Cloud Manager and Cloud Volumes ONTAP documentation

Cloud Manager 3.6

NetApp
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Cloud Manager and Cloud Volumes ONTAP documentation

OnCommand Cloud Manager enables you to deploy and manage NetApp Cloud Volumes ONTAP, which is a data management solution that provides protection, visibility, and control for your cloud-based workloads.

BlueXP

NetApp BlueXP extends and enhances the capabilities that were provided through Cloud Manager.

Go to the BlueXP documentation

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Release notes

Cloud Manager

What's new in Cloud Manager 3.6

OnCommand Cloud Manager typically introduces a new release every month to bring you new features, enhancements, and bug fixes.

Looking for a previous release?
What's new in 3.5
What's new in 3.4

Support for the AWS C2S Environment (2 May 2019)

Cloud Volumes ONTAP 9.5 and Cloud Manager 3.6.4 are now available to the U.S. Intelligence Community (IC) through the AWS Commercial Cloud Services (C2S) environment. You can deploy HA pairs and single node systems in C2S.

Quick Start Guide for the AWS Commercial Cloud Services Environment

Cloud Manager 3.6.6 (1 May 2019)

- Support for 6 TB disks in AWS
- Support for new disk sizes with single node systems in Azure
- Support for Standard SSDs with single node systems in Azure
- Automatic discovery of Kubernetes clusters created with the NetApp Kubernetes Service
- Ability to configure an NTP server

Support for 6 TB disks in AWS

You can now choose an EBS disk size of 6 TB with Cloud Volumes ONTAP for AWS. With the recent increased performance of General Purpose SSDs, a 6 TB disk is now the best choice for maximum performance.

This change is supported with Cloud Volumes ONTAP 9.5, 9.4, and 9.3.

Support for new disk sizes with single node systems in Azure

You can now use 8 TB, 16 TB, and 32 TB disks with single node systems in Azure. The increased disk sizes enable you to reach up to 368 TB of system capacity with disks alone when using the Premium or BYOL licenses.

This change is supported with Cloud Volumes ONTAP 9.5, 9.4, and 9.3.

Support for Standard SSDs with single node systems in Azure

Standard SSD Managed Disks are now supported with single node systems in Azure. These disks provide a level of performance in between Premium SSDs and Standard HDDs.

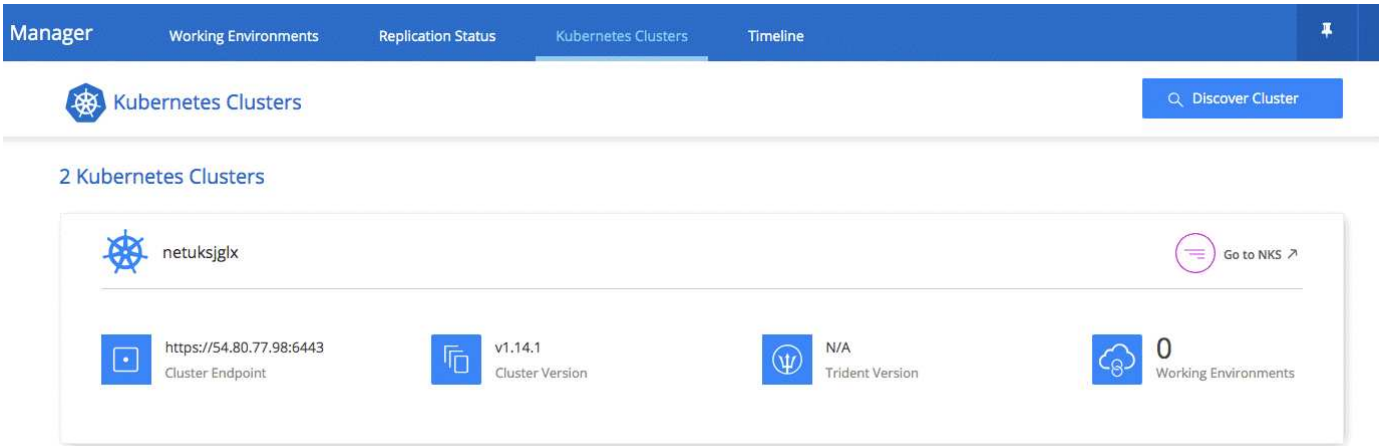
This change is supported with Cloud Volumes ONTAP 9.5, 9.4, and 9.3.

Learn more about Standard SSDs.

Automatic discovery of Kubernetes clusters created with the NetApp Kubernetes Service

Cloud Manager can now automatically discover the Kubernetes clusters that you deploy using the NetApp Kubernetes Service. This enables you to connect the Kubernetes clusters to your Cloud Volumes ONTAP systems so you can use them as persistent storage for your containers.

The following image shows an automatically discovered Kubernetes cluster. The "Go to NKS" link brings you directly to the NetApp Kubernetes Service.



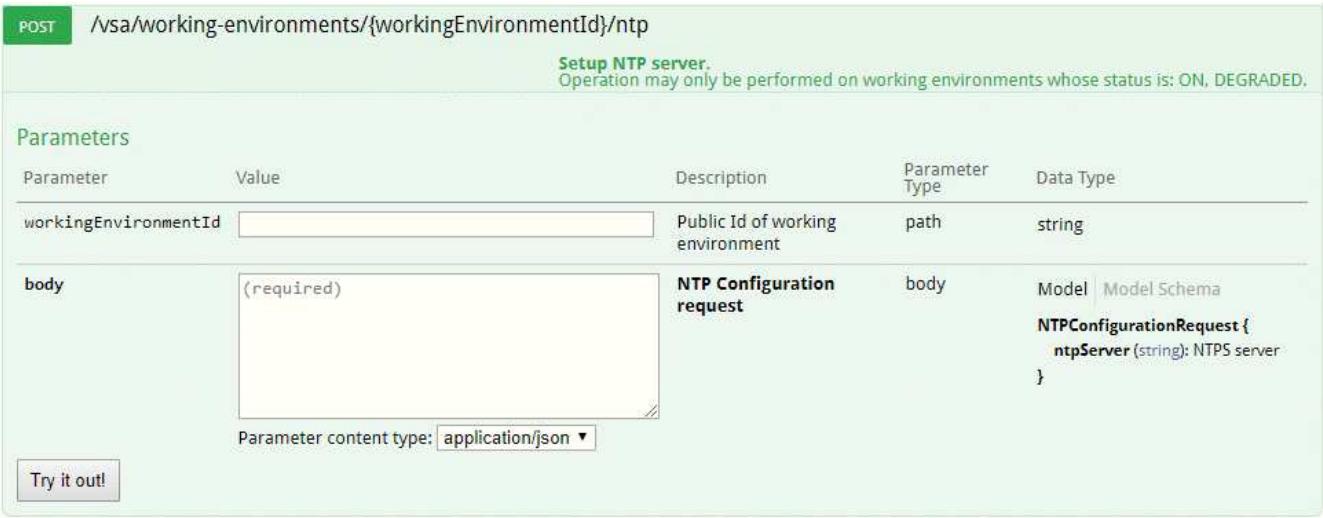
Learn how to connect your working environments to Kubernetes clusters.

Ability to configure an NTP server

You can now configure Cloud Volumes ONTAP to use a Network Time Protocol (NTP) server. Specifying an NTP server synchronizes the time between the systems in your network, which can help prevent issues due to time differences.

Specify an NTP server using the Cloud Manager API or from the user interface when you set up a CIFS server:

- The Cloud Manager APIs enable you to specify any address for the NTP server. Here's the API for a single-node system in AWS:



- When configuring a CIFS server, the Cloud Manager user interface enables you to specify an NTP server that uses the Active Directory domain. If you need to use a different address, then you should use the API.

  The following image shows the NTP Server field, which is available when setting up CIFS.

Cloud Manager 3.6.5 (2 Apr 2019)

Cloud Manager 3.6.5 includes the following enhancements.

- Kubernetes enhancements
- NetApp Support Site accounts are now managed at the system level
- AWS transit gateways can enable access to floating IP addresses
- Azure resource groups are now locked
- NFS 4 and NFS 4.1 are now enabled by default
- A new API enables you to delete ONTAP Snapshot copies

Kubernetes enhancements

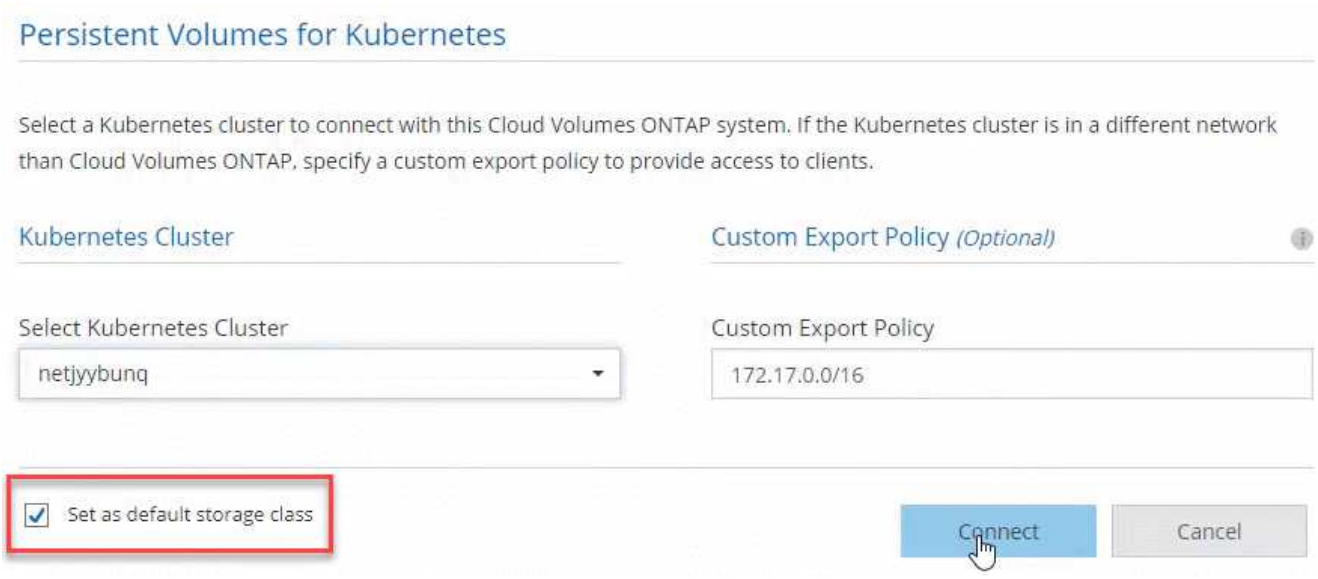
We made a few enhancements that make it easier for you to use Cloud Volumes ONTAP as persistent storage for containers:

- You can now add multiple Kubernetes clusters to Cloud Manager.

  This enables you to connect different clusters to different Cloud Volumes ONTAP systems and multiple clusters to the same Cloud Volumes ONTAP system.

- When you connect a cluster, you can now set Cloud Volumes ONTAP as the default storage class for the Kubernetes cluster.

  When a user creates a persistent volume, the Kubernetes cluster can use Cloud Volumes ONTAP as the backend storage by default:



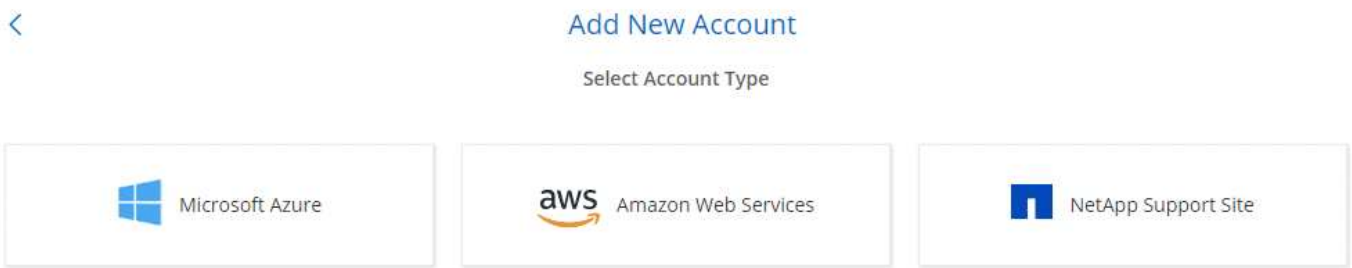
- We changed how Cloud Manager names the Kubernetes storage classes so they are more easily identifiable:
  - **netapp-file**: for binding a Persistent Volume to a single-node Cloud Volumes ONTAP system
  - **netapp-file-redundant**: for binding a Persistent Volume to a Cloud Volumes ONTAP HA pair
- The version of NetApp Trident that Cloud Manager installs was updated to the latest version.

Learn how to use Cloud Volumes ONTAP as persistent storage for Kubernetes.

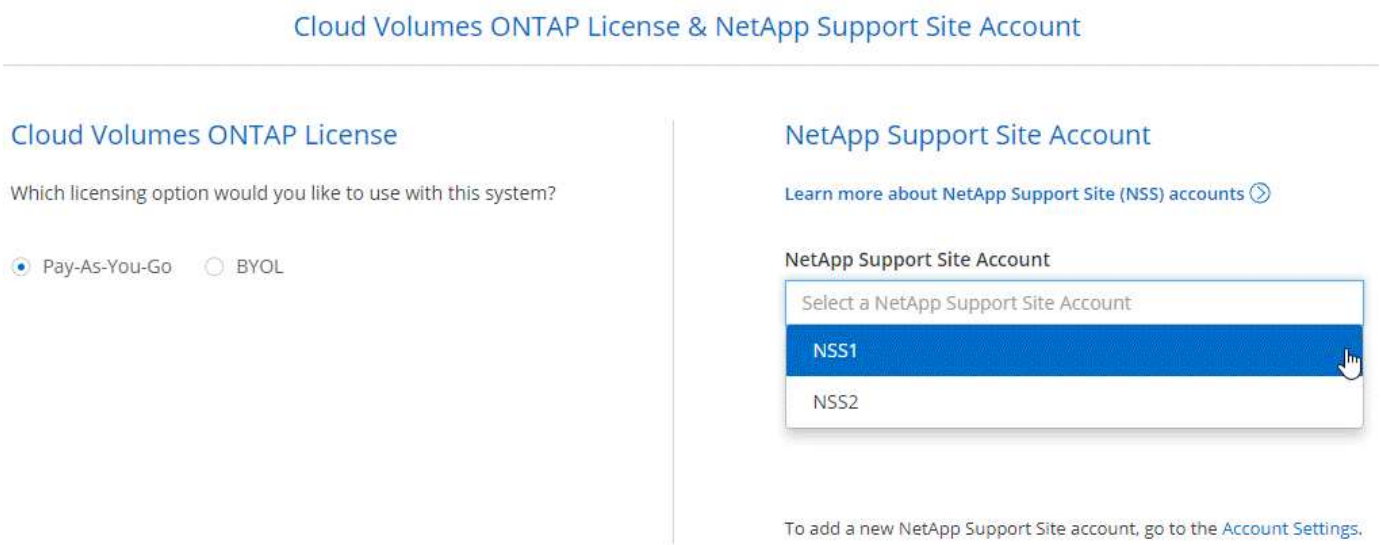
NetApp Support Site accounts are now managed at the system level

It's now easier to manage NetApp Support Site accounts in Cloud Manager.

In previous releases, you needed to link a NetApp Support Site account to a specific tenant. The accounts are now managed at the Cloud Manager system level in the same place that you manage cloud provider accounts. This change gives you the flexibility to choose between multiple NetApp Support Site accounts when registering your Cloud Volumes ONTAP systems.



When you create a new working environment, you simply select the NetApp Support Site account to register the Cloud Volumes ONTAP system with:



When Cloud Manager updates to 3.6.5, it automatically adds NetApp Support Site accounts for you, if you had previously linked tenants with an account.

Learn how to add NetApp Support Site accounts to Cloud Manager.

AWS transit gateways can enable access to floating IP addresses

An HA pair in multiple AWS Availability Zones uses *floating IP addresses* for NAS data access and for management interfaces. Until now, those floating IP addresses haven't been accessible from outside the VPC where the HA pair resides.

We verified that you can use an AWS transit gateway to enable access to the floating IP addresses from outside the VPC. That means NetApp management tools and NAS clients that are outside the VPC can access the floating IPs and take advantage of automatic failover.

Learn how to set up an AWS transit gateway for HA pairs in multiple AZs.

Azure resource groups are now locked

Cloud Manager now locks Cloud Volumes ONTAP resource groups in Azure when it creates them. Locking resource groups prevents users from accidentally deleting or modifying critical resources.

NFS 4 and NFS 4.1 are now enabled by default

Cloud Manager now enables the NFS 4 and NFS 4.1 protocols on every new Cloud Volumes ONTAP system that it creates. This change saves you time because you no longer need to manually enable those protocols yourself.

A new API enables you to delete ONTAP Snapshot copies

You can now delete Snapshot copies of read-write volumes by using a Cloud Manager API call.

Here's an example of the API call for an HA system in AWS:

```
DELETE  /aws/ha/volumes/{workingEnvironmentId}/{svmName}/{volumeName}/snapshot
        Delete snapshot manually.
        Operation may only be performed on working environments whose status is: ON, DEGRADED.
```

Similar API calls are available for single-node systems in AWS and for single-node and HA systems in Azure.

OnCommand Cloud Manager API Developer Guide

Cloud Manager 3.6.4 update (18 Mar 2019)

Cloud Manager was updated to support the 9.5 P1 patch release for Cloud Volumes ONTAP. With this patch release, HA pairs in Azure are now Generally Available (GA).

See the Cloud Volumes ONTAP 9.5 Release Notes for additional details, including important information about Azure region support for HA pairs.

Cloud Manager 3.6.4 (3 Mar 2019)

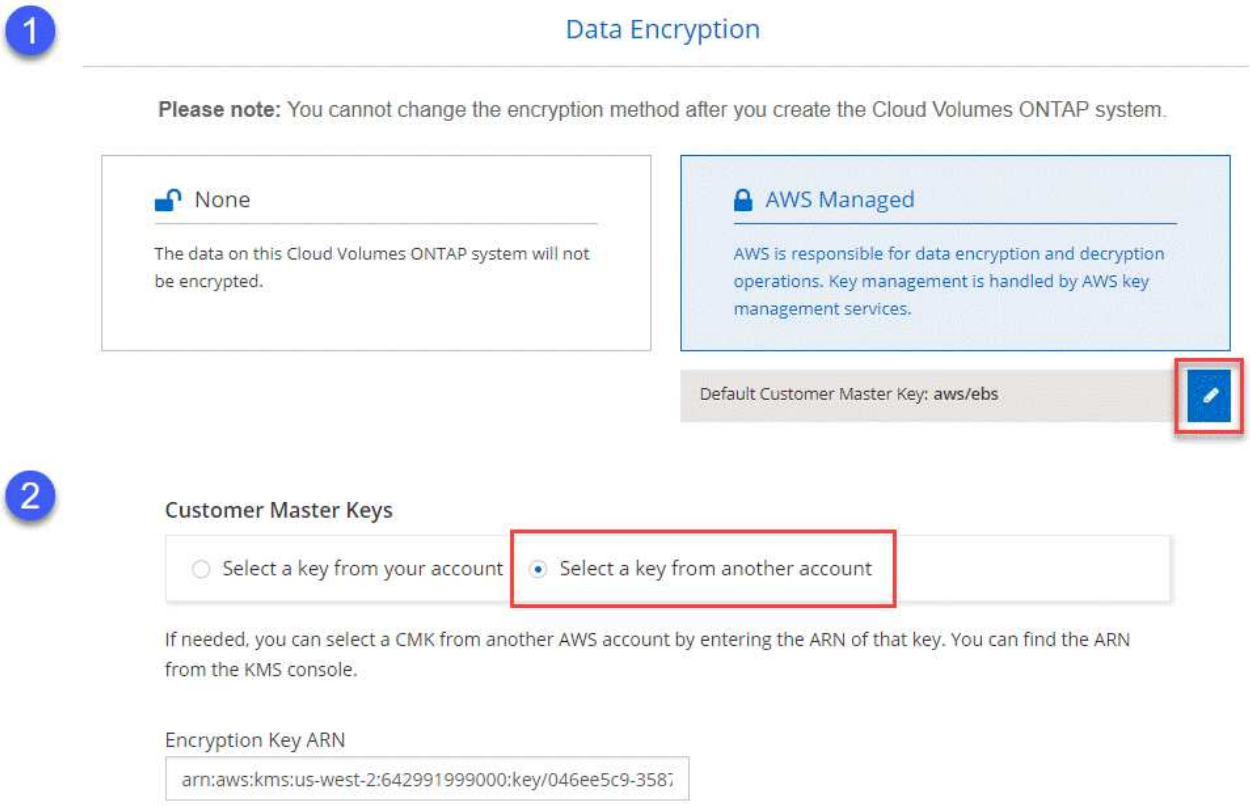
Cloud Manager 3.6.4 includes the following enhancements.

- AWS-managed encryption with a key from another account
- Recovery of failed disks
- Azure storage accounts enabled for HTTPS when data tiering to Blob containers

AWS-managed encryption with a key from another account

When launching a Cloud Volumes ONTAP system in AWS, you can now enable AWS-managed encryption using a Customer Master Key (CMK) from another AWS user account.

The following images show how to select the option when creating a new working environment:



Learn more about supported encryption technologies.

Recovery of failed disks

Cloud Manager now tries to recover failed disks from Cloud Volumes ONTAP systems. Successful attempts are noted in email notification reports. Here's a sample notification:

You can enable notification reports by editing your user account.

Azure storage accounts enabled for HTTPS when data tiering to Blob containers

When you set up a Cloud Volumes ONTAP system to tier inactive data to an Azure Blob container, Cloud Manager creates an Azure storage account for that container. Starting in this release, Cloud Manager now

enables new storage accounts with secure transfer (HTTPS). Existing storage accounts continue to use HTTP.

Cloud Manager 3.6.3 (4 Feb 2019)

Cloud Manager 3.6.3 includes the following enhancements.

- Support for Cloud Volumes ONTAP 9.5 GA
- 368 TB capacity limit for all Premium and BYOL configurations
- Support for new AWS regions
- Support for S3 Intelligent-Tiering
- Ability to disable data tiering on the initial aggregate
- Recommended EC2 instance type now t3.medium for Cloud Manager
- Postponement of scheduled shutdowns during data transfers

Support for Cloud Volumes ONTAP 9.5 GA

Cloud Manager now supports the General Availability (GA) release of Cloud Volumes ONTAP 9.5. This includes support for M5 and R5 instances in AWS. For more details about the 9.5 release, see the Cloud Volumes ONTAP 9.5 Release Notes.

368 TB capacity limit for all Premium and BYOL configurations

The system capacity limit for Cloud Volumes ONTAP Premium and BYOL is now 368 TB across all configurations: single node and HA in both AWS and Azure. This change applies to Cloud Volumes ONTAP 9.5, 9.4, and 9.3 (AWS only with 9.3).

For some configurations, disk limits prevent you from reaching the 368 TB capacity limit by using disks alone. In those cases, you can reach the 368 TB capacity limit by tiering inactive data to object storage. For example, a single node system in Azure could have 252 TB of disk-based capacity, which would allow up to 116 TB of inactive data in Azure Blob storage.

For information about disk limits, refer to storage limits in the Cloud Volumes ONTAP Release Notes.

Support for new AWS regions

Cloud Manager and Cloud Volumes ONTAP are now supported in the following AWS regions:

- Europe (Stockholm)

  Single node systems only. HA pairs are not supported at this time.

- GovCloud (US-East)

  This is in addition to support for the AWS GovCloud (US-West) region.

See the full list of supported regions.

Support for S3 Intelligent-Tiering

When you enable data tiering in AWS, Cloud Volumes ONTAP tiers inactive data to the S3 Standard storage class by default. You can now change the tiering level to the *Intelligent Tiering* storage class. This storage class optimizes storage costs by moving data between two tiers as data access patterns change. One tier is for

frequent access and the other is for infrequent access.

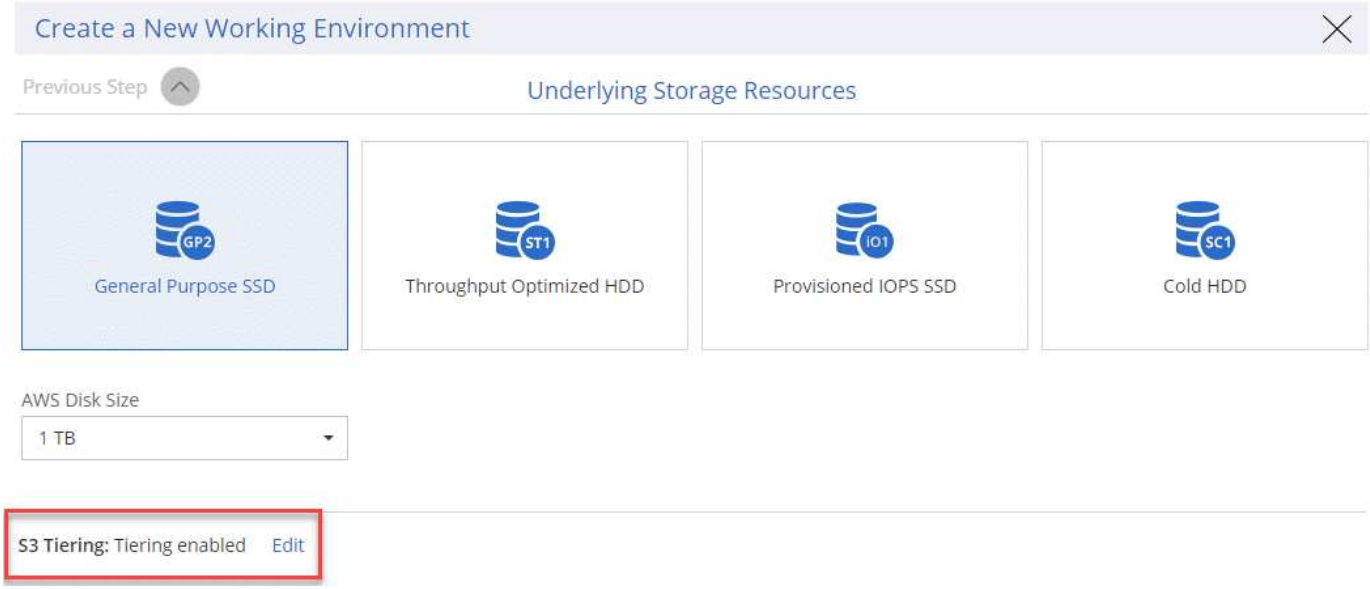
Just like in previous releases, you can also use the Standard-Infrequent Access tier and the One Zone-Infrequent Access tier.

Learn more about data tiering and learn how to change the storage class.

Ability to disable data tiering on the initial aggregate

In previous releases, Cloud Manager automatically enabled data tiering on the initial Cloud Volumes ONTAP aggregate. You can now choose to disable data tiering on this initial aggregate. (You can enable or disable data tiering on subsequent aggregates, as well.)

This new option is available when choosing the underlying storage resources. The following image shows an example when launching a system in AWS:



Recommended EC2 instance type now t3.medium for Cloud Manager

The instance type for Cloud Manager is now t3.medium when deploying Cloud Manager in AWS from NetApp Cloud Central. It is also the recommended instance type in the AWS Marketplace. This change enables support in the latest AWS regions and reduces instance costs. The recommended instance type was previously t2.medium, which is still supported.

Postponement of scheduled shutdowns during data transfers

If you scheduled an automatic shutdown of your Cloud Volumes ONTAP system, Cloud Manager now postpones the shutdown if an active data transfer is in progress. Cloud Manager shuts down the system after the transfer is complete.

Cloud Manager 3.6.2 (2 Jan 2019)

Cloud Manager 3.6.2 includes new features and enhancements.

- AWS spread placement group for Cloud Volumes ONTAP HA in a single AZ
- Ransomware protection

- New data replication policies
- Volume access control for Kubernetes

AWS spread placement group for Cloud Volumes ONTAP HA in a single AZ

When you deploy Cloud Volumes ONTAP HA in a single AWS Availability Zone, Cloud Manager now 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.

Cloud Manager requires new permissions for this feature. Ensure that the IAM policy that provides Cloud Manager with permissions includes the following actions:

```
"ec2:CreatePlacementGroup",
"ec2:DeletePlacementGroup"
```

You can find the entire list of required permissions in the latest AWS policy for Cloud Manager.

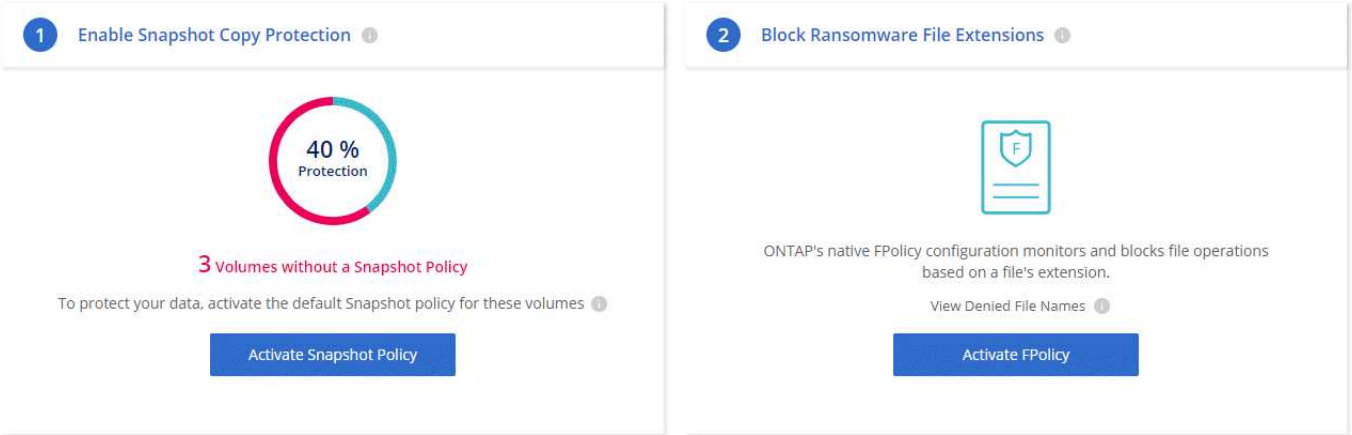
Ransomware protection

Ransomware attacks can cost a business time, resources, and reputation. Cloud Manager now 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.



Learn how to implement the NetApp solution for ransomware.

New data replication policies

Cloud Manager includes five new data replication policies that you can use for data protection.

Three of the policies configure disaster recovery and long-term retention of backups on the same destination volume. Each policy provides a different backup retention period:

- Mirror and Backup (7 year retention)
- Mirror and Backup (7 year retention with more weekly backups)
- Mirror and Backup (1 year retention, monthly)

The remaining policies provide more options for long-term retention of backups:

- Backup (1 month retention)
- Backup (1 week retention)

Simply drag-and-drop a working environment to select one of the new policies.

Volume access control for Kubernetes

You can now configure the export policy for Kubernetes Persistent Volumes. The export policy can enable access to clients if the Kubernetes cluster is in a different network than the Cloud Volumes ONTAP system.

You can configure the export policy when you connect a working environment to a Kubernetes cluster and by editing an existing volume.

Cloud Manager 3.6.1 (4 Dec 2018)

Cloud Manager 3.6.1 includes new features and enhancements.

- Support for Cloud Volumes ONTAP 9.5 in Azure
- Cloud Provider Accounts
- Enhancements to the AWS Cost report
- Support for new Azure regions

Support for Cloud Volumes ONTAP 9.5 in Azure

Cloud Manager now supports the Cloud Volumes ONTAP 9.5 release in Microsoft Azure, which includes a preview of high-availability (HA) pairs. You can request a preview license for an Azure HA pair by contacting us at ng-Cloud-Volume-ONTAP-preview@netapp.com.

For more details about the 9.5 release, see the Cloud Volumes ONTAP 9.5 Release Notes.

New Azure permissions required for Cloud Volumes ONTAP 9.5

Cloud Manager requires new Azure permissions for key features in the Cloud Volumes ONTAP 9.5 release. To ensure that Cloud Manager can deploy and manage Cloud Volumes ONTAP 9.5 systems, you should update your Cloud Manager policy by adding the following permissions:

```
"Microsoft.Network/loadBalancers/read",
"Microsoft.Network/loadBalancers/write",
"Microsoft.Network/loadBalancers/delete",
"Microsoft.Network/loadBalancers/backendAddressPools/read",
"Microsoft.Network/loadBalancers/backendAddressPools/join/action",
"Microsoft.Network/loadBalancers/frontendIPConfigurations/read",
"Microsoft.Network/loadBalancers/loadBalancingRules/read",
"Microsoft.Network/loadBalancers/probes/read",
"Microsoft.Network/loadBalancers/probes/join/action",
"Microsoft.Network/routeTables/join/action"
"Microsoft.Authorization/roleDefinitions/write",
"Microsoft.Authorization/roleAssignments/write",
"Microsoft.Web/sites/*"
"Microsoft.Storage/storageAccounts/delete",
"Microsoft.Storage/usages/read",
```

You can find the entire list of required permissions in the latest Azure policy for Cloud Manager.

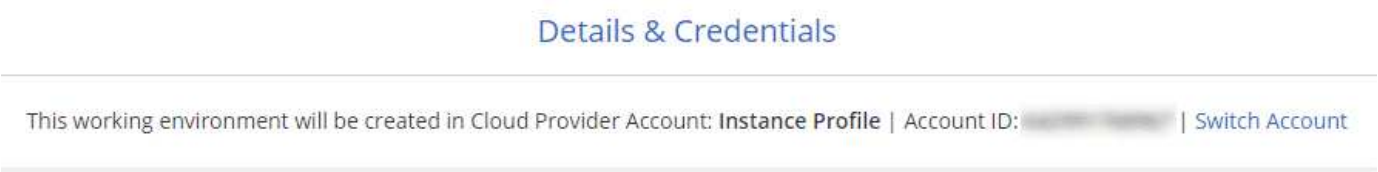
Learn how Cloud Manager uses these permissions.

Cloud Provider Accounts

It's now easier to manage multiple AWS and Azure accounts in Cloud Manager by using Cloud Provider Accounts.

In previous releases, you needed to specify cloud provider permissions for each Cloud Manager user account. The permissions are now managed at the Cloud Manager system level by using Cloud Provider Accounts.

When you create a new working environment, you simply select the account in which you want to deploy the Cloud Volumes ONTAP system:



When you upgrade to 3.6.1, Cloud Manager automatically creates Cloud Provider Accounts for you, based on your current configuration. If you have scripts, backwards compatibility is in place so nothing breaks.

- Learn how Cloud Provider Accounts and permissions work
- Learn how to set up and add Cloud Provider Accounts to Cloud Manager

Enhancements to the AWS Cost report

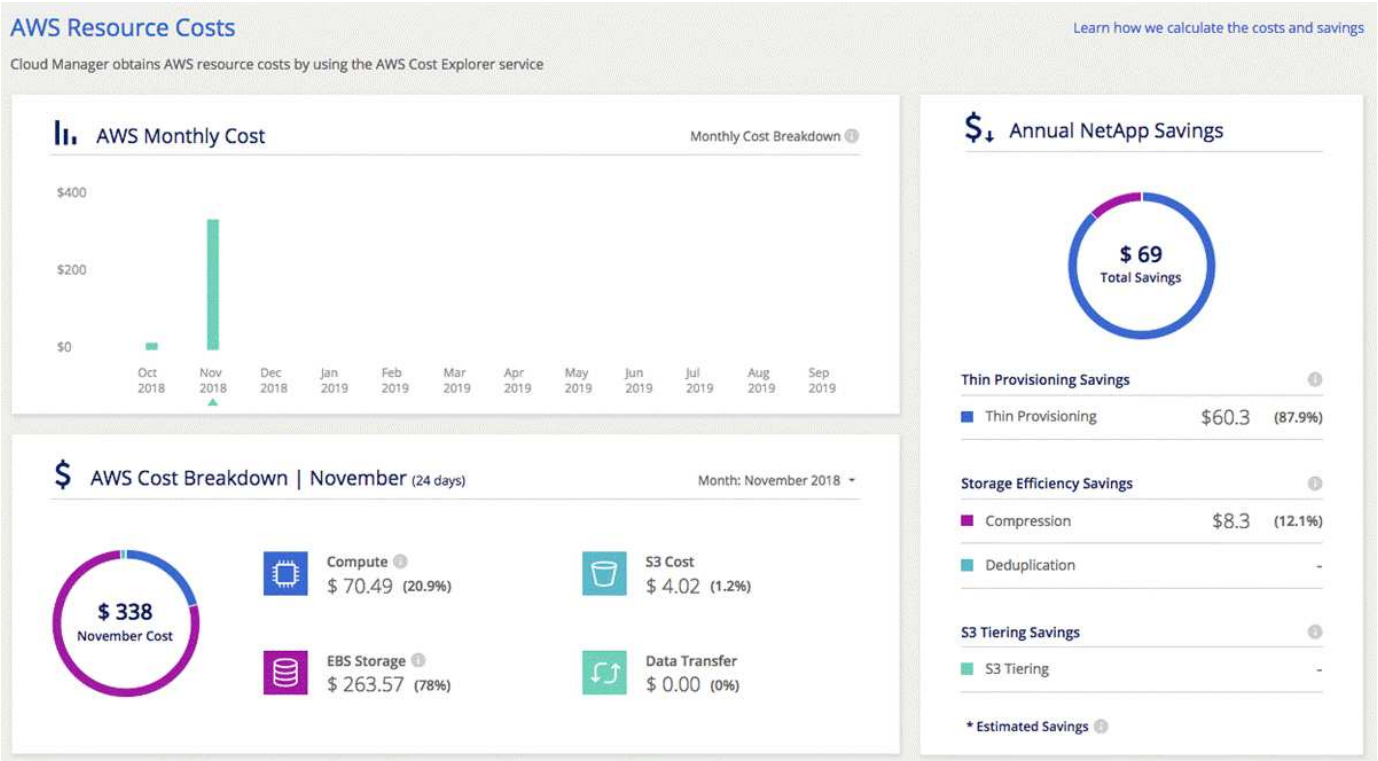
The AWS Cost report now provides more information and is easier to set up.

- The report breaks down the monthly resource costs associated with running Cloud Volumes ONTAP in AWS. You can view monthly costs for compute, EBS storage (including EBS snapshots), S3 storage, and data transfers.
- The report now shows cost savings when you tier inactive data to S3.
- We also simplified how Cloud Manager obtains cost data from AWS.

  Cloud Manager no longer needs access to billing reports that you store in an S3 bucket. Instead, Cloud Manager uses the Cost Explorer API. You just need to 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 NetApp-provided policy. New systems deployed from NetApp Cloud Central automatically include these permissions.



Support for new Azure regions

You can now deploy Cloud Manager and Cloud Volumes ONTAP in the France Central region.

Cloud Manager 3.6 (4 Nov 2018)

Cloud Manager 3.6 includes a new feature.

Using Cloud Volumes ONTAP as persistent storage for a Kubernetes cluster

Cloud Manager can now automate the deployment of NetApp Trident on a single Kubernetes cluster so you can use Cloud Volumes ONTAP as persistent storage for containers. Users can then request and manage Persistent Volumes using native Kubernetes interfaces and constructs, while taking advantage of ONTAP's advanced data management features without having to know anything about it.

Learn how to connect Cloud Volumes ONTAP systems to a Kubernetes cluster

Known issues

Known issues identify problems that might prevent you from using this release of the product successfully.

There are no known issues in this release of Cloud Manager.

You can find known issues for Cloud Volumes ONTAP in the Cloud Volumes ONTAP Release Notes and for ONTAP software in general in the ONTAP Release Notes.

Known limitations

Known limitations identify platforms, devices, or functions that are not supported by this release of the product, or that do not interoperate correctly with it. Review these limitations carefully.

Cloud Manager does not support FlexGroup volumes

While Cloud Volumes ONTAP supports FlexGroup volumes, Cloud Manager does not. If you create a FlexGroup volume from System Manager or from the CLI, then you should set Cloud Manager's Capacity Management mode to Manual. Automatic mode might not work properly with FlexGroup volumes.

Active Directory not supported by default with new installations of Cloud Manager

Starting with version 3.4, new installations of Cloud Manager do not support using your organization's Active Directory authentication for user management. If needed, NetApp can help you set up Active Directory with Cloud Manager. Click the chat icon in the lower right of Cloud Manager to get assistance.

Limitations with the AWS GovCloud (US) region

- Cloud Manager must be deployed in the AWS GovCloud (US) region if you want to launch Cloud Volumes ONTAP instances in the AWS GovCloud (US) region.
- When deployed in the AWS GovCloud (US) region, Cloud Manager cannot discover ONTAP clusters in a NetApp Private Storage for Microsoft Azure configuration or a NetApp Private Storage for SoftLayer configuration.

Volume View limitations

- The Volume View is not supported in the AWS GovCloud (US) region, in the AWS Commercial Cloud Services environment, and in Microsoft Azure.
- The Volume View enables you to create NFS volumes only.
- Cloud Manager does not launch Cloud Volumes ONTAP BYOL instances in the Volume View.

Cloud Manager does not set up iSCSI volumes

When you create a volume in Cloud Manager using the Storage System View, you can choose the NFS or CIFS protocol. You must use OnCommand System Manager to create a volume for iSCSI.

Storage Virtual Machine (SVM) limitation

Cloud Volumes ONTAP supports one data-serving SVM and one or more SVMs used for disaster recovery.

Cloud Manager does not provide any setup or orchestration support for SVM disaster recovery. It also does not support storage-related tasks on any additional SVMs. You must use System Manager or the CLI for SVM disaster recovery.

Concepts

Cloud Manager and Cloud Volumes ONTAP overview

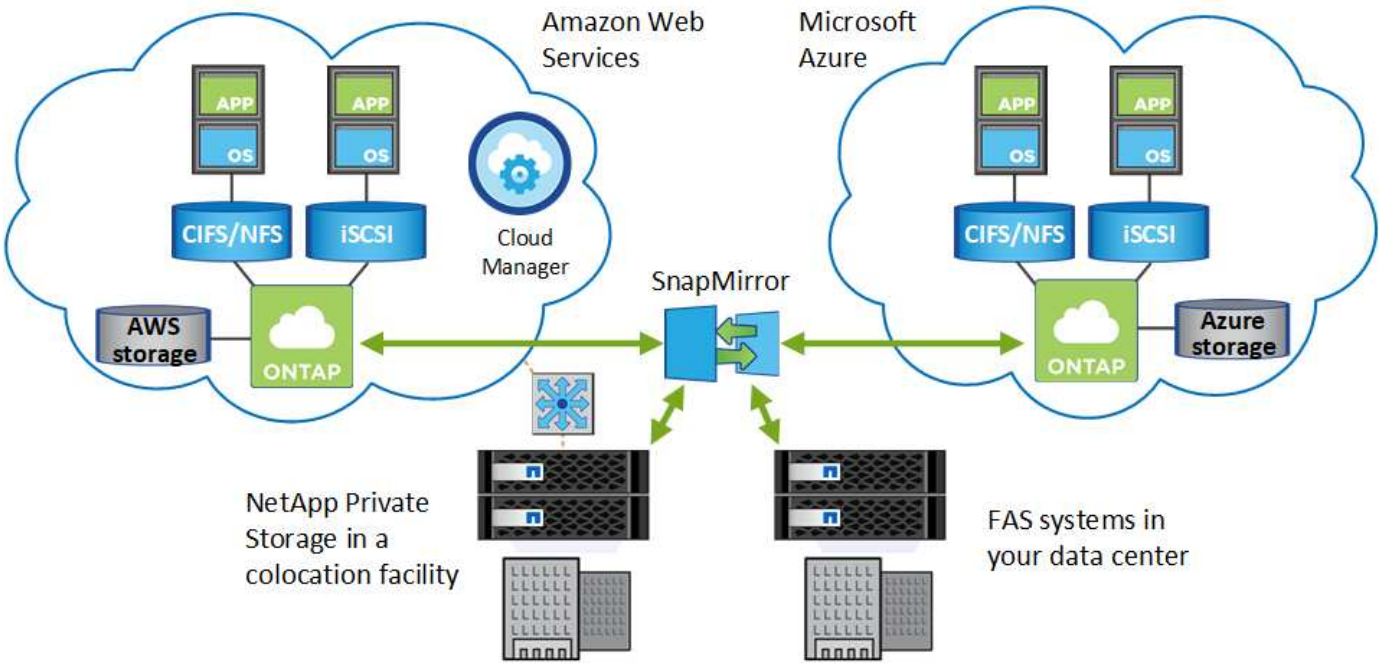
OnCommand Cloud Manager enables you to deploy Cloud Volumes ONTAP, which provides enterprise-class features for your cloud storage, and to easily replicate data across hybrid clouds built on NetApp.

Cloud Manager

Cloud Manager was built with simplicity in mind. It guides you through Cloud Volumes ONTAP setup in a few steps, eases data management by offering simplified storage provisioning and automated capacity management, enables drag-and-drop data replication across a hybrid cloud, and more.

Cloud Manager is required to deploy and manage Cloud Volumes ONTAP, but it can also discover and provision storage for on-premises ONTAP clusters. This provides a central point of control for your cloud and on-premises storage infrastructure.

You can run Cloud Manager in the cloud or in your network—it just needs a connection to the networks in which you want to deploy Cloud Volumes ONTAP. The following image shows Cloud Manager running in AWS and managing Cloud Volumes ONTAP systems in AWS and Azure. It also shows data replication across a hybrid cloud.



Learn more about Cloud Manager

Cloud Volumes ONTAP

Cloud Volumes ONTAP is a software-only storage appliance that runs the ONTAP data management software in the cloud. You can use Cloud Volumes ONTAP for production workloads, disaster recovery, DevOps, file shares, and database management.

Cloud Volumes ONTAP extends enterprise storage to the cloud 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 replication
  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.
- 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.

> Licenses for ONTAP features are included with Cloud Volumes ONTAP, except for NetApp Volume Encryption.

View supported Cloud Volumes ONTAP configurations

Learn more about Cloud Volumes ONTAP

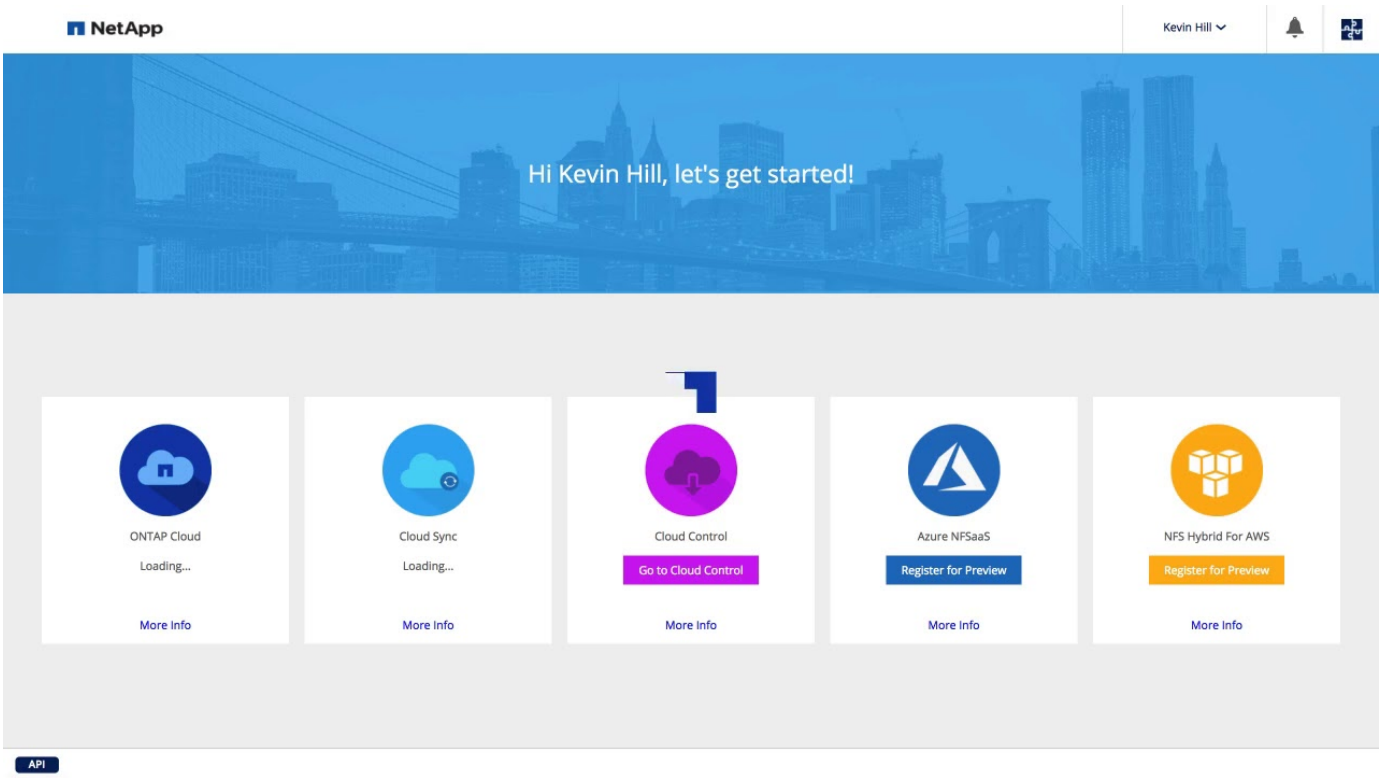
NetApp Cloud Central

NetApp Cloud Central provides a centralized location to access and manage NetApp cloud data services. These services enable you to run critical applications in the cloud, create automated DR sites, back up your SaaS data, and effectively migrate and control data across multiple clouds.

Cloud Manager's integration with NetApp Cloud Central provides several benefits, including a simplified deployment experience, a single location to view and manage multiple Cloud Manager systems, and centralized user authentication.

With centralized user authentication, you can use the same set of credentials across Cloud Manager systems and between Cloud Manager and other data services, such as Cloud Sync. It's also easy to reset your password if you forgot it.

The following video provides an overview of NetApp Cloud Central:



Cloud provider accounts and permissions

Cloud Manager enables you to choose the *cloud provider account* in which you want to deploy a Cloud Volumes ONTAP system. You should understand the permissions requirements before you add the accounts to Cloud Manager.

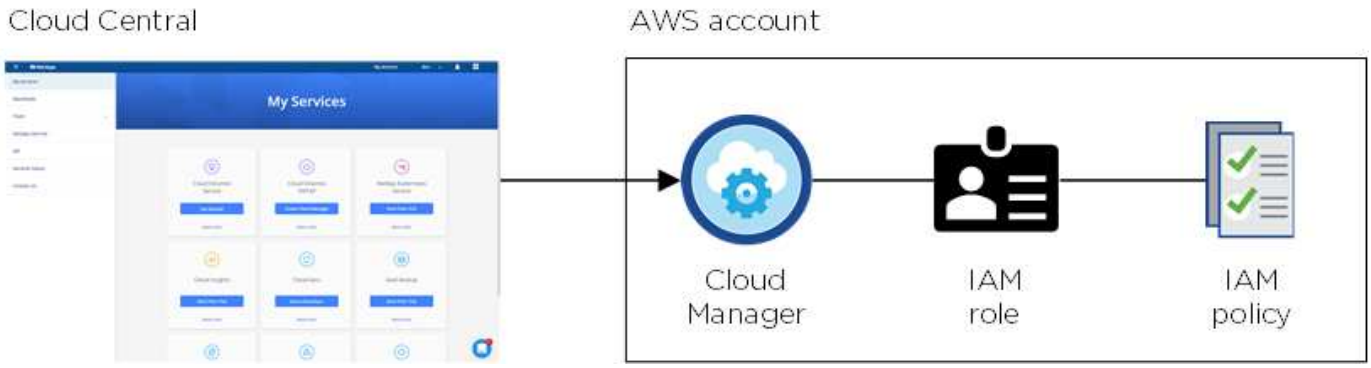
AWS accounts and permissions

You can deploy all of your Cloud Volumes ONTAP systems in the initial AWS account, or you can set up additional accounts.

The initial AWS account

When you deploy Cloud Manager from NetApp Cloud Central, you need to use an AWS account that has permissions to launch the Cloud Manager instance. The required permissions are listed in the NetApp Cloud Central policy for AWS.

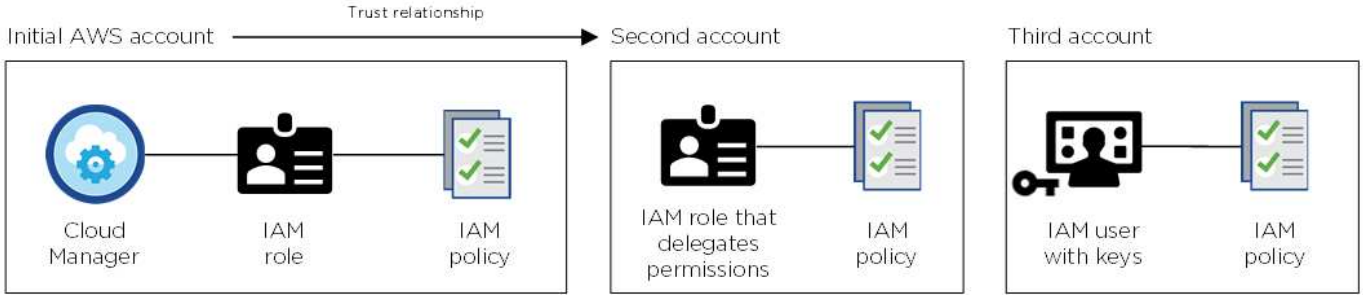
When Cloud Central launches the Cloud Manager instance in AWS, it creates an IAM role and an instance profile for the instance. It also attaches a policy that provides Cloud Manager with permissions to deploy and manage Cloud Volumes ONTAP in that AWS account. Review how Cloud Manager uses the permissions.



Cloud Manager selects this cloud provider account by default when you create a new working environment:

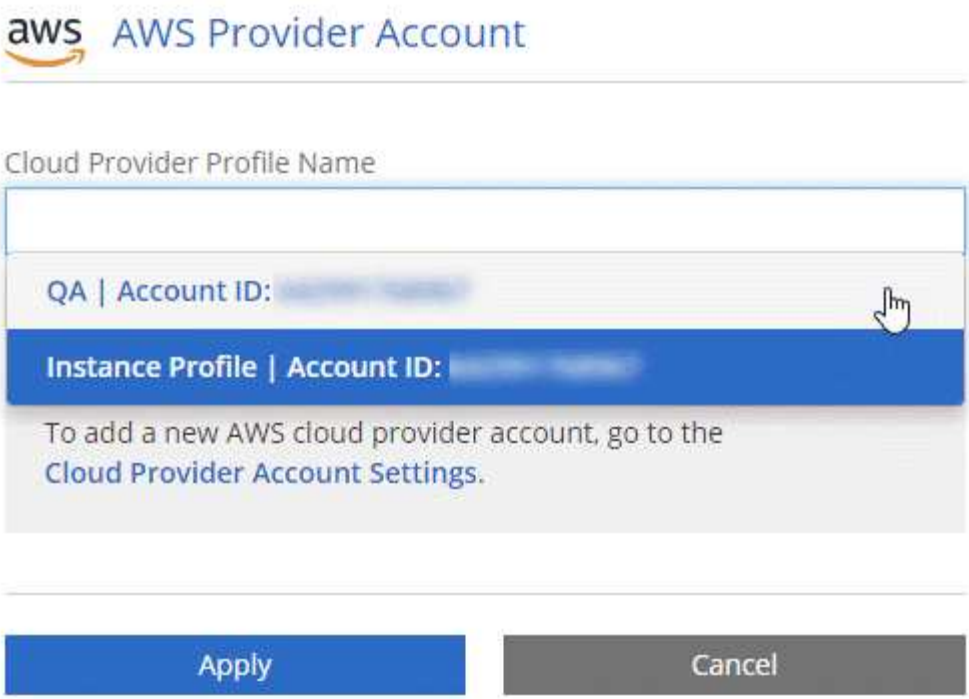
Additional AWS accounts

If you want to launch Cloud Volumes ONTAP in different AWS accounts, then you can either provide AWS keys for an IAM user or the ARN of a role in a trusted account. The following image shows two additional accounts, one providing permissions through an IAM role in a trusted account and another through the AWS keys of an IAM user:



You would then add the cloud provider accounts to Cloud Manager by specifying the Amazon Resource Name (ARN) of the IAM role, or the AWS keys for the IAM user.

After you add another account, you can switch to it when creating a new working environment:



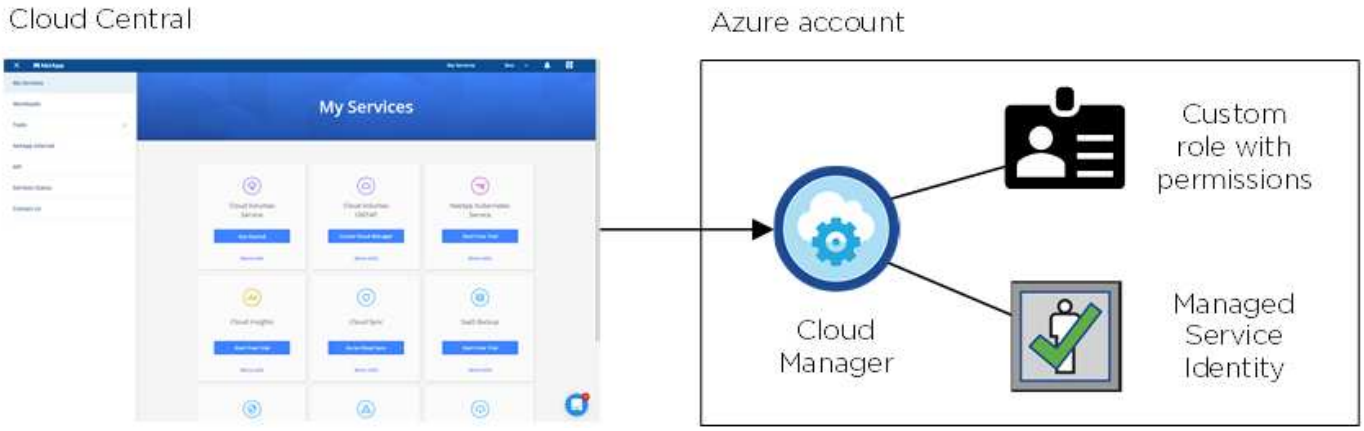
Azure accounts and permissions

You can deploy all of your Cloud Volumes ONTAP systems in the initial Azure account, or you can set up additional accounts.

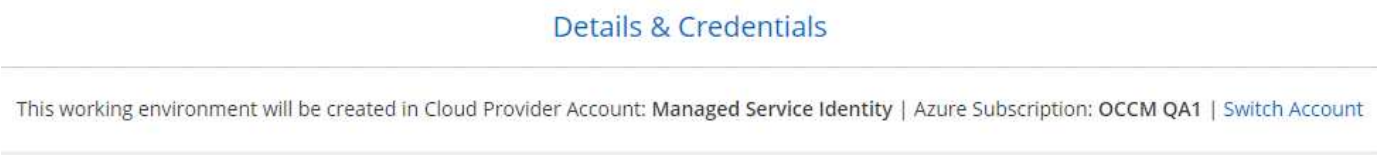
The initial Azure account

When you deploy Cloud Manager from NetApp Cloud Central, you need to use an Azure account that has permissions to deploy the Cloud Manager virtual machine. The required permissions are listed in the NetApp Cloud Central policy for Azure.

When Cloud Central deploys the Cloud Manager virtual machine in Azure, it enables a system-assigned managed identity on the Cloud Manager virtual machine, creates a custom role, and assigns it to the virtual machine. The role provides Cloud Manager with permissions to deploy and manage Cloud Volumes ONTAP in that Azure subscription. Review how Cloud Manager uses the permissions.



Cloud Manager selects this cloud provider account by default when you create a new working environment:

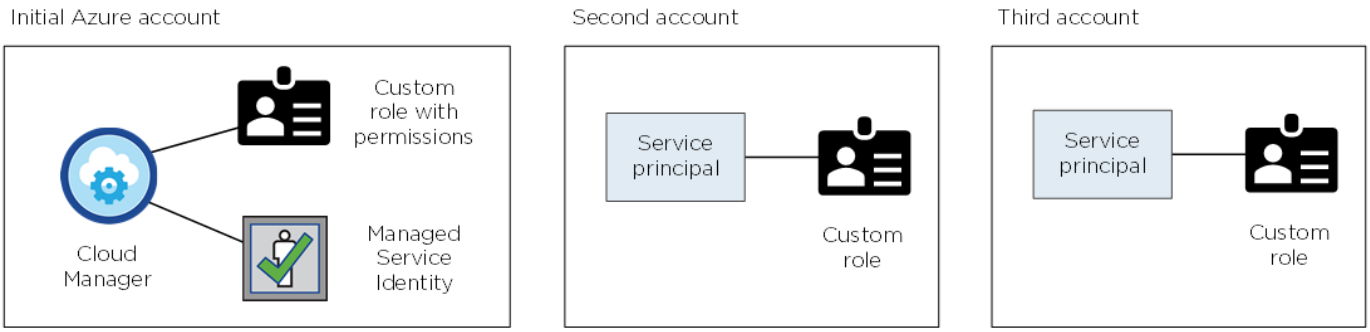


Additional Azure subscriptions for the initial account

The managed identity is associated with the subscription in which you launched Cloud Manager. If you want to select a different Azure subscription, then you need to associate the managed identity with those subscriptions.

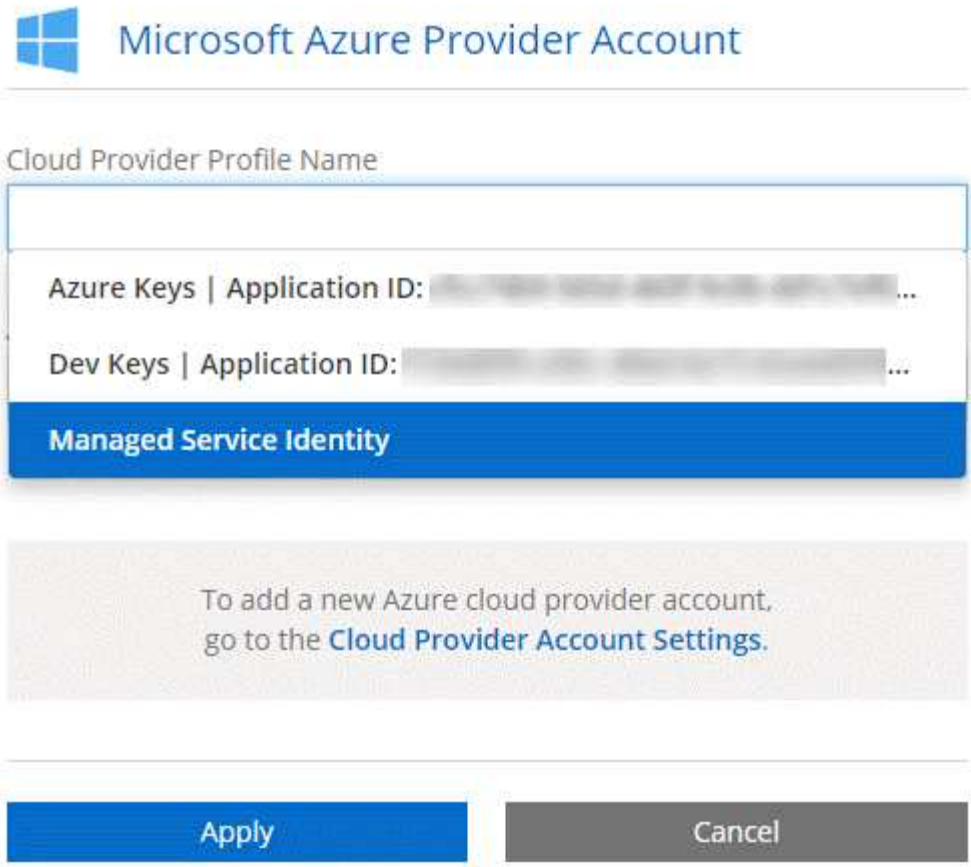
Additional Azure accounts

If you want to deploy Cloud Volumes ONTAP in different Azure accounts, then you must grant the required permissions by creating and setting up a service principal in Azure Active Directory for each Azure account. The following image shows two additional accounts, each set up with a service principal and custom role that provides permissions:



You would then add the cloud provider accounts to Cloud Manager by providing details about the AD service principal.

After you add another account, you can switch to it when creating a new working environment:



What about Marketplace deployments and on-prem deployments?

The sections above describe the recommended deployment method from NetApp Cloud Central. You can also deploy Cloud Manager from the AWS Marketplace, the Azure Marketplace, and you can install Cloud Manager on-premises.

If you use either of the Marketplaces, permissions are provided in the same way. You just need to manually create and set up the IAM role or managed identity for Cloud Manager, and then provide permissions for any additional accounts.

For on-premises deployments, you can't set up an IAM role or managed identity for the Cloud Manager system, but you can provide permissions just like you would for additional accounts.

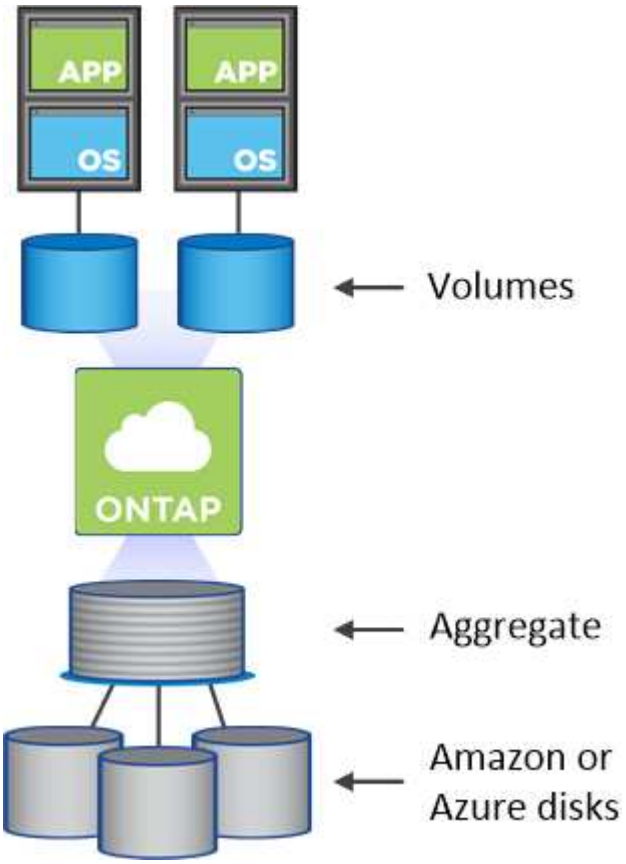
Storage

How Cloud Volumes ONTAP uses cloud storage

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

Overview

Cloud Volumes ONTAP uses AWS and Azure volumes as back-end storage. It sees these volumes 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 creating volumes and the default disk size when you deploy Cloud Volumes ONTAP.

> The total amount of storage purchased from AWS or Azure 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, 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 also pair an EBS disk with Amazon S3 for data tiering.

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.

For additional details about the use cases for these disks, refer to 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.

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 for data tiering.

HA pairs

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

For additional details about the use cases for these disks, see 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.

Data tiering overview

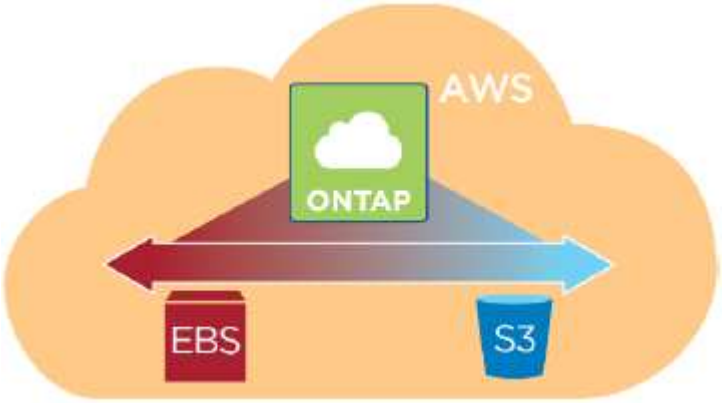
You can reduce your storage costs by enabling automated tiering of inactive data to low-cost object storage. Active data remains in high-performance SSDs or HDDs (the performance tier), while inactive data is tiered to low-cost object storage (the capacity tier). This enables you to reclaim space on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

Cloud Volumes ONTAP supports data tiering in AWS and in Microsoft Azure. Data tiering is powered by FabricPool technology.

You do not need to install a feature license to enable data tiering.

How data tiering works 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 in AWS

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

Capacity tier in AWS

By default, Cloud Volumes ONTAP tiers inactive data to the S3 *Standard* storage class. Standard is ideal for frequently accessed data stored across multiple Availability Zones.

If you do not plan to access the inactive data, you can reduce your storage costs by changing a system's tiering level to one of the following, after you deploy Cloud Volumes ONTAP:

Intelligent Tiering
: Optimizes storage costs by moving data between two tiers as data access patterns change. One tier is for frequent access and the other is for infrequent access.

One Zone-Infrequent Access
: For infrequently accessed data stored in a single Availability Zone.

Standard-Infrequent Access
: For infrequently accessed data stored across multiple Availability Zones.

The access costs are higher if you do access the data, so you must take that into consideration before you change the tiering level. For more details about S3 storage classes, refer to AWS documentation.

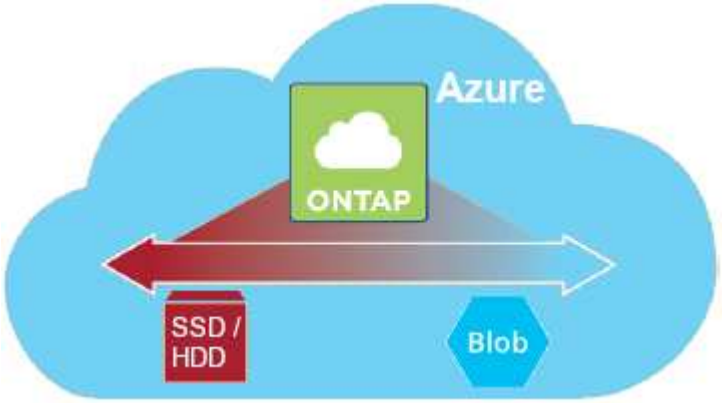
When you change the tiering level, inactive data starts in the Standard storage class and moves to the storage class that you selected, if the data is not accessed after 30 days. For details about changing the tiering level, see Tiering inactive data to low-cost object storage.

The tiering level is system wide—it is not per volume.

> A Cloud Volumes ONTAP working environment uses an S3 bucket for all tiered data from the system. A different S3 bucket is not used for each volume. This includes an HA working environment. Cloud Manager creates an S3 bucket and names it fabric-pool-*cluster unique identifier*.

How data tiering works in Microsoft 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 in Azure

The performance tier can be either Premium Storage (SSD) or Standard Storage (HDD).

Capacity tier in Azure

By default, Cloud Volumes ONTAP tiers inactive data to the Azure *hot* storage tier, which is ideal for frequently accessed data.

If you do not plan to access the inactive data, you can reduce your storage costs by changing a system's tiering level to the Azure *cool* storage tier after you deploy Cloud Volumes ONTAP. The cool tier is ideal for infrequently accessed data that will reside in the tier for at least 30 days.

The access costs are higher if you do access the data, so you must take that into consideration before you change the tiering level. For more details about Azure Blob storage tiers, refer to Azure documentation.

When you change the tiering level, inactive data starts in the hot storage tier and moves to the cool storage tier, if the data is not accessed after 30 days. For details about changing the tiering level, see Tiering inactive data to low-cost object storage.

The tiering level is system wide—it is not per volume.

> A Cloud Volumes ONTAP working environment uses an Azure Blob container for all tiered data from the system. A different container is not used for each volume. Cloud Manager creates a new storage account with a container for each Cloud Volumes ONTAP system. The name of the storage account is random.

How data tiering affects 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.

Cloud Volumes ONTAP supports the following tiering policies:

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.

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.

Backup

When you replicate a volume for disaster recovery or long-term retention, data for the destination volume starts in the capacity tier. If you activate the destination volume, the data gradually moves to the performance tier as it is read.

None

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

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 Cloud Manager 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 Cloud Manager 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

If the Cloud Manager Admin set the Capacity Management Mode to automatic, 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 cannot be returned to AWS or Azure in this scenario.

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

Manual capacity management

If the Cloud Manager 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.

Storage isolation using tenants

Cloud Manager enables you to provision and manage storage in isolated groups called tenants. You need to decide how to organize Cloud Manager users and their working environments across tenants.

Working environments

Cloud Manager represents storage systems as *working environments*. A working environment is any of the following:

- A single Cloud Volumes ONTAP system or an HA pair
- An on-premises ONTAP cluster in your network
- An ONTAP cluster in a NetApp Private Storage configuration

The following image shows a Cloud Volumes ONTAP working environment:

Tenants

A *tenant* isolates working environments in groups. You create one or more working environments within a tenant. The following image shows three tenants defined in Cloud Manager:

User management of tenants and working environments

The tenants and working environments that Cloud Manager users can manage depend on user role and assignments. The three distinct user roles are as follows:

Cloud Manager Admin

Administers the product and can access all tenants and working environments.

Tenant Admin

Administers a single tenant. Can create and manage all working environments and users in the tenant.

Working Environment Admin

Can create and manage one or more working environments in a tenant.

Example of how you can create tenants and users

If your organization has departments that operate independently, it is best to have a tenant for each department.

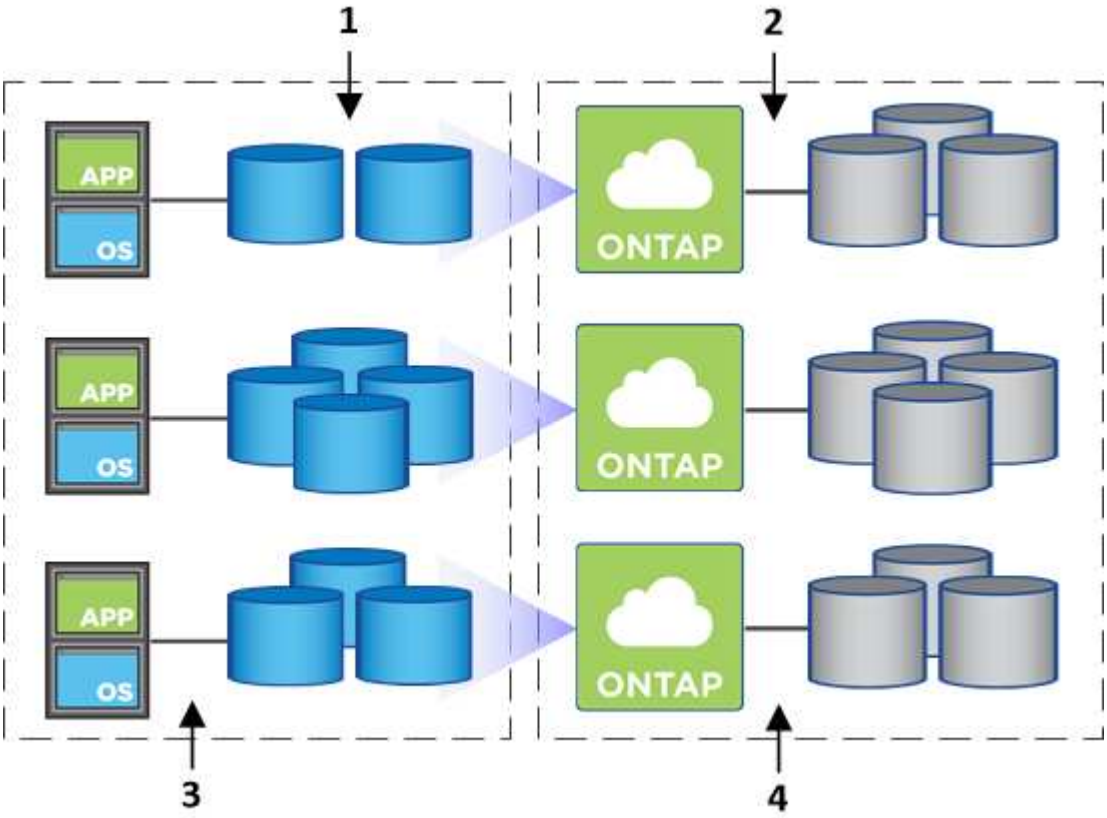
For example, you might create three tenants for three separate departments. You would then create a Tenant Admin for each tenant. Within each tenant would be one or more Working Environment Admins who manage working environments. The following image depicts this scenario:

Simplified storage management using the Volume View

Cloud Manager provides a separate management view called the *Volume View*, which further simplifies storage management in AWS.

The Volume View enables you to simply specify the NFS volumes that you need in AWS and then Cloud Manager handles the rest: it deploys Cloud Volumes ONTAP systems as needed and it makes capacity allocation decisions as volumes grow. This view gives you the benefits of enterprise-class storage in the cloud with very little storage management.

The following image shows how you interact with Cloud Manager in the Volume View:

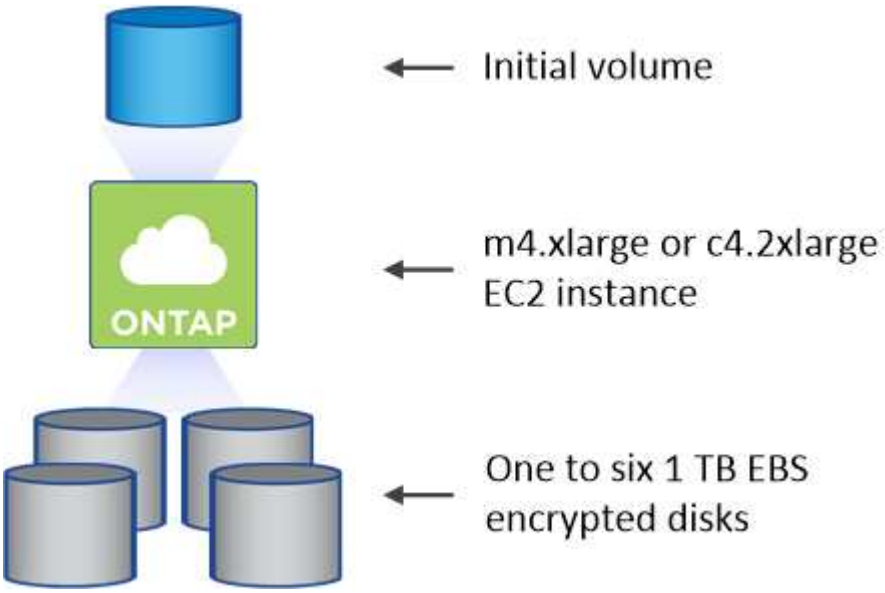


1. You create NFS volumes.
2. Cloud Manager launches Cloud Volumes ONTAP instances in AWS for new volumes or it creates volumes on existing instances. It also purchases physical EBS storage for the volumes.
3. You make the volumes available to your hosts and applications.
4. Cloud Manager makes capacity allocation decisions as your volumes grow.

   This means that you simply need to interact with volumes (the image on the left), while Cloud Manager interacts with the storage system and its underlying storage (the image on the right).

Allocation of cloud resources for the initial volume

When you create your first volume, Cloud Manager launches a Cloud Volumes ONTAP instance or a Cloud Volumes ONTAP HA pair in AWS and purchases Amazon EBS storage for the volume:



The size of the initial volume determines the EC2 instance type and the number of EBS disks.

> Cloud Manager launches a Cloud Volumes ONTAP Explore or Standard instance, depending on the initial volume size. As the volumes grow, Cloud Manager might prompt you to make an AWS instance change which means it needs to upgrade the instance's license to Standard or Premium. Upgrading increases the EBS raw capacity limit, which allows your volumes to grow.

> Cloud Manager does not launch Cloud Volumes ONTAP BYOL instances in the Volume View. You should use Cloud Manager in the Storage System View if you purchased a Cloud Volumes ONTAP license.

Allocation of cloud resources for additional volumes

When you create additional volumes, Cloud Manager creates the volumes on existing Cloud Volumes ONTAP instances or on new Cloud Volumes ONTAP instances. Cloud Manager can create a volume on an existing instance if the instance's AWS location and disk type match the requested volume, and if there is enough space.

NetApp storage efficiency features and storage costs

Cloud Manager automatically enables NetApp storage efficiency features on all volumes. These efficiencies can reduce the total amount of storage that you need. You might see a difference between your allocated capacity and the purchased AWS capacity, which can result in storage cost savings.

Capacity allocation decisions that Cloud Manager automatically handles

- Cloud Manager purchases additional EBS disks as capacity thresholds are exceeded. This happens as your volumes grow.
- Cloud Manager deletes unused sets of EBS disks if the disks contain no volumes for 12 hours.
- Cloud Manager moves volumes between sets of disks to avoid capacity issues.

  In some cases, this requires purchasing additional EBS disks. It also frees space on the original set of disks for new and existing volumes.

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.

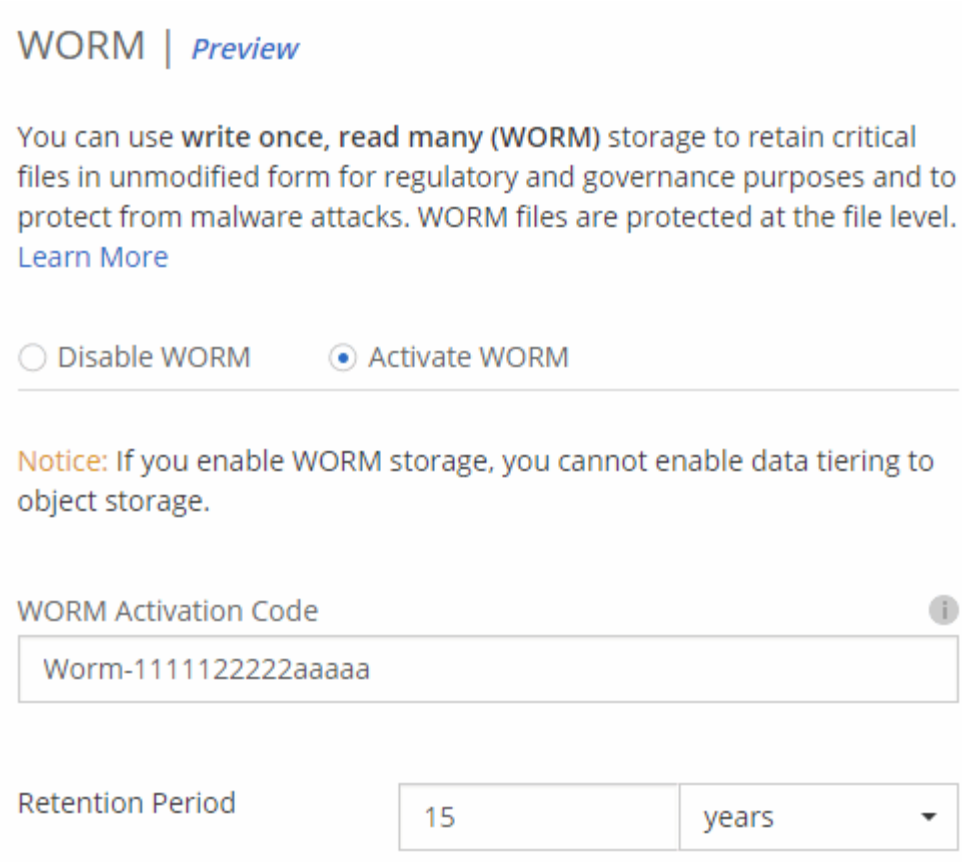
After the retention period has elapsed, you are responsible for deleting any files that you no longer need.

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:



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 cannot be enabled.

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.

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.

Cloud Volumes ONTAP HA in 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.

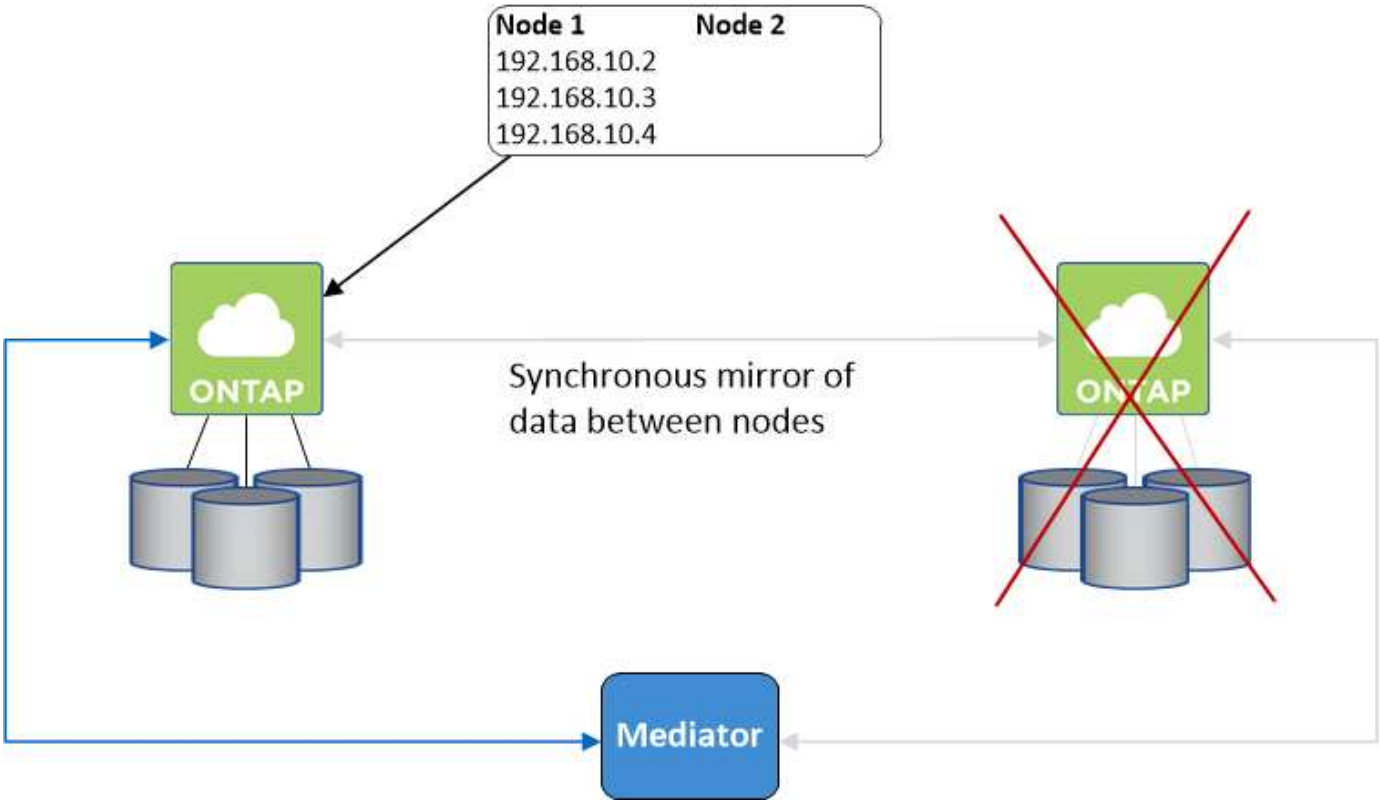
Storage takeover and giveback for iSCSI

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.

Storage 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

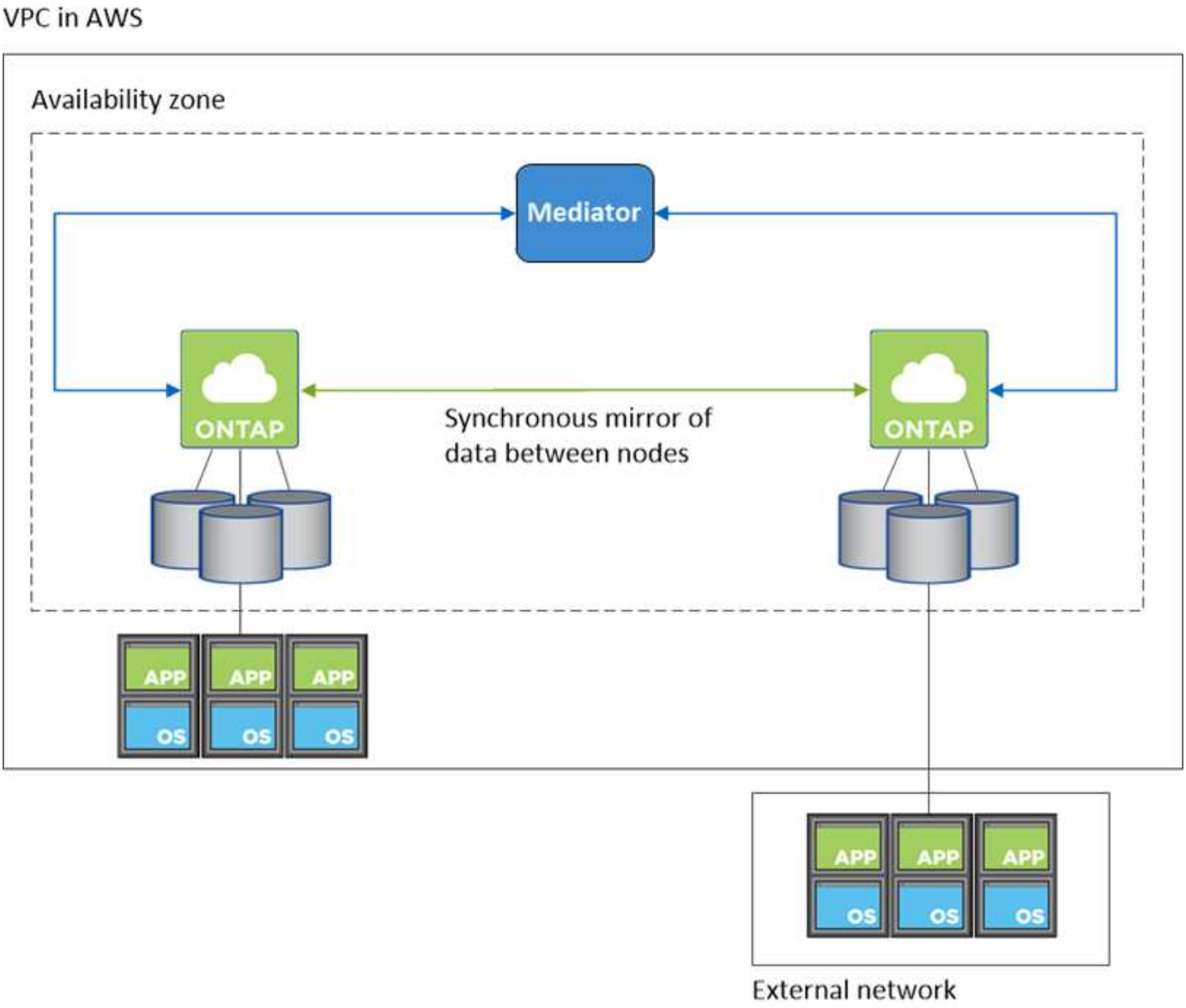
Deploying an HA configuration in a single Availability Zone (AZ) can ensure high availability of your data if an instance that runs a Cloud Volumes ONTAP node fails. All data is natively accessible from outside of the VPC.

> 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.



Storage 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 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.

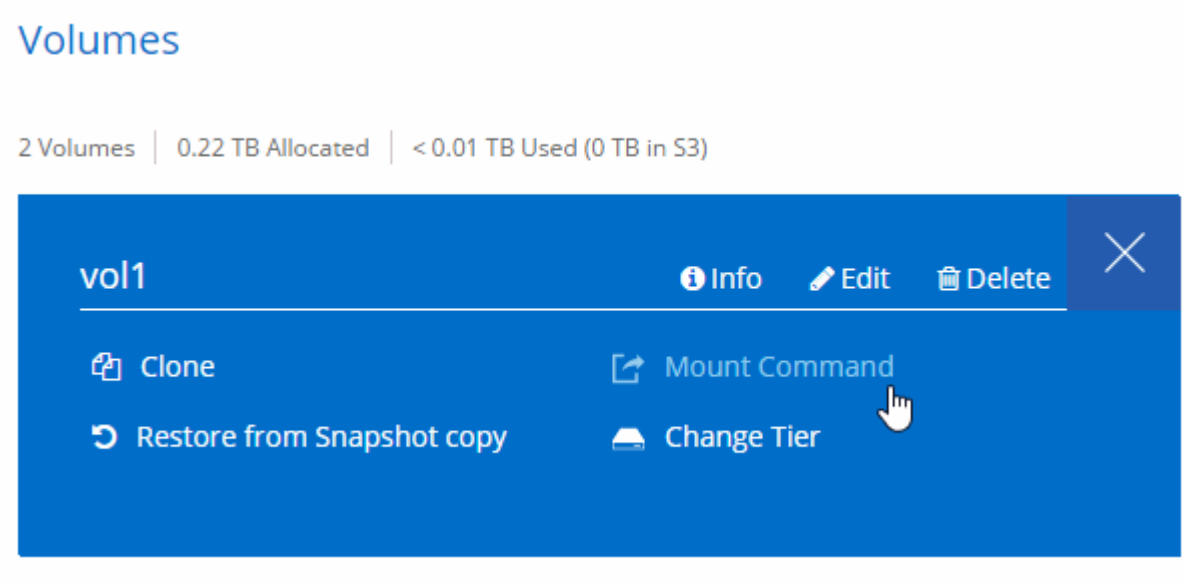
For more details about Cloud Volumes ONTAP performance, see Performance.

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. The following image shows the Storage System View:



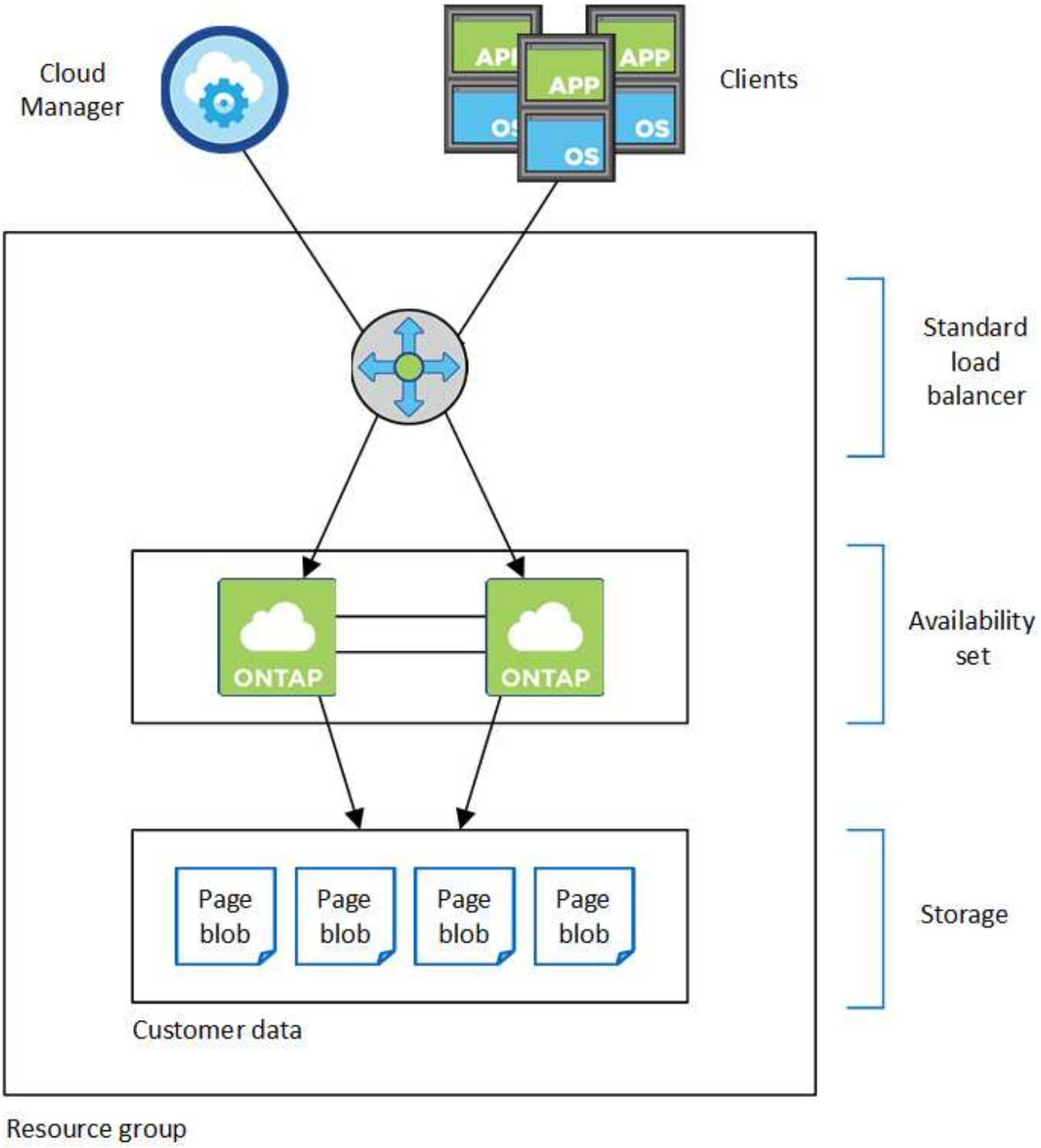
The following image shows the Volume View:

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:



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.

Storage

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 and root data:

- A node's boot data resides on a Premium SSD Managed Disk.
- A node's root data resides on a Premium Storage page blob.

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 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.
- Data tiering 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.

Evaluating

You can evaluate Cloud Volumes ONTAP before you pay for the software.

A 30-day free trial of a single-node Cloud Volumes ONTAP system is available from NetApp Cloud Central. There are no hourly software charges, but infrastructure charges still apply. A free trial automatically converts to a paid hourly subscription when it expires.

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.

Licensing

Each Cloud Volumes ONTAP BYOL system must have a license installed with an active subscription. If an active license is not installed, the Cloud Volumes ONTAP system shuts itself down after 30 days. Cloud Manager simplifies the process by managing licenses for you and by notifying you before they expire.

License management for a new system

When you create a BYOL system, Cloud Manager prompts you for a 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 cannot 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 Installing license files on Cloud Volumes ONTAP BYOL systems.

License expiration

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 do not 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 cannot 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 Installing license files on Cloud Volumes ONTAP BYOL systems.

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 Volume Encryption (starting with Cloud Volumes ONTAP 9.5)
- AWS Key Management Service
- Azure Storage Service Encryption

You can use NetApp Volume Encryption with native AWS and Azure encryption, which encrypt data at the hypervisor level.

NetApp Volume Encryption

NetApp Volume Encryption (NVE) is a software-based technology for encrypting data at rest one volume at a time. Data, Snapshot copies, and metadata are encrypted. Access to the data is given by a unique XTS-AES-256 key, one per volume.

Cloud Volumes ONTAP supports NetApp Volume Encryption with an external key management server. An Onboard Key Manager is not supported. You can find the supported key managers in the NetApp Interoperability Matrix Tool under the **Key Managers** solution.

You can enable NetApp Volume Encryption on a new or existing volume by using the CLI or System Manager. Cloud Manager does not support NetApp Volume Encryption. For instructions, see Encrypting volumes with NetApp Volume Encryption.

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).

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.

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

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.

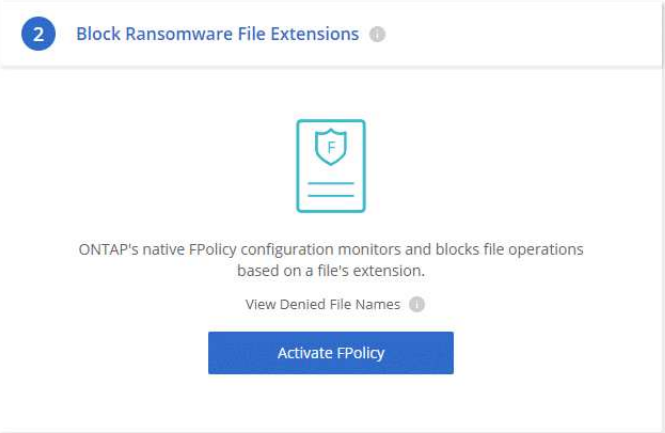
Ransomware protection

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.



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.

For Cloud Volumes ONTAP for AWS, refer to NetApp Technical Report 4383: Performance Characterization of Cloud Volumes ONTAP in Amazon Web Services with Application Workloads.

For Cloud Volumes ONTAP for Microsoft Azure, refer to NetApp Technical Report 4671: Performance Characterization of Cloud Volumes ONTAP in Azure with Application Workloads.

Getting started

Deployment overview

Before you get started, you might want to better understand your options for deploying OnCommand Cloud Manager and Cloud Volumes ONTAP.

Cloud Manager installation

Cloud Manager software is required to deploy and manage Cloud Volumes ONTAP. You can deploy Cloud Manager in any of the following locations:

- Amazon Web Services (AWS)
- Microsoft Azure
- IBM Cloud
- In your own network

How you deploy Cloud Manager depends on which location you choose:

Location	How to deploy Cloud Manager
AWS	Deploy Cloud Manager from NetApp Cloud Central
AWS C2S	Deploy Cloud Manager from the AWS Intelligence Community Marketplace
Azure generally available region	Deploy Cloud Manager from NetApp Cloud Central
Azure Government	Deploy Cloud Manager from the Azure US Government Marketplace
Azure Germany	Download and install the software on a Linux host
IBM Cloud	Download and install the software on a Linux host
On-premises network	Download and install the software on a Linux host

Cloud Manager setup

You might want to perform additional setup after you install Cloud Manager, such as adding additional cloud provider accounts, installing an HTTPS certificate, and more.

- Adding Cloud Provider Accounts to Cloud Manager
- Installing an HTTPS certificate
- Setting up users and tenants
- Setting up the AWS KMS

Cloud Volumes ONTAP deployment

After you get Cloud Manager up and running, you can start deploying Cloud Volumes ONTAP in AWS and in Microsoft Azure.

Getting started in AWS and Getting started in Azure provide instructions for getting Cloud Volumes ONTAP up

and running quickly. For additional help, refer to the following:

- Supported configurations for Cloud Volumes ONTAP 9.5
- Planning your configuration
- Launching Cloud Volumes ONTAP in AWS
- Launching Cloud Volumes ONTAP in Azure

Getting started with Cloud Volumes ONTAP in AWS

You can get started with Cloud Volumes ONTAP in AWS from NetApp Cloud Central.

1 Set up your networking

a. Enable outbound internet access from the target VPC so Cloud Manager and Cloud Volumes ONTAP can contact several endpoints.

   This step is important because Cloud Manager cannot deploy Cloud Volumes ONTAP without outbound internet access. If you need to limit outbound connectivity, refer to the list of endpoints for Cloud Manager and Cloud Volumes ONTAP.

b. 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.

2 Subscribe to Cloud Volumes ONTAP from the AWS Marketplace

Subscribing from the AWS Marketplace is required to accept the software terms. You should only subscribe from the Marketplace. Launching Cloud Volumes ONTAP from anywhere but Cloud Manager is not supported.

3 Provide the required AWS permissions

When you deploy Cloud Manager from NetApp Cloud Central, you need to use an AWS account that has permissions to deploy the instance.

a. Go to the AWS IAM console and create a policy by copying and pasting the contents of the NetApp Cloud Central policy for AWS.
b. Attach the policy to the IAM user.

4 Launch Cloud Manager from NetApp Cloud Central

Cloud Manager software is required to deploy and manage Cloud Volumes ONTAP. It takes just a few minutes to launch a Cloud Manager instance from Cloud Central.

5 Launch Cloud Volumes ONTAP using Cloud Manager

Once Cloud Manager is ready, just click Create, select the type of system that you would like to launch, and complete the steps in the wizard. After 25 minutes, your first Cloud Volumes ONTAP system should be up and running.

Related links

- Evaluating
- Networking requirements for Cloud Manager
- Networking requirements for Cloud Volumes ONTAP in AWS
- Security group rules for AWS
- Adding Cloud Provider Accounts to Cloud Manager
- What Cloud Manager does with AWS permissions
- Launching Cloud Volumes ONTAP in AWS
- Launching Cloud Manager from the AWS Marketplace

Getting started with Cloud Volumes ONTAP in Azure

You can get started with Cloud Volumes ONTAP in Azure from NetApp Cloud Central. Separate instructions are available to deploy Cloud Manager in Azure US Government regions and in Azure Germany regions.

1 Set up your networking

Enable outbound internet access from the target VNet so Cloud Manager and Cloud Volumes ONTAP can contact several endpoints.

This step is important because Cloud Manager cannot deploy Cloud Volumes ONTAP without outbound internet access. If you need to limit outbound connectivity, refer to the list of endpoints for Cloud Manager and Cloud Volumes ONTAP.

2 Provide the required Azure permissions

When you deploy Cloud Manager from NetApp Cloud Central, you need to use an Azure account that has permissions to deploy the Cloud Manager virtual machine.

a. Download the NetApp Cloud Central policy for Azure.
b. Modify the JSON file by adding your Azure subscription ID to the "AssignableScopes" field.
c. Use the JSON file to create a custom role in Azure named *Azure SetupAsService*.

   Example: **az role definition create --role-definition C:\Policy_for_Setup_As_Service_Azure.json**

d. From the Azure portal, assign the custom role to the user who will deploy Cloud Manager from Cloud Central.

Launch Cloud Manager from NetApp Cloud Central

Cloud Manager software is required to deploy and manage Cloud Volumes ONTAP. It takes just a few minutes to launch a Cloud Manager instance from Cloud Central.

Launch Cloud Volumes ONTAP using Cloud Manager

Once Cloud Manager is ready, just click Create, select the type of system that you would like to deploy, and complete the steps in the wizard. After 25 minutes, your first Cloud Volumes ONTAP system should be up and running.

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- Adding Cloud Provider Accounts to Cloud Manager
- What Cloud Manager does with Azure permissions
- Launching Cloud Volumes ONTAP in Azure
- Launching Cloud Manager from the Azure Marketplace

Setting up Cloud Manager

Adding cloud provider accounts to Cloud Manager

If you want to deploy Cloud Volumes ONTAP in different cloud accounts, then you need to provide the required permissions to those accounts and then add the details to Cloud Manager.

When you deploy Cloud Manager from Cloud Central, Cloud Manager automatically adds a cloud provider account for the account in which you deployed Cloud Manager. An initial cloud provider account is not added if you manually installed the Cloud Manager software on an existing system.

Setting up and adding AWS accounts to Cloud Manager

If you want to deploy Cloud Volumes ONTAP in different AWS accounts, then you need to provide the required permissions to those accounts and then add the details to Cloud Manager. How you provide the permissions depends on whether you want to provide Cloud Manager with AWS keys or the ARN of a role in a trusted account.

- Granting permissions when providing AWS keys
- Granting permissions by assuming IAM roles in other accounts

Granting permissions when providing AWS keys

If you want to provide Cloud Manager with AWS keys for an IAM user, then you need to grant the required

permissions to that user. The Cloud Manager IAM policy defines the AWS actions and resources that Cloud Manager is allowed to use.

Steps

1. Download the Cloud Manager IAM policy from the Cloud Manager Policies page.
2. From the IAM console, create your own policy by copying and pasting the text from the Cloud Manager IAM policy.

   AWS Documentation: Creating IAM Policies

3. Attach the policy to an IAM role or an IAM user.
   - AWS Documentation: Creating IAM Roles
   - AWS Documentation: Adding and Removing IAM Policies

Result

The account now has the required permissions. You can now add it to Cloud Manager.

Granting permissions by assuming IAM roles in other accounts

You can set up a trust relationship between the source AWS account in which you deployed the Cloud Manager instance and other AWS accounts by using IAM roles. You would then provide Cloud Manager with the ARN of the IAM roles from the trusted accounts.

Steps

1. Go to the target account where you want to deploy Cloud Volumes ONTAP and create an IAM role by selecting **Another AWS account**.

   Be sure to do the following:

   - Enter the ID of the account where the Cloud Manager instance resides.
   - Attach the Cloud Manager IAM policy, which is available from the Cloud Manager Policies page.

2. Go to the source account where the Cloud Manager instance resides and select the IAM role that is attached to the instance.
   a. Click **Trust Relationships > Edit trust relationship**.
   b. Add the "sts:AssumeRole" action and the ARN of the role that you created in the target account.

   Example

```
{
 "Version": "2012-10-17",
 "Statement": {
   "Effect": "Allow",
   "Action": "sts:AssumeRole",
   "Resource": "arn:aws:iam::ACCOUNT-B-ID:role/ACCOUNT-B-ROLENAME"
}
}
```

Result

The account now has the required permissions. You can now add it to Cloud Manager.

Adding AWS accounts to Cloud Manager

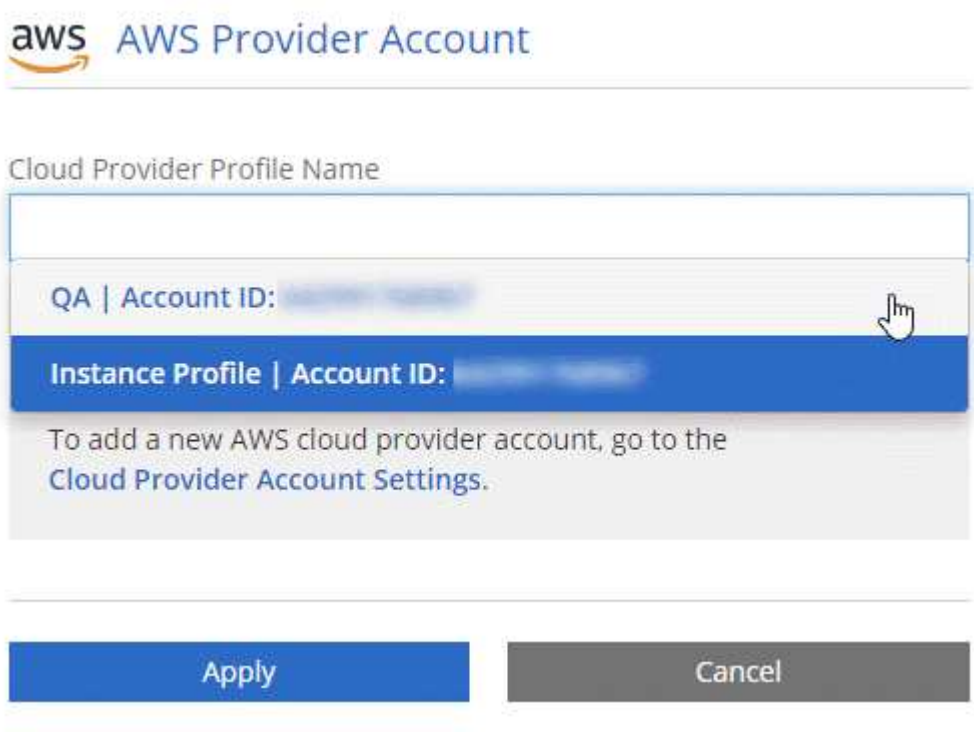
After you provide an AWS account with the required permissions, you can add the account to Cloud Manager. This enables you to launch Cloud Volumes ONTAP systems in that account.

Steps

1. In the upper right of the Cloud Manager console, click the task drop-down list, and then select **Account Settings**.
2. Click **Add New Account** and select **AWS**.
3. Choose whether you want to provide AWS keys or the ARN of a trusted IAM role.
4. Confirm that the policy requirements have been met and then click **Create Account**.

Result

You can now switch to another account from the Details and Credentials page when creating a new working environment:



Setting up and adding Azure accounts to Cloud Manager

If you want to deploy Cloud Volumes ONTAP in different Azure accounts, then you need to provide the required permissions to those accounts and then add details about the accounts to Cloud Manager.

- Granting Azure permissions using a service principal
- Adding Azure accounts to Cloud Manager

Granting Azure permissions using a service principal

Cloud Manager needs permissions to perform actions in Azure. You can grant the required permissions to an Azure account by creating and setting up a service principal in Azure Active Directory and by obtaining the Azure credentials that Cloud Manager needs.

About this task

The following image depicts how Cloud Manager obtains permissions to perform operations in Azure. A service principal object, which is tied to one or more Azure subscriptions, represents Cloud Manager in Azure Active Directory and is assigned to a custom role that allows the required permissions.

> The following steps use the new Azure portal. If you experience any issues, you should use the Azure classic portal.

Steps

1. Create a custom role with the required Cloud Manager permissions.
2. Create an Active Directory service principal.
3. Assign the custom Cloud Manager Operator role to the service principal.

Creating a custom role with the required Cloud Manager permissions

A custom role is required to provide Cloud Manager with the permissions that it needs to launch and manage Cloud Volumes ONTAP in Azure.

Steps

1. Download the Cloud Manager Azure policy.
2. Modify the JSON file by adding Azure subscription IDs to the assignable scope.

   You should add the ID for each Azure subscription from which users will create Cloud Volumes ONTAP systems.

   Example

   ```
   "AssignableScopes": [
   "/subscriptions/d333af45-0d07-4154-943d-c25fbzzzzzzz",
   "/subscriptions/54b91999-b3e6-4599-908e-416e0zzzzzzz",
   "/subscriptions/398e471c-3b42-4ae7-9b59-ce5bbzzzzzzz"
   ```

3. Use the JSON file to create a custom role in Azure.

   The following example shows how to create a custom role using the Azure CLI 2.0:

   az role definition create --role-definition C:\Policy_for_cloud_Manager_Azure_3.6.1.json

Result

You should now have a custom role called OnCommand Cloud Manager Operator.

Creating an Active Directory service principal

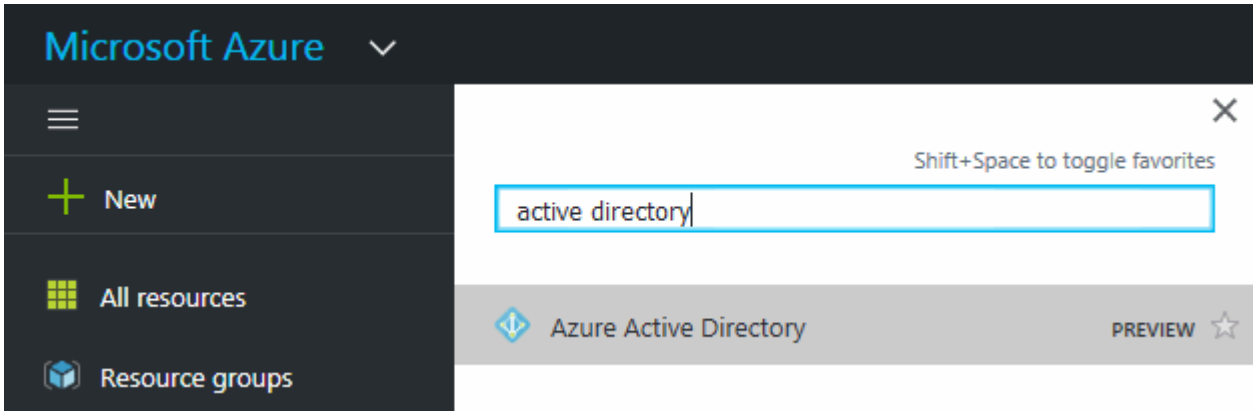
You must create an Active Directory service principal so Cloud Manager can authenticate with Azure Active Directory.

Before you begin

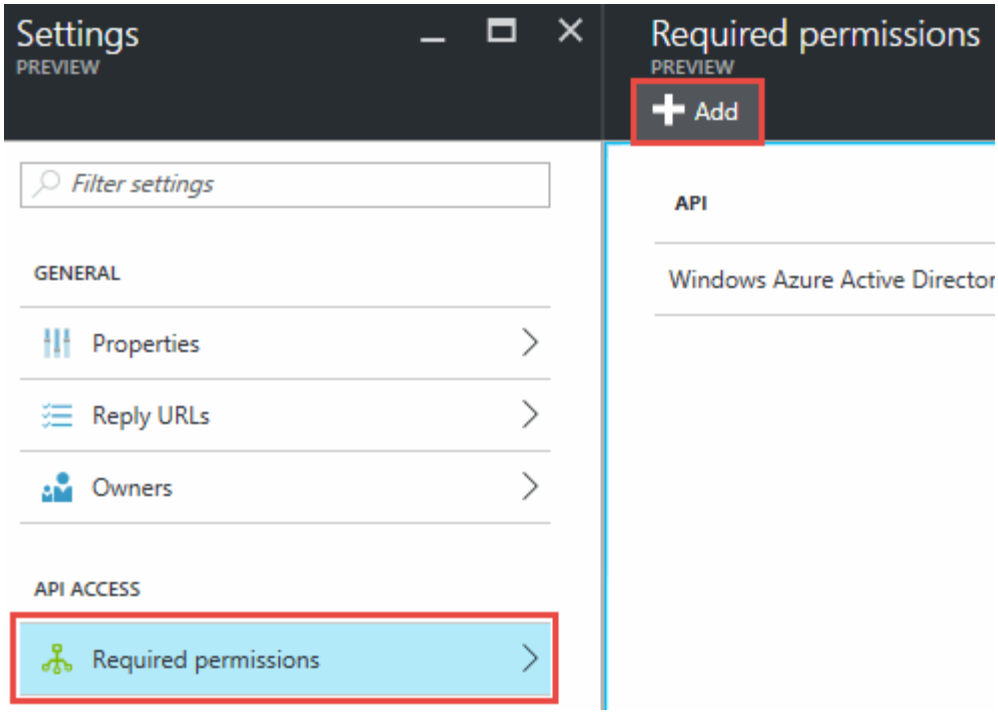
You must have the appropriate permissions in Azure to create an Active Directory application and to assign the application to a role. For details, refer to Microsoft Azure Documentation: Use portal to create Active Directory application and service principal that can access resources.

Steps

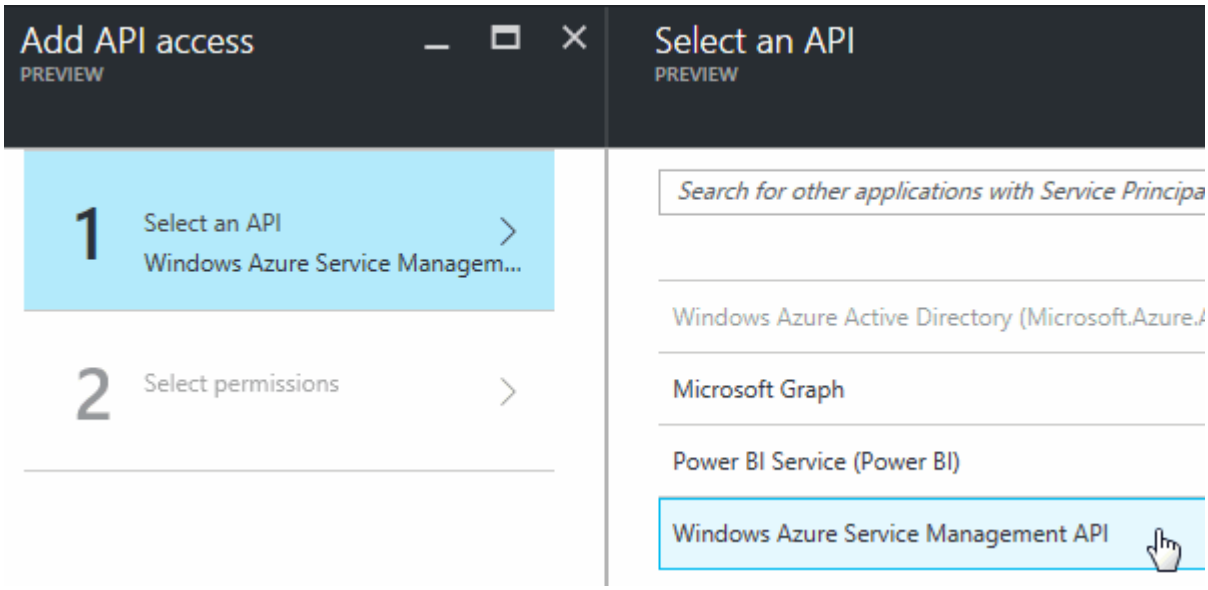
1. From the Azure portal, open the **Azure Active Directory** service.



2. In the menu, click **App registrations (Legacy)**.
3. Create the service principal:
   a. Click **New application registration**.
   b. Enter a name for the application, keep **Web app / API** selected, and then enter any URL—for example, http://url
   c. Click **Create**.
4. Modify the application to add the required permissions:
   a. Select the created application.
   b. Under Settings, click **Required permissions** and then click **Add**.



c. Click **Select an API**, select **Windows Azure Service Management API**, and then click **Select**.



d. Click **Access Azure Service Management as organization users**, click **Select** and then click **Done**.

5. Create a key for the service principal:

   a. Under Settings, click **Keys**.

   b. Enter a description, select a duration, and then click **Save**.

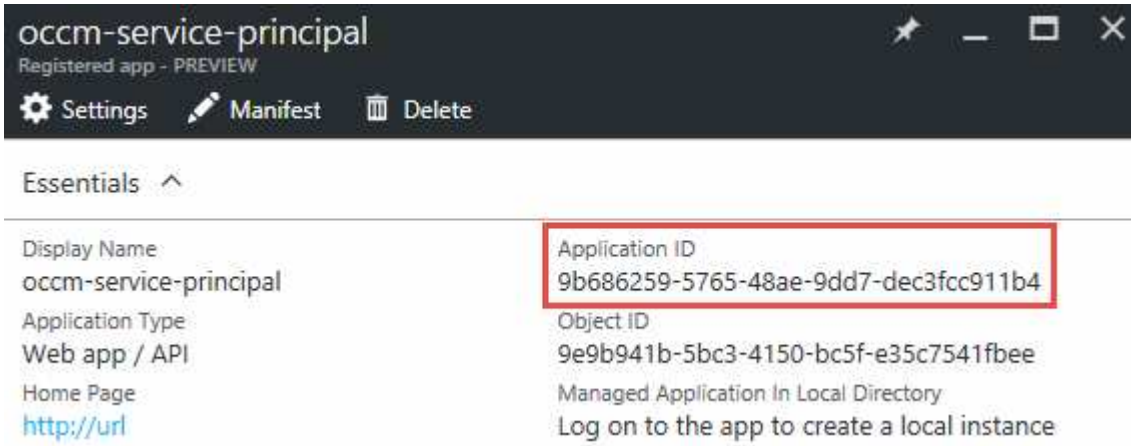
   c. Copy the key value.

      You need to enter the key value when you add a cloud provider account to Cloud Manager.

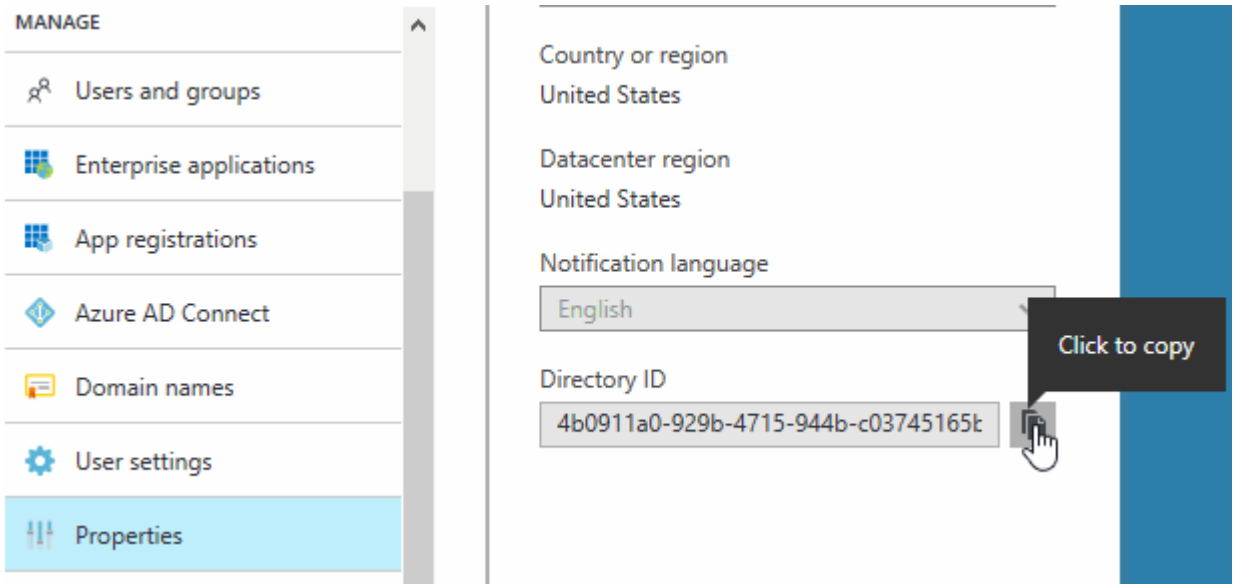
   d. Click **Properties** and then copy the application ID for the service principal.

      Similar to the key value, you need to enter the application ID in Cloud Manager when you add a cloud

provider account to Cloud Manager.



6. Obtain the Active Directory tenant ID for your organization:
   a. In the Active Directory menu, click **Properties**.
   b. Copy the Directory ID.



Just like the application ID and application key, you must enter the Active Directory tenant ID when you add a cloud provider account to Cloud Manager.

Result

You should now have an Active Directory service principal and you should have copied the application ID, the application key, and the Active Directory tenant ID. You need to enter this information in Cloud Manager when you add a cloud provider account.

Assigning the Cloud Manager Operator role to the service principal

You must bind the service principal to one or more Azure subscriptions and assign it the Cloud Manager Operator role so Cloud Manager has permissions in Azure.

About this task

If you want to deploy Cloud Volumes ONTAP from multiple Azure subscriptions, then you must bind the service

principal to each of those subscriptions. Cloud Manager enables you to select the subscription that you want to use when deploying Cloud Volumes ONTAP.

Steps

1. From the Azure portal, select **Subscriptions** in the left pane.
2. Select the subscription.
3. Click **Access control (IAM)** and then click **Add**.
4. Select the **OnCommand Cloud Manager Operator** role.
5. Search for the name of the application (you cannot find it in the list by scrolling).
6. Select the application, click **Select**, and then click **OK**.

Result

The service principal for Cloud Manager now has the required Azure permissions.

Adding Azure accounts to Cloud Manager

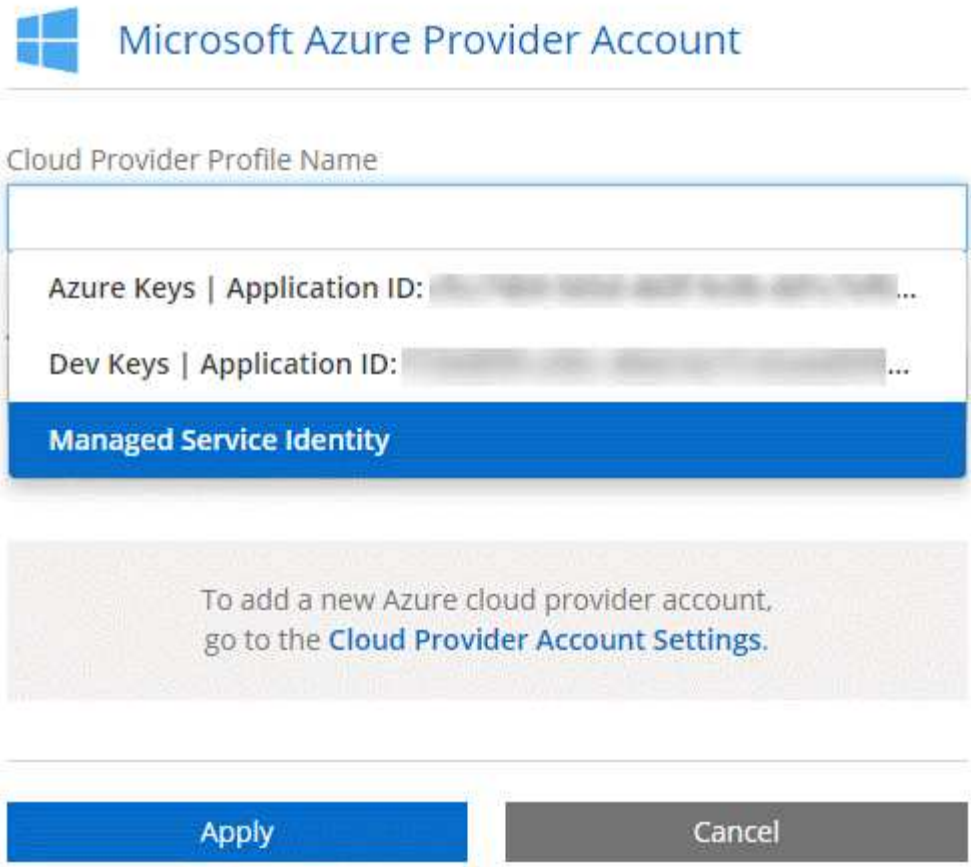
After you provide an Azure account with the required permissions, you can add the account to Cloud Manager. This enables you to launch Cloud Volumes ONTAP systems in that account.

Steps

1. In the upper right of the Cloud Manager console, click the task drop-down list, and then select **Account Settings**.
2. Click **Add New Account** and select **Microsoft Azure**.
3. Enter information about the Azure Active Directory service principal that grants the required permissions.
4. Confirm that the policy requirements have been met and then click **Create Account**.

Result

You can now switch to another account from the Details and Credentials page when creating a new working environment:



Associating additional Azure subscriptions with a managed identity

Cloud Manager enables you to choose the Azure account and subscription in which you want to deploy Cloud Volumes ONTAP. You can't select a different Azure subscription for the managed identity profile unless you associate the managed identity with those subscriptions.

About this task

A managed identity is the initial cloud provider account when you deploy Cloud Manager from NetApp Cloud Central. When you deployed Cloud Manager, Cloud Central created the OnCommand Cloud Manager Operator role and assigned it to the Cloud Manager virtual machine.

Steps

1. Log in to the Azure portal.
2. Open the **Subscriptions** service and then select the subscription in which you want to deploy Cloud Volumes ONTAP systems.
3. Click **Access control (IAM)**.
   a. Click **Add** > **Add role assignment** and then add the permissions:
      - Select the **OnCommand Cloud Manager Operator** role.

        OnCommand Cloud Manager Operator is the default name provided in the Cloud Manager policy. If you chose a different name for the role, then select that name instead.

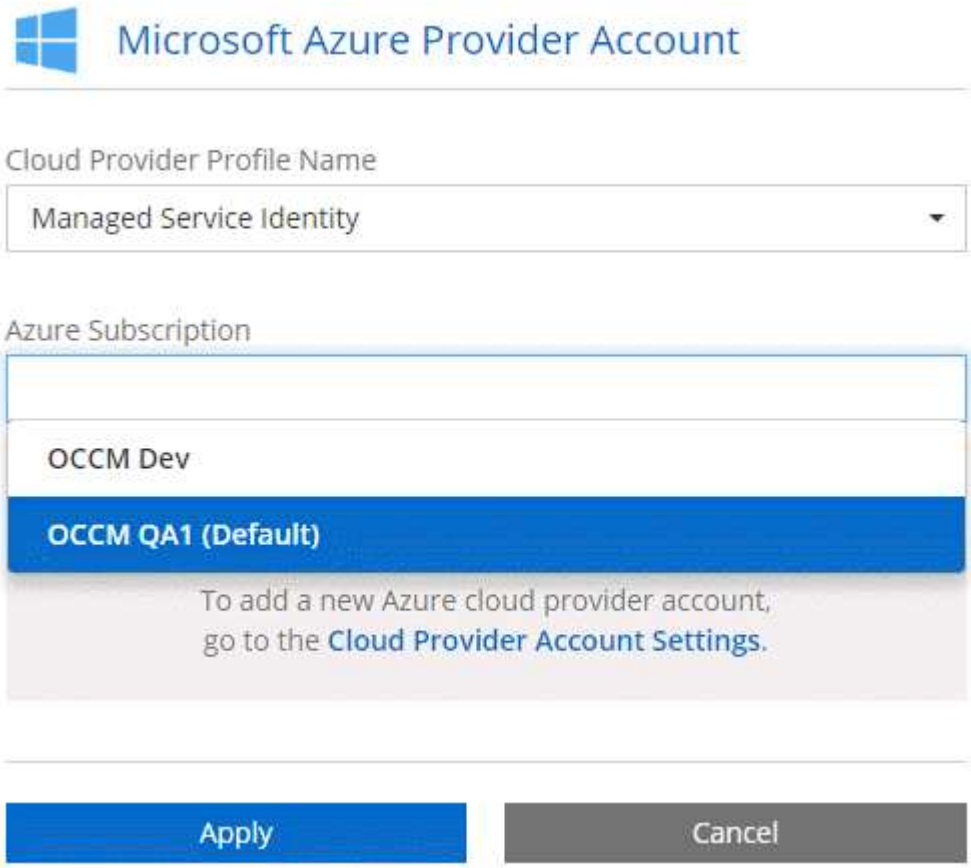
      - Assign access to a **Virtual Machine**.

- Select the subscription in which the Cloud Manager virtual machine was created.
- Select the Cloud Manager virtual machine.
- Click **Save**.

4. Repeat these steps for additional subscriptions.

Result

When you create a new working environment, you should now have the ability to select from multiple Azure subscriptions for the managed identity profile.



Adding NetApp Support Site accounts to Cloud Manager

Adding your NetApp Support Site account to Cloud Manager is required to deploy a BYOL system. It's also required to register pay-as-you-go systems and to upgrade ONTAP software.

Watch the following video to learn how to add NetApp Support Site accounts to Cloud Manager. Or scroll down to read the steps.

[] | *https://img.youtube.com/vi/V2fLTyztqYQ/maxresdefault.jpg*

Steps

1. If you don't have a NetApp Support Site account yet, register for one.
2. In the upper right of the Cloud Manager console, click the task drop-down list, and then select **Account**

Settings.

3. Click **Add New Account** and select **NetApp Support Site**.
4. Specify a name for the account and then enter the user name and password.
   - The account must be a customer-level account (not a guest or temp account).
   - If you plan to deploy BYOL systems:
     - The account must be authorized to access the serial numbers of the BYOL systems.
     - If you purchased a secure BYOL subscription, then a secure NSS account is required.
5. Click **Create Account.**

What's next?

Users can now select the account when creating new Cloud Volumes ONTAP systems and when registering existing systems.

- Launching Cloud Volumes ONTAP in AWS
- Launching Cloud Volumes ONTAP in Azure
- Registering pay-as-you-go systems
- Learn how Cloud Manager manages license files

Installing an HTTPS certificate for secure access

By default, Cloud Manager uses a self-signed certificate for HTTPS access to the web console. You can install a certificate signed by a certificate authority (CA), which provides better security protection than a self-signed certificate.

Steps

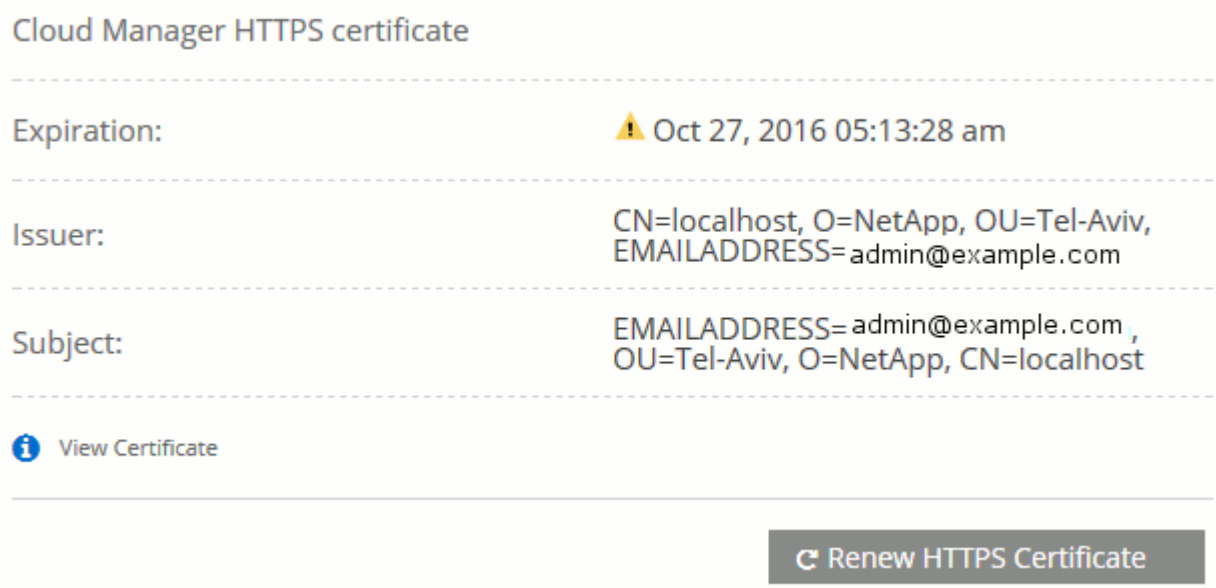
1. In the upper right of the Cloud Manager console, click the task drop-down list, and then select **HTTPS Setup**.
2. In the HTTPS Setup page, install a certificate by generating a certificate signing request (CSR) or by installing your own CA-signed certificate:

Option	Description
Generate a CSR	a. Enter the host name or DNS of the Cloud Manager host (its Common Name), and then click **Generate CSR**. Cloud Manager displays a certificate signing request. b. Use the CSR to submit an SSL certificate request to a CA. The certificate must use the Privacy Enhanced Mail (PEM) Base-64 encoded X.509 format. c. Copy the contents of the signed certificate, paste it in the Certificate field, and then click **Install**.

Option	Description
Install your own CA-signed certificate	a. Select **Install CA-signed certificate**. b. Load both the certificate file and the private key and then click **Install**. The certificate must use the Privacy Enhanced Mail (PEM) Base-64 encoded X.509 format.

Result

Cloud Manager now uses the CA-signed certificate to provide secure HTTPS access. The following image shows a Cloud Manager system that is configured for secure access:



Setting up users and tenants

Cloud Manager enables you to add additional Cloud Central users to Cloud Manager and to isolate working environments by using tenants.

Adding users to Cloud Manager

If additional users need to use your Cloud Manager system, they must sign up for an account in NetApp Cloud Central. You can then add the users to Cloud Manager.

Steps

1. If the user does not yet have an account in NetApp Cloud Central, send them a link to your Cloud Manager system and have them sign up.

   Wait until the user confirms that they have signed up for an account.

2. In Cloud Manager, click the user icon and then click **View Users**.
3. Click **New User**.
4. Enter the email address associated with the user account, select a role, and click **Add**.

What's next?

Inform the user that they can now log in to the Cloud Manager system.

Creating tenants

Tenants enable you to isolate your working environments into separate groups. You create one or more working environments within a tenant. Learn more about tenants.

Steps

1. Click the tenants icon and then click **Add Tenant**.

2. Enter a name, description, and cost center, if needed.
3. Click **Save**.

What's next?

You can now switch to this new tenant and add Tenant Admins and Working Environment Admins to this tenant.

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

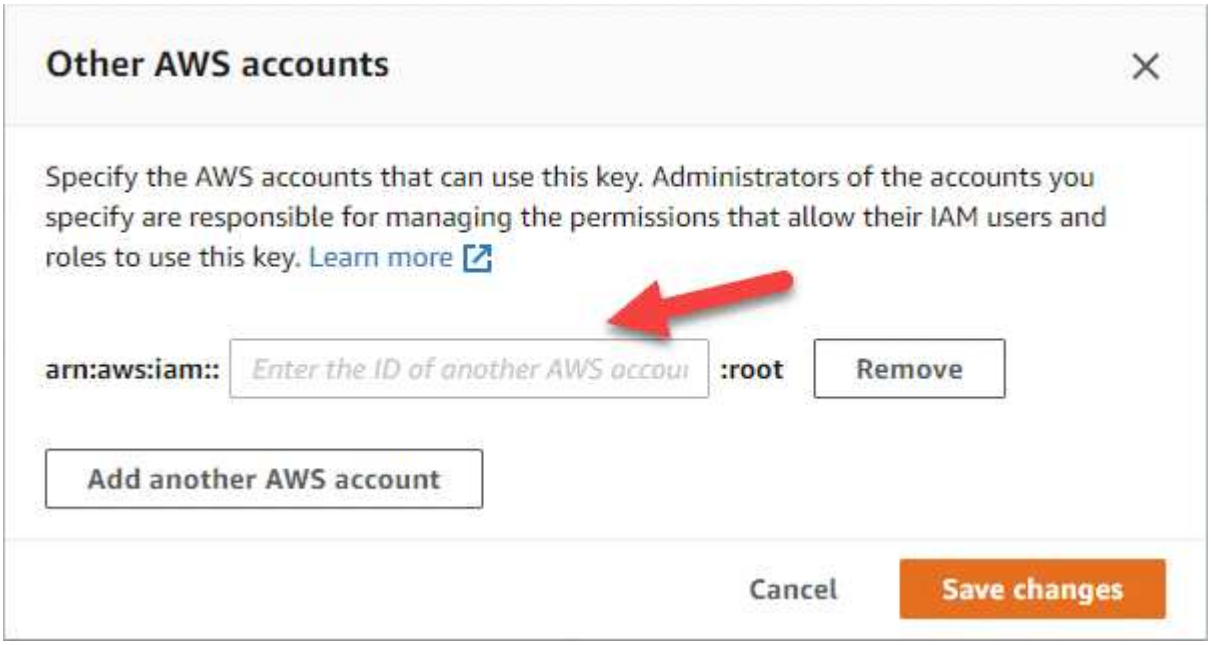
3. If the CMK is in a different AWS account, complete the following steps:
   a. Go to the KMS console from the account where the CMK resides.
   b. Select the key.
   c. In the **General configuration** pane, copy the ARN of the key.

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

   d. 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.



e. Now switch to the AWS account that provides Cloud Manager with permissions and open the IAM console.

f. Create an IAM policy that includes the permissions listed below.

g. 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.

Networking requirements

Networking requirements for Cloud Manager

You must set up your networking so that Cloud Manager can deploy Cloud Volumes ONTAP systems in AWS or in Microsoft Azure. 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, Cloud Manager prompts you to specify the proxy during setup. You can also specify the proxy server from the Settings page. Refer to Configuring Cloud Manager to use a proxy server.

Connection to target networks

Cloud Manager requires a network connection to the AWS VPCs and Azure VNets in which you want to deploy Cloud Volumes ONTAP.

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

Outbound internet access

Cloud Manager requires outbound internet access to deploy and manage Cloud Volumes ONTAP. Outbound internet access is also required when accessing Cloud Manager from your web browser and when running the Cloud Manager installer on a Linux host.

The following sections identify the specific endpoints.

Outbound internet access to manage Cloud Volumes ONTAP in AWS

Cloud Manager requires outbound internet access to contact the following endpoints when deploying and managing Cloud Volumes ONTAP in AWS:

Endpoints	Purpose
AWS services (amazonaws.com): • CloudFormation • Elastic Compute Cloud (EC2) • Key Management Service (KMS) • Security Token Service (STS) • Simple Storage Service (S3) The exact endpoint depends on the region in which you deploy Cloud Volumes ONTAP. Refer to AWS documentation for details.	Enables Cloud Manager 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.

Endpoints	Purpose
https://cognito-idp.us-east-1.amazonaws.com https://cognito-identity.us-east-1.amazonaws.com	Enables Cloud Manager to access and download manifests, templates, and Cloud Volumes ONTAP upgrade images.
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.
https://support.netapp.com/aods/asupmessage https://support.netapp.com/asupprod/post/1.0/postAsup	Communication with NetApp AutoSupport.
https://support.netapp.com/svcgw https://support.netapp.com/ServiceGW/entitlement	Communication with NetApp for licensing and support registration.
https://packages.cloud.google.com/yum https://github.com/NetApp/trident/releases/download/	Required to connect Cloud Volumes ONTAP systems with a Kubernetes cluster. The endpoints enable installation of NetApp Trident.
Various third-party locations, for example: • https://repo1.maven.org/maven2 • https://oss.sonatype.org/content/repositories • https://repo.typesafe.org Third-party locations are subject to change.	During upgrades, Cloud Manager downloads the latest packages for third-party dependencies.

Outbound internet access to manage Cloud Volumes ONTAP in Azure

Cloud Manager requires outbound internet access to contact the following endpoints when deploying and managing Cloud Volumes ONTAP in Microsoft 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.

Endpoints	Purpose
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	Enables Cloud Manager to access and download manifests, templates, and Cloud Volumes ONTAP upgrade images.
https://kinesis.us-east-1.amazonaws.com	Enables NetApp to stream data from audit records.
https://netapp-cloud-account.auth0.com	Communication with NetApp Cloud Central for centralized user authentication.
https://mysupport.netapp.com	Communication with NetApp AutoSupport.
https://support.netapp.com/svcgw https://support.netapp.com/ServiceGW/entitlement	Communication with NetApp for licensing and support registration.
https://packages.cloud.google.com/yum https://github.com/NetApp/trident/releases/download/	Required to connect Cloud Volumes ONTAP systems with a Kubernetes cluster. The endpoints enable installation of NetApp Trident.
Various third-party locations, for example: • https://repo1.maven.org/maven2 • https://oss.sonatype.org/content/repositories • https://repo.typesafe.org Third-party locations are subject to change.	During upgrades, Cloud Manager downloads the latest packages for third-party dependencies.

Outbound internet access from your web browser

Users must access Cloud Manager from a web browser. The machine running the web browser must have connections to the following endpoints:

Endpoints	Purpose
The Cloud Manager host	You must enter the host's IP address from a web browser to load the Cloud Manager console. Depending on your connectivity to your cloud provider, you can use the private IP or a public IP assigned to the host: • 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 In any case, you should secure network access by ensuring that security group rules allow access from only authorized IPs or subnets.
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.

Outbound internet access to install Cloud Manager on a Linux host

The Cloud Manager installer must access the following URLs during the installation process:

- http://dev.mysql.com/get/mysql-community-release-el7-5.noarch.rpm
- https://dl.fedoraproject.org/pub/epel/epel-release-latest-7.noarch.rpm
- https://s3.amazonaws.com/aws-cli/awscli-bundle.zip

Ports and security groups

- If you deploy Cloud Manager from Cloud Central or from the marketplace images, refer to the following:
  - Security group rules for Cloud Manager in AWS
  - Security group rules for Cloud Manager in Azure
- If you install Cloud Manager on an existing Linux host, see Cloud Manager host requirements.

Networking requirements for Cloud Volumes ONTAP in AWS

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

> Looking for the list of endpoints to which Cloud Manager requires access? They're now maintained in a single location. Click here for details.

General AWS networking 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.

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).

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.

AWS networking requirements for Cloud Volumes ONTAP HA 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.

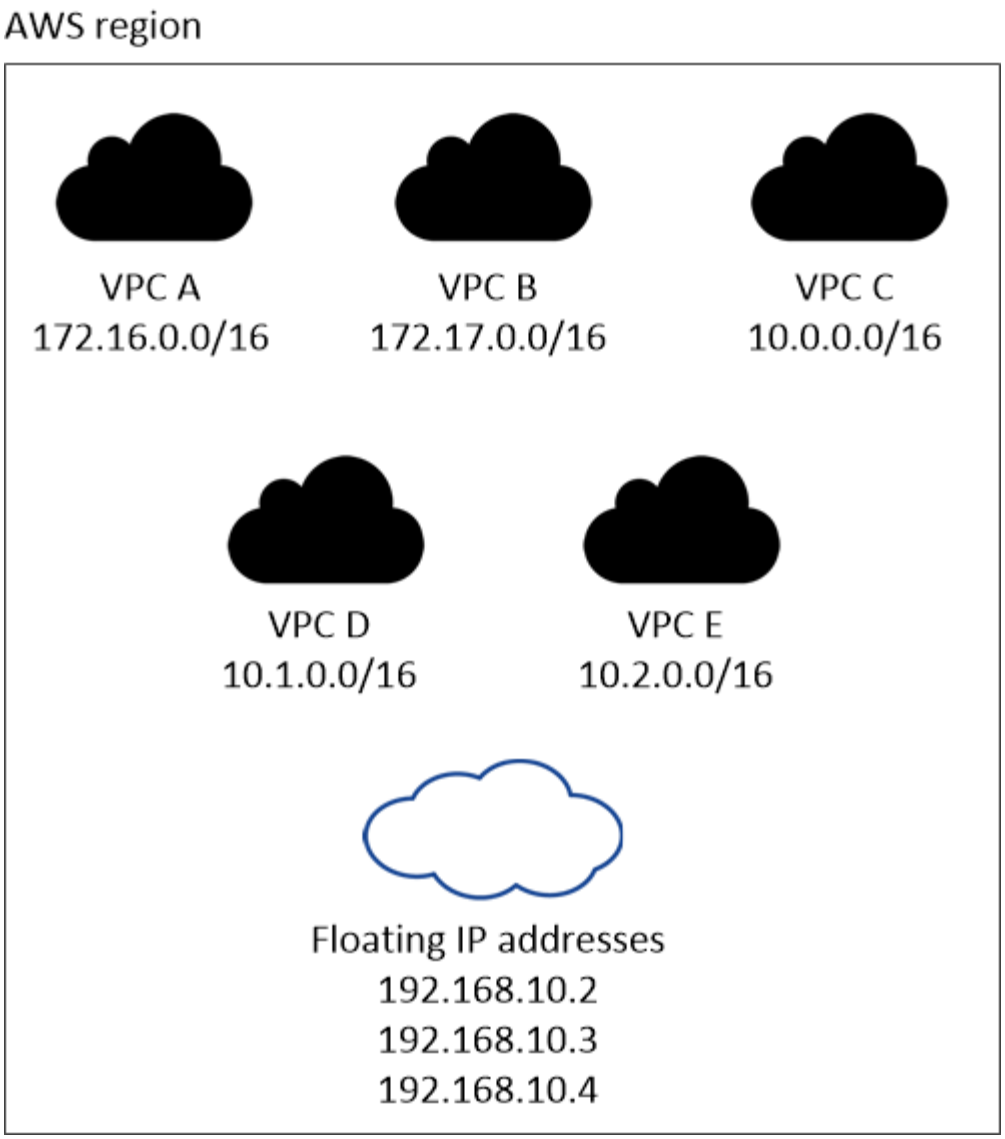
One floating IP address is for cluster management, one is for NFS/CIFS data on node 1, and one is for NFS/CIFS data on node 2. A fourth floating IP address for SVM management is optional.

> 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.



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 configuration

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

Sample VPC configurations

To better understand how you can deploy Cloud Manager and Cloud Volumes ONTAP in AWS, you should review the most common VPC configurations.

- A VPC with public and private subnets and a NAT device
- A VPC with a private subnet and a VPN connection to your network

A VPC with public and private subnets and a NAT device

This VPC configuration includes public and private subnets, an internet gateway that connects the VPC to the internet, and a NAT gateway or NAT instance in the public subnet that enables outbound internet traffic from the private subnet. In this configuration, you can run Cloud Manager in a public subnet or private subnet, but the public subnet is recommended because it allows access from hosts outside the VPC. You can then launch Cloud Volumes ONTAP instances in the private subnet.

> Instead of a NAT device, you can use an HTTP proxy to provide internet connectivity.

For more details about this scenario, refer to AWS Documentation: Scenario 2: VPC with Public and Private Subnets (NAT).

The following graphic shows Cloud Manager running in a public subnet and single node systems running in a private subnet:

A VPC with a private subnet and a VPN connection to your network

This VPC configuration is a hybrid cloud configuration in which Cloud Volumes ONTAP becomes an extension of your private environment. The configuration includes a private subnet and a virtual private gateway with a VPN connection to your network. Routing across the VPN tunnel allows EC2 instances to access the internet through your network and firewalls. You can run Cloud Manager in the private subnet or in your data center. You would then launch Cloud Volumes ONTAP in the private subnet.

> You can also use a proxy server in this configuration to allow internet access. The proxy server can be in your data center or in AWS.

If you want to replicate data between FAS systems in your data center and Cloud Volumes ONTAP systems in AWS, you should use a VPN connection so that the link is secure.

For more details about this scenario, refer to AWS Documentation: Scenario 4: VPC with a Private Subnet Only and AWS Managed VPN Access.

The following graphic shows Cloud Manager running in your data center and single node systems running in a private subnet:

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

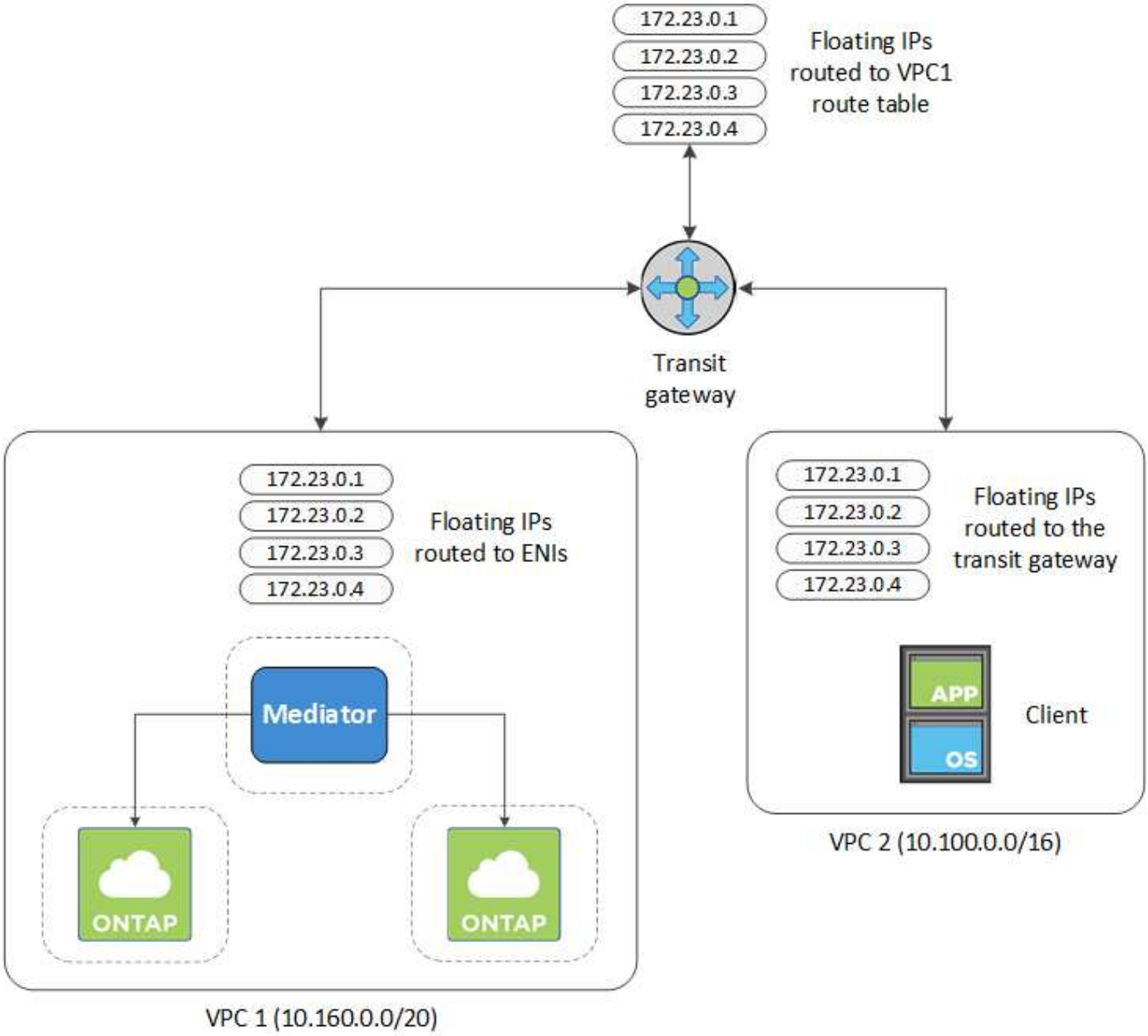
Set up an AWS transit gateway to enable access to an HA pair's floating IP addresses from outside the VPC where the HA pair resides.

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

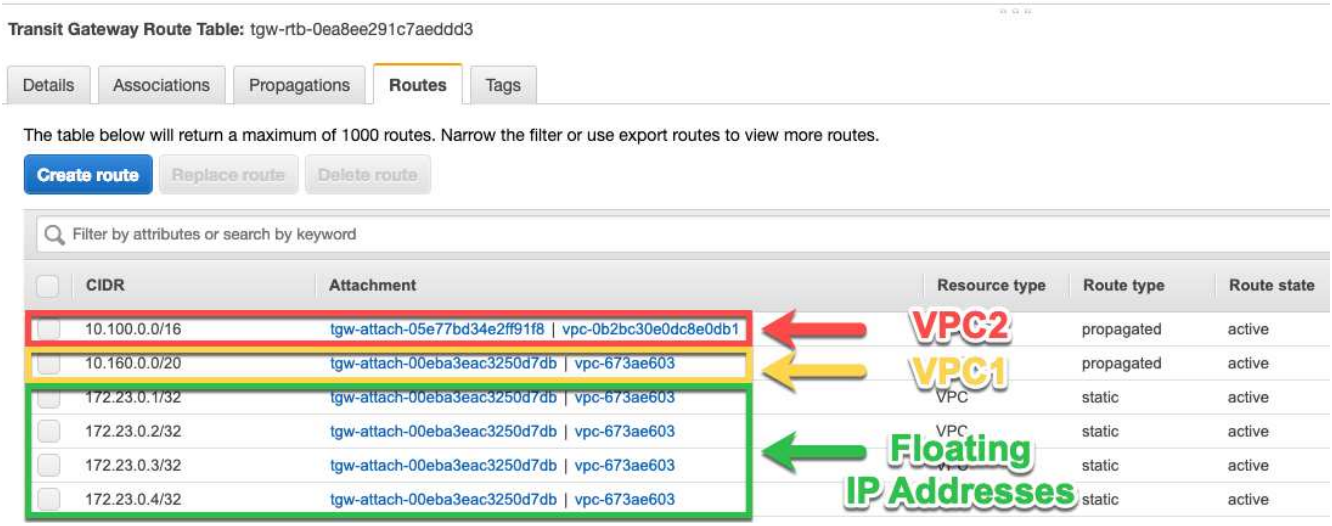
Auto failover

Cluster Management :	172.23.0.1
Data (nfs,cifs) :	**Node 1:** 172.23.0.2 | **Node 2:** 172.23.0.3

Access

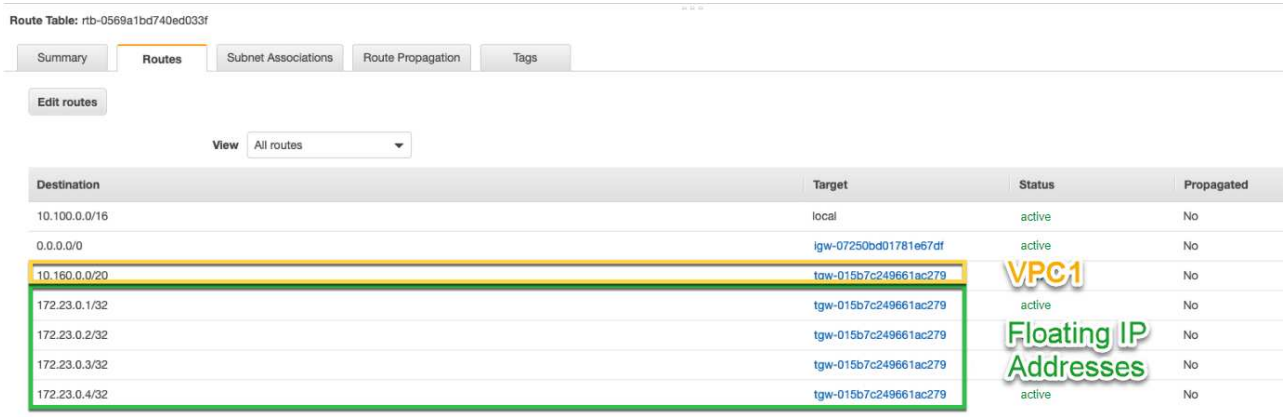
SVM Management :	172.23.0.4

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.



3. Modify the route table of VPCs that need to access the floating IP addresses.
   a. Add route entries to the floating IP addresses.
   b. Add a route entry to the CIDR block of the VPC where the HA pair resides.

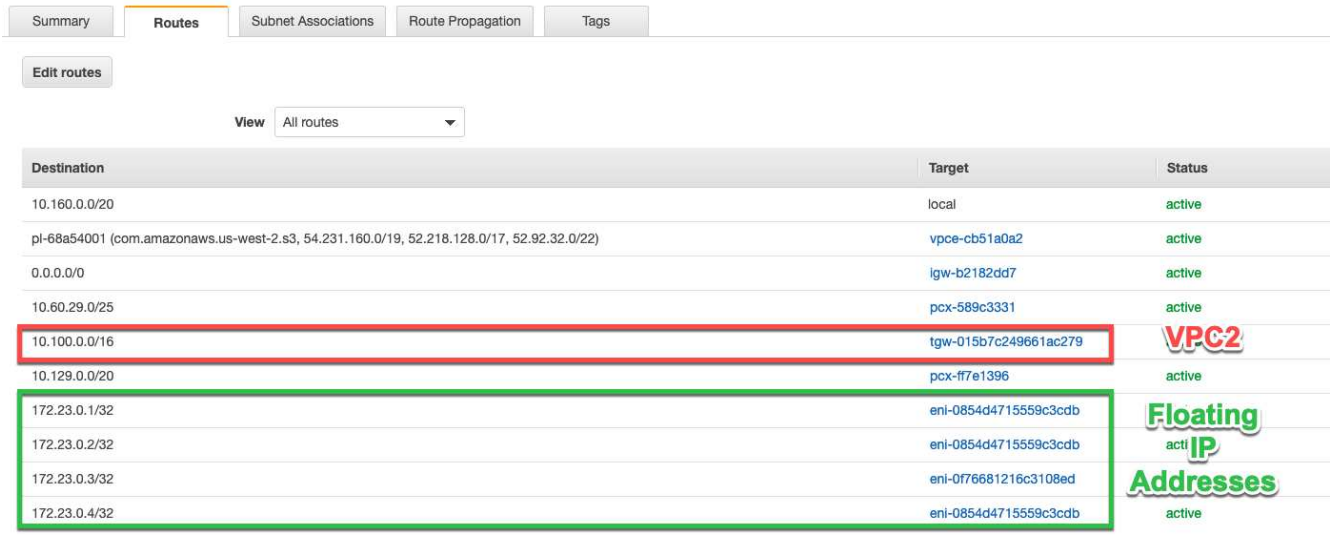
      The following sample image shows the route table for VPC 2, which includes routes to VPC 1 and the floating IP addresses.



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.

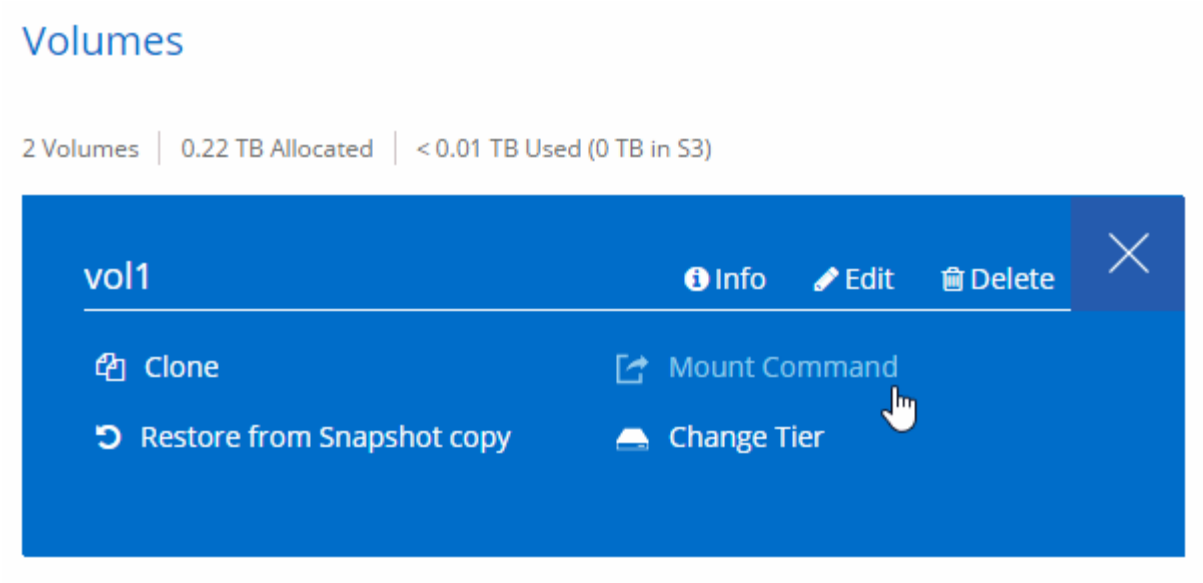
   This step is important because it completes the routing between the VPCs.

   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.



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**.



Related links

- High-availability pairs in AWS
- Networking requirements for Cloud Volumes ONTAP in AWS

Networking requirements for Cloud Volumes ONTAP in Azure

You must set up your Azure networking so Cloud Volumes ONTAP systems can operate properly.

> Looking for the list of endpoints to which Cloud Manager requires access? They're now maintained in a single location. Click here for details.

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 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

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 Azure Blob storage for data tiering

If you want to tier cold data to Azure Blob storage, you do not need to set up a VNet service endpoint as long as Cloud Manager has the required 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.

Additional deployment options

Cloud Manager host requirements

If you install Cloud Manager on your own host, then you must verify support for your configuration, which includes operating system requirements, port requirements, and so on.

Supported AWS EC2 instance types

t3.medium (recommended), t2.medium, and m4.large

Supported Azure VM sizes

A2, D2 v2, or D2 v3 (based on availability)

Supported operating systems

- CentOS 7.2
- CentOS 7.3
- CentOS 7.4
- Red Hat Enterprise Linux 7.2
- Red Hat Enterprise Linux 7.3
- Red Hat Enterprise Linux 7.4

  The Red Hat Enterprise Linux system must be registered with Red Hat Subscription Management. If it is not registered, the system cannot access repositories to update required 3rd party software during Cloud Manager installation.

  Cloud Manager is supported on English-language versions of these operating systems.

Hypervisor

A bare metal or hosted hypervisor that is certified to run CentOS or Red Hat Enterprise Linux
Red Hat Solution: Which hypervisors are certified to run Red Hat Enterprise Linux?

CPU

2.27 GHz or higher with two cores

RAM

4 GB

Free disk space

50 GB

Outbound internet access

Outbound internet access is required when installing Cloud Manager and when using Cloud Manager to deploy Cloud Volumes ONTAP. For a list of endpoints, see Networking requirements for Cloud Manager.

Ports

The following ports must be available:

- 80 for HTTP access
- 443 for HTTPS access
- 3306 for the Cloud Manager database
- 8080 for the Cloud Manager API proxy

If other services are using these ports, Cloud Manager installation fails.

> There is a potential conflict with port 3306. If another instance of MySQL is running on the host, it uses port 3306 by default. You must change the port that the existing MySQL instance uses.

You can change the default HTTP and HTTPS ports when you install Cloud Manager. You cannot change the default port for the MySQL database. If you change the HTTP and HTTPS ports, you must ensure that users can access the Cloud Manager web console from a remote host:

- Modify the security group to allow inbound connections through the ports.
- Specify the port when you enter the URL to the Cloud Manager web console.

Installing Cloud Manager on an existing Linux host

The most common way to deploy Cloud Manager is from Cloud Central or from a cloud provider's marketplace. But you have the option to download and install the Cloud Manager software on an existing Linux host in your network or in the cloud.

Before you begin

- A Red Hat Enterprise Linux system must be registered with Red Hat Subscription Management. If it is not registered, the system cannot access repositories to update required 3rd party software during Cloud Manager installation.
- The Cloud Manager installer accesses several URLs during the installation process. You must ensure that outbound internet access is allowed to those endpoints. Refer to Networking requirements for Cloud Manager.

About this task

- Root privileges are not required to install Cloud Manager.
- Cloud Manager installs the AWS command line tools (awscli) to enable recovery procedures from NetApp support.

  If you receive a message that installing the awscli failed, you can safely ignore the message. Cloud Manager can operate successfully without the tools.

- The installer that is available on the NetApp Support Site might be an earlier version. After installation, Cloud Manager automatically updates itself if a new version is available.

Steps

1. Review networking requirements:
   - Networking requirements for Cloud Manager
   - Networking requirements for Cloud Volumes ONTAP for AWS
   - Networking requirements for Cloud Volumes ONTAP for Azure
2. Review Cloud Manager host requirements.
3. Download the software from the NetApp Support Site, and then copy it to the Linux host.

   For help with connecting and copying the file to an EC2 instance in AWS, see AWS Documentation: Connecting to Your Linux Instance Using SSH.

4. Assign permissions to execute the script.

   Example

   ```
   chmod +x OnCommandCloudManager-V3.6.3.sh
   ```

5. Run the installation script:

   ```
   ./OnCommandCloudManager-V3.6.3.sh [silent] [proxy=ipaddress]
   [proxyport=port] [proxyuser=user_name] [proxypwd=password]
   ```

   silent runs the installation without prompting you for information.

   proxy is required if the Cloud Manager host is behind a proxy server.

   proxyport is the port for the proxy server.

   proxyuser is the user name for the proxy server, if basic authentication is required.

   proxypwd is the password for the user name that you specified.

6. Unless you specified the silent parameter, type **Y** to continue the script, and then enter the HTTP and HTTPS ports when prompted.

   If you change the HTTP and HTTPS ports, you must ensure that users can access the Cloud Manager web console from a remote host:

- Modify the security group to allow inbound connections through the ports.
- Specify the port when you enter the URL to the Cloud Manager web console.

  Cloud Manager is now installed. At the end of the installation, the Cloud Manager service (occm) restarts twice if you specified a proxy server.

7. Open a web browser and enter the following URL:

   https://*ipaddress*:*port*

   ipaddress can be localhost, a private IP address, or a public IP address, depending on the configuration of the Cloud Manager host. For example, if Cloud Manager is in the public cloud without a public IP address, you must enter a private IP address from a host that has a connection to the Cloud Manager host.

   port is required if you changed the default HTTP (80) or HTTPS (443) ports. For example, if the HTTPS port was changed to 8443, you would enter https://*ipaddress*:8443

8. Sign up for a NetApp Cloud Central account or log in if you already have one.
9. When you sign up or log in, Cloud Manager automatically adds your user account as the administrator for this system.
10. After you log in, enter a name for this Cloud Manager system.

After you finish

Set up permissions for your AWS and Azure accounts so Cloud Manager can deploy Cloud Volumes ONTAP:

- If you want to deploy Cloud Volumes ONTAP in AWS, set up an AWS account and then add it to Cloud Manager.
- If you want to deploy Cloud Volumes ONTAP in Azure, set up an Azure account and then add it to Cloud Manager.

Launching Cloud Manager from the AWS Marketplace

It is best to launch Cloud Manager in AWS using NetApp Cloud Central, but you can launch it from the AWS Marketplace, if needed.

If you launch Cloud Manager from the AWS Marketplace, Cloud Manager is still integrated with NetApp Cloud Central. Learn more about the integration.

About this task

The following steps describe how to launch the instance from the EC2 Console because the console enables you to attach an IAM role to the Cloud Manager instance. This is not possible using the 1-Click option.

Steps

1. Create an IAM policy and role for the EC2 instance:
   a. Download the Cloud Manager IAM policy from the following location:

      NetApp OnCommand Cloud Manager: AWS and Azure Policies

   b. From the IAM console, create your own policy by copying and pasting the text from the Cloud Manager IAM policy.

c. Create an IAM role with the role type Amazon EC2 and attach the policy that you created in the previous step to the role.

2. Go to the Cloud Manager page on the AWS Marketplace.
3. Click **Continue**.
4. On the Custom Launch tab, click **Launch with EC2 Console** for your region, and then make your selections:
   a. Depending on region availability, choose the t3.medium (recommended), t2.medium, or m4.large instance type.
   b. Select a VPC, subnet, IAM role, and other configuration options that meet your requirements.
   c. Keep the default storage options.
   d. Enter tags for the instance, if desired.
   e. Specify the required connection methods for the Cloud Manager instance: SSH, HTTP, and HTTPS.
   f. Click **Launch**.

Result

AWS launches the software with the specified settings. The Cloud Manager instance and software should be running in approximately five minutes.

After you finish

Log in to Cloud Manager by entering the public IP address or private IP address in a web browser and then complete the Setup wizard.

Deploying Cloud Manager from the Azure Marketplace

It is best to deploy Cloud Manager in Azure using NetApp Cloud Central, but you can deploy it from the Azure Marketplace, if needed.

Separate instructions are available to deploy Cloud Manager in Azure US Government regions and in Azure Germany regions.

> If you deploy Cloud Manager from the Azure Marketplace, Cloud Manager is still integrated with NetApp Cloud Central. Learn more about the integration.

Deploying Cloud Manager in Azure

You need to install and set up Cloud Manager so you can use it to launch Cloud Volumes ONTAP in Azure.

Steps

1. Go to the Azure Marketplace page for Cloud Manager.
2. Click **Get it now** and then click **Continue**.
3. From the Azure portal, click **Create** and follow the steps to configure the virtual machine.

   Note the following as you configure the VM:

   - Cloud Manager can perform optimally with either HDD or SSD disks.
   - Choose one of the recommended virtual machine sizes: A2, D2 v2, or D2 v3 (based on availability).

- For the network security group, Cloud Manager requires inbound connections using SSH, HTTP, and HTTPS.

  Learn more about security group rules for Cloud Manager.

- Under **Management**, enable **System assigned managed identity** for Cloud Manager by selecting **On**.

  This setting is important because a managed identity allows the Cloud Manager virtual machine to identify itself to Azure Active Directory without providing any credentials. Learn more about managed identities for Azure resources.

4. On the **Review + create** page, review your selections and click **Create** to start the deployment.

   Azure deploys the virtual machine with the specified settings. The virtual machine and Cloud Manager software should be running in approximately five minutes.

5. Open a web browser from a host that has a connection to the Cloud Manager virtual machine and enter the following URL:

   http://*ipaddress*:80

   When you log in, Cloud Manager automatically adds your user account as the administrator for this system.

6. After you log in, enter a name for the Cloud Manager system.

Result

Cloud Manager is now installed and set up. You must grant Azure permissions before users can deploy Cloud Volumes ONTAP in Azure.

Granting Azure permissions to Cloud Manager

When you deployed Cloud Manager in Azure, you should have enabled a system-assigned managed identity. You must now grant the required Azure permissions by creating a custom role and then by assigning the role to the Cloud Manager virtual machine for one or more subscriptions.

Steps

1. Create a custom role using the Cloud Manager policy:

   a. Download the Cloud Manager Azure policy.

   b. Modify the JSON file by adding Azure subscription IDs to the assignable scope.

      You should add the ID for each Azure subscription from which users will create Cloud Volumes ONTAP systems.

      Example

      ```
      "AssignableScopes": [
      "/subscriptions/d333af45-0d07-4154-943d-c25fbzzzzzzz",
      "/subscriptions/54b91999-b3e6-4599-908e-416e0zzzzzzz",
      "/subscriptions/398e471c-3b42-4ae7-9b59-ce5bbzzzzzzz"
      ```

   c. Use the JSON file to create a custom role in Azure.

      The following example shows how to create a custom role using the Azure CLI 2.0:

az role definition create --role-definition C:\Policy_for_cloud_Manager_Azure_3.6.1.json

You should now have a custom role called OnCommand Cloud Manager Operator that you can assign to the Cloud Manager virtual machine.

2. Assign the role to the Cloud Manager virtual machine for one or more subscriptions:
   a. Open the **Subscriptions** service and then select the subscription in which you want to deploy Cloud Volumes ONTAP systems.
   b. Click **Access control (IAM)**.
   c. Click **Add** > **Add role assignment** and then add the permissions:
      - Select the **OnCommand Cloud Manager Operator** role.

        OnCommand Cloud Manager Operator is the default name provided in the Cloud Manager policy. If you chose a different name for the role, then select that name instead.

      - Assign access to a **Virtual Machine**.
      - Select the subscription in which the Cloud Manager virtual machine was created.
      - Select the Cloud Manager virtual machine.
      - Click **Save**.
   d. If you want to deploy Cloud Volumes ONTAP from additional subscriptions, switch to that subscription and then repeat these steps.

Result

Cloud Manager now has the permissions that it needs to deploy and manage Cloud Volumes ONTAP in Azure.

Deploying Cloud Manager in an Azure US Government region

To get Cloud Manager up and running in a US Government region, first deploy Cloud Manager from the Azure Government Marketplace. Then provide the permissions that Cloud Manager needs to deploy and manage Cloud Volumes ONTAP systems.

For a list of supported Azure US Government regions, see Cloud Volumes Global Regions.

Deploying Cloud Manager from the Azure US Government Marketplace

Cloud Manager is available as an image in the Azure US Government Marketplace.

Steps

1. Search for OnCommand Cloud Manager in the Azure US Government portal.
2. Click **Create** and follow the steps to configure the virtual machine.

   Note the following as you configure the virtual machine:

   - Cloud Manager can perform optimally with either HDD or SSD disks.
   - You should choose one of the recommended virtual machine sizes: A2, D2 v2, or D2 v3 (based on availability).
   - For the network security group, it is best to choose **Advanced**.

The **Advanced** option creates a new security group that includes the required inbound rules for Cloud Manager. If you choose Basic, refer to Security group rules for the list of required rules.

3. On the summary page, review your selections and click **Create** to start the deployment.

   Azure deploys the virtual machine with the specified settings. The virtual machine and Cloud Manager software should be running in approximately five minutes.

4. Open a web browser from a host that has a connection to the Cloud Manager virtual machine and enter the following URL:

   http://*ipaddress*:80

   When you log in, Cloud Manager automatically adds your user account as the administrator for this system.

5. After you log in, enter a name for the Cloud Manager system.

Result

Cloud Manager is now installed and set up. You must grant Azure permissions before users can deploy Cloud Volumes ONTAP in Azure.

Granting Azure permissions to Cloud Manager using a managed identity

The easiest way to provide permissions is by enabling a managed identity on the Cloud Manager virtual machine and then by assigning the required permissions to the virtual machine. If preferred, an alternative way is to grant Azure permissions using a service principal.

Steps

1. Enable a managed identity on the Cloud Manager virtual machine:
   a. Navigate to the Cloud Manager virtual machine and select **Identity**.
   b. Under **System Assigned**, click **On** and then click **Save**.
2. Create a custom role using the Cloud Manager policy:
   a. Download the Cloud Manager Azure policy.
   b. Modify the JSON file by adding Azure subscription IDs to the assignable scope.

      You should add the ID for each Azure subscription from which users will create Cloud Volumes ONTAP systems.

      Example

      "AssignableScopes": [
      "/subscriptions/d333af45-0d07-4154-943d-c25fbzzzzzzz",
      "/subscriptions/54b91999-b3e6-4599-908e-416e0zzzzzzz",
      "/subscriptions/398e471c-3b42-4ae7-9b59-ce5bbzzzzzzz"

   c. Use the JSON file to create a custom role in Azure.

      The following example shows how to create a custom role using the Azure CLI 2.0:

      az role definition create --role-definition C:\Policy_for_cloud_Manager_Azure_3.6.1.json

      You should now have a custom role called OnCommand Cloud Manager Operator that you can assign

to the Cloud Manager virtual machine.

3. Assign the role to the Cloud Manager virtual machine for one or more subscriptions:
   a. Open the **Subscriptions** service and then select the subscription in which you want to deploy Cloud Volumes ONTAP systems.
   b. Click **Access control (IAM)**.
   c. Click **Add**, click **Add role assignment**, and then add the permissions:
      - Select the **OnCommand Cloud Manager Operator** role.

        OnCommand Cloud Manager Operator is the default name provided in the Cloud Manager policy. If you chose a different name for the role, then select that name instead.

      - Assign access to a **Virtual Machine**.
      - Select the subscription in which the Cloud Manager virtual machine was created.
      - Type the name of the virtual machine and then select it.
      - Click **Save**.
   d. If you want to deploy Cloud Volumes ONTAP from additional subscriptions, switch to that subscription and then repeat these steps.

Result

Cloud Manager now has the permissions that it needs to deploy and manage Cloud Volumes ONTAP in Azure.

Installing Cloud Manager in an Azure Germany region

The Azure Marketplace is not available in the Azure Germany regions, so you must download the Cloud Manager installer from the NetApp Support Site and install it on an existing Linux host in the region.

Steps

1. Review networking requirements for Azure.
2. Review Cloud Manager host requirements.
3. Download and install Cloud Manager.
4. Grant Azure permissions to Cloud Manager using a service principal.

After you finish

Cloud Manager is now ready to deploy Cloud Volumes ONTAP in the Azure Germany region, just like any other region. However, you might want to perform additional setup first.

Deploying Cloud Volumes ONTAP

Before you create Cloud Volumes ONTAP systems

Before you use Cloud Manager to create and manage Cloud Volumes ONTAP systems, your Cloud Manager administrator should have prepared networking and installed and set up Cloud Manager.

Your administrator should have followed instructions to get up and running in AWS or in Azure, and optionally set up Cloud Manager.

The following conditions should exist before you start deploying Cloud Volumes ONTAP:

- AWS and Azure networking requirements were met for Cloud Manager and Cloud Volumes ONTAP.
- Cloud Manager has permissions to perform operations in AWS and Azure on your behalf.
- Each Cloud Volumes ONTAP product that users will deploy was subscribed to from the AWS Marketplace.
- Cloud Manager was installed.
- (Optional) Additional tenants were defined.
- (Optional) Additional user accounts were created, which can include Tenant Admins and Working Environment Admins.

Logging in to Cloud Manager

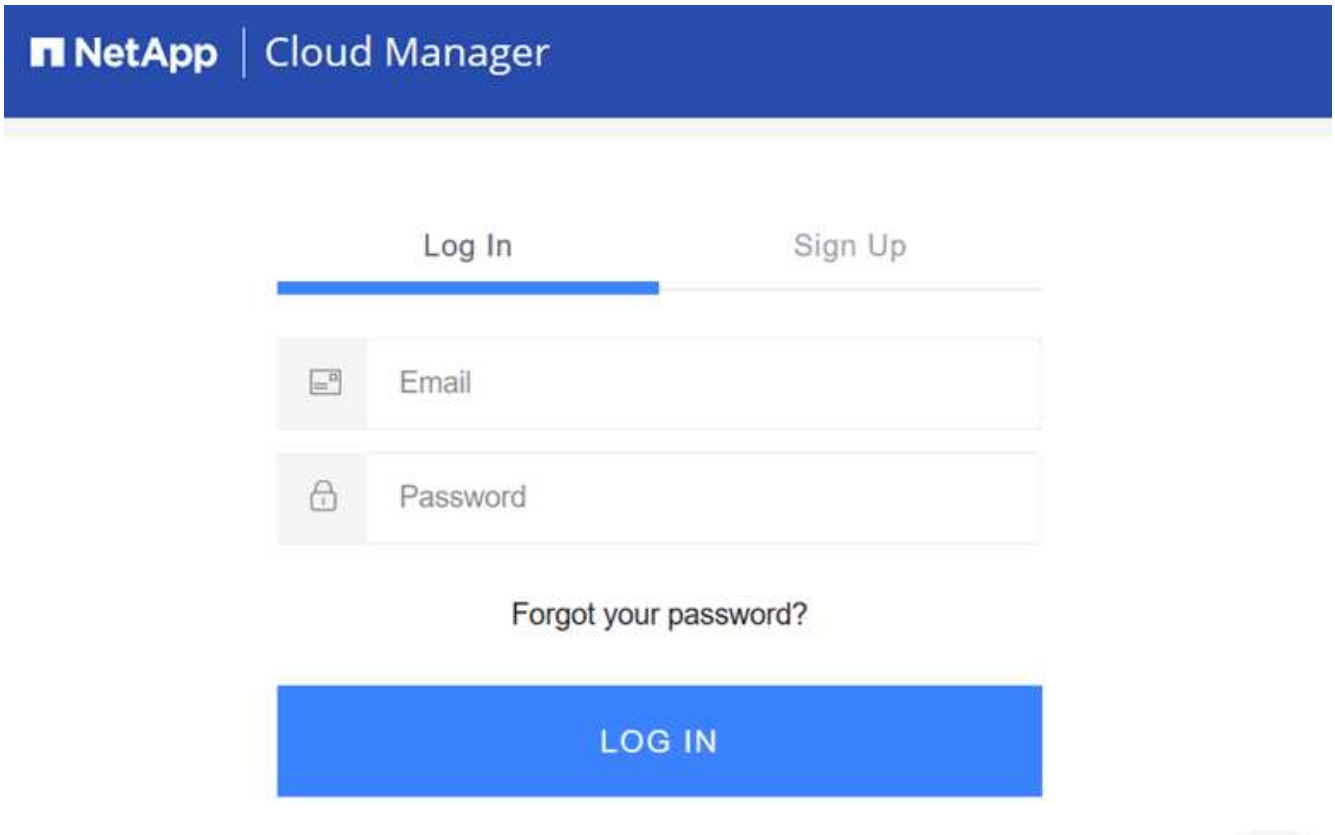
You can log in to Cloud Manager from any web browser that has a connection to the Cloud Manager system. You should log in using a NetApp Cloud Central user account.

Steps

1. Open a web browser and log in to NetApp Cloud Central.
2. Click **Go to Cloud Data Services** and select **Cloud Volumes ONTAP**.
3. Click **Go to Cloud Manager** for the Cloud Manager system that you want to access.

   If you do not see any systems listed, make sure that the Cloud Manager administrator added your NetApp Cloud Central account to the system.

4. Log in to Cloud Manager using your NetApp Cloud Central account.



Planning your Cloud Volumes ONTAP configuration

When you deploy Cloud Volumes ONTAP, 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 AWS and Azure 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 9.5
- Supported configurations for Cloud Volumes ONTAP 9.4
- Supported configurations for ONTAP Cloud 9.3

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 9.5
- Storage limits for Cloud Volumes ONTAP 9.4
- Storage limits for ONTAP Cloud 9.3

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:

[] | *https://img.youtube.com/vi/GELcXmOuYPw/maxresdefault.jpg*

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: Introduction to Microsoft Azure Storage.

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 write speed

Cloud Manager enables you to choose a write speed setting for single node Cloud Volumes ONTAP systems. 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.

Difference between normal write speed and high write speed

When you choose normal write speed, data is written directly to disk, thereby reducing the likelihood of data loss in the event of an unplanned system outage.

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, AWS EBS volume performance 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.

Recommendations when using high write speed

If you enable high write speed, you should ensure write protection at the application layer.

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.

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	

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)	

Enabling Flash Cache on Cloud Volumes ONTAP in AWS

Some EC2 instance types include local NVMe storage, which Cloud Volumes ONTAP uses as *Flash Cache*. Flash Cache speeds access to data through real-time intelligent caching of recently read user data and NetApp metadata. It is effective for random read-intensive workloads, including databases, email, and file services.

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

Steps

1. Select one of the following EC2 instance types, which are available with the Premium and BYOL licenses:
   - c5d.4xlarge
   - c5d.9xlarge
   - r5d.2xlarge
2. Disable compression on all volumes.

   Compression must be disabled on all volumes to take advantage of the Flash Cache performance improvements. You can choose no storage efficiency when creating a volume from Cloud Manager, or you can create a volume and then disable data compression by using the CLI.

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 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 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 Working Environments page, click **Add Working Environment**.
2. Under Create, select **Cloud Volumes ONTAP**.
3. On the Details and Credentials page, optionally change the AWS account, enter a working environment name, add tags if needed, and then enter a password.

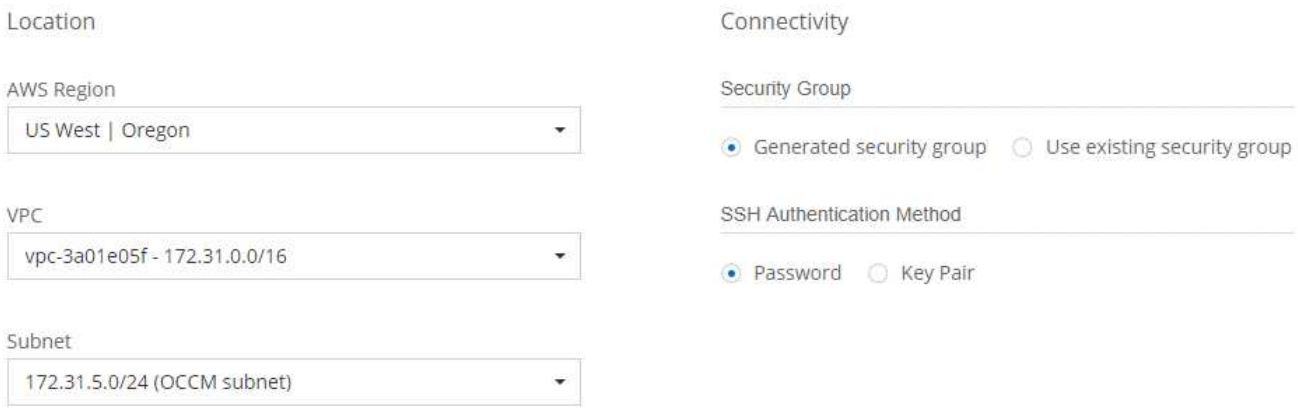
   Some of the fields in this page are self-explanatory. The following table describes fields for which you might need guidance:

Field	Description
Switch Account	You can choose a different account if you added additional Cloud Provider Accounts. For details, see Adding Cloud Provider Accounts to Cloud Manager.
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.
Add tags	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. 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. For information about tags, refer to AWS Documentation: Tagging your Amazon EC2 Resources.
Credentials	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.

If AWS keys were not specified for your Cloud Manager account, you are prompted to enter them after you click Continue. You need to enter them before you can proceed.

4. On the Location & Connectivity page, enter the network information that you recorded in the AWS worksheet and then click **Continue**.

   The following image shows the Location & Connectivity page filled out:



5. On the Data Encryption page, 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.

   Learn how to set up the AWS KMS for Cloud Volumes ONTAP.

   Learn more about supported encryption technologies.

6. On the License and Support Site Account page, 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. On the Preconfigured Packages page, 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.

8. On the IAM Role page, 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.

9. On the Licensing page, change the Cloud Volumes ONTAP version as needed, select a license, an instance type, the instance tenancy, and then click **Continue**.

   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 9.4 RC1 and 9.4 GA is available. The update does not occur from one release to another—for example, from 9.3 to 9.4.

10. On the Underlying Storage Resources page, choose settings for the initial aggregate: a disk type, a size for each disk, and whether S3 tiering should be enabled.

    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.

11. On the Write Speed & WORM page, choose **Normal** or **High** write speed, and activate write once, read many (WORM) storage, if desired.

    Learn more about write speed.

    Learn more about WORM storage.

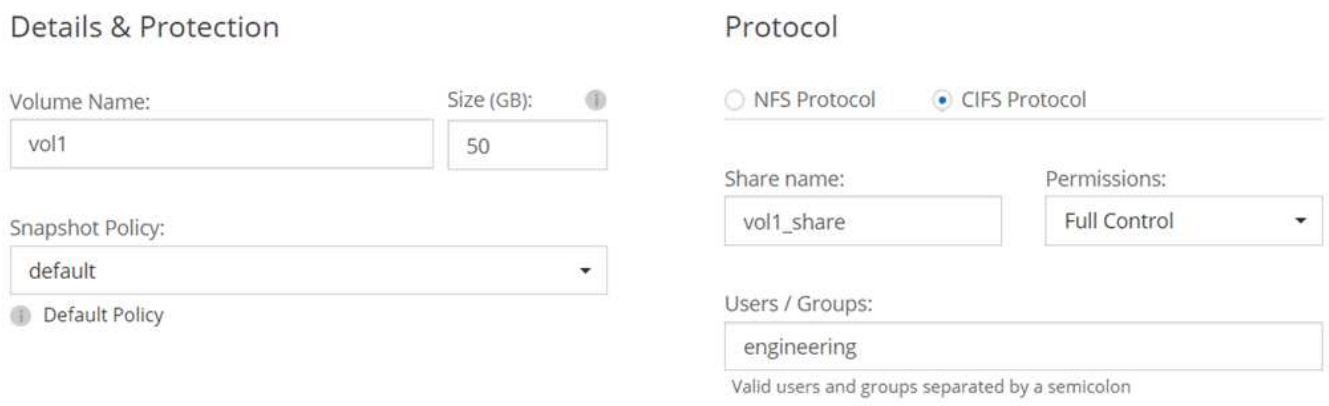
12. On the Create Volume page, enter details for the new volume, and then click **Continue**.

    You might skip this step if you want to create a volume for iSCSI. Cloud Manager sets up volumes for NFS and CIFS only.

    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.

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



13. If you chose the CIFS protocol, set up a CIFS server on the CIFS Setup page:

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.

Field	Description
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. On the Usage Profile, Disk Type, and Tiering Policy page, choose whether you want to enable storage efficiency features and edit the S3 tiering policy, if needed.

    For more information, see Understanding volume usage profiles and Data tiering overview.

15. On the Review & Approve page, review and confirm your selections:
    a. 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 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 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.

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 Working Environments page, click **Add Working Environment**.
2. Under Create, select **Cloud Volumes ONTAP HA**.
3. On the Details and Credentials page, optionally change the AWS account, 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
Switch Account	You can choose a different account if you added additional Cloud Provider Accounts. For details, see Adding Cloud Provider Accounts to Cloud Manager.
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.
Add tags	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. For information about tags, refer to AWS Documentation: Tagging your Amazon EC2 Resources.
Credentials	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.

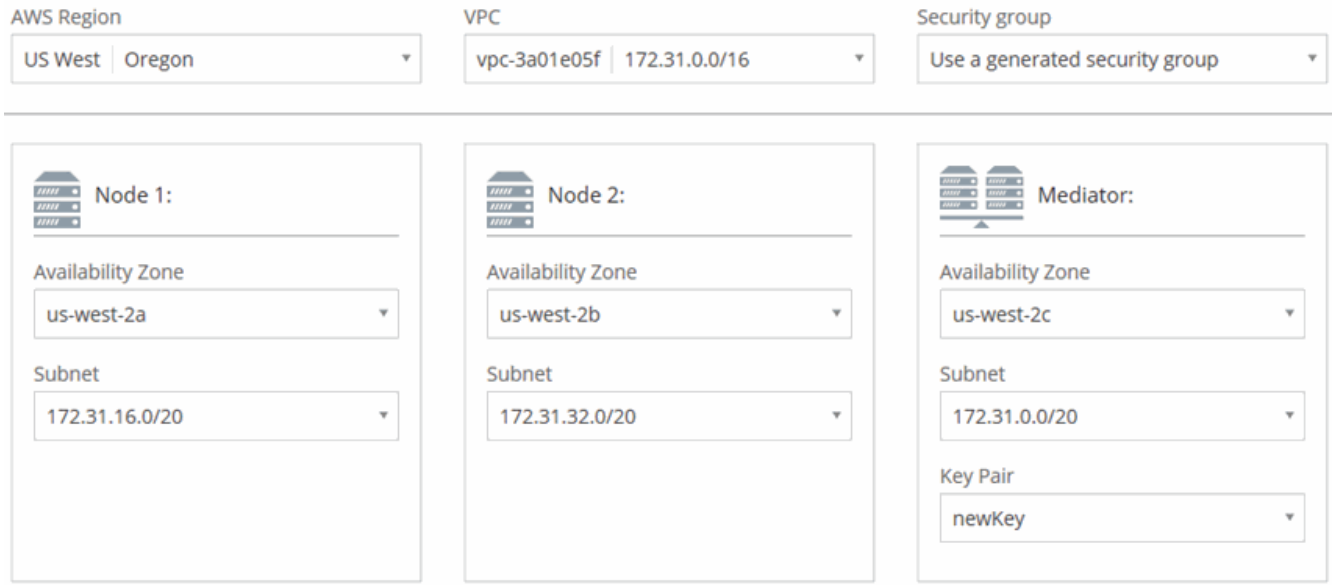
   > If AWS keys were not specified for your Cloud Manager account, you are prompted to enter them after you click Continue. You must enter the AWS keys before you proceed.

4. On the HA Deployment Models page, choose an HA configuration.

   For an overview of the deployment models, see Cloud Volumes ONTAP HA for AWS.

5. On the Region & VPC page, enter the network information that you recorded in the AWS worksheet and then click **Continue**.

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



6. On the Connectivity and SSH Authentication page, choose connection methods for the HA pair and the mediator.
7. If you chose multiple AZs, specify the floating IP addresses and then click **Continue**.

   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.

8. If you chose multiple AZs, select the route tables that should include routes to the floating IP addresses and then click **Continue**.

   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.

9. On the Data Encryption page, 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.

   Learn how to set up the AWS KMS for Cloud Volumes ONTAP.

   Learn more about supported encryption technologies.

10. On the License and Support Site Account page, 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.

11. On the Preconfigured Packages page, 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.

12. On the IAM Role page, 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.

13. On the Licensing page, change the Cloud Volumes ONTAP version as needed, select a license, an instance type, the instance tenancy, and then click **Continue**.

    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 9.4 RC1 and 9.4 GA is available. The update does not occur from one release to another—for example, from 9.3 to 9.4.

14. On the Underlying Storage Resources page, choose settings for the initial aggregate: a disk type, a size for each disk, and whether S3 tiering should be enabled.

    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.

15. On the WORM page, activate write once, read many (WORM) storage, if desired.

    Learn more about WORM storage.

16. On the Create Volume page, enter details for the new volume, and then click **Continue**.

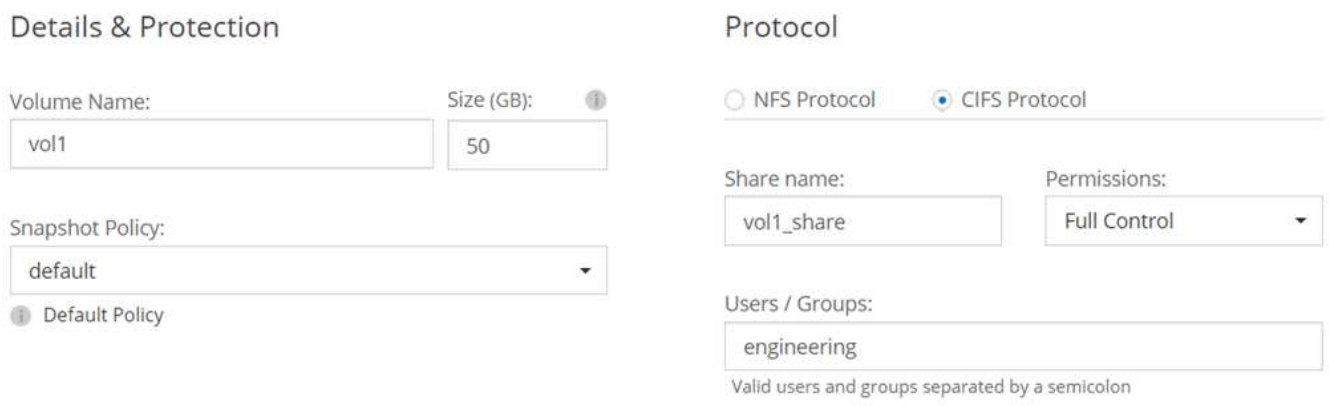
    You might skip this step if you want to create a volume for iSCSI. Cloud Manager sets up volumes for NFS and CIFS only.

    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.

Field	Description
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.

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



17. If you selected the CIFS protocol, set up a CIFS server on the CIFS Setup page:

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.

18. On the Usage Profile, Disk Type, and Tiering Policy page, choose whether you want to enable storage efficiency features and edit the S3 tiering policy, if needed.

For more information, see Understanding volume usage profiles and Data tiering overview.

19. On the Review & Approve page, review and confirm your selections:
    a. 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.

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

- Make sure that your Azure account has the required permissions, especially if you upgraded from a previous release and are deploying an HA system for the first time.

  See the new permissions required to deploy HA systems.

- You should have chose 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.

Steps

1. On the Working Environments page, click **Add Working Environment**
2. Under Create, select a single node system in Azure or an HA pair in Azure.
3. On the Details and Credentials page, optionally change the Azure account or 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
Switch Account	You can choose a different account or subscription if you added additional Cloud Provider Accounts.
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	If you uncheck **Use Default**, you can enter the name of a new resource group. If you want to use an existing resource group, then you must use the API.
Tags	Tags are metadata for your Azure resources. Cloud Manager adds the tags to the Cloud Volumes ONTAP system and each Azure resource associated with the system. 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. For information about tags, refer to Microsoft Azure Documentation: Using tags to organize your Azure resources.
Credentials	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.

4. On the Location page, select a location and security group, select the checkbox to confirm network connectivity, and then click **Continue**.
5. On the License and Support Site Account page, 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.

6. On the Preconfigured Packages page, 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.

7. On the Licensing page, change the Cloud Volumes ONTAP version as needed, select a license and a virtual machine type, and then click **Continue**.

   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 9.5 RC1 and 9.5 GA is available. The update does not occur from one release to another—for example, from 9.4 to 9.5.

8. On the Azure Marketplace page, follow the steps if Cloud Manager could not enable programmatic deployments of Cloud Volumes ONTAP.
9. On the Underlying Storage Resources page, choose settings for the initial aggregate: a disk type, a size for each disk, and whether data tiering should be enabled.

   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.

10. On the Write Speed & WORM page, 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.

    Learn more about WORM storage.

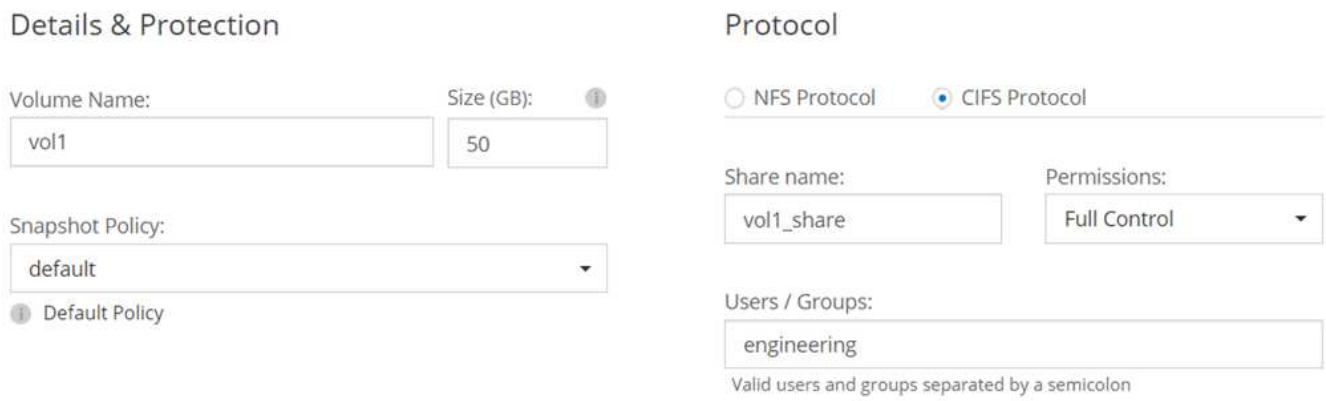
11. On the Create Volume page, enter details for the new volume, and then click **Continue**.

    You should skip this step if you want to use iSCSI. Cloud Manager enables you to create volumes for NFS and CIFS only.

    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.

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



12. If you chose the CIFS protocol, set up a CIFS server on the CIFS Setup page:

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.

13. On the Usage Profile, Disk Type, and Tiering Policy page, choose whether you want to enable storage efficiency features and change the tiering policy, if needed.

    Storage tiering is supported with single node systems only.

    For more information, see Understanding volume usage profiles and Data tiering overview.

14. On the Review & Approve page, review and confirm your selections:
    a. Review details about the configuration.
    b. Click **More information** to review details about support and the Azure 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.

Registering pay-as-you-go systems

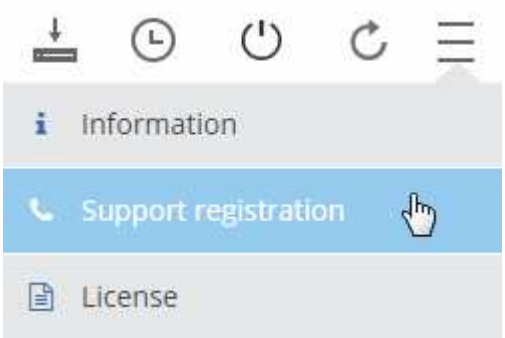
Support from NetApp is included with Cloud Volumes ONTAP Explore, Standard, and Premium systems, but you must first activate support by registering the systems with NetApp.

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 Working Environments 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

Synchronize the system time using NTP	Specifying an NTP server synchronizes the time between the systems in your network, which can help prevent issues due to time differences.
	
	Specify an NTP server using the Cloud Manager API or from the user interface when you set up a CIFS server.
	
	• Modifying the CIFS server
	• Cloud Manager API Developer Guide
	
	For example, here's the API for a single-node system in AWS:
	
	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 | Model Schema
	NTPConfigurationRequest {
	ntpServer (string): NTPS server
	}
	Parameter content type: application/json
	Try it out!

Optional: Configure AutoSupport	AutoSupport proactively monitors the health of your system and automatically sends messages to NetApp technical support by default. If the Cloud Manager 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. 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.
Optional: Configure EMS	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. You can configure EMS using the CLI. For instructions, see the ONTAP 9 EMS Configuration Express Guide.

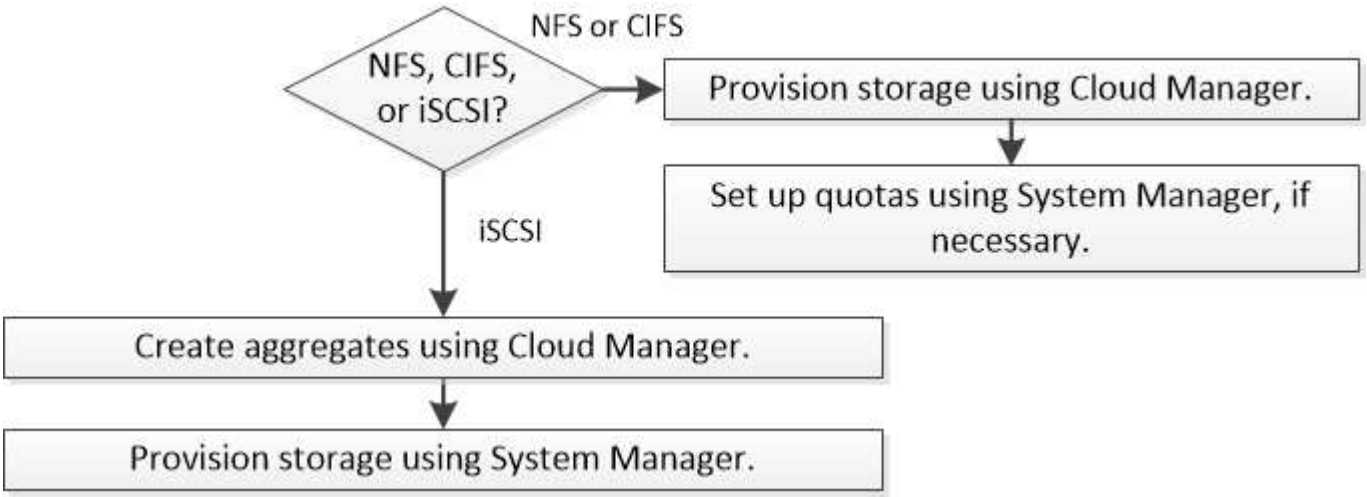
Task	Description
Optional: Create an SVM management network interface (LIF) for HA systems in multiple AWS Availability Zones	A storage virtual machine (SVM) management network interface (LIF) is required if you want to use SnapCenter or SnapDrive for Windows with an HA pair. The SVM management LIF must use a *floating* IP address when using an HA pair across multiple AWS Availability Zones. Cloud Manager prompts you to specify the floating IP address when you launch the HA pair. If you did not specify the IP address, you can create the SVM Management LIF yourself from System Manager or the CLI. The following example shows how to create the LIF from the CLI: `network interface create -vserver svm_cloud -lif svm_mgmt -role data -data-protocol none -home-node cloud-01 -home-port e0a -address 10.0.2.126 -netmask 255.255.255.0 -status-admin up -firewall -policy mgmt`
Optional: Change the backup location of configuration files	Cloud Volumes ONTAP automatically creates configuration backup files that contain information about the configurable options that it needs to operate properly. By default, Cloud Volumes ONTAP backs up the files to the Cloud Manager 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. You can change the backup location using the CLI. See the ONTAP 9 System Administration Reference.

Provisioning storage

Provisioning storage

You can provision additional NFS and CIFS storage for your Cloud Volumes ONTAP systems from Cloud Manager by managing volumes and aggregates. If you need to create iSCSI storage, you should do so from System Manager.

> 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.



Provisioning volumes

If you need more storage after you launch a Cloud Volumes ONTAP system, you can provision new NFS and CIFS volumes from Cloud Manager.

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 Working Environments page, double-click the name of the Cloud Volumes ONTAP system on which you want to provision 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**.

Action	Steps
Create a new volume on a specific aggregate	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.

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	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.

Field	Description
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.

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 S3 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.

Provisioning 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 Working Environments 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 Working Environments 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**.

Provisioning iSCSI LUNs

If you want to create iSCSI LUNs, you need to do so from System Manager.

Before you begin

- The Host Utilities must be installed and set up on the hosts that will connect to the LUN.
- You must have recorded the iSCSI initiator name from the host. You need to supply this name when you create an igroup for the LUN.
- Before you create volumes in System Manager, you must ensure that you have an aggregate with sufficient space. You need to create aggregates in Cloud Manager. For details, see Creating aggregates.

About this task

These steps describe how to use System Manager for version 9.3 and later.

Steps

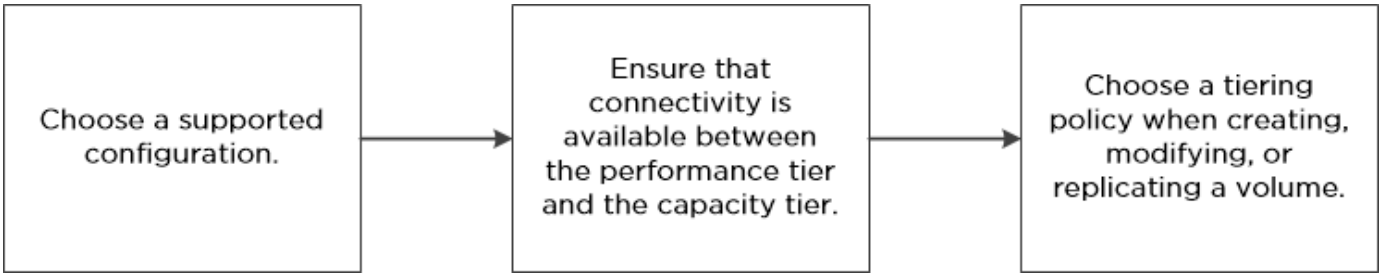
1. Log in to System Manager.
2. Click **Storage > LUNs**.
3. Click **Create** and follow the prompts to create the LUN.
4. Connect to the LUN from your hosts.

   For instructions, see the Host Utilities documentation for your operating system.

Tiering inactive data to low-cost object storage

You can reduce storage costs in AWS and Azure by combining an SSD or HDD performance tier for hot data with an object storage capacity tier for inactive data. For a high-level overview, see Data tiering overview.

To set up data tiering, you simply need to do the following:



What's not required for data tiering

- You do not need to install a feature license to enable data tiering.
- You do not need to create the capacity tier (either an S3 bucket or an Azure Blob container). Cloud Manager does that for you.

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 version 9.2 in AWS and version 9.4 in Microsoft Azure.
  - Data tiering is not supported with HA pairs in Microsoft Azure.
  - 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.
- Data tiering is supported with encryption technologies.
- Thin provisioning must be enabled on volumes.

Requirements for tiering data in AWS

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?.

Requirements for tiering data in Microsoft Azure

You do not 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 the appropriate permission:

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

These permissions are included in the latest Cloud Manager policy.

Tiering data on 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

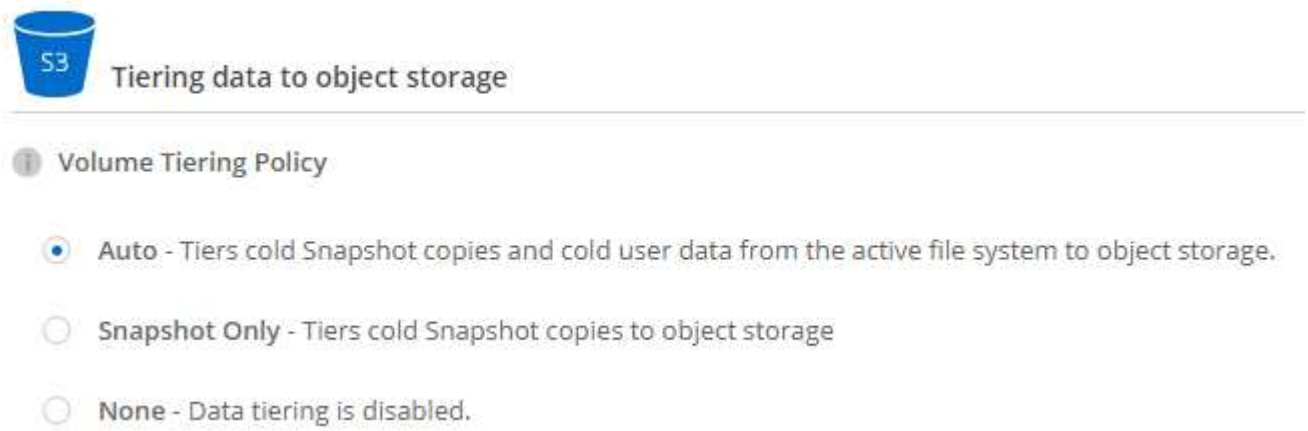
1. In the working environment, create a new volume or change the tier of an existing volume:

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 the Snapshot Only policy or the Auto policy.

   For a description of these policies, see Data tiering overview.

   Example



   Cloud Manager creates a new aggregate for the volume if a data tiering-enabled aggregate does not already exist.

   If you prefer to create aggregates yourself, you can enable data tiering on aggregates when you create them.

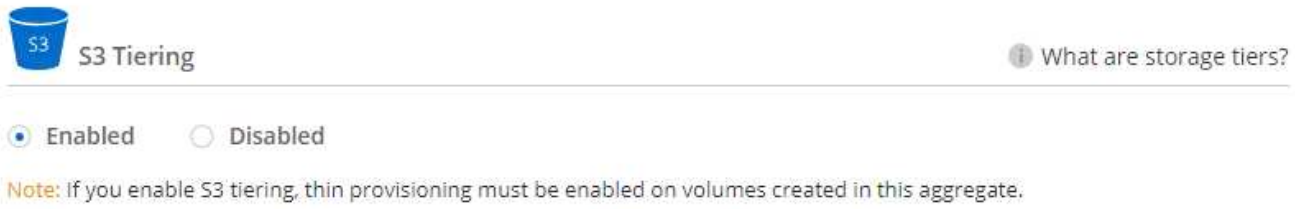
Tiering data on data protection volumes

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 Working Environments 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



   For help with replicating data, see Replicating data to and from the cloud.

Changing the tiering level

When you enable data tiering, Cloud Volumes ONTAP tiers inactive data to the S3 *Standard* storage class in AWS or to the *hot* storage tier in Azure. After you deploy Cloud Volumes ONTAP, you can reduce your storage costs by changing the tiering level for inactive data that has not 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 tiering level.

About this task

The tiering level is system wide—it is not per volume.

In AWS, you can change the tiering level so inactive data moves to one of the following storage classes after 30 days of inactivity:

- Intelligent Tiering
- Standard-Infrequent Access
- One Zone-Infrequent Access

In Azure, you can change the tiering level so inactive data moves to the *cool* storage tier after 30 days of inactivity.

For more information about how tiering levels work, see Data tiering overview.

Steps

1. From the working environment, click the menu icon and then click **Tiering Level**.
2. Choose the tiering level and then click **Save**.

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. Getting started includes a few steps.

If you deploy Kubernetes clusters using the NetApp Kubernetes Service, Cloud Manager can automatically discover the clusters from your NetApp Cloud Central account. If that's the case, skip the first two steps and start with step 3.

1 Verify network connectivity

a. A network connection must be available between Cloud Manager and the Kubernetes clusters, and from the Kubernetes clusters to Cloud Volumes ONTAP systems.

b. Cloud Manager needs an outbound internet connection to access the following endpoints when installing Trident:

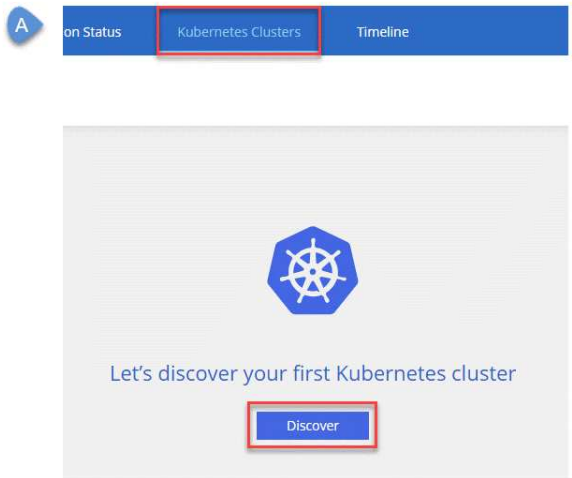
   https://packages.cloud.google.com/yum
   https://github.com/NetApp/trident/releases/download/

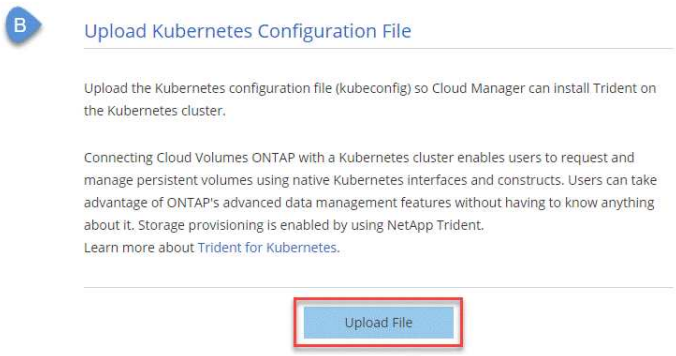
   Cloud Manager installs Trident on a Kubernetes cluster when you connect a working environment to the cluster.

2 Upload Kubernetes configuration files to Cloud Manager

For each Kubernetes cluster, the Cloud Manager Admin needs to upload a configuration file (kubeconfig) that is in YAML format. After you upload the file, Cloud Manager verifies connectivity to the cluster and saves an encrypted copy of the kubeconfig file.

Click **Kubernetes Clusters > Discover > Upload File** and select the kubeconfig file.





3 Connect your working environments to Kubernetes clusters

From the working environment, click the Kubernetes icon and follow the prompts. You can connect different clusters to different Cloud Volumes ONTAP systems and multiple clusters to the same Cloud Volumes ONTAP system.

You have the option to set the NetApp storage class as the default storage class for the Kubernetes cluster. When a user creates a persistent volume, the Kubernetes cluster can use connected Cloud Volumes ONTAP

systems as the backend storage by default.

4 Start provisioning Persistent Volumes

Request and manage Persistent Volumes using native Kubernetes interfaces and constructs. Cloud Manager creates two Kubernetes storage classes that you can use when provisioning Persistent Volumes:

- **netapp-file**: for binding Persistent Volumes to single-node Cloud Volumes ONTAP systems
- **netapp-file-redundant**: for binding Persistent Volumes to Cloud Volumes ONTAP HA pairs

Cloud Manager configures Trident to use the following provisioning options by default:

- Thin volumes
- The default Snapshot policy
- Accessible Snapshot directory

Learn more about provisioning your first volume with Trident for Kubernetes

What are the trident_trident volumes?

Cloud Manager creates a volume on the first Cloud Volumes ONTAP system that you connect to a Kubernetes cluster. The name of the volume is appended with "_trident_trident." Cloud Volumes ONTAP systems use this volume to connect to the Kubernetes cluster. You should not delete these volumes.

What happens when you disconnect or remove a Kubernetes cluster?

Cloud Manager enables you to disconnect individual Cloud Volumes ONTAP systems from a Kubernetes cluster. When you disconnect a system, you can no longer use that Cloud Volumes ONTAP system as persistent storage for containers. Existing Persistent Volumes are not deleted.

After you disconnect all systems from a Kubernetes cluster, you can also remove the entire Kubernetes configuration from Cloud Manager. Cloud Manager does not uninstall Trident when you remove the cluster and it does not delete any Persistent Volumes.

Both of these actions are available through APIs only. We plan to add the actions to the interface in a future release.
Click here for details about the APIs.

Encrypting volumes with NetApp Volume Encryption

NetApp Volume Encryption (NVE) is a software-based technology for encrypting data at rest one volume at a time. Data, Snapshot copies, and metadata are encrypted. Access to the data is given by a unique XTS-AES-256 key, one per volume.

About this task

At this time, Cloud Volumes ONTAP supports NetApp Volume Encryption with an external key management server. An Onboard Key Manager is not supported.

You need to set up NetApp Volume Encryption from the ONTAP CLI. You can then use either the CLI or System Manager to enable encryption on specific volumes. Cloud Manager does not support NetApp Volume Encryption from its user interface and from its APIs.

Learn more about supported encryption technologies.

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 a NetApp Volume Encryption license on the Cloud Volumes ONTAP system.

   ONTAP 9 NetApp Encryption Power Guide: Installing the license

4. Install SSL certificates and connect to the external key management servers.

   ONTAP 9 NetApp Encryption Power Guide: Configuring external key management

5. Create a new encrypted volume or convert an existing unencrypted volume using either the CLI or System Manager.
   - CLI:
     - For new volumes, use the **volume create** command with the -encrypt parameter.

       ONTAP 9 NetApp Encryption Power Guide: Enabling encryption on a new volume

- For existing volumes, use the **volume encryption conversion start** command.

  ONTAP 9 NetApp Encryption Power Guide: Enabling encryption on an existing volume with the volume encryption conversion start command

- System Manager:
  - For new volumes, click **Storage > Volumes > Create > Create FlexVol** and then select **Encrypted**.

    ONTAP 9 Cluster Management using System Manager: Creating FlexVol volumes

  - For existing volumes, select the volume, click **Edit**, and then select **Encrypted**.

    ONTAP 9 Cluster Management using System Manager: Editing volume properties

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 Working Environments 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**.
Edit a volume (read-write volumes only)	a. Select a volume, and then click **Edit**. b. Modify the volume's Snapshot policy, NFS access control list, or share permissions, and then click **Update**.
Clone a volume	a. Select a volume, and then click **Clone**. b. Modify the clone name as needed, and then click **Clone**. 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. To learn more about FlexClone volumes, see the ONTAP 9 Logical Storage Management Guide.

Task	Action
Restore data from a Snapshot copy to a new volume	a. Select a volume, and then click **Restore from Snapshot copy**. b. Select a Snapshot copy, enter a name for the new volume, and then click **Restore**.
Create a Snapshot copy on demand	a. Select a volume, and then click **Create a Snapshot copy**. b. Change the name, if needed, and then click **Create**.
Get the NFS mount command	a. Select a volume, and then click **Mount Command**. b. Click **Copy**.
Change the underlying disk type	a. Select a volume, and then click **Change Disk Type & Tiering Policy**. b. Select the disk type, and then click **Change**. Cloud Manager moves the volume to an existing aggregate that uses the selected disk type or it creates a new aggregate for the volume.
Change the tiering policy	a. Select a volume, and then click **Change Disk Type & Tiering Policy**. b. Click **Edit Policy**. c. Select a different policy and click **Change**. 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.
Enable or disable sync to S3 for a volume	Select a volume and then click **Sync to S3** or **Delete Sync Relationship**. The sync to S3 feature must be enabled before you can use these options. For instructions, see Syncing data to AWS S3
Delete a volume	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 Working Environments 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	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**. All disks in an aggregate must be the same size.
Delete an aggregate	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.

Task	Action
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.

3. Click **Save**.

Result

Cloud Volumes ONTAP updates the CIFS server with the changes.

Moving a volume to avoid capacity issues

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

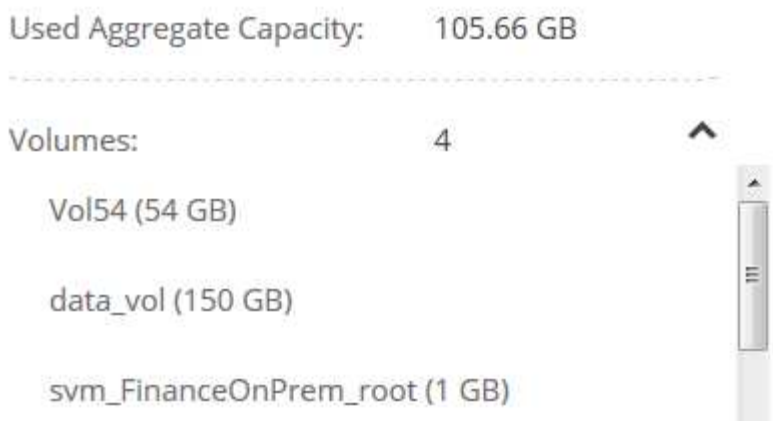
If Cloud Manager cannot provide recommendations for moving a volume to avoid capacity issues, you must identify the volumes that you need to move and whether you should move them to another aggregate on the same system or to another system.

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.



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.

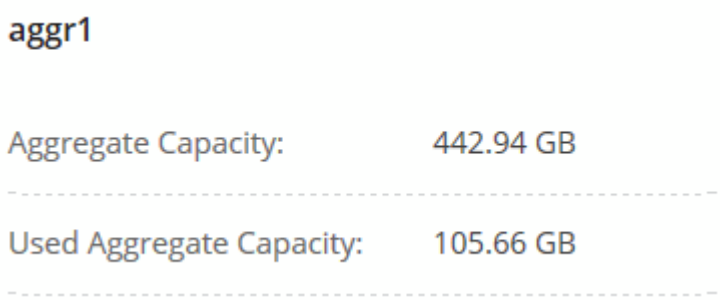
About this task

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).

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.

Provisioning NFS volumes from the Volume View

Changing to the Volume View

Cloud Manager provides two management views: the Storage System View for managing storage systems across a hybrid cloud and the Volume View for creating volumes in AWS without having to manage storage systems. You can switch between these views, but those instances should be rare because a single view should meet your needs.

For more information about the Volume View, see Simplified storage management using the Volume View.

Steps

1. In the upper right of the Cloud Manager console, click the menu, and then click **View Selection**.
2. On the View Selection page, select **Storage System View**, and then click **Switch**.

Result

Cloud Manager switches to the Volume View.

Creating and mounting NFS volumes

You can use Cloud Manager to create NFS volumes that provide enterprise-class features on top of AWS storage.

Creating NFS volumes

You can create a volume attached to a single AWS instance or to an instance that is mirrored to another instance to provide high availability.

Steps

1. In the Volumes tab, click **Create New Volume**.
2. On the Create New Volume page, select a volume type:

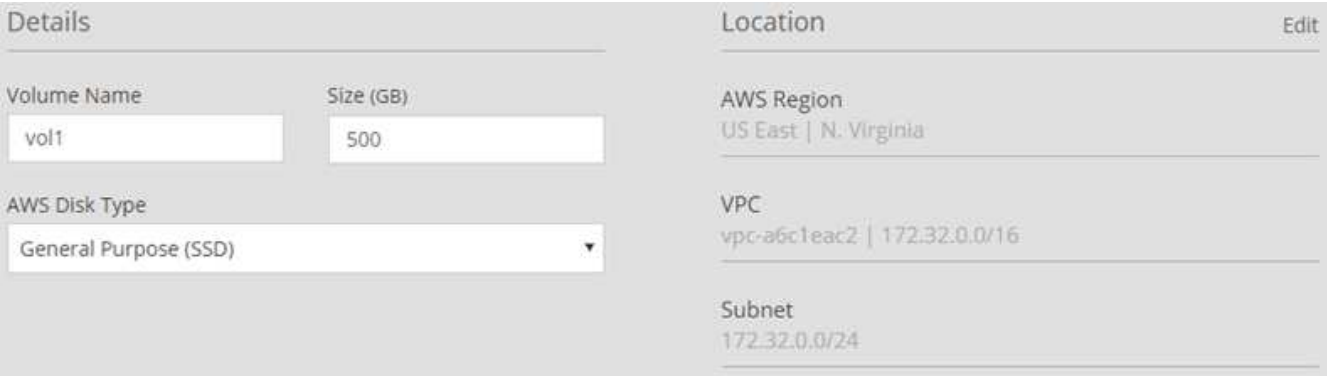
Option	Description
Create Volume	Creates a volume attached to a single AWS instance.
Create HA volume	Creates a volume attached to a single AWS instance and mirrored to another instance to provide high availability in case of failures. Click the Info icon to see additional details about the instances required for an HA volume.

3. If you chose Create Volume, specify details for your first volume, and then click **Create**.

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

Field	Description
Size	The maximum size for the volume depends on the capacity available in existing storage systems. Thin provisioning is automatically enabled on the volume, which enables you to create a volume that is bigger than the physical storage currently available to it. Instead of preallocating storage space, space is allocated to each volume as data is written.
AWS Disk Type	You should choose the disk that meets your requirements for both performance and cost. • General Purpose SSD disks balance cost and performance for a broad range of workloads. Performance is defined in terms of IOPS. • 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. For more details, refer to AWS Documentation: EBS Volume Types.

The following image shows the Create Volume page filled out:



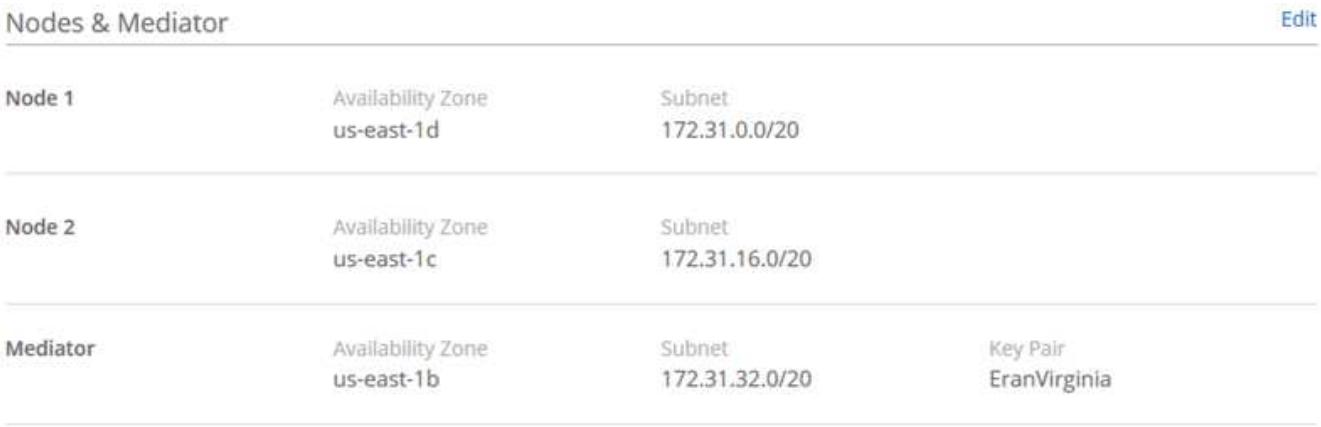
4. If you chose Create HA volume, specify details for the volume, and then click **Create**.

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

Field	Description
Size	The maximum size for the volume depends on the capacity available in existing storage systems. Thin provisioning is automatically enabled on the volume, which enables you to create a volume that is bigger than the physical storage currently available to it. Instead of preallocating storage space, space is allocated to each volume as data is written.

Field	Description
AWS Disk Type	You should choose the disk that meets your requirements for both performance and cost. • General Purpose SSD disks balance cost and performance for a broad range of workloads. Performance is defined in terms of IOPS. • Throughput Optimized HDD disks are for frequently accessed workloads that require fast and consistent throughput. For more details, refer to AWS Documentation: EBS Volume Types.
Location	You should choose a VPC that includes three subnets in three separate Availability Zones.
Nodes and Mediator	If possible, Cloud Manager chooses separate Availability Zones for each instance because it is the supported and optimal configuration.
Floating IP	The IP addresses must be outside of the CIDR block for all VPCs in the region.
Route Table	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 HA pair. For more details, refer to AWS Documentation: Route Tables.

The following image shows the Nodes and Mediator page. Each instance is in a separate Availability Zone.



Result

Cloud Manager creates the volume on an existing system or on a new system. If a new system is required, creating the volume can take approximately 25 minutes.

Mounting volumes to Linux hosts

After you create a volume, you should mount it to your hosts so that they can access the volume.

Steps

1. In the Volumes tab, place your mouse cursor over the volume, select the menu icon, and then click **Mount**.
2. Click **Copy**.
3. On your Linux hosts, modify the copied text by changing the destination directory, and then enter the command to mount the volume.

Managing NFS volumes

You can manage NFS volumes by cloning them, managing data access, changing the underlying disk type, and more.

Cloning volumes

If you need an instantaneous copy of your data without using a lot of disk space, you can create a clone of an existing volume.

About this task

The cloned 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.

Steps

1. In the Volumes tab, place your mouse cursor over the volume, select the menu icon, and then click **Clone**.
2. Modify the name of the cloned volume, if needed, and then click **Clone**.

Result

Cloud Manager creates a new volume that is a clone of an existing volume.

Managing data access to volumes

When you create a volume, Cloud Manager makes the volume available to all EC2 instances in the VPC in which the volume was created. You can modify this default value if you need to restrict data access to the volume.

Steps

1. In the Volumes tab, place your mouse cursor over the volume, select the menu icon, and then click **Manage Access**.
2. Modify the volume access list, and then click **Save**.

Changing the underlying AWS disk for a volume

You can change the underlying AWS disk that a volume uses to provide storage. For example, if higher performance is needed, you can change from a Throughput Optimized HDD to a General Purpose SSD.

Steps

1. In the Volumes tab, place your mouse cursor over the volume, select the menu icon, and then click **Change Disk**.
2. Select the AWS disk type and click **Change**.

Result

Cloud Manager moves the volume to an existing aggregate that uses the selected disk type or it creates a new aggregate for the volume.

Viewing and modifying AWS resources

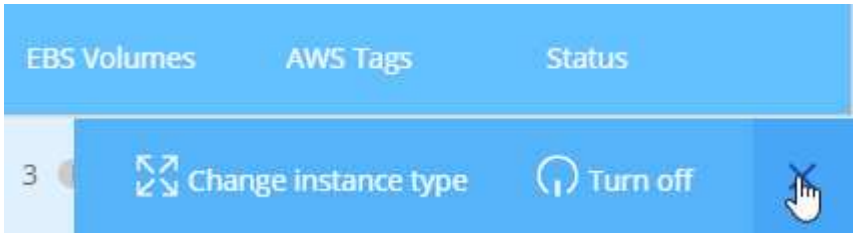
When you create a new volume, Cloud Manager allocates the AWS instances and EBS storage required for that volume. If required, you can view details about AWS instances and EBS storage, change instance types, and turn instances off and on.

Steps

1. Click **AWS Resources**.

   The list of AWS instances displays. You can view details such as instance type, AWS location, and the volumes attached to the instance.

2. If required, select the menu icon next to the Status column, and then choose one of the available actions:



Deleting volumes

You can delete volumes that you no longer need.

Steps

1. In the Volumes tab, place your mouse cursor over the volume, select the menu icon, and then click **Delete**.
2. Click **Delete** to confirm that you want to delete the volume.

Managing data across a hybrid cloud

Discovering and managing ONTAP clusters

Cloud Manager can discover the ONTAP clusters in your on-premises environment, in a NetApp Private Storage configuration, and in the IBM Cloud. Discovering these clusters enables you to easily replicate data across your hybrid cloud environment directly from Cloud Manager.

Discovering ONTAP clusters

Discovering an ONTAP cluster in Cloud Manager enables you to provision storage and replicate data across your hybrid cloud.

Before you begin

You must have the cluster management IP address and the password for the admin user account to add the cluster to Cloud Manager.

Cloud Manager discovers ONTAP clusters using HTTPS. If you use custom firewall policies, they must meet the following requirements:

- The Cloud Manager host must allow outbound HTTPS access through port 443.

  If Cloud Manager is in AWS, all outbound communication is allowed by the predefined security group.

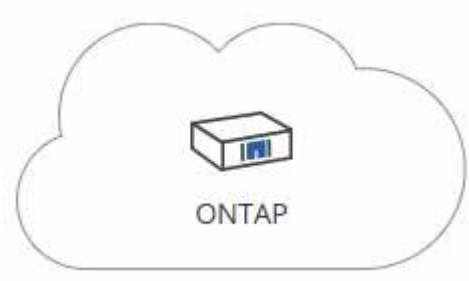
- The ONTAP cluster must allow inbound HTTPS access through port 443.

  The default "mgmt" firewall policy allows inbound HTTPS access from all IP addresses. If you modified this default policy, or if you created your own firewall policy, you must associate the HTTPS protocol with that policy and enable access from the Cloud Manager host.

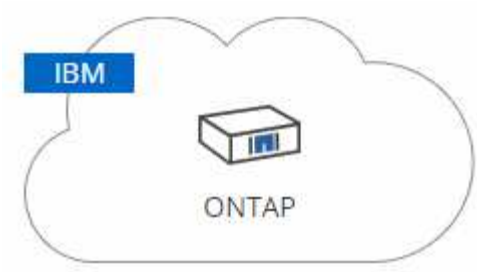
Steps

1. On the Working Environments page, click **Add Working Environment**.
2. Under **Discover**, select one of the icons to discover an ONTAP cluster.

   The following icon enables you to discover an on-premises cluster or a NetApp Private Storage configuration:

   The following icon enables you to discover ONTAP in the IBM Cloud:



3. On the **ONTAP Cluster Details** page, enter the cluster management IP address and the password for the admin user account.

   If you selected the first icon, you must also choose the working environment type: either an on-premises cluster or a NetApp Private Storage configuration.

4. On the Details page, enter a name and description for the working environment, and then click **Go**.

Result

Cloud Manager discovers the cluster. You can now create volumes, replicate data to and from the cluster, and launch OnCommand System Manager to perform advanced tasks.

Provisioning volumes on ONTAP clusters

Cloud Manager enables you to provision NFS and CIFS volumes on ONTAP clusters.

Before you begin

NFS or CIFS must be set up on the cluster. You can set up NFS and CIFS using System Manager or the CLI.

About this task

You can create volumes on existing aggregates. You cannot create new aggregates from Cloud Manager.

Steps

1. On the Working Environments page, double-click the name of the ONTAP cluster on which you want to provision volumes.
2. Click **Add New Volume**.
3. On the Create New Volume page, enter details for the volume, and then click **Create**.

   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.
Usage Profile	Usage profiles define the NetApp storage efficiency features that are enabled for a volume.
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.

Replicating data to and from the cloud

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.

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.

Choosing a replication policy

A replication policy defines how the storage system replicates data from a source volume to a destination volume. You must choose a replication policy when you set up data replication in Cloud Manager.

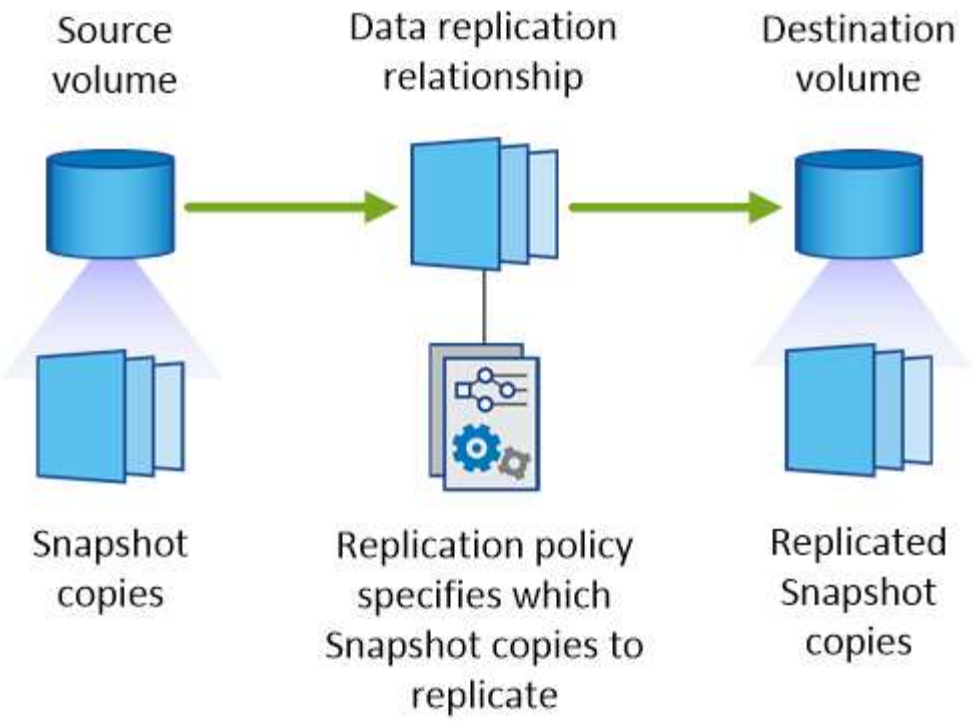
What replication policies do

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.

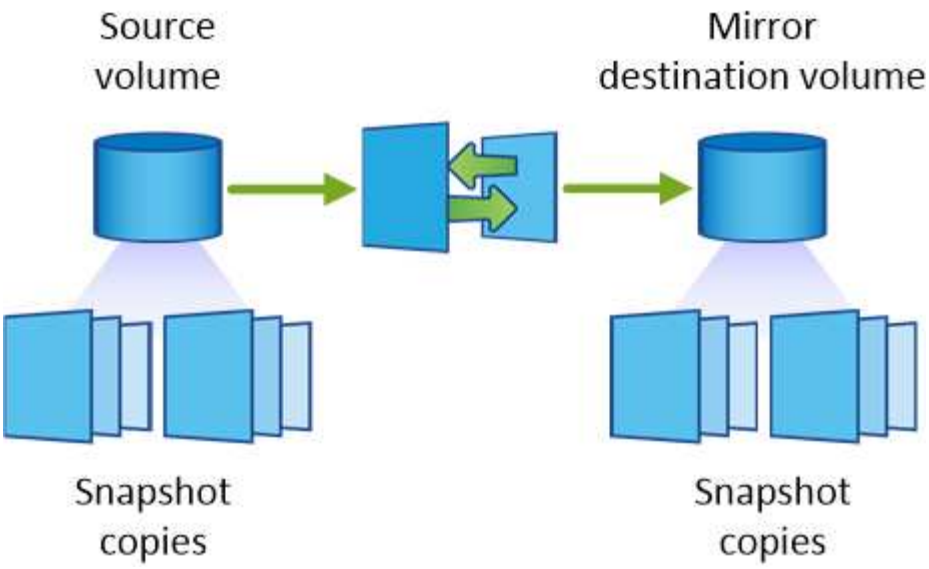
- A *Backup* policy replicates specific Snapshot copies to a destination volume and typically retains them for a longer period of time than you would on the source volume.

  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.

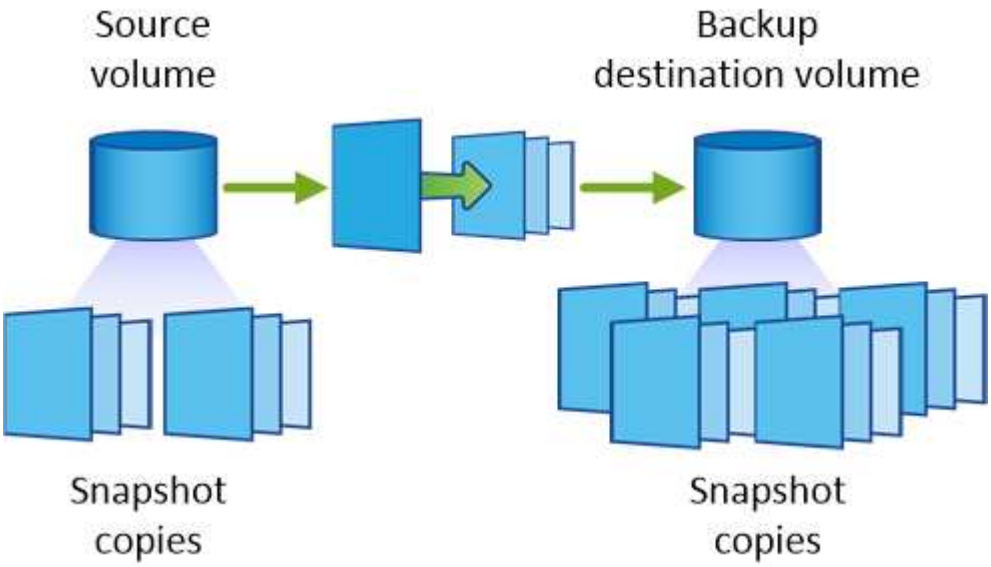
- A *Mirror and Backup* policy provides both disaster recovery and long-term retention.

  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 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 10000, 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.

Replicating data 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

1. On the Working Environments 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

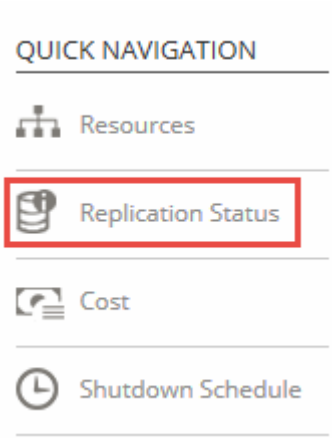
Cloud Manager starts the data replication process. You can view details about the replication in the Replication Status page.

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

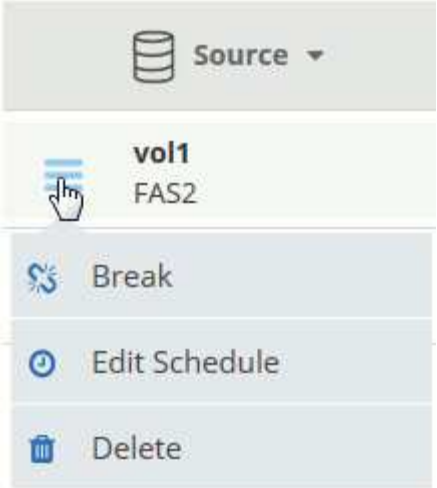
1. On the Working Environments page, view the replication status for all assigned working environments in the tenant or for a specific working environment:

Option	Action
All assigned working environments in the tenant	Click Replication Status from the navigation bar. 
A specific working environment	Select the working environment, and then click Replication Status. 

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	Breaks the relationship between the source and destination volumes, and activates the destination volume for data access. 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. For information about configuring a destination volume for data access and reactivating a source volume, see the ONTAP 9 Volume Disaster Recovery Express Guide.
Resync	Reestablishes a broken relationship between volumes and resumes data replication according to the defined schedule. ⓘ When you resynchronize the volumes, the contents on the destination volume are overwritten by the contents on the source volume. 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.
Reverse Resync	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. 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.
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.

Action	Description
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.

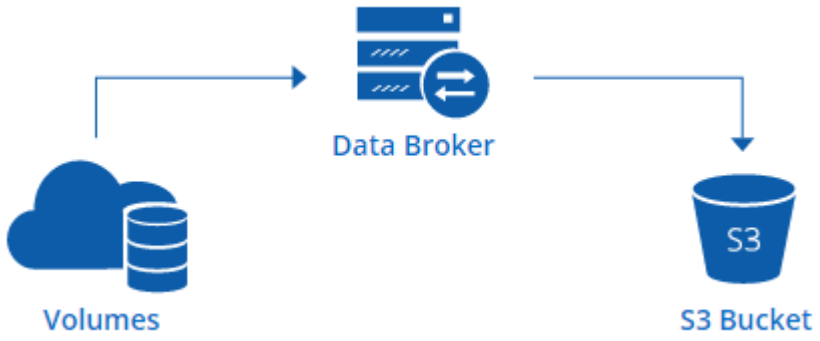
Syncing data to AWS S3

You can sync data from ONTAP volumes to an AWS S3 bucket by integrating a working environment with NetApp Cloud Sync. You can then use the synced data as a secondary copy or for data processing using AWS services like EMR and Redshift.

How the sync to S3 feature works

You can integrate a working environment with the Cloud Sync service at any time. When you integrate a working environment, the Cloud Sync service syncs data from the selected volumes to a single S3 bucket. The integration works with Cloud Volumes ONTAP working environments, as well as ONTAP clusters that are on-premises or part of a NetApp Private Storage (NPS) configuration.

To sync the data, the service launches a data broker instance in your VPC. Cloud Sync uses one data broker per working environment to sync data from volumes to an S3 bucket. After the initial sync, the service syncs any changed data once per day at midnight.



If you want to perform advanced Cloud Sync actions, go directly to the Cloud Sync service. From there, you can perform actions such as syncing from S3 to an NFS server, choosing different S3 buckets for volumes, and modifying schedules.

The sync to S3 feature is available for Cloud Manager Admins and Tenant Admins only.

14-day free trial

If you are a new Cloud Sync user, your first 14 days are free. After the free trial ends, you must pay for each *sync relationship* at an hourly rate or by purchasing licenses. Each volume that you sync to an S3 bucket is considered a sync relationship. You can set up both payment options directly from Cloud Sync in the License

Settings page.

How to get help

Use the following options for any support related to the Cloud Manager sync to S3 feature or for Cloud Sync in general:

- General product feedback: ng-cloudsync-contact@netapp.com
- Technical Support options:
  - NetApp Cloud Sync Communities
  - In-product chat (lower-right corner of Cloud Manager)

Integrating a working environment with the Cloud Sync service

If you want to sync volumes to AWS S3 directly from Cloud Manager, then you must integrate the working environment with the Cloud Sync service.

[] | *https://img.youtube.com/vi/3hOtLs70_xE/maxresdefault.jpg*

Steps

1. Open a working environment and click **Sync to S3**.
2. Click **Sync** and follow the prompts to sync your data to S3.

> You cannot sync data protection volumes to S3. The volumes must be writable.

Managing volume sync relationships

After you integrate a working environment with the Cloud Sync service, you can sync additional volumes, stop syncing a volume, and remove the integration with Cloud Sync.

Steps

1. On the Working Environments page, double-click the working environment on which you want to manage sync relationships.
2. If you want to enable or disable sync to S3 for a volume, select the volume and then click **Sync to S3** or **Delete Sync Relationship**.
3. If you want to delete all sync relationships for a working environment, click the **Sync to S3** tab and then click **Delete Sync**.

   This action does not delete synced data from the S3 bucket. If the data broker is not being used in any other sync relationships, then the Cloud Sync service deletes the data broker.

Administering Cloud Volumes ONTAP

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 OnCommand System Manager

You might need to perform some Cloud Volumes ONTAP tasks from OnCommand 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 Working Environments 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.

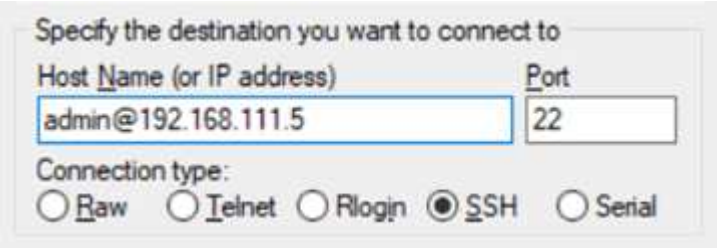
> When deployed in multiple AZs, Cloud Volumes ONTAP HA configurations use a floating IP address for the cluster management interface, which means external routing is not available. You must connect from a host that is part of the same routing domain.

Steps

1. In Cloud Manager, identify the IP address of the cluster management interface:
   a. On the Working Environments 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

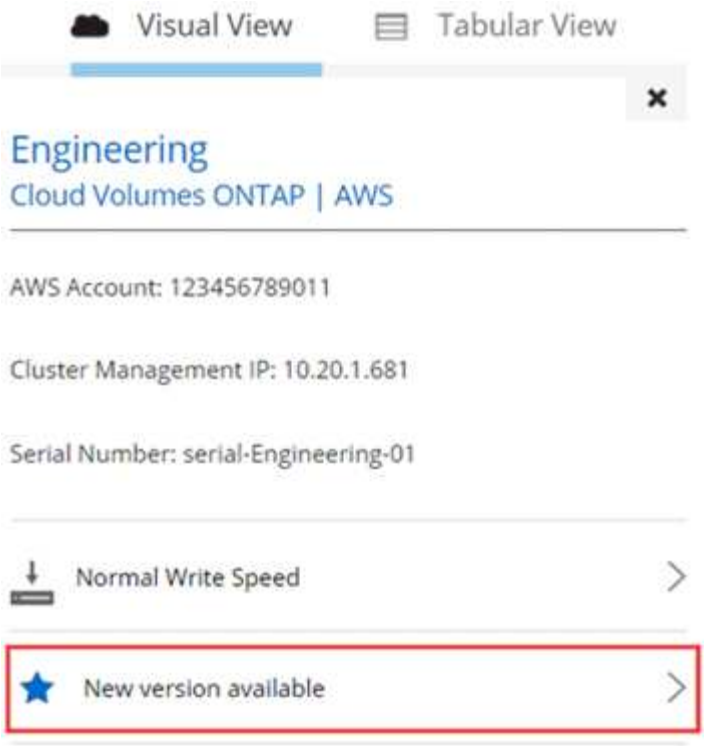
```
Password: ********
COT2::>
```

Updating Cloud Volumes ONTAP software

Cloud Manager includes several options that you can use to upgrade to the current Cloud Volumes ONTAP release or to downgrade Cloud Volumes ONTAP to an earlier release. You should prepare Cloud Volumes ONTAP systems before you upgrade or downgrade the software.

Overview

Cloud Manager displays a notification in Cloud Volumes ONTAP working environments when a new version of Cloud Volumes ONTAP is available:



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 to the latest version.

> For HA systems, Cloud Manager might upgrade the HA mediator as part of the upgrade process.

Advanced options for software updates

Cloud Manager also provides the following advanced options for updating Cloud Volumes ONTAP software:

- Software updates using an image on an external URL

  This option is helpful if Cloud Manager cannot access the S3 bucket to upgrade the software, if you were provided with a patch, or if you want to downgrade the software to a specific version.

  For details, see Upgrading or downgrading Cloud Volumes ONTAP by using an HTTP or FTP server.

- Software updates using the alternate image on the system

  You can use this option to downgrade to the previous version by making the alternate software image the default image. This option is not available for HA pairs.

  For details, see Downgrading Cloud Volumes ONTAP by using a local image.

Preparing to update Cloud Volumes ONTAP software

Before performing an upgrade or downgrade, you must verify that your systems are ready and make any required configuration changes.

- Planning for downtime
- Reviewing version requirements
- Suspending SnapMirror transfers
- Verifying that aggregates are online

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.

Upgrades of HA pairs are nondisruptive. A nondisruptive upgrade upgrades both nodes in an HA pair concurrently while maintaining service to clients.

Reviewing version requirements

The version of ONTAP that you can upgrade or downgrade to varies based on the version of ONTAP currently running on your system.

To understand version requirements, refer to ONTAP 9 Documentation: Cluster update requirements.

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

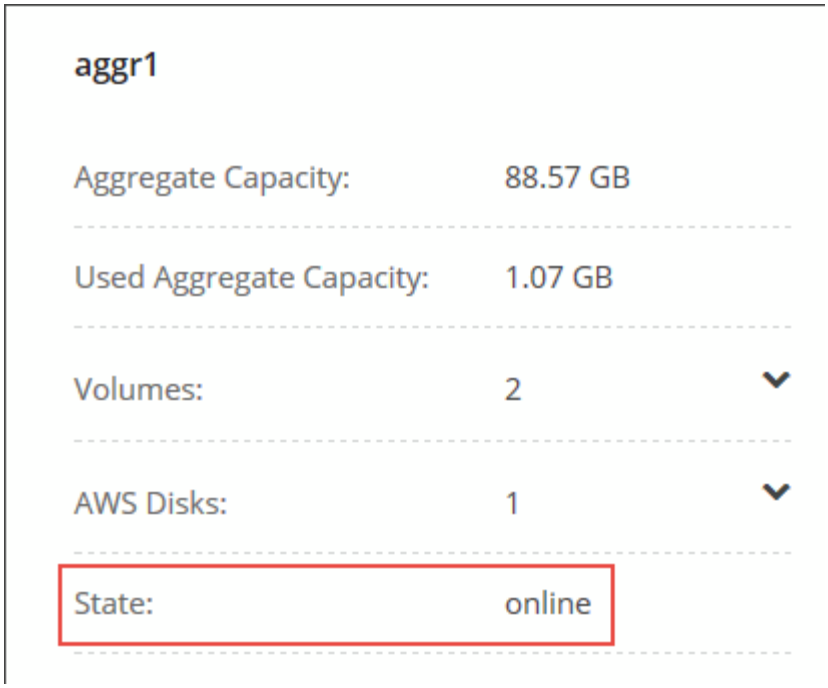
Aggregates for Cloud Volumes ONTAP must be online before you update the software. Aggregates should be online in most configurations, but if they are not, then you should bring them online.

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.



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 to the latest version

You can upgrade to the latest version of Cloud Volumes ONTAP directly from Cloud Manager. Cloud Manager notifies you when a new version is available.

Before you begin

Cloud Manager operations such as volume or aggregate creation must not be in progress for the Cloud Volumes ONTAP system.

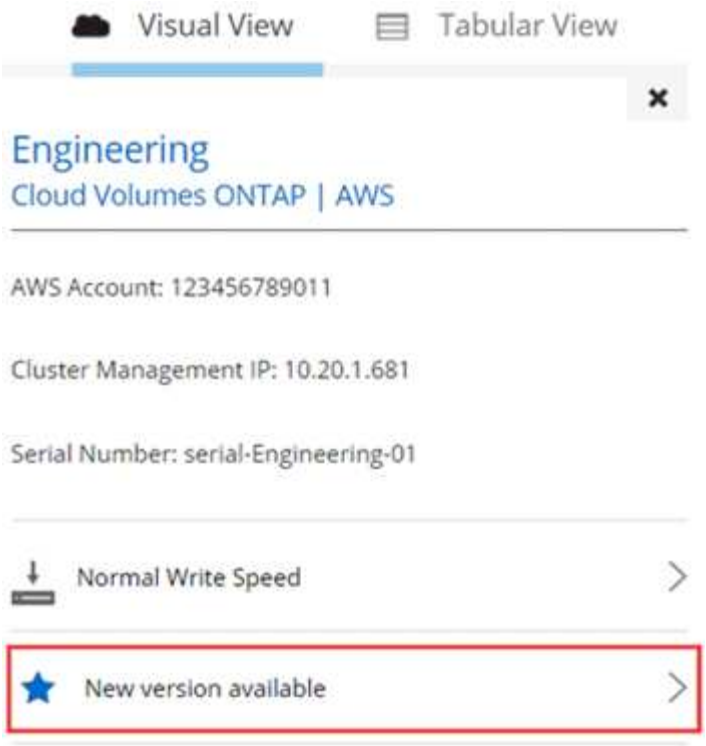
About this task

- 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.
- Upgrades of HA pairs are nondisruptive. A nondisruptive upgrade upgrades both nodes in an HA pair concurrently while maintaining service to clients.

Steps

1. Click **Working Environments**.
2. Select a working environment.

   A notification appears in the right pane if a new version is available:



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 or downgrading 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 update from Cloud Manager. You might use this option if Cloud Manager cannot access the S3 bucket to upgrade the software or if you want to downgrade the software.

About this task

- 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.
- Upgrades of HA pairs are nondisruptive. A nondisruptive upgrade upgrades both nodes in an HA pair concurrently while maintaining service to clients.

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 VPC, 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 AWS.
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.

Downgrading Cloud Volumes ONTAP by using a local image

Transitioning Cloud Volumes ONTAP to an earlier release in the same release family (for example, 9.5 to 9.4) is referred to as a downgrade. You can downgrade without assistance when downgrading new or test clusters, but you should contact technical support if you want to downgrade a production cluster.

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. You can use this option to downgrade to the previous version of Cloud Volumes ONTAP, if you are experiencing issues with the current image.

About this task

This downgrade process is available for single Cloud Volumes ONTAP systems only. It is not available for HA pairs. The process takes the Cloud Volumes ONTAP system offline for up to 25 minutes.

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 instances as your storage needs change. For example, you can change between pay-as-you-go configurations, change the instance or VM type, and move to an alternate subscription.

Installing license files on Cloud Volumes ONTAP BYOL systems

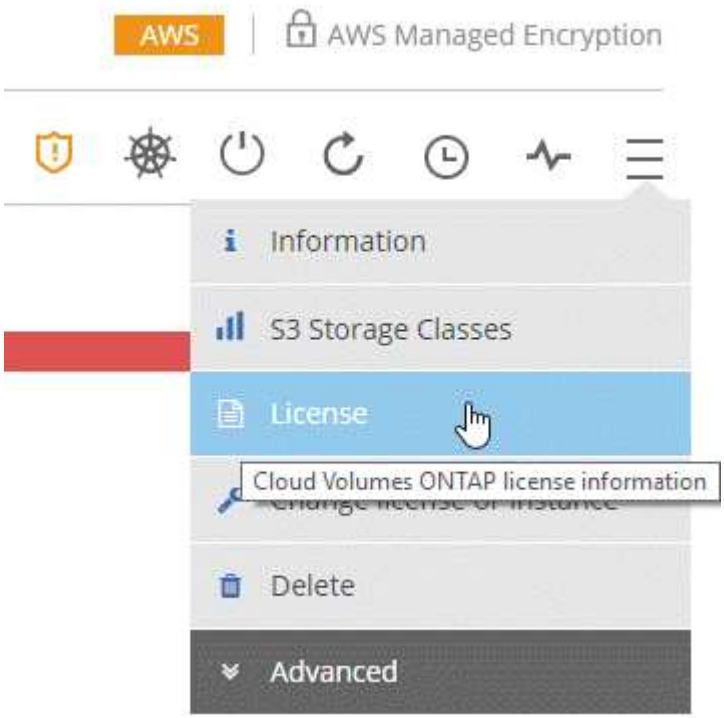
If Cloud Manager cannot obtain a BYOL license file from NetApp, you can obtain the file yourself and then manually upload the file to Cloud Manager so it can install the license on the Cloud Volumes ONTAP system.

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 (either **NetApp Cloud Volumes ONTAP BYOL for AWS**, **NetApp Cloud Volumes ONTAP BYOL for Azure**, or **NetApp Cloud Volumes ONTAP BYOL HA for AWS**), 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.
4. In Cloud Manager, open the Cloud Volumes ONTAP BYOL working environment.
5. Click the menu icon and then click **License**.



6. Click **Upload License File**.
7. Click **Upload** and then select the file.

Result

Cloud Manager installs the new license file on the Cloud Volumes ONTAP system.

Changing the instance or virtual machine type for Cloud Volumes ONTAP

You can choose from several instance or virtual machine types when you launch Cloud Volumes ONTAP in AWS or Azure. You can change the instance or virtual machine type at any time if you determine that it is undersized or oversized for your needs.

About this task

- 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 virtual machine type affects AWS or Azure service charges.

Steps

1. From the working environment, click the menu icon, and then click **Change license or instance** for AWS or click **Change license or VM** for Azure.
2. If you are using a pay-as-you-go configuration, you can optionally choose a different license.
3. Select an instance or virtual 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 EC2 instance types or Azure virtual 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 virtual machine type affects AWS or Azure service charges.

Steps

1. From the working environment, click the menu icon, and then click **Change license or instance** for AWS or click **Change license or VM** for Azure.

2. Select a license type and an instance type or virtual 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 virtual machine type, or both.

Moving to an alternate Cloud Volumes ONTAP configuration

If you want to move between a pay-as-you-go subscription and a BYOL subscription or between a single Cloud Volumes ONTAP system and an HA pair, you can 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

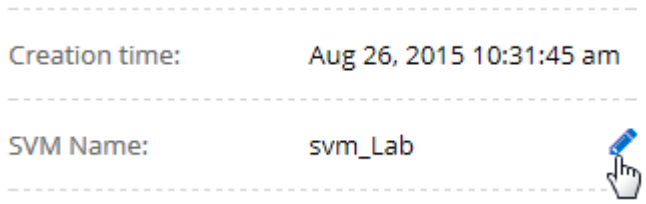
2. Set up one-time data replication between the systems for each volume that you must replicate.
3. Terminate the Cloud Volumes ONTAP system that you no longer need by deleting the original working environment.

Modifying the storage virtual machine name

Cloud Manager automatically names the storage virtual machine (SVM) for Cloud Volumes ONTAP. You can modify the name of the SVM if you have strict naming standards. For example, you might want it to match how you name the SVMs for your ONTAP clusters.

Steps

1. From the working environment, click the menu icon, and then click **Information**.
2. Click the edit icon to the right of the SVM name.



3. In the Modify SVM Name dialog box, modify the SVM 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.

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.

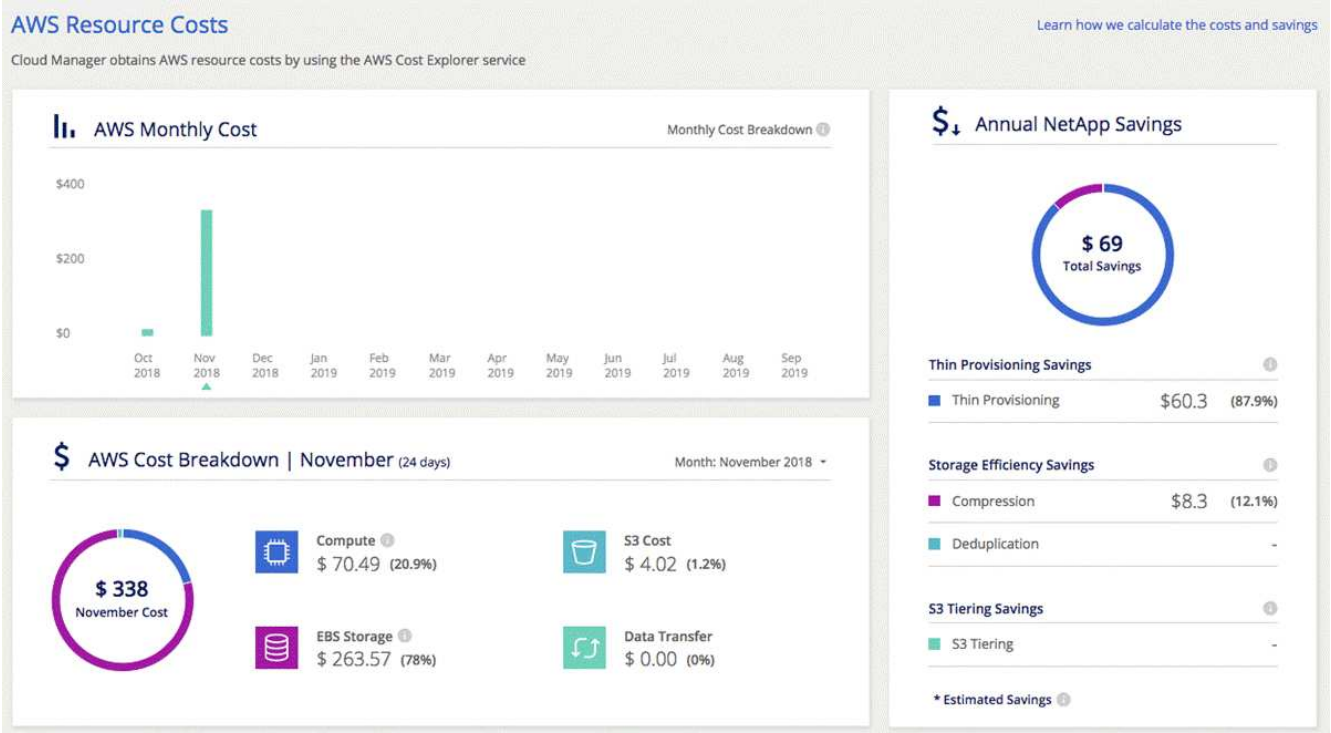
   b. Activate the **WorkingEnvironmentId** tag.

   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 Working Environments 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:

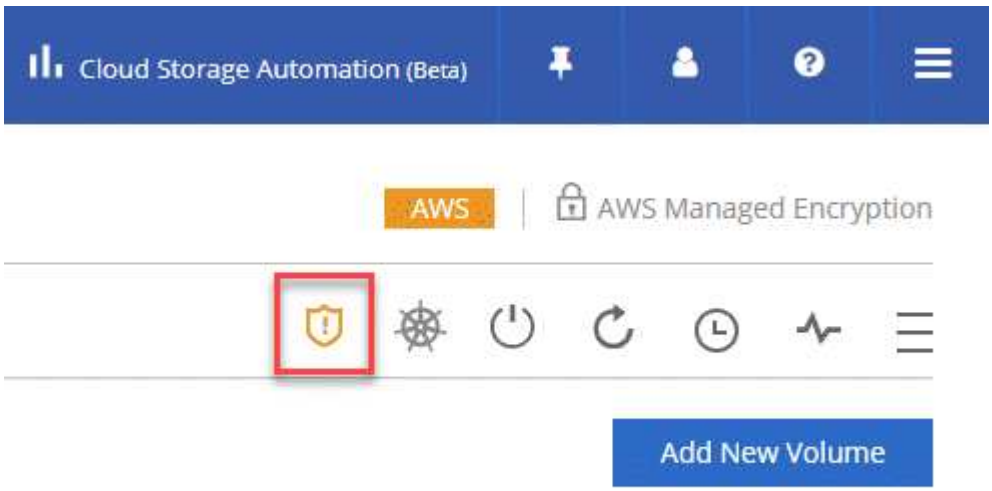


Improving protection against ransomware

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.

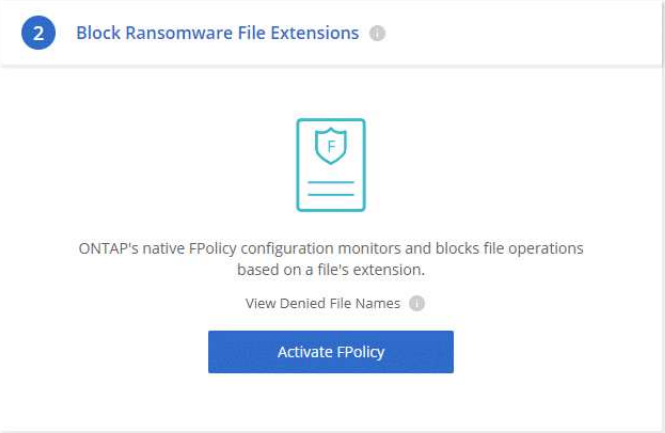


2. Implement the NetApp solution for ransomware:
   a. Click **Activate Snapshot Policy**, if you have volumes that do not have a Snapshot policy enabled.

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.

b. 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.



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 your Cloud Manager system became unusable and you launched a new system, but you could not restore all Cloud Volumes ONTAP systems from a recent Cloud Manager backup.

Before you begin

You must know the password for the Cloud Volumes ONTAP admin user account.

Steps

1. On the Working Environments page, click **Add Working Environment**.
2. Under Discover, select **Cloud Volumes ONTAP**.

3. On the Region page, choose the region where the instances are running, and then select the instances.
4. 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 tenant.

Deleting a Cloud Volumes ONTAP working environment

It is best to delete Cloud Volumes ONTAP systems from Cloud Manager, rather than from AWS or Azure. For example, if you terminate a licensed Cloud Volumes ONTAP instance from AWS, you cannot 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.

Administering Cloud Manager

Updating Cloud Manager

You can update Cloud Manager to the latest version or with a patch that NetApp personnel shared with you.

Enabling automatic updates

Cloud Manager can automatically update itself when a new version is available. This ensures that you are running the latest version.

About this task

Cloud Manager automatically updates at 12:00 midnight if no operations are running.

Steps

1. In the upper right of the Cloud Manager console, click the task drop-down list, and then select **Settings**.
2. Select the checkbox under Automatic Cloud Manager Updates and then click **Save**.

Updating Cloud Manager to the latest version

You should enable automatic updates to Cloud Manager, but you can always do a manual update directly from the web console. Cloud Manager obtains the software update from a NetApp-owned S3 bucket in AWS.

Before you begin

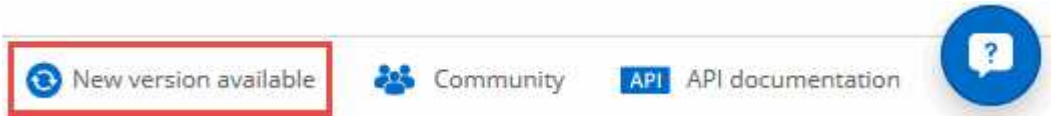
You should have reviewed what is new in the release to identify new requirements and changes in support.

About this task

The software update takes a few minutes. Cloud Manager will not be available during the update.

Steps

1. Check whether a new version is available by looking at the lower-right corner of the console:



2. If a new version is available, click **Timeline** to determine whether any tasks are in progress.

   If any tasks are in progress, wait for them to finish before you proceed to the next step.

3. In the lower-right of the console, click **New version available**.
4. On the Cloud Manager Software Update page, click **Update** next to the version that you want.
5. Complete the confirmation dialog box, and then click **OK**:
   a. Keep the option to download a backup because you can use it to restore your Cloud Manager configuration, if necessary.
   b. Read the terms and conditions, and then select the **I read and approve the terms and conditions (EULA)** check box.

6. When prompted, save the Cloud Manager backup.

Result

Cloud Manager starts the update process. You can log in to the console after a few minutes.

Updating Cloud Manager with a patch

If NetApp shared a patch with you, you can update Cloud Manager with the supplied patch directly from the Cloud Manager web console.

About this task

The patch update typically takes a few minutes. Cloud Manager will not be available during the update.

Steps

1. In the upper-right hand corner of the Cloud Manager console, click the task drop-down list, and then select **Update**.
2. Click the link to update Cloud Manager with the supplied patch.

3. Complete the confirmation dialog box and then click **OK**:
   a. Keep the option to download a backup enabled because you can use it to restore your Cloud Manager configuration, if necessary.
   b. Read the terms and conditions and then select the **I read and approve the terms and conditions (EULA)** check box.
4. Select the patch that you were provided.
5. When prompted, save the Cloud Manager backup.

Result

Cloud Manager applies the patch. You can log in to the console after a few minutes.

Backing up and restoring Cloud Manager

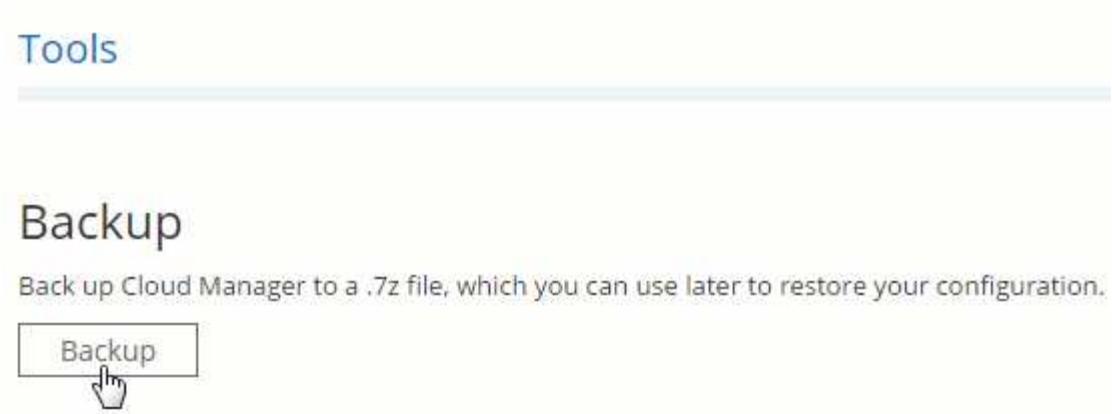
Cloud Manager enables you to back up and restore its database to protect your configuration and troubleshoot issues.

Backing up Cloud Manager

It is a good practice to back up the Cloud Manager database on a periodic basis. If you experience problems, you can restore Cloud Manager from a previous backup.

Steps

1. In the upper right of the Cloud Manager console, click the task drop-down list, and then select **Tools**.
2. Click **Backup**.



3. When prompted, save the backup file to a secure location so that you can retrieve it when needed.

Restoring Cloud Manager from a backup

Restoring Cloud Manager from a backup replaces existing data with the data from the backup.

Steps

1. In the upper-right hand corner of the Cloud Manager console, click the task drop-down list, and then select **Tools**.
2. Click **Restore**.
3. Click **OK** to confirm.
4. Select the backup.

Result

Cloud Manager restores the database from the backup file.

Removing Cloud Volumes ONTAP working environments

The Cloud Manager Admin can remove a Cloud Volumes ONTAP working environment to move it to another system or to troubleshoot discovery issues.

About this task

Removing a Cloud Volumes ONTAP working environment removes it from Cloud Manager. It does not delete the Cloud Volumes ONTAP system. You can later rediscover the working environment.

Removing a working environment from Cloud Manager enables you to do the following:

- Rediscover it in another tenant
- Rediscover it from another Cloud Manager system
- Rediscover it if you had problems during the initial discovery

Steps

1. In the upper-right corner of the Cloud Manager console, click the task drop-down list, and then select **Tools**.
2. From the Tools page, click **Launch**.
3. Select the Cloud Volumes ONTAP working environment that you want to remove.

4. On the Review and Approve page, click **Go**.

Result

Cloud Manager removes the working environment. Users can rediscover this working environment from the Working Environments page at any time.

Editing user accounts

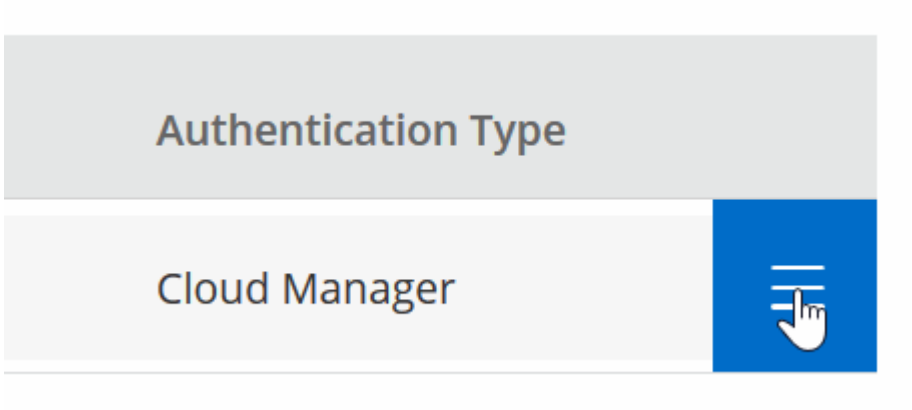
You can modify user accounts in Cloud Manager by enabling and disabling the notification report.

About this task

Password and user information must be changed in NetApp Cloud Central.

Steps

1. In the upper-right corner of the Cloud Manager console, click the user icon, and then select **View Users**.
2. Select the menu icon at the end of the row and click **Edit User**.



3. In the User Settings page, modify the user account.

Configuring Cloud Manager to use a proxy server

When you first deploy Cloud Manager, it prompts you to enter a proxy server if the system does not have internet access. You can also manually enter and modify the proxy from Cloud Manager's settings.

About this task

If your corporate policies dictate that you use a proxy server for all HTTP communication to the internet, then you must configure Cloud Manager to use that proxy server. The proxy server can be in the cloud or in your network.

When you configure Cloud Manager to use a proxy server, Cloud Manager, Cloud Volumes ONTAP, and the HA mediator all use the proxy server.

Steps

1. In the upper-right corner of the Cloud Manager console, click the task drop-down list, and then select **Settings**.

2. Under HTTP Proxy, enter the server using the syntax http://*address:port*, specify a user name and password if basic authentication is required for the server, and then click **Save**.

> Cloud Manager does not support passwords that include the @ character.

Result

After you specify the proxy server, new Cloud Volumes ONTAP systems are automatically configured to use the proxy server when sending AutoSupport messages. If you do not specify the proxy server before users create Cloud Volumes ONTAP systems, then they must use System Manager to manually set the proxy server in the AutoSupport options for each system.

Renewing the Cloud Manager HTTPS certificate

You should renew the Cloud Manager HTTPS certificate before it expires to ensure secure access to the Cloud Manager web console. If you do not renew the certificate before it expires, a warning appears when users access the web console using HTTPS.

Steps

1. In the upper right of the Cloud Manager console, click the task drop-down list, and then select **HTTPS Setup**.

   Details about the Cloud Manager certificate displays, including the expiration date.

2. Click **Renew HTTPS Certificate** and follow the steps to generate a CSR or install your own CA-signed certificate.

Result

Cloud Manager uses the new CA-signed certificate to provide secure HTTPS access.

Uninstalling Cloud Manager

Cloud Manager includes an uninstallation script that you can use to uninstall the software to troubleshoot issues or to permanently remove the software from the host.

Steps

1. If you are going to reinstall Cloud Manager, back up the database before you uninstall the software:
   a. In the upper-right corner of the Cloud Manager console, click the task drop-down list, and then select **Tools**.
   b. Click **Backup** and save the backup file to your local machine.
2. From the Linux host, run the uninstallation script:

   /opt/application/netapp/cloudmanager/bin/uninstall.sh [silent]

   silent runs the script without prompting you for confirmation.

APIs and automation

Automation samples for infrastructure as code

Use the resources on this page to get help integrating Cloud Manager and Cloud Volumes ONTAP with your infrastructure as code.

DevOps teams use a variety of tools to automate the setup of new environments, which allows them to treat infrastructure as code. Two such tools are Ansible and Terraform. We have developed Ansible and Terraform samples that DevOps team can use with Cloud Manager to automate and integrate Cloud Volumes ONTAP with infrastructure as code.

View the automation samples.

For example, you can use sample Ansible playbooks to deploy Cloud Manager and Cloud Volumes ONTAP, create an aggregate, and create a volume. Modify the samples for your environment or create new playbooks based on the samples.

Related links

- NetApp Cloud Blog: Using Cloud Manager REST APIs with Federated Access
- NetApp Cloud Blog: Cloud Automation with Cloud Volumes ONTAP and REST
- NetApp Cloud Blog: Automated Data Cloning for Cloud-Based Testing of Software Applications
- NetApp Blog: Infrastructure-As-Code (IaC) Accelerated with Ansible + NetApp
- NetApp thePub: Configuration Management & Automation with Ansible
- NetApp thePub: Roles for Ansible ONTAP use

Reference

Frequently asked questions: Integrating Cloud Manager with NetApp Cloud Central

When upgrading to Cloud Manager 3.5, NetApp will choose specific Cloud Manager systems to integrate with NetApp Cloud Central, if they are not already integrated. This FAQ can answer questions that you might have about the process.

What is NetApp Cloud Central?

NetApp Cloud Central provides a centralized location to access and manage NetApp cloud data services. These services enable you to run critical applications in the cloud, create automated DR sites, back up your SaaS data, and effectively migrate and control data across multiple clouds.

Why is NetApp integrating my Cloud Manager system with Cloud Central?

Cloud Manager's integration with NetApp Cloud Central provides several benefits, including a simplified deployment experience, a single location to view and manage multiple Cloud Manager systems, and centralized user authentication.

What happens during the integration process?

NetApp migrates all local user accounts in your Cloud Manager system to the centralized user authentication available in Cloud Central.

How does centralized user authentication work?

With centralized user authentication, you can use the same set of credentials across Cloud Manager systems and between Cloud Manager and other data services, such as Cloud Sync. It's also easy to reset your password if you forget it.

Do I need to sign up for a Cloud Central user account?

NetApp will create a Cloud Central user account for you when we integrate your Cloud Manager system with Cloud Central. You simply need to reset your password to complete the registration process.

What if I already have a Cloud Central user account?

If the email address that you use to log in to Cloud Manager matches the email address for a Cloud Central user account, then you can log right in to your Cloud Manager system.

What if my Cloud Manager system has multiple user accounts?

NetApp migrates all local user accounts to Cloud Central user accounts. Every user needs to reset his or her password.

What if I have a user account that uses the same email address across multiple Cloud Manager systems?

You just need to reset your password once and then you can use the same Cloud Central user account to log in to each Cloud Manager system.

What if my local user account uses an invalid email address?

Resetting your password requires a valid email address. Contact us through the chat icon that is available in the lower right of the Cloud Manager interface.

What if I have automation scripts for Cloud Manager APIs?

All APIs are backwards compatible. You will need to update scripts that use passwords, if you change your password when you reset it.

What if my Cloud Manager system uses LDAP?

If your system uses LDAP, NetApp cannot automatically integrate the system with Cloud Central. You need to manually perform the following steps:

1. Deploy a new Cloud Manager system from NetApp Cloud Central.
2. Set up LDAP with the new system.
3. Discover existing Cloud Volumes ONTAP systems from the new Cloud Manager system.
4. Delete the old Cloud Manager system.

Does it matter where I installed my Cloud Manager system?

No. NetApp will integrate systems with Cloud Central no matter where they reside, whether that's in AWS, Azure, or on your premises.

> The only exception is the AWS Commercial Cloud Services Environment.

Security group rules for AWS

Cloud Manager creates AWS security groups that include the inbound and outbound rules that Cloud Manager 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 Manager

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

Inbound rules for Cloud Manager

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

Protocol	Port	Purpose
SSH	22	Provides SSH access to the Cloud Manager host
HTTP	80	Provides HTTP access from client web browsers to the Cloud Manager web console
HTTPS	443	Provides HTTPS access from client web browsers to the Cloud Manager web console

Outbound rules for Cloud Manager

The predefined security group for Cloud Manager 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 Manager 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 Cloud Manager.

The source IP address is the Cloud Manager 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	HTTPS	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

Service	Protocol	Port	Destination	Purpose
DNS	UDP	53	DNS	Used for DNS resolve by Cloud Manager

Rules for Cloud Volumes ONTAP

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

Inbound rules for Cloud Volumes ONTAP

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
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

Protocol	Port	Purpose
UDP	4049	NFS rquotad protocol

Outbound rules for Cloud Volumes ONTAP

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	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)	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	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	18600–18699	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
SnapMirror	TCP	11104	Intercluster LIF	ONTAP intercluster LIFs	Management of intercluster communication sessions for SnapMirror
	TCP	11105	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 Cloud Manager

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	Cloud Manager 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

Security group rules for Azure

Cloud Manager creates Azure security groups that include the inbound and outbound rules that Cloud Manager 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 Manager

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

Inbound rules for Cloud Manager

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

Protocol	Port	Purpose
SSH	22	Provides SSH access to the Cloud Manager host
HTTP	80	Provides HTTP access from client web browsers to the Cloud Manager web console
HTTPS	443	Provides HTTPS access from client web browsers to the Cloud Manager web console

Outbound rules for Cloud Manager

The predefined security group for Cloud Manager 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 Manager 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 Cloud Manager.

> The source IP address is the Cloud Manager 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	HTTPS	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
DNS	UDP	53	DNS	Used for DNS resolve by Cloud Manager

Rules for Cloud Volumes ONTAP

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

Inbound rules for single node systems

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

Priority	Name	Port	Protocol	Source	Destination	Action	Description
1005	inbound_161-162 _tcp	161-162	TCP	Any	Any	Allow	Simple network management protocol
1006	inbound_161-162 _udp	161-162	UDP	Any	Any	Allow	Simple network management protocol
1007	inbound_443	443	TCP	Any	Any	Allow	HTTPS access to the System Manager web console using the IP address of the cluster management LIF
1008	inbound_445	445	TCP	Any	Any	Allow	Microsoft SMB/CIFS over TCP with NetBIOS framing
1009	inbound_635 _tcp	635	TCP	Any	Any	Allow	NFS mount
1010	inbound_635 _udp	635	TCP	Any	Any	Allow	NFS mount
1011	inbound_749	749	TCP	Any	Any	Allow	Kerberos
1012	inbound_2049_tcp	2049	TCP	Any	Any	Allow	NFS server daemon
1013	inbound_2049_udp	2049	UDP	Any	Any	Allow	NFS server daemon
1014	inbound_3260	3260	TCP	Any	Any	Allow	iSCSI access through the iSCSI data LIF
1015	inbound_4045-4046_tcp	4045-4046	TCP	Any	Any	Allow	NFS lock daemon and network status monitor
1016	inbound_4045-4046_udp	4045-4046	UDP	Any	Any	Allow	NFS lock daemon and network status monitor
1017	inbound_10000	10000	TCP	Any	Any	Allow	Backup using NDMP
1018	inbound_11104-11105	11104-11105	TCP	Any	Any	Allow	SnapMirror data transfer
3000	inbound_deny _all_tcp	Any	TCP	Any	Any	Deny	Block all other TCP inbound traffic
3001	inbound_deny _all_udp	Any	UDP	Any	Any	Deny	Block all other UDP inbound traffic
65000	AllowVnetInBound	Any	Any	VirtualNetwork	VirtualNetwork	Allow	Inbound traffic from within the VNet
65001	AllowAzureLoad BalancerInBound	Any	Any	AzureLoadBalancer	Any	Allow	Data traffic from the Azure Standard Load Balancer
65500	DenyAllInBound	Any	Any	Any	Any	Deny	Block all other inbound traffic

Inbound rules for HA systems

> 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	Name	Port	Protocol	Source	Destination	Action	Description
100	inbound_443	443	Any	Any	Any	Allow	HTTPS access to the System Manager web console using the IP address of the cluster management LIF
101	inbound_111_tcp	111	Any	Any	Any	Allow	Remote procedure call for NFS
102	inbound_2049_tcp	2049	Any	Any	Any	Allow	NFS server daemon
111	inbound_ssh	22	Any	Any	Any	Allow	SSH access to the IP address of the cluster management LIF or a node management LIF
121	inbound_53	53	Any	Any	Any	Allow	DNS and CIFS
65000	AllowVnetInBound	Any	Any	VirtualNetwork	VirtualNetwork	Allow	Inbound traffic from within the VNet
65001	AllowAzureLoadBalancerInBound	Any	Any	AzureLoadBalancer	Any	Allow	Data traffic from the Azure Standard Load Balancer
65500	DenyAllInBound	Any	Any	Any	Any	Deny	Block all other inbound traffic

Outbound rules for Cloud Volumes ONTAP

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 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	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)	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	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)
DHCP	UDP	68	Node management LIF	DHCP	DHCP client for first-time setup

Service	Protocol	Port	Source	Destination	Purpose
DHCPS	UDP	67	Node management LIF	DHCP	DHCP server
DNS	UDP	53	Node management LIF and data LIF (NFS, CIFS)	DNS	DNS
NDMP	TCP	18600–18699	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
SnapMirror	TCP	11104	Intercluster LIF	ONTAP intercluster LIFs	Management of intercluster communication sessions for SnapMirror
	TCP	11105	Intercluster LIF	ONTAP intercluster LIFs	SnapMirror data transfer
Syslog	UDP	514	Node management LIF	Syslog server	Syslog forward messages

AWS and Azure permissions for Cloud Manager

Cloud Manager requires permissions to perform actions in AWS and Azure on your behalf. These permissions are included in the policies provided by NetApp. You might want to understand what Cloud Manager does with these permissions.

What Cloud Manager does with AWS permissions

Cloud Manager uses an AWS account to make API calls to several AWS services, including EC2, S3, CloudFormation, IAM, the Security Token Service (STS), and the Key Management Service (KMS).

Actions	Purpose
"ec2:StartInstances", "ec2:StopInstances", "ec2:DescribeInstances", "ec2:DescribeInstanceStatus", "ec2:RunInstances", "ec2:TerminateInstances", "ec2:ModifyInstanceAttribute",	Launches a Cloud Volumes ONTAP instance and stops, starts, and monitors the instance.
"ec2:DescribeInstanceAttribute",	Verifies that enhanced networking is enabled for supported instance types.
"ec2:DescribeRouteTables", "ec2:DescribeImages",	Launches a Cloud Volumes ONTAP HA configuration.
"ec2:CreateTags",	Tags every resource that Cloud Manager creates with the "WorkingEnvironment" and "WorkingEnvironmentId" tags. Cloud Manager uses these tags for maintenance and cost allocation.
"ec2:CreateVolume", "ec2:DescribeVolumes", "ec2:ModifyVolumeAttribute", "ec2:AttachVolume", "ec2:DeleteVolume", "ec2:DetachVolume",	Manages the EBS volumes that Cloud Volumes ONTAP uses as back-end storage.
"ec2:CreateSecurityGroup", "ec2:DeleteSecurityGroup", "ec2:DescribeSecurityGroups", "ec2:RevokeSecurityGroupEgress", "ec2:AuthorizeSecurityGroupEgress", "ec2:AuthorizeSecurityGroupIngress", "ec2:RevokeSecurityGroupIngress",	Creates predefined security groups for Cloud Volumes ONTAP.
"ec2:CreateNetworkInterface", "ec2:DescribeNetworkInterfaces", "ec2:DeleteNetworkInterface", "ec2:ModifyNetworkInterfaceAttribute",	Creates and manages network interfaces for Cloud Volumes ONTAP in the target subnet.
"ec2:DescribeSubnets", "ec2:DescribeVpcs",	Gets the list of destination subnets and security groups, which is needed when creating a new working environment for Cloud Volumes ONTAP.
"ec2:DescribeDhcpOptions",	Determines DNS servers and the default domain name when launching Cloud Volumes ONTAP instances.
"ec2:CreateSnapshot", "ec2:DeleteSnapshot", "ec2:DescribeSnapshots",	Takes snapshots of EBS volumes during initial setup and whenever a Cloud Volumes ONTAP instance is stopped.
"ec2:GetConsoleOutput",	Captures the Cloud Volumes ONTAP console, which is attached to AutoSupport messages.
"ec2:DescribeKeyPairs",	Obtains the list of available key pairs when launching instances.

Actions	Purpose
"ec2:DescribeRegions",	Gets a list of available AWS regions.
"ec2:DeleteTags", "ec2:DescribeTags",	Manages tags for resources associated with Cloud Volumes ONTAP instances.
"cloudformation:CreateStack", "cloudformation:DeleteStack", "cloudformation:DescribeStacks", "cloudformation:DescribeStackEvents", "cloudformation:ValidateTemplate",	Launches Cloud Volumes ONTAP instances.
"iam:PassRole", "iam:CreateRole", "iam:DeleteRole", "iam:PutRolePolicy", "iam:CreateInstanceProfile", "iam:DeleteRolePolicy", "iam:AddRoleToInstanceProfile", "iam:RemoveRoleFromInstanceProfile", "iam:DeleteInstanceProfile",	Launches a Cloud Volumes ONTAP HA configuration.
"iam:ListInstanceProfiles", "sts:DecodeAuthorizationMessage", "ec2:AssociateIamInstanceProfile", "ec2:DescribeIamInstanceProfileAssociations", "ec2:DisassociateIamInstanceProfile",	Manages instance profiles for Cloud Volumes ONTAP instances.
"s3:GetBucketTagging", "s3:GetBucketLocation", "s3:ListAllMyBuckets", "s3:ListBucket"	Obtains information about AWS S3 buckets so Cloud Manager can integrate with the NetApp Data Fabric Cloud Sync service.
"s3:CreateBucket", "s3:DeleteBucket", "s3:GetLifecycleConfiguration", "s3:PutLifecycleConfiguration", "s3:PutBucketTagging", "s3:ListBucketVersions",	Manages the S3 bucket that a Cloud Volumes ONTAP system uses as a capacity tier.
"kms:List*", "kms:Describe*"	Obtains information about keys from the AWS Key Management Service.
"ce:GetReservationUtilization", "ce:GetDimensionValues", "ce:GetCostAndUsage", "ce:GetTags"	Obtains AWS cost data for Cloud Volumes ONTAP.
"ec2:CreatePlacementGroup", "ec2:DeletePlacementGroup"	When you deploy an HA configuration in a single AWS Availability Zone, Cloud Manager launches the two HA nodes and the mediator in an AWS spread placement group.

What Cloud Manager does with Azure permissions

The Cloud Manager Azure policy includes the permissions that Cloud Manager needs to deploy and manage Cloud Volumes ONTAP in Azure.

Actions	Purpose
"Microsoft.Compute/locations/operations/read", "Microsoft.Compute/locations/vmSizes/read", "Microsoft.Compute/operations/read", "Microsoft.Compute/virtualMachines/instanceView/read", "Microsoft.Compute/virtualMachines/powerOff/action", "Microsoft.Compute/virtualMachines/read", "Microsoft.Compute/virtualMachines/restart/action", "Microsoft.Compute/virtualMachines/start/action", "Microsoft.Compute/virtualMachines/deallocate/action", "Microsoft.Compute/virtualMachines/vmSizes/read", "Microsoft.Compute/virtualMachines/write",	Creates Cloud Volumes ONTAP and stops, starts, deletes, and obtains the status of the system.
"Microsoft.Compute/images/write", "Microsoft.Compute/images/read",	Enables Cloud Volumes ONTAP deployment from a VHD.
"Microsoft.Compute/disks/delete", "Microsoft.Compute/disks/read", "Microsoft.Compute/disks/write", "Microsoft.Storage/checknameavailability/read", "Microsoft.Storage/operations/read", "Microsoft.Storage/storageAccounts/listkeys/action", "Microsoft.Storage/storageAccounts/read", "Microsoft.Storage/storageAccounts/regeneratekey/action", "Microsoft.Storage/storageAccounts/write" "Microsoft.Storage/storageAccounts/delete", "Microsoft.Storage/usages/read",	Manages Azure storage accounts and disks, and attaches the disks to Cloud Volumes ONTAP.
"Microsoft.Network/networkInterfaces/read", "Microsoft.Network/networkInterfaces/write", "Microsoft.Network/networkInterfaces/join/action",	Creates and manages network interfaces for Cloud Volumes ONTAP in the target subnet.
"Microsoft.Network/networkSecurityGroups/read", "Microsoft.Network/networkSecurityGroups/write", "Microsoft.Network/networkSecurityGroups/join/action",	Creates predefined network security groups for Cloud Volumes ONTAP.

Actions	Purpose
"Microsoft.Resources/subscriptions/locations/read", "Microsoft.Network/locations/operationResults/read", "Microsoft.Network/locations/operations/read", "Microsoft.Network/virtualNetworks/read", "Microsoft.Network/virtualNetworks/checkIpAddressAvailability/read", "Microsoft.Network/virtualNetworks/subnets/read", "Microsoft.Network/virtualNetworks/subnets/virtualMachines/read", "Microsoft.Network/virtualNetworks/virtualMachines/read", "Microsoft.Network/virtualNetworks/subnets/join/action",	Gets network information about regions, the target VNet and subnet, and adds Cloud Volumes ONTAP to VNets.
"Microsoft.Network/virtualNetworks/subnets/write", "Microsoft.Network/routeTables/join/action",	Enables VNet service endpoints for data tiering.
"Microsoft.Resources/deployments/operations/read", "Microsoft.Resources/deployments/read", "Microsoft.Resources/deployments/write",	Deploys Cloud Volumes ONTAP from a template.
"Microsoft.Resources/deployments/operations/read", "Microsoft.Resources/deployments/read", "Microsoft.Resources/deployments/write", "Microsoft.Resources/resources/read", "Microsoft.Resources/subscriptions/operationresults/read", "Microsoft.Resources/subscriptions/resourceGroups/delete", "Microsoft.Resources/subscriptions/resourceGroups/read", "Microsoft.Resources/subscriptions/resourcegroups/resources/read", "Microsoft.Resources/subscriptions/resourceGroups/write",	Creates and manages resource groups for Cloud Volumes ONTAP.
"Microsoft.Compute/snapshots/write", "Microsoft.Compute/snapshots/read", "Microsoft.Compute/disks/beginGetAccess/action"	Creates and manages Azure managed snapshots.
"Microsoft.Compute/availabilitySets/write", "Microsoft.Compute/availabilitySets/read",	Creates and manages availability sets for Cloud Volumes ONTAP.
"Microsoft.MarketplaceOrdering/offertypes/publishers/offers/plans/agreements/read", "Microsoft.MarketplaceOrdering/offertypes/publishers/offers/plans/agreements/write"	Enables programmatic deployments from the Azure Marketplace.

Actions	Purpose
"Microsoft.Network/loadBalancers/read", "Microsoft.Network/loadBalancers/write", "Microsoft.Network/loadBalancers/delete", "Microsoft.Network/loadBalancers/backendAddressPools/read", "Microsoft.Network/loadBalancers/backendAddressPools/join/action", "Microsoft.Network/loadBalancers/frontendIPConfigurations/read", "Microsoft.Network/loadBalancers/loadBalancingRules/read", "Microsoft.Network/loadBalancers/probes/read", "Microsoft.Network/loadBalancers/probes/join/action",	Manages an Azure load balancer for HA pairs.
"Microsoft.Authorization/locks/*"	Enables management of locks on Azure disks.
"Microsoft.Authorization/roleDefinitions/write", "Microsoft.Authorization/roleAssignments/write", "Microsoft.Web/sites/*"	Manages failover for HA pairs.

Default configurations

Details about how Cloud Manager and Cloud Volumes ONTAP are configured by default can help you administer the systems.

Default configuration for Cloud Manager on Linux

If you need to troubleshoot Cloud Manager or your Linux host, it might help to understand how Cloud Manager is configured.

- If you deployed Cloud Manager from NetApp Cloud Central (or directly from the AWS Marketplace or Azure Marketplace), note the following:
  - In AWS, the user name for the EC2 Linux instance is ec2-user.
  - For both AWS and Azure, the operating system for the Cloud Manager image is Red Hat Enterprise Linux 7.4 (HVM).

    The operating system does not include a GUI. You must use a terminal to access the system.
- The Cloud Manager installation folder resides in the following location:

  /opt/application/netapp/cloudmanager
- Log files are contained in the following folder:

  /opt/application/netapp/cloudmanager/log
- The Cloud Manager service is named occm.
- The occm service is dependent on the MySQL service.

  If the MySQL service is down, then the occm service is down too.

- Cloud Manager installs the following packages on the Linux host, if they are not already installed:
  - 7Zip
  - AWSCLI
  - Java
  - Kubectl
  - MySQL
  - Tridentctl
  - Wget

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.

- Cloud Volumes ONTAP is available as a single-node system and as an HA pair in both AWS and Azure.
- Cloud Manager creates one data-serving SVM when it deploys Cloud Volumes ONTAP. While you can create another data-serving SVM from System Manager or the CLI, using multiple data-serving SVMs is not supported.
- Several network interfaces are created by default:
  - A cluster management LIF
  - An intercluster LIF
  - 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 Cloud Manager using HTTPS.
- When logged in to Cloud Manager, the backups are accessible from https://ipaddress/occm/offboxconfig/
- 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 The Cloud Manager Admin can modify this value from the Settings page.

Attribute	Value set by Cloud Manager
Security style	NTFS for CIFS volumes UNIX for NFS volumes
Space guarantee style	none
UNIX permissions (NFS only)	777

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

Boot and root data for Cloud Volumes ONTAP

In addition to the storage for user data, Cloud Manager also purchases cloud storage for boot and root data on each Cloud Volumes ONTAP system.

AWS

- One Provisioned IOPS SSD disk for Cloud Volumes ONTAP boot data, which is approximately 45 GB and 1,250 PIOPS
- One General Purpose SSD disk for Cloud Volumes ONTAP root data, which is approximately 140 GB
- One EBS snapshot for each boot disk and root disk

In an HA pair, both Cloud Volumes ONTAP nodes replicate its root disk to the partner node.

Azure

- One Premium Storage SSD disk for Cloud Volumes ONTAP boot data, which is approximately 73 GB
- One Premium Storage SSD disk for Cloud Volumes ONTAP root data, which is approximately 140 GB
- One Azure snapshot for each boot disk and root disk

Where the disks reside

Cloud Manager lays out the storage from AWS and Azure as follows:

- Boot data resides on a disk attached to the EC2 instance or Azure 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.

User roles

Each Cloud Manager user account is assigned a role that defines permissions.

Task	Cloud Manager Admin	Tenant Admin	Working Environment Admin
Manage tenants	Yes	No	No
Manage working environments	Yes	Yes, for the assigned tenant	Yes, for assigned working environments
Integrate a working environment with Cloud Sync	Yes	Yes	No
View data replication status	Yes	Yes, for the assigned tenant	Yes, for assigned working environments
View the timeline	Yes	Yes	Yes
Create and delete user accounts	Yes	Yes, for the assigned tenant	No
Modify user accounts	Yes	Yes, for the assigned tenant	Yes, for their own account
Manage account settings	Yes	No	No
Setup Kubernetes	Yes	No	No
Switch between the Storage System View and the Volume View	Yes	No	No
Modify settings	Yes	No	No
View and manage the Support Dashboard	Yes	No	No
Back up and restore Cloud Manager	Yes	No	No
Remove a working environment	Yes	No	No
Update Cloud Manager	Yes	No	No
Install an HTTPS certificate	Yes	No	No
Set up Active Directory	Yes	No	No
Enable the Cloud Storage Automation Report	Yes	No	No

Where to get help and find more information

You can get help and find more information about Cloud Manager and Cloud Volumes ONTAP through various resources, including videos, forums, and support.

- Videos for Cloud Manager and Cloud Volumes ONTAP

  Watch videos that show you how to deploy and manage Cloud Volumes ONTAP in AWS and Azure and

how to replicate data across your hybrid cloud.

- Policies for Cloud Manager

  Download JSON files that include the permissions that Cloud Manager needs to perform actions in AWS and Azure.

- Cloud Manager API Developer Guide

  Read an overview of the APIs, examples of how to use them, and an API reference.

- Training for Cloud Volumes ONTAP
  - Cloud Volumes ONTAP Fundamentals
  - Cloud Volumes ONTAP Deployment and Management for Azure
- Technical reports
  - NetApp Technical Report 4383: Performance Characterization of Cloud Volumes ONTAP in Amazon Web Services with Application Workloads
  - NetApp Technical Report 4671: Performance Characterization of Cloud Volumes ONTAP in Azure with Application Workloads
- Cloud Volumes ONTAP 9 SVM Disaster Recovery Preparation Express Guide

  Describes how to quickly configure a destination SVM in preparation for disaster recovery.

- Cloud Volumes ONTAP 9 SVM Disaster Recovery Express Guide

  Describes how to quickly activate a destination SVM after a disaster, and then reactivate the source SVM.

- ONTAP 9 Documentation Center

  Access product documentation for ONTAP, which can help you as you use Cloud Volumes ONTAP.

- NetApp Cloud Volumes ONTAP Support

  Access support resources to get help and troubleshoot issues with Cloud Volumes ONTAP.

- NetApp Community: Cloud Data Services

  Connect with peers, ask questions, exchange ideas, find resources, and share best practices.

- NetApp Cloud Central

  Find information about additional NetApp products and solutions for the cloud.

- NetApp Product Documentation

  Search NetApp product documentation for instructions, resources, and answers.

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