



Manage Cloud Volumes ONTAP

Cloud Manager

NetApp

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Manage Cloud Volumes ONTAP

Learn

Learn about Cloud Volumes ONTAP

Cloud Volumes ONTAP enables you to optimize your cloud storage costs and performance while enhancing data protection, security, and compliance.

Cloud Volumes ONTAP is a software-only storage appliance that runs ONTAP data management software in the cloud. It provides enterprise-grade storage with the following key features:

- Storage efficiencies

Leverage built-in data deduplication, data compression, thin provisioning, and cloning to minimize storage costs.

- High availability

Ensure enterprise reliability and continuous operations in case of failures in your cloud environment.

- Data protection

Cloud Volumes ONTAP leverages SnapMirror, NetApp's industry-leading replication technology, to replicate on-premises data to the cloud so it's easy to have secondary copies available for multiple use cases.

Cloud Volumes ONTAP also integrates with Cloud Backup Service to deliver backup and restore capabilities for protection, and long-term archive of your cloud data.

- Data tiering

Switch between high and low-performance storage pools on-demand without taking applications offline.

- Application consistency

Ensure consistency of NetApp Snapshot copies using NetApp SnapCenter.

- Data security

Cloud Volumes ONTAP supports data encryption and provides protection against viruses and ransomware.

- Privacy compliance controls

Integration with Cloud Compliance helps you understand data context and identify sensitive data.



Licenses for ONTAP features are included with Cloud Volumes ONTAP.

[View supported Cloud Volumes ONTAP configurations](#)

[Learn more about Cloud Volumes ONTAP](#)

Storage

Disks and aggregates

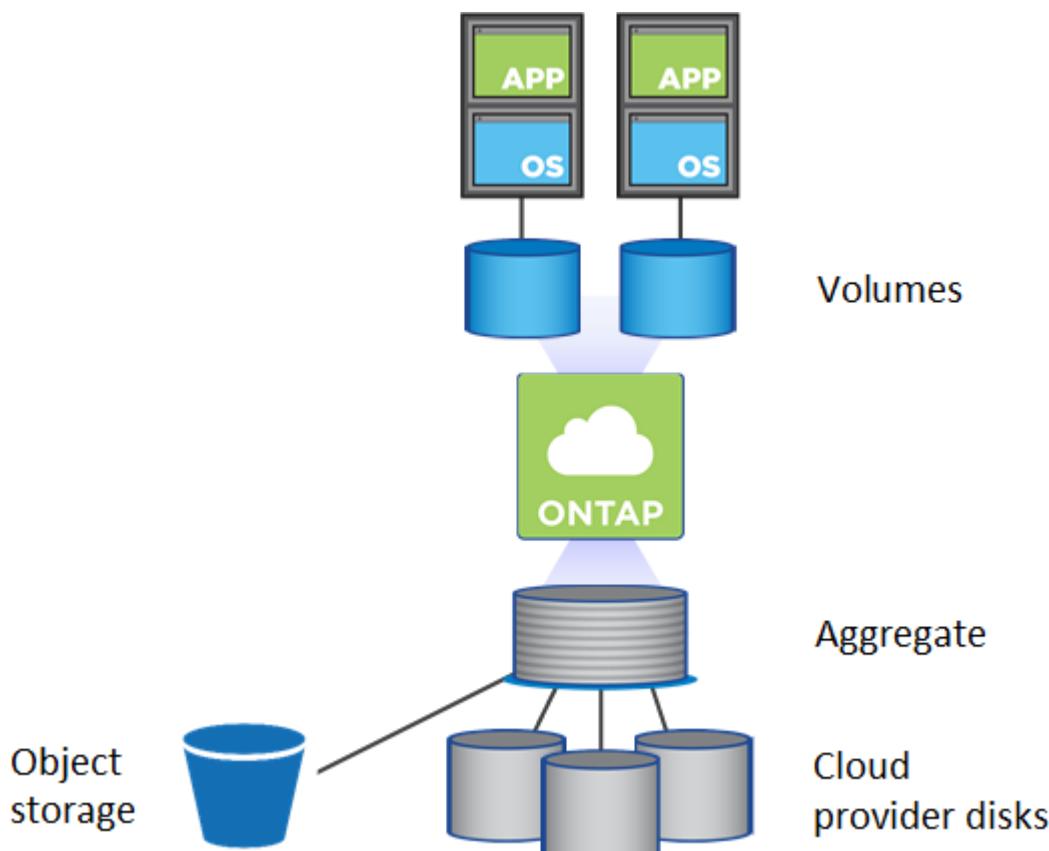
Understanding how Cloud Volumes ONTAP uses cloud storage can help you understand your storage costs.



All disks and aggregates must be created and deleted directly from Cloud Manager. You should not perform these actions from another management tool. Doing so can impact system stability, hamper the ability to add disks in the future, and potentially generate redundant cloud provider fees.

Overview

Cloud Volumes ONTAP uses cloud provider storage as disks and groups them into one or more aggregates. Aggregates provide storage to one or more volumes.



Several types of cloud disks are supported. You choose the disk type when you create a volume and the default disk size when you deploy Cloud Volumes ONTAP.



The total amount of storage purchased from a cloud provider is the *raw capacity*. The *usable capacity* is less because approximately 12 to 14 percent is overhead that is reserved for Cloud Volumes ONTAP use. For example, if Cloud Manager creates a 500 GB aggregate, the usable capacity is 442.94 GB.

AWS storage

In AWS, Cloud Volumes ONTAP uses EBS storage for user data and local NVMe storage as Flash Cache on some EC2 instance types.

EBS storage

In AWS, an aggregate can contain up to 6 disks that are all the same size. The maximum disk size is 16 TB.

The underlying EBS disk type can be either General Purpose SSD, Provisioned IOPS SSD, Throughput Optimized HDD, or Cold HDD. You can pair an EBS disk with Amazon S3 to [tier inactive data to low-cost object storage](#).

At a high level, the differences between EBS disk types are as follows:

- *General Purpose SSD* disks balance cost and performance for a broad range of workloads. Performance is defined in terms of IOPS.
- *Provisioned IOPS SSD* disks are for critical applications that require the highest performance at a higher cost.
- *Throughput Optimized HDD* disks are for frequently accessed workloads that require fast and consistent throughput at a lower price.
- *Cold HDD* disks are meant for backups, or infrequently accessed data, because the performance is very low. Like Throughput Optimized HDD disks, performance is defined in terms of throughput.



Cold HDD disks are not supported with HA configurations and with data tiering.

Local NVMe storage

Some EC2 instance types include local NVMe storage, which Cloud Volumes ONTAP uses as [Flash Cache](#).

Related links

- [AWS documentation: EBS Volume Types](#)
- [Learn how to choose disk types and disk sizes for your systems in AWS](#)
- [Review storage limits for Cloud Volumes ONTAP in AWS](#)
- [Review supported configurations for Cloud Volumes ONTAP in AWS](#)

Azure storage

In Azure, an aggregate can contain up to 12 disks that are all the same size. The disk type and maximum disk size depends on whether you use a single node system or an HA pair:

Single node systems

Single node systems can use three types of Azure Managed Disks:

- *Premium SSD Managed Disks* provide high performance for I/O-intensive workloads at a higher cost.
- *Standard SSD Managed Disks* provide consistent performance for workloads that require low IOPS.
- *Standard HDD Managed Disks* are a good choice if you don't need high IOPS and want to reduce your costs.

Each managed disk type has a maximum disk size of 32 TB.

You can pair a managed disk with Azure Blob storage to [tier inactive data to low-cost object storage](#).

HA pairs

HA pairs use Premium page blobs, which have a maximum disk size of 8 TB.

Related links

- [Microsoft Azure documentation: Introduction to Microsoft Azure Storage](#)
- [Learn how to choose disk types and disk sizes for your systems in Azure](#)
- [Review storage limits for Cloud Volumes ONTAP in Azure](#)

GCP storage

In GCP, an aggregate can contain up to 6 disks that are all the same size. The maximum disk size is 16 TB.

The disk type can be either *Zonal SSD persistent disks* or *Zonal standard persistent disks*. You can pair persistent disks with a Google Storage bucket to [tier inactive data to low-cost object storage](#).

Related links

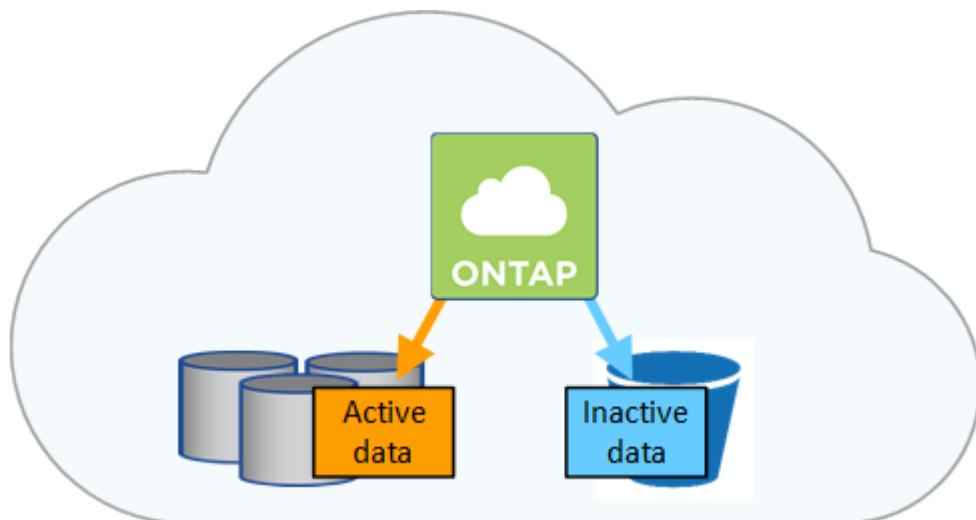
- [Google Cloud Platform documentation: Storage Options](#)
- [Review storage limits for Cloud Volumes ONTAP in GCP](#)

RAID type

The RAID type for each Cloud Volumes ONTAP aggregate is RAID0 (striping). No other RAID types are supported. Cloud Volumes ONTAP relies on the cloud provider for disk availability and durability.

Data tiering overview

Reduce your storage costs by enabling automated tiering of inactive data to low-cost object storage. Active data remains in high-performance SSDs or HDDs, while inactive data is tiered to low-cost object storage. This enables you to reclaim space on your primary storage and shrink secondary storage.



Cloud Volumes ONTAP supports data tiering in AWS, Azure, and Google Cloud Platform. Data tiering is

powered by FabricPool technology.



You don't need to install a feature license to enable data tiering (FabricPool).

Data tiering in AWS

When you enable data tiering in AWS, Cloud Volumes ONTAP uses EBS as a performance tier for hot data and AWS S3 as a capacity tier for inactive data.

Performance tier

The performance tier can be General Purpose SSDs, Provisioned IOPS SSDs, or Throughput Optimized HDDs.

Capacity tier

A Cloud Volumes ONTAP system tiers inactive data to a single S3 bucket using the *Standard* storage class. Standard is ideal for frequently accessed data stored across multiple Availability Zones.



Cloud Manager creates a single S3 bucket for each working environment and names it `fabric-pool-cluster unique identifier`. A different S3 bucket is not created for each volume.

Storage classes

The default storage class for tiered data in AWS is *Standard*. If you don't plan to access the inactive data, you can reduce your storage costs by changing the storage class to one of the following: *Intelligent Tiering*, *One-Zone Infrequent Access*, or *Standard-Infrequent Access*. When you change the storage class, inactive data starts in the Standard storage class and transitions to the storage class that you selected, if the data is not accessed after 30 days.

The access costs are higher if you do access the data, so take that into consideration before you change the storage class. [Learn more about Amazon S3 storage classes](#).

You can select a storage class when you create the working environment and you can change it any time after. For details about changing the storage class, see [Tiering inactive data to low-cost object storage](#).

The storage class for data tiering is system wide—it's not per volume.

Data tiering in Azure

When you enable data tiering in Azure, Cloud Volumes ONTAP uses Azure managed disks as a performance tier for hot data and Azure Blob storage as a capacity tier for inactive data.

Performance tier

The performance tier can be either SSDs or HDDs.

Capacity tier

A Cloud Volumes ONTAP system tiers inactive data to a single Blob container using the Azure *hot* storage tier. The hot tier is ideal for frequently accessed data.



Cloud Manager creates a new storage account with a single container for each Cloud Volumes ONTAP working environment. The name of the storage account is random. A different container is not created for each volume.

Storage access tiers

The default storage access tier for tiered data in Azure is the *hot* tier. If you don't plan to access the inactive data, you can reduce your storage costs by changing to the *cool* storage tier. When you change the storage tier, inactive data starts in the hot storage tier and transitions to the cool storage tier, if the data is not accessed after 30 days.

The access costs are higher if you do access the data, so take that into consideration before you change the storage tier. [Learn more about Azure Blob storage access tiers](#).

You can select a storage tier when you create the working environment and you can change it any time after. For details about changing the storage tier, see [Tiering inactive data to low-cost object storage](#).

The storage access tier for data tiering is system wide—it's not per volume.

Data tiering in GCP

When you enable data tiering in GCP, Cloud Volumes ONTAP uses persistent disks as a performance tier for hot data and a Google Cloud Storage bucket as a capacity tier for inactive data.

Performance tier

The performance tier can be either SSDs or HDDs (standard disks).

Capacity tier

A Cloud Volumes ONTAP system tiers inactive data to a single Google Cloud Storage bucket using the *Regional* storage class.



Cloud Manager creates a single bucket for each working environment and names it *fabric-pool-cluster unique identifier*. A different bucket is not created for each volume.

Storage classes

The default storage class for tiered data is the *Standard Storage* class. If the data is infrequently accessed, you can reduce your storage costs by changing to *Nearline Storage* or *Coldline Storage*. When you change the storage class, inactive data starts in the Standard Storage class and transitions to the storage class that you selected, if the data is not accessed after 30 days.

The access costs are higher if you do access the data, so take that into consideration before you change the storage class. [Learn more about storage classes for Google Cloud Storage](#).

You can select a storage tier when you create the working environment and you can change it any time after. For details about changing the storage class, see [Tiering inactive data to low-cost object storage](#).

The storage class for data tiering is system wide—it's not per volume.

Data tiering and capacity limits

If you enable data tiering, a system's capacity limit stays the same. The limit is spread across the performance tier and the capacity tier.

Volume tiering policies

To enable data tiering, you must select a volume tiering policy when you create, modify, or replicate a volume. You can select a different policy for each volume.

Some tiering policies have an associated minimum cooling period, which sets the time that user data in a

volume must remain inactive for the data to be considered "cold" and moved to the capacity tier. The cooling period starts when data is written to the aggregate.



You can change the minimum cooling period and default aggregate threshold of 50% (more on that below). [Learn how to change the cooling period](#) and [learn how to change the threshold](#).

Cloud Manager enables you to choose from the following volume tiering policies when you create or modify a volume:

Snapshot Only

After an aggregate has reached 50% capacity, Cloud Volumes ONTAP tiers cold user data of Snapshot copies that are not associated with the active file system to the capacity tier. The cooling period is approximately 2 days.

If read, cold data blocks on the capacity tier become hot and are moved to the performance tier.

All

All data (not including metadata) is immediately marked as cold and tiered to object storage as soon as possible. There is no need to wait 48 hours for new blocks in a volume to become cold. Note that blocks located in the volume prior to the All policy being set require 48 hours to become cold.

If read, cold data blocks on the cloud tier stay cold and are not written back to the performance tier. This policy is available starting with ONTAP 9.6.

Auto

After an aggregate has reached 50% capacity, Cloud Volumes ONTAP tiers cold data blocks in a volume to a capacity tier. The cold data includes not just Snapshot copies but also cold user data from the active file system. The cooling period is approximately 31 days.

This policy is supported starting with Cloud Volumes ONTAP 9.4.

If read by random reads, the cold data blocks in the capacity tier become hot and move to the performance tier. If read by sequential reads, such as those associated with index and antivirus scans, the cold data blocks stay cold and do not move to the performance tier.

None

Keeps data of a volume in the performance tier, preventing it from being moved to the capacity tier.

When you replicate a volume, you can choose whether to tier the data to object storage. If you do, Cloud Manager applies the **Backup** policy to the data protection volume. Starting with Cloud Volumes ONTAP 9.6, the **All** tiering policy replaces the backup policy.

Turning off Cloud Volumes ONTAP impacts the cooling period

Data blocks are cooled by cooling scans. During this process, blocks that haven't been used have their block temperature moved (cooled) to the next lower value. The default cooling time depends on the volume tiering policy:

- Auto: 31 days
- Snapshot Only: 2 days

Cloud Volumes ONTAP must be running for the cooling scan to work. If Cloud Volumes ONTAP is turned off,

cooling will stop, as well. As a result, you can experience longer cooling times.



When Cloud Volumes ONTAP is turned off, the temperature of each block is preserved until you restart the system. For example, if the temperature of a block is 5 when you turn the system off, the temp is still 5 when you turn the system back on.

Setting up data tiering

For instructions and a list of supported configurations, see [Tiering inactive data to low-cost object storage](#).

Storage management

Cloud Manager provides simplified and advanced management of Cloud Volumes ONTAP storage.



All disks and aggregates must be created and deleted directly from Cloud Manager. You should not perform these actions from another management tool. Doing so can impact system stability, hamper the ability to add disks in the future, and potentially generate redundant cloud provider fees.

Storage provisioning

Cloud Manager makes storage provisioning for Cloud Volumes ONTAP easy by purchasing disks and managing aggregates for you. You simply need to create volumes. You can use an advanced allocation option to provision aggregates yourself, if desired.

Simplified provisioning

Aggregates provide cloud storage to volumes. Cloud Manager creates aggregates for you when you launch an instance, and when you provision additional volumes.

When you create a volume, Cloud Manager does one of three things:

- It places the volume on an existing aggregate that has sufficient free space.
- It places the volume on an existing aggregate by purchasing more disks for that aggregate.
- It purchases disks for a new aggregate and places the volume on that aggregate.

Cloud Manager determines where to place a new volume by looking at several factors: an aggregate's maximum size, whether thin provisioning is enabled, and free space thresholds for aggregates.



The Account Admin can modify free space thresholds from the **Settings** page.

Disk size selection for aggregates in AWS

When Cloud Manager creates new aggregates for Cloud Volumes ONTAP in AWS, it gradually increases the disk size in an aggregate, as the number of aggregates in the system increases. Cloud Manager does this to ensure that you can utilize the system's maximum capacity before it reaches the maximum number of data disks allowed by AWS.

For example, Cloud Manager might choose the following disk sizes for aggregates in a Cloud Volumes ONTAP Premium or BYOL system:

Aggregate number	Disk size	Max aggregate capacity
1	500 MB	3 TB
4	1 TB	6 TB
6	2 TB	12 TB

You can choose the disk size yourself by using the advanced allocation option.

Advanced allocation

Rather than let Cloud Manager manage aggregates for you, you can do it yourself. From the [Advanced allocation page](#), you can create new aggregates that include a specific number of disks, add disks to an existing aggregate, and create volumes in specific aggregates.

Capacity management

The Account Admin can choose whether Cloud Manager notifies you of storage capacity decisions or whether Cloud Manager automatically manages capacity requirements for you. It might help for you to understand how these modes work.

Automatic capacity management

The Capacity Management Mode is set to automatic by default. In this mode, Cloud Manager automatically purchases new disks for Cloud Volumes ONTAP instances when more capacity is needed, deletes unused collections of disks (aggregates), moves volumes between aggregates when needed, and attempts to unfail disks.

The following examples illustrate how this mode works:

- If an aggregate with 5 or fewer EBS disks reaches the capacity threshold, Cloud Manager automatically purchases new disks for that aggregate so volumes can continue to grow.
- If an aggregate with 12 Azure disks reaches the capacity threshold, Cloud Manager automatically moves a volume from that aggregate to an aggregate with available capacity or to a new aggregate.

If Cloud Manager creates a new aggregate for the volume, it chooses a disk size that accommodates the size of that volume.

Note that free space is now available on the original aggregate. Existing volumes or new volumes can use that space. The space can't be returned to AWS, Azure, or GCP in this scenario.

- If an aggregate contains no volumes for more than 12 hours, Cloud Manager deletes it.

Management of LUNs with automatic capacity management

Cloud Manager's automatic capacity management doesn't apply to LUNs. When Cloud Manager creates a LUN, it disables the autogrow feature.

Management of inodes with automatic capacity management

Cloud Manager monitors inode usage on a volume. When 85% of the inodes are used, Cloud Manager increases the size of the volume to increase the number of available inodes. The number of files a volume can contain is determined by how many inodes it has.

Manual capacity management

If the Account Admin set the Capacity Management Mode to manual, Cloud Manager displays Action Required messages when capacity decisions must be made. The same examples described in the automatic mode apply to the manual mode, but it is up to you to accept the actions.

Write speed

Cloud Manager enables you to choose normal or high write speed for Cloud Volumes ONTAP. Before you choose a write speed, you should understand the differences between the normal and high settings and risks and recommendations when using high write speed.

High write speed is supported with all types of single node systems. It's also supported with HA pairs in AWS and Azure when using a specific instance or VM type (refer to the sections below for the list of supported instances and VM types). High write speed is not supported with HA pairs in GCP.

Normal write speed

When you choose normal write speed, data is written directly to disk. When data is written directly to disk, reduces the likelihood of data loss in the event of an unplanned system outage, or a cascading failure involving an unplanned system outage (HA pairs only).

Normal write speed is the default option.

High write speed

When you choose high write speed, data is buffered in memory before it is written to disk, which provides faster write performance. Due to this caching, there is the potential for data loss if an unplanned system outage occurs.

The amount of data that can be lost in the event of an unplanned system outage is the span of the last two consistency points. A consistency point is the act of writing buffered data to disk. A consistency point occurs when the write log is full or after 10 seconds (whichever comes first). However, the performance of the storage provided by your cloud provider can affect consistency point processing time.

When to use high write speed

High write speed is a good choice if fast write performance is required for your workload and you can withstand the risk of data loss in the event of an unplanned system outage, or a cascading failure involving an unplanned system outage (HA pairs only).

Recommendations when using high write speed

If you enable high write speed, you should ensure write protection at the application layer, or that the applications can tolerate data loss, if it occurs.

Configurations that support high write speed

Not all Cloud Volumes ONTAP configurations support high write speed. Those configurations use normal write speed by default.

AWS

If you use a single node system, Cloud Volumes ONTAP supports high write speed with all instance types.

If you use an HA pair, Cloud Volumes ONTAP supports high write speed with the following instance types, starting with the 9.8 release:

- c5.9xlarge
- c5.18xlarge
- c5d.4xlarge
- c5d.9xlarge
- c5d.18xlarge
- c5n.9xlarge
- c5n.18xlarge
- m5.2xlarge
- m5.4xlarge
- m5.16xlarge
- m5d.8xlarge
- m5d.12xlarge
- m5n.2xlarge
- r5.2xlarge
- r5.8xlarge
- r5.12xlarge
- r5d.2xlarge

Azure

If you use a single node system, Cloud Volumes ONTAP supports high write speed with all VM types.

If you use an HA pair, Cloud Volumes ONTAP supports high write speed with the following VM types, starting with the 9.8 release:

- DS5_v2
- DS14_v2
- DS15_v2
- E48s_v3

Google Cloud

If you use a single node system, Cloud Volumes ONTAP supports high write speed with all machine types.

Cloud Volumes ONTAP doesn't support high write speed with HA pairs in Google Cloud.

How to select a write speed

You can choose a write speed when you create a new working environment and you can [change the write](#)

speed for an existing system.

What to expect if data loss occurs

If you choose high write speed and data loss occurs, the system should be able to boot up and continue to serve data without user intervention. Two EMS messages will be reported when a node runs into data loss. One is wafl.root.content.changed with the ERROR severity level event, the other is nv.check.failed with the DEBUG severity level event. Both messages must be present as an indication of data loss.

How to stop data access if data loss occurs

If you are concerned about data loss, want the applications to stop running upon data loss, and the data access to be resumed after the data loss issue is properly addressed, you can use the NVFAIL option from the CLI to achieve that goal.

To enable the NVFAIL option

```
vol modify -volume <vol-name> -nvfail on
```

To check NVFAIL settings

```
vol show -volume <vol-name> -fields nvfail
```

To disable the NVFAIL option

```
vol modify -volume <vol-name> -nvfail off
```

When data loss occurs, an NFS or iSCSI volume with NVFAIL enabled should stop serving data (there's no impact to CIFS which is a stateless protocol). For more details, refer to [How NVFAIL impacts access to NFS volumes or LUNs](#).

To check the NVFAIL state

```
vol show -fields in-nvfailed-state
```

After the data loss issue is properly addressed, you can clear the NVFAIL state and the volume will be available for data access.

To clear the NVFAIL state

```
vol modify -volume <vol-name> -in-nvfailed-state false
```

Flash Cache

Some Cloud Volumes ONTAP configurations in AWS and Azure include local NVMe storage, which Cloud Volumes ONTAP uses as *Flash Cache* for better performance.

What's Flash Cache?

Flash Cache speeds access to data through real-time intelligent caching of recently read user data and NetApp metadata. It's effective for random read-intensive workloads, including databases, email, and file services.

Supported instances in AWS

Select one of the following EC2 instance types with a new or existing Cloud Volumes ONTAP Premium or BYOL system:

- c5d.4xlarge

- c5d.9xlarge
- c5d.18xlarge
- m5d.8xlarge
- m5d.12xlarge
- r5d.2xlarge

Supported VM type in Azure

Select the Standard_L8s_v2 VM type with a single node Cloud Volumes ONTAP BYOL system in Azure.

Limitations

- Compression must be disabled on all volumes to take advantage of the Flash Cache performance improvements.

Choose no storage efficiency when creating a volume from Cloud Manager, or create a volume and then [disable data compression by using the CLI](#).

- Cache rewarming after a reboot is not supported with Cloud Volumes ONTAP.

WORM storage

You can activate write once, read many (WORM) storage on a Cloud Volumes ONTAP system to retain files in unmodified form for a specified retention period. WORM storage is powered by SnapLock technology in Enterprise mode, which means WORM files are protected at the file level.

Once a file has been committed to WORM storage, it cannot be modified, even after the retention period has expired. A tamper-proof clock determines when the retention period for a WORM file has elapsed.

After the retention period has elapsed, you are responsible for deleting any files that you no longer need.

Activating WORM storage

You can activate WORM storage on a Cloud Volumes ONTAP system when you create a new working environment. This includes specifying an activation code and setting the default retention period for files. You can obtain an activation code by using the chat icon in the lower right of the Cloud Manager interface.



You cannot activate WORM storage on individual volumes—WORM must be activated at the system level.

The following image shows how to activate WORM storage when creating a working environment:

WORM | [Preview](#)

You can use write once, read many (WORM) storage to retain critical files in unmodified form for regulatory and governance purposes and to protect from malware attacks. WORM files are protected at the file level.

[Learn More](#)

Disable WORM Activate WORM

Notice: If you enable WORM storage, you cannot enable data tiering to object storage.

WORM Activation Code



Worm-111112222aaaaaa

Retention Period

15

years



Committing files to WORM

You can use an application to commit files to WORM over NFS or CIFS, or use the ONTAP CLI to autocommit files to WORM automatically. You can also use a WORM appendable file to retain data that is written incrementally, like log information.

After you activate WORM storage on a Cloud Volumes ONTAP system, you must use the ONTAP CLI for all management of WORM storage. For instructions, refer to [ONTAP documentation](#).



Cloud Volumes ONTAP support for WORM storage is equivalent to SnapLock Enterprise mode.

Limitations

- If you delete or move a disk directly from AWS or Azure, then a volume can be deleted before its expiry date.
- When WORM storage is activated, data tiering to object storage can't be enabled.
- Cloud Backup must be disabled in order to enable WORM storage.

High-availability pairs

High-availability pairs in AWS

A Cloud Volumes ONTAP high availability (HA) configuration provides nondisruptive operations and fault tolerance. In AWS, data is synchronously mirrored between the two nodes.

Overview

In AWS, Cloud Volumes ONTAP HA configurations include the following components:

- Two Cloud Volumes ONTAP nodes whose data is synchronously mirrored between each other.
- A mediator instance that provides a communication channel between the nodes to assist in storage takeover and giveback processes.



The mediator instance runs the Linux operating system on a t2.micro instance and uses one EBS magnetic disk that is approximately 8 GB.

Storage takeover and giveback

If a node goes down, the other node can serve data for its partner to provide continued data service. Clients can access the same data from the partner node because the data was synchronously mirrored to the partner.

After the node reboots, the partner must resync data before it can return the storage. The time that it takes to resync data depends on how much data was changed while the node was down.

Storage takeover, resync, and giveback are all automatic by default. No user action is required.

RPO and RTO

An HA configuration maintains high availability of your data as follows:

- The recovery point objective (RPO) is 0 seconds.
Your data is transactionally consistent with no data loss.
- The recovery time objective (RTO) is 60 seconds.
In the event of an outage, data should be available in 60 seconds or less.

HA deployment models

You can ensure the high availability of your data by deploying an HA configuration across multiple Availability Zones (AZs) or in a single AZ. You should review more details about each configuration to choose which best fits your needs.

Multiple Availability Zones

Deploying an HA configuration in multiple Availability Zones (AZs) ensures high availability of your data if a failure occurs with an AZ or an instance that runs a Cloud Volumes ONTAP node. You should understand how NAS IP addresses impact data access and storage failover.

NFS and CIFS data access

When an HA configuration is spread across multiple Availability Zones, *floating IP addresses* enable NAS client access. The floating IP addresses, which must be outside of the CIDR blocks for all VPCs in the region, can migrate between nodes when failures occur. They aren't natively accessible to clients that are outside of the VPC, unless you [set up an AWS transit gateway](#).

If you can't set up a transit gateway, private IP addresses are available for NAS clients that are outside the VPC. However, these IP addresses are static—they can't failover between nodes.

You should review requirements for floating IP addresses and route tables before you deploy an HA configuration across multiple Availability Zones. You must specify the floating IP addresses when you deploy

the configuration. The private IP addresses are automatically created by Cloud Manager.

For details, see [AWS networking requirements for Cloud Volumes ONTAP HA in multiple AZs](#).

iSCSI data access

Cross-VPC data communication is not an issue since iSCSI does not use floating IP addresses.

Takeover and giveback for iSCSI

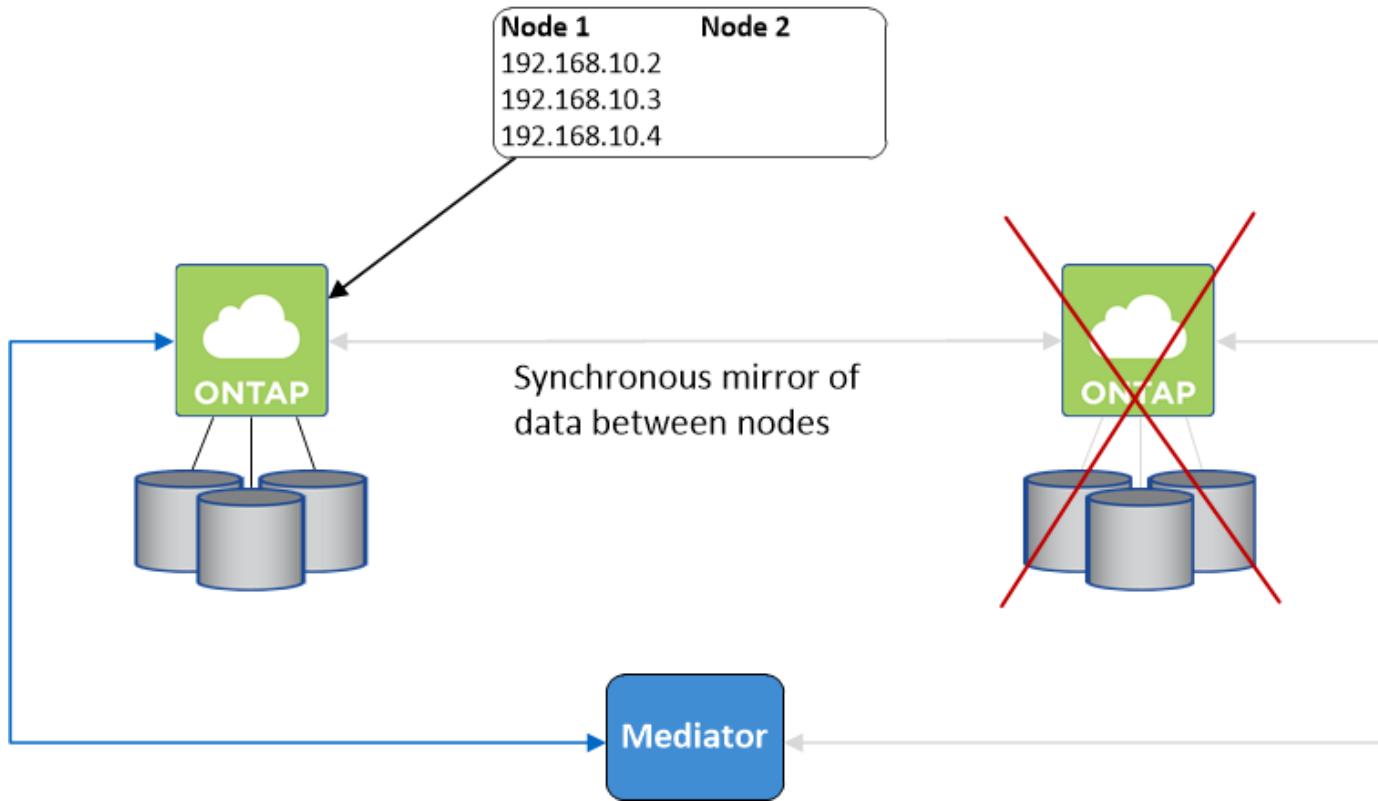
For iSCSI, Cloud Volumes ONTAP uses multipath I/O (MPIO) and Asymmetric Logical Unit Access (ALUA) to manage path failover between the active-optimized and non-optimized paths.



For information about which specific host configurations support ALUA, see the [NetApp Interoperability Matrix Tool](#) and the Host Utilities Installation and Setup Guide for your host operating system.

Takeover and giveback for NAS

When takeover occurs in a NAS configuration using floating IPs, the node's floating IP address that clients use to access data moves to the other node. The following image depicts storage takeover in a NAS configuration using floating IPs. If node 2 goes down, the floating IP address for node 2 moves to node 1.



NAS data IPs used for external VPC access cannot migrate between nodes if failures occur. If a node goes offline, you must manually remount volumes to clients outside the VPC by using the IP address on the other node.

After the failed node comes back online, remount clients to volumes using the original IP address. This step is needed to avoid transferring unnecessary data between two HA nodes, which can cause significant performance and stability impact.

You can easily identify the correct IP address from Cloud Manager by selecting the volume and clicking **Mount Command**.

Cloud Volumes ONTAP HA in a single Availability Zone

Deploying an HA configuration in a single Availability Zone (AZ) can ensure high availability of your data if an instance that runs a Cloud Volumes ONTAP node fails. All data is natively accessible from outside of the VPC.



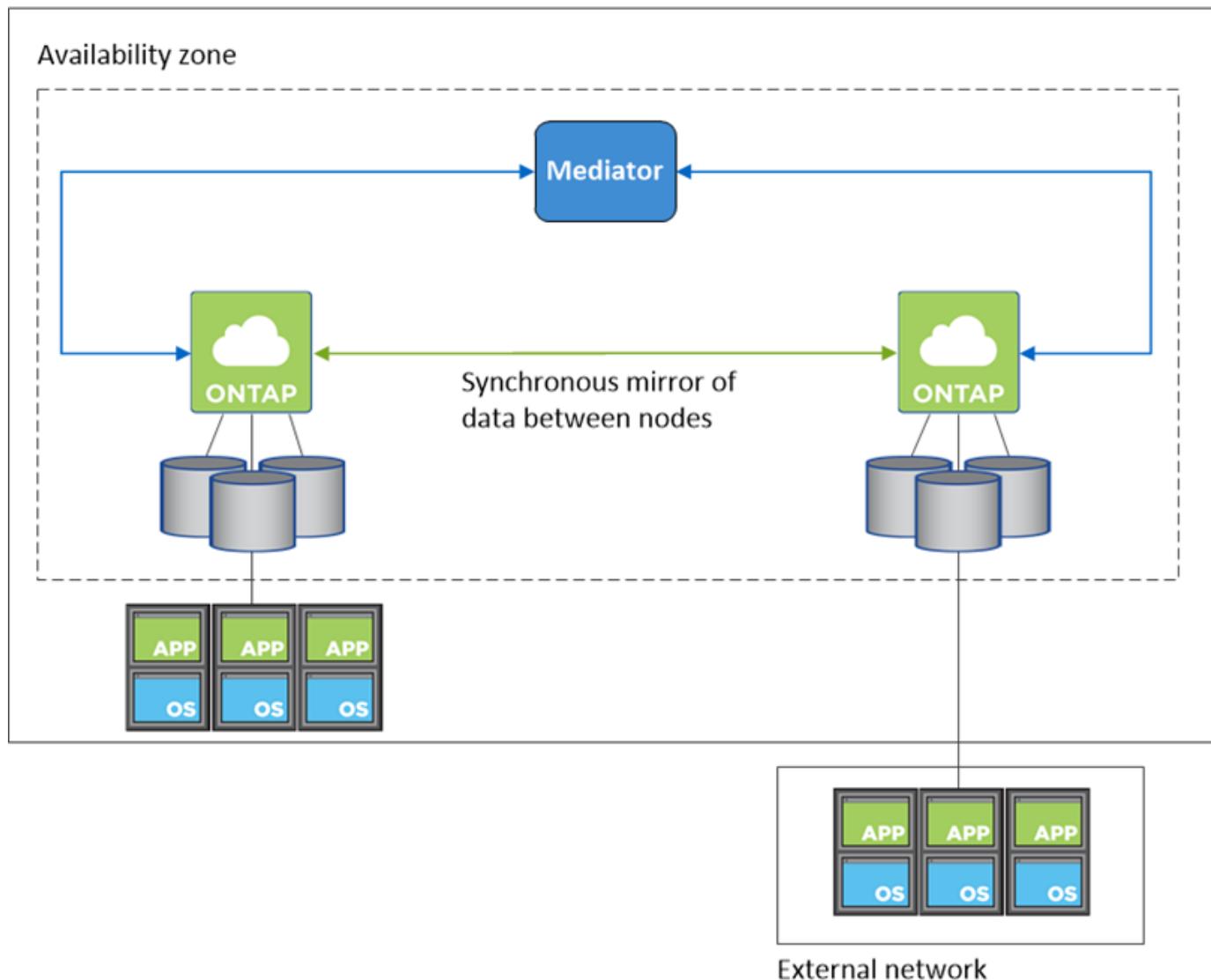
Cloud Manager creates an [AWS spread placement group](#) and launches the two HA nodes in that placement group. The placement group reduces the risk of simultaneous failures by spreading the instances across distinct underlying hardware. This feature improves redundancy from a compute perspective and not from disk failure perspective.

Data access

Because this configuration is in a single AZ, it does not require floating IP addresses. You can use the same IP address for data access from within the VPC and from outside the VPC.

The following image shows an HA configuration in a single AZ. Data is accessible from within the VPC and from outside the VPC.

VPC in AWS



Takeover and giveback

For iSCSI, Cloud Volumes ONTAP uses multipath I/O (MPIO) and Asymmetric Logical Unit Access (ALUA) to manage path failover between the active-optimized and non-optimized paths.



For information about which specific host configurations support ALUA, see the [NetApp Interoperability Matrix Tool](#) and the Host Utilities Installation and Setup Guide for your host operating system.

For NAS configurations, the data IP addresses can migrate between HA nodes if failures occur. This ensures client access to storage.

How storage works in an HA pair

Unlike an ONTAP cluster, storage in a Cloud Volumes ONTAP HA pair is not shared between nodes. Instead, data is synchronously mirrored between the nodes so that the data is available in the event of failure.

Storage allocation

When you create a new volume and additional disks are required, Cloud Manager allocates the same number of disks to both nodes, creates a mirrored aggregate, and then creates the new volume. For example, if two disks are required for the volume, Cloud Manager allocates two disks per node for a total of four disks.

Storage configurations

You can use an HA pair as an active-active configuration, in which both nodes serve data to clients, or as an active-passive configuration, in which the passive node responds to data requests only if it has taken over storage for the active node.



You can set up an active-active configuration only when using Cloud Manager in the Storage System View.

Performance expectations

A Cloud Volumes ONTAP HA configuration synchronously replicates data between nodes, which consumes network bandwidth. As a result, you can expect the following performance in comparison to a single-node Cloud Volumes ONTAP configuration:

- For HA configurations that serve data from only one node, read performance is comparable to the read performance of a single-node configuration, whereas write performance is lower.
- For HA configurations that serve data from both nodes, read performance is higher than the read performance of a single-node configuration, and write performance is the same or higher.

For more details about Cloud Volumes ONTAP performance, see [Performance](#).

Client access to storage

Clients should access NFS and CIFS volumes by using the data IP address of the node on which the volume resides. If NAS clients access a volume by using the IP address of the partner node, traffic goes between both nodes, which reduces performance.

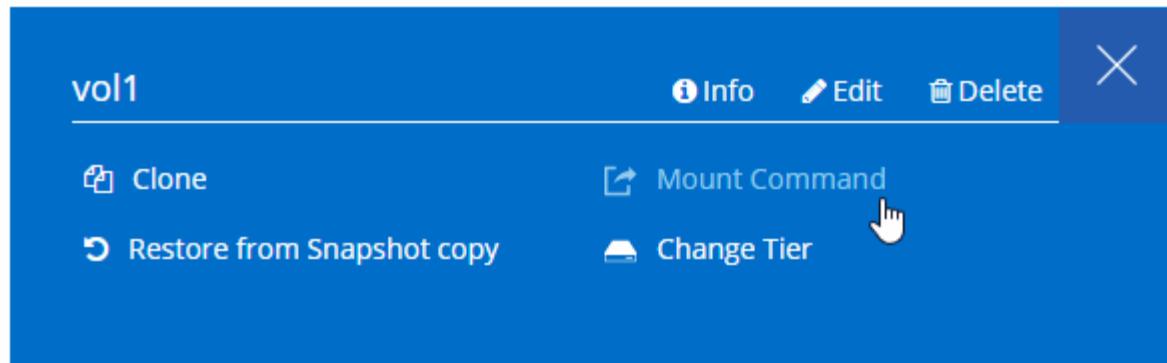


If you move a volume between nodes in an HA pair, you should remount the volume by using the IP address of the other node. Otherwise, you can experience reduced performance. If clients support NFSv4 referrals or folder redirection for CIFS, you can enable those features on the Cloud Volumes ONTAP systems to avoid remounting the volume. For details, see ONTAP documentation.

You can easily identify the correct IP address from Cloud Manager:

Volumes

2 Volumes | 0.22 TB Allocated | < 0.01 TB Used (0 TB in S3)

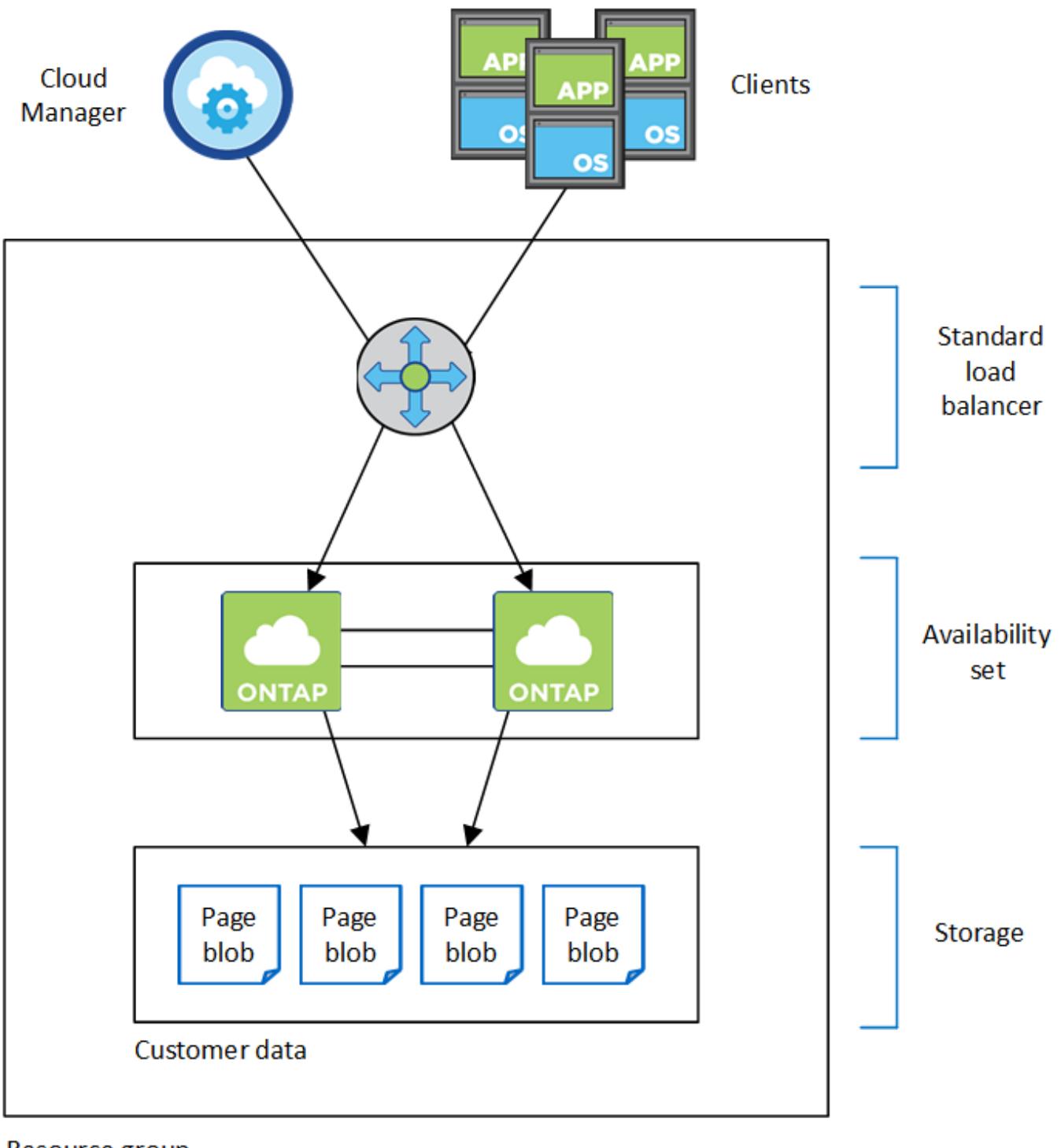


High-availability pairs in Azure

A Cloud Volumes ONTAP high availability (HA) pair provides enterprise reliability and continuous operations in case of failures in your cloud environment. In Azure, storage is shared between the two nodes.

HA components

A Cloud Volumes ONTAP HA configuration in Azure includes the following components:



Resource group

Note the following about the Azure components that Cloud Manager deploys for you:

Azure Standard Load Balancer

The load balancer manages incoming traffic to the Cloud Volumes ONTAP HA pair.

Availability Set

The Availability Set ensures that the nodes are in different fault and update domains.

Disks

Customer data resides on Premium Storage page blobs. Each node has access to the other node's storage. Additional storage is also required for [boot, root, and core data](#).

Storage accounts

- One storage account is required for managed disks.
- One or more storage accounts are required for the Premium Storage page blobs, as the disk capacity limit per storage account is reached.

[Azure documentation: Azure Storage scalability and performance targets for storage accounts](#).

- One storage account is required for data tiering to Azure Blob storage.
- Starting with Cloud Volumes ONTAP 9.7, the storage accounts that Cloud Manager creates for HA pairs are general-purpose v2 storage accounts.
- You can enable an HTTPS connection from a Cloud Volumes ONTAP 9.7 HA pair to Azure storage accounts when creating a working environment. Note that enabling this option can impact write performance. You can't change the setting after you create the working environment.

RPO and RTO

An HA configuration maintains high availability of your data as follows:

- The recovery point objective (RPO) is 0 seconds.
Your data is transactionally consistent with no data loss.
- The recovery time objective (RTO) is 60 seconds.
In the event of an outage, data should be available in 60 seconds or less.

Storage takeover and giveback

Similar to a physical ONTAP cluster, storage in an Azure HA pair is shared between nodes. Connections to the partner's storage allows each node to access the other's storage in the event of a *takeover*. Network path failover mechanisms ensure that clients and hosts continue to communicate with the surviving node. The partner *gives back* storage when the node is brought back on line.

For NAS configurations, data IP addresses automatically migrate between HA nodes if failures occur.

For iSCSI, Cloud Volumes ONTAP uses multipath I/O (MPIO) and Asymmetric Logical Unit Access (ALUA) to manage path failover between the active-optimized and non-optimized paths.



For information about which specific host configurations support ALUA, see the [NetApp Interoperability Matrix Tool](#) and the Host Utilities Installation and Setup Guide for your host operating system.

Storage takeover, resync, and giveback are all automatic by default. No user action is required.

Storage configurations

You can use an HA pair as an active-active configuration, in which both nodes serve data to clients, or as an active-passive configuration, in which the passive node responds to data requests only if it has taken over storage for the active node.

HA limitations

The following limitations affect Cloud Volumes ONTAP HA pairs in Azure:

- HA pairs are supported with Cloud Volumes ONTAP Standard, Premium, and BYOL. Explore is not supported.
- NFSv4 is not supported. NFSv3 is supported.
- HA pairs are not supported in some regions.

[See the list of supported Azure regions.](#)

[Learn how to deploy an HA system in Azure.](#)

High-availability pairs in Google Cloud Platform

A Cloud Volumes ONTAP high availability (HA) configuration provides nondisruptive operations and fault tolerance. In Google Cloud Platform, data is synchronously mirrored between the two nodes.

HA components

Cloud Volumes ONTAP HA configurations in GCP include the following components:

- Two Cloud Volumes ONTAP nodes whose data is synchronously mirrored between each other.
- A mediator instance that provides a communication channel between the nodes to assist in storage takeover and giveback processes.

The mediator runs the Linux operating system on a f1-micro instance and uses two standard persistent disks that are 10 GB each.

- Four Virtual Private Clouds (VPCs) are required for the HA configuration.

The configuration uses four VPCs because GCP requires that each network interface resides in a separate VPC network.

- Four Google Cloud internal load balancers (TCP/UDP) that manage incoming traffic to the Cloud Volumes ONTAP HA pair.

[Learn about networking requirements.](#)

Storage takeover and giveback

If a node goes down, the other node can serve data for its partner to provide continued data service. Clients can access the same data from the partner node because the data was synchronously mirrored to the partner.

After the node reboots, the partner must resync data before it can return the storage. The time that it takes to resync data depends on how much data was changed while the node was down.

Storage takeover, resync, and giveback are all automatic by default. No user action is required.

RPO and RTO

An HA configuration maintains high availability of your data as follows:

- The recovery point objective (RPO) is 0 seconds.

Your data is transactionally consistent with no data loss.

- The recovery time objective (RTO) is 60 seconds.

In the event of an outage, data should be available in 60 seconds or less.

HA deployment models

You can ensure the high availability of your data by deploying an HA configuration in multiple zones or in a single zone.

Multiple zones (recommended)

Deploying an HA configuration across three zones ensures continuous data availability if a failure occurs within a zone. Note that write performance is slightly lower compared to using a single zone, but it's minimal.

Single zone

When deployed in a single zone, a Cloud Volumes ONTAP HA configuration uses a spread placement policy. This policy ensures that an HA configuration is protected from a single point of failure within the zone, without having to use separate zones to achieve fault isolation.

This deployment model does lower your costs because there are no data egress charges between zones.

How storage works in an HA pair

Unlike an ONTAP cluster, storage in a Cloud Volumes ONTAP HA pair in GCP is not shared between nodes. Instead, data is synchronously mirrored between the nodes so that the data is available in the event of failure.

Storage allocation

When you create a new volume and additional disks are required, Cloud Manager allocates the same number of disks to both nodes, creates a mirrored aggregate, and then creates the new volume. For example, if two disks are required for the volume, Cloud Manager allocates two disks per node for a total of four disks.

Storage configurations

You can use an HA pair as an active-active configuration, in which both nodes serve data to clients, or as an active-passive configuration, in which the passive node responds to data requests only if it has taken over storage for the active node.

Performance expectations for an HA configuration

A Cloud Volumes ONTAP HA configuration synchronously replicates data between nodes, which consumes network bandwidth. As a result, you can expect the following performance in comparison to a single-node Cloud Volumes ONTAP configuration:

- For HA configurations that serve data from only one node, read performance is comparable to the read performance of a single-node configuration, whereas write performance is lower.
- For HA configurations that serve data from both nodes, read performance is higher than the read performance of a single-node configuration, and write performance is the same or higher.

For more details about Cloud Volumes ONTAP performance, see [Performance](#).

Client access to storage

Clients should access NFS and CIFS volumes by using the data IP address of the node on which the volume resides. If NAS clients access a volume by using the IP address of the partner node, traffic goes between both nodes, which reduces performance.



If you move a volume between nodes in an HA pair, you should remount the volume by using the IP address of the other node. Otherwise, you can experience reduced performance. If clients support NFSv4 referrals or folder redirection for CIFS, you can enable those features on the Cloud Volumes ONTAP systems to avoid remounting the volume. For details, see ONTAP documentation.

You can easily identify the correct IP address from Cloud Manager:

Volumes

2 Volumes | 0.22 TB Allocated | < 0.01 TB Used (0 TB in S3)

The screenshot shows a Cloud Manager interface for a volume named 'vol1'. At the top, there are navigation links: 'Cloud Volumes ONTAP', 'Cloud Volumes ONTAP', 'Cloud Volumes ONTAP', 'Cloud Volumes ONTAP', and 'Cloud Volumes ONTAP'. Below this is a summary bar with the text '2 Volumes | 0.22 TB Allocated | < 0.01 TB Used (0 TB in S3)'. The main area displays the volume 'vol1' with its status as 'Available'. To the right of the volume name are three action buttons: 'Info' (with a blue info icon), 'Edit' (with a blue edit icon), and 'Delete' (with a blue trash icon). Below these buttons is a horizontal line. Underneath the volume name, there are four options: 'Clone' (with a blue clone icon), 'Mount Command' (with a blue mount icon, currently selected and highlighted with a cursor icon), 'Restore from Snapshot copy' (with a blue restore icon), and 'Change Tier' (with a blue tier icon).

Related links

- [Learn about networking requirements](#)
- [Learn how to get started in GCP](#)

Evaluating

You can evaluate Cloud Volumes ONTAP before you pay for the software. The most common way is to launch the PAYGO version of your first Cloud Volumes ONTAP system to get a 30-day free trial. An evaluation BYOL license is also an option.

If you need assistance with your proof of concept, contact [the Sales team](#) or reach out through the chat option available from [NetApp Cloud Central](#) and from within Cloud Manager.

30-day free trials for PAYGO

A 30-day free trial is available if you plan to pay for Cloud Volumes ONTAP as you go. You can start a 30-day free trial of Cloud Volumes ONTAP from Cloud Manager by creating your first Cloud Volumes ONTAP system in a payer's account.

There are no hourly software license charges for the instance, but infrastructure charges from your cloud

provider still apply.

A free trial automatically converts to a paid hourly subscription when it expires. If you terminate the instance within the time limit, the next instance that you deploy is not part of the free trial (even if it's deployed within those 30 days).

Pay-as-you-go trials are awarded through a cloud provider and are not extendable by any means.

Evaluation licenses for BYOL

An evaluation BYOL license is an option for customers who expect to pay for Cloud Volumes ONTAP by purchasing a termed license from NetApp. You can obtain an evaluation license from your account team, your Sales Engineer, or your partner.

The evaluation key is good for 30 days, and can be used multiple times, each for 30 days (regardless of the creation day).

At the end of 30 days, daily shutdowns will occur, so it's best to plan ahead. You can apply a new BYOL license on top of the evaluation license for an in-place upgrade (this requires a restart of single node systems). Your hosted data is **not** deleted at the end of the trial period.



You can't upgrade Cloud Volumes ONTAP software when using an evaluation license.

Licensing

Each Cloud Volumes ONTAP BYOL system must have a system license installed with an active subscription. Cloud Manager simplifies the process by managing licenses for you and by notifying you before they expire. BYOL licenses are also available for Cloud Backup.

BYOL system licenses

You can purchase multiple licenses for a Cloud Volumes ONTAP BYOL system to allocate more than 368 TB of capacity. For example, you might purchase two licenses to allocate up to 736 TB of capacity to Cloud Volumes ONTAP. Or you could purchase four licenses to get up to 1.4 PB.

The number of licenses that you can purchase for a single node system or HA pair is unlimited.

Be aware that disk limits can prevent you from reaching the capacity limit by using disks alone. You can go beyond the disk limit by [tiering inactive data to object storage](#). For information about disk limits, refer to [storage limits in the Cloud Volumes ONTAP Release Notes](#).

License management for a new system

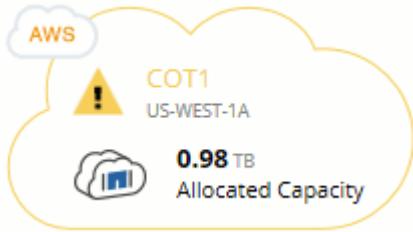
When you create a BYOL system, Cloud Manager prompts you for the serial number of your license and your NetApp Support Site account. Cloud Manager uses the account to download the license file from NetApp and to install it on the Cloud Volumes ONTAP system.

[Learn how to add NetApp Support Site accounts to Cloud Manager.](#)

If Cloud Manager can't access the license file over the secure internet connection, you can obtain the file yourself and then manually upload the file to Cloud Manager. For instructions, see [Managing BYOL licenses for Cloud Volumes ONTAP](#).

License expiration warning

Cloud Manager warns you 30 days before a license is due to expire and again when the license expires. The following image shows a 30-day expiration warning:



You can select the working environment to review the message.

If you don't renew the license in time, the Cloud Volumes ONTAP system shuts itself down. If you restart it, it shuts itself down again.



Cloud Volumes ONTAP can also notify you through email, an SNMP traphost, or syslog server using EMS (Event Management System) event notifications. For instructions, see the [ONTAP 9 EMS Configuration Express Guide](#).

License renewal

When you renew a BYOL subscription by contacting a NetApp representative, Cloud Manager automatically obtains the new license from NetApp and installs it on the Cloud Volumes ONTAP system.

If Cloud Manager can't access the license file over the secure internet connection, you can obtain the file yourself and then manually upload the file to Cloud Manager. For instructions, see [Managing BYOL licenses for Cloud Volumes ONTAP](#).

BYOL backup licenses

A BYOL backup license allows you to purchase a license from NetApp to use Cloud Backup for a certain period of time and for a maximum amount backup space. When either limit is reached you will need to renew the license.

[Learn more about the Cloud Backup BYOL license.](#)

Security

Cloud Volumes ONTAP supports data encryption and provides protection against viruses and ransomware.

Encryption of data at rest

Cloud Volumes ONTAP supports the following encryption technologies:

- NetApp encryption solutions (NVE and NAE)
- AWS Key Management Service
- Azure Storage Service Encryption
- Google Cloud Platform default encryption

You can use NetApp encryption solutions with native encryption from AWS, Azure, or GCP, which encrypt data at the hypervisor level. Doing so would provide double encryption, which might be desired for very sensitive data. When the encrypted data is accessed, it's unencrypted twice—once at the hypervisor-level (using keys from the cloud provider) and then again using NetApp encryption solutions (using keys from an external key manager).

NetApp encryption solutions (NVE and NAE)

Cloud Volumes ONTAP supports both NetApp Volume Encryption (NVE) and NetApp Aggregate Encryption (NAE) with an external key manager. NVE and NAE are software-based solutions that enable (FIPS) 140-2-compliant data-at-rest encryption of volumes.

- NVE encrypts data at rest one volume at a time. Each data volume has its own unique encryption key.
- NAE is an extension of NVE—it encrypts data for each volume, and the volumes share a key across the aggregate. NAE also allows common blocks across all volumes in the aggregate to be deduplicated.

Both NVE and NAE use AES 256-bit encryption.

[Learn more about NetApp Volume Encryption and NetApp Aggregate Encryption.](#)

Starting with Cloud Volumes ONTAP 9.7, new aggregates will have NetApp Aggregate Encryption (NAE) enabled by default after you set up an external key manager. New volumes that aren't part of an NAE aggregate will have NetApp Volume Encryption (NVE) enabled by default (for example, if you have existing aggregates that were created before setting up an external key manager).

Setting up a supported key manager is the only required step. For set up instructions, see [Encrypting volumes with NetApp encryption solutions](#).

AWS Key Management Service

When you launch a Cloud Volumes ONTAP system in AWS, you can enable data encryption using the [AWS Key Management Service \(KMS\)](#). Cloud Manager requests data keys using a customer master key (CMK).



You can't change the AWS data encryption method after you create a Cloud Volumes ONTAP system.

If you want to use this encryption option, then you must ensure that the AWS KMS is set up appropriately. For details, see [Setting up the AWS KMS](#).

Azure Storage Service Encryption

[Azure Storage Service Encryption](#) for data at rest is enabled by default for Cloud Volumes ONTAP data in Azure. No setup is required.

You can encrypt Azure managed disks on single node Cloud Volumes ONTAP systems using external keys from another account. This feature is supported using Cloud Manager APIs.

You just need to add the following to the API request when creating the single node system:

```
"azureEncryptionParameters": {  
    "key": <azure id of encryptionset>  
}
```



Customer-managed keys are not supported with Cloud Volumes ONTAP HA pairs.

Google Cloud Platform default encryption

[Google Cloud Platform data-at-rest encryption](#) is enabled by default for Cloud Volumes ONTAP. No setup is required.

While Google Cloud Storage always encrypts your data before it's written to disk, you can use Cloud Manager APIs to create a Cloud Volumes ONTAP system that uses *customer-managed encryption* keys. These are keys that you generate and manage in GCP using the Cloud Key Management Service. [Learn more](#).

ONTAP virus scanning

You can use integrated antivirus functionality on ONTAP systems to protect data from being compromised by viruses or other malicious code.

ONTAP virus scanning, called `Vscan`, combines best-in-class third-party antivirus software with ONTAP features that give you the flexibility you need to control which files get scanned and when.

For information about the vendors, software, and versions supported by Vscan, see the [NetApp Interoperability Matrix](#).

For information about how to configure and manage the antivirus functionality on ONTAP systems, see the [ONTAP 9 Antivirus Configuration Guide](#).

Ransomware protection

Ransomware attacks can cost a business time, resources, and reputation. Cloud Manager enables you to implement the NetApp solution for ransomware, which provides effective tools for visibility, detection, and remediation.

- Cloud Manager identifies volumes that are not protected by a Snapshot policy and enables you to activate the default Snapshot policy on those volumes.

Snapshot copies are read-only, which prevents ransomware corruption. They can also provide the granularity to create images of a single file copy or a complete disaster recovery solution.

- Cloud Manager also enables you to block common ransomware file extensions by enabling ONTAP's FPolicy solution.

Ransomware Protection

Ransomware attacks can cost a business time, resources, and reputation. The NetApp solution for ransomware provides effective tools for visibility, detection, and remediation. [Learn More](#)

1 Enable Snapshot Copy Protection 



50 %
Protection

1 Volumes without a Snapshot Policy

To protect your data, activate the default Snapshot policy for these volumes 

[Activate Snapshot Policy](#)

2 Block Ransomware File Extensions 



ONTAP's native FPolicy configuration monitors and blocks file operations based on a file's extension.

[View Denied File Names](#) 

[Activate FPolicy](#)

[Learn how to implement the NetApp solution for ransomware.](#)

Performance

You can review performance results to help you decide which workloads are appropriate for Cloud Volumes ONTAP.

- Cloud Volumes ONTAP for AWS

[NetApp Technical Report 4383: Performance Characterization of Cloud Volumes ONTAP in Amazon Web Services with Application Workloads.](#)

- Cloud Volumes ONTAP for Microsoft Azure

[NetApp Technical Report 4671: Performance Characterization of Cloud Volumes ONTAP in Azure with Application Workloads.](#)

- Cloud Volumes ONTAP for Google Cloud

[NetApp Technical Report 4816: Performance Characterization of Cloud Volumes ONTAP for Google Cloud.](#)

Default configuration for Cloud Volumes ONTAP

Understanding how Cloud Volumes ONTAP is configured by default can help you set up and administer your systems, especially if you are familiar with ONTAP because the default setup for Cloud Volumes ONTAP is different than ONTAP.

Defaults

- Cloud Volumes ONTAP is available as a single-node system and as an HA pair in AWS, Azure, and GCP.
- Cloud Manager creates one data-serving storage VM when it deploys Cloud Volumes ONTAP. Some configurations support additional storage VMs. [Learn more about managing storage VMs.](#)
- Cloud Manager automatically installs the following ONTAP feature licenses on Cloud Volumes ONTAP:
 - CIFS

- FlexCache
- FlexClone
- iSCSI
- NetApp Volume Encryption (only for BYOL or registered PAYGO systems)
- NFS
- SnapMirror
- SnapRestore
- SnapVault
- Several network interfaces are created by default:
 - A cluster management LIF
 - An intercluster LIF
 - An SVM management LIF on HA systems in Azure and in GCP, on single node systems in AWS, and optionally on HA systems in multiple AWS Availability Zones
 - A node management LIF
 - An iSCSI data LIF
 - A CIFS and NFS data LIF



LIF failover is disabled by default for Cloud Volumes ONTAP due to EC2 requirements. Migrating a LIF to a different port breaks the external mapping between IP addresses and network interfaces on the instance, making the LIF inaccessible.

- Cloud Volumes ONTAP sends configuration backups to the Connector using HTTPS.

The backups are accessible from <https://ipaddress/occm/offboxconfig/> where *ipaddress* is the IP address of the Connector host.

- Cloud Manager sets a few volume attributes differently than other management tools (System Manager or the CLI, for example).

The following table lists the volume attributes that Cloud Manager sets differently from the defaults:

Attribute	Value set by Cloud Manager
Autosize mode	grow
Maximum autosize	1,000 percent <div data-bbox="432 1615 489 1679" data-label="Image"> </div> The Account Admin can modify this value from the Settings page.
Security style	NTFS for CIFS volumes UNIX for NFS volumes
Space guarantee style	none

Attribute	Value set by Cloud Manager
UNIX permissions (NFS only)	777

See the *volume create* man page for information about these attributes.

Internal disks for system data

In addition to the storage for user data, Cloud Manager also purchases cloud storage for system data.

AWS

- Two disks per node for boot and root data:
 - 9.7: 160 GB io1 disk for boot data and a 220 GB gp2 disk for root data
 - 9.6: 93 GB io1 disk for boot data and a 140 GB gp2 disk for root data
 - 9.5: 45 GB io1 disk for boot data and a 140 GB gp2 disk for root data
- Starting with version 9.8, a 540 GB General Purpose SSD for a core disk when using a C5, M5, or R5 instance type
- One EBS snapshot for each boot disk and root disk
- For HA pairs, one EBS volume for the Mediator instance, which is approximately 8 GB

Azure (single node)

- Three Premium SSD disks:
 - One 10 GB disk for boot data
 - One 140 GB disk for root data
 - One 128 GB disk for NVRAM

If the virtual machine that you chose for Cloud Volumes ONTAP supports Ultra SSDs, then the system uses an Ultra SSD for NVRAM, rather than a Premium SSD.

- One 1024 GB Standard HDD disk for saving cores
- One Azure snapshot for each boot disk and root disk

Azure (HA pairs)

- Two 10 GB Premium SSD disks for the boot volume (one per node)
- Two 140 GB Premium Storage page blobs for the root volume (one per node)
- Two 1024 GB Standard HDD disks for saving cores (one per node)
- Two 128 GB Premium SSD disks for NVRAM (one per node)
- One Azure snapshot for each boot disk and root disk

GCP

- One 10 GB Standard persistent disk for boot data

- One 64 GB Standard persistent disk for root data
- One 500 GB Standard persistent disk for NVRAM
- One 315 GB Standard persistent disk for saving cores
- One GCP snapshot each for the boot disk and root disk

For an HA pair, there are two disks per node for root data.

Where the disks reside

Cloud Manager lays out the storage as follows:

- Boot data resides on a disk attached to the instance or virtual machine.

This disk, which contains the boot image, is not available to Cloud Volumes ONTAP.

- Root data, which contains the system configuration and logs, resides in aggr0.
- The storage virtual machine (SVM) root volume resides in aggr1.
- Data volumes also reside in aggr1.

Encryption

Boot and root disks are always encrypted in Azure and Google Cloud Platform because encryption is enabled by default in those cloud providers.

When you enable data encryption in AWS using the Key Management Service (KMS), the boot and root disks for Cloud Volumes ONTAP are encrypted, as well. This includes the boot disk for the mediator instance in an HA pair. The disks are encrypted using the CMK that you select when you create the working environment.

Get started in AWS

Getting started with Cloud Volumes ONTAP for AWS

Get started with Cloud Volumes ONTAP for AWS in a few steps.



Create a Connector

If you don't have a [Connector](#) yet, an Account Admin needs to create one. [Learn how to create a Connector in AWS.](#)

When you create your first Cloud Volumes ONTAP working environment, Cloud Manager prompts you to deploy a Connector if you don't have one yet.



Plan your configuration

Cloud Manager offers preconfigured packages that match your workload requirements, or you can create your own configuration. If you choose your own configuration, you should understand the options available to you. [Learn more.](#)

3

Set up your networking

- a. Ensure that your VPC and subnets will support connectivity between the Connector and Cloud Volumes ONTAP.
- b. Enable outbound internet access from the target VPC so the Connector and Cloud Volumes ONTAP can contact several endpoints.

This step is important because the Connector can't manage Cloud Volumes ONTAP without outbound internet access. If you need to limit outbound connectivity, refer to the list of endpoints for [the Connector and Cloud Volumes ONTAP](#).

- c. Set up a VPC endpoint to the S3 service.

A VPC endpoint is required if you want to tier cold data from Cloud Volumes ONTAP to low-cost object storage.

[Learn more about networking requirements](#).

4

Set up the AWS KMS

If you want to use Amazon encryption with Cloud Volumes ONTAP, then you need to ensure that an active Customer Master Key (CMK) exists. You also need to modify the key policy for each CMK by adding the IAM role that provides permissions to the Connector as a *key user*. [Learn more](#).

5

Launch Cloud Volumes ONTAP using Cloud Manager

Click **Add Working Environment**, select the type of system that you would like to deploy, and complete the steps in the wizard. [Read step-by-step instructions](#).

Related links

- [Evaluating](#)
- [Creating a Connector from Cloud Manager](#)
- [Launching a Connector from the AWS Marketplace](#)
- [Installing the Connector software on a Linux host](#)
- [What Cloud Manager does with AWS permissions](#)

Planning your Cloud Volumes ONTAP configuration in AWS

When you deploy Cloud Volumes ONTAP in AWS, you can choose a preconfigured system that matches your workload requirements, or you can create your own configuration. If you choose your own configuration, you should understand the options available to you.

Viewing supported regions

Cloud Volumes ONTAP is supported in most AWS regions. [View the full list of supported regions.](#)

Newer AWS regions must be enabled before you can create and manage resources in those regions. [Learn how to enable a region.](#)

Choosing a license type

Cloud Volumes ONTAP is available in two pricing options: pay-as-you-go and Bring Your Own License (BYOL). For pay-as-you-go, you can choose from three licenses: Explore, Standard, or Premium. Each license provides different capacity and compute options.

[Supported configurations for Cloud Volumes ONTAP 9.8 in AWS](#)

Choosing a supported instance

Cloud Volumes ONTAP supports several instance types, depending on the license type that you choose.

[Supported configurations for Cloud Volumes ONTAP 9.8 in AWS](#)

Choosing a configuration that supports Flash Cache

Some Cloud Volumes ONTAP configurations in AWS include local NVMe storage, which Cloud Volumes ONTAP uses as *Flash Cache* for better performance. [Learn more about Flash Cache.](#)

Understanding storage limits

The raw capacity limit for a Cloud Volumes ONTAP system is tied to the license. Additional limits impact the size of aggregates and volumes. You should be aware of these limits as you plan your configuration.

[Storage limits for Cloud Volumes ONTAP 9.8 in AWS](#)

Sizing your system in AWS

Sizing your Cloud Volumes ONTAP system can help you meet requirements for performance and capacity. You should be aware of a few key points when choosing an instance type, disk type, and disk size:

Instance type

- Match your workload requirements to the maximum throughput and IOPS for each EC2 instance type.
- If several users write to the system at the same time, choose an instance type that has enough CPUs to manage the requests.
- If you have an application that is mostly reads, then choose a system with enough RAM.
 - [AWS Documentation: Amazon EC2 Instance Types](#)
 - [AWS Documentation: Amazon EBS–Optimized Instances](#)

EBS disk type

General Purpose SSDs are the most common disk type for Cloud Volumes ONTAP. To view the use cases for EBS disks, refer to [AWS Documentation: EBS Volume Types](#).

EBS disk size

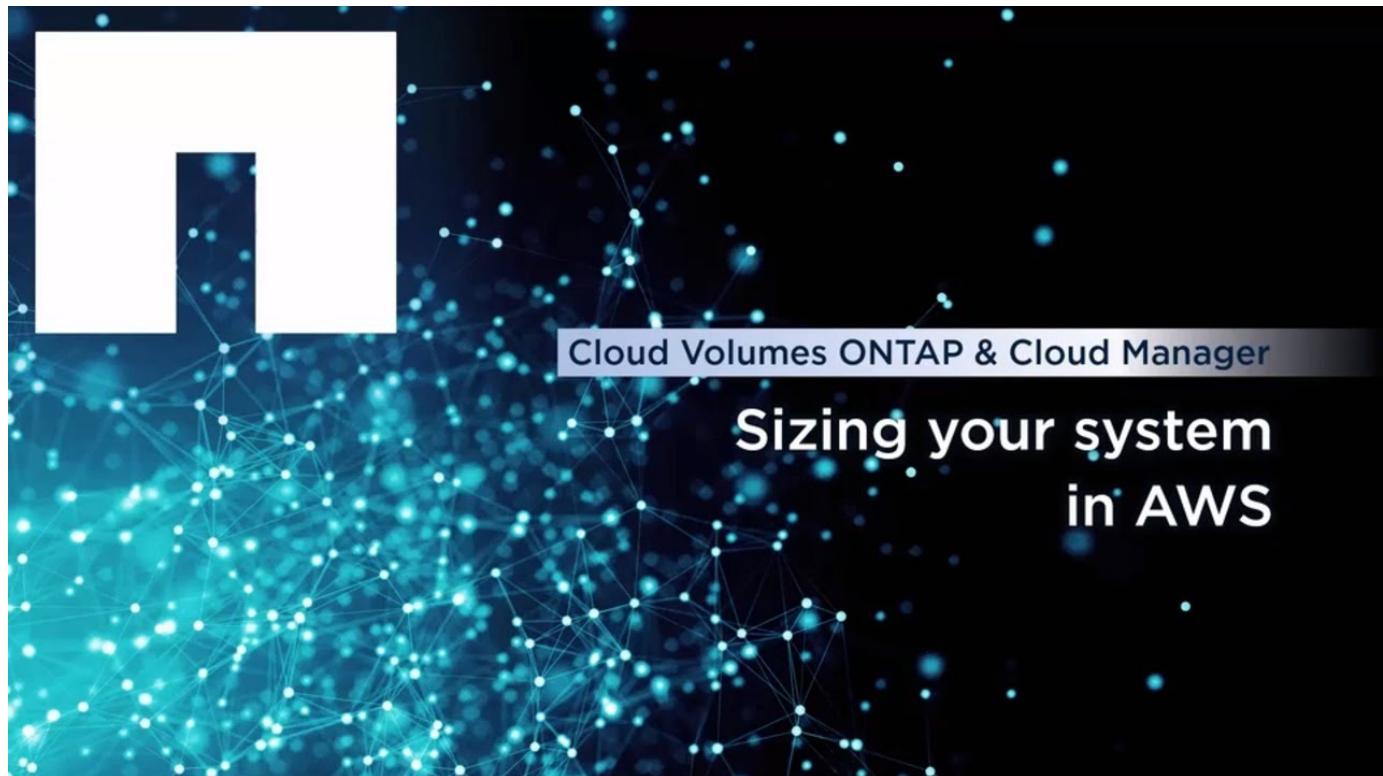
You need to choose an initial disk size when you launch a Cloud Volumes ONTAP system. After that, you

can let Cloud Manager manage a system's capacity for you, but if you want to build aggregates yourself, be aware of the following:

- All disks in an aggregate must be the same size.
- The performance of EBS disks is tied to disk size. The size determines the baseline IOPS and maximum burst duration for SSD disks and the baseline and burst throughput for HDD disks.
- Ultimately, you should choose the disk size that gives you the *sustained performance* that you need.
- Even if you do choose larger disks (for example, six 4 TB disks), you might not get all of the IOPS because the EC2 instance can reach its bandwidth limit.

For more details about EBS disk performance, refer to [AWS Documentation: EBS Volume Types](#).

Watch the following video for more details about sizing your Cloud Volumes ONTAP system in AWS:



Preparing to deploy Cloud Volumes ONTAP in an AWS Outpost

If you have an AWS Outpost, you can deploy Cloud Volumes ONTAP in that Outpost by selecting the Outpost VPC in the Working Environment wizard. The experience is the same as any other VPC that resides in AWS. Note that you will need to first deploy a Connector in your AWS Outpost.

There are a few limitations to point out:

- Only single node Cloud Volumes ONTAP systems are supported at this time
- The EC2 instances that you can use with Cloud Volumes ONTAP are limited to what's available in your Outpost
- Only General Purpose SSDs are supported at this time

AWS network information worksheet

When you launch Cloud Volumes ONTAP in AWS, you need to specify details about your VPC network. You can use a worksheet to collect the information from your administrator.

Network information for Cloud Volumes ONTAP

AWS information	Your value
Region	
VPC	
Subnet	
Security group (if using your own)	

Network information for an HA pair in multiple AZs

AWS information	Your value
Region	
VPC	
Security group (if using your own)	
Node 1 availability zone	
Node 1 subnet	
Node 2 availability zone	
Node 2 subnet	
Mediator availability zone	
Mediator subnet	
Key pair for the mediator	
Floating IP address for cluster management port	
Floating IP address for data on node 1	
Floating IP address for data on node 2	
Route tables for floating IP addresses	

Choosing a write speed

Cloud Manager enables you to choose a write speed setting for Cloud Volumes ONTAP. Before you choose a write speed, you should understand the differences between the normal and high settings and risks and recommendations when using high write speed. [Learn more about write speed](#).

Choosing a volume usage profile

ONTAP includes several storage efficiency features that can reduce the total amount of storage that you need. When you create a volume in Cloud Manager, you can choose a profile that enables these features or a profile that disables them. You should learn more about these features to help you decide which profile to use.

NetApp storage efficiency features provide the following benefits:

Thin provisioning

Presents more logical storage to hosts or users than you actually have in your physical storage pool. Instead of preallocating storage space, storage space is allocated dynamically to each volume as data is written.

Deduplication

Improves efficiency by locating identical blocks of data and replacing them with references to a single shared block. This technique reduces storage capacity requirements by eliminating redundant blocks of data that reside in the same volume.

Compression

Reduces the physical capacity required to store data by compressing data within a volume on primary, secondary, and archive storage.

Set up your networking

Networking requirements for Cloud Volumes ONTAP in AWS

Set up your AWS networking so Cloud Volumes ONTAP systems can operate properly.

General requirements for Cloud Volumes ONTAP

The following requirements must be met in AWS.

Outbound internet access for Cloud Volumes ONTAP nodes

Cloud Volumes ONTAP nodes require outbound internet access to send messages to NetApp AutoSupport, which proactively monitors the health of your storage.

Routing and firewall policies must allow AWS HTTP/HTTPS traffic to the following endpoints so Cloud Volumes ONTAP can send AutoSupport messages:

- <https://support.netapp.com/aods/asupmessage>
- <https://support.netapp.com/asupprod/post/1.0/postAsup>

If you have a NAT instance, you must define an inbound security group rule that allows HTTPS traffic from the private subnet to the internet.

[Learn how to configure AutoSupport.](#)

Outbound internet access for the HA mediator

The HA mediator instance must have an outbound connection to the AWS EC2 service so it can assist with storage failover. To provide the connection, you can add a public IP address, specify a proxy server, or use a manual option.

The manual option can be a NAT gateway or an interface VPC endpoint from the target subnet to the AWS

EC2 service. For details about VPC endpoints, refer to [AWS Documentation: Interface VPC Endpoints \(AWS PrivateLink\)](#).

Number of IP addresses

Cloud Manager allocates the following number of IP addresses to Cloud Volumes ONTAP in AWS:

- Single node: 6 IP addresses
- HA pairs in single AZs: 15 addresses
- HA pairs in multiple AZs: 15 or 16 IP addresses

Note that Cloud Manager creates an SVM management LIF on single node systems, but not on HA pairs in a single AZ. You can choose whether to create an SVM management LIF on HA pairs in multiple AZs.



A LIF is an IP address associated with a physical port. An SVM management LIF is required for management tools like SnapCenter.

Security groups

You do not need to create security groups because Cloud Manager does that for you. If you need to use your own, refer to [Security group rules](#).

Connection from Cloud Volumes ONTAP to AWS S3 for data tiering

If you want to use EBS as a performance tier and AWS S3 as a capacity tier, you must ensure that Cloud Volumes ONTAP has a connection to S3. The best way to provide that connection is by creating a VPC Endpoint to the S3 service. For instructions, see [AWS Documentation: Creating a Gateway Endpoint](#).

When you create the VPC Endpoint, be sure to select the region, VPC, and route table that corresponds to the Cloud Volumes ONTAP instance. You must also modify the security group to add an outbound HTTPS rule that enables traffic to the S3 endpoint. Otherwise, Cloud Volumes ONTAP cannot connect to the S3 service.

If you experience any issues, see [AWS Support Knowledge Center: Why can't I connect to an S3 bucket using a gateway VPC endpoint?](#)

Connections to ONTAP systems in other networks

To replicate data between a Cloud Volumes ONTAP system in AWS and ONTAP systems in other networks, you must have a VPN connection between the AWS VPC and the other network—for example, an Azure VNet or your corporate network. For instructions, see [AWS Documentation: Setting Up an AWS VPN Connection](#).

DNS and Active Directory for CIFS

If you want to provision CIFS storage, you must set up DNS and Active Directory in AWS or extend your on-premises setup to AWS.

The DNS server must provide name resolution services for the Active Directory environment. You can configure DHCP option sets to use the default EC2 DNS server, which must not be the DNS server used by the Active Directory environment.

For instructions, refer to [AWS Documentation: Active Directory Domain Services on the AWS Cloud: Quick Start Reference Deployment](#).

Requirements for HA pairs in multiple AZs

Additional AWS networking requirements apply to Cloud Volumes ONTAP HA configurations that use multiple Availability Zones (AZs). You should review these requirements before you launch an HA pair because you must enter the networking details in Cloud Manager.

To understand how HA pairs work, see [High-availability pairs](#).

Availability Zones

This HA deployment model uses multiple AZs to ensure high availability of your data. You should use a dedicated AZ for each Cloud Volumes ONTAP instance and the mediator instance, which provides a communication channel between the HA pair.

Floating IP addresses for NAS data and cluster/SVM management

HA configurations in multiple AZs use floating IP addresses that migrate between nodes if failures occur. They are not natively accessible from outside the VPC, unless you [set up an AWS transit gateway](#).

One floating IP address is for cluster management, one is for NFS/CIFS data on node 1, and one is for NFS/CIFS data on node 2. A fourth floating IP address for SVM management is optional.



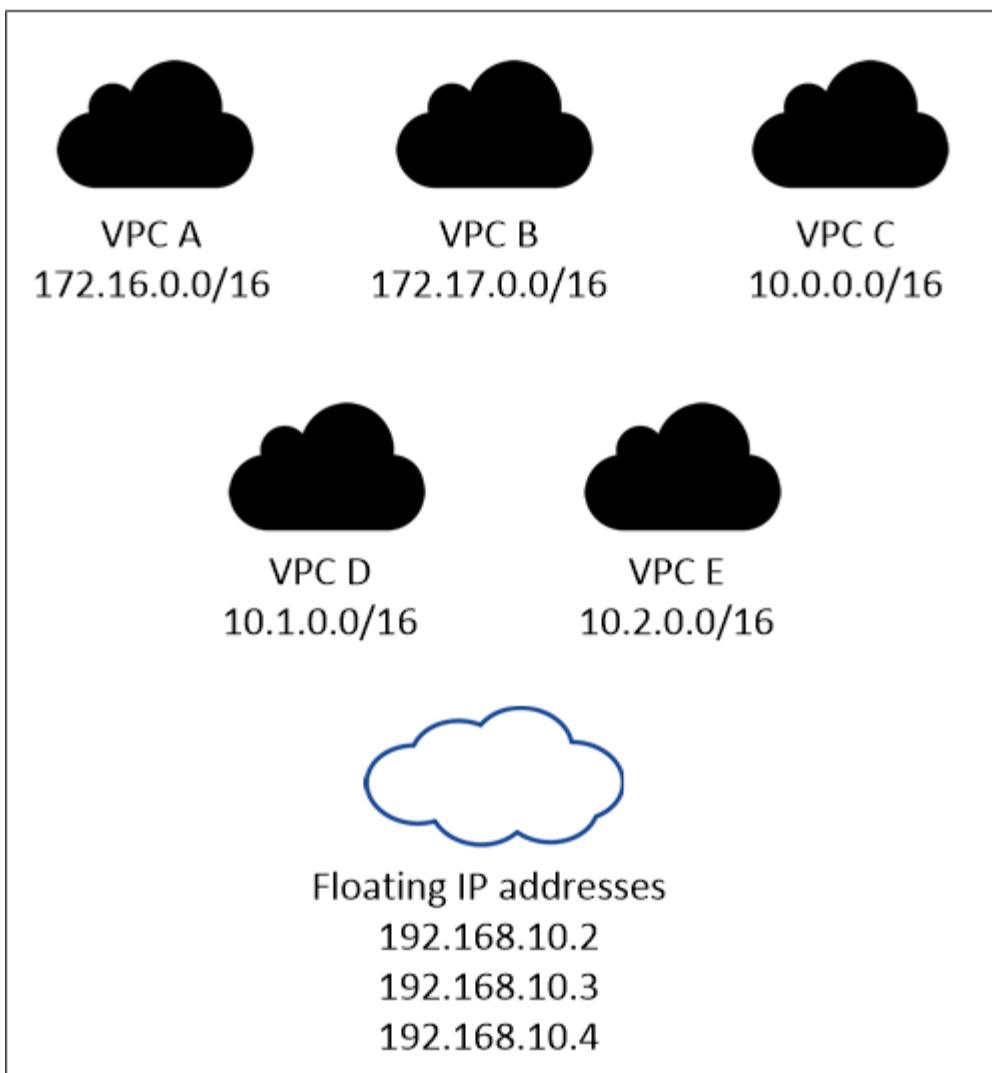
A floating IP address is required for the SVM management LIF if you use SnapDrive for Windows or SnapCenter with the HA pair. If you don't specify the IP address when you deploy the system, you can create the LIF later. For details, see [Setting up Cloud Volumes ONTAP](#).

You need to enter the floating IP addresses in Cloud Manager when you create a Cloud Volumes ONTAP HA working environment. Cloud Manager allocates the IP addresses to the HA pair when it launches the system.

The floating IP addresses must be outside of the CIDR blocks for all VPCs in the AWS region in which you deploy the HA configuration. Think of the floating IP addresses as a logical subnet that's outside of the VPCs in your region.

The following example shows the relationship between floating IP addresses and the VPCs in an AWS region. While the floating IP addresses are outside the CIDR blocks for all VPCs, they're routable to subnets through route tables.

AWS region



Cloud Manager automatically creates static IP addresses for iSCSI access and for NAS access from clients outside the VPC. You don't need to meet any requirements for these types of IP addresses.

Transit gateway to enable floating IP access from outside the VPC

[Set up an AWS transit gateway](#) to enable access to an HA pair's floating IP addresses from outside the VPC where the HA pair resides.

Route tables

After you specify the floating IP addresses in Cloud Manager, you need to select the route tables that should include routes to the floating IP addresses. This enables client access to the HA pair.

If you have just one route table for the subnets in your VPC (the main route table), then Cloud Manager automatically adds the floating IP addresses to that route table. If you have more than one route table, it's very important to select the correct route tables when launching the HA pair. Otherwise, some clients might not have access to Cloud Volumes ONTAP.

For example, you might have two subnets that are associated with different route tables. If you select route table A, but not route table B, then clients in the subnet associated with route table A can access the HA

pair, but clients in the subnet associated with route table B can't.

For more information about route tables, refer to [AWS Documentation: Route Tables](#).

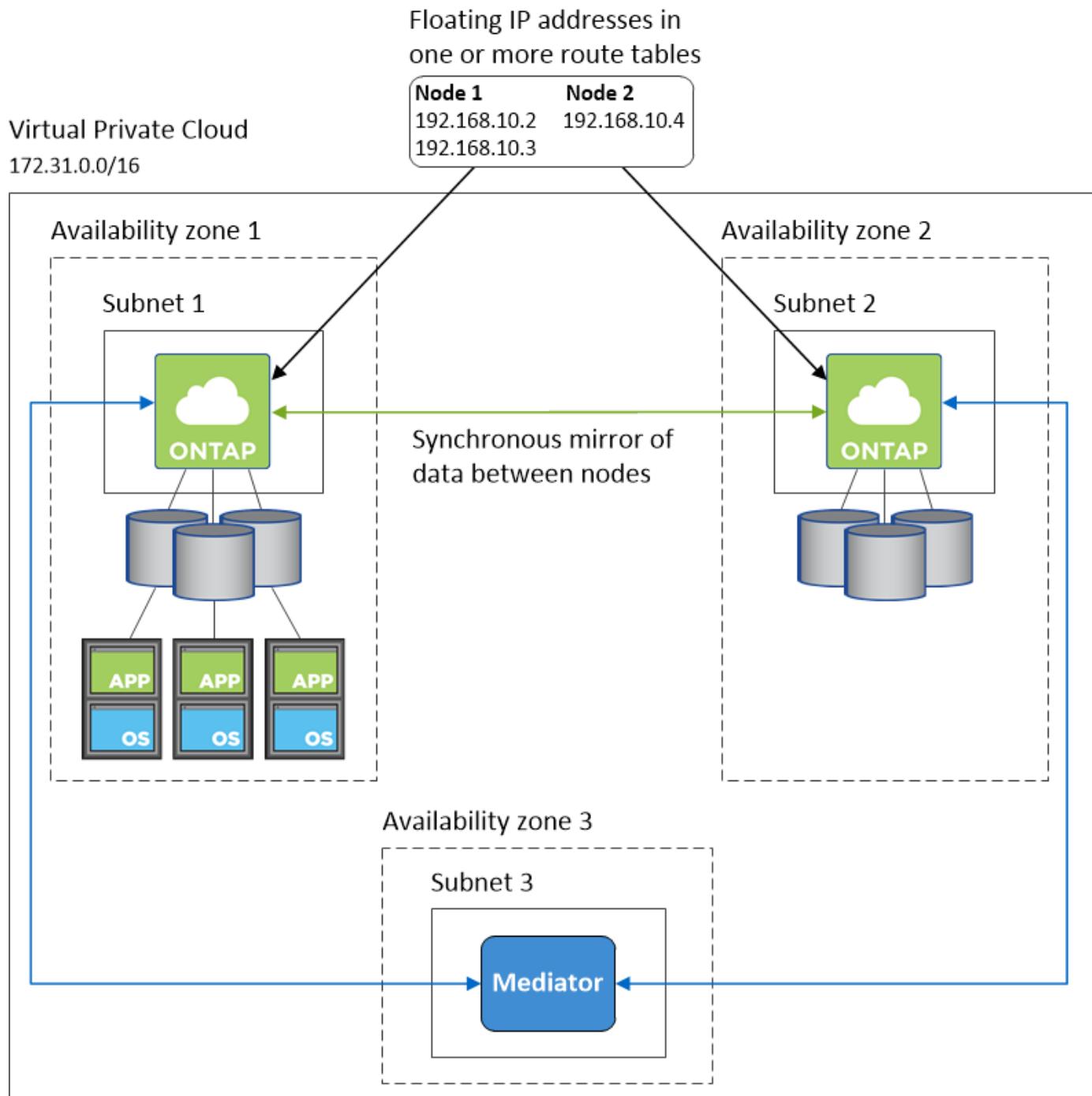
Connection to NetApp management tools

To use NetApp management tools with HA configurations that are in multiple AZs, you have two connection options:

1. Deploy the NetApp management tools in a different VPC and [set up an AWS transit gateway](#). The gateway enables access to the floating IP address for the cluster management interface from outside the VPC.
2. Deploy the NetApp management tools in the same VPC with a similar routing configuration as NAS clients.

Example HA configuration

The following image shows an optimal HA configuration in AWS operating as an active-passive configuration:



Requirements for the Connector

Set up your networking so that the Connector can manage resources and processes within your public cloud environment. The most important step is ensuring outbound internet access to various endpoints.



If your network uses a proxy server for all communication to the internet, you can specify the proxy server from the Settings page. Refer to [Configuring the Connector to use a proxy server](#).

Connection to target networks

A Connector requires a network connection to the VPCs and VNets in which you want to deploy Cloud

Volumes ONTAP

For example, if you install a Connector in your corporate network, then you must set up a VPN connection to the VPC or VNet in which you launch Cloud Volumes ONTAP.

Outbound internet access

The Connector requires outbound internet access to manage resources and processes within your public cloud environment. A Connector contacts the following endpoints when managing resources in AWS:

Endpoints	Purpose
AWS services (amazonaws.com): <ul style="list-style-type: none">• CloudFormation• Elastic Compute Cloud (EC2)• Key Management Service (KMS)• Security Token Service (STS)• Simple Storage Service (S3) <p>The exact endpoint depends on the region in which you deploy Cloud Volumes ONTAP. Refer to AWS documentation for details.</p>	Enables the Connector to deploy and manage Cloud Volumes ONTAP in AWS.
https://api.services.cloud.netapp.com:443	API requests to NetApp Cloud Central.
https://cloud.support.netapp.com.s3.us-west-1.amazonaws.com	Provides access to software images, manifests, and templates.
https://cognito-idp.us-east-1.amazonaws.com https://cognito-identity.us-east-1.amazonaws.com https://sts.amazonaws.com https://cloud-support-netapp-com-accelerated.s3.amazonaws.com	Enables the Connector to access and download manifests, templates, and Cloud Volumes ONTAP upgrade images.
https://cloudmanagerinfraprod.azurecr.io	Access to software images of container components for an infrastructure that's running Docker and provides a solution for service integrations with Cloud Manager.
https://kinesis.us-east-1.amazonaws.com	Enables NetApp to stream data from audit records.
https://cloudmanager.cloud.netapp.com	Communication with the Cloud Manager service, which includes Cloud Central accounts.
https://netapp-cloud-account.auth0.com	Communication with NetApp Cloud Central for centralized user authentication.
support.netapp.com:443	Communication with NetApp AutoSupport.

Endpoints	Purpose
https://support.netapp.com/svcgw https://support.netapp.com/ServiceGW/entitlement https://eval.lic.netapp.com.s3.us-west-1.amazonaws.com https://cloud-support-netapp-com.s3.us-west-1.amazonaws.com	Communication with NetApp for system licensing and support registration.
https://client.infra.support.netapp.com.s3.us-west-1.amazonaws.com https://cloud-support-netapp-com-accelerated.s3.us-west-1.amazonaws.com https://trigger.asup.netapp.com.s3.us-west-1.amazonaws.com	Enables NetApp to collect information needed to troubleshoot support issues.
https://ipa-signer.cloudmanager.netapp.com	Enables Cloud Manager to generate licenses (for example, a FlexCache license for Cloud Volumes ONTAP)
Various third-party locations, for example: <ul style="list-style-type: none"> • https://repo1.maven.org/maven2 • https://oss.sonatype.org/content/repositories • https://repo.typesafe.com <p>Third-party locations are subject to change.</p>	During upgrades, Cloud Manager downloads the latest packages for third-party dependencies.

While you should perform almost all tasks from the SaaS user interface, a local user interface is still available on the Connector. The machine running the web browser must have connections to the following endpoints:

Endpoints	Purpose
The Connector host	<p>You must enter the host's IP address from a web browser to load the Cloud Manager console.</p> <p>Depending on your connectivity to your cloud provider, you can use the private IP or a public IP assigned to the host:</p> <ul style="list-style-type: none"> • A private IP works if you have a VPN and direct connect access to your virtual network • A public IP works in any networking scenario <p>In any case, you should secure network access by ensuring that security group rules allow access from only authorized IPs or subnets.</p>
https://auth0.com https://cdn.auth0.com https://netapp-cloud-account.auth0.com https://services.cloud.netapp.com	Your web browser connects to these endpoints for centralized user authentication through NetApp Cloud Central.

Endpoints	Purpose
https://widget.intercom.io	For in-product chat that enables you to talk to NetApp cloud experts.

Setting up an AWS transit gateway for HA pairs in multiple AZs

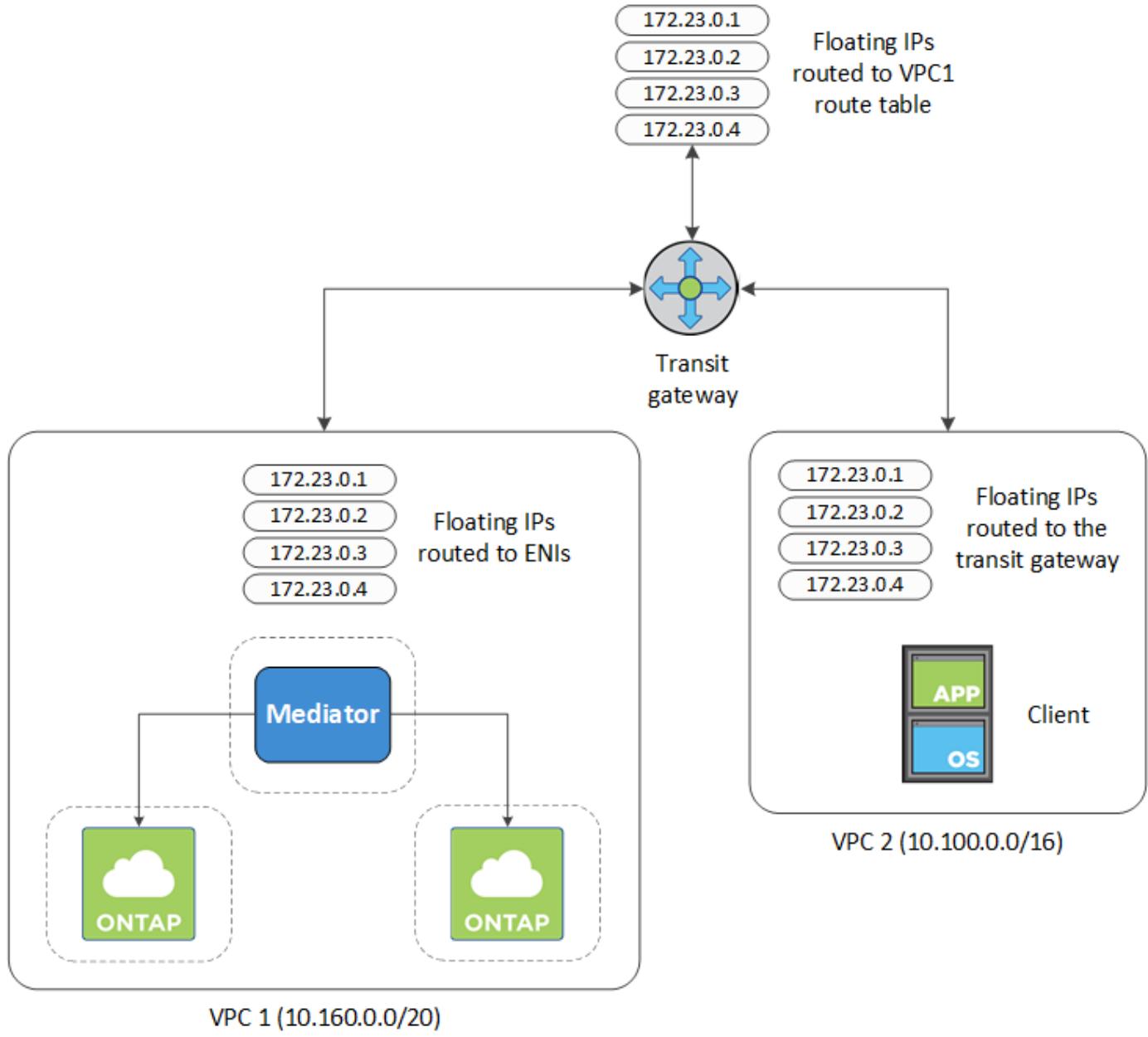
Set up an AWS transit gateway to enable access to an HA pair's [floating IP addresses](#) from outside the VPC where the HA pair resides.

When a Cloud Volumes ONTAP HA configuration is spread across multiple AWS Availability Zones, floating IP addresses are required for NAS data access from within the VPC. These floating IP addresses can migrate between nodes when failures occur, but they are not natively accessible from outside the VPC. Separate private IP addresses provide data access from outside the VPC, but they don't provide automatic failover.

Floating IP addresses are also required for the cluster management interface and the optional SVM management LIF.

If you set up an AWS transit gateway, you enable access to the floating IP addresses from outside the VPC where the HA pair resides. That means NAS clients and NetApp management tools outside the VPC can access the floating IPs.

Here's an example that shows two VPCs connected by a transit gateway. An HA system resides in one VPC, while a client resides in the other. You could then mount a NAS volume on the client using the floating IP address.



The following steps illustrate how to set up a similar configuration.

Steps

1. Create a transit gateway and attach the VPCs to the gateway.
2. Create routes in the transit gateway's route table by specifying the HA pair's floating IP addresses.

You can find the floating IP addresses on the Working Environment Information page in Cloud Manager. Here's an example:

NFS & CIFS access from within the VPC using Floating IP

Auto failover

Cluster Management : 172.23.0.1

Data (nfs,cifs) : Node 1: 172.23.0.2 | Node 2: 172.23.0.3

Access

SVM Management : 172.23.0.4

The following sample image shows the route table for the transit gateway. It includes routes to the CIDR blocks of the two VPCs and four floating IP addresses used by Cloud Volumes ONTAP.

Transit Gateway Route Table: tgw-rtb-0ea8ee291c7aedd3					
Details	Associations	Propagations	Routes	Tags	
The table below will return a maximum of 1000 routes. Narrow the filter or use export routes to view more routes.					
Create route	Replace route	Delete route			
<input type="text"/> Filter by attributes or search by keyword					
CIDR	Attachment		Resource type	Route type	Route state
10.100.0.0/16	tgw-attach-05e77bd34e2ff91f8 vpc-0b2bc30e0dc8e0db1		VPC2	propagated	active
10.160.0.0/20	tgw-attach-00eba3eac3250d7db vpc-673ae603		VPC1	propagated	active
172.23.0.1/32	tgw-attach-00eba3eac3250d7db vpc-673ae603	VPC	static	active	
172.23.0.2/32	tgw-attach-00eba3eac3250d7db vpc-673ae603	VPC	static	active	
172.23.0.3/32	tgw-attach-00eba3eac3250d7db vpc-673ae603	VPC	static	active	
172.23.0.4/32	tgw-attach-00eba3eac3250d7db vpc-673ae603	VPC	static	active	

3. Modify the route table of VPCs that need to access the floating IP addresses.

- Add route entries to the floating IP addresses.
- Add a route entry to the CIDR block of the VPC where the HA pair resides.

The following sample image shows the route table for VPC 2, which includes routes to VPC 1 and the floating IP addresses.

Route Table: rtb-0569a1bd740ed033f				
Summary	Routes	Subnet Associations	Route Propagation	Tags
Edit routes				
View All routes ▾				
Destination	Target	Status	Propagated	
10.100.0.0/16	local	active	No	
0.0.0.0/0	igw-07250bd01781e67df	active	No	
10.160.0.0/20	taw-015b7c249661ac279	active	No	VPC1
172.23.0.1/32	tgw-015b7c249661ac279	active	No	
172.23.0.2/32	tgw-015b7c249661ac279	active	No	
172.23.0.3/32	tgw-015b7c249661ac279	active	No	
172.23.0.4/32	tgw-015b7c249661ac279	active	No	Floating IP Addresses

4. Modify the route table for the HA pair's VPC by adding a route to the VPC that needs access to the floating IP addresses.

This step is important because it completes the routing between the VPCs.

The following sample image shows the route table for VPC 1. It includes a route to the floating IP addresses and to VPC 2, which is where a client resides. Cloud Manager automatically added the floating IPs to the route table when it deployed the HA pair.

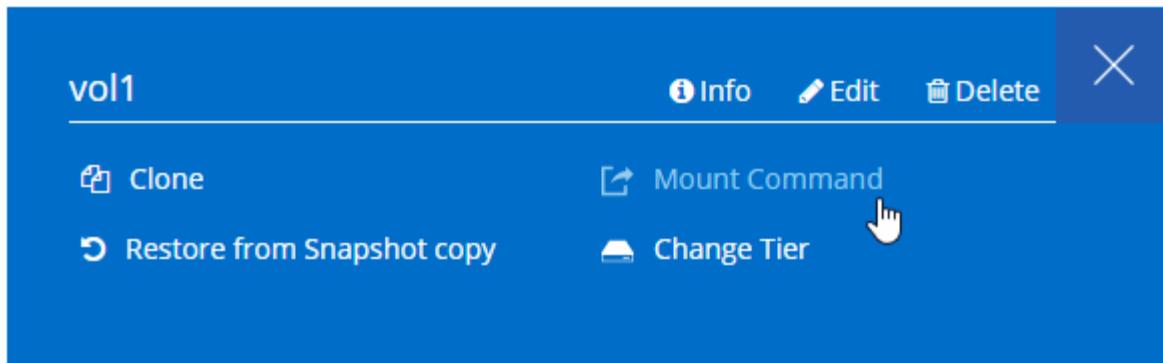
Route Table: rtb-0569a1bd740ed033f				
Summary	Routes	Subnet Associations	Route Propagation	Tags
Edit routes				
View All routes ▾				
Destination	Target	Status		
10.160.0.0/20	local	active		
pl-68a54001 (com.amazonaws.us-west-2.s3, 54.231.160.0/19, 52.218.128.0/17, 52.92.32.0/22)	vpce-cb51a0a2	active		
0.0.0.0/0	igw-b2182dd7	active		
10.60.29.0/25	pcx-589c3331	active		
10.100.0.0/16	tgw-015b7c249661ac279	active		VPC2
10.129.0.0/20	pcx-ff7e1396	active		
172.23.0.1/32	eni-0854d4715559c3cdb	active		
172.23.0.2/32	eni-0854d4715559c3cdb	active		
172.23.0.3/32	eni-0f76681216c3108ed	active		
172.23.0.4/32	eni-0854d4715559c3cdb	active		Floating IP Addresses

5. Mount volumes to clients using the floating IP address.

You can find the correct IP address in Cloud Manager by selecting a volume and clicking **Mount Command**.

Volumes

2 Volumes | 0.22 TB Allocated | < 0.01 TB Used (0 TB in S3)



Related links

- [High-availability pairs in AWS](#)
- [Networking requirements for Cloud Volumes ONTAP in AWS](#)

Security group rules for AWS

Cloud Manager creates AWS security groups that include the inbound and outbound rules that the Connector and Cloud Volumes ONTAP need to operate successfully. You might want to refer to the ports for testing purposes or if you prefer your to use own security groups.

Rules for Cloud Volumes ONTAP

The security group for Cloud Volumes ONTAP requires both inbound and outbound rules.

Inbound rules

The source for inbound rules in the predefined security group is 0.0.0.0/0.

Protocol	Port	Purpose
All ICMP	All	Pinging the instance
HTTP	80	HTTP access to the System Manager web console using the IP address of the cluster management LIF
HTTPS	443	HTTPS access to the System Manager web console using the IP address of the cluster management LIF
SSH	22	SSH access to the IP address of the cluster management LIF or a node management LIF
TCP	111	Remote procedure call for NFS
TCP	139	NetBIOS service session for CIFS

Protocol	Port	Purpose
TCP	161-162	Simple network management protocol
TCP	445	Microsoft SMB/CIFS over TCP with NetBIOS framing
TCP	635	NFS mount
TCP	749	Kerberos
TCP	2049	NFS server daemon
TCP	3260	iSCSI access through the iSCSI data LIF
TCP	4045	NFS lock daemon
TCP	4046	Network status monitor for NFS
TCP	10000	Backup using NDMP
TCP	11104	Management of intercluster communication sessions for SnapMirror
TCP	11105	SnapMirror data transfer using intercluster LIFs
UDP	111	Remote procedure call for NFS
UDP	161-162	Simple network management protocol
UDP	635	NFS mount
UDP	2049	NFS server daemon
UDP	4045	NFS lock daemon
UDP	4046	Network status monitor for NFS
UDP	4049	NFS rquotad protocol

Outbound rules

The predefined security group for Cloud Volumes ONTAP opens all outbound traffic. If that is acceptable, follow the basic outbound rules. If you need more rigid rules, use the advanced outbound rules.

Basic outbound rules

The predefined security group for Cloud Volumes ONTAP includes the following outbound rules.

Protocol	Port	Purpose
All ICMP	All	All outbound traffic
All TCP	All	All outbound traffic
All UDP	All	All outbound traffic

Advanced outbound rules

If you need rigid rules for outbound traffic, you can use the following information to open only those ports that are required for outbound communication by Cloud Volumes ONTAP.



The source is the interface (IP address) on the Cloud Volumes ONTAP system.

Service	Protocol	Port	Source	Destination	Purpose
Active Directory	TCP	88	Node management LIF	Active Directory forest	Kerberos V authentication
	UDP	137	Node management LIF	Active Directory forest	NetBIOS name service
	UDP	138	Node management LIF	Active Directory forest	NetBIOS datagram service
	TCP	139	Node management LIF	Active Directory forest	NetBIOS service session
	TCP & UDP	389	Node management LIF	Active Directory forest	LDAP
	TCP	445	Node management LIF	Active Directory forest	Microsoft SMB/CIFS over TCP with NetBIOS framing
	TCP	464	Node management LIF	Active Directory forest	Kerberos V change & set password (SET_CHANGE)
	UDP	464	Node management LIF	Active Directory forest	Kerberos key administration
	TCP	749	Node management LIF	Active Directory forest	Kerberos V change & set Password (RPCSEC_GSS)
	TCP	88	Data LIF (NFS, CIFS, iSCSI)	Active Directory forest	Kerberos V authentication
	UDP	137	Data LIF (NFS, CIFS)	Active Directory forest	NetBIOS name service
	UDP	138	Data LIF (NFS, CIFS)	Active Directory forest	NetBIOS datagram service
	TCP	139	Data LIF (NFS, CIFS)	Active Directory forest	NetBIOS service session
	TCP & UDP	389	Data LIF (NFS, CIFS)	Active Directory forest	LDAP
	TCP	445	Data LIF (NFS, CIFS)	Active Directory forest	Microsoft SMB/CIFS over TCP with NetBIOS framing
	TCP	464	Data LIF (NFS, CIFS)	Active Directory forest	Kerberos V change & set password (SET_CHANGE)
	UDP	464	Data LIF (NFS, CIFS)	Active Directory forest	Kerberos key administration
	TCP	749	Data LIF (NFS, CIFS)	Active Directory forest	Kerberos V change & set password (RPCSEC_GSS)
Backup to S3	TCP	5010	Intercluster LIF	Backup endpoint or restore endpoint	Back up and restore operations for the Backup to S3 feature

Service	Protocol	Port	Source	Destination	Purpose
Cluster	All traffic	All traffic	All LIFs on one node	All LIFs on the other node	Intercluster communications (Cloud Volumes ONTAP HA only)
	TCP	3000	Node management LIF	HA mediator	ZAPI calls (Cloud Volumes ONTAP HA only)
	ICMP	1	Node management LIF	HA mediator	Keep alive (Cloud Volumes ONTAP HA only)
DHCP	UDP	68	Node management LIF	DHCP	DHCP client for first-time setup
DHCPS	UDP	67	Node management LIF	DHCP	DHCP server
DNS	UDP	53	Node management LIF and data LIF (NFS, CIFS)	DNS	DNS
NDMP	TCP	1860 0–18 699	Node management LIF	Destination servers	NDMP copy
SMTP	TCP	25	Node management LIF	Mail server	SMTP alerts, can be used for AutoSupport
SNMP	TCP	161	Node management LIF	Monitor server	Monitoring by SNMP traps
	UDP	161	Node management LIF	Monitor server	Monitoring by SNMP traps
	TCP	162	Node management LIF	Monitor server	Monitoring by SNMP traps
	UDP	162	Node management LIF	Monitor server	Monitoring by SNMP traps
SnapMirr or	TCP	1110 4	Intercluster LIF	ONTAP intercluster LIFs	Management of intercluster communication sessions for SnapMirror
	TCP	1110 5	Intercluster LIF	ONTAP intercluster LIFs	SnapMirror data transfer
Syslog	UDP	514	Node management LIF	Syslog server	Syslog forward messages

Rules for the HA mediator external security group

The predefined external security group for the Cloud Volumes ONTAP HA mediator includes the following inbound and outbound rules.

Inbound rules

The source for inbound rules is 0.0.0.0/0.

Protocol	Port	Purpose
SSH	22	SSH connections to the HA mediator
TCP	3000	RESTful API access from the Connector

Outbound rules

The predefined security group for the HA mediator opens all outbound traffic. If that is acceptable, follow the basic outbound rules. If you need more rigid rules, use the advanced outbound rules.

Basic outbound rules

The predefined security group for the HA mediator includes the following outbound rules.

Protocol	Port	Purpose
All TCP	All	All outbound traffic
All UDP	All	All outbound traffic

Advanced outbound rules

If you need rigid rules for outbound traffic, you can use the following information to open only those ports that are required for outbound communication by the HA mediator.

Protocol	Port	Destination	Purpose
HTTP	80	Connector IP address	Download upgrades for the mediator
HTTPS	443	AWS API services	Assist with storage failover
UDP	53	AWS API services	Assist with storage failover



Rather than open ports 443 and 53, you can create an interface VPC endpoint from the target subnet to the AWS EC2 service.

Rules for the HA mediator internal security group

The predefined internal security group for the Cloud Volumes ONTAP HA mediator includes the following rules. Cloud Manager always creates this security group. You do not have the option to use your own.

Inbound rules

The predefined security group includes the following inbound rules.

Protocol	Port	Purpose
All traffic	All	Communication between the HA mediator and HA nodes

Outbound rules

The predefined security group includes the following outbound rules.

Protocol	Port	Purpose
All traffic	All	Communication between the HA mediator and HA nodes

Rules for the Connector

The security group for the Connector requires both inbound and outbound rules.

Inbound rules

Protocol	Port	Purpose
SSH	22	Provides SSH access to the Connector host
HTTP	80	Provides HTTP access from client web browsers to the local user interface and connections from Cloud Compliance
HTTPS	443	Provides HTTPS access from client web browsers to the local user interface
TCP	3128	Provides the Cloud Compliance instance with internet access, if your AWS network doesn't use a NAT or proxy

Outbound rules

The predefined security group for the Connector opens all outbound traffic. If that is acceptable, follow the basic outbound rules. If you need more rigid rules, use the advanced outbound rules.

Basic outbound rules

The predefined security group for the Connector includes the following outbound rules.

Protocol	Port	Purpose
All TCP	All	All outbound traffic
All UDP	All	All outbound traffic

Advanced outbound rules

If you need rigid rules for outbound traffic, you can use the following information to open only those ports that are required for outbound communication by the Connector.



The source IP address is the Connector host.

Service	Protocol	Port	Destination	Purpose
Active Directory	TCP	88	Active Directory forest	Kerberos V authentication
	TCP	139	Active Directory forest	NetBIOS service session
	TCP	389	Active Directory forest	LDAP
	TCP	445	Active Directory forest	Microsoft SMB/CIFS over TCP with NetBIOS framing
	TCP	464	Active Directory forest	Kerberos V change & set password (SET_CHANGE)
	TCP	749	Active Directory forest	Active Directory Kerberos V change & set password (RPCSEC_GSS)
	UDP	137	Active Directory forest	NetBIOS name service
	UDP	138	Active Directory forest	NetBIOS datagram service
	UDP	464	Active Directory forest	Kerberos key administration
API calls and AutoSupport	HTTP	443	Outbound internet and ONTAP cluster management LIF	API calls to AWS and ONTAP, and sending AutoSupport messages to NetApp
API calls	TCP	3000	ONTAP cluster management LIF	API calls to ONTAP
	TCP	8088	Backup to S3	API calls to Backup to S3
DNS	UDP	53	DNS	Used for DNS resolve by Cloud Manager
Cloud Compliance	HTTP	80	Cloud Compliance instance	Cloud Compliance for Cloud Volumes ONTAP

Setting up the AWS KMS

If you want to use Amazon encryption with Cloud Volumes ONTAP, then you need to set up the AWS Key Management Service (KMS).

Steps

1. Ensure that an active Customer Master Key (CMK) exists.

The CMK can be an AWS-managed CMK or a customer-managed CMK. It can be in the same AWS account as Cloud Manager and Cloud Volumes ONTAP or in a different AWS account.

[AWS Documentation: Customer Master Keys \(CMKs\)](#)

2. Modify the key policy for each CMK by adding the IAM role that provides permissions to Cloud Manager as a *key user*.

Adding the IAM role as a key user gives Cloud Manager permissions to use the CMK with Cloud Volumes ONTAP.

[AWS Documentation: Editing Keys](#)

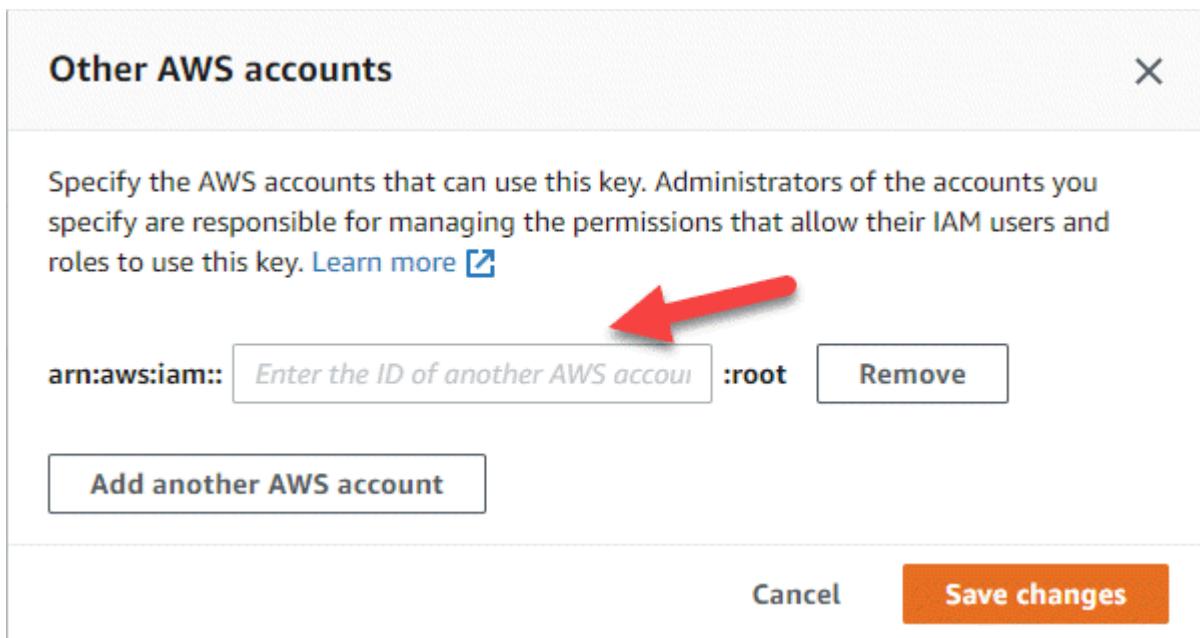
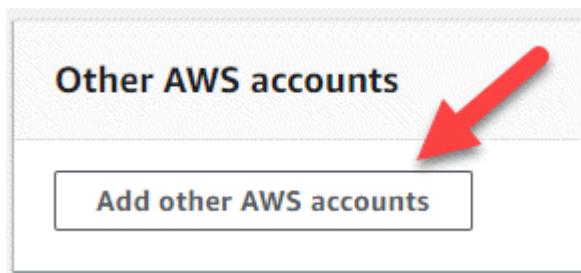
3. If the CMK is in a different AWS account, complete the following steps:

- Go to the KMS console from the account where the CMK resides.
- Select the key.
- In the **General configuration** pane, copy the ARN of the key.

You'll need to provide the ARN to Cloud Manager when you create the Cloud Volumes ONTAP system.

- In the **Other AWS accounts** pane, add the AWS account that provides Cloud Manager with permissions.

In most cases, this is the account where Cloud Manager resides. If Cloud Manager wasn't installed in AWS, it would be the account for which you provided AWS access keys to Cloud Manager.



- Now switch to the AWS account that provides Cloud Manager with permissions and open the IAM console.
- Create an IAM policy that includes the permissions listed below.
- Attach the policy to the IAM role or IAM user that provides permissions to Cloud Manager.

The following policy provides the permissions that Cloud Manager needs to use the CMK from the external AWS account. Be sure to modify the region and account ID in the "Resource" sections.

```

{
    "Version": "2012-10-17",
    "Statement": [
        {
            "Sid": "AllowUseOfTheKey",
            "Effect": "Allow",
            "Action": [
                "kms:Encrypt",
                "kms:Decrypt",
                "kms:ReEncrypt*",
                "kms:GenerateDataKey*",
                "kms:DescribeKey"
            ],
            "Resource": [
                "arn:aws:kms:us-east-
1:externalaccountid:key/externalkeyid"
            ]
        },
        {
            "Sid": "AllowAttachmentOfPersistentResources",
            "Effect": "Allow",
            "Action": [
                "kms>CreateGrant",
                "kms>ListGrants",
                "kms:RevokeGrant"
            ],
            "Resource": [
                "arn:aws:kms:us-east-
1:externalaccountid:key/externalaccountid"
            ],
            "Condition": {
                "Bool": {
                    "kms:GrantIsForAWSResource": true
                }
            }
        }
    ]
}

```

For additional details about this process, see [AWS Documentation: Allowing External AWS Accounts to Access a CMK](#).

Launching Cloud Volumes ONTAP in AWS

You can launch Cloud Volumes ONTAP in a single-system configuration or as an HA pair

in AWS.

Launching a single-node Cloud Volumes ONTAP system in AWS

If you want to launch Cloud Volumes ONTAP in AWS, you need to create a new working environment in Cloud Manager.

Before you begin

- You should have a [Connector that is associated with your workspace](#).



You must be an Account Admin to create a Connector. When you create your first Cloud Volumes ONTAP working environment, Cloud Manager prompts you to create a Connector if you don't have one yet.

- [You should be prepared to leave the Connector running at all times](#).
- You should have prepared by choosing a configuration and by obtaining AWS networking information from your administrator. For details, see [Planning your Cloud Volumes ONTAP configuration](#).
- If you want to launch a BYOL system, you must have the 20-digit serial number (license key).
- If you want to use CIFS, you must have set up DNS and Active Directory. For details, see [Networking requirements for Cloud Volumes ONTAP in AWS](#).

About this task

Immediately after you create the working environment, Cloud Manager launches a test instance in the specified VPC to verify connectivity. If successful, Cloud Manager immediately terminates the instance and then starts deploying the Cloud Volumes ONTAP system. If Cloud Manager cannot verify connectivity, creation of the working environment fails. The test instance is either a t2.nano (for default VPC tenancy) or m3.medium (for dedicated VPC tenancy).

Steps

1. On the Canvas page, click **Add Working Environment** and follow the prompts.
2. **Choose a Location:** Select **Amazon Web Services** and **Cloud Volumes ONTAP Single Node**.
3. **Details and Credentials:** Optionally change the AWS credentials and subscription, enter a working environment name, add tags if needed, and then enter a password.

Some of the fields in this page are self-explanatory. The following table describes fields for which you might need guidance:

Field	Description
Working Environment Name	Cloud Manager uses the working environment name to name both the Cloud Volumes ONTAP system and the Amazon EC2 instance. It also uses the name as the prefix for the predefined security group, if you select that option.

Field	Description
Add tags	<p>AWS tags are metadata for your AWS resources. Cloud Manager adds the tags to the Cloud Volumes ONTAP instance and each AWS resource associated with the instance.</p> <p>You can add up to four tags from the user interface when creating a working environment, and then you can add more after its created. Note that the API does not limit you to four tags when creating a working environment.</p> <p>For information about tags, refer to AWS Documentation: Tagging your Amazon EC2 Resources.</p>
User name and password	<p>These are the credentials for the Cloud Volumes ONTAP cluster admin account. You can use these credentials to connect to Cloud Volumes ONTAP through OnCommand System Manager or its CLI.</p>
Edit Credentials	<p>Choose the AWS credentials and marketplace subscription to use with this Cloud Volumes ONTAP system.</p> <p>Click Add Subscription to associate the selected credentials with a subscription.</p> <p>To create a pay-as-you-go Cloud Volumes ONTAP system, you need to select AWS credentials that are associated with a subscription to Cloud Volumes ONTAP from the AWS Marketplace. You'll be charged from this subscription for every Cloud Volumes ONTAP 9.6 and later PAYGO system that you create and each add-on feature that you enable.</p> <p>Learn how to add additional AWS credentials to Cloud Manager.</p>

The following video shows how to associate a pay-as-you-go Marketplace subscription to your AWS credentials:

► https://docs.netapp.com/us-en/occm/media/video_subscribing_aws.mp4 (video)

If multiple IAM users work in the same AWS account, then each user needs to subscribe. After the first user subscribes, the AWS Marketplace informs subsequent users that they're already subscribed, as shown in the image below. While a subscription is in place for the AWS account, each IAM user needs to associate themselves with that subscription. If you see the message shown below, click the **click here** link to go to Cloud Central and complete the process.



Cloud Manager (for Cloud Volumes ONTAP)

You are currently subscribed to this product and will be charged for your accumulated usage at the end of your next billing cycle, based on the costs listed in Pricing information on the right.



Having issues signing up for your product?

If you were unable to complete the set-up process for this software, please [click here](#) to be taken to the product's registration area.

[Subscribe](#)

You are already subscribed to this product

Pricing Details

Software Fees

4. **Services:** Keep the services enabled or disable the individual services that you don't want to use with Cloud Volumes ONTAP.

- Learn more about Cloud Compliance.
- Learn more about Cloud Backup.
- Learn more about Monitoring.

5. Location & Connectivity: Enter the network information that you recorded in the AWS worksheet.

If you have an AWS Outpost, you can deploy a single node Cloud Volumes ONTAP system in that Outpost by selecting the Outpost VPC. The experience is the same as any other VPC that resides in AWS.

The following image shows the page filled out:

Location	Connectivity
AWS Region	Security Group
US West Oregon	<input checked="" type="radio"/> Generated security group <input type="radio"/> Use existing security group
VPC	SSH Authentication Method
vpc-3a01e05f - 172.31.0.0/16	<input checked="" type="radio"/> Password <input type="radio"/> Key Pair
Subnet	
172.31.5.0/24 (OCCM subnet)	

6. Data Encryption: Choose no data encryption or AWS-managed encryption.

For AWS-managed encryption, you can choose a different Customer Master Key (CMK) from your account or another AWS account.



You can't change the AWS data encryption method after you create a Cloud Volumes ONTAP system.

[Learn how to set up the AWS KMS for Cloud Volumes ONTAP.](#)

[Learn more about supported encryption technologies.](#)

7. License and Support Site Account: Specify whether you want to use pay-as-you-go or BYOL, and then specify a NetApp Support Site account.

To understand how licenses work, see [Licensing](#).

A NetApp Support Site Account is optional for pay-as-you-go, but required for BYOL systems. [Learn how to add NetApp Support Site accounts.](#)

8. Preconfigured Packages: Select one of the packages to quickly launch Cloud Volumes ONTAP, or click [Create my own configuration](#).

If you choose one of the packages, you only need to specify a volume and then review and approve the configuration.

9. IAM Role: You should keep the default option to let Cloud Manager create the role for you.

If you prefer to use your own policy, it must meet [policy requirements for Cloud Volumes ONTAP nodes](#).

10. **Licensing:** Change the Cloud Volumes ONTAP version as needed, select a license, an instance type, and the instance tenancy.

If your needs change after you launch the instance, you can modify the license or instance type later.



If a newer Release Candidate, General Availability, or patch release is available for the selected version, then Cloud Manager updates the system to that version when creating the working environment. For example, the update occurs if you select Cloud Volumes ONTAP 9.6 RC1 and 9.6 GA is available. The update does not occur from one release to another—for example, from 9.6 to 9.7.

11. **Underlying Storage Resources:** Choose settings for the initial aggregate: a disk type, a size for each disk, and whether data tiering should be enabled.

Note the following:

- The disk type is for the initial volume. You can choose a different disk type for subsequent volumes.
- The disk size is for all disks in the initial aggregate and for any additional aggregates that Cloud Manager creates when you use the simple provisioning option. You can create aggregates that use a different disk size by using the advanced allocation option.

For help choosing a disk type and size, see [Sizing your system in AWS](#).

- You can choose a specific volume tiering policy when you create or edit a volume.
- If you disable data tiering, you can enable it on subsequent aggregates.

[Learn how data tiering works.](#)

12. **Write Speed & WORM:** Choose **Normal** or **High** write speed, and activate write once, read many (WORM) storage, if desired.

[Learn more about write speed.](#)

WORM can't be enabled if data tiering was enabled.

[Learn more about WORM storage.](#)

13. **Create Volume:** Enter details for the new volume or click **Skip**.

Some of the fields in this page are self-explanatory. The following table describes fields for which you might need guidance:

Field	Description
Size	The maximum size that you can enter largely depends on whether you enable thin provisioning, which enables you to create a volume that is bigger than the physical storage currently available to it.
Access control (for NFS only)	An export policy defines the clients in the subnet that can access the volume. By default, Cloud Manager enters a value that provides access to all instances in the subnet.

Field	Description
Permissions and Users / Groups (for CIFS only)	These fields enable you to control the level of access to a share for users and groups (also called access control lists or ACLs). You can specify local or domain Windows users or groups, or UNIX users or groups. If you specify a domain Windows user name, you must include the user's domain using the format domain\username.
Snapshot Policy	A Snapshot copy policy specifies the frequency and number of automatically created NetApp Snapshot copies. A NetApp Snapshot copy is a point-in-time file system image that has no performance impact and requires minimal storage. You can choose the default policy or none. You might choose none for transient data: for example, tempdb for Microsoft SQL Server.
Advanced options (for NFS only)	Select an NFS version for the volume: either NFSv3 or NFSv4.
Initiator group and IQN (for iSCSI only)	<p>iSCSI storage targets are called LUNs (logical units) and are presented to hosts as standard block devices.</p> <p>Initiator groups are tables of iSCSI host node names and control which initiators have access to which LUNs.</p> <p>iSCSI targets connect to the network through standard Ethernet network adapters (NICs), TCP offload engine (TOE) cards with software initiators, converged network adapters (CNAs) or dedicated host bus adapters (HBAs) and are identified by iSCSI qualified names (IQNs).</p> <p>When you create an iSCSI volume, Cloud Manager automatically creates a LUN for you. We've made it simple by creating just one LUN per volume, so there's no management involved. After you create the volume, use the IQN to connect to the LUN from your hosts.</p>

The following image shows the Volume page filled out for the CIFS protocol:

Volume Details, Protection & Protocol

<h4>Details & Protection</h4> <div style="margin-top: 10px;"> <div style="display: flex; justify-content: space-between;"> Volume Name: Size (GB): </div> <div style="display: flex; align-items: center;"> <input style="width: 150px; height: 30px; margin-right: 10px; border: 1px solid #ccc; border-radius: 5px; padding: 2px;" type="text" value="vol"/> 250 </div> </div> <div style="margin-top: 10px;"> Snapshot Policy: <div style="display: flex; align-items: center;"> <input style="width: 150px; height: 30px; margin-right: 10px; border: 1px solid #ccc; border-radius: 5px; padding: 2px;" type="text" value="default"/> ▼ </div> </div> <div style="margin-top: 10px;"> Default Policy </div>	<h4>Protocol</h4> <div style="display: flex; justify-content: space-around; border-bottom: 1px solid #ccc; margin-bottom: 10px;"> NFS CIFS iSCSI </div> <div style="display: flex; justify-content: space-between;"> Share name: vol_share </div> <div style="display: flex; justify-content: space-between;"> Permissions: Full Control </div> <div style="margin-top: 10px;"> Users / Groups: <div style="border: 1px solid #ccc; padding: 2px 10px; width: 150px; margin-top: 5px;">engineering</div> </div> <div style="font-size: small; margin-top: 5px;"> Valid users and groups separated by a semicolon </div>
--	---

14. **CIFS Setup:** If you chose the CIFS protocol, set up a CIFS server.

Field	Description
DNS Primary and Secondary IP Address	The IP addresses of the DNS servers that provide name resolution for the CIFS server. The listed DNS servers must contain the service location records (SRV) needed to locate the Active Directory LDAP servers and domain controllers for the domain that the CIFS server will join.
Active Directory Domain to join	The FQDN of the Active Directory (AD) domain that you want the CIFS server to join.
Credentials authorized to join the domain	The name and password of a Windows account with sufficient privileges to add computers to the specified Organizational Unit (OU) within the AD domain.
CIFS server NetBIOS name	A CIFS server name that is unique in the AD domain.
Organizational Unit	The organizational unit within the AD domain to associate with the CIFS server. The default is CN=Computers. If you configure AWS Managed Microsoft AD as the AD server for Cloud Volumes ONTAP, you should enter OU=Computers,OU=corp in this field.
DNS Domain	The DNS domain for the Cloud Volumes ONTAP storage virtual machine (SVM). In most cases, the domain is the same as the AD domain.
NTP Server	Select Use Active Directory Domain to configure an NTP server using the Active Directory DNS. If you need to configure an NTP server using a different address, then you should use the API. See the Cloud Manager API Developer Guide for details.

15. **Usage Profile, Disk Type, and Tiering Policy:** Choose whether you want to enable storage efficiency features and edit the volume tiering policy, if needed.

For more information, see [Understanding volume usage profiles](#) and [Data tiering overview](#).

16. **Review & Approve:** Review and confirm your selections.

- Review details about the configuration.
- Click **More information** to review details about support and the AWS resources that Cloud Manager will purchase.
- Select the **I understand...** check boxes.
- Click **Go**.

Result

Cloud Manager launches the Cloud Volumes ONTAP instance. You can track the progress in the timeline.

If you experience any issues launching the Cloud Volumes ONTAP instance, review the failure message. You can also select the working environment and click Re-create environment.

For additional help, go to [NetApp Cloud Volumes ONTAP Support](#).

After you finish

- If you provisioned a CIFS share, give users or groups permissions to the files and folders and verify that those users can access the share and create a file.
- If you want to apply quotas to volumes, use System Manager or the CLI.

Quotas enable you to restrict or track the disk space and number of files used by a user, group, or qtree.

Launching a Cloud Volumes ONTAP HA pair in AWS

If you want to launch a Cloud Volumes ONTAP HA pair in AWS, you need to create an HA working environment in Cloud Manager.

Before you begin

- You should have a [Connector that is associated with your workspace](#).



You must be an Account Admin to create a Connector. When you create your first Cloud Volumes ONTAP working environment, Cloud Manager prompts you to create a Connector if you don't have one yet.

- [You should be prepared to leave the Connector running at all times](#).
- You should have prepared by choosing a configuration and by obtaining AWS networking information from your administrator. For details, see [Planning your Cloud Volumes ONTAP configuration](#).
- If you purchased BYOL licenses, you must have a 20-digit serial number (license key) for each node.
- If you want to use CIFS, you must have set up DNS and Active Directory. For details, see [Networking requirements for Cloud Volumes ONTAP in AWS](#).

Limitation

At this time, HA pairs are not supported with AWS Outposts.

About this task

Immediately after you create the working environment, Cloud Manager launches a test instance in the specified VPC to verify connectivity. If successful, Cloud Manager immediately terminates the instance and then starts deploying the Cloud Volumes ONTAP system. If Cloud Manager cannot verify connectivity, creation of the working environment fails. The test instance is either a t2.nano (for default VPC tenancy) or m3.medium (for dedicated VPC tenancy).

Steps

1. On the Canvas page, click **Add Working Environment** and follow the prompts.
2. **Choose a Location:** Select **Amazon Web Services** and **Cloud Volumes ONTAP Single Node**.
3. **Details and Credentials:** Optionally change the AWS credentials and subscription, enter a working environment name, add tags if needed, and then enter a password.

Some of the fields in this page are self-explanatory. The following table describes fields for which you might need guidance:

Field	Description
Working Environment Name	Cloud Manager uses the working environment name to name both the Cloud Volumes ONTAP system and the Amazon EC2 instance. It also uses the name as the prefix for the predefined security group, if you select that option.

Field	Description
Add tags	<p>AWS tags are metadata for your AWS resources. Cloud Manager adds the tags to the Cloud Volumes ONTAP instance and each AWS resource associated with the instance.</p> <p>You can add up to four tags from the user interface when creating a working environment, and then you can add more after its created. Note that the API does not limit you to four tags when creating a working environment.</p> <p>For information about tags, refer to AWS Documentation: Tagging your Amazon EC2 Resources.</p>
User name and password	<p>These are the credentials for the Cloud Volumes ONTAP cluster admin account. You can use these credentials to connect to Cloud Volumes ONTAP through OnCommand System Manager or its CLI.</p>
Edit Credentials	<p>Choose the AWS credentials and marketplace subscription to use with this Cloud Volumes ONTAP system.</p> <p>Click Add Subscription to associate the selected credentials with a subscription.</p> <p>To create a pay-as-you-go Cloud Volumes ONTAP system, you need to select AWS credentials that are associated with a subscription to Cloud Volumes ONTAP from the AWS Marketplace. You'll be charged from this subscription for every Cloud Volumes ONTAP 9.6 and later PAYGO system that you create and each add-on feature that you enable.</p> <p>Learn how to add additional AWS credentials to Cloud Manager.</p>

The following video shows how to associate a pay-as-you-go Marketplace subscription to your AWS credentials:

► https://docs.netapp.com/us-en/occm/media/video_subscribing_aws.mp4 (video)



If multiple IAM users work in the same AWS account, then each user needs to subscribe. After the first user subscribes, the AWS Marketplace informs subsequent users that they're already subscribed, as shown in the image below. While a subscription is in place for the AWS account, each IAM user needs to associate themselves with that subscription. If you see the message shown below, click the **click here** link to go to Cloud Central and complete the process.

4. **Services:** Keep the services enabled or disable the individual services that you don't want to use with this Cloud Volumes ONTAP system.
 - [Learn more about Cloud Compliance](#).
 - [Learn more about Cloud Backup](#).
 - [Learn more about Monitoring](#).
5. **HA Deployment Models:** Choose an HA configuration.

For an overview of the deployment models, see [Cloud Volumes ONTAP HA for AWS](#).

6. Region & VPC: Enter the network information that you recorded in the AWS worksheet.

The following image shows the page filled out for a multiple AZ configuration:

The screenshot shows the 'Region & VPC' configuration page. At the top, there are dropdown menus for 'AWS Region' (US East | N. Virginia), 'VPC' (vpc-a76d91c2 - 172.31.0.0/16), and 'Security group' (Use a generated security group). Below these, there are three sections for 'Node 1:', 'Node 2:', and 'Mediator:'. Each section contains fields for 'Availability Zone' (us-east-1a, us-east-1b, us-east-1c respectively) and 'Subnet' (172.31.8.0/24, 172.31.9.0/24, 172.31.2.0/24).

7. Connectivity and SSH Authentication: Choose connection methods for the HA pair and the mediator.

8. Floating IPs: If you chose multiple AZs, specify the floating IP addresses.

The IP addresses must be outside of the CIDR block for all VPCs in the region. For additional details, see [AWS networking requirements for Cloud Volumes ONTAP HA in multiple AZs](#).

9. Route Tables: If you chose multiple AZs, select the route tables that should include routes to the floating IP addresses.

If you have more than one route table, it is very important to select the correct route tables. Otherwise, some clients might not have access to the Cloud Volumes ONTAP HA pair. For more information about route tables, refer to [AWS Documentation: Route Tables](#).

10. Data Encryption: Choose no data encryption or AWS-managed encryption.

For AWS-managed encryption, you can choose a different Customer Master Key (CMK) from your account or another AWS account.



You can't change the AWS data encryption method after you create a Cloud Volumes ONTAP system.

[Learn how to set up the AWS KMS for Cloud Volumes ONTAP.](#)

[Learn more about supported encryption technologies.](#)

11. License and Support Site Account: Specify whether you want to use pay-as-you-go or BYOL, and then specify a NetApp Support Site account.

To understand how licenses work, see [Licensing](#).

A NetApp Support Site Account is optional for pay-as-you-go, but required for BYOL systems. Learn how to add [NetApp Support Site accounts](#).

12. **Preconfigured Packages:** Select one of the packages to quickly launch a Cloud Volumes ONTAP system, or click [Create my own configuration](#).

If you choose one of the packages, you only need to specify a volume and then review and approve the configuration.

13. **IAM Role:** You should keep the default option to let Cloud Manager create the roles for you.

If you prefer to use your own policy, it must meet [policy requirements for Cloud Volumes ONTAP nodes and the HA mediator](#).

14. **Licensing:** Change the Cloud Volumes ONTAP version as needed, select a license, an instance type, and the instance tenancy.

If your needs change after you launch the instances, you can modify the license or instance type later.



If a newer Release Candidate, General Availability, or patch release is available for the selected version, then Cloud Manager updates the system to that version when creating the working environment. For example, the update occurs if you select Cloud Volumes ONTAP 9.6 RC1 and 9.6 GA is available. The update does not occur from one release to another—for example, from 9.6 to 9.7.

15. **Underlying Storage Resources:** Choose settings for the initial aggregate: a disk type, a size for each disk, and whether data tiering should be enabled.

Note the following:

- The disk type is for the initial volume. You can choose a different disk type for subsequent volumes.
- The disk size is for all disks in the initial aggregate and for any additional aggregates that Cloud Manager creates when you use the simple provisioning option. You can create aggregates that use a different disk size by using the advanced allocation option.

For help choosing a disk type and size, see [Sizing your system in AWS](#).

- You can choose a specific volume tiering policy when you create or edit a volume.
- If you disable data tiering, you can enable it on subsequent aggregates.

[Learn how data tiering works](#).

16. **Write Speed & WORM:** Choose **Normal** or **High** write speed, and activate write once, read many (WORM) storage, if desired.

[Learn more about write speed](#).

WORM can't be enabled if data tiering was enabled.

[Learn more about WORM storage](#).

17. **Create Volume:** Enter details for the new volume or click **Skip**.

Some of the fields in this page are self-explanatory. The following table describes fields for which you might need guidance:

Field	Description
Size	The maximum size that you can enter largely depends on whether you enable thin provisioning, which enables you to create a volume that is bigger than the physical storage currently available to it.
Access control (for NFS only)	An export policy defines the clients in the subnet that can access the volume. By default, Cloud Manager enters a value that provides access to all instances in the subnet.
Permissions and Users / Groups (for CIFS only)	These fields enable you to control the level of access to a share for users and groups (also called access control lists or ACLs). You can specify local or domain Windows users or groups, or UNIX users or groups. If you specify a domain Windows user name, you must include the user's domain using the format domain\username.
Snapshot Policy	A Snapshot copy policy specifies the frequency and number of automatically created NetApp Snapshot copies. A NetApp Snapshot copy is a point-in-time file system image that has no performance impact and requires minimal storage. You can choose the default policy or none. You might choose none for transient data: for example, tempdb for Microsoft SQL Server.
Advanced options (for NFS only)	Select an NFS version for the volume: either NFSv3 or NFSv4.
Initiator group and IQN (for iSCSI only)	<p>iSCSI storage targets are called LUNs (logical units) and are presented to hosts as standard block devices.</p> <p>Initiator groups are tables of iSCSI host node names and control which initiators have access to which LUNs.</p> <p>iSCSI targets connect to the network through standard Ethernet network adapters (NICs), TCP offload engine (TOE) cards with software initiators, converged network adapters (CNAs) or dedicated host bus adapters (HBAs) and are identified by iSCSI qualified names (IQNs).</p> <p>When you create an iSCSI volume, Cloud Manager automatically creates a LUN for you. We've made it simple by creating just one LUN per volume, so there's no management involved. After you create the volume, use the IQN to connect to the LUN from your hosts.</p>

The following image shows the Volume page filled out for the CIFS protocol:

Volume Details, Protection & Protocol

Details & Protection <div style="margin-top: 10px;"> Volume Name: <input type="text" value="vol"/> Size (GB): <input type="text" value="250"/> </div> <div style="margin-top: 10px;"> Snapshot Policy: <input type="text" value="default"/> </div> <div style="margin-top: 10px;"> <small>Default Policy</small> </div>	Protocol <div style="margin-top: 10px;"> NFS CIFS iSCSI </div> <div style="margin-top: 10px;"> Share name: <input type="text" value="vol_share"/> Permissions: <input type="text" value="Full Control"/> </div> <div style="margin-top: 10px;"> Users / Groups: <input type="text" value="engineering"/> </div> <div style="margin-top: 5px; font-size: small;"> Valid users and groups separated by a semicolon </div>
--	---

18. **CIFS Setup:** If you selected the CIFS protocol, set up a CIFS server.

Field	Description
DNS Primary and Secondary IP Address	The IP addresses of the DNS servers that provide name resolution for the CIFS server. The listed DNS servers must contain the service location records (SRV) needed to locate the Active Directory LDAP servers and domain controllers for the domain that the CIFS server will join.
Active Directory Domain to join	The FQDN of the Active Directory (AD) domain that you want the CIFS server to join.
Credentials authorized to join the domain	The name and password of a Windows account with sufficient privileges to add computers to the specified Organizational Unit (OU) within the AD domain.
CIFS server NetBIOS name	A CIFS server name that is unique in the AD domain.
Organizational Unit	The organizational unit within the AD domain to associate with the CIFS server. The default is CN=Computers. If you configure AWS Managed Microsoft AD as the AD server for Cloud Volumes ONTAP, you should enter OU=Computers,OU=corp in this field.
DNS Domain	The DNS domain for the Cloud Volumes ONTAP storage virtual machine (SVM). In most cases, the domain is the same as the AD domain.
NTP Server	Select Use Active Directory Domain to configure an NTP server using the Active Directory DNS. If you need to configure an NTP server using a different address, then you should use the API. See the Cloud Manager API Developer Guide for details.

19. **Usage Profile, Disk Type, and Tiering Policy:** Choose whether you want to enable storage efficiency features and edit the volume tiering policy, if needed.

For more information, see [Understanding volume usage profiles](#) and [Data tiering overview](#).

20. **Review & Approve:** Review and confirm your selections.

- Review details about the configuration.

- b. Click **More information** to review details about support and the AWS resources that Cloud Manager will purchase.
- c. Select the **I understand...** check boxes.
- d. Click **Go**.

Result

Cloud Manager launches the Cloud Volumes ONTAP HA pair. You can track the progress in the timeline.

If you experience any issues launching the HA pair, review the failure message. You can also select the working environment and click Re-create environment.

For additional help, go to [NetApp Cloud Volumes ONTAP Support](#).

After you finish

- If you provisioned a CIFS share, give users or groups permissions to the files and folders and verify that those users can access the share and create a file.
- If you want to apply quotas to volumes, use System Manager or the CLI.

Quotas enable you to restrict or track the disk space and number of files used by a user, group, or qtree.

Get started in Azure

Getting started with Cloud Volumes ONTAP for Azure

Get started with Cloud Volumes ONTAP for Azure in a few steps.



Create a Connector

If you don't have a [Connector](#) yet, an Account Admin needs to create one. [Learn how to create a Connector in Azure](#).

When you create your first Cloud Volumes ONTAP working environment, Cloud Manager prompts you to deploy a Connector if you don't have one yet.



Plan your configuration

Cloud Manager offers preconfigured packages that match your workload requirements, or you can create your own configuration. If you choose your own configuration, you should understand the options available to you. [Learn more](#).



Set up your networking

- a. Ensure that your VNet and subnets will support connectivity between the Connector and Cloud Volumes ONTAP.
- b. Enable outbound internet access from the target VNet so the Connector and Cloud Volumes ONTAP can contact several endpoints.

This step is important because the Connector can't manage Cloud Volumes ONTAP without outbound internet access. If you need to limit outbound connectivity, refer to the list of endpoints for [the Connector and Cloud Volumes ONTAP](#).

[Learn more about networking requirements.](#)



Launch Cloud Volumes ONTAP using Cloud Manager

Click **Add Working Environment**, select the type of system that you would like to deploy, and complete the steps in the wizard. [Read step-by-step instructions.](#)

Related links

- [Evaluating](#)
- [Creating a Connector from Cloud Manager](#)
- [Creating a Connector from the Azure Marketplace](#)
- [Installing the Connector software on a Linux host](#)
- [What Cloud Manager does with Azure permissions](#)

Planning your Cloud Volumes ONTAP configuration in Azure

When you deploy Cloud Volumes ONTAP in Azure, you can choose a preconfigured system that matches your workload requirements, or you can create your own configuration. If you choose your own configuration, you should understand the options available to you.

Choosing a license type

Cloud Volumes ONTAP is available in two pricing options: pay-as-you-go and Bring Your Own License (BYOL). For pay-as-you-go, you can choose from three licenses: Explore, Standard, or Premium. Each license provides different capacity and compute options.

[Supported configurations for Cloud Volumes ONTAP 9.8 in Azure](#)

Supported VM types

Cloud Volumes ONTAP supports several VM types, depending on the license type that you choose.

[Supported configurations for Cloud Volumes ONTAP 9.8 in Azure](#)

Understanding storage limits

The raw capacity limit for a Cloud Volumes ONTAP system is tied to the license. Additional limits impact the size of aggregates and volumes. You should be aware of these limits as you plan your configuration.

[Storage limits for Cloud Volumes ONTAP 9.8 in Azure](#)

Sizing your system in Azure

Sizing your Cloud Volumes ONTAP system can help you meet requirements for performance and capacity. You

should be aware of a few key points when choosing a VM type, disk type, and disk size:

Virtual machine type

Look at the supported virtual machine types in the [Cloud Volumes ONTAP Release Notes](#) and then review details about each supported VM type. Be aware that each VM type supports a specific number of data disks.

- [Azure documentation: General purpose virtual machine sizes](#)
- [Azure documentation: Memory optimized virtual machine sizes](#)

Azure disk type

When you create volumes for Cloud Volumes ONTAP, you need to choose the underlying cloud storage that Cloud Volumes ONTAP uses as a disk.

HA systems use Premium page blobs. Meanwhile, single node systems can use two types of Azure Managed Disks:

- *Premium SSD Managed Disks* provide high performance for I/O-intensive workloads at a higher cost.
- *Standard SSD Managed Disks* provide consistent performance for workloads that require low IOPS.
- *Standard HDD Managed Disks* are a good choice if you don't need high IOPS and want to reduce your costs.

For additional details about the use cases for these disks, see [Microsoft Azure Documentation: What disk types are available in Azure?](#).

Azure disk size

When you launch Cloud Volumes ONTAP instances, you must choose the default disk size for aggregates. Cloud Manager uses this disk size for the initial aggregate, and for any additional aggregates that it creates when you use the simple provisioning option. You can create aggregates that use a disk size different from the default by [using the advanced allocation option](#).



All disks in an aggregate must be the same size.

When choosing a disk size, you should take several factors into consideration. The disk size impacts how much you pay for storage, the size of volumes that you can create in an aggregate, the total capacity available to Cloud Volumes ONTAP, and storage performance.

The performance of Azure Premium Storage is tied to the disk size. Larger disks provide higher IOPS and throughput. For example, choosing 1 TB disks can provide better performance than 500 GB disks, at a higher cost.

There are no performance differences between disk sizes for Standard Storage. You should choose disk size based on the capacity that you need.

Refer to Azure for IOPS and throughput by disk size:

- [Microsoft Azure: Managed Disks pricing](#)
- [Microsoft Azure: Page Blobs pricing](#)

Choosing a configuration that supports Flash Cache

A Cloud Volumes ONTAP configuration in Azure includes local NVMe storage, which Cloud Volumes ONTAP uses as *Flash Cache* for better performance. [Learn more about Flash Cache](#).

Azure network information worksheet

When you deploy Cloud Volumes ONTAP in Azure, you need to specify details about your virtual network. You can use a worksheet to collect the information from your administrator.

Azure information	Your value
Region	
Virtual network (VNet)	
Subnet	
Network security group (if using your own)	

Choosing a write speed

Cloud Manager enables you to choose a write speed setting for Cloud Volumes ONTAP. Before you choose a write speed, you should understand the differences between the normal and high settings and risks and recommendations when using high write speed. [Learn more about write speed](#).

Choosing a volume usage profile

ONTAP includes several storage efficiency features that can reduce the total amount of storage that you need. When you create a volume in Cloud Manager, you can choose a profile that enables these features or a profile that disables them. You should learn more about these features to help you decide which profile to use.

NetApp storage efficiency features provide the following benefits:

Thin provisioning

Presents more logical storage to hosts or users than you actually have in your physical storage pool. Instead of preallocating storage space, storage space is allocated dynamically to each volume as data is written.

Deduplication

Improves efficiency by locating identical blocks of data and replacing them with references to a single shared block. This technique reduces storage capacity requirements by eliminating redundant blocks of data that reside in the same volume.

Compression

Reduces the physical capacity required to store data by compressing data within a volume on primary, secondary, and archive storage.

Networking requirements for Cloud Volumes ONTAP in Azure

Set up your Azure networking so Cloud Volumes ONTAP systems can operate properly. This includes networking for the Connector and Cloud Volumes ONTAP.

Requirements for Cloud Volumes ONTAP

The following networking requirements must be met in Azure.

Outbound internet access for Cloud Volumes ONTAP

Cloud Volumes ONTAP requires outbound internet access to send messages to NetApp AutoSupport, which proactively monitors the health of your storage.

Routing and firewall policies must allow HTTP/HTTPS traffic to the following endpoints so Cloud Volumes ONTAP can send AutoSupport messages:

- <https://support.netapp.com/aods/asupmessage>
- <https://support.netapp.com/asupprod/post/1.0/postAsup>

[Learn how to configure AutoSupport.](#)

Security groups

You do not need to create security groups because Cloud Manager does that for you. If you need to use your own, refer to the security group rules listed below.

Number of IP addresses

Cloud Manager allocates the following number of IP addresses to Cloud Volumes ONTAP in Azure:

- Single node: 5 IP addresses
- HA pair: 16 IP addresses

Note that Cloud Manager creates an SVM management LIF on HA pairs, but not on single node systems in Azure.



A LIF is an IP address associated with a physical port. An SVM management LIF is required for management tools like SnapCenter.

Connection from Cloud Volumes ONTAP to Azure Blob storage for data tiering

If you want to tier cold data to Azure Blob storage, you don't need to set up a connection between the performance tier and the capacity tier as long as Cloud Manager has the required permissions. Cloud Manager enables a VNet service endpoint for you if the Cloud Manager policy has these permissions:

```
"Microsoft.Network/virtualNetworks/subnets/write",  
"Microsoft.Network/routeTables/join/action",
```

These permissions are included in the latest [Cloud Manager policy](#).

For details about setting up data tiering, see [Tiering cold data to low-cost object storage](#).

Connections to ONTAP systems in other networks

To replicate data between a Cloud Volumes ONTAP system in Azure and ONTAP systems in other networks, you must have a VPN connection between the Azure VNet and the other network—for example, an AWS VPC or your corporate network.

For instructions, refer to [Microsoft Azure Documentation: Create a Site-to-Site connection in the Azure](#)

portal.

Requirements for the Connector

Set up your networking so that the Connector can manage resources and processes within your public cloud environment. The most important step is ensuring outbound internet access to various endpoints.



If your network uses a proxy server for all communication to the internet, you can specify the proxy server from the Settings page. Refer to [Configuring the Connector to use a proxy server](#).

Connections to target networks

A Connector requires a network connection to the VPCs and VNets in which you want to deploy Cloud Volumes ONTAP.

For example, if you install a Connector in your corporate network, then you must set up a VPN connection to the VPC or VNet in which you launch Cloud Volumes ONTAP.

Outbound internet access

The Connector requires outbound internet access to manage resources and processes within your public cloud environment. A Connector contacts the following endpoints when managing resources in Azure:

Endpoints	Purpose
https://management.azure.com https://login.microsoftonline.com	Enables Cloud Manager to deploy and manage Cloud Volumes ONTAP in most Azure regions.
https://management.microsoftazure.de https://login.microsoftonline.de	Enables Cloud Manager to deploy and manage Cloud Volumes ONTAP in the Azure Germany regions.
https://management.usgovcloudapi.net https://login.microsoftonline.com	Enables Cloud Manager to deploy and manage Cloud Volumes ONTAP in the Azure US Gov regions.
https://api.services.cloud.netapp.com:443	API requests to NetApp Cloud Central.
https://cloud.support.netapp.com.s3.us-west-1.amazonaws.com	Provides access to software images, manifests, and templates.
https://cognito-idp.us-east-1.amazonaws.com https://cognito-identity.us-east-1.amazonaws.com https://sts.amazonaws.com https://cloud-support-netapp-com-accelerated.s3.amazonaws.com	Enables the Connector to access and download manifests, templates, and Cloud Volumes ONTAP upgrade images.
https://cloudmanagerinfraprod.azurecr.io	Access to software images of container components for an infrastructure that's running Docker and provides a solution for service integrations with Cloud Manager.
https://kinesis.us-east-1.amazonaws.com	Enables NetApp to stream data from audit records.
https://cloudmanager.cloud.netapp.com	Communication with the Cloud Manager service, which includes Cloud Central accounts.

Endpoints	Purpose
https://netapp-cloud-account.auth0.com	Communication with NetApp Cloud Central for centralized user authentication.
support.netapp.com:443	Communication with NetApp AutoSupport.
https://support.netapp.com/svcgw https://support.netapp.com/ServiceGW/entitlement https://eval.lic.netapp.com.s3.us-west-1.amazonaws.com https://cloud-support-netapp-com.s3.us-west-1.amazonaws.com	Communication with NetApp for system licensing and support registration.
https://client.infra.support.netapp.com.s3.us-west-1.amazonaws.com https://cloud-support-netapp-com-accelerated.s3.us-west-1.amazonaws.com https://trigger.asup.netapp.com.s3.us-west-1.amazonaws.com	Enables NetApp to collect information needed to troubleshoot support issues.
https://ipa-signer.cloudmanager.netapp.com	Enables Cloud Manager to generate licenses (for example, a FlexCache license for Cloud Volumes ONTAP)
*.blob.core.windows.net	Required for HA pairs when using a proxy.
Various third-party locations, for example: <ul style="list-style-type: none"> • https://repo1.maven.org/maven2 • https://oss.sonatype.org/content/repositories • https://repo.typesafe.com 	During upgrades, Cloud Manager downloads the latest packages for third-party dependencies.
Third-party locations are subject to change.	

While you should perform almost all tasks from the SaaS user interface, a local user interface is still available on the Connector. The machine running the web browser must have connections to the following endpoints:

Endpoints	Purpose
The Connector host	<p>You must enter the host's IP address from a web browser to load the Cloud Manager console.</p> <p>Depending on your connectivity to your cloud provider, you can use the private IP or a public IP assigned to the host:</p> <ul style="list-style-type: none"> • A private IP works if you have a VPN and direct connect access to your virtual network • A public IP works in any networking scenario <p>In any case, you should secure network access by ensuring that security group rules allow access from only authorized IPs or subnets.</p>
https://auth0.com https://cdn.auth0.com https://netapp-cloud-account.auth0.com https://services.cloud.netapp.com	Your web browser connects to these endpoints for centralized user authentication through NetApp Cloud Central.
https://widget.intercom.io	For in-product chat that enables you to talk to NetApp cloud experts.

Security group rules for Cloud Volumes ONTAP

Cloud Manager creates Azure security groups that include the inbound and outbound rules that Cloud Volumes ONTAP needs to operate successfully. You might want to refer to the ports for testing purposes or if you prefer your to use own security groups.

The security group for Cloud Volumes ONTAP requires both inbound and outbound rules.

Inbound rules for single node systems

The rules listed below allow traffic, unless the description notes that it blocks specific inbound traffic.

Priority and name	Port and protocol	Source and destination	Description
1000 inbound_ssh	22 TCP	Any to Any	SSH access to the IP address of the cluster management LIF or a node management LIF
1001 inbound_http	80 TCP	Any to Any	HTTP access to the System Manager web console using the IP address of the cluster management LIF
1002 inbound_111_tcp	111 TCP	Any to Any	Remote procedure call for NFS
1003 inbound_111_udp	111 UDP	Any to Any	Remote procedure call for NFS
1004 inbound_139	139 TCP	Any to Any	NetBIOS service session for CIFS

Priority and name	Port and protocol	Source and destination	Description
1005 inbound_161-162_tcp	161-162 TCP	Any to Any	Simple network management protocol
1006 inbound_161-162_udp	161-162 UDP	Any to Any	Simple network management protocol
1007 inbound_443	443 TCP	Any to Any	HTTPS access to the System Manager web console using the IP address of the cluster management LIF
1008 inbound_445	445 TCP	Any to Any	Microsoft SMB/CIFS over TCP with NetBIOS framing
1009 inbound_635_tcp	635 TCP	Any to Any	NFS mount
1010 inbound_635_udp	635 UDP	Any to Any	NFS mount
1011 inbound_749	749 TCP	Any to Any	Kerberos
1012 inbound_2049_tcp	2049 TCP	Any to Any	NFS server daemon
1013 inbound_2049_udp	2049 UDP	Any to Any	NFS server daemon
1014 inbound_3260	3260 TCP	Any to Any	iSCSI access through the iSCSI data LIF
1015 inbound_4045-4046_tcp	4045-4046 TCP	Any to Any	NFS lock daemon and network status monitor
1016 inbound_4045-4046_udp	4045-4046 UDP	Any to Any	NFS lock daemon and network status monitor
1017 inbound_10000	10000 TCP	Any to Any	Backup using NDMP
1018 inbound_11104-11105	11104-11105 TCP	Any to Any	SnapMirror data transfer
3000 inbound_deny_all_tcp	Any port TCP	Any to Any	Block all other TCP inbound traffic
3001 inbound_deny_all_udp	Any port UDP	Any to Any	Block all other UDP inbound traffic

Priority and name	Port and protocol	Source and destination	Description
65000 AllowVnetInBound	Any port Any protocol	VirtualNetwork to VirtualNetwork	Inbound traffic from within the VNet
65001 AllowAzureLoadBalancerInBound	Any port Any protocol	AzureLoadBalancer to Any	Data traffic from the Azure Standard Load Balancer
65500 DenyAllInBound	Any port Any protocol	Any to Any	Block all other inbound traffic

Inbound rules for HA systems

The rules listed below allow traffic, unless the description notes that it blocks specific inbound traffic.



HA systems have less inbound rules than single node systems because inbound data traffic goes through the Azure Standard Load Balancer. Because of this, traffic from the Load Balancer should be open, as shown in the "AllowAzureLoadBalancerInBound" rule.

Priority and name	Port and protocol	Source and destination	Description
100 inbound_443	443 Any protocol	Any to Any	HTTPS access to the System Manager web console using the IP address of the cluster management LIF
101 inbound_111_tcp	111 Any protocol	Any to Any	Remote procedure call for NFS
102 inbound_2049_tcp	2049 Any protocol	Any to Any	NFS server daemon
111 inbound_ssh	22 Any protocol	Any to Any	SSH access to the IP address of the cluster management LIF or a node management LIF
121 inbound_53	53 Any protocol	Any to Any	DNS and CIFS
65000 AllowVnetInBound	Any port Any protocol	VirtualNetwork to VirtualNetwork	Inbound traffic from within the VNet
65001 AllowAzureLoadBalancerInBound	Any port Any protocol	AzureLoadBalancer to Any	Data traffic from the Azure Standard Load Balancer

Priority and name	Port and protocol	Source and destination	Description
65500 DenyAllInBound	Any port Any protocol	Any to Any	Block all other inbound traffic

Outbound rules

The predefined security group for Cloud Volumes ONTAP opens all outbound traffic. If that is acceptable, follow the basic outbound rules. If you need more rigid rules, use the advanced outbound rules.

Basic outbound rules

The predefined security group for Cloud Volumes ONTAP includes the following outbound rules.

Port	Protocol	Purpose
All	All TCP	All outbound traffic
All	All UDP	All outbound traffic

Advanced outbound rules

If you need rigid rules for outbound traffic, you can use the following information to open only those ports that are required for outbound communication by Cloud Volumes ONTAP.



The source is the interface (IP address) on the Cloud Volumes ONTAP system.

Service	Port	Protocol	Source	Destination	Purpose
Active Directory	88	TCP	Node management LIF	Active Directory forest	Kerberos V authentication
	137	UDP	Node management LIF	Active Directory forest	NetBIOS name service
	138	UDP	Node management LIF	Active Directory forest	NetBIOS datagram service
	139	TCP	Node management LIF	Active Directory forest	NetBIOS service session
	389	TCP & UDP	Node management LIF	Active Directory forest	LDAP
	445	TCP	Node management LIF	Active Directory forest	Microsoft SMB/CIFS over TCP with NetBIOS framing
	464	TCP	Node management LIF	Active Directory forest	Kerberos V change & set password (SET_CHANGE)
	464	UDP	Node management LIF	Active Directory forest	Kerberos key administration
	749	TCP	Node management LIF	Active Directory forest	Kerberos V change & set Password (RPCSEC_GSS)
	88	TCP	Data LIF (NFS, CIFS, iSCSI)	Active Directory forest	Kerberos V authentication
	137	UDP	Data LIF (NFS, CIFS)	Active Directory forest	NetBIOS name service
	138	UDP	Data LIF (NFS, CIFS)	Active Directory forest	NetBIOS datagram service
	139	TCP	Data LIF (NFS, CIFS)	Active Directory forest	NetBIOS service session
	389	TCP & UDP	Data LIF (NFS, CIFS)	Active Directory forest	LDAP
DHCP	445	TCP	Data LIF (NFS, CIFS)	Active Directory forest	Microsoft SMB/CIFS over TCP with NetBIOS framing
	464	TCP	Data LIF (NFS, CIFS)	Active Directory forest	Kerberos V change & set password (SET_CHANGE)
	464	UDP	Data LIF (NFS, CIFS)	Active Directory forest	Kerberos key administration
	749	TCP	Data LIF (NFS, CIFS)	Active Directory forest	Kerberos V change & set password (RPCSEC_GSS)
	68	UDP	Node management LIF	DHCP	DHCP client for first-time setup

Service	Port	Protocol	Source	Destination	Purpose
DHCPS	67	UDP	Node management LIF	DHCP	DHCP server
DNS	53	UDP	Node management LIF and data LIF (NFS, CIFS)	DNS	DNS
NDMP	18600–18699	TCP	Node management LIF	Destination servers	NDMP copy
SMTP	25	TCP	Node management LIF	Mail server	SMTP alerts, can be used for AutoSupport
SNMP	161	TCP	Node management LIF	Monitor server	Monitoring by SNMP traps
	161	UDP	Node management LIF	Monitor server	Monitoring by SNMP traps
	162	TCP	Node management LIF	Monitor server	Monitoring by SNMP traps
	162	UDP	Node management LIF	Monitor server	Monitoring by SNMP traps
SnapMirror	11104	TCP	Intercluster LIF	ONTAP intercluster LIFs	Management of intercluster communication sessions for SnapMirror
	11105	TCP	Intercluster LIF	ONTAP intercluster LIFs	SnapMirror data transfer
Syslog	514	UDP	Node management LIF	Syslog server	Syslog forward messages

Security group rules for the Connector

The security group for the Connector requires both inbound and outbound rules.

Inbound rules

Port	Protocol	Purpose
22	SSH	Provides SSH access to the Connector host
80	HTTP	Provides HTTP access from client web browsers to the local user interface
443	HTTPS	Provides HTTPS access from client web browsers to the local user interface

Outbound rules

The predefined security group for the Connector opens all outbound traffic. If that is acceptable, follow the basic outbound rules. If you need more rigid rules, use the advanced outbound rules.

Basic outbound rules

The predefined security group for the Connector includes the following outbound rules.

Port	Protocol	Purpose
All	All TCP	All outbound traffic
All	All UDP	All outbound traffic

Advanced outbound rules

If you need rigid rules for outbound traffic, you can use the following information to open only those ports that are required for outbound communication by the Connector.



The source IP address is the Connector host.

Service	Port	Protocol	Destination	Purpose
Active Directory	88	TCP	Active Directory forest	Kerberos V authentication
	139	TCP	Active Directory forest	NetBIOS service session
	389	TCP	Active Directory forest	LDAP
	445	TCP	Active Directory forest	Microsoft SMB/CIFS over TCP with NetBIOS framing
	464	TCP	Active Directory forest	Kerberos V change & set password (SET_CHANGE)
	749	TCP	Active Directory forest	Active Directory Kerberos V change & set password (RPCSEC_GSS)
	137	UDP	Active Directory forest	NetBIOS name service
	138	UDP	Active Directory forest	NetBIOS datagram service
	464	UDP	Active Directory forest	Kerberos key administration
API calls and AutoSupport	443	HTTP	Outbound internet and ONTAP cluster management LIF	API calls to AWS and ONTAP, and sending AutoSupport messages to NetApp
API calls	3000	TCP	ONTAP cluster management LIF	API calls to ONTAP
DNS	53	UDP	DNS	Used for DNS resolve by Cloud Manager

Launching Cloud Volumes ONTAP in Azure

You can launch a single node system or an HA pair in Azure by creating a Cloud Volumes ONTAP working environment in Cloud Manager.

Before you begin

- You should have a [Connector that is associated with your workspace](#).



You must be an Account Admin to create a Connector. When you create your first Cloud Volumes ONTAP working environment, Cloud Manager prompts you to create a Connector if you don't have one yet.

- You should be prepared to leave the Connector running at all times.
- You should have chosen a configuration and obtained Azure networking information from your administrator. For details, see [Planning your Cloud Volumes ONTAP configuration](#).
- To deploy a BYOL system, you need the 20-digit serial number (license key) for each node.

About this task

When Cloud Manager creates a Cloud Volumes ONTAP system in Azure, it creates several Azure objects, such as a resource group, network interfaces, and storage accounts. You can review a summary of the resources at the end of the wizard.

Potential for Data Loss

Deploying Cloud Volumes ONTAP in an existing, shared resource group is not recommended due to the risk of data loss. While rollback is currently disabled by default when using the API to deploy into an existing resource group, deleting Cloud Volumes ONTAP will potentially delete other resources from that shared group.



The best practice is to use a new, dedicated resource group for Cloud Volumes ONTAP. This is the default and only recommended option when deploying Cloud Volumes ONTAP in Azure from Cloud Manager.

Steps

1. On the Canvas page, click **Add Working Environment** and follow the prompts.
2. **Choose a Location:** Select **Microsoft Azure** and **Cloud Volumes ONTAP Single Node** or **Cloud Volumes ONTAP High Availability**.
3. **Details and Credentials:** Optionally change the Azure credentials and subscription, specify a cluster name and resource group name, add tags if needed, and then specify credentials.

The following table describes fields for which you might need guidance:

Field	Description
Working Environment Name	Cloud Manager uses the working environment name to name both the Cloud Volumes ONTAP system and the Azure virtual machine. It also uses the name as the prefix for the predefined security group, if you select that option.
Resource Group Name	Keep the default name for the new resource group or uncheck Use Default and enter your own name for the new resource group. The best practice is to use a new, dedicated resource group for Cloud Volumes ONTAP. While it is possible to deploy Cloud Volumes ONTAP in an existing, shared resource group by using the API, it's not recommended due to the risk of data loss. See the warning above for more details.

Field	Description
Tags	<p>Tags are metadata for your Azure resources. When you enter tags in this field, Cloud Manager adds them to the resource group associated with the Cloud Volumes ONTAP system.</p> <p>You can add up to four tags from the user interface when creating a working environment, and then you can add more after its created. Note that the API does not limit you to four tags when creating a working environment.</p> <p>For information about tags, refer to Microsoft Azure Documentation: Using tags to organize your Azure resources.</p>
User name and password	<p>These are the credentials for the Cloud Volumes ONTAP cluster admin account. You can use these credentials to connect to Cloud Volumes ONTAP through OnCommand System Manager or its CLI.</p>
Edit Credentials	<p>You can choose different Azure credentials and a different Azure subscription to use with this Cloud Volumes ONTAP system. You need to associate an Azure Marketplace subscription with the selected Azure subscription in order to deploy a pay-as-you-go Cloud Volumes ONTAP system. Learn how to add credentials.</p>

The following video shows how to associate a Marketplace subscription to an Azure subscription:

► [https://docs.netapp.com/us-en/occm/media/video_subscribing_azure.mp4 \(video\)](https://docs.netapp.com/us-en/occm/media/video_subscribing_azure.mp4)

4. **Services:** Keep the services enabled or disable the individual services that you don't want to use with Cloud Volumes ONTAP.
 - [Learn more about Cloud Compliance](#).
 - [Learn more about Cloud Backup](#).
 - [Learn more about the Monitoring service](#).

5. **Location & Connectivity:** Select a location and security group, and select the checkbox to confirm network connectivity between the Connector and the target location.

For single node systems, you can choose the Availability Zone in which you'd like to deploy Cloud Volumes ONTAP. If you don't select an AZ, Cloud Manager will select one for you.

6. **License and Support Site Account:** Specify whether you want to use pay-as-you-go or BYOL, and then specify a NetApp Support Site account.

To understand how licenses work, see [Licensing](#).

A NetApp Support Site Account is optional for pay-as-you-go, but required for BYOL systems. [Learn how to add NetApp Support Site accounts](#).

7. **Preconfigured Packages:** Select one of the packages to quickly deploy a Cloud Volumes ONTAP system, or click [Create my own configuration](#).

If you choose one of the packages, you only need to specify a volume and then review and approve the configuration.

8. **Licensing:** Change the Cloud Volumes ONTAP version as needed, select a license, and select a virtual machine type.

If your needs change after you launch the system, you can modify the license or virtual machine type later.



If a newer Release Candidate, General Availability, or patch release is available for the selected version, then Cloud Manager updates the system to that version when creating the working environment. For example, the update occurs if you select Cloud Volumes ONTAP 9.6 RC1 and 9.6 GA is available. The update does not occur from one release to another—for example, from 9.6 to 9.7.

9. **Subscribe from the Azure Marketplace:** Follow the steps if Cloud Manager could not enable programmatic deployments of Cloud Volumes ONTAP.
10. **Underlying Storage Resources:** Choose settings for the initial aggregate: a disk type, a size for each disk, and whether data tiering to Blob storage should be enabled.

Note the following:

- The disk type is for the initial volume. You can choose a different disk type for subsequent volumes.
- The disk size is for all disks in the initial aggregate and for any additional aggregates that Cloud Manager creates when you use the simple provisioning option. You can create aggregates that use a different disk size by using the advanced allocation option.

For help choosing a disk type and size, see [Sizing your system in Azure](#).

- You can choose a specific volume tiering policy when you create or edit a volume.
- If you disable data tiering, you can enable it on subsequent aggregates.

[Learn more about data tiering](#).

11. **Write Speed & WORM** (single node systems only): Choose **Normal** or **High** write speed, and activate write once, read many (WORM) storage, if desired.

[Learn more about write speed](#).

WORM can't be enabled if data tiering was enabled.

[Learn more about WORM storage](#).

12. **Secure Communication to Storage & WORM** (HA only): Choose whether to enable an HTTPS connection to Azure storage accounts, and activate write once, read many (WORM) storage, if desired.

The HTTPS connection is from a Cloud Volumes ONTAP 9.7 HA pair to Azure storage accounts. Note that enabling this option can impact write performance. You can't change the setting after you create the working environment.

[Learn more about WORM storage](#).

13. **Create Volume:** Enter details for the new volume or click **Skip**.

Some of the fields in this page are self-explanatory. The following table describes fields for which you might need guidance:

Field	Description
Size	The maximum size that you can enter largely depends on whether you enable thin provisioning, which enables you to create a volume that is bigger than the physical storage currently available to it.
Access control (for NFS only)	An export policy defines the clients in the subnet that can access the volume. By default, Cloud Manager enters a value that provides access to all instances in the subnet.
Permissions and Users / Groups (for CIFS only)	These fields enable you to control the level of access to a share for users and groups (also called access control lists or ACLs). You can specify local or domain Windows users or groups, or UNIX users or groups. If you specify a domain Windows user name, you must include the user's domain using the format domain\username.
Snapshot Policy	A Snapshot copy policy specifies the frequency and number of automatically created NetApp Snapshot copies. A NetApp Snapshot copy is a point-in-time file system image that has no performance impact and requires minimal storage. You can choose the default policy or none. You might choose none for transient data: for example, tempdb for Microsoft SQL Server.
Advanced options (for NFS only)	Select an NFS version for the volume: either NFSv3 or NFSv4.
Initiator group and IQN (for iSCSI only)	<p>iSCSI storage targets are called LUNs (logical units) and are presented to hosts as standard block devices.</p> <p>Initiator groups are tables of iSCSI host node names and control which initiators have access to which LUNs.</p> <p>iSCSI targets connect to the network through standard Ethernet network adapters (NICs), TCP offload engine (TOE) cards with software initiators, converged network adapters (CNAs) or dedicated host bus adapters (HBAs) and are identified by iSCSI qualified names (IQNs).</p> <p>When you create an iSCSI volume, Cloud Manager automatically creates a LUN for you. We've made it simple by creating just one LUN per volume, so there's no management involved. After you create the volume, use the IQN to connect to the LUN from your hosts.</p>

The following image shows the Volume page filled out for the CIFS protocol:

Volume Details, Protection & Protocol

Details & Protection <div style="margin-top: 10px;"> Volume Name: <input type="text" value="vol"/> Size (GB): <input type="text" value="250"/> </div> <div style="margin-top: 10px;"> Snapshot Policy: <input type="text" value="default"/> <div style="float: right;"><small>Default Policy</small></div> </div>	Protocol <div style="margin-top: 10px;"> NFS CIFS iSCSI </div> <div style="margin-top: 10px;"> Share name: <input type="text" value="vol_share"/> Permissions: <input type="text" value="Full Control"/> </div> <div style="margin-top: 10px;"> Users / Groups: <input type="text" value="engineering"/> <div style="font-size: small; margin-top: -10px;">Valid users and groups separated by a semicolon</div> </div>
--	--

14. **CIFS Setup:** If you chose the CIFS protocol, set up a CIFS server.

Field	Description
DNS Primary and Secondary IP Address	The IP addresses of the DNS servers that provide name resolution for the CIFS server. The listed DNS servers must contain the service location records (SRV) needed to locate the Active Directory LDAP servers and domain controllers for the domain that the CIFS server will join.
Active Directory Domain to join	The FQDN of the Active Directory (AD) domain that you want the CIFS server to join.
Credentials authorized to join the domain	The name and password of a Windows account with sufficient privileges to add computers to the specified Organizational Unit (OU) within the AD domain.
CIFS server NetBIOS name	A CIFS server name that is unique in the AD domain.
Organizational Unit	The organizational unit within the AD domain to associate with the CIFS server. The default is CN=Computers. To configure Azure AD Domain Services as the AD server for Cloud Volumes ONTAP, you should enter OU=AADDC Computers or OU=AADDC Users in this field. Azure Documentation: Create an Organizational Unit (OU) in an Azure AD Domain Services managed domain
DNS Domain	The DNS domain for the Cloud Volumes ONTAP storage virtual machine (SVM). In most cases, the domain is the same as the AD domain.
NTP Server	Select Use Active Directory Domain to configure an NTP server using the Active Directory DNS. If you need to configure an NTP server using a different address, then you should use the API. See the Cloud Manager API Developer Guide for details.

15. **Usage Profile, Disk Type, and Tiering Policy:** Choose whether you want to enable storage efficiency features and change the volume tiering policy, if needed.

For more information, see [Understanding volume usage profiles](#) and [Data tiering overview](#).

16. **Review & Approve:** Review and confirm your selections.
- Review details about the configuration.
 - Click **More information** to review details about support and the Azure resources that Cloud Manager will purchase.
 - Select the **I understand...** check boxes.
 - Click **Go**.

Result

Cloud Manager deploys the Cloud Volumes ONTAP system. You can track the progress in the timeline.

If you experience any issues deploying the Cloud Volumes ONTAP system, review the failure message. You can also select the working environment and click **Re-create environment**.

For additional help, go to [NetApp Cloud Volumes ONTAP Support](#).

After you finish

- If you provisioned a CIFS share, give users or groups permissions to the files and folders and verify that those users can access the share and create a file.
- If you want to apply quotas to volumes, use System Manager or the CLI.

Quotas enable you to restrict or track the disk space and number of files used by a user, group, or qtree.

Get started in GCP

Getting started with Cloud Volumes ONTAP for Google Cloud

Get started with Cloud Volumes ONTAP for GCP in a few steps.

1

Create a Connector

If you don't have a [Connector](#) yet, an Account Admin needs to create one. [Learn how to create a Connector in GCP](#).

When you create your first Cloud Volumes ONTAP working environment, Cloud Manager prompts you to deploy a Connector if you don't have one yet.

2

Plan your configuration

Cloud Manager offers preconfigured packages that match your workload requirements, or you can create your own configuration. If you choose your own configuration, you should understand the options available to you.

[Learn more about planning your configuration](#).

3

Set up your networking

- a. Ensure that your VPC and subnets will support connectivity between the Connector and Cloud Volumes ONTAP.
- b. If you plan to enable data tiering, [configure the Cloud Volumes ONTAP subnet for Private Google Access](#).
- c. If you're deploying an HA pair, ensure that you have four VPCs, each with their own subnet.
- d. If you're using a shared VPC, provide the *Compute Network User* role to the Connector service account.
- e. Enable outbound internet access from the target VPC so the Connector and Cloud Volumes ONTAP can contact several endpoints.

This step is important because the Connector can't manage Cloud Volumes ONTAP without outbound internet access. If you need to limit outbound connectivity, refer to the list of endpoints for [the Connector and Cloud Volumes ONTAP](#).

[Learn more about networking requirements](#).

4

Set up a service account

Cloud Volumes ONTAP requires a Google Cloud service account for two purposes. The first is when you enable [data tiering](#) to tier cold data to low-cost object storage in Google Cloud. The second is when you enable the [Cloud Backup Service](#) to back up volumes to low-cost object storage.

You can set up one service account and use it for both purposes. The service account must have the **Storage Admin** role.

[Read step-by-step instructions](#).

5

Enable Google Cloud APIs

Enable the following Google Cloud APIs in your project. These APIs are required to deploy the Connector and Cloud Volumes ONTAP.

- Cloud Deployment Manager V2 API
- Cloud Logging API
- Cloud Resource Manager API
- Compute Engine API
- Identity and Access Management (IAM) API

6

Launch Cloud Volumes ONTAP using Cloud Manager

Click **Add Working Environment**, select the type of system that you would like to deploy, and complete the steps in the wizard. [Read step-by-step instructions](#).

Related links

- [Evaluating](#)
- [Creating a Connector from Cloud Manager](#)

- [Installing the Connector software on a Linux host](#)
- [What Cloud Manager does with GCP permissions](#)

Planning your Cloud Volumes ONTAP configuration in Google Cloud

When you deploy Cloud Volumes ONTAP in Google Cloud, you can choose a preconfigured system that matches your workload requirements, or you can create your own configuration. If you choose your own configuration, you should understand the options available to you.

Choosing a license type

Cloud Volumes ONTAP is available in two pricing options: pay-as-you-go and Bring Your Own License (BYOL). For pay-as-you-go, you can choose from three licenses: Explore, Standard, or Premium. Each license provides different capacity and compute options.

[Supported configurations for Cloud Volumes ONTAP 9.8 in GCP](#)

Supported machine types

Cloud Volumes ONTAP supports several machine types, depending on the license type that you choose.

[Supported configurations for Cloud Volumes ONTAP 9.8 in GCP](#)

Understanding storage limits

The raw capacity limit for a Cloud Volumes ONTAP system is tied to the license. Additional limits impact the size of aggregates and volumes. You should be aware of these limits as you plan your configuration.

[Storage limits for Cloud Volumes ONTAP 9.8 in GCP](#)

Sizing your system in GCP

Sizing your Cloud Volumes ONTAP system can help you meet requirements for performance and capacity. You should be aware of a few key points when choosing a machine type, disk type, and disk size:

Machine type

Look at the supported machine types in the [Cloud Volumes ONTAP Release Notes](#) and then review details from Google about each supported machine type. Match your workload requirements to the number of vCPUs and memory for the machine type. Note that each CPU core increases networking performance.

Refer to the following for more details:

- [Google Cloud documentation: N1 standard machine types](#)
- [Google Cloud documentation: Performance](#)

GCP disk type

When you create volumes for Cloud Volumes ONTAP, you need to choose the underlying cloud storage that Cloud Volumes ONTAP uses for a disk. The disk type can be either *Zonal SSD persistent disks* or *Zonal standard persistent disks*.

SSD persistent disks are best for workloads that require high rates of random IOPS, while Standard

persistent disks are economical and can handle sequential read/write operations. For more details, see [Google Cloud documentation: Zonal Persistent disks \(Standard and SSD\)](#).

GCP disk size

You need to choose an initial disk size when you deploy a Cloud Volumes ONTAP system. After that you can let Cloud Manager manage a system's capacity for you, but if you want to build aggregates yourself, be aware of the following:

- All disks in an aggregate must be the same size.
- Determine the space that you need, while taking performance into consideration.
- The performance of persistent disks scales automatically with disk size and the number of vCPUs available to the system.

Refer to the following for more details:

- [Google Cloud documentation: Zonal Persistent disks \(Standard and SSD\)](#)
- [Google Cloud documentation: Optimizing Persistent Disk and Local SSD Performance](#)

GCP network information worksheet

When you deploy Cloud Volumes ONTAP in GCP, you need to specify details about your virtual network. You can use a worksheet to collect the information from your administrator.

Network information for a single-node system

GCP information	Your value
Region	
Zone	
VPC network	
Subnet	
Firewall policy (if using your own)	

Network information for an HA pair in multiple zones

GCP information	Your value
Region	
Zone for Node 1	
Zone for Node 2	
Zone for the mediator	
VPC-0 and subnet	
VPC-1 and subnet	
VPC-2 and subnet	
VPC-3 and subnet	

GCP information	Your value
Firewall policy (if using your own)	

Network information for an HA pair in a single zone

GCP information	Your value
Region	
Zone	
VPC-0 and subnet	
VPC-1 and subnet	
VPC-2 and subnet	
VPC-3 and subnet	
Firewall policy (if using your own)	

Choosing a write speed

Cloud Manager enables you to choose a write speed setting for Cloud Volumes ONTAP, except for high availability (HA) pairs in Google Cloud. Before you choose a write speed, you should understand the differences between the normal and high settings and risks and recommendations when using high write speed. [Learn more about write speed](#).

Choosing a volume usage profile

ONTAP includes several storage efficiency features that can reduce the total amount of storage that you need. When you create a volume in Cloud Manager, you can choose a profile that enables these features or a profile that disables them. You should learn more about these features to help you decide which profile to use.

NetApp storage efficiency features provide the following benefits:

Thin provisioning

Presents more logical storage to hosts or users than you actually have in your physical storage pool. Instead of preallocating storage space, storage space is allocated dynamically to each volume as data is written.

Deduplication

Improves efficiency by locating identical blocks of data and replacing them with references to a single shared block. This technique reduces storage capacity requirements by eliminating redundant blocks of data that reside in the same volume.

Compression

Reduces the physical capacity required to store data by compressing data within a volume on primary, secondary, and archive storage.

Networking requirements for Cloud Volumes ONTAP in GCP

Set up your Google Cloud Platform networking so Cloud Volumes ONTAP systems can

operate properly. This includes networking for the Connector and Cloud Volumes ONTAP.

If you want to deploy an HA pair, you should [learn how HA pairs work in GCP](#).

Requirements for Cloud Volumes ONTAP

The following requirements must be met in GCP.

Virtual Private Cloud for single node systems

One VPC is required for a single node system.

Cloud Volumes ONTAP and the Connector are supported in a Google Cloud shared VPC and also in standalone VPCs.

A shared VPC enables you to configure and centrally manage virtual networks across multiple projects. You can set up shared VPC networks in the *host project* and deploy the Connector and Cloud Volumes ONTAP virtual machine instances in a *service project*. [Google Cloud documentation: Shared VPC overview](#).

The only requirement when using a shared VPC is to provide the [Compute Network User role](#) to the Connector service account. Cloud Manager needs these permissions to query the firewalls, VPC, and subnets in the host project.

Virtual Private Clouds for HA pairs

Four Virtual Private Clouds (VPCs) are required for the HA configuration. Four VPCs are required because GCP requires that each network interface resides in a separate VPC network.

Cloud Manager will prompt you to choose four VPCs when you create the HA pair:

- VPC-0 for inbound connections to the data and nodes
- VPC-1, VPC-2, and VPC-3 for internal communication between the nodes and the HA mediator

Similar to a single node system, an HA pair is supported in a shared VPC and also in standalone VPCs. However, only VPC-0 can be a shared VPC. All other VPCs must be a standalone VPC.

The only requirement when using a shared VPC is to provide the [Compute Network User role](#) to the Connector service account. Cloud Manager needs these permissions to query the firewalls, VPC, and subnets in the host project.

Outbound internet access for Cloud Volumes ONTAP

Cloud Volumes ONTAP requires outbound internet access to send messages to NetApp AutoSupport, which proactively monitors the health of your storage.

Routing and firewall policies must allow HTTP/HTTPS traffic to the following endpoints so Cloud Volumes ONTAP can send AutoSupport messages:

- <https://support.netapp.com/aods/asupmessage>
- <https://support.netapp.com/asupprod/post/1.0/postAsup>

[Learn how to configure AutoSupport](#).



If you're using an HA pair, the HA mediator doesn't require outbound internet access.

Number of IP addresses

Cloud Manager allocates the following number of IP addresses to Cloud Volumes ONTAP in GCP:

- **Single node:** 5 IP addresses

Cloud Manager doesn't create an SVM management LIF for single node systems in GCP.

A LIF is an IP address associated with a physical port. An SVM management LIF is required for management tools like SnapCenter.

- **HA pair:** 17 IP addresses

- 10 IP addresses for VPC-0
- Two IP addresses for VPC-1
- Two IP addresses for VPC-2
- Three IP addresses for VPC-3

Firewall rules

You don't need to create firewall rules because Cloud Manager does that for you. If you need to use your own, refer to the firewall rules listed below.

Note that two sets of firewall rules are required for an HA configuration:

- One set of rules for HA components in VPC-0. These rules enable data access to Cloud Volumes ONTAP. [Learn more](#).
- Another set of rules for HA components in VPC-1, VPC-2, and VPC-3. These rules are open for inbound & outbound communication between the HA components. [Learn more](#).

Connection from Cloud Volumes ONTAP to Google Cloud Storage for data tiering

If you want to tier cold data to a Google Cloud Storage bucket, the subnet in which Cloud Volumes ONTAP resides must be configured for Private Google Access (if you're using an HA pair, this is the subnet in VPC-0). For instructions, refer to [Google Cloud documentation: Configuring Private Google Access](#).

For additional steps required to set up data tiering in Cloud Manager, see [Tiering cold data to low-cost object storage](#).

Connections to ONTAP systems in other networks

To replicate data between a Cloud Volumes ONTAP system in GCP and ONTAP systems in other networks, you must have a VPN connection between the VPC and the other network—for example, your corporate network.

For instructions, refer to [Google Cloud documentation: Cloud VPN overview](#).

Requirements for the Connector

Set up your networking so that the Connector can manage resources and processes within your public cloud environment. The most important step is ensuring outbound internet access to various endpoints.



If your network uses a proxy server for all communication to the internet, you can specify the proxy server from the Settings page. Refer to [Configuring the Connector to use a proxy server](#).

Connection to target networks

A Connector requires a network connection to the VPCs in which you want to deploy Cloud Volumes ONTAP. If you're deploying an HA pair, then the Connector needs a connection to all four VPCs.

Outbound internet access

The Connector requires outbound internet access to manage resources and processes within your public cloud environment. A Connector contacts the following endpoints when managing resources in GCP:

Endpoints	Purpose
https://www.googleapis.com	Enables the Connector to contact Google APIs for deploying and managing Cloud Volumes ONTAP in GCP.
https://api.services.cloud.netapp.com:443	API requests to NetApp Cloud Central.
https://cloud.support.netapp.com.s3.us-west-1.amazonaws.com	Provides access to software images, manifests, and templates.
https://cognito-idp.us-east-1.amazonaws.com https://cognito-identity.us-east-1.amazonaws.com https://sts.amazonaws.com https://cloud-support-netapp-com-accelerated.s3.amazonaws.com	Enables the Connector to access and download manifests, templates, and Cloud Volumes ONTAP upgrade images.
https://cloudmanagerinfraprod.azurecr.io	Access to software images of container components for an infrastructure that's running Docker and provides a solution for service integrations with Cloud Manager.
https://kinesis.us-east-1.amazonaws.com	Enables NetApp to stream data from audit records.
https://cloudmanager.cloud.netapp.com	Communication with the Cloud Manager service, which includes Cloud Central accounts.
https://netapp-cloud-account.auth0.com	Communication with NetApp Cloud Central for centralized user authentication.
support.netapp.com:443	Communication with NetApp AutoSupport.
https://support.netapp.com/svcgw https://support.netapp.com/ServiceGW/entitlement https://eval.lic.netapp.com.s3.us-west-1.amazonaws.com https://cloud-support-netapp-com.s3.us-west-1.amazonaws.com	Communication with NetApp for system licensing and support registration.
https://client.infra.support.netapp.com.s3.us-west-1.amazonaws.com https://cloud-support-netapp-com-accelerated.s3.us-west-1.amazonaws.com https://trigger.asup.netapp.com.s3.us-west-1.amazonaws.com	Enables NetApp to collect information needed to troubleshoot support issues.
https://ipa-signer.cloudmanager.netapp.com	Enables Cloud Manager to generate licenses (for example, a FlexCache license for Cloud Volumes ONTAP)

Endpoints	Purpose
<p>Various third-party locations, for example:</p> <ul style="list-style-type: none"> • https://repo1.maven.org/maven2 • https://oss.sonatype.org/content/repositories • https://repo.typesafe.com <p>Third-party locations are subject to change.</p>	<p>During upgrades, Cloud Manager downloads the latest packages for third-party dependencies.</p>

While you should perform almost all tasks from the SaaS user interface, a local user interface is still available on the Connector. The machine running the web browser must have connections to the following endpoints:

Endpoints	Purpose
The Connector host	<p>You must enter the host's IP address from a web browser to load the Cloud Manager console.</p> <p>Depending on your connectivity to your cloud provider, you can use the private IP or a public IP assigned to the host:</p> <ul style="list-style-type: none"> • A private IP works if you have a VPN and direct connect access to your virtual network • A public IP works in any networking scenario <p>In any case, you should secure network access by ensuring that security group rules allow access from only authorized IPs or subnets.</p>
https://auth0.com https://cdn.auth0.com https://netapp-cloud-account.auth0.com https://services.cloud.netapp.com	<p>Your web browser connects to these endpoints for centralized user authentication through NetApp Cloud Central.</p>
https://widget.intercom.io	<p>For in-product chat that enables you to talk to NetApp cloud experts.</p>

Firewall rules for Cloud Volumes ONTAP

Cloud Manager creates GCP firewall rules that include the inbound and outbound rules that Cloud Volumes ONTAP needs to operate successfully. You might want to refer to the ports for testing purposes or if you prefer your to use own firewall rules.

The firewall rules for Cloud Volumes ONTAP requires both inbound and outbound rules.

If you're deploying an HA configuration, these are the firewall rules for Cloud Volumes ONTAP in VPC-0.

Inbound rules

The source for inbound rules in the predefined security group is 0.0.0.0/0.

Protocol	Port	Purpose
All ICMP	All	Pinging the instance
HTTP	80	HTTP access to the System Manager web console using the IP address of the cluster management LIF
HTTPS	443	HTTPS access to the System Manager web console using the IP address of the cluster management LIF
SSH	22	SSH access to the IP address of the cluster management LIF or a node management LIF
TCP	111	Remote procedure call for NFS
TCP	139	NetBIOS service session for CIFS
TCP	161-162	Simple network management protocol
TCP	445	Microsoft SMB/CIFS over TCP with NetBIOS framing
TCP	635	NFS mount
TCP	749	Kerberos
TCP	2049	NFS server daemon
TCP	3260	iSCSI access through the iSCSI data LIF
TCP	4045	NFS lock daemon
TCP	4046	Network status monitor for NFS
TCP	10000	Backup using NDMP
TCP	11104	Management of intercluster communication sessions for SnapMirror
TCP	11105	SnapMirror data transfer using intercluster LIFs
TCP	63001-63050	Load balance probe ports to determine which node is healthy (required for HA pairs only)
UDP	111	Remote procedure call for NFS
UDP	161-162	Simple network management protocol
UDP	635	NFS mount
UDP	2049	NFS server daemon
UDP	4045	NFS lock daemon
UDP	4046	Network status monitor for NFS
UDP	4049	NFS rquotad protocol

Outbound rules

The predefined security group for Cloud Volumes ONTAP opens all outbound traffic. If that is acceptable, follow the basic outbound rules. If you need more rigid rules, use the advanced outbound rules.

Basic outbound rules

The predefined security group for Cloud Volumes ONTAP includes the following outbound rules.

Protocol	Port	Purpose
All ICMP	All	All outbound traffic
All TCP	All	All outbound traffic
All UDP	All	All outbound traffic

Advanced outbound rules

If you need rigid rules for outbound traffic, you can use the following information to open only those ports that are required for outbound communication by Cloud Volumes ONTAP.



The source is the interface (IP address) on the Cloud Volumes ONTAP system.

Service	Protocol	Port	Source	Destination	Purpose
Active Directory	TCP	88	Node management LIF	Active Directory forest	Kerberos V authentication
	UDP	137	Node management LIF	Active Directory forest	NetBIOS name service
	UDP	138	Node management LIF	Active Directory forest	NetBIOS datagram service
	TCP	139	Node management LIF	Active Directory forest	NetBIOS service session
	TCP & UDP	389	Node management LIF	Active Directory forest	LDAP
	TCP	445	Node management LIF	Active Directory forest	Microsoft SMB/CIFS over TCP with NetBIOS framing
	TCP	464	Node management LIF	Active Directory forest	Kerberos V change & set password (SET_CHANGE)
	UDP	464	Node management LIF	Active Directory forest	Kerberos key administration
	TCP	749	Node management LIF	Active Directory forest	Kerberos V change & set Password (RPCSEC_GSS)
	TCP	88	Data LIF (NFS, CIFS, iSCSI)	Active Directory forest	Kerberos V authentication
	UDP	137	Data LIF (NFS, CIFS)	Active Directory forest	NetBIOS name service
	UDP	138	Data LIF (NFS, CIFS)	Active Directory forest	NetBIOS datagram service
	TCP	139	Data LIF (NFS, CIFS)	Active Directory forest	NetBIOS service session
	TCP & UDP	389	Data LIF (NFS, CIFS)	Active Directory forest	LDAP
	TCP	445	Data LIF (NFS, CIFS)	Active Directory forest	Microsoft SMB/CIFS over TCP with NetBIOS framing
	TCP	464	Data LIF (NFS, CIFS)	Active Directory forest	Kerberos V change & set password (SET_CHANGE)
	UDP	464	Data LIF (NFS, CIFS)	Active Directory forest	Kerberos key administration
	TCP	749	Data LIF (NFS, CIFS)	Active Directory forest	Kerberos V change & set password (RPCSEC_GSS)

Service	Protocol	Port	Source	Destination	Purpose
Cluster	All traffic	All traffic	All LIFs on one node	All LIFs on the other node	Intercluster communications (Cloud Volumes ONTAP HA only)
	TCP	3000	Node management LIF	HA mediator	ZAPI calls (Cloud Volumes ONTAP HA only)
	ICMP	1	Node management LIF	HA mediator	Keep alive (Cloud Volumes ONTAP HA only)
DHCP	UDP	68	Node management LIF	DHCP	DHCP client for first-time setup
DHCPS	UDP	67	Node management LIF	DHCP	DHCP server
DNS	UDP	53	Node management LIF and data LIF (NFS, CIFS)	DNS	DNS
NDMP	TCP	1860 0–18 699	Node management LIF	Destination servers	NDMP copy
SMTP	TCP	25	Node management LIF	Mail server	SMTP alerts, can be used for AutoSupport
SNMP	TCP	161	Node management LIF	Monitor server	Monitoring by SNMP traps
	UDP	161	Node management LIF	Monitor server	Monitoring by SNMP traps
	TCP	162	Node management LIF	Monitor server	Monitoring by SNMP traps
	UDP	162	Node management LIF	Monitor server	Monitoring by SNMP traps
SnapMirr or	TCP	1110 4	Intercluster LIF	ONTAP intercluster LIFs	Management of intercluster communication sessions for SnapMirror
	TCP	1110 5	Intercluster LIF	ONTAP intercluster LIFs	SnapMirror data transfer
Syslog	UDP	514	Node management LIF	Syslog server	Syslog forward messages

Firewall rules for VPC-1, VPC-2, and VPC-3

In GCP, an HA configuration is deployed across four VPCs. The firewall rules needed for the HA configuration in VPC-0 are [listed above for Cloud Volumes ONTAP](#).

Meanwhile, the predefined firewall policy that Cloud Manager creates for instances in VPC-1, VPC-2, and VPC-3 enables ingress communication over all protocols and ports. These rules enable communication between the HA nodes and the HA mediator.

Firewall rules for the Connector

The firewall rules for the Connector requires both inbound and outbound rules.

Inbound rules

Protocol	Port	Purpose
SSH	22	Provides SSH access to the Connector host
HTTP	80	Provides HTTP access from client web browsers to the local user interface
HTTPS	443	Provides HTTPS access from client web browsers to the local user interface

Outbound rules

The predefined firewall rules for the Connector opens all outbound traffic. If that is acceptable, follow the basic outbound rules. If you need more rigid rules, use the advanced outbound rules.

Basic outbound rules

The predefined firewall rules for the Connector includes the following outbound rules.

Protocol	Port	Purpose
All TCP	All	All outbound traffic
All UDP	All	All outbound traffic

Advanced outbound rules

If you need rigid rules for outbound traffic, you can use the following information to open only those ports that are required for outbound communication by the Connector.



The source IP address is the Connector host.

Service	Protocol	Port	Destination	Purpose
Active Directory	TCP	88	Active Directory forest	Kerberos V authentication
	TCP	139	Active Directory forest	NetBIOS service session
	TCP	389	Active Directory forest	LDAP
	TCP	445	Active Directory forest	Microsoft SMB/CIFS over TCP with NetBIOS framing
	TCP	464	Active Directory forest	Kerberos V change & set password (SET_CHANGE)
	TCP	749	Active Directory forest	Active Directory Kerberos V change & set password (RPCSEC_GSS)
	UDP	137	Active Directory forest	NetBIOS name service
	UDP	138	Active Directory forest	NetBIOS datagram service
	UDP	464	Active Directory forest	Kerberos key administration
API calls and AutoSupport	HTTP	443	Outbound internet and ONTAP cluster management LIF	API calls to GCP and ONTAP, and sending AutoSupport messages to NetApp
API calls	TCP	3000	ONTAP cluster management LIF	API calls to ONTAP
DNS	UDP	53	DNS	Used for DNS resolve by Cloud Manager

Create a service account for data tiering and backups

Cloud Volumes ONTAP requires a Google Cloud service account for two purposes. The first is when you enable [data tiering](#) to tier cold data to low-cost object storage in Google Cloud. The second is when you enable the [Cloud Backup Service](#) to back up volumes to low-cost object storage.

Cloud Volumes ONTAP uses the service account to access and manage one bucket for tiered data and another bucket for backups.

You can set up one service account and use it for both purposes. The service account must have the **Storage Admin** role.

Steps

1. In the Google Cloud console, [go to the Service accounts page](#).
2. Select your project.
3. Click **Create service account** and provide the required information.
 - a. **Service account details:** Enter a name and description.
 - b. **Grant this service account access to project:** Select the **Storage Admin** role.

Create service account

Service account details

2 Grant this service account access to project (optional)

Grant this service account access to OCCM-Dev so that it has permission to complete specific actions on the resources in your project. [Learn more](#)

Select a role Condition

storage admin

Cloud ML Service Agent
Cloud ML service agent can act as log writer, Cloud Storage admin, Artifact Registry Reader, BigQuery writer, and service account access token creator.

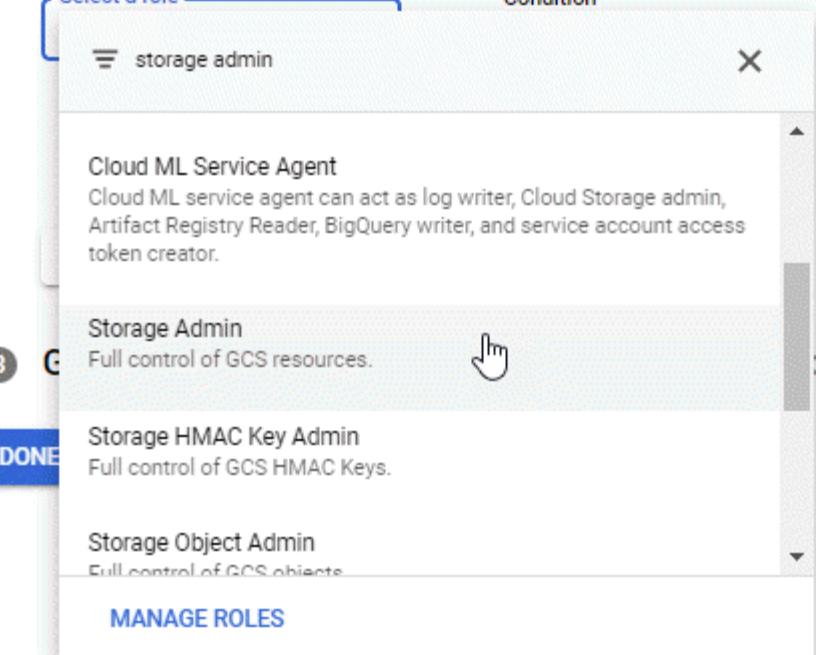
Storage Admin
Full control of GCS resources.

Storage HMAC Key Admin
Full control of GCS HMAC Keys.

Storage Object Admin
Full control of GCS objects.

DONE

MANAGE ROLES



- c. **Grant users access to this service account:** Add the Connector service account as a *Service Account User* to this new service account.

This step is required for data tiering only. It's not required for the Cloud Backup Service.

Create service account

Service account details

Grant this service account access to project (optional)

3 Grant users access to this service account (optional)

Grant access to users or groups that need to perform actions as this service account. [Learn more](#)

Service account users role

netapp-cloud-manager@iam.gserviceaccount.com 



Grant users the permissions to deploy jobs and VMs with this service account

Service account admins role



Grant users the permission to administer this service account

DONE

CANCEL

What's next?

You'll need to select the service account later when you create a Cloud Volumes ONTAP working environment.

Details and Credentials

default-project	gcp-sub2	Edit Project
Google Cloud Project	Marketplace Subscription	
Details	Credentials	
Working Environment Name (Cluster Name)	User Name	
<input type="text" value="cloudvolumesontap"/>	<input type="text" value="admin"/>	
Service Account ⓘ	Password	
<input checked="" type="checkbox"/>	<input type="text"/>	
Service Account Name	Confirm Password	
<input type="text" value="account1"/>	<input type="text"/>	
+ Add Labels Optional Field Up to four labels		

Using customer-managed encryption keys with Cloud Volumes ONTAP

While Google Cloud Storage always encrypts your data before it's written to disk, you can use Cloud Manager APIs to create a Cloud Volumes ONTAP system that uses *customer-managed encryption keys*. These are keys that you generate and manage in GCP using the Cloud Key Management Service.

Steps

1. Give the Connector service account permission to use the encryption key.

The screenshot shows the Google Cloud Platform IAM & Admin interface. At the top, there are navigation icons and a user profile. Below that is a header with 'HIDE INFO PANEL' and a back arrow. The main title is 'key1'. Under the 'PERMISSIONS' tab, there is a note: 'Edit or delete permissions below or "Add Member" to grant new'. A button '+ ADD MEMBER' with a person icon is present. There is also a toggle switch for 'Show inherited permissions'. Below this, there are filters for 'Filter tree' and a help icon. The main list is titled 'Role / Member' with an up arrow. It contains two items: 'Cloud KMS Admin (1)' and 'Cloud KMS CryptoKey Encrypter/Decrypter (2)'. The first item has a dropdown arrow and a list of members. One member, 'cloudmanager-service-account-1@occm-dev.iam.gserviceaccount.com', is highlighted with a yellow box. To the right of the member list are a trash bin icon and a pencil icon.

2. Obtain the "id" of the key by invoking the get command for the /gcp/vsa/metadata/gcp-encryption-keys API.
3. Use the "GcpEncryption" parameter with your API request when creating a working environment.

Example

```
"gcpEncryptionParameters": {  
    "key": "projects/tlv-support/locations/us-  
east4/keyRings/Nikiskeys/cryptoKeys/generatedkey1"  
}
```

Refer to the [API Developer Guide](#) for more details about using the "GcpEncryption" parameter.

Launching Cloud Volumes ONTAP in GCP

You can launch Cloud Volumes ONTAP in a single-node configuration or as an HA pair in Google Cloud Platform.

Launching a single-node system in GCP

Create a working environment in Cloud Manager to launch Cloud Volumes ONTAP in GCP.

What you'll need

- You should have a [Connector that is associated with your workspace](#).



You must be an Account Admin to create a Connector. When you create your first Cloud Volumes ONTAP working environment, Cloud Manager prompts you to create a Connector if you don't have one yet.

- [You should be prepared to leave the Connector running at all times.](#)
- You should have chosen a configuration and obtained GCP networking information from your administrator. For details, see [Planning your Cloud Volumes ONTAP configuration](#).
- To deploy a BYOL system, you need the 20-digit serial number (license key).
- The following Google Cloud APIs should be [enabled in your project](#):
 - Cloud Deployment Manager V2 API
 - Cloud Logging API
 - Cloud Resource Manager API
 - Compute Engine API
 - Identity and Access Management (IAM) API

Steps

1. On the Canvas page, click **Add Working Environment** and follow the prompts.
2. **Choose a Location:** Select **Google Cloud** and **Cloud Volumes ONTAP**.
3. **Details & Credentials:** Select a project, specify a cluster name, optionally select a Service Account, optionally add labels, and then specify credentials.

The following table describes fields for which you might need guidance:

Field	Description
Working Environment Name	Cloud Manager uses the working environment name to name both the Cloud Volumes ONTAP system and the GCP VM instance. It also uses the name as the prefix for the predefined security group, if you select that option.
Service Account Name	If you plan to use data tiering or Cloud Backup with Cloud Volumes ONTAP, then you need to enable Service Account and select a service account that has the predefined Storage Admin role. Learn how to create a service account .
Add Labels	<p>Labels are metadata for your GCP resources. Cloud Manager adds the labels to the Cloud Volumes ONTAP system and GCP resources associated with the system.</p> <p>You can add up to four labels from the user interface when creating a working environment, and then you can add more after its created. Note that the API does not limit you to four labels when creating a working environment.</p> <p>For information about labels, refer to Google Cloud Documentation: Labeling Resources.</p>

Field	Description
User name and password	These are the credentials for the Cloud Volumes ONTAP cluster admin account. You can use these credentials to connect to Cloud Volumes ONTAP through System Manager or its CLI.
Edit Project	<p>Select the project where you want Cloud Volumes ONTAP to reside. The default project is the project where Cloud Manager resides.</p> <p>If you don't see any additional projects in the drop-down list, then you haven't yet associated the Cloud Manager service account with other projects. Go to the Google Cloud console, open the IAM service, and select the project. Add the service account with the Cloud Manager role to that project. You'll need to repeat this step for each project.</p> <p> This is the service account that you set up for Cloud Manager, as described in step 4b on this page.</p> <p>Click Add Subscription to associate the selected credentials with a subscription.</p> <p>To create a pay-as-you-go Cloud Volumes ONTAP system, you need to select a GCP project that's associated with a subscription to Cloud Volumes ONTAP from the GCP Marketplace.</p>

The following video shows how to associate a pay-as-you-go Marketplace subscription to your GCP project:

► https://docs.netapp.com/us-en/occm/media/video_subscribing_gcp.mp4 (video)

4. **Services:** Select the services that you want to use on this system. In order to select Cloud Backup, or to use Tiering, you must have specified the Service Account in step 3.
5. **Location & Connectivity:** Select a location, choose a firewall policy, and select the checkbox to confirm network connectivity to Google Cloud storage for data tiering.

If you want to tier cold data to a Google Cloud Storage bucket, the subnet in which Cloud Volumes ONTAP resides must be configured for Private Google Access. For instructions, refer to [Google Cloud Documentation: Configuring Private Google Access](#).

6. **License & Support Site Account:** Specify whether you want to use pay-as-you-go or BYOL, and then specify a NetApp Support Site account.

To understand how licenses work, see [Licensing](#).

A NetApp Support Site Account is optional for pay-as-you-go, but required for BYOL systems. [Learn how to add NetApp Support Site accounts](#).

7. **Preconfigured Packages:** Select one of the packages to quickly deploy a Cloud Volumes ONTAP system, or click **Create my own configuration**.

If you choose one of the packages, you only need to specify a volume and then review and approve the configuration.

8. **Licensing:** Change the Cloud Volumes ONTAP version as needed, select a license, and select a virtual machine type.

If your needs change after you launch the system, you can modify the license or virtual machine type later.



If a newer Release Candidate, General Availability, or patch release is available for the selected version, then Cloud Manager updates the system to that version when creating the working environment. For example, the update occurs if you select Cloud Volumes ONTAP 9.6 RC1 and 9.6 GA is available. The update does not occur from one release to another—for example, from 9.6 to 9.7.

9. **Underlying Storage Resources:** Choose settings for the initial aggregate: a disk type and the size for each disk.

The disk type is for the initial volume. You can choose a different disk type for subsequent volumes.

The disk size is for all disks in the initial aggregate and for any additional aggregates that Cloud Manager creates when you use the simple provisioning option. You can create aggregates that use a different disk size by using the advanced allocation option.

For help choosing a disk type and size, see [Sizing your system in GCP](#).

10. **Write Speed & WORM:** Choose **Normal** or **High** write speed, and activate write once, read many (WORM) storage, if desired.

Choosing a write speed is supported with single node systems only.

[Learn more about write speed](#).

WORM can't be enabled if data tiering was enabled.

[Learn more about WORM storage](#).

11. **Data Tiering in Google Cloud Platform:** Choose whether to enable data tiering on the initial aggregate, choose a storage class for the tiered data, and then either select a service account that has the predefined Storage Admin role (required for Cloud Volumes ONTAP 9.7 or later), or select a GCP account (required for Cloud Volumes ONTAP 9.6).

Note the following:

- Cloud Manager sets the service account on the Cloud Volumes ONTAP instance. This service account provides permissions for data tiering to a Google Cloud Storage bucket. Be sure to add the Connector service account as a user of the tiering service account, otherwise, you can't select it from Cloud Manager.
- For help with adding a GCP account, see [Setting up and adding GCP accounts for data tiering with 9.6](#).
- You can choose a specific volume tiering policy when you create or edit a volume.
- If you disable data tiering, you can enable it on subsequent aggregates, but you'll need to turn off the system and add a service account from the GCP console.

[Learn more about data tiering](#).

12. **Create Volume:** Enter details for the new volume or click **Skip**.

Some of the fields in this page are self-explanatory. The following table describes fields for which you might need guidance:

Field	Description
Size	The maximum size that you can enter largely depends on whether you enable thin provisioning, which enables you to create a volume that is bigger than the physical storage currently available to it.
Access control (for NFS only)	An export policy defines the clients in the subnet that can access the volume. By default, Cloud Manager enters a value that provides access to all instances in the subnet.
Permissions and Users / Groups (for CIFS only)	These fields enable you to control the level of access to a share for users and groups (also called access control lists or ACLs). You can specify local or domain Windows users or groups, or UNIX users or groups. If you specify a domain Windows user name, you must include the user's domain using the format domain\username.
Snapshot Policy	A Snapshot copy policy specifies the frequency and number of automatically created NetApp Snapshot copies. A NetApp Snapshot copy is a point-in-time file system image that has no performance impact and requires minimal storage. You can choose the default policy or none. You might choose none for transient data: for example, tempdb for Microsoft SQL Server.
Advanced options (for NFS only)	Select an NFS version for the volume: either NFSv3 or NFSv4.
Initiator group and IQN (for iSCSI only)	<p>iSCSI storage targets are called LUNs (logical units) and are presented to hosts as standard block devices.</p> <p>Initiator groups are tables of iSCSI host node names and control which initiators have access to which LUNs.</p> <p>iSCSI targets connect to the network through standard Ethernet network adapters (NICs), TCP offload engine (TOE) cards with software initiators, converged network adapters (CNAs) or dedicated host bus adapters (HBAs) and are identified by iSCSI qualified names (IQNs).</p> <p>When you create an iSCSI volume, Cloud Manager automatically creates a LUN for you. We've made it simple by creating just one LUN per volume, so there's no management involved. After you create the volume, use the IQN to connect to the LUN from your hosts.</p>

The following image shows the Volume page filled out for the CIFS protocol:

Volume Details, Protection & Protocol

Details & Protection <div style="margin-top: 10px;"> Volume Name: <input type="text" value="vol"/> Size (GB): <input type="text" value="250"/> </div> <div style="margin-top: 10px;"> Snapshot Policy: <input type="text" value="default"/> <div style="float: right;"><small>Default Policy</small></div> </div>	Protocol <div style="margin-top: 10px;"> NFS CIFS iSCSI </div> <div style="margin-top: 10px;"> Share name: <input type="text" value="vol_share"/> Permissions: <input type="text" value="Full Control"/> </div> <div style="margin-top: 10px;"> Users / Groups: <input type="text" value="engineering"/> <div style="font-size: small; margin-top: -10px;">Valid users and groups separated by a semicolon</div> </div>
--	---

13. **CIFS Setup:** If you chose the CIFS protocol, set up a CIFS server.

Field	Description
DNS Primary and Secondary IP Address	The IP addresses of the DNS servers that provide name resolution for the CIFS server. The listed DNS servers must contain the service location records (SRV) needed to locate the Active Directory LDAP servers and domain controllers for the domain that the CIFS server will join.
Active Directory Domain to join	The FQDN of the Active Directory (AD) domain that you want the CIFS server to join.
Credentials authorized to join the domain	The name and password of a Windows account with sufficient privileges to add computers to the specified Organizational Unit (OU) within the AD domain.
CIFS server NetBIOS name	A CIFS server name that is unique in the AD domain.
Organizational Unit	The organizational unit within the AD domain to associate with the CIFS server. The default is CN=Computers.
DNS Domain	The DNS domain for the Cloud Volumes ONTAP storage virtual machine (SVM). In most cases, the domain is the same as the AD domain.
NTP Server	Select Use Active Directory Domain to configure an NTP server using the Active Directory DNS. If you need to configure an NTP server using a different address, then you should use the API. See the Cloud Manager API Developer Guide for details.

14. **Usage Profile, Disk Type, and Tiering Policy:** Choose whether you want to enable storage efficiency features and change the volume tiering policy, if needed.

For more information, see [Understanding volume usage profiles](#) and [Data tiering overview](#).

15. **Review & Approve:** Review and confirm your selections.

- a. Review details about the configuration.
- b. Click **More information** to review details about support and the GCP resources that Cloud Manager will purchase.

c. Select the **I understand...** check boxes.

d. Click **Go**.

Result

Cloud Manager deploys the Cloud Volumes ONTAP system. You can track the progress in the timeline.

If you experience any issues deploying the Cloud Volumes ONTAP system, review the failure message. You can also select the working environment and click **Re-create environment**.

For additional help, go to [NetApp Cloud Volumes ONTAP Support](#).

After you finish

- If you provisioned a CIFS share, give users or groups permissions to the files and folders and verify that those users can access the share and create a file.
- If you want to apply quotas to volumes, use System Manager or the CLI.

Quotas enable you to restrict or track the disk space and number of files used by a user, group, or qtree.

Launching an HA pair in GCP

Create a working environment in Cloud Manager to launch Cloud Volumes ONTAP in GCP.

What you'll need

- You should have a [Connector that is associated with your workspace](#).



You must be an Account Admin to create a Connector. When you create your first Cloud Volumes ONTAP working environment, Cloud Manager prompts you to create a Connector if you don't have one yet.

- The service account associated with the Connector [should have the latest permissions](#).
- [You should be prepared to leave the Connector running at all times](#).
- You should have chosen a configuration and obtained GCP networking information from your administrator. For details, see [Planning your Cloud Volumes ONTAP configuration](#).
- To deploy a BYOL system, you need the 20-digit serial number (license key) for each node.
- The following Google Cloud APIs should be [enabled in your project](#):
 - Cloud Deployment Manager V2 API
 - Cloud Logging API
 - Cloud Resource Manager API
 - Compute Engine API
 - Identity and Access Management (IAM) API

Steps

1. On the Canvas page, click **Add Working Environment** and follow the prompts.
2. **Choose a Location:** Select **Google Cloud** and **Cloud Volumes ONTAP HA**.
3. **Details & Credentials:** Select a project, specify a cluster name, optionally select a Service Account, optionally add labels, and then specify credentials.

The following table describes fields for which you might need guidance:

Field	Description
Working Environment Name	Cloud Manager uses the working environment name to name both the Cloud Volumes ONTAP system and the GCP VM instance. It also uses the name as the prefix for the predefined security group, if you select that option.
Service Account Name	If you plan to use the Tiering or Cloud Backup services, you need to enable the Service Account switch and then select the Service Account that has the predefined Storage Admin role.
Add Labels	<p>Labels are metadata for your GCP resources. Cloud Manager adds the labels to the Cloud Volumes ONTAP system and GCP resources associated with the system.</p> <p>You can add up to four labels from the user interface when creating a working environment, and then you can add more after its created. Note that the API does not limit you to four labels when creating a working environment.</p> <p>For information about labels, refer to Google Cloud Documentation: Labeling Resources.</p>
User name and password	These are the credentials for the Cloud Volumes ONTAP cluster admin account. You can use these credentials to connect to Cloud Volumes ONTAP through System Manager or its CLI.
Edit Project	<p>Select the project where you want Cloud Volumes ONTAP to reside. The default project is the project where Cloud Manager resides.</p> <p>If you don't see any additional projects in the drop-down list, then you haven't yet associated the Cloud Manager service account with other projects. Go to the Google Cloud console, open the IAM service, and select the project. Add the service account with the Cloud Manager role to that project. You'll need to repeat this step for each project.</p> <p> This is the service account that you set up for Cloud Manager, as described in step 4b on this page.</p> <p>Click Add Subscription to associate the selected credentials with a subscription.</p> <p>To create a pay-as-you-go Cloud Volumes ONTAP system, you need to select a GCP project that's associated with a subscription to Cloud Volumes ONTAP from the GCP Marketplace.</p>

The following video shows how to associate a pay-as-you-go Marketplace subscription to your GCP project:

► https://docs.netapp.com/us-en/occm/media/video_subscribing_gcp.mp4 (video)

4. **Services:** Select the services that you want to use on this system. In order to select Cloud Backup, or to use Tiering, you must have specified the Service Account in step 3.
5. **HA Deployment Models:** Choose multiple zones (recommended) or a single zone for the HA configuration. Then select a region and zones.

[Learn more about HA deployment models.](#)

6. **Connectivity:** Select four different VPCs for the HA configuration, a subnet in each VPC, and then choose a firewall policy.

[Learn more about networking requirements.](#)

7. **License & Support Site Account:** Specify whether you want to use pay-as-you-go or BYOL, and then specify a NetApp Support Site account.

To understand how licenses work, see [Licensing](#).

A NetApp Support Site Account is optional for pay-as-you-go, but required for BYOL systems. [Learn how to add NetApp Support Site accounts](#).

8. **Preconfigured Packages:** Select one of the packages to quickly deploy a Cloud Volumes ONTAP system, or click [Create my own configuration](#).

If you choose one of the packages, you only need to specify a volume and then review and approve the configuration.

9. **Licensing:** Change the Cloud Volumes ONTAP version as needed, select a license, and select a virtual machine type.

If your needs change after you launch the system, you can modify the license or virtual machine type later.



If a newer Release Candidate, General Availability, or patch release is available for the selected version, then Cloud Manager updates the system to that version when creating the working environment. For example, the update occurs if you select Cloud Volumes ONTAP 9.8 RC1 and 9.8 GA is available. The update does not occur from one release to another—for example, from 9.7 to 9.8.

10. **Underlying Storage Resources:** Choose settings for the initial aggregate: a disk type and the size for each disk.

The disk type is for the initial volume. You can choose a different disk type for subsequent volumes.

The disk size is for all disks in the initial aggregate and for any additional aggregates that Cloud Manager creates when you use the simple provisioning option. You can create aggregates that use a different disk size by using the advanced allocation option.

For help choosing a disk type and size, see [Sizing your system in GCP](#).

11. **WORM:** Activate write once, read many (WORM) storage, if desired.

WORM can't be enabled if data tiering was enabled. [Learn more about WORM storage](#).

12. **Data Tiering in Google Cloud Platform:** Choose whether to enable data tiering on the initial aggregate, choose a storage class for the tiered data, and then select a service account that has the predefined Storage Admin role.

Note the following:

- Cloud Manager sets the service account on the Cloud Volumes ONTAP instance. This service account provides permissions for data tiering to a Google Cloud Storage bucket. Be sure to add the Connector service account as a user of the tiering service account, otherwise, you can't select it from Cloud Manager.
- You can choose a specific volume tiering policy when you create or edit a volume.
- If you disable data tiering, you can enable it on subsequent aggregates, but you'll need to turn off the system and add a service account from the GCP console.

[Learn more about data tiering.](#)

13. Create Volume:

Enter details for the new volume or click **Skip**.

Some of the fields in this page are self-explanatory. The following table describes fields for which you might need guidance:

Field	Description
Size	The maximum size that you can enter largely depends on whether you enable thin provisioning, which enables you to create a volume that is bigger than the physical storage currently available to it.
Access control (for NFS only)	An export policy defines the clients in the subnet that can access the volume. By default, Cloud Manager enters a value that provides access to all instances in the subnet.
Permissions and Users / Groups (for CIFS only)	These fields enable you to control the level of access to a share for users and groups (also called access control lists or ACLs). You can specify local or domain Windows users or groups, or UNIX users or groups. If you specify a domain Windows user name, you must include the user's domain using the format domain\username.
Snapshot Policy	A Snapshot copy policy specifies the frequency and number of automatically created NetApp Snapshot copies. A NetApp Snapshot copy is a point-in-time file system image that has no performance impact and requires minimal storage. You can choose the default policy or none. You might choose none for transient data: for example, tempdb for Microsoft SQL Server.
Advanced options (for NFS only)	Select an NFS version for the volume: either NFSv3 or NFSv4.
Initiator group and IQN (for iSCSI only)	<p>iSCSI storage targets are called LUNs (logical units) and are presented to hosts as standard block devices.</p> <p>Initiator groups are tables of iSCSI host node names and control which initiators have access to which LUNs.</p> <p>iSCSI targets connect to the network through standard Ethernet network adapters (NICs), TCP offload engine (TOE) cards with software initiators, converged network adapters (CNAs) or dedicated host bus adapters (HBAs) and are identified by iSCSI qualified names (IQNs).</p> <p>When you create an iSCSI volume, Cloud Manager automatically creates a LUN for you. We've made it simple by creating just one LUN per volume, so there's no management involved. After you create the volume, use the IQN to connect to the LUN from your hosts.</p>

The following image shows the Volume page filled out for the CIFS protocol:

The screenshot shows the 'Volume Details, Protection & Protocol' page. In the 'Protocol' section, 'CIFS' is selected. Under 'Details & Protection', the 'Volume Name' is 'vol' and the 'Size (GB)' is '250'. The 'Snapshot Policy' is set to 'default'. A note indicates 'Default Policy'. In the 'Protocol' section, the 'Share name' is 'vol_share' and the 'Permissions' are 'Full Control'. The 'Users / Groups' field contains 'engineering'. A note states 'Valid users and groups separated by a semicolon'.

14. **CIFS Setup:** If you chose the CIFS protocol, set up a CIFS server.

Field	Description
DNS Primary and Secondary IP Address	The IP addresses of the DNS servers that provide name resolution for the CIFS server. The listed DNS servers must contain the service location records (SRV) needed to locate the Active Directory LDAP servers and domain controllers for the domain that the CIFS server will join.
Active Directory Domain to join	The FQDN of the Active Directory (AD) domain that you want the CIFS server to join.
Credentials authorized to join the domain	The name and password of a Windows account with sufficient privileges to add computers to the specified Organizational Unit (OU) within the AD domain.
CIFS server NetBIOS name	A CIFS server name that is unique in the AD domain.
Organizational Unit	The organizational unit within the AD domain to associate with the CIFS server. The default is CN=Computers.
DNS Domain	The DNS domain for the Cloud Volumes ONTAP storage virtual machine (SVM). In most cases, the domain is the same as the AD domain.
NTP Server	Select Use Active Directory Domain to configure an NTP server using the Active Directory DNS. If you need to configure an NTP server using a different address, then you should use the API. See the Cloud Manager API Developer Guide for details.

15. **Usage Profile, Disk Type, and Tiering Policy:** Choose whether you want to enable storage efficiency features and change the volume tiering policy, if needed.

For more information, see [Understanding volume usage profiles](#) and [Data tiering overview](#).

16. **Review & Approve:** Review and confirm your selections.

a. Review details about the configuration.

- b. Click **More information** to review details about support and the GCP resources that Cloud Manager will purchase.
- c. Select the **I understand...** check boxes.
- d. Click **Go**.

Result

Cloud Manager deploys the Cloud Volumes ONTAP system. You can track the progress in the timeline.

If you experience any issues deploying the Cloud Volumes ONTAP system, review the failure message. You can also select the working environment and click **Re-create environment**.

For additional help, go to [NetApp Cloud Volumes ONTAP Support](#).

After you finish

- If you provisioned a CIFS share, give users or groups permissions to the files and folders and verify that those users can access the share and create a file.
- If you want to apply quotas to volumes, use System Manager or the CLI.

Quotas enable you to restrict or track the disk space and number of files used by a user, group, or qtree.

Provision and manage storage

Provisioning storage

You can provision additional storage for your Cloud Volumes ONTAP systems from Cloud Manager by managing volumes and aggregates.



All disks and aggregates must be created and deleted directly from Cloud Manager. You should not perform these actions from another management tool. Doing so can impact system stability, hamper the ability to add disks in the future, and potentially generate redundant cloud provider fees.

Creating FlexVol volumes

If you need more storage after you launch a Cloud Volumes ONTAP system, you can create new FlexVol volumes for NFS, CIFS, or iSCSI from Cloud Manager.

About this task

When you create an iSCSI volume, Cloud Manager automatically creates a LUN for you. We've made it simple by creating just one LUN per volume, so there's no management involved. After you create the volume, [use the IQN to connect to the LUN from your hosts](#).



You can create additional LUNs from System Manager or the CLI.

Before you begin

If you want to use CIFS in AWS, you must have set up DNS and Active Directory. For details, see [Networking requirements for Cloud Volumes ONTAP for AWS](#).

Steps

1. On the Canvas page, double-click the name of the Cloud Volumes ONTAP system on which you want to provision FlexVol volumes.
2. Create a new volume on any aggregate or on a specific aggregate:

Action	Steps
Create a new volume and let Cloud Manager choose the containing aggregate	Click Add New Volume .
Create a new volume on a specific aggregate	<ol style="list-style-type: none"> a. Click the menu icon, and then click Advanced > Advanced allocation. b. Click the menu for an aggregate. c. Click Create volume.

3. Enter details for the new volume, and then click **Continue**.

Some of the fields in this page are self-explanatory. The following table describes fields for which you might need guidance:

Field	Description
Size	The maximum size that you can enter largely depends on whether you enable thin provisioning, which enables you to create a volume that is bigger than the physical storage currently available to it.
Access control (for NFS only)	An export policy defines the clients in the subnet that can access the volume. By default, Cloud Manager enters a value that provides access to all instances in the subnet.
Permissions and Users / Groups (for CIFS only)	These fields enable you to control the level of access to a share for users and groups (also called access control lists or ACLs). You can specify local or domain Windows users or groups, or UNIX users or groups. If you specify a domain Windows user name, you must include the user's domain using the format domain\username.
Snapshot Policy	A Snapshot copy policy specifies the frequency and number of automatically created NetApp Snapshot copies. A NetApp Snapshot copy is a point-in-time file system image that has no performance impact and requires minimal storage. You can choose the default policy or none. You might choose none for transient data: for example, tempdb for Microsoft SQL Server.
Advanced options (for NFS only)	Select an NFS version for the volume: either NFSv3 or NFSv4.

Field	Description
Initiator group and IQN (for iSCSI only)	<p>iSCSI storage targets are called LUNs (logical units) and are presented to hosts as standard block devices.</p> <p>Initiator groups are tables of iSCSI host node names and control which initiators have access to which LUNs.</p> <p>iSCSI targets connect to the network through standard Ethernet network adapters (NICs), TCP offload engine (TOE) cards with software initiators, converged network adapters (CNAs) or dedicated host bus adapters (HBAs) and are identified by iSCSI qualified names (IQNs).</p> <p>When you create an iSCSI volume, Cloud Manager automatically creates a LUN for you. We've made it simple by creating just one LUN per volume, so there's no management involved. After you create the volume, use the IQN to connect to the LUN from your hosts.</p>

4. If you chose the CIFS protocol and the CIFS server has not been set up, specify details for the server in the Create a CIFS Server dialog box, and then click **Save and continue**:

Field	Description
DNS Primary and Secondary IP Address	<p>The IP addresses of the DNS servers that provide name resolution for the CIFS server.</p> <p>The listed DNS servers must contain the service location records (SRV) needed to locate the Active Directory LDAP servers and domain controllers for the domain that the CIFS server will join.</p>
Active Directory Domain to join	The FQDN of the Active Directory (AD) domain that you want the CIFS server to join.
Credentials authorized to join the domain	The name and password of a Windows account with sufficient privileges to add computers to the specified Organizational Unit (OU) within the AD domain.
CIFS server NetBIOS name	A CIFS server name that is unique in the AD domain.
Organizational Unit	<p>The organizational unit within the AD domain to associate with the CIFS server. The default is CN=Computers.</p> <ul style="list-style-type: none"> • To configure AWS Managed Microsoft AD as the AD server for Cloud Volumes ONTAP, you should enter OU=Computers,OU=corp in this field. • To configure Azure AD Domain Services as the AD server for Cloud Volumes ONTAP, you should enter OU=AADDC Computers or OU=AADDC Users in this field. <p>Azure Documentation: Create an Organizational Unit (OU) in an Azure AD Domain Services managed domain</p>
DNS Domain	The DNS domain for the Cloud Volumes ONTAP storage virtual machine (SVM). In most cases, the domain is the same as the AD domain.

Field	Description
NTP Server	Select Use Active Directory Domain to configure an NTP server using the Active Directory DNS. If you need to configure an NTP server using a different address, then you should use the API. See the Cloud Manager API Developer Guide for details.

5. On the Usage Profile, Disk Type, and Tiering Policy page, choose whether you want to enable storage efficiency features, choose a disk type, and edit the tiering policy, if needed.

For help, refer to the following:

- [Understanding volume usage profiles](#)
- [Sizing your system in AWS](#)
- [Sizing your system in Azure](#)
- [Data tiering overview](#)

6. Click **Go**.

Result

Cloud Volumes ONTAP provisions the volume.

After you finish

If you provisioned a CIFS share, give users or groups permissions to the files and folders and verify that those users can access the share and create a file.

If you want to apply quotas to volumes, you must use System Manager or the CLI. Quotas enable you to restrict or track the disk space and number of files used by a user, group, or qtree.

Creating FlexVol volumes on the second node in an HA configuration

By default, Cloud Manager creates volumes on the first node in an HA configuration. If you need an active-active configuration, in which both nodes serve data to clients, you must create aggregates and volumes on the second node.

Steps

1. On the Canvas page, double-click the name of the Cloud Volumes ONTAP working environment on which you want to manage aggregates.
2. Click the menu icon and then click **Advanced > Advanced allocation**.
3. Click **Add Aggregate** and then create the aggregate.
4. For Home Node, choose the second node in the HA pair.
5. After Cloud Manager creates the aggregate, select it and then click **Create volume**.
6. Enter details for the new volume, and then click **Create**.

After you finish

You can create additional volumes on this aggregate if required.



For HA pairs deployed in multiple AWS Availability Zones, you must mount the volume to clients by using the floating IP address of the node on which the volume resides.

Creating aggregates

You can create aggregates yourself or let Cloud Manager do it for you when it creates volumes. The benefit of creating aggregates yourself is that you can choose the underlying disk size, which enables you to size your aggregate for the capacity or the performance that you need.

Steps

1. On the Canvas page, double-click the name of the Cloud Volumes ONTAP instance on which you want to manage aggregates.
2. Click the menu icon, and then click **Advanced > Advanced allocation**.
3. Click **Add Aggregate** and then specify details for the aggregate.

For help with disk type and disk size, see [Planning your configuration](#).

4. Click **Go**, and then click **Approve and Purchase**.

Connecting a LUN to a host

When you create an iSCSI volume, Cloud Manager automatically creates a LUN for you. We've made it simple by creating just one LUN per volume, so there's no management involved. After you create the volume, use the IQN to connect to the LUN from your hosts.

Note the following:

1. Cloud Manager's automatic capacity management doesn't apply to LUNs. When Cloud Manager creates a LUN, it disables the autogrow feature.
2. You can create additional LUNs from System Manager or the CLI.

Steps

1. On the Canvas page, double-click the Cloud Volumes ONTAP working environment on which you want to manage volumes.
2. Select a volume, and then click **Target IQN**.
3. Click **Copy** to copy the IQN name.
4. Set up an iSCSI connection from the host to the LUN.
 - [ONTAP 9 iSCSI express configuration for Red Hat Enterprise Linux: Starting the iSCSI sessions with the target](#)
 - [ONTAP 9 iSCSI express configuration for Windows: Starting iSCSI sessions with the target](#)

Using FlexCache volumes to accelerate data access

A FlexCache volume is a storage volume that caches NFS read data from an origin (or source) volume. Subsequent reads to the cached data result in faster access to that data.

You can use FlexCache volumes to speed up access to data or to offload traffic from heavily accessed volumes. FlexCache volumes help improve performance, especially when clients need to access the same data repeatedly, because the data can be served directly without having to access the origin volume. FlexCache volumes work well for system workloads that are read-intensive.

Cloud Manager does not provide management of FlexCache volumes at this time, but you can use the ONTAP CLI or ONTAP System Manager to create and manage FlexCache volumes:

- [FlexCache Volumes for Faster Data Access Power Guide](#)
- [Creating FlexCache volumes in System Manager](#)

Starting with the 3.7.2 release, Cloud Manager generates a FlexCache license for all new Cloud Volumes ONTAP systems. The license includes a 500 GB usage limit.



To generate the license, Cloud Manager needs to access <https://ipa-signer.cloudmanager.netapp.com>. Make sure that this URL is accessible from your firewall.



Managing existing storage

Cloud Manager enables you to manage volumes, aggregates, and CIFS servers. It also prompts you to move volumes to avoid capacity issues.

Managing existing volumes

You can manage existing volumes as your storage needs change. You can view, edit, clone, restore, and delete volumes.

Steps

1. On the Canvas page, double-click the Cloud Volumes ONTAP working environment on which you want to manage volumes.
2. Manage your volumes:

Task	Action
View information about a volume	Select a volume, and then click Info .

Task	Action
Edit a volume (read-write volumes only)	<p>a. Select a volume, and then click Edit.</p> <p>b. Modify the volume's Snapshot policy, NFS protocol version, NFS access control list, or share permissions, and then click Update.</p> <p> If you need custom Snapshot policies, you can create them by using System Manager.</p>
Clone a volume	<p>a. Select a volume, and then click Clone.</p> <p>b. Modify the clone name as needed, and then click Clone.</p> <p>This process creates a FlexClone volume. A FlexClone volume is a writable, point-in-time copy that is space-efficient because it uses a small amount of space for metadata, and then only consumes additional space as data is changed or added.</p> <p>To learn more about FlexClone volumes, see the ONTAP 9 Logical Storage Management Guide.</p>
Restore data from a Snapshot copy to a new volume	<p>a. Select a volume, and then click Restore from Snapshot copy.</p> <p>b. Select a Snapshot copy, enter a name for the new volume, and then click Restore.</p>
Create a Snapshot copy on demand	<p>a. Select a volume, and then click Create a Snapshot copy.</p> <p>b. Change the name, if needed, and then click Create.</p>
Get the NFS mount command	<p>a. Select a volume, and then click Mount Command.</p> <p>b. Click Copy.</p>
View the target iQN for an iSCSI volume	<p>a. Select a volume, and then click Target iQN.</p> <p>b. Click Copy.</p> <p>c. Use the IQN to connect to the LUN from your hosts.</p>
Change the underlying disk type	<p>a. Select a volume, and then click Change Disk Type & Tiering Policy.</p> <p>b. Select the disk type, and then click Change.</p> <p> Cloud Manager moves the volume to an existing aggregate that uses the selected disk type or it creates a new aggregate for the volume.</p>

Task	Action
Change the tiering policy	<ol style="list-style-type: none"> a. Select a volume, and then click Change Disk Type & Tiering Policy. b. Click Edit Policy. c. Select a different policy and click Change. <p> Cloud Manager moves the volume to an existing aggregate that uses the selected disk type with tiering, or it creates a new aggregate for the volume.</p>
Delete a volume	<ol style="list-style-type: none"> a. Select a volume, and then click Delete. b. Click Delete again to confirm.

Managing existing aggregates

Manage aggregates yourself by adding disks, viewing information about the aggregates, and by deleting them.

Before you begin

If you want to delete an aggregate, you must have first deleted the volumes in the aggregate.

About this task

If an aggregate is running out of space, you can move volumes to another aggregate by using OnCommand System Manager.

Steps

1. On the Canvas page, double-click the Cloud Volumes ONTAP working environment on which you want to manage aggregates.
2. Click the menu icon and then click **Advanced > Advanced allocation**.
3. Manage your aggregates:

Task	Action
View information about an aggregate	Select an aggregate and click Info .
Create a volume on a specific aggregate	Select an aggregate and click Create volume .
Add disks to an aggregate	<ol style="list-style-type: none"> a. Select an aggregate and click Add AWS disks or Add Azure disks. b. Select the number of disks that you want to add and click Add. <p> All disks in an aggregate must be the same size.</p>
Delete an aggregate	<ol style="list-style-type: none"> a. Select an aggregate that does not contain any volumes and click Delete. b. Click Delete again to confirm.

Modifying the CIFS server

If you change your DNS servers or Active Directory domain, you need to modify the CIFS server in Cloud Volumes ONTAP so that it can continue to serve storage to clients.

Steps

1. From the working environment, click the menu icon and then click **Advanced > CIFS setup**.
2. Specify settings for the CIFS server:

Task	Action
DNS Primary and Secondary IP Address	The IP addresses of the DNS servers that provide name resolution for the CIFS server. The listed DNS servers must contain the service location records (SRV) needed to locate the Active Directory LDAP servers and domain controllers for the domain that the CIFS server will join.
Active Directory Domain to join	The FQDN of the Active Directory (AD) domain that you want the CIFS server to join.
Credentials authorized to join the domain	The name and password of a Windows account with sufficient privileges to add computers to the specified Organizational Unit (OU) within the AD domain.
CIFS server NetBIOS name	A CIFS server name that is unique in the AD domain.
Organizational Unit	The organizational unit within the AD domain to associate with the CIFS server. The default is CN=Computers. If you configure AWS Managed Microsoft AD as the AD server for Cloud Volumes ONTAP, you should enter OU=Computers,OU=corp in this field.
DNS Domain	The DNS domain for the Cloud Volumes ONTAP storage virtual machine (SVM). In most cases, the domain is the same as the AD domain.
NTP Server	Select Use Active Directory Domain to configure an NTP server using the Active Directory DNS. If you need to configure an NTP server using a different address, then you should use the API. See the Cloud Manager API Developer Guide for details.

3. Click **Save**.

Result

Cloud Volumes ONTAP updates the CIFS server with the changes.

Moving a volume

Move volumes for capacity utilization, improved performance, and to satisfy service-level agreements.

You can move a volume in System Manager by selecting a volume and the destination aggregate, starting the volume move operation, and optionally monitoring the volume move job. When using System Manager, a volume move operation finishes automatically.

Steps

1. Use System Manager or the CLI to move the volumes to the aggregate.

In most situations, you can use System Manager to move volumes.

For instructions, see the [ONTAP 9 Volume Move Express Guide](#).

Moving a volume when Cloud Manager displays an Action Required message

Cloud Manager might display an Action Required message that says moving a volume is necessary to avoid capacity issues, but that it cannot provide recommendations to correct the issue. If this happens, you need to identify how to correct the issue and then move one or more volumes.

Steps

1. [Identify how to correct the issue](#).
2. Based on your analysis, move volumes to avoid capacity issues:
 - [Move volumes to another system](#).
 - [Move volumes to another aggregate on the same system](#).

Identifying how to correct capacity issues

If Cloud Manager cannot provide recommendations for moving a volume to avoid capacity issues, you must identify the volumes that you need to move and whether you should move them to another aggregate on the same system or to another system.

Steps

1. View the advanced information in the Action Required message to identify the aggregate that has reached its capacity limit.

For example, the advanced information should say something similar to the following: Aggregate aggr1 has reached its capacity limit.

2. Identify one or more volumes to move out of the aggregate:

- a. In the working environment, click the menu icon, and then click **Advanced > Advanced allocation**.
- b. Select the aggregate, and then click **Info**.
- c. Expand the list of volumes.

Used Aggregate Capacity: 105.66 GB

Volumes:

4

Vol54 (54 GB)

data_vol (150 GB)

svm_FinanceOnPrem_root (1 GB)



- d. Review the size of each volume and choose one or more volumes to move out of the aggregate.

You should choose volumes that are large enough to free space in the aggregate so that you avoid additional capacity issues in the future.

3. If the system has not reached the disk limit, you should move the volumes to an existing aggregate or a new aggregate on the same system.

For details, see [Moving volumes to another aggregate to avoid capacity issues](#).

4. If the system has reached the disk limit, do any of the following:

- a. Delete any unused volumes.
- b. Rearrange volumes to free space on an aggregate.

For details, see [Moving volumes to another aggregate to avoid capacity issues](#).

- c. Move two or more volumes to another system that has space.

For details, see [Moving volumes to another system to avoid capacity issues](#).

Moving volumes to another system to avoid capacity issues

You can move one or more volumes to another Cloud Volumes ONTAP system to avoid capacity issues. You might need to do this if the system reached its disk limit.

About this task

You can follow the steps in this task to correct the following Action Required message:

Moving a volume is necessary to avoid capacity issues; however, Cloud Manager cannot perform this action for you because the system has reached the disk limit.

Steps

1. Identify a Cloud Volumes ONTAP system that has available capacity, or deploy a new system.
2. Drag and drop the source working environment on the target working environment to perform a one-time data replication of the volume.

For details, see [Replicating data between systems](#).

3. Go to the Replication Status page, and then break the SnapMirror relationship to convert the replicated volume from a data protection volume to a read/write volume.

For details, see [Managing data replication schedules and relationships](#).

4. Configure the volume for data access.

For information about configuring a destination volume for data access, see the [ONTAP 9 Volume Disaster Recovery Express Guide](#).

5. Delete the original volume.

For details, see [Managing existing volumes](#).

Moving volumes to another aggregate to avoid capacity issues

You can move one or more volumes to another aggregate to avoid capacity issues.

About this task

You can follow the steps in this task to correct the following Action Required message:

Moving two or more volumes is necessary to avoid capacity issues; however, Cloud Manager cannot perform this action for you.

Steps

1. Verify whether an existing aggregate has available capacity for the volumes that you need to move:
 - a. In the working environment, click the menu icon, and then click **Advanced > Advanced allocation**.
 - b. Select each aggregate, click **Info**, and then view the available capacity (aggregate capacity minus used aggregate capacity).

aggr1

Aggregate Capacity: 442.94 GB

Used Aggregate Capacity: 105.66 GB

2. If needed, add disks to an existing aggregate:
 - a. Select the aggregate, and then click **Add disks**.
 - b. Select the number of disks to add, and then click **Add**.
3. If no aggregates have available capacity, create a new aggregate.

For details, see [Creating aggregates](#).

4. Use System Manager or the CLI to move the volumes to the aggregate.
5. In most situations, you can use System Manager to move volumes.

For instructions, see the [ONTAP 9 Volume Move Express Guide](#).

Reasons why a volume move might perform slowly

Moving a volume might take longer than you expect if any of the following conditions are true for Cloud Volumes ONTAP:

- The volume is a clone.
- The volume is a parent of a clone.
- The source or destination aggregate has a single Throughput Optimized HDD (st1) disk.
- The Cloud Volumes ONTAP system is in AWS and one aggregate uses an older naming scheme for objects. Both aggregates have to use the same name format.

An older naming scheme is used if data tiering was enabled on an aggregate in the 9.4 release or earlier.

- The encryption settings don't match on the source and destination aggregates, or a rekey is in progress.
- The *-tiering-policy* option was specified on the volume move to change the tiering policy.
- The *-generate-destination-key* option was specified on the volume move.

Tiering inactive data to low-cost object storage

You can reduce storage costs for Cloud Volumes ONTAP by combining an SSD or HDD performance tier for hot data with an object storage capacity tier for inactive data. Data tiering is powered by FabricPool technology. For a high-level overview, see [Data tiering overview](#).

To set up data tiering, you need to do the following:



1 Choose a supported configuration

Most configurations are supported. If you have a Cloud Volumes ONTAP Standard, Premium, or BYOL system running the most recent version, then you should be good to go. [Learn more](#).



2 Ensure connectivity between Cloud Volumes ONTAP and object storage

- For AWS, you'll need a VPC Endpoint to S3. [Learn more](#).
- For Azure, you won't need to do anything as long as Cloud Manager has the required permissions. [Learn more](#).
- For GCP, you need to configure the subnet for Private Google Access and set up a service account. [Learn more](#).



3 Ensure that you have an aggregate with tiering enabled

Data tiering must be enabled on an aggregate in order to enable data tiering on a volume. You should be aware of the requirements for new volumes and for existing volumes. [Learn more](#).



4 Choose a tiering policy when creating, modifying, or replicating a volume

Cloud Manager prompts you to choose a tiering policy when you create, modify, or replicate a volume.

- [Tiering data on read-write volumes](#)
- [Tiering data on data protection volumes](#)

What's not required for data tiering?

- You don't need to install a feature license to enable data tiering.
- You don't need to create the capacity tier (an S3 bucket, Azure Blob container, or GCP bucket). Cloud Manager does that for you.
- You don't need to enable data tiering at the system level.



Cloud Manager creates an object store for cold data when the system is created, [as long as there are no connectivity or permissions issues](#). After that, you just need to enable data tiering on volumes (and in some cases, [on aggregates](#)).

Configurations that support data tiering

You can enable data tiering when using specific configurations and features:

- Data tiering is supported with Cloud Volumes ONTAP Standard, Premium, and BYOL, starting with the following versions:
 - Version 9.2 in AWS
 - Version 9.4 in Azure with single node systems
 - Version 9.6 in Azure with HA pairs
 - Version 9.6 in GCP



Data tiering is not supported in Azure with the DS3_v2 virtual machine type.

- In AWS, the performance tier can be General Purpose SSDs, Provisioned IOPS SSDs, or Throughput Optimized HDDs.
- In Azure, the performance tier can be Premium SSD managed disks, Standard SSD managed disks, or Standard HDD managed disks.
- In GCP, the performance tier can be either SSDs or HDDs (standard disks).
- Data tiering is supported with encryption technologies.
- Thin provisioning must be enabled on volumes.

Requirements

Depending on your cloud provider, certain connections and permissions must be set up so that Cloud Volumes ONTAP can tier cold data to object storage.

Requirements to tier cold data to AWS S3

Ensure that Cloud Volumes ONTAP has a connection to S3. The best way to provide that connection is by creating a VPC Endpoint to the S3 service. For instructions, see [AWS Documentation: Creating a Gateway Endpoint](#).

When you create the VPC Endpoint, be sure to select the region, VPC, and route table that corresponds to the Cloud Volumes ONTAP instance. You must also modify the security group to add an outbound HTTPS rule that enables traffic to the S3 endpoint. Otherwise, Cloud Volumes ONTAP cannot connect to the S3 service.

If you experience any issues, see [AWS Support Knowledge Center: Why can't I connect to an S3 bucket using a gateway VPC endpoint?](#).

Requirements to tier cold data to Azure Blob storage

You don't need to set up a connection between the performance tier and the capacity tier as long as Cloud Manager has the required permissions. Cloud Manager enables a VNet service endpoint for you if the Cloud Manager policy has these permissions:

```
"Microsoft.Network/virtualNetworks/subnets/write",  
"Microsoft.Network/routeTables/join/action",
```

The permissions are included in the latest [Cloud Manager policy](#).

Requirements to tier cold data to a Google Cloud Storage bucket

- The subnet in which Cloud Volumes ONTAP resides must be configured for Private Google Access. For instructions, refer to [Google Cloud Documentation: Configuring Private Google Access](#).
- You need a service account that meets the following requirements:
 - It must have the predefined Storage Admin role.
 - The Connector service account must be a *Service Account User* of this tiering service account.

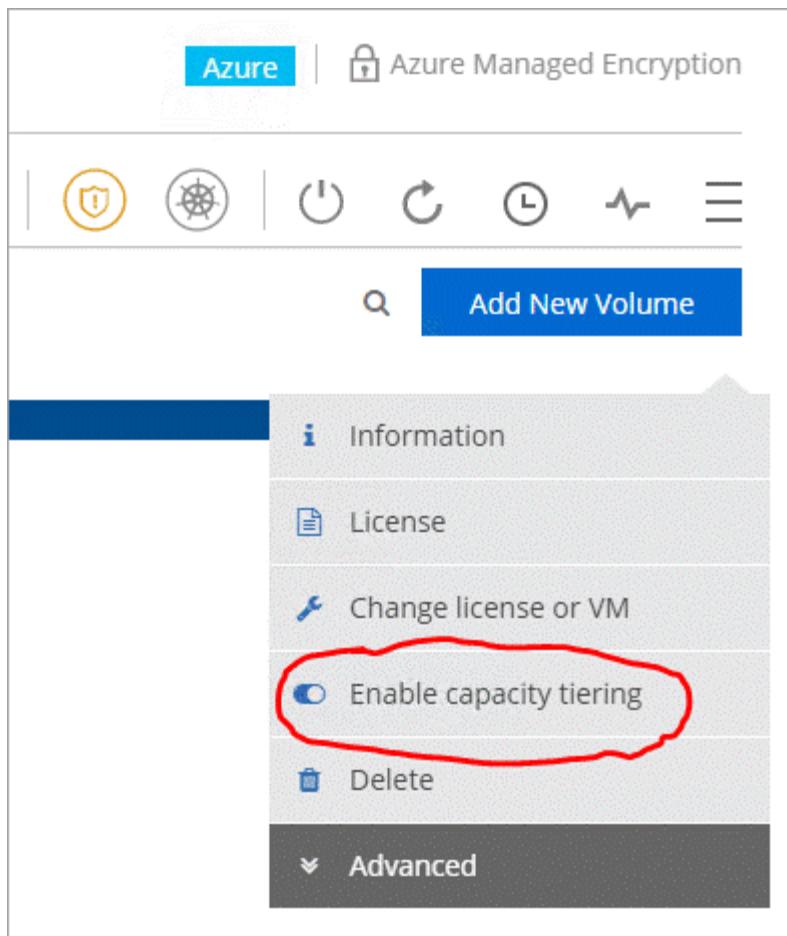
[Read step-by-step instructions](#).

Enabling data tiering after implementing the requirements

Cloud Manager creates an object store for cold data when the system is created, as long as there are no connectivity or permissions issues. If you didn't implement the requirements listed above until after you created the system, then you'll need to manually enable tiering, which creates the object store.

Steps

1. [Ensure that you've met all requirements](#).
2. On the Canvas page, double-click the name of the Cloud Volumes ONTAP instance.
3. Click the menu icon and select **Enable capacity tiering**.



You'll only see this option if data tiering couldn't be enabled when Cloud Manager created the system.

4. Click **Enable** so Cloud Manager can create the object store that this Cloud Volumes ONTAP system will use for tiered data.

Ensuring that tiering is enabled on aggregates

Data tiering must be enabled on an aggregate in order to enable data tiering on a volume. You should be aware of the requirements for new volumes and for existing volumes.

- **New volumes**

If you're enabling data tiering on a new volume, then you don't need to worry about enabling data tiering on an aggregate. Cloud Manager creates the volume on an existing aggregate that has tiering enabled, or it creates a new aggregate for the volume if a data tiering-enabled aggregate doesn't already exist.

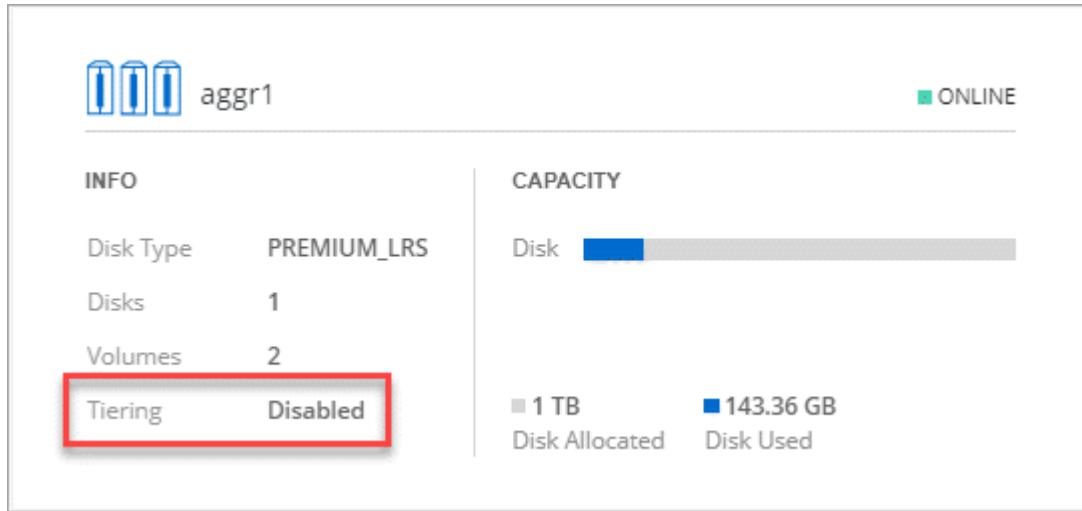
- **Existing volumes**

If you want to enable data tiering on an existing volume, then you'll need to ensure that data tiering is enabled on the underlying aggregate. If data tiering isn't enabled on the existing aggregate, then you'll need to use System Manager to attach an existing aggregate to the object store.

Steps to confirm whether tiering is enabled on an aggregate

1. Open the working environment in Cloud Manager.

2. Click the menu icon, click **Advanced**, and then click **Advanced allocation**.
3. Verify whether tiering is enabled or disabled on the aggregate.



Steps to enable tiering on an aggregate

1. In System Manager, click **Storage > Tiers**.
2. Click the action menu for the aggregate and select **Attach Cloud Tiers**.
3. Select the cloud tier to attach and click **Save**.

What's next?

You can now enable data tiering on new and existing volumes, as explained in the next section.

Tiering data from read-write volumes

Cloud Volumes ONTAP can tier inactive data on read-write volumes to cost-effective object storage, freeing up the performance tier for hot data.

Steps

1. In the working environment, create a new volume or change the tier of an existing volume:

Task	Action
Create a new volume	Click Add New Volume .
Modify an existing volume	Select the volume and click Change Disk Type & Tiering Policy .

2. Select a tiering policy.

For a description of these policies, see [Data tiering overview](#).

Example



Tiering data to object storage

Volume Tiering Policy

- All - Immediately tiers all data (not including metadata) to object storage.
- Auto - Tiers cold Snapshot copies and cold user data from the active file system to object storage.
- Snapshot Only - Tiers cold Snapshot copies to object storage
- None - Data tiering is disabled.

Working Environment S3 Storage classes: Standard

Cloud Manager creates a new aggregate for the volume if a data tiering-enabled aggregate does not already exist.

Tiering data from data protection volumes

Cloud Volumes ONTAP can tier data from a data protection volume to a capacity tier. If you activate the destination volume, the data gradually moves to the performance tier as it is read.

Steps

1. On the Canvas page, select the working environment that contains the source volume, and then drag it to the working environment to which you want to replicate the volume.
2. Follow the prompts until you reach the tiering page and enable data tiering to object storage.

Example



S3 Tiering

What are storage tiers?

- Enabled
- Disabled

Note: If you enable S3 tiering, thin provisioning must be enabled on volumes created in this aggregate.

For help with replicating data, see [Replicating data to and from the cloud](#).

Changing the storage class for tiered data

After you deploy Cloud Volumes ONTAP, you can reduce your storage costs by changing the storage class for inactive data that hasn't been accessed for 30 days. The access costs are higher if you do access the data, so you must take that into consideration before you change the storage class.

The storage class for tiered data is system wide—it's not per volume.

For information about supported storage classes, see [Data tiering overview](#).

Steps

1. From the working environment, click the menu icon and then click **Storage Classes** or **Blob Storage Tiering**.
2. Choose a storage class and then click **Save**.

Manage storage VMs

A storage VM is a virtual machine running within ONTAP that provides storage and data services to your clients. You might know this as an SVM or a *vserver*. Cloud Volumes ONTAP is configured with one storage VM by default, but some configurations support additional storage VMs.

Supported number of storage VMs

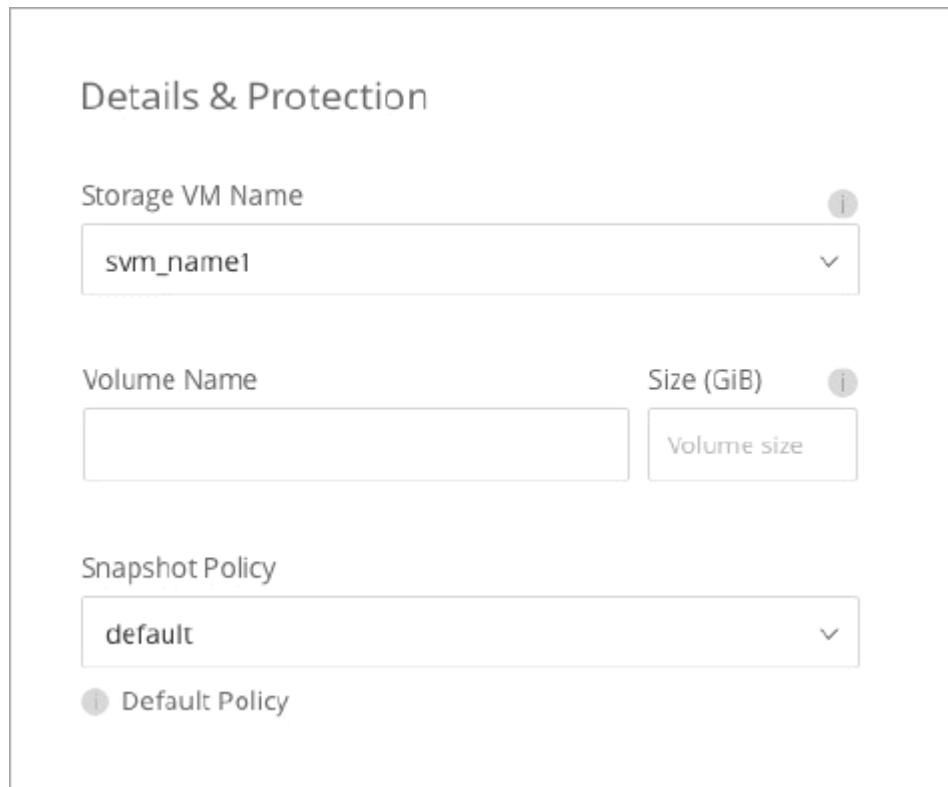
Cloud Volumes ONTAP 9.7 and 9.8 support multiple storage VMs in AWS with certain configurations and an add-on license. [View the number of supported storage VMs in AWS](#). Contact your account team to obtain an SVM add-on license.

All other Cloud Volumes ONTAP configurations support one data-serving storage VM and one destination storage VM used for disaster recovery. You can activate the destination storage VM for data access if there's an outage on the source storage VM.

Work with storage VMs in Cloud Manager

Cloud Manager supports any additional storage VMs that you create from System Manager or the CLI.

For example, the following image shows how you can choose a storage VM when you create a volume.



And the following image shows how you can choose a storage VM when replicating a volume to another system.

The screenshot shows a configuration interface with three main fields:

- Destination Volume Name:** A text input field containing "volume_copy".
- Destination Storage VM Name:** A dropdown menu currently set to "svm_name1".
- Destination Aggregate:** A dropdown menu currently set to "Automatically select the best aggregate".

Create data-serving storage VMs for Cloud Volumes ONTAP in AWS

As noted above, multiple storage VMs are supported with Cloud Volumes ONTAP in AWS. To create additional storage VMs, you need to allocate IP addresses in AWS and then run ONTAP commands based on your Cloud Volumes ONTAP configuration.

Verify limits for your configuration

Each EC2 instance supports a maximum number of private IPv4 addresses per network interface. You need to verify the limit before you allocate IP addresses in AWS for the new storage VM.

Steps

1. Go the [Storage limits section in the Cloud Volumes ONTAP Release Notes](#).
2. Identify the maximum number of IP addresses per interface for your instance type.
3. Make note of this number because you'll need it in the next section when you allocate IP addresses in AWS.

Allocate IP addresses in AWS

Private IPv4 addresses must be assigned to port e0a in AWS before you create LIFs for the new storage VM.

Note that an optional management LIF for a storage VM requires a private IP address on a single node system and on an HA pair in a single AZ. This management LIF provides a connection to management tools like SnapCenter.

Steps

1. Log in to AWS and open the EC2 service.
2. Select the Cloud Volumes ONTAP instance and click **Networking**.

If you're creating a storage VM on an HA pair, select node 1.

3. Scroll down to **Network interfaces** and click the **Interface ID** for port e0a.

Name	Insta...	Instance state	Instance type	Status check
danielleAws	i-070...	Running	m5.2xlarge	2/2 check
occmTiering0702	i-0a7...	Stopped	m5.2xlarge	-
cvoTiering1	i-02a...	Stopped	m5.2xlarge	-

Interface ID	Description
eni-07c301...	Interface for Node & Cluster Management, Inter-Cluster Communication, and Data - e0a

4. Select the network interface and click **Actions > Manage IP addresses**.
5. Expand the list of IP addresses for e0a.
6. Verify the IP addresses:
 - a. Count the number of allocated IP addresses to confirm that the port has room for additional IPs.
You should have identified the maximum number of supported IP addresses per interface in the previous section of this page.
 - b. Optional: Go to the CLI for Cloud Volumes ONTAP and run **network interface show** to confirm that each of these IP addresses are in use.
If an IP address isn't in use, then you can use it with the new storage VM.
7. Back in the AWS Console, click **Assign new IP address** to assign additional IP addresses based on the amount that you need for the new storage VM.
 - Single node system: One unused secondary private IP is required.
An optional secondary private IP is required if you want to create a management LIF on the storage VM.
 - HA pair in a single AZ: One unused secondary private IP is required on node 1.
An optional secondary private IP is required if you want to create a management LIF on the storage VM.
 - HA pair in multiple AZs: One unused secondary private IP is required on each node.
8. If you're allocating the IP address on an HA pair in a single AZ, enable **Allow secondary private IPv4 addresses to be reassigned**.
9. Click **Save**.
10. If you have an HA pair in multiple AZs, then you'll need to repeat these steps for node 2.

Create a storage VM on a single node system

These steps create a new storage VM on a single node system. One private IP address is required to create a NAS LIF and another optional private IP address is needed if you want to create a management LIF.

Steps

1. Create the storage VM and a route to the storage VM.

```
vserver create -rootvolume-security-style mixed -rootvolume root_svm_2  
-snapshot-policy default -vserver svm_2 -aggregate aggr1
```

```
network route create -destination 0.0.0.0/0 -vserver svm_2 -gateway  
subnet_gateway
```

2. Create a NAS LIF.

```
network interface create -auto-revert true -vserver svm_2 -service  
-policy default-data-files -home-port e0a -address private_ip_x -netmask  
node1Mask -lif ip_nas_2 -home-node cvo-node
```

Where *private_ip_x* is an unused secondary private IP on e0a.

3. Optional: Create a storage VM management LIF.

```
network interface create -auto-revert true -vserver svm_2 -service  
-policy default-management -home-port e0a -address private_ip_y -netmask  
node1Mask -lif ip_svm_mgmt_2 -home-node cvo-node
```

Where *private_ip_y* is another unused secondary private IP on e0a.

Create a storage VM on an HA pair in a single AZ

These steps create a new storage VM on an HA pair in a single AZ. One private IP address is required to create a NAS LIF and another optional private IP address is needed if you want to create a management LIF.

Both of these LIFs get allocated on node 1. The private IP addresses can move between nodes if failures occur.

Steps

1. Create the storage VM and a route to the storage VM.

```
vserver create -rootvolume-security-style mixed -rootvolume root_svm_2  
-snapshot-policy default -vserver svm_2 -aggregate aggr1
```

```
network route create -destination 0.0.0.0/0 -vserver svm_2 -gateway  
subnet_gateway
```

2. Create a NAS LIF on node 1.

```
network interface create -auto-revert true -vserver svm_2 -service  
-policy default-data-files -home-port e0a -address private_ip_x -netmask  
node1Mask -lif ip_nas_2 -home-node cvo-node1
```

Where *private_ip_x* is an unused secondary private IP on e0a of cvo-node1. This IP address can be relocated to the e0a of cvo-node2 in case of takeover because the service policy default-data-files indicates that IPs can migrate to the partner node.

3. Optional: Create a storage VM management LIF on node 1.

```
network interface create -auto-revert true -vserver svm_2 -service  
-policy default-management -home-port e0a -address private_ip_y -netmask  
node1Mask -lif ip_svm_mgmt_2 -home-node cvo-node1
```

Where *private_ip_y* is another unused secondary private IP on e0a.

Create a storage VM on an HA pair in multiple AZs

These steps create a new storage VM on an HA pair in multiple AZs.

A *floating* IP address is required for a NAS LIF and is optional for a management LIF. These floating IP addresses don't require you to allocate private IPs in AWS. Instead, the floating IPs are automatically configured in the AWS route table to point to a specific node's ENI in the same VPC.

In order for floating IPs to work with ONTAP, a private IP address must be configured on every storage VM on each node. This is reflected in the steps below where an iSCSI LIF is created on node 1 and on node 2.

Steps

1. Create the storage VM and a route to the storage VM.

```
vserver create -rootvolume-security-style mixed -rootvolume root_svm_2  
-snapshot-policy default -vserver svm_2 -aggregate aggr1
```

```
network route create -destination 0.0.0.0/0 -vserver svm_2 -gateway  
subnet_gateway
```

2. Create a NAS LIF on node 1.

```
network interface create -auto-revert true -vserver svm_2 -service  
-policy default-data-files -home-port e0a -address floating_ip -netmask  
node1Mask -lif ip_nas_floating_2 -home-node cvo-node1
```

- The floating IP address must be outside of the CIDR blocks for all VPCs in the AWS region in which you deploy the HA configuration. 192.168.209.27 is an example floating IP address. [Learn more about choosing a floating IP address](#).
- `-service-policy default-data-files` indicates that IPs can migrate to the partner node.

3. Optional: Create a storage VM management LIF on node 1.

```
network interface create -auto-revert true -vserver svm_2 -service
-policy default-management -home-port e0a -address floating_ip -netmask
node1Mask -lif ip_svm_mgmt_2 -home-node cvo-node1
```

4. Create an iSCSI LIF on node 1.

```
network interface create -vserver svm_2 -service-policy default-data-
blocks -home-port e0a -address private_ip -netmask node1Mask -lif
ip_node1_iscsi_2 -home-node cvo-node1
```

- This iSCSI LIF is required to support LIF migration of the floating IPs in the storage VM. It doesn't have to be an iSCSI LIF, but it can't be configured to migrate between nodes.
- `-service-policy default-data-block` indicates that an IP address does not migrate between nodes.
- `private_ip` is an unused secondary private IP address on eth0 (e0a) of cvo_node1.

5. Create an iSCSI LIF on node 2.

```
network interface create -vserver svm_2 -service-policy default-data-
blocks -home-port e0a -address private_ip -netmaskNode2Mask -lif
ip_node2_iscsi_2 -home-node cvo-node2
```

- This iSCSI LIF is required to support LIF migration of the floating IPs in the storage VM. It doesn't have to be an iSCSI LIF, but it can't be configured to migrate between nodes.
- `-service-policy default-data-block` indicates that an IP address does not migrate between nodes.
- `private_ip` is an unused secondary private IP address on eth0 (e0a) of cvo_node2.

Manage storage VMs for disaster recovery

Cloud Manager doesn't provide any setup or orchestration support for storage VM disaster recovery. You must use System Manager or the CLI.

- [SVM Disaster Recovery Preparation Express Guide](#)
- [SVM Disaster Recovery Express Guide](#)

Using Cloud Volumes ONTAP as persistent storage for Kubernetes

Cloud Manager can automate the deployment of NetApp Trident on Kubernetes clusters so you can use Cloud Volumes ONTAP as persistent storage for containers.

Trident is a fully-supported open source project maintained by NetApp. Trident integrates natively with Kubernetes and its Persistent Volume framework to seamlessly provision and manage volumes from systems running any combination of NetApp's storage platforms. [Learn more about Trident](#).



The Kubernetes feature isn't supported with on-prem ONTAP clusters. It's supported with Cloud Volumes ONTAP only.

Quick start

Get started quickly by following these steps or scroll down to the remaining sections for full details.

1

Review prerequisites

Ensure that your environment can meet the prerequisites, which includes connectivity between Kubernetes clusters and Cloud Volumes ONTAP, connectivity between Kubernetes clusters and a Connector, a minimum Kubernetes version of 1.14, at least one worker node in a cluster, and more. [See the complete list](#).

2

Add your Kubernetes clusters to Cloud Manager

In Cloud Manager, click **K8s** and discover clusters directly from your cloud provider's managed service or import a cluster by providing a kubeconfig file.

3

Connect your clusters to Cloud Volumes ONTAP

After you add a Kubernetes cluster, click **Connect to Working Environment** to connect the cluster to one or more Cloud Volumes ONTAP systems.

4

Start provisioning Persistent Volumes

Request and manage Persistent Volumes using native Kubernetes interfaces and constructs. Cloud Manager creates NFS and iSCSI storage classes that you can use when provisioning Persistent Volumes.

[Learn more about provisioning your first volume with Trident for Kubernetes](#).

Reviewing prerequisites

Before you get started, ensure that your Kubernetes clusters and Connector meet specific requirements.

Kubernetes cluster requirements

- Network connectivity is required between a Kubernetes cluster and the Connector and between a Kubernetes cluster and Cloud Volumes ONTAP.

Both the Connector and Cloud Volumes ONTAP need a connection to the Kubernetes API endpoint:

- For managed clusters, set up a route between a cluster’s VPC and the VPC where the Connector and Cloud Volumes ONTAP reside.
- For other clusters, the IP address of the master node or load balancer (as listed in the kubeconfig file) must be reachable by the Connector and Cloud Volumes ONTAP, and it must present a valid TLS certificate.
- A Kubernetes cluster can be in any location that has the network connectivity listed above.
- A Kubernetes cluster must be running version 1.14 at a minimum.

The maximum supported version is defined by Trident. [Click here to see the maximum supported Kubernetes version.](#)

- A Kubernetes cluster must have at least one worker node.
- For clusters running in Amazon Elastic Kubernetes Service (Amazon EKS), each cluster needs an IAM role added in order to resolve a permissions error. After you add the cluster, Cloud Manager will prompt you with the exact `eksctl` command that resolves the error.

[Learn about IAM permissions boundaries.](#)

- For clusters running in Azure Kubernetes Service (AKS), those clusters must be assigned the *Azure Kubernetes Service RBAC Cluster Admin* role. This is required so Cloud Manager can install Trident and configure storage classes on the cluster.
- For clusters running in Google Kubernetes Engine (GKE), those clusters must not use the default Container Optimized OS. You should switch them to use Ubuntu.

GKE defaults to using the Google [container-optimized image](#), which doesn’t have the utilities that Trident needs to mount volumes.

Connector requirements

Ensure that the following permissions are in place for the Connector.

Required permissions to discover and manage EKS clusters

The Connector needs Admin permissions to discover and manage Kubernetes clusters running in Amazon Elastic Kubernetes Service (EKS):

```
{
  "Version": "2012-10-17",
  "Statement": [
    {
      "Sid": "VisualEditor0",
      "Effect": "Allow",
      "Action": "eks:*",
      "Resource": "*"
    }
  ]
}
```

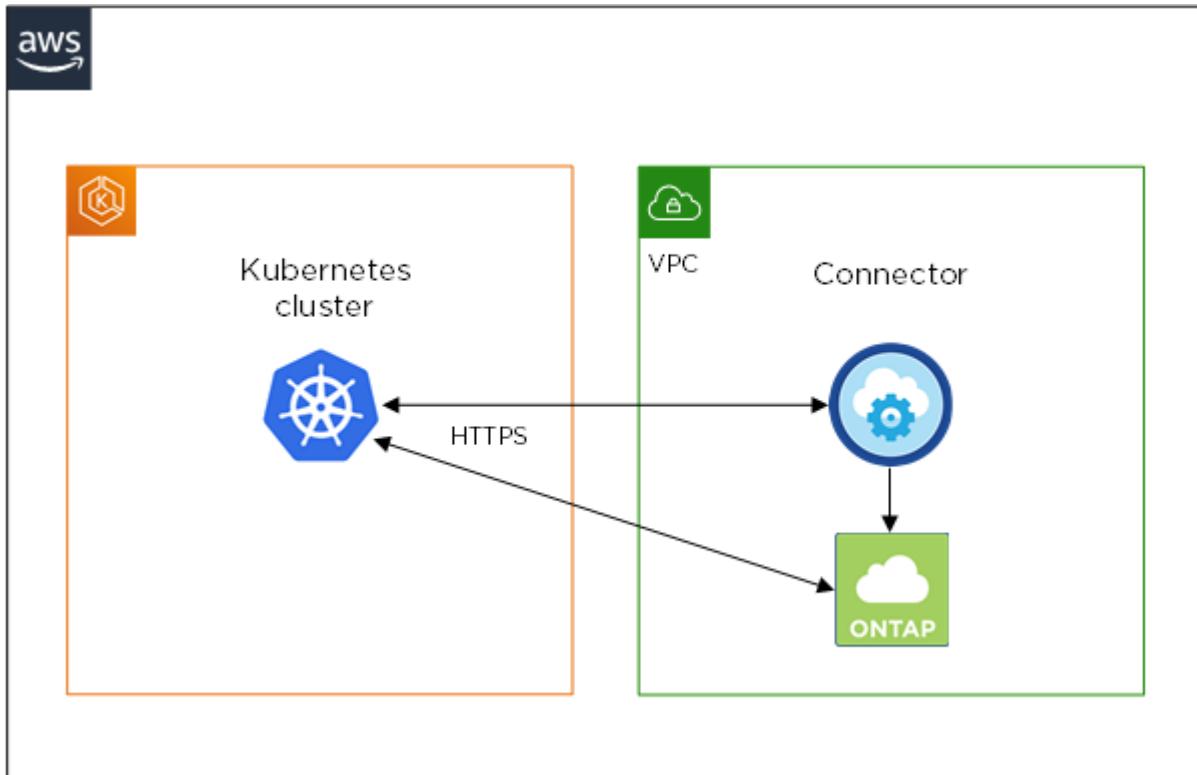
Required permissions to discover and manage GKE clusters

The Connector needs the following permissions to discover and manage Kubernetes clusters running in Google Kubernetes Engine (GKE):

```
container.*
```

Example setup

The following image shows an example of a Kubernetes cluster running in Amazon Elastic Kubernetes Service (Amazon EKS) and its connections to the Connector and Cloud Volumes ONTAP.



Adding Kubernetes clusters

Add Kubernetes clusters to Cloud Manager by discovering the clusters running in your cloud provider's managed Kubernetes service or by importing a cluster's kubeconfig file.

Steps

1. At the top of Cloud Manager, click **K8s**.
2. Click **Add Cluster**.
3. Choose one of the available options:
 - Click **Discover Clusters** to discover the managed clusters that Cloud Manager has access to based on permissions that you provided to the Connector.

For example, if your Connector is running in Google Cloud, Cloud Manager uses the permissions from the Connector's service account to discover clusters running in Google Kubernetes Engine (GKE).

- Click **Import Cluster** to import a cluster using a kubeconfig file.

After you upload the file, Cloud Manager verifies connectivity to the cluster and saves an encrypted copy of the kubeconfig file.

Result

Cloud Manager adds the Kubernetes cluster. You can now connect the cluster to Cloud Volumes ONTAP.

Connecting a cluster to Cloud Volumes ONTAP

Connect a Kubernetes cluster to Cloud Volumes ONTAP so you can use Cloud Volumes ONTAP as persistent storage for containers.

Steps

1. At the top of Cloud Manager, click **K8s**.
2. Click **Connect to Working Environment** for the cluster that you just added.

Status	Cluster Name	Added By	Version	Working Environments	Date Added
✓	kubernetes	Import	v1.18.0	Connect to Working Environment	August 30, 2020

3. Select a working environment and click **Continue**.
4. Choose the NetApp storage class to use as the default storage class for the Kubernetes cluster and click **Continue**.

When a user creates a persistent volume, the Kubernetes cluster can use this storage class as the backend storage by default.

5. Choose whether to use default auto export policies or whether to add a custom CIDR block.

Select Storage Class Type

Working Environment Information

Name	ishai0ntap4k8
Connected Clusters	None
Region	asia-east1
Zones	asia-east1-a
High Availability	Not Supported
Storage Classes	NFS Single Node Default iSCSI Single Node

Export Policy Information

If you plan to use NFS volumes you will need to set an export policy to allow connectivity between your clusters and your volumes.

Use the default auto-export policies. (Suitable for most cases.)

OR

General Network CIDR ⓘ
0.0.0.0/0

6. Click **Add Working Environment**.

Result

Cloud Manager connects the working environment to the cluster, which can take up to 15 minutes.

Managing your clusters

Cloud Manager enables you to manage your Kubernetes clusters by changing the default storage class, upgrading Trident, and more.

Changing the default storage class

Make sure that you've set a Cloud Volumes ONTAP storage class as the default storage class so clusters use Cloud Volumes ONTAP as the backend storage.

Steps

1. At the top of Cloud Manager, click **K8s**.
2. Click the name of the Kubernetes cluster.
3. In the **Storage Classes** table, click the actions menu on the far right for the storage class that you'd like to set as the default.

6 Storage Classes

Storage Class ID	Provisioner	Volumes	Labels	
Gp2	aws	0		...
NFS Single Node	NetApp	0		...
NFS High Availability Default	NetApp	0		...
iSCSI High Availability	NetApp	0		
iSCSI Single Node	NetApp	0		

Set as Default

4. Click **Set as Default**.

Upgrading Trident

You can upgrade Trident from Cloud Manager when a new version is available.

Steps

1. At the top of Cloud Manager, click **K8s**.
2. Click the name of the Kubernetes cluster.
3. If a new version is available, click **Upgrade** next to the Trident version.

The screenshot shows the 'Cluster Details' page for a cluster named 'kubernetes-baldwin'. The page includes a header with 'Cluster List > Cluster Details >' and two buttons: 'Connect to Working Environment' and 'Remove Cluster'. Below the header, there's a summary table with columns: Status (Running), Cluster Version (1.15), Added by (Discovery), Volumes (2), VPC (vpc-0485a0b201c3a1f2d), Date Added (September 3, 2020), and Trident Version (v20.04). A red arrow points to the 'Upgrade' button in the Trident Version row. At the bottom right, it says 'Provider AWS'.

Updating the kubeconfig file

If you added your cluster to Cloud Manager by importing the kubeconfig file, you can upload the latest kubeconfig file to Cloud Manager at any time. You might do this if you've updated the credentials, if you've changed users or roles, or if something changed that affects the cluster, user, namespaces, or authentication.

Steps

1. At the top of Cloud Manager, click **K8s**.
2. Click the name of the Kubernetes cluster.
3. Click **Update Kubeconfig**.
4. When prompted through your web browser, select the updated kubeconfig file and click **Open**.

Result

Cloud Manager updates information about the Kubernetes cluster based on the latest kubeconfig file.

Disconnecting a cluster

When you disconnect a cluster from Cloud Volumes ONTAP, you can no longer use that Cloud Volumes ONTAP system as persistent storage for containers. Existing Persistent Volumes are not deleted.

Steps

1. At the top of Cloud Manager, click **K8s**.
2. Click the name of the Kubernetes cluster.
3. In the **Working Environments** table, click the actions menu on the far right for the working environment that you want to disconnect.

4. Click **Disconnect**.

Result

Cloud Manager disconnects the cluster from the Cloud Volumes ONTAP system.

Removing a cluster

Remove decommissioned clusters from Cloud Manager after you disconnect all working environments from the cluster.

Steps

1. At the top of Cloud Manager, click **K8s**.
2. Click the name of the Kubernetes cluster.
3. Click **Remove Cluster**.

Encrypting volumes with NetApp encryption solutions

Cloud Volumes ONTAP supports both NetApp Volume Encryption (NVE) and NetApp Aggregate Encryption (NAE) with an external key manager. NVE and NAE are software-based solutions that enable (FIPS) 140-2-compliant data-at-rest encryption of volumes. [Learn more about these encryption solutions](#).

Starting with Cloud Volumes ONTAP 9.7, new aggregates will have NAE enabled by default after you set up an

external key manager. New volumes that aren't part of an NAE aggregate will have NVE enabled by default (for example, if you have existing aggregates that were created before setting up an external key manager).

Cloud Volumes ONTAP doesn't support onboard key management.

What you'll need

Your Cloud Volumes ONTAP system should be registered with NetApp support. Starting with Cloud Manager 3.7.1, a NetApp Volume Encryption license is automatically installed on each Cloud Volumes ONTAP system that is registered with NetApp Support.

- [Adding NetApp Support Site accounts to Cloud Manager](#)
- [Registering pay-as-you-go systems](#)



Cloud Manager doesn't install the NVE license on systems that reside in the China region.

Steps

1. Review the list of supported key managers in the [NetApp Interoperability Matrix Tool](#).



Search for the **Key Managers** solution.

2. [Connect to the Cloud Volumes ONTAP CLI](#).
3. Install SSL certificates and connect to the external key management servers.

[ONTAP 9 NetApp Encryption Power Guide: Configuring external key management](#)

Replicating data between systems

You can replicate data between working environments by choosing a one-time data replication for data transfer, or a recurring schedule for disaster recovery or long-term retention. For example, you can set up data replication from an on-prem ONTAP system to Cloud Volumes ONTAP for disaster recovery.

Cloud Manager simplifies data replication between volumes on separate systems using SnapMirror and SnapVault technologies. You simply need to identify the source volume and the destination volume, and then choose a replication policy and schedule. Cloud Manager purchases the required disks, configures relationships, applies the replication policy, and then initiates the baseline transfer between volumes.



The baseline transfer includes a full copy of the source data. Subsequent transfers contain differential copies of the source data.

Cloud Manager enables data replication between the following types of working environments:

- From a Cloud Volumes ONTAP system to another Cloud Volumes ONTAP system
- Between a Cloud Volumes ONTAP system and an on-prem ONTAP cluster
- From an on-prem ONTAP cluster to another on-prem ONTAP cluster

Data replication requirements

Before you can replicate data, you should confirm that specific requirements are met for both Cloud Volumes ONTAP systems and ONTAP clusters.

Version requirements

You should verify that the source and destination volumes are running compatible ONTAP versions before replicating data. For details, see the [Data Protection Power Guide](#).

Requirements specific to Cloud Volumes ONTAP

- The instance's security group must include the required inbound and outbound rules: specifically, rules for ICMP and ports 11104 and 11105.

These rules are included in the predefined security group.

- To replicate data between two Cloud Volumes ONTAP systems in different subnets, the subnets must be routed together (this is the default setting).
- To replicate data between a Cloud Volumes ONTAP system in AWS and a system in Azure, you must have a VPN connection between the AWS VPC and the Azure VNet.

Requirements specific to ONTAP clusters

- An active SnapMirror license must be installed.
- If the cluster is on your premises, you should have a connection from your corporate network to AWS or Azure, which is typically a VPN connection.
- ONTAP clusters must meet additional subnet, port, firewall, and cluster requirements.

For details, see the Cluster and SVM Peering Express Guide for your version of ONTAP.

Setting up data replication between systems

You can replicate data between Cloud Volumes ONTAP systems and ONTAP clusters by choosing a one-time data replication, which can help you move data to and from the cloud, or a recurring schedule, which can help with disaster recovery or long-term retention.

About this task

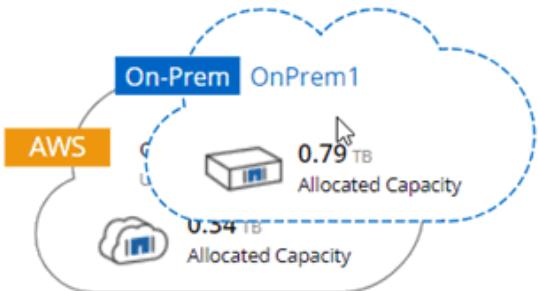
Cloud Manager supports simple, fanout, and cascade data protection configurations:

- In a simple configuration, replication occurs from volume A to volume B.
- In a fanout configuration, replication occurs from volume A to multiple destinations.
- In a cascade configuration, replication occurs from volume A to volume B and from volume B to volume C.

You can configure fanout and cascade configurations in Cloud Manager by setting up multiple data replications between systems. For example, by replicating a volume from system A to system B and then by replicating the same volume from system B to system C.

Steps

- On the Canvas page, select the working environment that contains the source volume, and then drag it to the working environment to which you want to replicate the volume:



2. If the Source and Destination Peering Setup pages appear, select all of the intercluster LIFs for the cluster peer relationship.

The intercluster network should be configured so that cluster peers have *pair-wise full-mesh connectivity*, which means that each pair of clusters in a cluster peer relationship has connectivity among all of their intercluster LIFs.

These pages appear if an ONTAP cluster that has multiple LIFs is the source or destination.

3. On the Source Volume Selection page, select the volume that you want to replicate.
4. On the Destination Volume Name and Tiering page, specify the destination volume name, choose an underlying disk type, change any of the advanced options, and then click **Continue**.

If the destination is an ONTAP cluster, you must also specify the destination SVM and aggregate.

5. On the Max Transfer Rate page, specify the maximum rate (in megabytes per second) at which data can be transferred.
6. On the Replication Policy page, choose one of the default policies or click **Additional Policies**, and then select one of the advanced policies.

For help, see [Choosing a replication policy](#).

If you choose a custom backup (SnapVault) policy, the labels associated with the policy must match the labels of the Snapshot copies on the source volume. For more information, see [How backup policies work](#).

7. On the Schedule page, choose a one-time copy or a recurring schedule.

Several default schedules are available. If you want a different schedule, you must create a new schedule on the *destination* cluster using System Manager.

8. On the Review page, review your selections, and then click **Go**.

Result

Cloud Manager starts the data replication process. You can view details about the replication in the Replication Status page.

Managing data replication schedules and relationships

After you set up data replication between two systems, you can manage the data replication schedule and relationship from Cloud Manager.

Steps

1. On the Canvas page, view the replication status for all working environments in the workspace or for a

specific working environment:

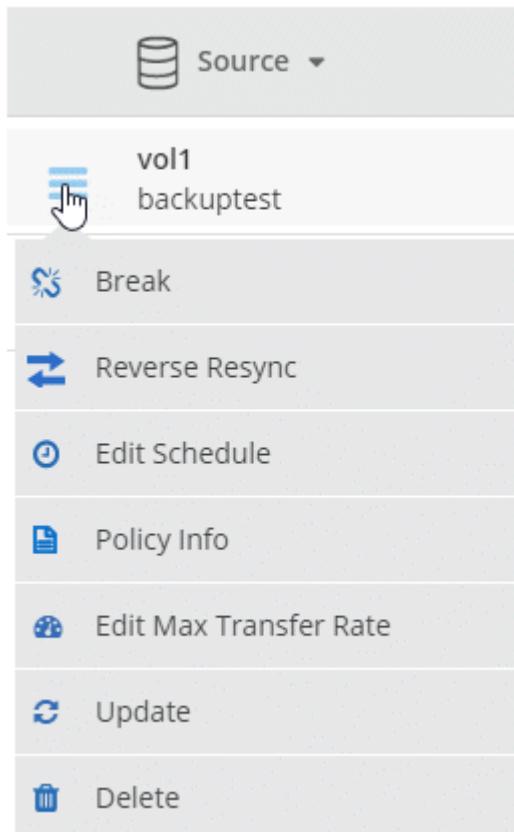
Option	Action
All working environments in the workspace	At the top of Cloud Manager, click Replication .
A specific working environment	Open the working environment and click Replications .

2. Review the status of the data replication relationships to verify that they are healthy.



If the Status of a relationship is idle and the Mirror State is uninitialized, you must initialize the relationship from the destination system for the data replication to occur according to the defined schedule. You can initialize the relationship by using System Manager or the command-line interface (CLI). These states can appear when the destination system fails and then comes back online.

3. Select the menu icon next to the source volume, and then choose one of the available actions.



The following table describes the available actions:

Action	Description
Break	<p>Breaks the relationship between the source and destination volumes, and activates the destination volume for data access.</p> <p>This option is typically used when the source volume cannot serve data due to events such as data corruption, accidental deletion, or an offline state.</p> <p>For information about configuring a destination volume for data access and reactivating a source volume, see the ONTAP 9 Volume Disaster Recovery Express Guide.</p>
Resync	<p>Reestablishes a broken relationship between volumes and resumes data replication according to the defined schedule.</p> <p> When you resynchronize the volumes, the contents on the destination volume are overwritten by the contents on the source volume.</p> <p>To perform a reverse resync, which resynchronizes the data from the destination volume to the source volume, see the ONTAP 9 Volume Disaster Recovery Express Guide.</p>
Reverse Resync	<p>Reverses the roles of the source and destination volumes. Contents from the original source volume are overwritten by contents of the destination volume. This is helpful when you want to reactivate a source volume that went offline.</p> <p>Any data written to the original source volume between the last data replication and the time that the source volume was disabled is not preserved.</p>
Edit Schedule	Enables you to choose a different schedule for data replication.
Policy Info	Shows you the protection policy assigned to the data replication relationship.
Edit Max Transfer Rate	Enables you to edit the maximum rate (in kilobytes per second) at which data can be transferred.
Update	Starts an incremental transfer to update the destination volume.
Delete	Deletes the data protection relationship between the source and destination volumes, which means that data replication no longer occurs between the volumes. This action does not activate the destination volume for data access. This action also deletes the cluster peer relationship and the storage virtual machine (SVM) peer relationship, if there are no other data protection relationships between the systems.

Result

After you select an action, Cloud Manager updates the relationship or schedule.

Choosing a replication policy

You might need help choosing a replication policy when you set up data replication in Cloud Manager. A replication policy defines how the storage system replicates data from a source volume to a destination volume.

What replication policies do

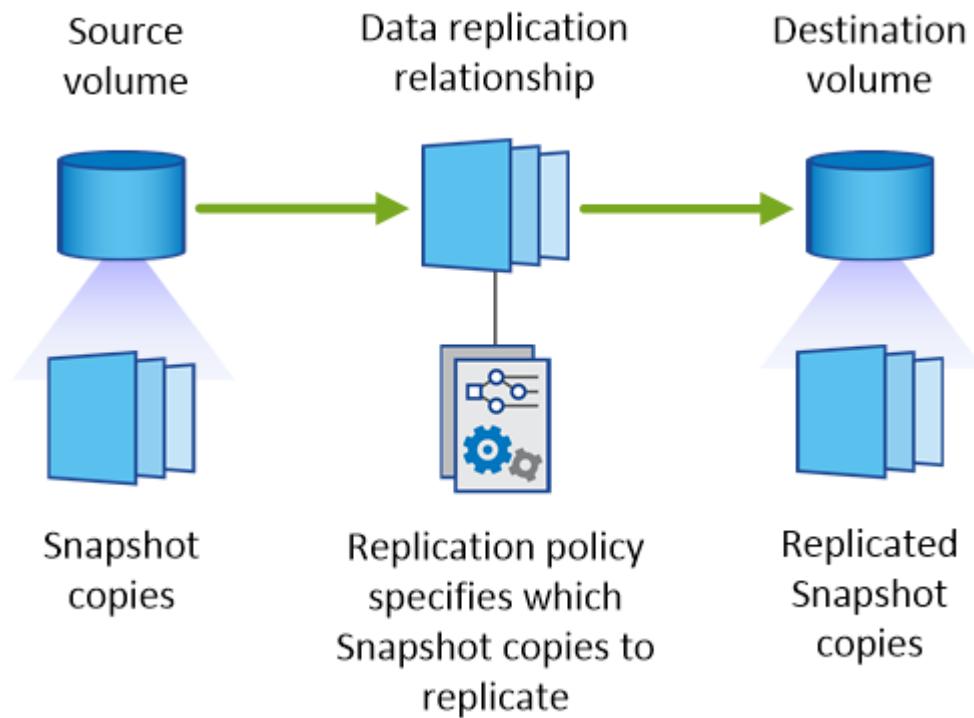
The ONTAP operating system automatically creates backups called Snapshot copies. A Snapshot copy is a read-only image of a volume that captures the state of the file system at a point in time.

When you replicate data between systems, you replicate Snapshot copies from a source volume to a destination volume. A replication policy specifies which Snapshot copies to replicate from the source volume to the destination volume.



Replication policies are also referred to as *protection* policies because they are powered by SnapMirror and SnapVault technologies, which provide disaster recovery protection and disk-to-disk backup and recovery.

The following image shows the relationship between Snapshot copies and replication policies:

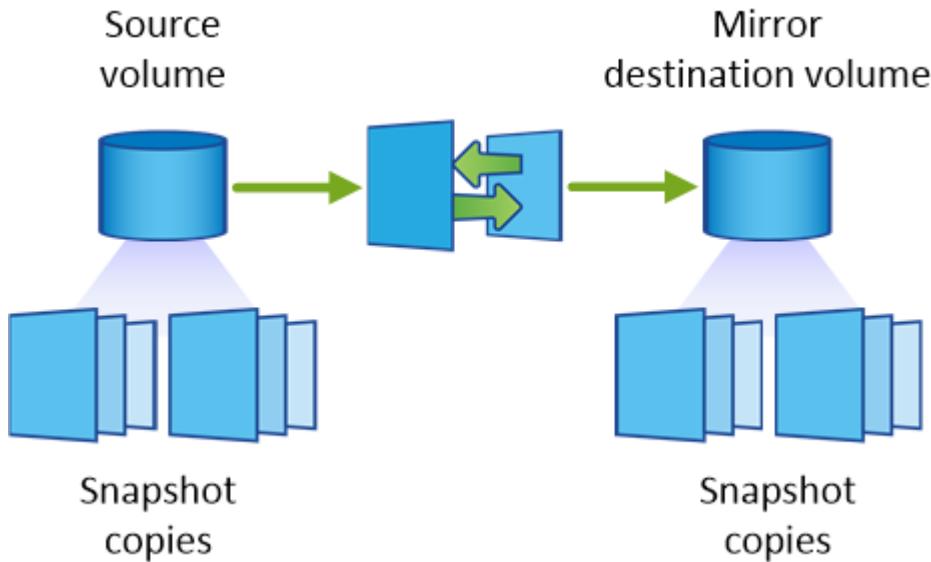


Types of replication policies

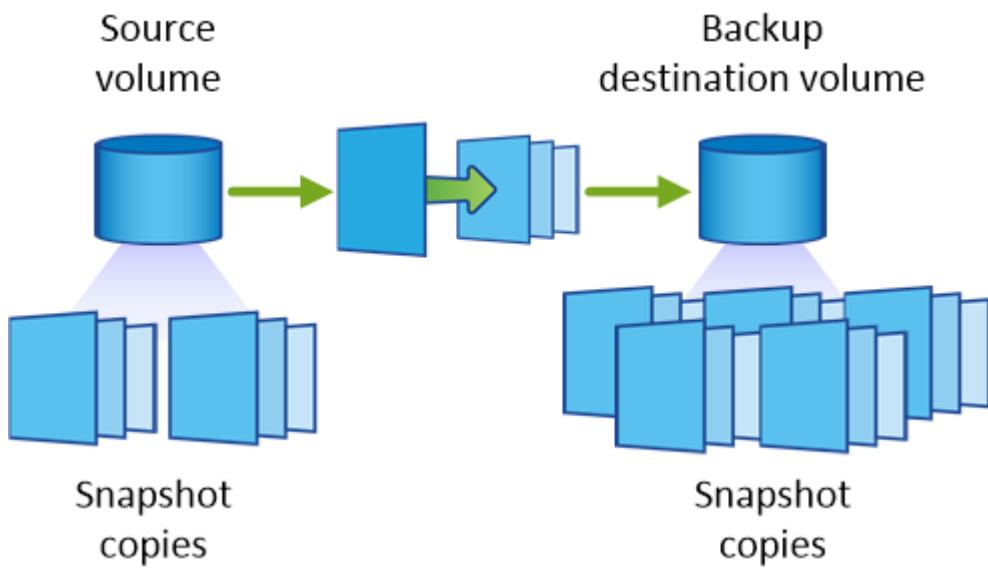
There are three types of replication policies:

- A *Mirror* policy replicates newly created Snapshot copies to a destination volume.
You can use these Snapshot copies to protect the source volume in preparation for disaster recovery or for one-time data replication. You can activate the destination volume for data access at any time.
- A *Backup* policy replicates specific Snapshot copies to a destination volume and typically retains them for a longer period of time than you would on the source volume.
You can restore data from these Snapshot copies when data is corrupted or lost, and retain them for standards compliance and other governance-related purposes.
- A *Mirror and Backup* policy provides both disaster recovery and long-term retention.
Each system includes a default Mirror and Backup policy, which works well for many situations. If you find that you need custom policies, you can create your own using System Manager.

The following images show the difference between the Mirror and Backup policies. A Mirror policy mirrors the Snapshot copies available on the source volume.



A Backup policy typically retains Snapshot copies longer than they are retained on the source volume:



How Backup policies work

Unlike Mirror policies, Backup (SnapVault) policies replicate specific Snapshot copies to a destination volume. It is important to understand how Backup policies work if you want to use your own policies instead of the default policies.

Understanding the relationship between Snapshot copy labels and Backup policies

A Snapshot policy defines how the system creates Snapshot copies of volumes. The policy specifies when to create the Snapshot copies, how many copies to retain, and how to label them. For example, a system might create one Snapshot copy every day at 12:10 a.m., retain the two most recent copies, and label them "daily".

A Backup policy includes rules that specify which labeled Snapshot copies to replicate to a destination volume and how many copies to retain. The labels defined in a Backup policy must match one or more labels defined in a Snapshot policy. Otherwise, the system cannot replicate any Snapshot copies.

For example, a Backup policy that includes the labels "daily" and "weekly" results in replication of Snapshot

copies that include only those labels. No other Snapshot copies are replicated, as shown in the following image:

Default policies and custom policies

The default Snapshot policy creates hourly, daily, and weekly Snapshot copies, retaining six hourly, two daily, and two weekly Snapshot copies.

You can easily use a default Backup policy with the default Snapshot policy. The default Backup policies replicate daily and weekly Snapshot copies, retaining seven daily and 52 weekly Snapshot copies.

If you create custom policies, the labels defined by those policies must match. You can create custom policies using System Manager.

Data replication from NetApp HCI to Cloud Volumes ONTAP

If you're trying to replicate data from NetApp HCI to Cloud Volumes ONTAP, you can do so on a NetApp HCI system running NetApp Element software using SnapMirror. Alternatively, you can replicate data on volumes created on an ONTAP Select system running as a virtual guest in a NetApp HCI solution to Cloud Volumes ONTAP.

Refer to the following technical reports for details:

- [Technical Report 4641: NetApp HCI Data Protection](#)
- [Technical Report 4651: NetApp SolidFire SnapMirror Architecture and Configuration](#)

Monitor performance

Learn about the Monitoring service

The Monitoring service gives you insights into the health and performance of your Cloud Volumes ONTAP instances and helps you troubleshoot and optimize the performance of your cloud storage environment.

Features

- Automatically monitor all volumes
- View volume performance data in terms of IOPS, throughput, and latency
- Identify performance issues to minimize impact on your users and apps

Supported cloud providers

The Monitoring service is supported with Cloud Volumes ONTAP for AWS and Cloud Volumes ONTAP for Azure.

Cost

NetApp doesn't charge you for using the Monitoring service, but Cloud Manager launches a virtual machine in your VPC to facilitate monitoring. This VM results in charges from your cloud provider.

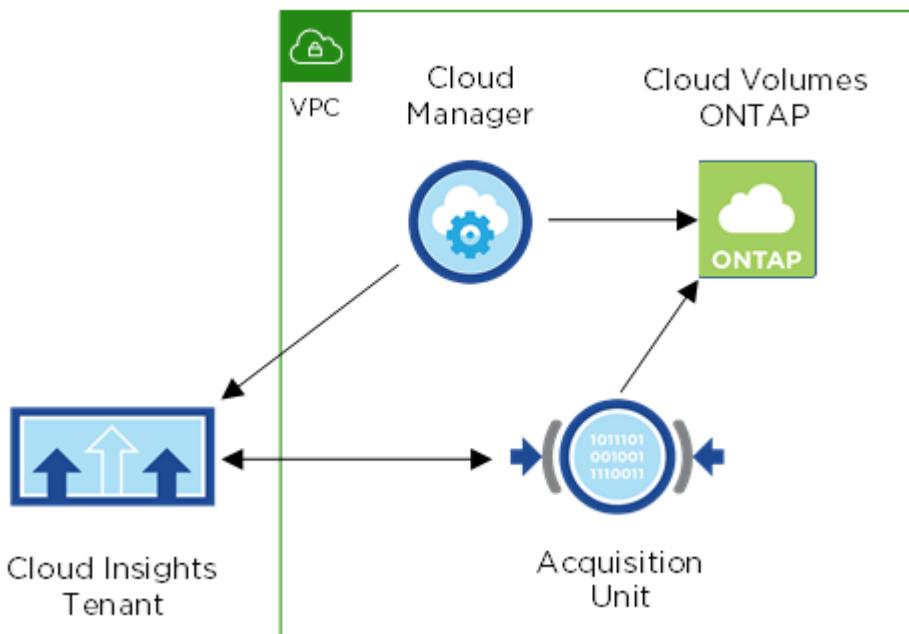
How the Monitoring service works

Cloud Manager leverages [NetApp's Cloud Insights service](#) to provide monitoring.

At a high-level, Cloud Insights integration with Cloud Manager works like this:

1. You enable the Monitoring service on Cloud Volumes ONTAP.
2. Cloud Manager configures your environment. It does the following:
 - a. Creates a Cloud Insights tenant (also called *environment*) and associates all users in your Cloud Central account to the tenant.
 - b. Enables a 30-day free trial of Cloud Insights.
 - c. Deploys a virtual machine in your VPC/VNet called an Acquisition Unit. The Acquisition Unit facilitates monitoring of volumes (this is the VM mentioned in the Cost section above).
 - d. Connects the Acquisition Unit to Cloud Volumes ONTAP and to the Cloud Insights tenant.
3. In Cloud Manager, you click Monitoring and use the performance data to troubleshoot and optimize performance.

The following image shows the relationship between these components in an AWS VPC:



The Acquisition Unit

When you enable Monitoring, Cloud Manager deploys an Acquisition Unit in the same subnet as the Connector.

An *Acquisition Unit* collects performance data from Cloud Volumes ONTAP and sends it to the Cloud Insights tenant. Cloud Manager then queries that data and presents it to you.

Note the following about the Acquisition Unit instance:

- In AWS, the Acquisition Unit runs on a t3.xlarge instance with a 100 GB GP2 volume.
- In Azure, the Acquisition Unit runs on a D4_v3 virtual machine with a 30 GB Standard SSD.
- The instance is named *AcquisitionUnit* with a generated hash (UUID) concatenated to it. For example:

AcquisitionUnit-FAN7FqeH

- Only one Acquisition Unit is deployed per Connector.
- The instance must be running to access performance information in the Monitoring tab.

Cloud Insights tenant

Cloud Manager sets up a *tenant* for you when you enable Monitoring. A Cloud Insights tenant enables you to access the performance data that the Acquisition Unit collects. The tenant is a secure data partition within the NetApp Cloud Insights service.

Cloud Insights web interface

The Monitoring tab in Cloud Manager provides basic performance data for your volumes. You can go to the Cloud Insights web interface from your browser to perform more in-depth monitoring and to configure alerts for your Cloud Volumes ONTAP systems.

Free trial and subscription

Cloud Manager enables a 30-day free trial of Cloud Insights to provide performance data within Cloud Manager and for you to explore the features that Cloud Insights Standard Edition has to offer.

You need to subscribe by the end of the free trial or your Cloud Insights tenant will eventually be deleted. You can subscribe to either the Basic, Standard, or Premium edition to continue using the Monitoring feature within Cloud Manager.

[Learn how to subscribe to Cloud Insights.](#)

Monitoring Cloud Volumes ONTAP

Complete a few steps to start monitoring Cloud Volumes ONTAP performance.

Quick start

Get started quickly by following these steps or scroll down to the remaining sections for full details.



Verify support for your configuration

- You must be a new Cloud Insights customer.
- You need a Cloud Volumes ONTAP system running in AWS or Azure.
- For AWS, you need a Connector running version 3.8.4 or later.
- For Azure, you need a Connector running version 3.9.3 or later.



Enable Monitoring on your new or existing system

- New working environments: Be sure to keep Monitoring enabled when you create the working environment (it's enabled by default).
- Existing working environments: Select a working environment and click **Start Monitoring**.



3 View performance data

Click **Monitoring** and view performance data for your volumes.



4 Subscribe to Cloud Insights

Subscribe before your 30-day free trial ends to continue seeing performance data within Cloud Manager and Cloud Insights. [Learn how to subscribe](#).

Requirements

Read the following requirements to make sure that you have a supported configuration.

Supported Cloud Volumes ONTAP versions

Any version of Cloud Volumes ONTAP in AWS or in Azure.

Supported Connector

- For AWS, you need a Connector running version 3.8.4 or later.
- For Azure, you need a Connector running version 3.9.3 or later.



You can view a Connector's version by clicking the icon and then **Support > Connector**.

Cloud Insights requirement

You must be a new Cloud Insights customer. Monitoring isn't supported if you already have a Cloud Insights tenant.

Email address for Cloud Central

The email address for your Cloud Central user account should be your business email address. Free email domains like gmail and hotmail aren't supported when creating a Cloud Insights tenant.

Networking for the Acquisition Unit

The Acquisition Unit uses 2-way/mutual authentication to connect to the Cloud Insights server. The client certificate must be passed to the Cloud Insights server to be authenticated. To accomplish this, the proxy must be set up to forward the http request to the Cloud Insights server without decrypting the data.

The Acquisition Unit uses the following two endpoints to communicate with Cloud Insights. If you have a firewall between the Acquisition Unit server and Cloud Insights, you need these endpoints when configuring firewall rules:

```
https://aulogin.<Cloud Insights Domain>
https://<your-tenant-ID>.<Cloud Insights Domain>
```

For example:

```
https://aulogin.c01.cloudinsights.netapp.com  
https://cg0c586a-ee05-45rb-a5ac-  
333b5ae7718d7.c01.cloudinsights.netapp.com
```

Contact us through the in-product chat if you need help identifying your Cloud Insights domain and tenant ID.

Networking for the Connector

Similar to the Acquisition Unit, the Connector must have outbound connectivity to the Cloud Insights tenant. But the endpoint that the Connector contacts is slightly different. It contacts the tenant host URL using the shortened tenant ID:

```
https://<your-short-tenant-ID>.<Cloud Insights Domain>
```

For example:

```
https://abcd12345.c01.cloudinsights.netapp.com
```

Again, you can contact us through the in-product chat if you need help identifying the tenant host URL.

Enabling monitoring on a new system

The Monitoring service is enabled by default in the working environment wizard. Be sure to keep the option enabled.

Steps

1. Click **Create Cloud Volumes ONTAP**.
2. Select Amazon Web Services or Microsoft Azure as the cloud provider and then choose a single node or HA system.
3. Fill out the Details & Credentials page.
4. On the Services page, leave the Monitoring service enabled and click **Continue**.



Monitoring



NetApp Monitoring is an infrastructure monitoring tool that gives you visibility into your complete infrastructure. With Monitoring, you can monitor, troubleshoot and optimize all your resources including your public clouds and your private data centers.

ADVANTAGES

- Automatically monitor all volumes - no configuration is required
- Prevent performance issues from impacting your users and apps

CLARIFICATIONS

- Activation is free, but requires deploying a small-size cloud instance which will incur charges by your cloud provider
- Monitoring can be disabled at any time

Enabling monitoring on an existing system

Enable monitoring at any time from the working environment.

Steps

1. At the top of Cloud Manager, click **Canvas**.
2. Select a working environment.
3. In the pane on the right, click **Start Monitoring**.

The screenshot shows the Cloud Manager interface with the following details:

- CVO2**: Status is **On | AWS**. Action buttons: **i**, **⋮**, **X**.
- SERVICES** section:
 - Cloud Compliance**: Status is **Off**. Action button: **Enable Compliance**.
 - Backup to Cloud**: Status is **On**. Information: **1 Volume Backed Up**. Action button: **⋮**.
 - Kubernetes**: Status is **Off**. Action button: **Activate Kubernetes**.
 - Monitoring**: Status is **Off**. Action button: **Start Monitoring** (with a hand cursor icon).

Monitoring your volumes

Monitor performance by viewing IOPS, throughput, and latency for each of your volumes.

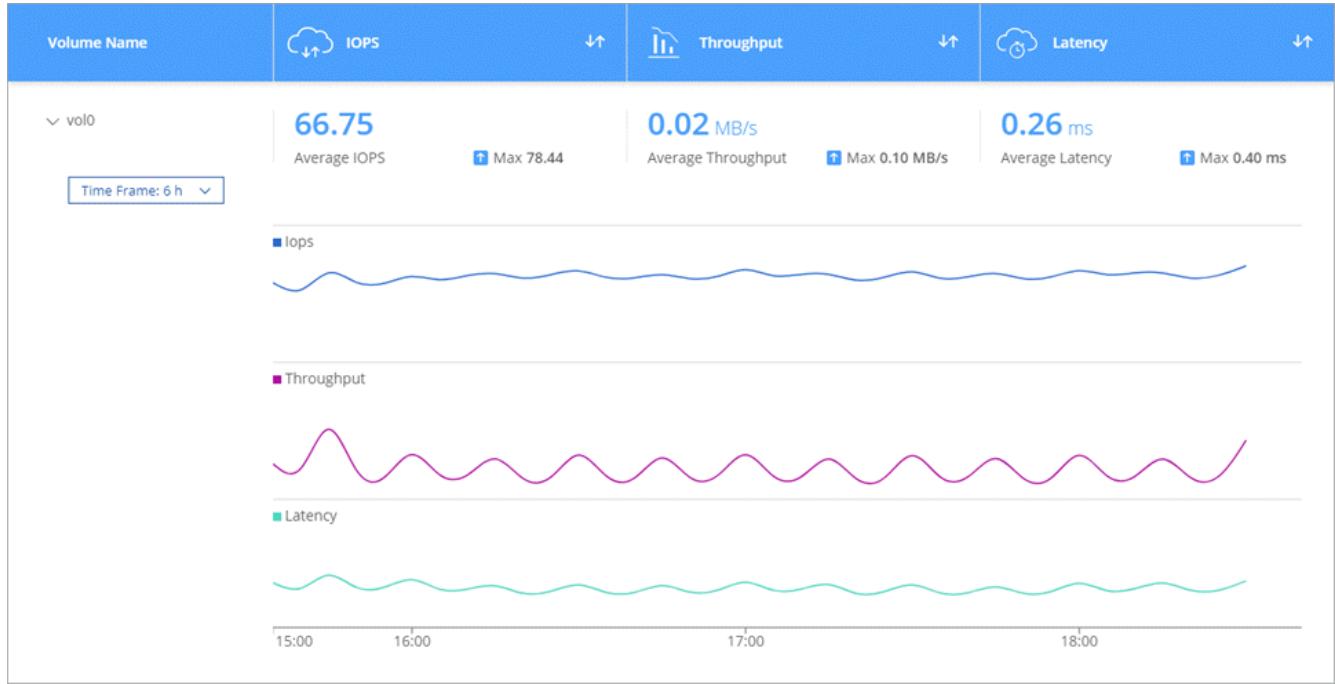
Steps

1. At the top of Cloud Manager, click **Monitoring**.
2. Filter the contents of the dashboard to get the information that you need.
 - Select a specific working environment.
 - Select a different timeframe.
 - Select a specific SVM.
 - Search for a specific volume.

The following image highlights each of these options:

The screenshot shows the Cloud Manager interface with the 'Monitoring' tab selected. At the top, there are two status cards: '0.02 MB/s Average Network Throughput' and '5.55 % Average CPU Utilization'. Below these are two volume entries: 'vol0' with IOPS of 66.75, throughput of 0.02 MB/s, and latency of 0.26 ms; and 'volaws2' with IOPS of 50.02, throughput of 12.60 MB/s, and latency of 0.19 ms. A search bar and a 'Time Frame: 6 h' dropdown are also visible.

- Click a volume in the table to expand the row and view a timeline for IOPS, throughput, and latency.



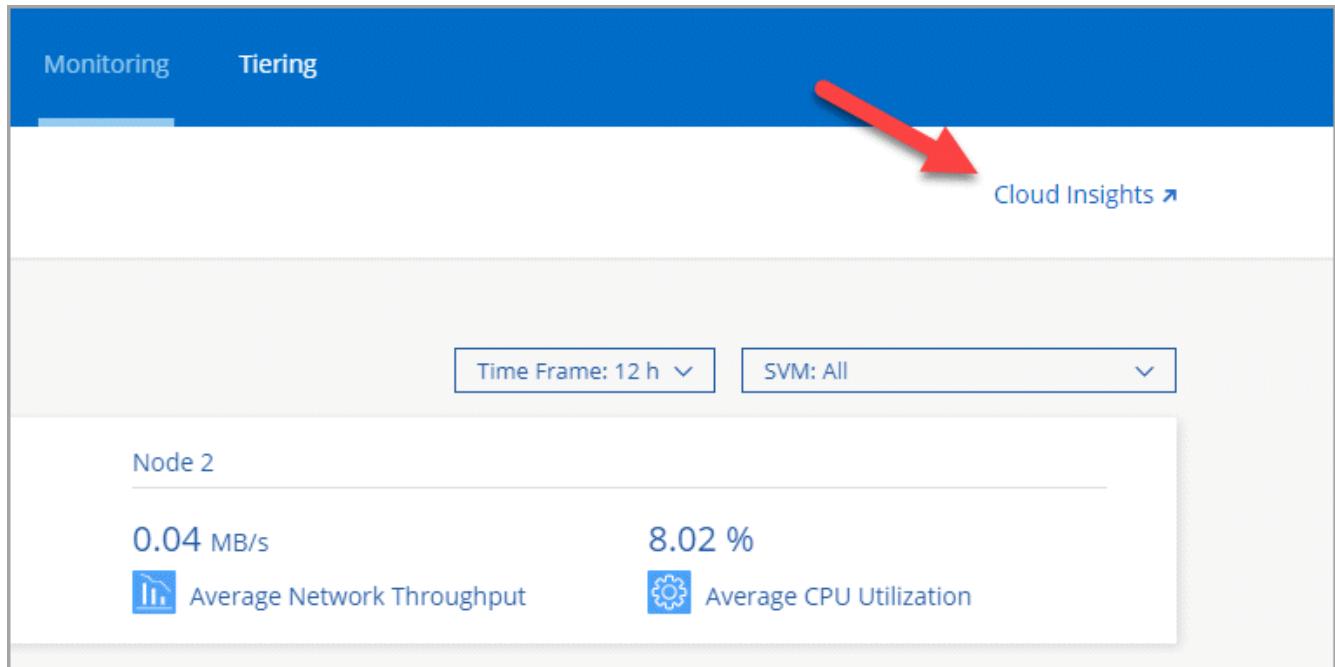
- Use the data to identify performance issues to minimize impact on your users and apps.

Getting more information from Cloud Insights

The Monitoring tab in Cloud Manager provides basic performance data for your volumes. You can go to the Cloud Insights web interface from your browser to perform more in-depth monitoring and to configure alerts for your Cloud Volumes ONTAP systems.

Steps

- At the top of Cloud Manager, click **Monitoring**.
- Click the **Cloud Insights** link.



Result

Cloud Insights open in a new browser tab. If you need help, refer to the [Cloud Insights documentation](#).

Disabling monitoring

If you no longer want to monitor Cloud Volumes ONTAP, you can disable the service at any time.



If you disable monitoring from each of your working environments, you'll need to delete the virtual machine instance yourself. The instance is named *AcquisitionUnit* with a generated hash (UUID) concatenated to it. For example: *AcquisitionUnit-FAN7FqeH*

Steps

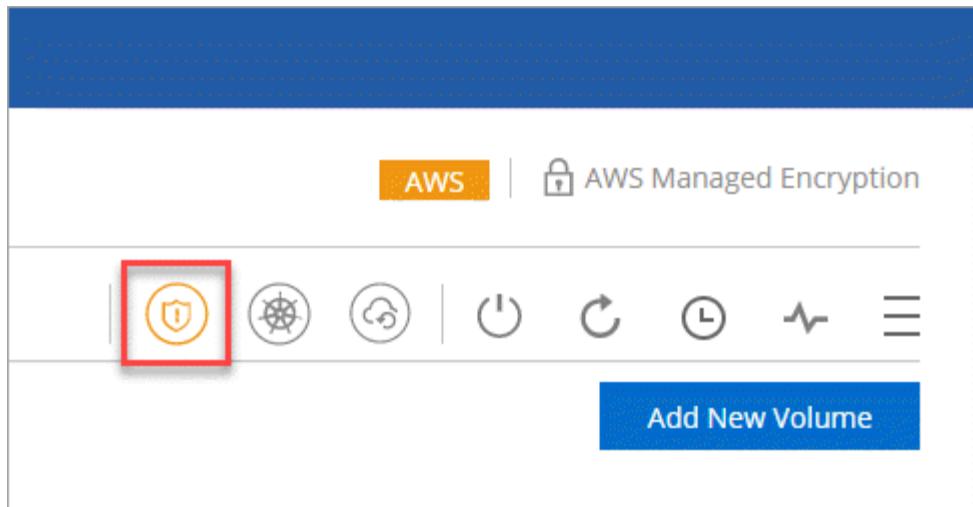
1. At the top of Cloud Manager, click **Canvas**.
2. Select a working environment.
3. In the pane on the right, click the icon and select **Deactivate Scan**.

Improving protection against ransomware

Ransomware attacks can cost a business time, resources, and reputation. Cloud Manager enables you to implement the NetApp solution for ransomware, which provides effective tools for visibility, detection, and remediation.

Steps

1. From the working environment, click the **Ransomware** icon.



2. Implement the NetApp solution for ransomware:

- Click **Activate Snapshot Policy**, if you have volumes that do not have a Snapshot policy enabled.

NetApp Snapshot technology provides the industry's best solution for ransomware remediation. The key to a successful recovery is restoring from uninfected backups. Snapshot copies are read-only, which prevents ransomware corruption. They can also provide the granularity to create images of a single file copy or a complete disaster recovery solution.

- Click **Activate FPolicy** to enable ONTAP's FPolicy solution, which can block file operations based on a file's extension.

This preventative solution improves protection from ransomware attacks by blocking common ransomware file types.

Ransomware Protection

Ransomware attacks can cost a business time, resources, and reputation. The NetApp solution for ransomware provides effective tools for visibility, detection, and remediation. [Learn More](#)

1 Enable Snapshot Copy Protection

50 % Protection

1 Volumes without a Snapshot Policy

To protect your data, activate the default Snapshot policy for these volumes

[Activate Snapshot Policy](#)

2 Block Ransomware File Extensions

ONTAP's native FPolicy configuration monitors and blocks file operations based on a file's extension.

[View Denied File Names](#)

[Activate FPolicy](#)

Administer

Registering pay-as-you-go systems

Support from NetApp is included with Cloud Volumes ONTAP Explore, Standard, and Premium systems, but you must first activate support by registering the systems with

NetApp.

Registering a PAYGO system with NetApp is required to upgrade ONTAP software using any of the methods described on this page.



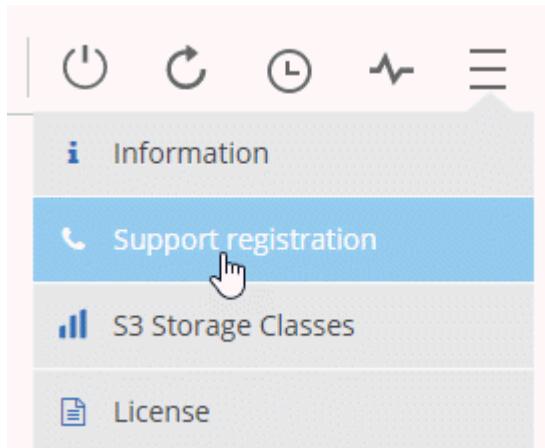
A system that isn't registered for support will still receive the software update notifications that appear in Cloud Manager when a new version is available. But you will need to register the system before you can upgrade the software.

Steps

1. If you have not yet added your NetApp Support Site account to Cloud Manager, go to **Account Settings** and add it now.

[Learn how to add NetApp Support Site accounts.](#)

2. On the Canvas page, double-click the name of the system that you want to register.
3. Click the menu icon and then click **Support registration**:



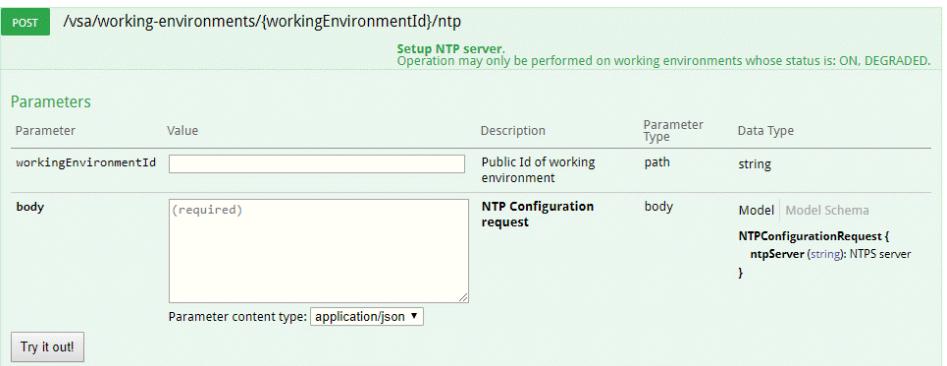
4. Select a NetApp Support Site account and click **Register**.

Result

Cloud Manager registers the system with NetApp.

Setting up Cloud Volumes ONTAP

After you deploy Cloud Volumes ONTAP, you can set it up by synchronizing the system time using NTP and by performing a few optional tasks from either System Manager or the CLI.

Task	Description
<p>Synchronize the system time using NTP</p>	<p>Specifying an NTP server synchronizes the time between the systems in your network, which can help prevent issues due to time differences.</p> <p>Specify an NTP server using the Cloud Manager API or from the user interface when you set up a CIFS server.</p> <ul style="list-style-type: none"> • Modifying the CIFS server • Cloud Manager API Developer Guide <p>For example, here's the API for a single-node system in AWS:</p>  <pre> POST /vsa/working-environments/{workingEnvironmentId}/ntp Setup NTP server. Operation may only be performed on working environments whose status is: ON, DEGRADED. Parameters Parameter Value Description Parameter Type Data Type workingEnvironmentId [] Public Id of working environment path string body (required) NTP Configuration request body Model<NTPConfigurationRequest> NTPConfigurationRequest { ntpServer(string): NTPs server } Parameter content type: application/json ▾ Try it out! </pre>
<p>Optional: Configure AutoSupport</p>	<p>AutoSupport proactively monitors the health of your system and automatically sends messages to NetApp technical support by default.</p> <p>If the Account Admin added a proxy server to Cloud Manager before you launched your instance, Cloud Volumes ONTAP is configured to use that proxy server for AutoSupport messages.</p> <p>You should test AutoSupport to ensure that it can send messages. For instructions, see the System Manager Help or the ONTAP 9 System Administration Reference.</p>
<p>Optional: Configure the Cloud Manager Connector as the AutoSupport proxy</p>	<p>If your environment requires a proxy server to send AutoSupport messages, you can configure the Connector to act as the proxy. No configuration for the Connector is required, other than internet access. You simply need to go to the CLI for Cloud Volumes ONTAP and run the following command:</p> <pre>system node autosupport modify -proxy-url <connector-ip-address></pre>
<p>Optional: Configure EMS</p>	<p>The Event Management System (EMS) collects and displays information about events that occur on Cloud Volumes ONTAP systems. To receive event notifications, you can set event destinations (email addresses, SNMP trap hosts, or syslog servers) and event routes for a particular event severity.</p> <p>You can configure EMS using the CLI. For instructions, see the ONTAP 9 EMS Configuration Express Guide.</p>

Task	Description
Optional: Change the backup location of configuration files	<p>Cloud Volumes ONTAP automatically creates configuration backup files that contain information about the configurable options that it needs to operate properly.</p> <p>By default, Cloud Volumes ONTAP backs up the files to the Connector host every eight hours. If you want to send the backups to an alternate location, you can change the location to an FTP or HTTP server in your data center or in AWS. For example, you might already have a backup location for your FAS storage systems.</p> <p>You can change the backup location using the CLI. See the ONTAP 9 System Administration Reference.</p>

Managing BYOL licenses for Cloud Volumes ONTAP

Add a Cloud Volumes ONTAP BYOL system license to add additional capacity, update an existing system license, and manage BYOL licenses for Cloud Backup.

Managing system licenses

You can purchase multiple licenses for a Cloud Volumes ONTAP BYOL system to allocate more than 368 TB of capacity. For example, you might purchase two licenses to allocate up to 736 TB of capacity to Cloud Volumes ONTAP. Or you could purchase four licenses to get up to 1.4 PB.

The number of licenses that you can purchase for a single node system or HA pair is unlimited.

Obtaining a system license file

In most cases, Cloud Manager can automatically obtain your license file using your NetApp Support Site account. But if it can't, then you'll need to manually upload the license file. If you don't have the license file, you can obtain it from netapp.com.

Steps

1. Go to the [NetApp License File Generator](#) and log in using your NetApp Support Site credentials.
2. Enter your password, choose your product, enter the serial number, confirm that you have read and accepted the privacy policy, and then click **Submit**.

Example

3. Choose whether you want to receive the serialnumber.NLF JSON file through email or direct download.

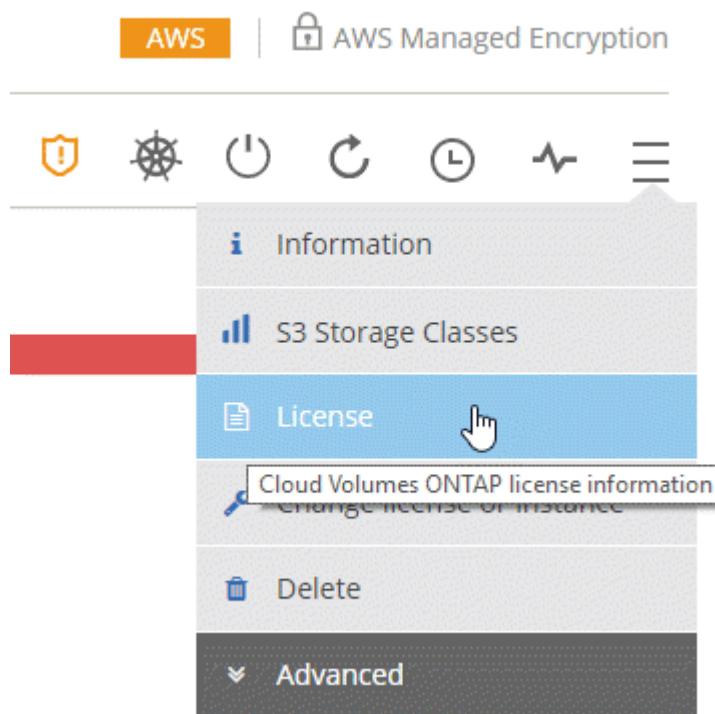
Adding a new system license

Add a new BYOL system license at any time to allocate an additional 368 TB of capacity to your Cloud Volumes ONTAP BYOL system.

Steps

1. In Cloud Manager, open the Cloud Volumes ONTAP BYOL working environment.

2. Click the menu icon and then click **License**.



3. Click **Add CVO System License**.

A screenshot of the 'BYOL Licenses' page. At the top, it shows '1 Cloud Volumes ONTAP System License | 0 Backup License'. There are two buttons: 'Add CVO System License' and 'Add Backup License'. Below this is a card for a 'Cloud Volumes ONTAP System License'. It includes a circular icon with a document, the text 'Cloud Volumes ONTAP System License', 'License Type', 'Platform Serial Number: 90820', and 'Update CVO System License'. A note at the bottom says '① License Expired: August 01, 2020'.

4. Choose to enter the serial number or to upload the license file.

5. Click **Add License**.

Result

Cloud Manager installs the new license file on the Cloud Volumes ONTAP system.

Updating a system license

When you renew a BYOL subscription by contacting a NetApp representative, Cloud Manager automatically obtains the new license from NetApp and installs it on the Cloud Volumes ONTAP system.

If Cloud Manager can't access the license file over the secure internet connection, you can obtain the file yourself and then manually upload the file to Cloud Manager.

Steps

1. In Cloud Manager, open the Cloud Volumes ONTAP BYOL working environment.
2. Click the menu icon and then click **License**.

3. Click **Update CVO System License**.

The screenshot shows the 'BYOL Licenses' section of the Cloud Manager interface. At the top, it displays '1 Cloud Volumes ONTAP System License | 0 Backup License'. Below this, there's a card for the 'Cloud Volumes ONTAP System License' with a 'License Type' icon (a document with a lock). The card also shows 'Platform Serial Number: 90820' and a red message '① License Expired: August 01, 2020'. At the top right of the card are two buttons: 'Add CVO System License' and 'Add Backup License'. To the right of the card is a large blue button labeled 'Update CVO System License'.

4. Click **Upload File** and select the license file.

5. Click **Update License**.

Result

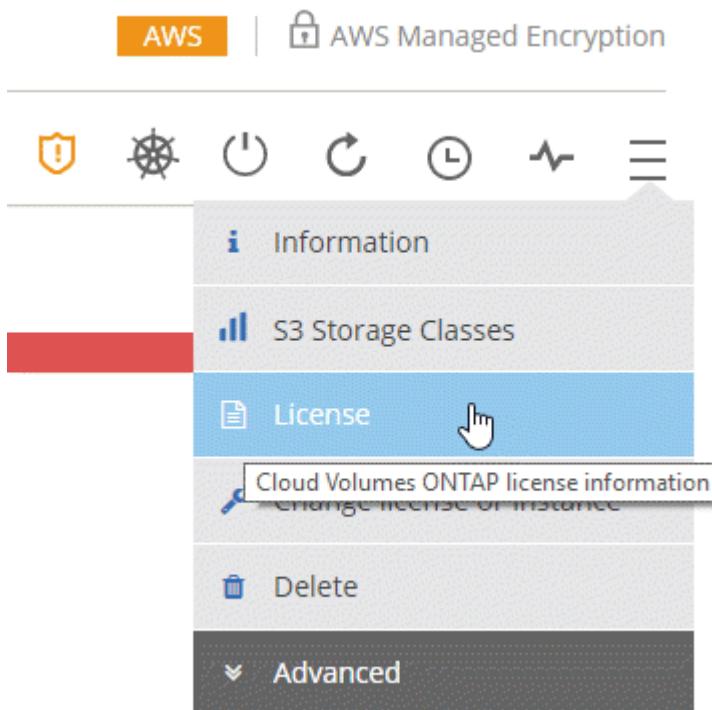
Cloud Manager updates the license on the Cloud Volumes ONTAP system.

Adding and updating your Backup BYOL license

You use the BYOL Licenses page to add or update your Backup BYOL license.

Steps

1. In Cloud Manager, open the Cloud Volumes ONTAP BYOL working environment.
2. Click the menu icon and then click **License**.



3. Click **Add Backup License** or **Update Backup License** depending on whether you are adding a new license or updating an existing license.

Total License Information

Instance Type:	m5.2xlarge	Total Attached EBS Capacity :	200 TB	Total Used Tiering Capacity:	60 TB
Total License Limit :	368 TB 	Total Used EBS Capacity :	180 TB	Total Allocated ONTAP Capacity :	100 TB
Total Backup Capacity Limit :	368 TB	Total Used Backup Capacity :	200 TB		

BYOL Licenses

1 Cloud Volumes ONTAP System License | 1 Backup License

Add CVO System License

Add Backup License 



Cloud Volumes ONTAP System License

License Type

Update CVO System License

Platform Serial Number Node 1: 9012013000000000000020

License Expiry: April 10, 2021

Platform Serial Number Node 2: 9012013000000000000021

License Expiry: April 10, 2021



Backup License

License Type

Update Backup License 

Platform Serial Number: 90120130000000000022

License Expiry: April 10, 2021

License Capacity Limit: 368 TB (Used Capacity 200 TB)

4. Enter the license information and click **Add License**:

- If you have the serial number, select the **Enter Backup BYOL Serial Number** option and enter the serial number.
- If you have the backup license file, select the **Upload Backup BYOL License** option and follow the prompts to attach the file.

Add Backup License

A Backup license enables Backup to Cloud for a certain period of time and for a maximum amount backup space.

Enter Backup BYOL Serial Number Upload Backup BYOL License

Enter Backup BYOL Serial Number

Add License **Cancel**

Result

Cloud Manager adds or updates the license so that your Cloud Backup service is active.

Upgrading Cloud Volumes ONTAP software

Cloud Manager includes several options that you can use to upgrade to the current Cloud

Volumes ONTAP release. You should prepare Cloud Volumes ONTAP systems before you upgrade the software.

Requirements

You should be aware of the following requirements before you start the Cloud Volumes ONTAP upgrade process.

Software upgrades must be completed by Cloud Manager

Upgrades of Cloud Volumes ONTAP must be completed from Cloud Manager. You should not upgrade Cloud Volumes ONTAP by using System Manager or the CLI. Doing so can impact system stability.

Cloud Volumes ONTAP must be registered with NetApp Support

Cloud Volumes ONTAP must be registered with NetApp support in order to upgrade the software using any of the methods described on this page. This applies to both PAYGO and BYOL. You'll need to [manually register PAYGO systems](#), while BYOL systems are registered by default.



A system that isn't registered for support will still receive the software update notifications that appear in Cloud Manager when a new version is available. But you will need to register the system before you can upgrade the software.

A note about downgrades

Cloud Manager doesn't support downgrading Cloud Volumes ONTAP to a previous version. Contact NetApp technical support for help with downgrades.

Ways to upgrade Cloud Volumes ONTAP

Cloud Manager displays a notification in Cloud Volumes ONTAP working environments when a new version of Cloud Volumes ONTAP is available:

The screenshot shows the Cloud Manager dashboard. At the top, there's a cloud icon and the text "Visual View". Below it, a system card for "cloudvolumesontap1" is displayed, indicating it is "On | AWS". The card has three icons: a blue circle with a white "i", a grey circle with three dots, and a grey circle with an "X". Underneath the card, a red box highlights the "NOTIFICATIONS" section. Inside this section, a blue star icon is followed by the text "New version available" and a small grey arrow icon. The "SERVICES" section follows, featuring a "Cloud Compliance" card with a blue cloud icon containing a lock, the text "Cloud Compliance", "On", and a green checkmark icon with the text "No Personal Files Found".

You can start the upgrade process from this notification, which automates the process by obtaining the software image from an S3 bucket, installing the image, and then restarting the system. For details, see [Upgrading Cloud Volumes ONTAP from Cloud Manager notifications](#).



For HA systems in AWS, Cloud Manager might upgrade the HA mediator as part of the upgrade process.

Cloud Manager also provides the following advanced options for upgrading Cloud Volumes ONTAP software with both PAYGO and BYOL:

- Software upgrades using an image on an external URL

This option is helpful if Cloud Manager can't access the S3 bucket to upgrade the software or if you were provided with a patch.

For details, see [Upgrading Cloud Volumes ONTAP by using an HTTP or FTP server](#).

- Software upgrades using the alternate image on the system

You can use this option to upgrade by making the alternate software image the default image. This option is not available for HA pairs.

For details, see [Upgrading Cloud Volumes ONTAP by using a local image](#).

Preparing to upgrade Cloud Volumes ONTAP software

Before performing an upgrade, you must verify that your systems are ready and make any required configuration changes.

- Understanding supported upgrade paths
- Planning for downtime
- Verifying that automatic giveback is still enabled
- Suspending SnapMirror transfers
- Verifying that aggregates are online

Understanding supported upgrade paths

You need to upgrade Cloud Volumes ONTAP by one release at a time. You can't upgrade by skipping a release.

For example, if you're currently running Cloud Volumes ONTAP 9.6 and you want to upgrade to 9.8, then you first need to upgrade to 9.7. From there, you can upgrade to 9.8.

Refer to the "Upgrade notes" in the [Cloud Volumes ONTAP Release Notes](#) for more details.

Planning for downtime

When you upgrade a single-node system, the upgrade process takes the system offline for up to 25 minutes, during which I/O is interrupted.

Upgrading an HA pair is nondisruptive and I/O is uninterrupted. During this nondisruptive upgrade process, each node is upgraded in tandem to continue serving I/O to clients.

Verifying that automatic giveback is still enabled

Automatic giveback must be enabled on a Cloud Volumes ONTAP HA pair (this is the default setting). If it isn't, then the operation will fail.

[ONTAP 9 Documentation: Commands for configuring automatic giveback](#)

Suspending SnapMirror transfers

If a Cloud Volumes ONTAP system has active SnapMirror relationships, it is best to suspend transfers before you update the Cloud Volumes ONTAP software. Suspending the transfers prevents SnapMirror failures. You must suspend the transfers from the destination system.

About this task

These steps describe how to use System Manager for version 9.3 and later.

Steps

1. [Log in to System Manager](#) from the destination system.
2. Click **Protection > Relationships**.
3. Select the relationship and click **Operations > Quiesce**.

Verifying that aggregates are online

Aggregates for Cloud Volumes ONTAP must be online before you update the software. Aggregates should be online in most configurations, but if they are not, then you should bring them online.

About this task

These steps describe how to use System Manager for version 9.3 and later.

Steps

1. In the working environment, click the menu icon, and then click **Advanced > Advanced allocation**.
2. Select an aggregate, click **Info**, and then verify that the state is online.

The screenshot shows a detailed view of an aggregate named 'aggr1'. The aggregate has a capacity of 88.57 GB and is currently using 1.07 GB. It contains 2 volumes and 1 AWS disk. The 'State' field is explicitly labeled as 'online' and is highlighted with a red rectangular border.

Aggregate Capacity:	88.57 GB
Used Aggregate Capacity:	1.07 GB
Volumes:	2
AWS Disks:	1
State:	online

3. If the aggregate is offline, use System Manager to bring the aggregate online:
 - a. [Log in to System Manager](#).
 - b. Click **Storage > Aggregates & Disks > Aggregates**.
 - c. Select the aggregate, and then click **More Actions > Status > Online**.

Upgrading Cloud Volumes ONTAP from Cloud Manager notifications

Cloud Manager notifies you when a new version of Cloud Volumes ONTAP is available. Click the notification to start the upgrade process.

Before you begin

Cloud Manager operations such as volume or aggregate creation must not be in progress for the Cloud Volumes ONTAP system.

Steps

1. Click **Canvas**.
2. Select a working environment.

A notification appears in the right pane if a new version is available:

The screenshot shows the Cloud Manager interface. At the top, there's a cloud icon and the text "Visual View". Below that, a card for "cloudvolumesontap1" is shown, indicating it's "On | AWS". The main area has two sections: "NOTIFICATIONS" and "SERVICES". The "NOTIFICATIONS" section has a red border around it and contains a message: "★ New version available". The "SERVICES" section contains a card for "Cloud Compliance" which is "On" and shows "No Personal Files Found".

3. If a new version is available, click **Upgrade**.
4. In the Release Information page, click the link to read the Release Notes for the specified version, and then select the **I have read...** check box.
5. In the End User License Agreement (EULA) page, read the EULA, and then select **I read and approve the EULA**.
6. In the Review and Approve page, read the important notes, select **I understand...**, and then click **Go**.

Result

Cloud Manager starts the software upgrade. You can perform actions on the working environment once the software update is complete.

After you finish

If you suspended SnapMirror transfers, use System Manager to resume the transfers.

Upgrading Cloud Volumes ONTAP by using an HTTP or FTP server

You can place the Cloud Volumes ONTAP software image on an HTTP or FTP server and then initiate the software upgrade from Cloud Manager. You might use this option if Cloud Manager can't access the S3 bucket to upgrade the software.

Steps

1. Set up an HTTP server or FTP server that can host the Cloud Volumes ONTAP software image.
2. If you have a VPN connection to the virtual network, you can place the Cloud Volumes ONTAP software image on an HTTP server or FTP server in your own network. Otherwise, you must place the file on an HTTP server or FTP server in the cloud.
3. If you use your own security group for Cloud Volumes ONTAP, ensure that the outbound rules allow HTTP or FTP connections so Cloud Volumes ONTAP can access the software image.



The predefined Cloud Volumes ONTAP security group allows outbound HTTP and FTP connections by default.

4. Obtain the software image from [the NetApp Support Site](#).
5. Copy the software image to the directory on the HTTP or FTP server from which the file will be served.
6. From the working environment in Cloud Manager, click the menu icon, and then click **Advanced > Update Cloud Volumes ONTAP**.
7. On the update software page, choose **Select an image available from a URL**, enter the URL, and then click **Change Image**.
8. Click **Proceed** to confirm.

Result

Cloud Manager starts the software update. You can perform actions on the working environment once the software update is complete.

After you finish

If you suspended SnapMirror transfers, use System Manager to resume the transfers.

Upgrading Cloud Volumes ONTAP by using a local image

Each Cloud Volumes ONTAP system can hold two software images: the current image that is running, and an alternate image that you can boot. Cloud Manager can change the alternate image to be the default image.

Steps

1. From the working environment, click the menu icon, and then click **Advanced > Update Cloud Volumes ONTAP**.
2. On the update software page, select the alternate image, and then click **Change Image**.
3. Click **Proceed** to confirm.

Result

Cloud Manager starts the software update. You can perform actions on the working environment once the software update is complete.

After you finish

If you suspended SnapMirror transfers, use System Manager to resume the transfers.

Modifying Cloud Volumes ONTAP systems

You might need to change the configuration of Cloud Volumes ONTAP systems as your storage needs change. For example, you can change between pay-as-you-go configurations, change the instance or VM type, and more.

Changing the instance or machine type for Cloud Volumes ONTAP

You can choose from several instance or machine types when you launch Cloud Volumes ONTAP in AWS, Azure, or GCP. You can change the instance or machine type at any time if you determine that it is undersized or oversized for your needs.

About this task

- Automatic giveback must be enabled on a Cloud Volumes ONTAP HA pair (this is the default setting). If it isn't, then the operation will fail.

[ONTAP 9 Documentation: Commands for configuring automatic giveback](#)

- Changing the instance or machine type affects cloud provider service charges.
- The operation restarts Cloud Volumes ONTAP.

For single node systems, I/O is interrupted.

For HA pairs, the change is nondisruptive. HA pairs continue to serve data.



Cloud Manager gracefully changes one node at a time by initiating takeover and waiting for give back. NetApp's QA team tested both writing and reading files during this process and didn't see any issues on the client side. As connections changed, we did see retries on the I/O level, but the application layer overcame these short "re-wire" of NFS/CIFS connections.

Steps

- From the working environment, click the menu icon, and then click **Change license or instance** for AWS, **Change license or VM** for Azure, or **Change license or machine** for GCP.
- If you are using a pay-as-you-go configuration, you can optionally choose a different license.
- Select an instance or machine type, select the check box to confirm that you understand the implications of the change, and then click **OK**.

Result

Cloud Volumes ONTAP reboots with the new configuration.

Changing between pay-as-you-go configurations

After you launch pay-as-you-go Cloud Volumes ONTAP systems, you can change between the Explore, Standard, and Premium configurations at any time by modifying the license. Changing the license increases or decreases the raw capacity limit and enables you to choose from different AWS instance types or Azure virtual machine types.



In GCP, a single machine type is available for each pay-as-you-go configuration. You can't choose between different machine types.

About this task

Note the following about changing between pay-as-you-go licenses:

- The operation restarts Cloud Volumes ONTAP.

For single node systems, I/O is interrupted.

For HA pairs, the change is nondisruptive. HA pairs continue to serve data.

- Changing the instance or machine type affects cloud provider service charges.

Steps

- From the working environment, click the menu icon, and then click **Change license or instance** for AWS,

Change license or VM for Azure, or **Change license or machine** for GCP.

2. Select a license type and an instance type or machine type, select the check box to confirm that you understand the implications of the change, and then click **OK**.

Result

Cloud Volumes ONTAP reboots with the new license, instance type or machine type, or both.

Moving to an alternate Cloud Volumes ONTAP configuration

If you want to switch between a pay-as-you-go subscription and a BYOL subscription or between a single Cloud Volumes ONTAP system and an HA pair, then you need to deploy a new system and then replicate data from the existing system to the new system.

Steps

1. Create a new Cloud Volumes ONTAP working environment.

[Launching Cloud Volumes ONTAP in AWS](#)

[Launching Cloud Volumes ONTAP in Azure](#)

[Launching Cloud Volumes ONTAP in GCP](#)

2. [Set up one-time data replication](#) between the systems for each volume that you must replicate.
3. Terminate the Cloud Volumes ONTAP system that you no longer need by [deleting the original working environment](#).

Changing write speed to normal or high

Cloud Manager enables you to choose a normal or high write speed for Cloud Volumes ONTAP. The default write speed is normal. You can change to high write speed if fast write performance is required for your workload.

High write speed is supported with all types of single node systems. It's also supported with HA pairs in AWS and Azure when using a specific instance or VM type ([click here to see the list of supported instances and VM types](#)). High write speed is not supported with HA pairs in GCP.

Before you change the write speed, you should [understand the differences between the normal and high settings](#).

About this task

- Ensure that operations such as volume or aggregate creation are not in progress.
- Be aware that this change restarts Cloud Volumes ONTAP.

Steps

1. From the working environment, click the menu icon, and then click **Advanced > Writing Speed**.
2. Select **Normal** or **High**.

If you choose High, then you'll need to read the "I understand..." statement and confirm by checking the box.

3. Click **Save**, review the confirmation message, and then click **Proceed**.

Modifying the storage VM name

Cloud Manager automatically names the single storage VM (SVM) that it creates for Cloud Volumes ONTAP. You can modify the name of the SVM if you have strict naming standards. For example, you might want the name to match how you name the SVMs for your ONTAP clusters.

But if you created any additional SVMs for Cloud Volumes ONTAP, then you can't rename the SVMs from Cloud Manager. You'll need to do so directly from Cloud Volumes ONTAP by using System Manager or the CLI.

Steps

1. From the working environment, click the menu icon, and then click **Information**.
2. Click the edit icon to the right of the storage VM name.

The screenshot shows the 'Working Environment Information' page for an ONTAP system. The page has a header with a back arrow and the title. Below the header, there is a section titled 'ONTAP' with a horizontal line. Under 'ONTAP', there are five data entries, each consisting of a label and a value, separated by a horizontal line:

Serial Number:	[REDACTED]
System ID:	system-id-capacitytest
Cluster Name:	capacitytest
ONTAP Version:	9.7RC1
Date Created:	Jul 6, 2020 07:42:02 am

Below the 'ONTAP' section, there is another section labeled 'Storage VM Name:' with the value 'svm_capacitytest' followed by an edit icon (pencil and circular arrow). This edit icon is the same one mentioned in the steps above.

3. In the Modify SVM Name dialog box, change the name, and then click **Save**.

Changing the password for Cloud Volumes ONTAP

Cloud Volumes ONTAP includes a cluster admin account. You can change the password for this account from Cloud Manager, if needed.



You should not change the password for the admin account through System Manager or the CLI. The password will not be reflected in Cloud Manager. As a result, Cloud Manager cannot monitor the instance properly.

Steps

1. From the working environment, click the menu icon, and then click **Advanced > Set password**.
2. Enter the new password twice and then click **Save**.

The new password must be different than one of the last six passwords that you used.

Changing the network MTU for c4.4xlarge and c4.8xlarge instances

By default, Cloud Volumes ONTAP is configured to use 9,000 MTU (also called jumbo frames) when you choose the c4.4xlarge instance or the c4.8xlarge instance in AWS. You can change the network MTU to 1,500 bytes if that is more appropriate for your network configuration.

About this task

A network maximum transmission unit (MTU) of 9,000 bytes can provide the highest maximum network throughput possible for specific configurations.

9,000 MTU is a good choice if clients in the same VPC communicate with the Cloud Volumes ONTAP system and some or all of those clients also support 9,000 MTU. If traffic leaves the VPC, packet fragmentation can occur, which degrades performance.

A network MTU of 1,500 bytes is a good choice if clients or systems outside of the VPC communicate with the Cloud Volumes ONTAP system.

Steps

1. From the working environment, click the menu icon and then click **Advanced > Network Utilization**.
2. Select **Standard or Jumbo Frames**.
3. Click **Change**.

Changing route tables associated with HA pairs in multiple AWS AZs

You can modify the AWS route tables that include routes to the floating IP addresses for an HA pair. You might do this if new NFS or CIFS clients need to access an HA pair in AWS.

Steps

1. From the working environment, click the menu icon and then click **Information**.
2. Click **Route Tables**.
3. Modify the list of selected route tables and then click **Save**.

Result

Cloud Manager sends an AWS request to modify the route tables.

Managing the state of Cloud Volumes ONTAP

You can stop and start Cloud Volumes ONTAP from Cloud Manager to manage your cloud compute costs.

Scheduling automatic shutdowns of Cloud Volumes ONTAP

You might want to shut down Cloud Volumes ONTAP during specific time intervals to lower your compute costs. Rather than do this manually, you can configure Cloud Manager to automatically shut down and then restart systems at specific times.

About this task

When you schedule an automatic shutdown of your Cloud Volumes ONTAP system, Cloud Manager postpones

the shutdown if an active data transfer is in progress. Cloud Manager shuts down the system after the transfer is complete.

This task schedules automatic shutdowns of both nodes in an HA pair.

Steps

1. From the working environment, click the clock icon:



2. Specify the shutdown schedule:

- a. Choose whether you want to shut down the system every day, every weekday, every weekend, or any combination of the three options.
- b. Specify when you want to turn off the system and for how long you want it turned off.

Example

The following image shows a schedule that instructs Cloud Manager to shut down the system every Saturday at 12:00 a.m. for 48 hours. Cloud Manager restarts the system every Monday at 12:00 a.m.

<input type="checkbox"/> Turn off every weekday Mon, Tue, Wed, Thu, Fri	turn off at	08	:	00	PM	for	12	Hours (1-24)
<hr/>								
<input checked="" type="checkbox"/> Turn off every weekend Sat	turn off at	12	:	00	AM	for	48	Hours (1-48)

3. Click **Save**.

Result

Cloud Manager saves the schedule. The clock icon changes to indicate that a schedule is set:



Stopping Cloud Volumes ONTAP

Stopping Cloud Volumes ONTAP saves you from accruing compute costs and creates snapshots of the root and boot disks, which can be helpful for troubleshooting.

About this task

When you stop an HA pair, Cloud Manager shuts down both nodes.

Steps

1. From the working environment, click the **Turn off** icon.



2. Keep the option to create snapshots enabled because the snapshots can enable system recovery.

3. Click **Turn Off**.

It can take up to a few minutes to stop the system. You can restart systems at a later time from the working environment page.

Monitoring AWS resource costs

Cloud Manager enables you to view the resource costs associated with running Cloud Volumes ONTAP in AWS. You can also see how much money you saved by using NetApp features that can reduce storage costs.

About this task

Cloud Manager updates the costs when you refresh the page. You should refer to AWS for final cost details.

Step

1. Verify that Cloud Manager can obtain cost information from AWS:

- a. Ensure that the IAM policy that provides Cloud Manager with permissions includes the following actions:

```
"ce:GetReservationUtilization",
"ce:GetDimensionValues",
"ce:GetCostAndUsage",
"ce:GetTags"
```

These actions are included in the latest [Cloud Manager policy](#). New systems deployed from NetApp Cloud Central automatically include these permissions.

- b. [Activate the **WorkingEnvironmentId** tag](#).

To track your AWS costs, Cloud Manager assigns a cost allocation tag to Cloud Volumes ONTAP instances. After you create your first working environment, activate the **WorkingEnvironmentId** tag. User-defined tags don't appear on AWS billing reports until you activate them in the Billing and Cost Management console.

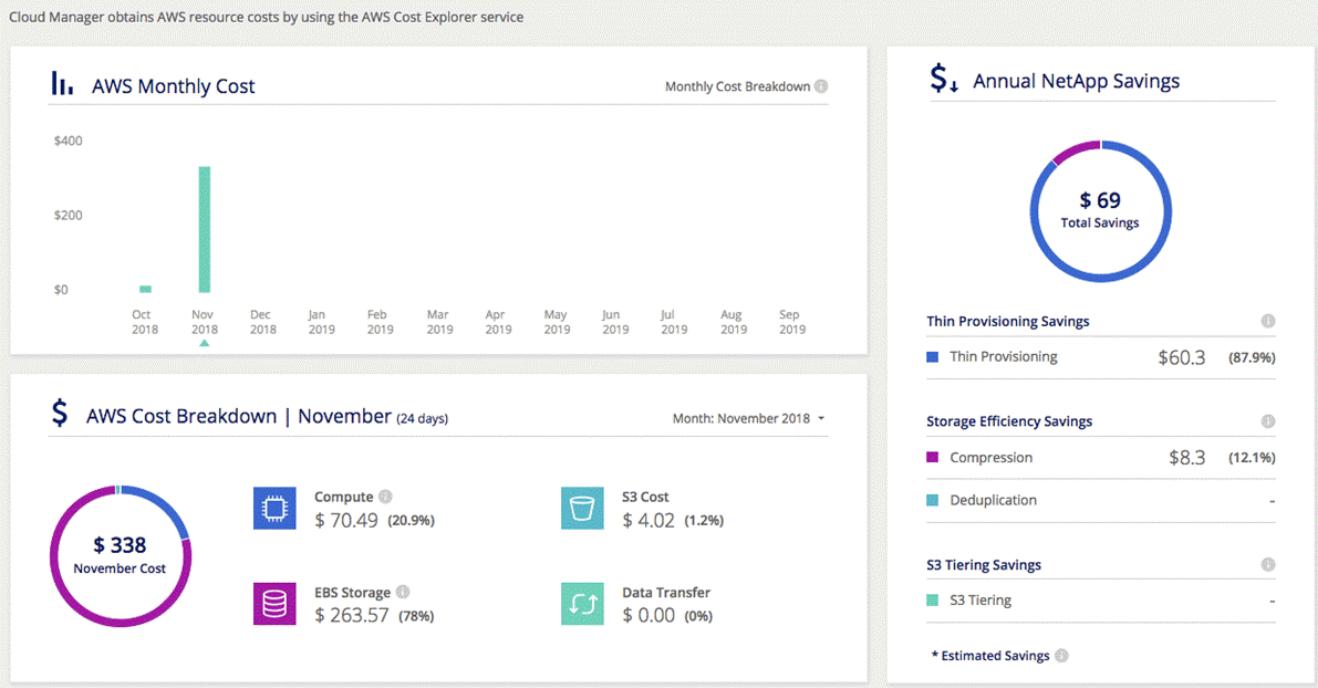
2. On the Canvas page, select a Cloud Volumes ONTAP working environment and then click **Cost**.

The Cost page displays costs for the current and previous months and shows your annual NetApp savings, if you enabled NetApp's cost-saving features on volumes.

The following image shows a sample Cost page:

AWS Resource Costs

[Learn how we calculate the costs and savings](#)



Connecting to Cloud Volumes ONTAP

If you need to perform advanced management of Cloud Volumes ONTAP, you can do so using OnCommand System Manager or the command line interface.

Connecting to System Manager

You might need to perform some Cloud Volumes ONTAP tasks from System Manager, which is a browser-based management tool that runs on the Cloud Volumes ONTAP system. For example, you need to use System Manager if you want to create LUNs.

Before you begin

The computer from which you are accessing Cloud Manager must have a network connection to Cloud Volumes ONTAP. For example, you might need to log in to Cloud Manager from a jump host in AWS or Azure.



When deployed in multiple AWS Availability Zones, Cloud Volumes ONTAP HA configurations use a floating IP address for the cluster management interface, which means external routing is not available. You must connect from a host that is part of the same routing domain.

Steps

1. From the Canvas page, double-click the Cloud Volumes ONTAP system that you want to manage with System Manager.
 2. Click the menu icon, and then click **Advanced > System Manager**.
 3. Click **Launch**.
- System Manager loads in a new browser tab.
4. At the login screen, enter **admin** in the User Name field, enter the password that you specified when you created the working environment, and then click **Sign In**.

Result

The System Manager console loads. You can now use it to manage Cloud Volumes ONTAP.

Connecting to the Cloud Volumes ONTAP CLI

The Cloud Volumes ONTAP CLI enables you to execute all administrative commands and is a good choice for advanced tasks or if you are more comfortable using the CLI. You can connect to the CLI using Secure Shell (SSH).

Before you begin

The host from which you use SSH to connect to Cloud Volumes ONTAP must have a network connection to Cloud Volumes ONTAP. For example, you might need to use SSH from a jump host in AWS or Azure.



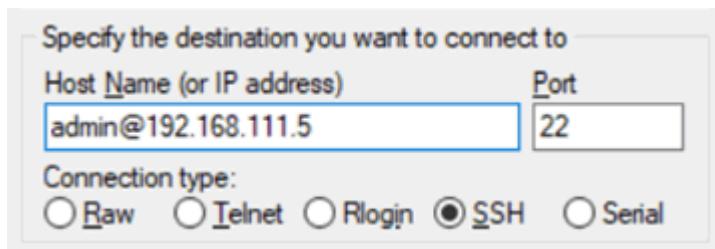
When deployed in multiple AZs, Cloud Volumes ONTAP HA configurations use a floating IP address for the cluster management interface, which means external routing is not available. You must connect from a host that is part of the same routing domain.

Steps

1. In Cloud Manager, identify the IP address of the cluster management interface:
 - a. On the Canvas page, select the Cloud Volumes ONTAP system.
 - b. Copy the cluster management IP address that appears in the right pane.
2. Use SSH to connect to the cluster management interface IP address using the admin account.

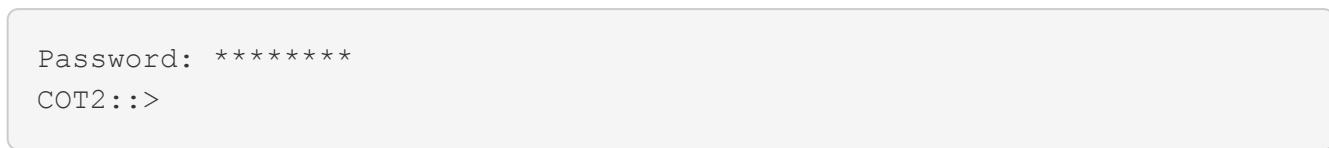
Example

The following image shows an example using PuTTY:



3. At the login prompt, enter the password for the admin account.

Example



Adding existing Cloud Volumes ONTAP systems to Cloud Manager

You can discover and add existing Cloud Volumes ONTAP systems to Cloud Manager. You might do this if you deployed a new Cloud Manager system.

Before you begin

You must know the password for the Cloud Volumes ONTAP admin user account.

Steps

1. On the Canvas page, click **Add Working Environment**.
2. Select the cloud provider in which the system resides.
3. Choose the type of Cloud Volumes ONTAP system.
4. Click the link to discover an existing system.

The screenshot shows a web interface titled "Define Your Working Environment". It displays three options for creating a working environment:

- Cloud Volumes ONTAP** (Single Node): Selected (indicated by a checkmark icon).
- Cloud Volumes ONTAP HA** (High Availability)
- Cloud Volumes Service** (High Availability)

Below the options, a message states: "You're about to create a new Cloud Volumes ONTAP system in AWS." A red box highlights a link: "If you want to discover an existing Cloud Volumes ONTAP in AWS, [click here](#)".

5. On the Region page, choose the region where the instances are running, and then select the instances.
6. On the Credentials page, enter the password for the Cloud Volumes ONTAP admin user, and then click **Go**.

Result

Cloud Manager adds the Cloud Volumes ONTAP instances to the workspace.

Overriding CIFS locks for Cloud Volumes ONTAP HA in Azure

The Account Admin can enable a setting in Cloud Manager that prevents issues with Cloud Volumes ONTAP storage failover during Azure maintenance events. When you enable this setting, Cloud Volumes ONTAP vetoes CIFS locks and resets active CIFS sessions.

About this task

Microsoft Azure schedules periodic maintenance events on its virtual machines. When a maintenance event occurs on a node in a Cloud Volumes ONTAP HA pair, the HA pair initiates storage takeover. If there are active CIFS sessions during this maintenance event, the locks on CIFS files can prevent storage failover.

If you enable this setting, Cloud Volumes ONTAP will veto the locks and reset the active CIFS sessions. As a result, the HA pair can complete storage failover during these maintenance events.



This process might be disruptive to CIFS clients. Data that is not committed from CIFS clients could be lost.

What you'll need

You need to create a Connector before you can change Cloud Manager settings. [Learn how](#).

Steps

1. In the upper right of the Cloud Manager console, click the Settings icon, and select **Cloud Manager Settings**.



2. Under **HA CIFS Locks**, select the checkbox and click **Save**.

Using an Azure Private Link with Cloud Volumes ONTAP

By default, Cloud Manager enables an Azure Private Link connection between Cloud Volumes ONTAP and its associated storage accounts. A Private Link secures connections between endpoints in Azure and provides performance benefits. [Learn more](#).

In most cases, there's nothing that you need to do—Cloud Manager manages the Azure Private Link for you. But if you use Azure Private DNS, then you'll need to edit a configuration file. You can also disable the Private Link connection, if desired.

Providing Cloud Manager with details about your Azure Private DNS

If you use [Azure Private DNS](#), then you need to modify a configuration file on each Connector. Otherwise, Cloud Manager can't enable the Azure Private Link connection between Cloud Volumes ONTAP and its associated storage accounts.

Note that the DNS name must match Azure DNS naming requirements [as shown in Azure documentation](#).

Steps

1. SSH to the Connector host and log in.
2. Navigate to the following directory: /opt/application/netapp/cloudmanager
3. Edit app.conf by modifying the following parameter as shown:

```
"user-private-dns-zone-settings": {  
    "use-existing": true,  
    "resource-group": "<resource group name of the DNS zone>"  
}
```

4. Save the file and log off the Connector.

A reboot isn't required.

Disabling Azure Private Link connections

If required for your Azure configuration, you can disable the Azure Private Link connection between Cloud Volumes ONTAP and storage accounts.

Steps

1. In the upper right of the Cloud Manager console, click the Settings icon, and select **Cloud Manager Settings**.
2. Under Azure Cloud Volumes ONTAP Configuration, deselect **Private Link connection between Cloud Volumes ONTAP and storage accounts**.
3. Click **Save**.

Deleting a Cloud Volumes ONTAP working environment

It is best to delete Cloud Volumes ONTAP systems from Cloud Manager, rather than from your cloud provider's console. For example, if you terminate a licensed Cloud Volumes ONTAP instance from AWS, then you can't use the license key for another instance. You must delete the working environment from Cloud Manager to release the license.

About this task

When you delete a working environment, Cloud Manager terminates instances, deletes disks, and snapshots.



Cloud Volumes ONTAP instances have termination protection enabled to help prevent accidental termination from AWS. However, if you do terminate a Cloud Volumes ONTAP instance from AWS, you must go to the AWS CloudFormation console and delete the instance's stack. The stack name is the name of the working environment.

Steps

1. From the working environment, click menu icon and then click **Delete**.
2. Type the name of the working environment and then click **Delete**.

It can take up to 5 minutes to delete the working environment.

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