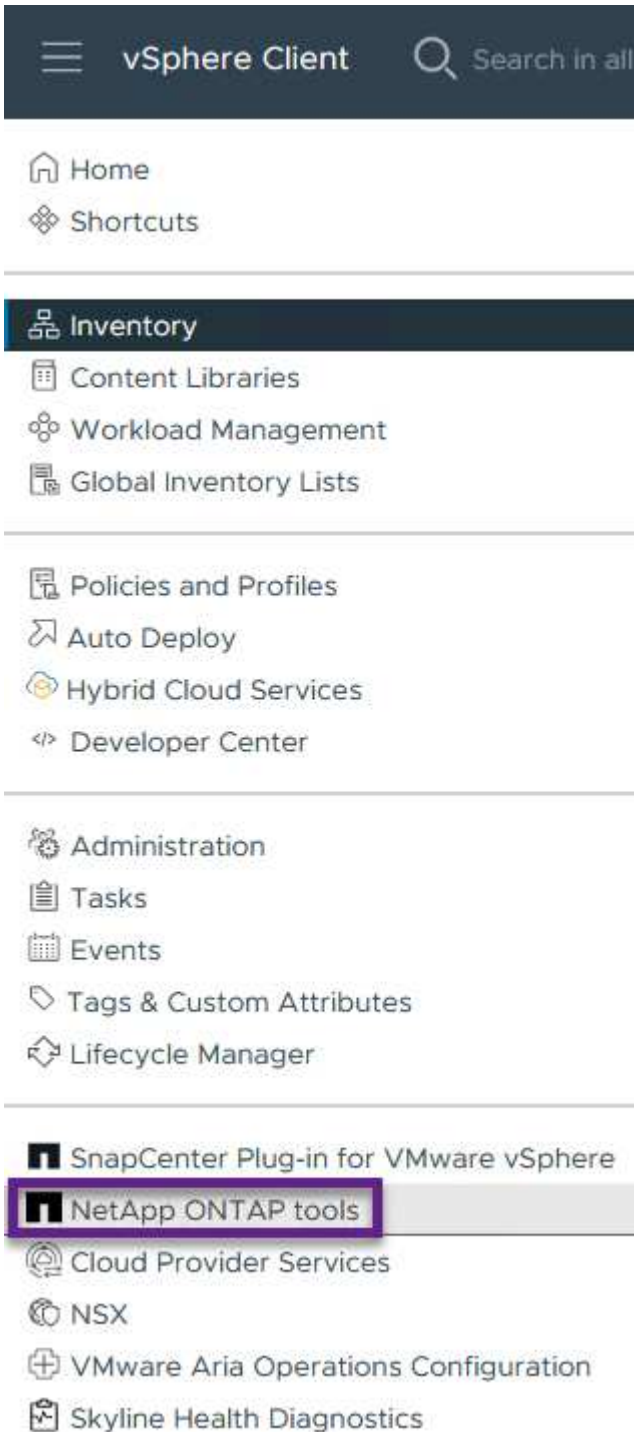
### **Solution Deployment**

#### **Create a vVols datastore in ONTAP Tools**

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

## Add a storage system to ONTAP Tools.

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**.



NetApp ONTAP tools INSTANCE 10.61.181.154:8443 ▾

Overview

**Storage Systems**

Storage capability profile

**Storage Systems**

**ADD** **REDISCOVER ALL**

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

## Add Storage System



Any communication between ONTAP tools plug-in and the storage system should be mutually authenticated.

vCenter server 10.61.181.205 ▾

**Name or IP address:** 10.192.102.103

**Username:** admin

**Password:** ●●●●●●●●

**Port:** 443

### Advanced options ^

**ONTAP Cluster Certificate:**  Automatically fetch  Manually upload

CANCEL

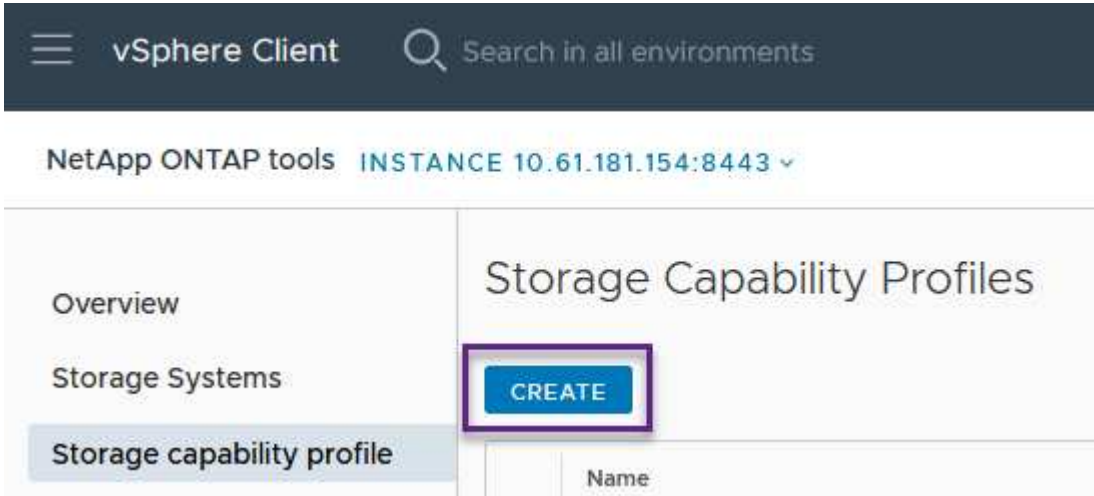
**ADD**

## Create a storage capability profile in ONTAP Tools

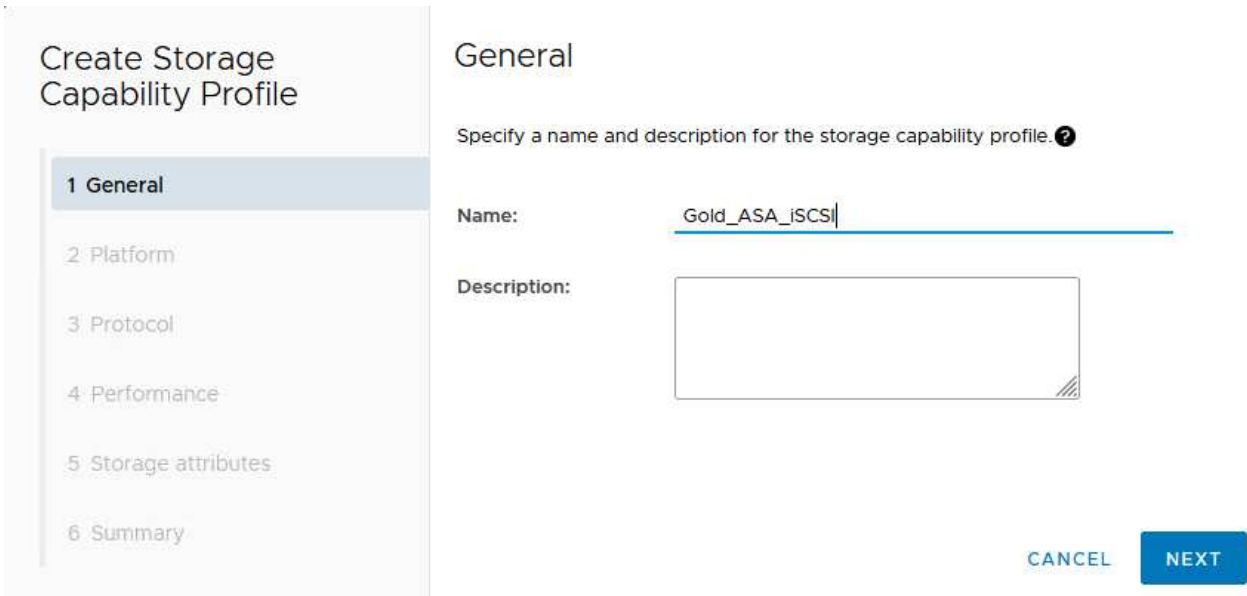
Storage capability profiles describe the features provided by a storage array or storage system. They include quality of service definitions and are used to select storage systems that meet the parameters defined in the profile.

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**.



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



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 Capability Profile

1 General

2 Platform

3 Protocol

4 Performance

5 Storage attributes

6 Summary

## Platform

Platform: Performance

Asymmetric:

CANCEL

BACK

NEXT

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

## Create Storage Capability Profile

1 General

2 Platform

3 Protocol

4 Performance

5 Storage attributes

6 Summary

## Protocol

Protocol:

Any

Any

FCP

iSCSI

NVMe/FC

CANCEL

BACK

NEXT

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

## Create Storage Capability Profile

1 General

2 Platform

3 Protocol

4 Performance

5 Storage attributes

6 Summary

## Performance

None ⓘ

QoS policy group ⓘ

Min IOPS:

\_\_\_\_\_

Max IOPS:

6000

Unlimited

CANCEL

BACK

NEXT

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

## Create Storage Capability Profile

1 General

2 Platform

3 Protocol

4 Performance

5 Storage attributes

6 Summary

## Storage attributes

Deduplication:

Yes

Compression:

Yes

Space reserve:

Thin

Encryption:

No

Tiering policy (FabricPool):

None

CANCEL

BACK

NEXT

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

## Create Storage Capability Profile

- 1 General
- 2 Platform
- 3 Protocol
- 4 Performance
- 5 Storage attributes
- 6 Summary**

## Summary

Name:	ASA_Gold
Description:	N/A
Platform:	Performance
Asymmetric:	No
Protocol:	Any
Max IOPS:	6000 IOPS
Space reserve:	Thin
Deduplication:	Yes
Compression:	Yes
Encryption:	No
Tiering policy (FabricPool):	None

CANCEL

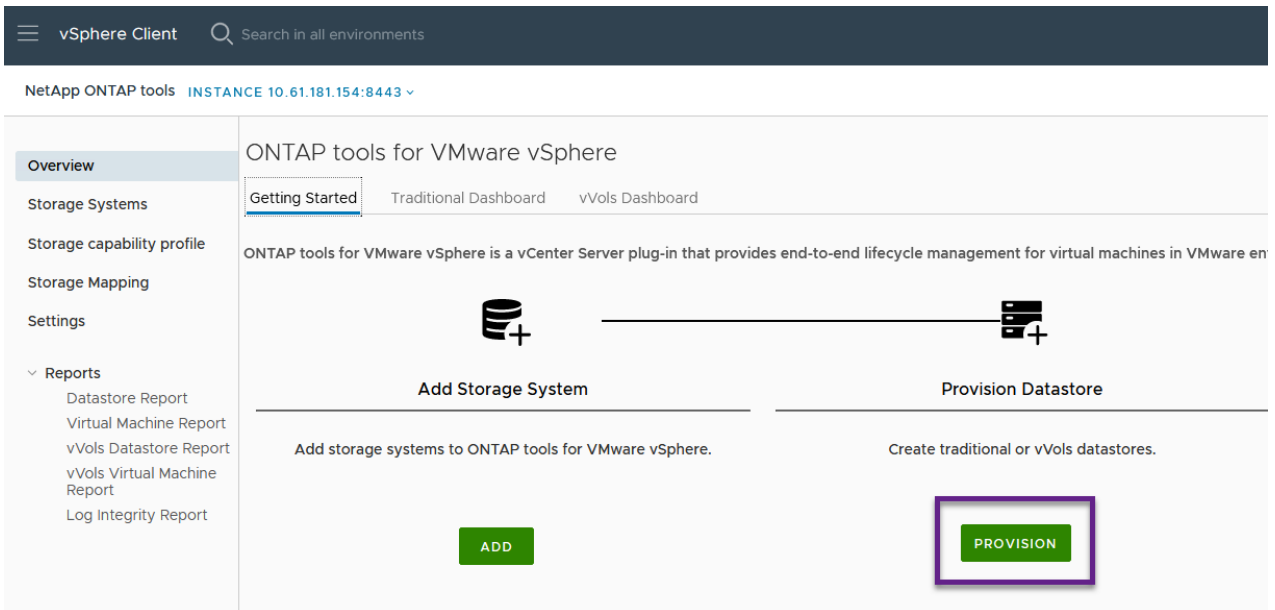
BACK

FINISH

## Create a vVols datastore in ONTAP Tools

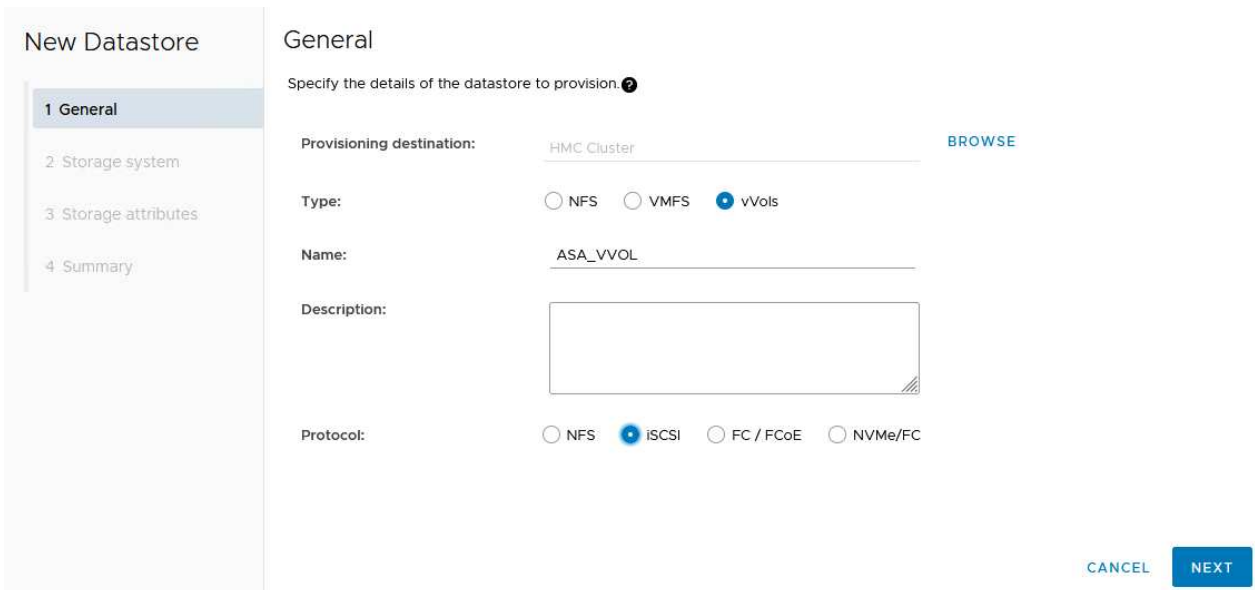
To create a vVols datastore in ONTAP Tools complete the following steps:

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



The screenshot shows the vSphere Client interface for ONTAP tools. The left sidebar contains a navigation menu with 'Overview' selected. The main content area is titled 'ONTAP tools for VMware vSphere' and has three tabs: 'Getting Started', 'Traditional Dashboard', and 'vVols Dashboard'. Below the tabs, there is a description: 'ONTAP tools for VMware vSphere is a vCenter Server plug-in that provides end-to-end lifecycle management for virtual machines in VMware en'. Two main actions are presented: 'Add Storage System' with a green 'ADD' button, and 'Provision Datastore' with a green 'PROVISION' button that is highlighted by a purple rectangular box.

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



The screenshot shows the 'New Datastore' wizard in the 'General' step. The left sidebar shows the wizard steps: '1 General', '2 Storage system', '3 Storage attributes', and '4 Summary'. The main content area is titled 'General' and contains the following fields: 'Specify the details of the datastore to provision.' with a help icon; 'Provisioning destination:' with 'HMC Cluster' and a 'BROWSE' button; 'Type:' with radio buttons for 'NFS', 'VMFS', and 'vVols' (selected); 'Name:' with 'ASA\_VVOL'; 'Description:' with an empty text area; and 'Protocol:' with radio buttons for 'NFS', 'iSCSI' (selected), 'FC / FCoE', and 'NVMe/FC'. At the bottom right, there are 'CANCEL' and 'NEXT' buttons.

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

## New Datastore

1 General

2 Storage system

3 Storage attributes

4 Summary

## Storage system

Specify the storage capability profiles and the storage system you want to use.

Storage capability profiles:

FAS\_Default  
FAS\_Max20  
**Custom profiles**  
Gold\_ASA\_JSCSI  
Gold\_ASA

Storage system:

HCG-NetApp-A400-E3U03 (10.192.102.103)

Storage VM:

svml

CANCEL

BACK

NEXT

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

3 Storage attributes

4 Summary

## Storage attributes

Specify the storage details for provisioning the datastore.

Volumes:  Create new volumes  Select volumes

Create new volumes

Name	Size	Storage Capability Profile	Aggregate
 FlexVol volumes are not added.			

Name	Size(GB) ⓘ	Storage capability profile	Aggregates	Space reserve
ASA_VVOL	2000	Gold_ASA	HCG_A400_E3u3b_NVMe	Thin

ADD

CANCEL

BACK

NEXT

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

### New Datastore

- 1 General
- 2 Storage system
- 3 Storage attributes
- 4 Summary

### Summary

**General**

vCenter server: 10.61.181.205

Provisioning destination: HMC Cluster

Datastore name: ASA\_VVOL

Datastore type: vVols

Protocol: iSCSI

Storage capability profile: Gold\_ASA

**Storage system details**

Storage system: HCG-NetApp-A400-E3U03

SVM: svm1

**Storage attributes**

New FlexVol Name	New FlexVol Size	Aggregate	Storage Capability Profile

CANCEL
BACK
FINISH

### Create a VM storage policy in the vSphere client

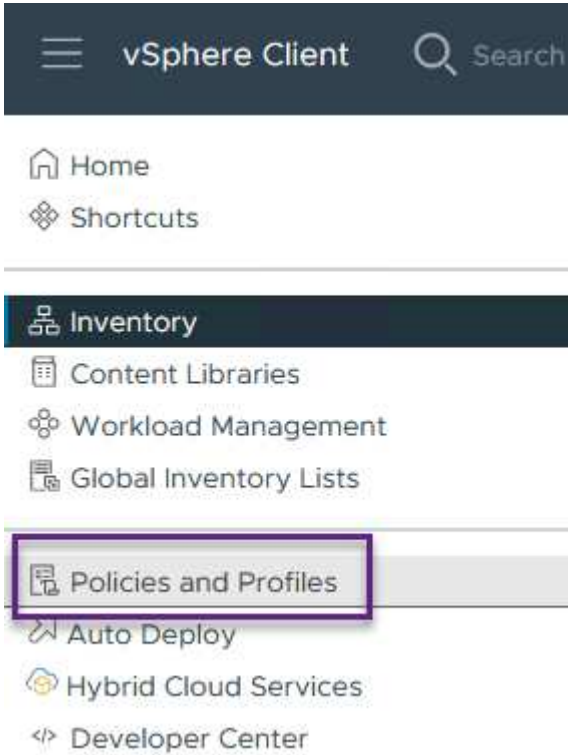
A VM storage policy is a set of rules and requirements that define how virtual machine (VM) data should be stored and managed. It specifies the desired storage characteristics, such as performance, availability, and data services, for a particular VM.

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.

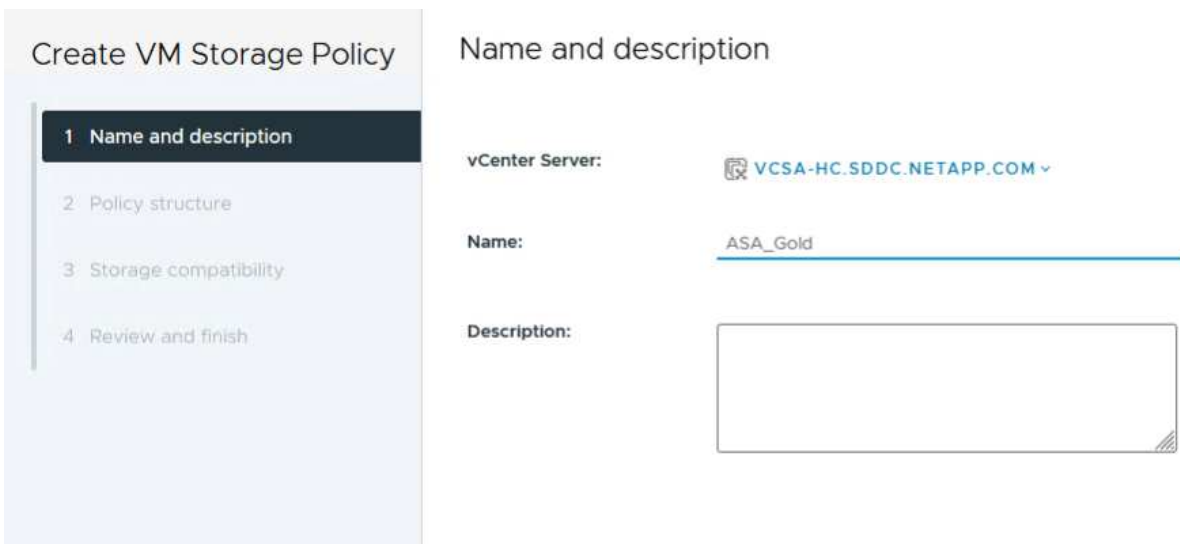
## Create a VM storage policy

To create a VM storage policy complete the following steps:

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

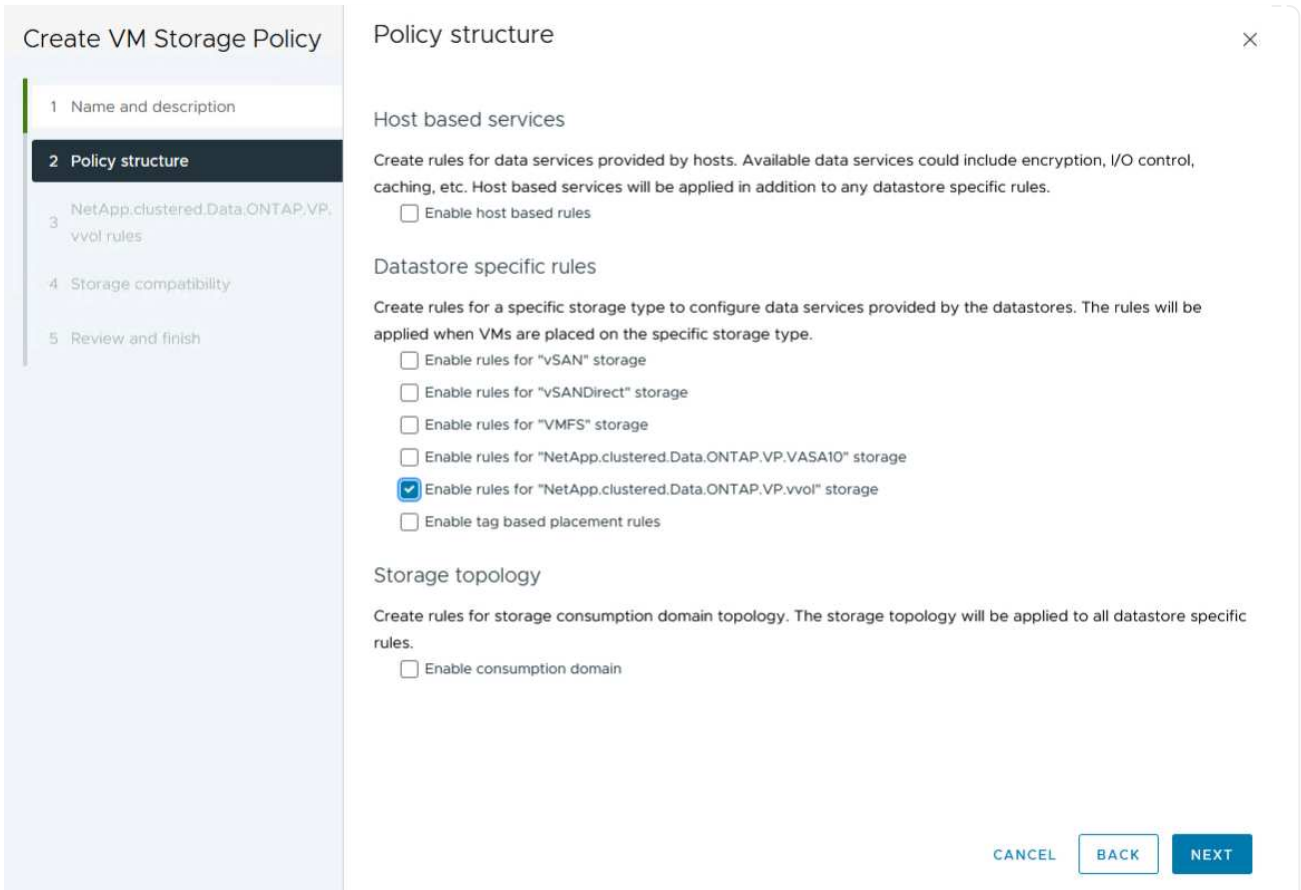


2. In the **Create VM Storage Policy** wizard, first fill out a name and description for the policy and click on **Next** to continue.

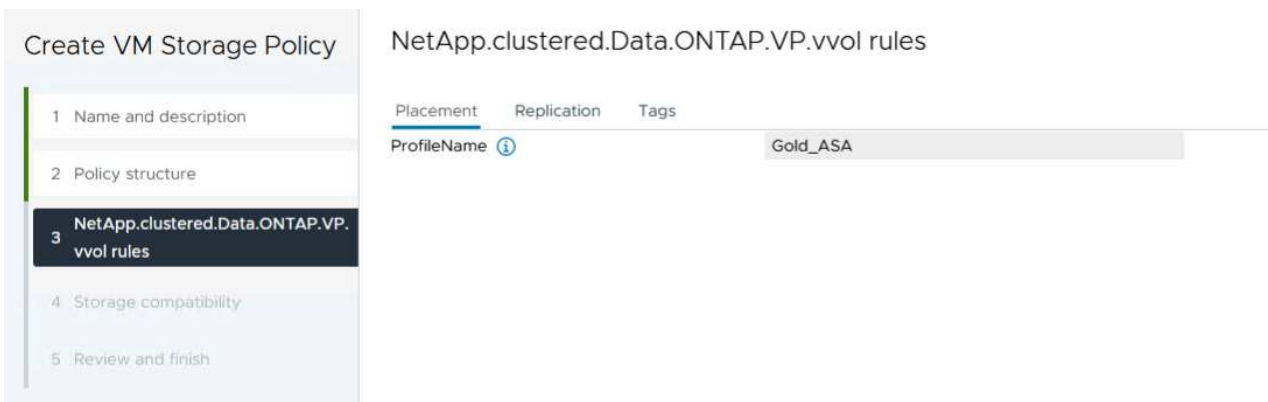
A screenshot of the 'Create VM Storage Policy' wizard. The wizard has four steps: 1. Name and description (active), 2. Policy structure, 3. Storage compatibility, and 4. Review and finish. The 'Name and description' step shows the following fields:

- vCenter Server:** VCSA-HC.SDDC.NETAPP.COM
- Name:** ASA\_Gold
- Description:** (empty text area)

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



- 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.



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

### Create a VM storage policy in the vSphere client

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

In this case, the task involves creating a VM storage policy to specify that a virtual machine will be generated

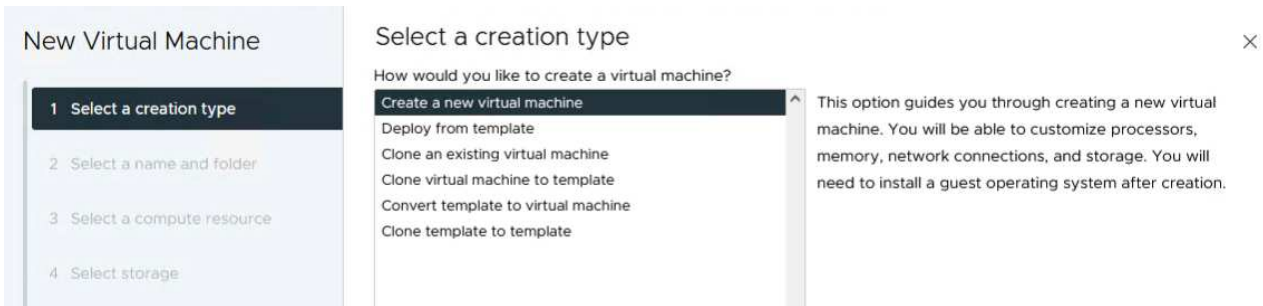


on vVol datastores and to establish a one-to-one mapping with the previously generated storage capability profile.

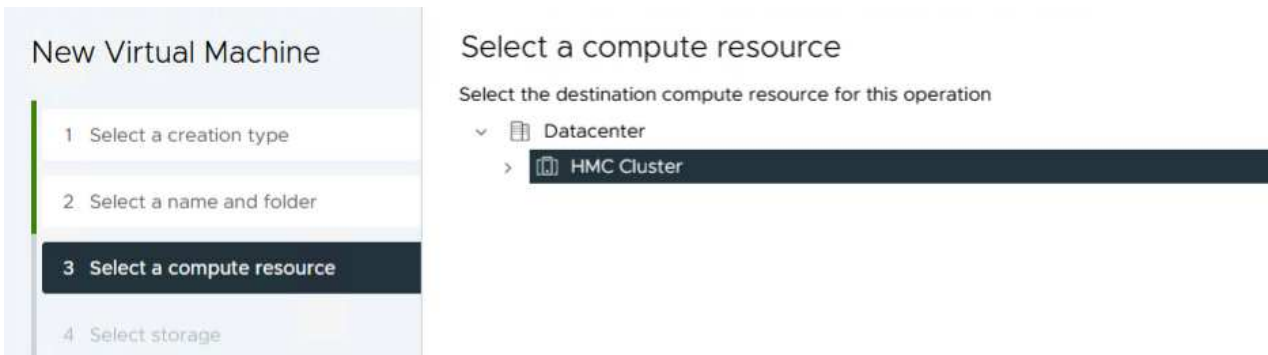
## Create a virtual machine on a vVol datastore

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**.



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**.

## New Virtual Machine

- 1 Select a creation type
- 2 Select a name and folder
- 3 Select a compute resource
- 4 Select storage**
- 5 Select compatibility
- 6 Select a guest OS
- 7 Customize hardware
- 8 Ready to complete

## Select storage

Select the storage for the configuration and disk files

Encrypt this virtual machine [?](#)

VM Storage Policy ASA\_Gold ▾

Disable Storage DRS for this virtual machine

	Name	Storage Compatibility	Capacity	Provisioned	Free	
<input checked="" type="radio"/>	ASA_VVOLS_1	Compatible	1.95 TB	9 MB	1.95 TB	V
<input type="radio"/>	ASA400_ISCSI01	Incompatible	2 TB	185.32 GB	1.9 TB	V
<input type="radio"/>	DemoDS	Incompatible	800 GB	6.99 GB	793.01 GB	N
<input type="radio"/>	destination	Incompatible	250 GB	32.66 MB	249.97 GB	N
<input type="radio"/>	DRaaSTest	Incompatible	1 TB	133.27 GB	956.83 GB	N
<input type="radio"/>	esxi-hc-01 local	Incompatible	349.25 GB	1.41 GB	347.84 GB	V
<input type="radio"/>	esxi-hc-02 local	Incompatible	349.25 GB	1.41 GB	347.84 GB	V
<input type="radio"/>	esxi-hc-03 local	Incompatible	349.25 GB	1.41 GB	347.84 GB	V

Manage Columns      Items per page: 10      1 - 10 of 15 items      1 / 2

Compatibility

Validating...

CANCEL

BACK

NEXT

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).

8. Finally, review the summary page and click on **Finish** to create the VM.

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.

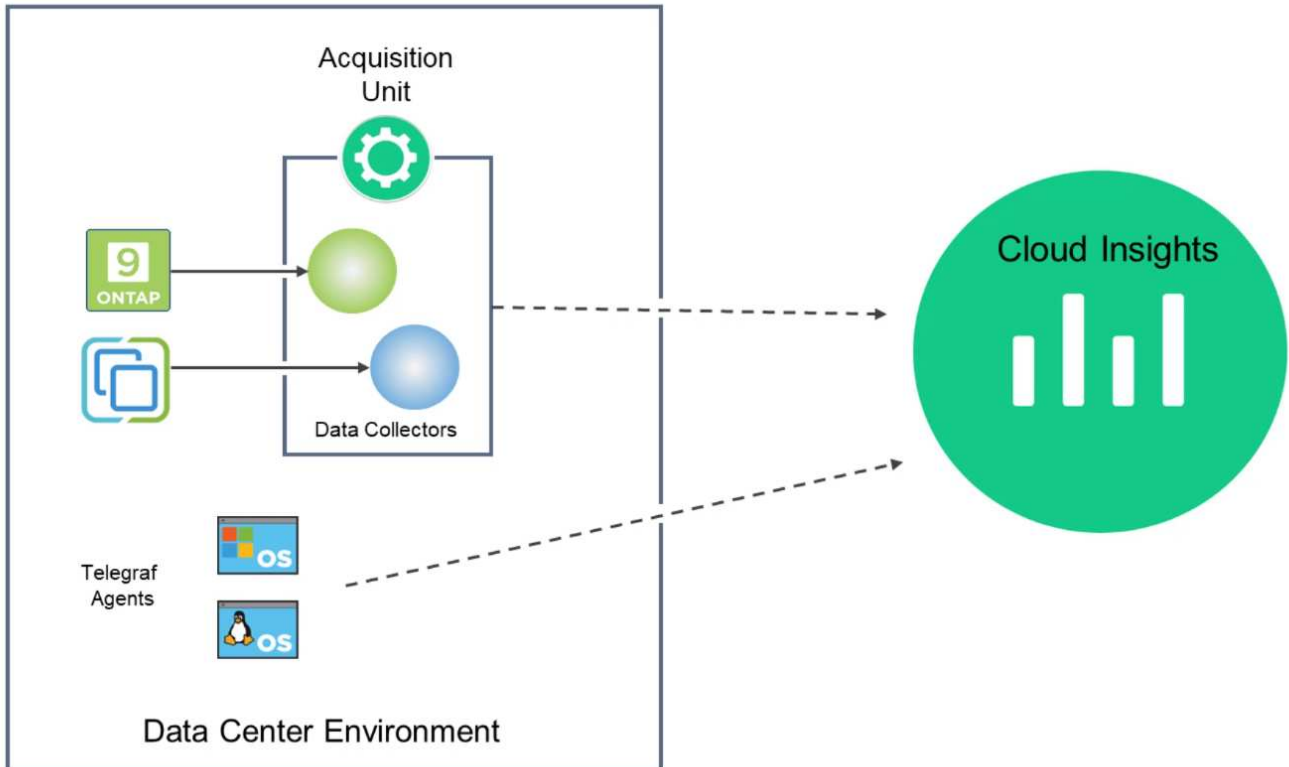
Author: Josh Powell - NetApp Solutions Engineering

### 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.

Cloud Insights architecture diagram:



## 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 Acquisition Unit software installed on a local VM with network connectivity to assets for data collection.

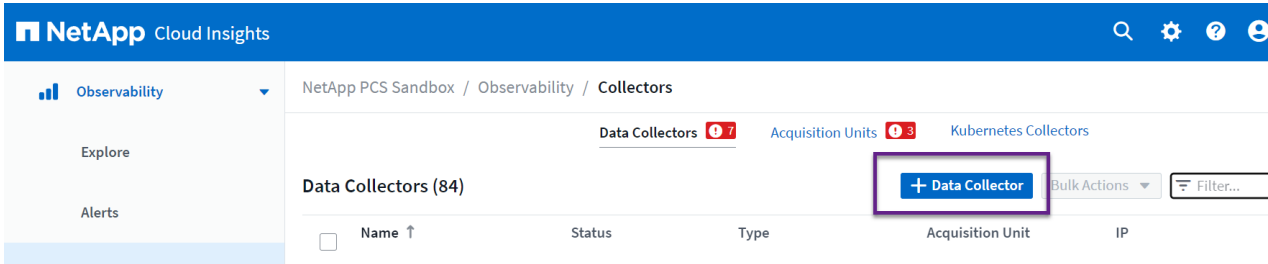
## **Solution Deployment**

### **Configure Data Collectors**

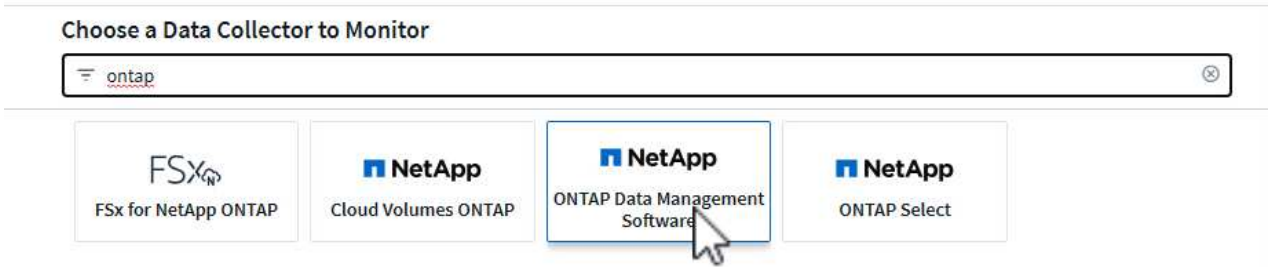
To configure Data Collectors for VMware vSphere and ONTAP storage systems complete the following steps:

## Add a Data Collector for an ONTAP storage systems

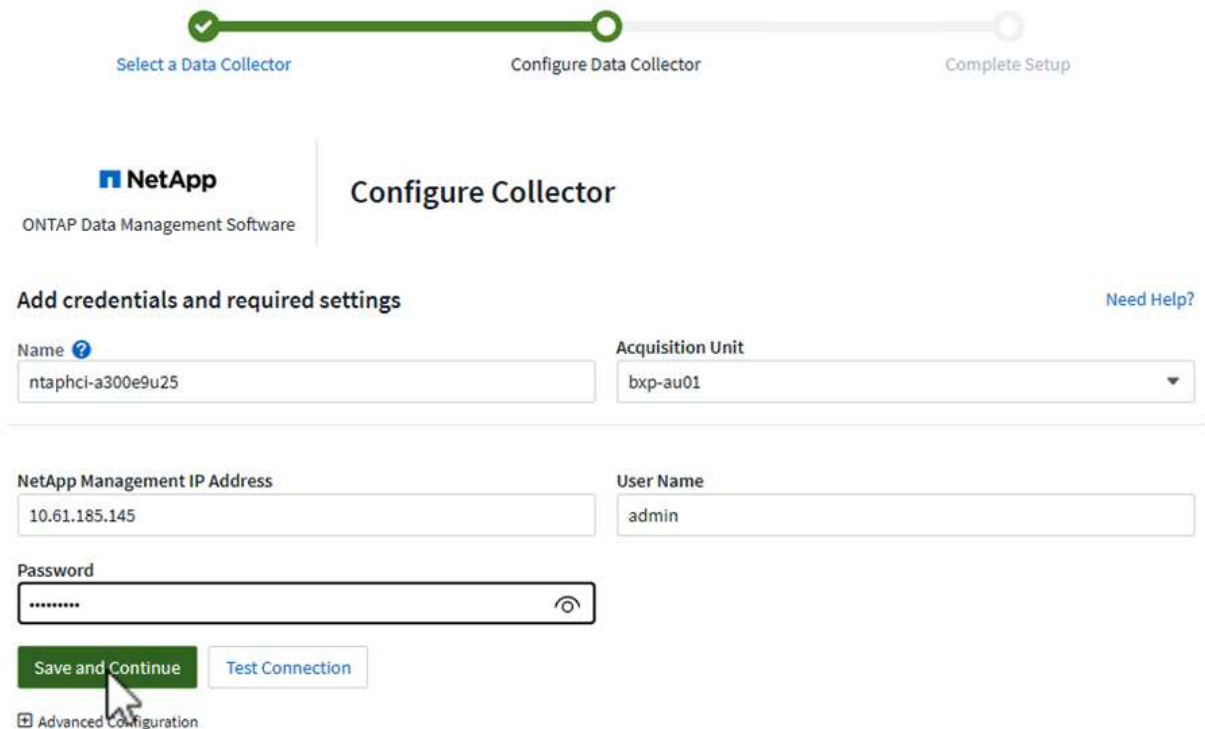
1. Once logged into Cloud Insights, navigate to **Observability > Collectors > Data Collectors** and press the button to install a new Data Collector.



2. From here search for **ONTAP** and click on **ONTAP Data Management Software**.

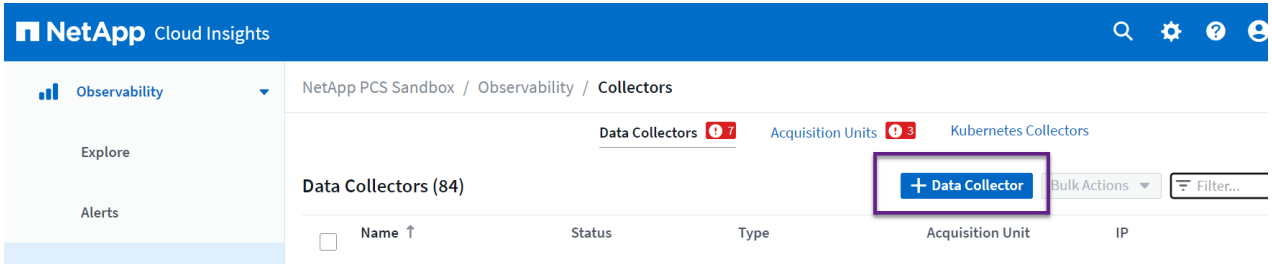


3. On the **Configure Collector** page fill out a name for the collector, specify the correct **Acquisition Unit** and provide the credentials for the ONTAP storage system. Click on **Save and Continue** and then **Complete Setup** at the bottom of the page to complete the configuration.

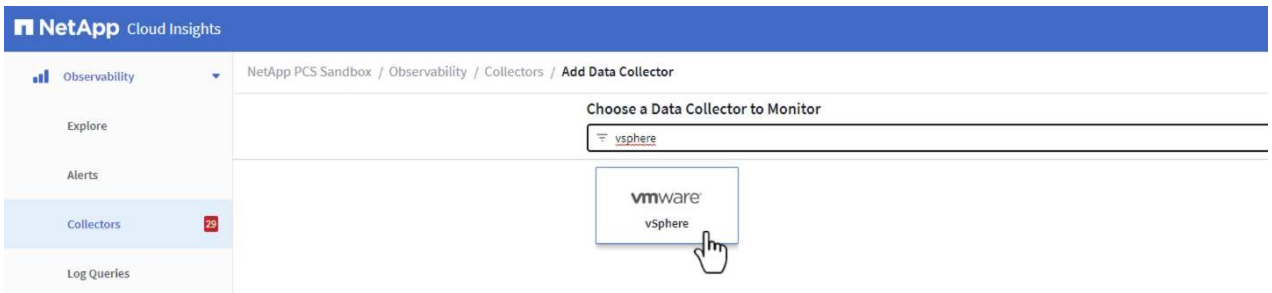


## Add a Data Collector for a VMware vSphere cluster

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



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



3. 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.





## Configure Collector

### Add credentials and required settings

[Need Help?](#)

Name <a href="#">?</a> VCSA7	Acquisition Unit bxp-au01
---------------------------------	------------------------------

Virtual Center IP Address 10.61.181.210	User Name administrator@vsphere.local
--	--

Password *****
-------------------

<input type="button" value="Complete Setup"/>	<input type="button" value="Test Connection"/>
---	--

#### Advanced Configuration

##### Collecting:

- Inventory
- VM Performance

Inventory Poll Interval (min) 20	Communication Port 443
-------------------------------------	---------------------------

Filter VMs by ESX_HOST	Choose 'Exclude' or 'Include' to Specify a List Exclude
---------------------------	--

Filter Device List (Comma Separated Values For Filtering By ESX_HOST, CLUSTER, and DATACENTER Only)	Performance Poll Interval (sec) 300
---	--

 Collect basic performance metrics only

<input type="button" value="Complete Setup"/>	<input type="button" value="Test Connection"/>
---	--

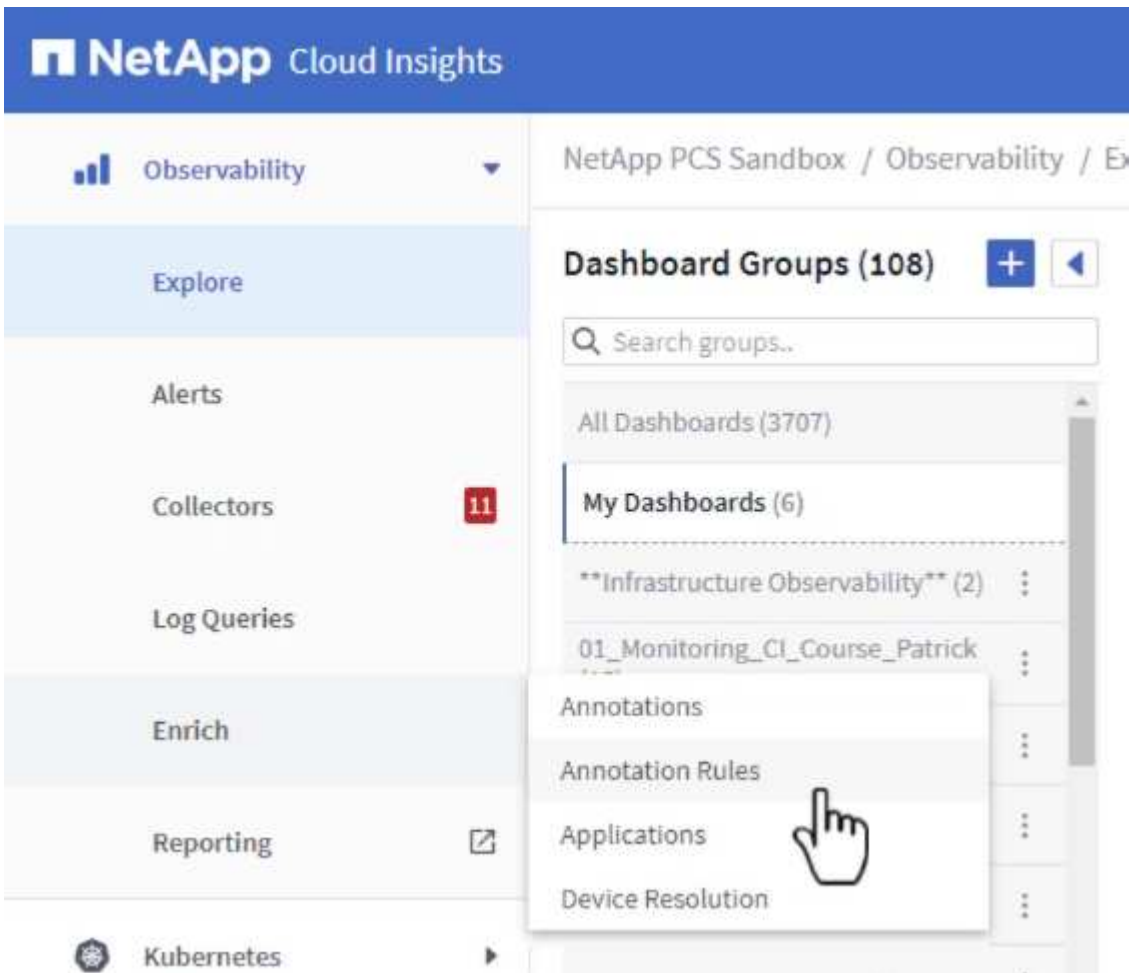
## Add Annotations to assets

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**.

## Use Annotation Rules to tag assets

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.



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**

**Query**

**Annotation**

**Value**

- Finally, in the upper right hand corner of the **Annotation Rules** page click on **Run All Rules** to run the rule and apply the annotation to the assets.

NetApp PCS Sandbox / Observability / Enrich / **Annotation Rules**

Rules running... **Run All Rules**

**Annotation rules (217)**

Name	Resource Type	Query	Annotation	Value
Annotate Tier 1 Storage Pools	Storage Pool	Find Storage Pools (no aggro) for Tier...	Tier	Tier 1
Annotate Tier 2 Storage Pools	Storage Pool	Find Storage Pools (no aggro) for Tier...	Tier	Tier 2

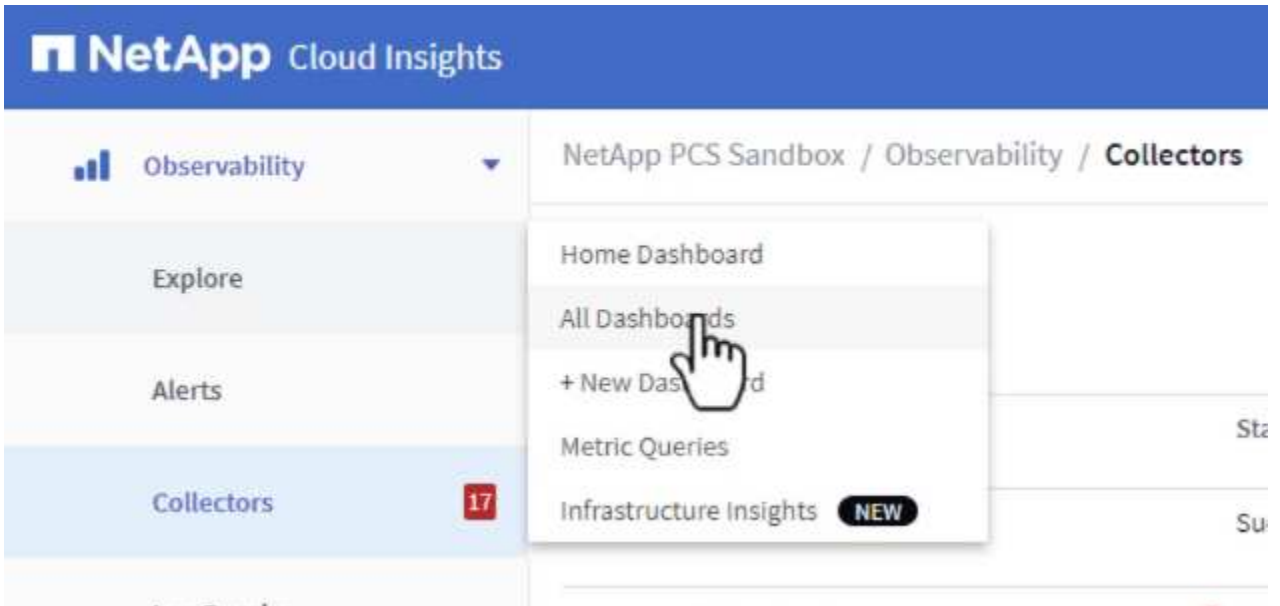
### Explore and correlate assets

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

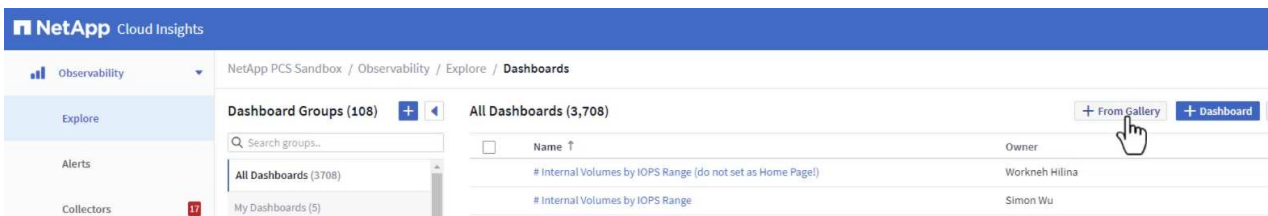
This sections illustrates how to use dashboards to correlate assets.

## Correlating assets from a storage performance Dashboard

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



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



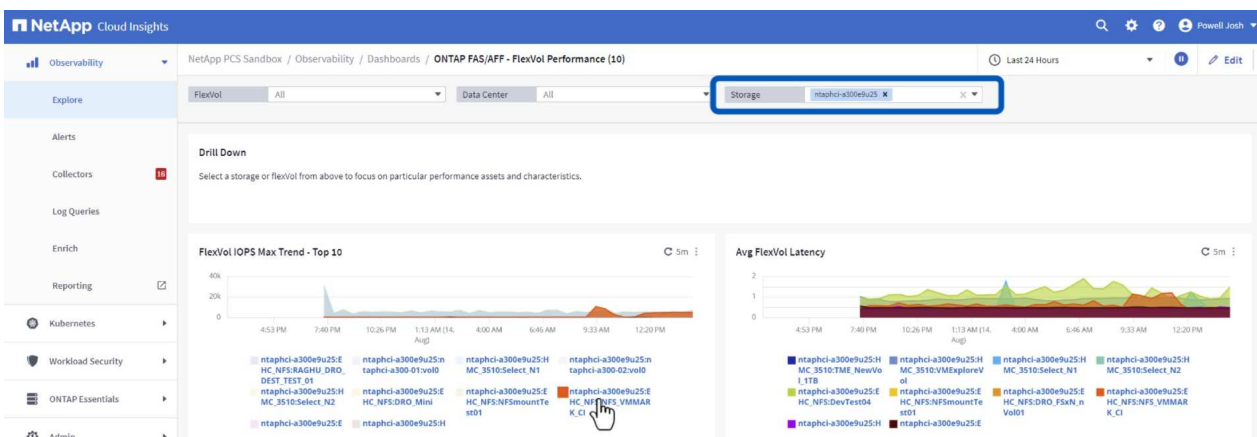
3. Choose a dashboard for FlexVol performance from the list and click on the **Add Dashboards** button at the bottom of the page.

- ONTAP FAS/AFF - Cluster Capacity
- 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
- StorageGRID - ILM Performance Monitoring
- StorageGRID - MetaData Usage
- StorageGRID - S3 Performance Monitoring
- VMware Admin - ESX Hosts Overview
- VMware Admin - Overview
- VMware Admin - VM Performance
- VMware Admin - Where are opportunities to right size?
- VMware Admin - Where can I potentially reclaim waste?
- VMware Admin - Where do I have VM Latency?

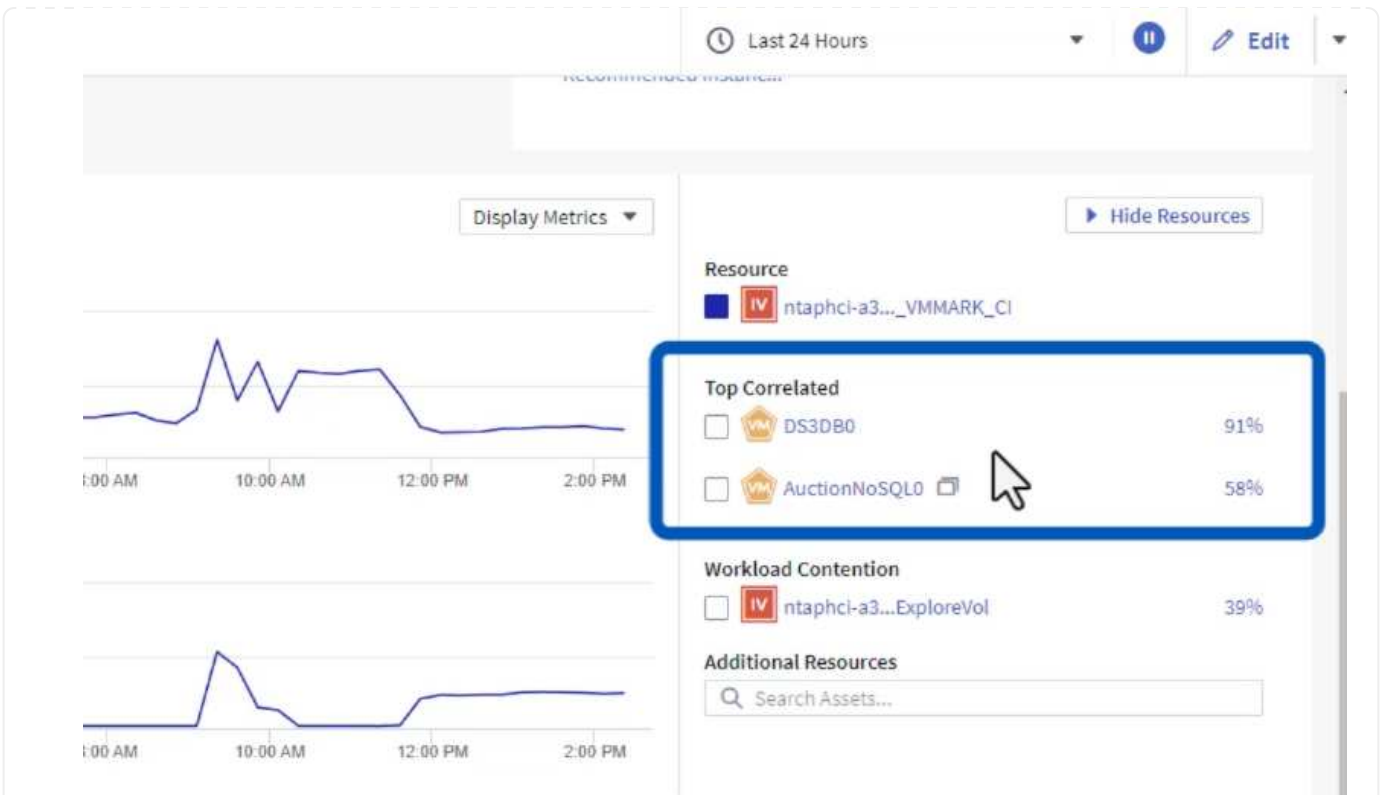
**+ Additional Dashboards (13)**  
 These dashboards require additional data collectors to be installed. [Add More](#)

[Add Dashboards](#) [Go Back](#)

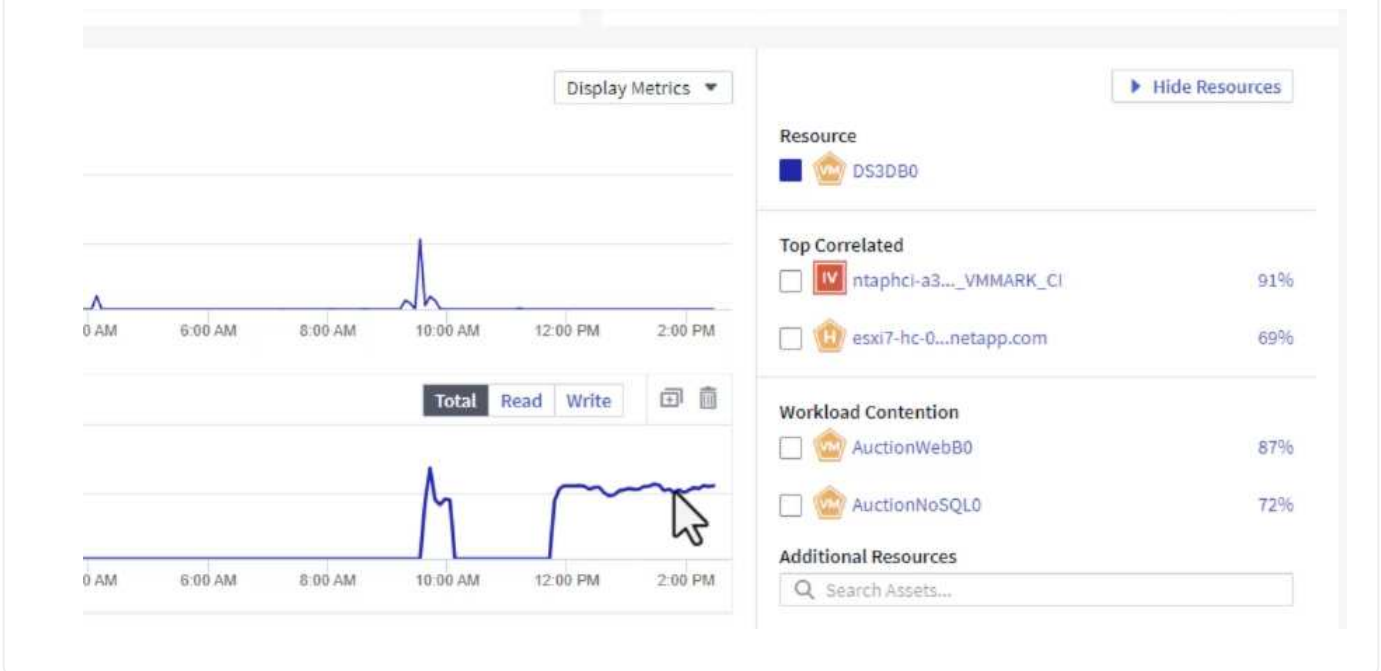
4. Once imported, open the dashboard. From here you can see various widgets with detailed performance data. Add a filter to view a single storage system and select a storage volume to drill into it's details.



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.



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



### 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.

## Use a Top VM Latency dashboard to isolate noisy neighbors

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

NetApp PCS Sandbox / Observability / Explore / Dashboards

Dashboard Groups (108) + - My Dashboards (6) + From Gallery + Dashboard

Search groups..

All Dashboards (3709)

My Dashboards (6)

- \*\*Infrastructure Observability\*\* (2)
- 01\_Monitoring\_CI\_Course\_Patrick (15)
- 02\_Monitoring\_CI\_Course\_Vish (5)
- 1\_Str Dashboards (8)

Name ↑	Owner
All SAN Array Status (2)	Powell Josh
Cloud Volumes ONTAP - FlexVol Performance (6)	Powell Josh
ONTAP - Volume Workload Performance (Frontend) (7)	Powell Josh
VMware Admin - Where are opportunities to right size? (37)	Powell Josh
VMware Admin - Where can I potentially reclaim waste? (11)	Powell Josh
<input checked="" type="checkbox"/> VMware Admin - Where do I have VM Latency? (9)	Powell Josh

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

/ VMware Admin - Where do I have VM Latency? (9) Last 3 Hours

VirtualMachine All Data Center Solutions Engineering X X diskLatency.total ≥ All

! 5m Avg Latency (all hypervisors) C 5m VM Count With Latency Concern C 5m Avg Latency (all VMs)

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.

VM Count With Latency Concern

5m

50

VM's

Avg Latency (all VMs)

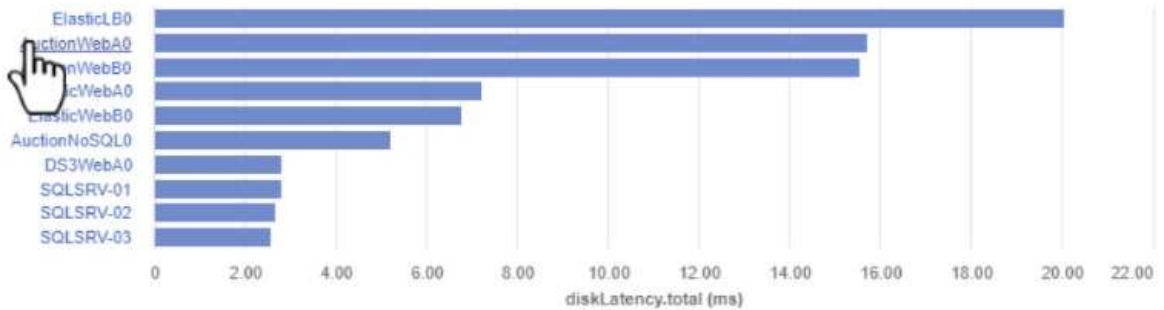
5m

1.55 ms

diskLatency.total

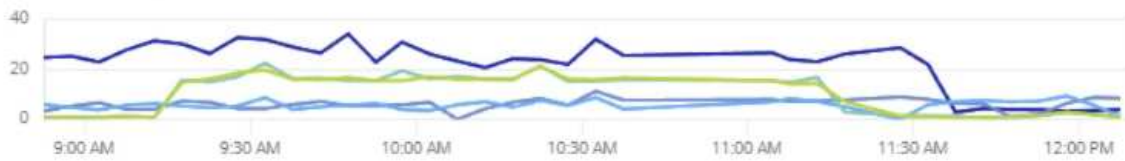
Avg VM Latency - Top 10

5m

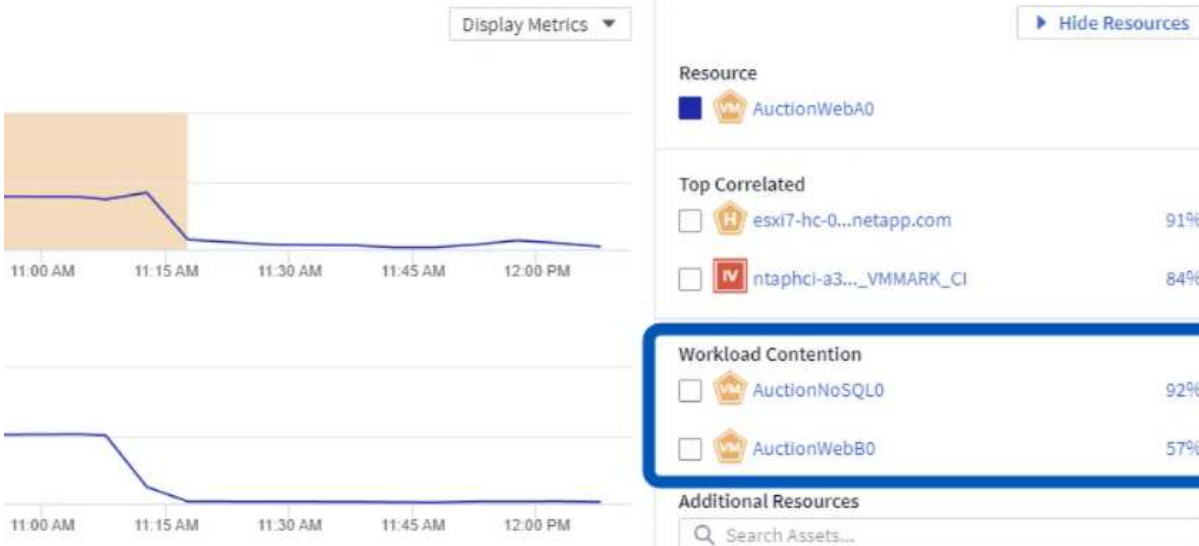


Top 5 Avg VM Latency Trend

30s



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





### **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.

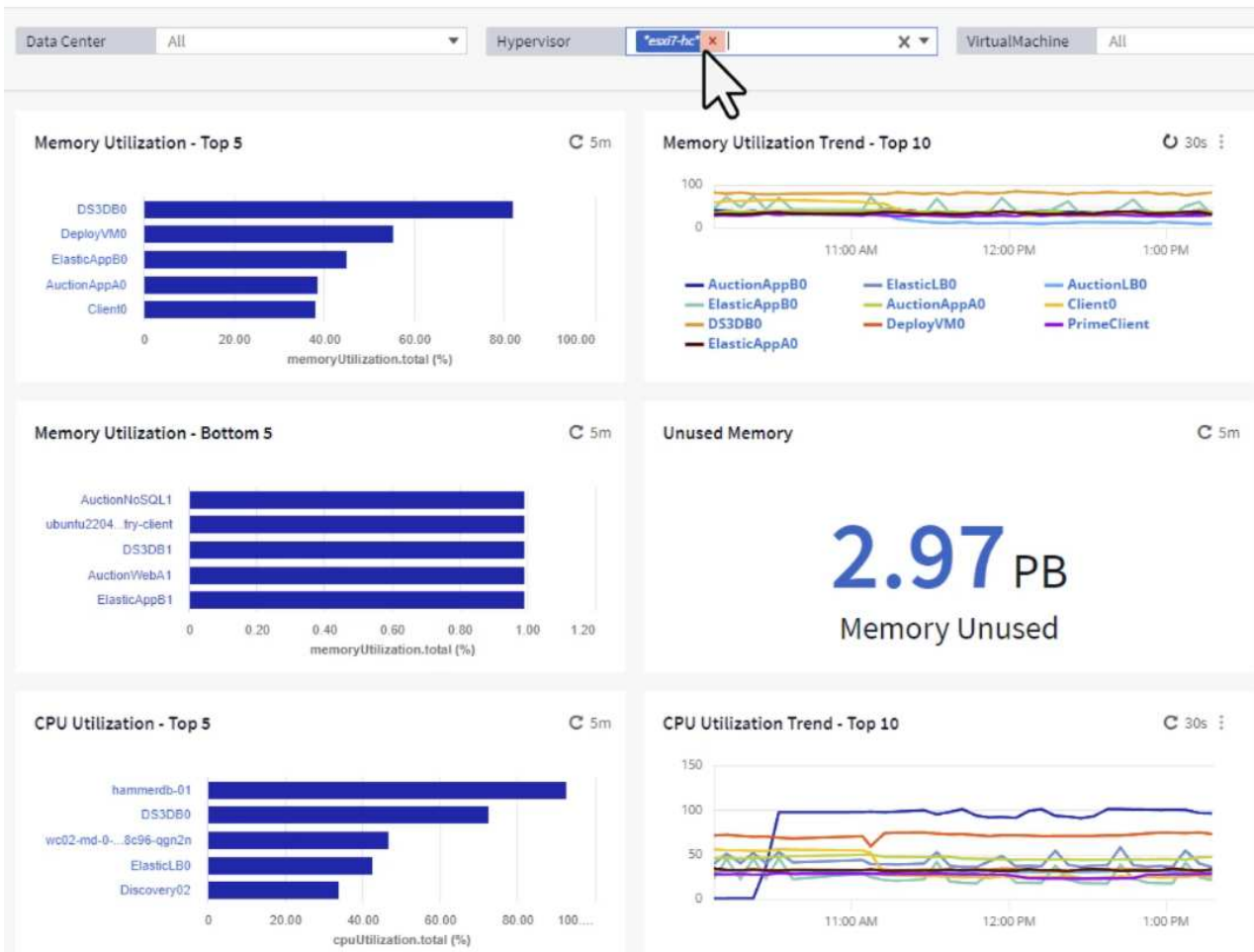
## Identify opportunities to right size VMs

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

### My Dashboards (6)

<input type="checkbox"/>	Name ↑
	<a href="#">All SAN Array Status (2)</a>
	<a href="#">Cloud Volumes ONTAP - FlexVol Performance (6)</a>
	<a href="#">ONTAP - Volume Workload Performance (Frontend) (7)</a>
<input type="checkbox"/>	<a href="#">VMware Admin - Where are opportunities to right size? (37)</a>
	<a href="#">VMware Admin - Where do I have VMs that potentially reclaim waste? (11)</a>
	<a href="#">VMware Admin - Where do I have VM Latency? (9)</a>

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

5m

121 items found

Virtual Machine	memory (MiB)	memoryUt... ↓
DS3DB0	768.0	81.64
DeployVM0	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

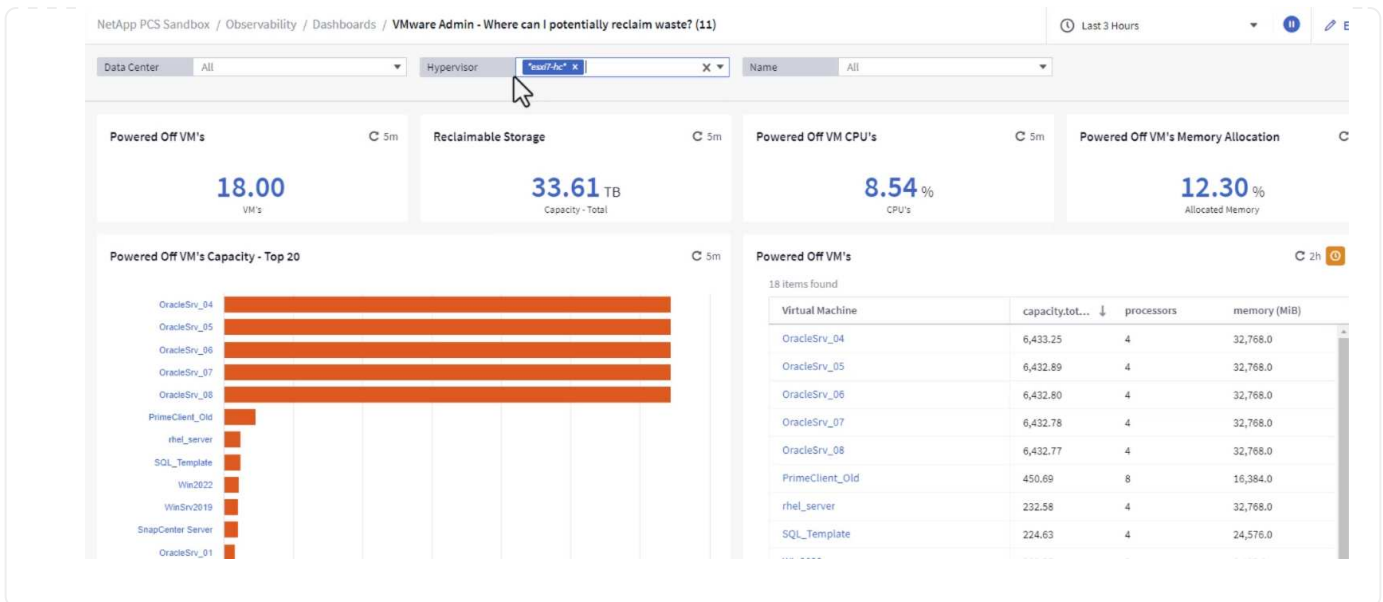
## CPU Utilization

5m

121 items found

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

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

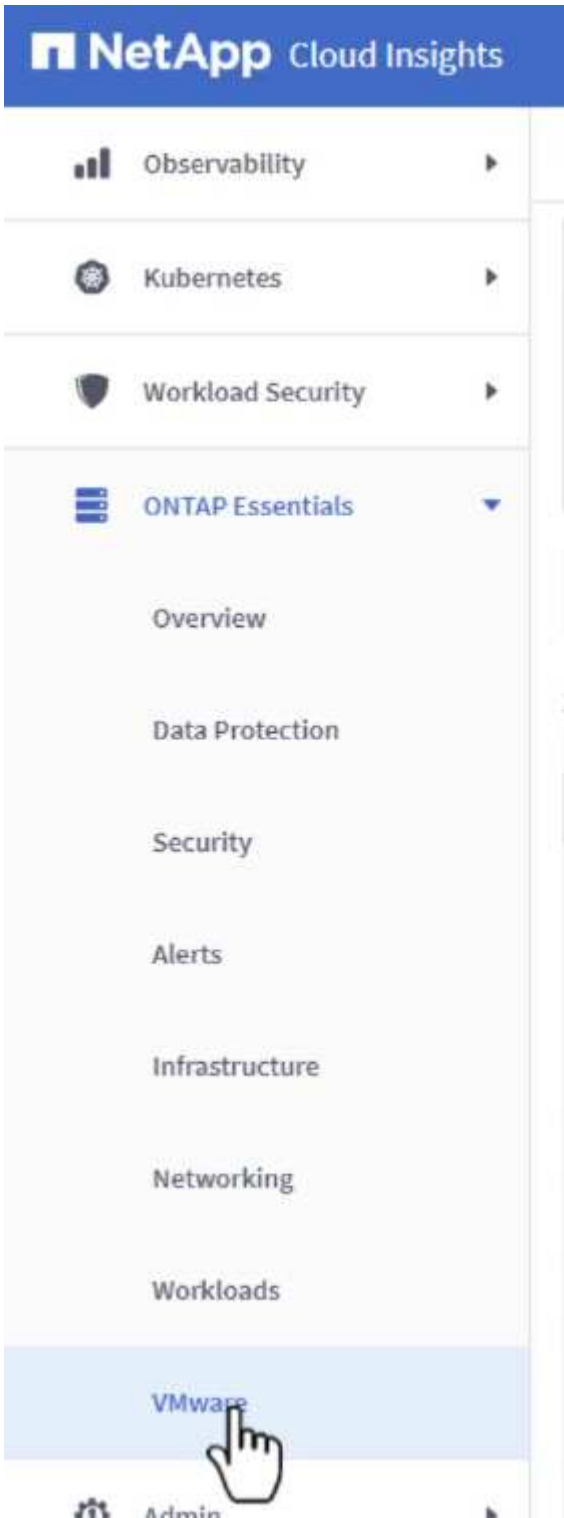


### Use queries to isolate and sort metrics

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.

## View a detailed VMware query under ONTAP Essentials

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



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.

The screenshot shows a dashboard for 'VirtualMachine' with filters for 'storageResources.storage.vendor' (NetApp) and 'host.Los' (vmware). The table below displays 281 items found, listing various VMs and their performance metrics.

Virtual Machine	name	powerState	capacity.used (GiB)	capacity.total (GiB)	capacityRatio.us...	diskIops.total (I/O/s)	diskLatency.total...	diskThroughput...
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](#)

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