



# **Get started in Amazon Web Services**

## **Cloud Volumes ONTAP**

NetApp  
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# Get started in Amazon Web Services

## Quick start for Cloud Volumes ONTAP in AWS

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

1

### Create a Connector

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

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

2

### Plan your configuration

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

3

### Set up your networking

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

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

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

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

[Learn more about networking requirements.](#)

4

### Set up the AWS KMS

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

5

### Launch Cloud Volumes ONTAP using Cloud Manager

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

## Related links

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

# Planning your Cloud Volumes ONTAP configuration in AWS

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

## Viewing supported regions

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

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

## Choosing a license

Several licensing options are available for Cloud Volumes ONTAP. Each option enables you to choose a consumption model that meets your needs. [Learn about licensing options for Cloud Volumes ONTAP.](#)

## Choosing a supported instance

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

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

## Choosing a configuration that supports Flash Cache

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

## Understanding storage limits

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

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

## Sizing your system in AWS

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

## Instance type

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

## EBS disk type

At a high level, the differences between EBS disk types are as follows. To learn more about the use cases for EBS disks, refer to [AWS Documentation: EBS Volume Types](#).

- *General Purpose SSD (gp3)* disks are the lowest-cost SSDs that balance cost and performance for a broad range of workloads. Performance is defined in terms of IOPS and throughput. gp3 disks are supported with Cloud Volumes ONTAP 9.7 and later.

When you select a gp3 disk, Cloud Manager fills in default IOPS and throughput values that provide performance that is equivalent to a gp2 disk based on the selected disk size. You can increase the values to get better performance at a higher cost, but we do not support lower values because it can result in inferior performance. In short, stick with the default values or increase them. Don't lower them. [Learn more about gp3 disks and their performance](#).

- *General Purpose SSD (gp2)* disks balance cost and performance for a broad range of workloads. Performance is defined in terms of IOPS.
- *Provisioned IOPS SSD (io1)* disks are for critical applications that require the highest performance at a higher cost.
- *Throughput Optimized HDD (st1)* disks are for frequently accessed workloads that require fast and consistent throughput at a lower price.



Tiering data to object storage is not recommended when using Throughput Optimized HDDs (st1).

## 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 [create 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 TiB 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:



## Viewing default system disks

In addition to the storage for user data, Cloud Manager also purchases cloud storage for Cloud Volumes ONTAP system data (boot data, root data, core data, and NVRAM). For planning purposes, it might help for you to review these details before you deploy Cloud Volumes ONTAP.

[View the default disks for Cloud Volumes ONTAP system data in AWS.](#)



The Connector also requires a system disk. [View details about the Connector's default configuration.](#)

## Preparing to deploy Cloud Volumes ONTAP in an AWS Outpost

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

There are a few limitations to point out:

- Only single node Cloud Volumes ONTAP systems are supported at this time
- The EC2 instances that you can use with Cloud Volumes ONTAP are limited to what's available in your Outpost
- Only General Purpose SSDs (gp2) are supported at this time

## AWS network information worksheet

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

## Network information for Cloud Volumes ONTAP

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

## Network information for an HA pair in multiple AZs

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

## Choosing a write speed

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

## Choosing a volume usage profile

ONTAP includes several storage efficiency features that can reduce the total amount of storage that you need. When you create a volume in Cloud Manager, you can choose a profile that enables these features or a profile

that disables them. You should learn more about these features to help you decide which profile to use.

NetApp storage efficiency features provide the following benefits:

### **Thin provisioning**

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

### **Deduplication**

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

### **Compression**

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

## **Set up your networking**

### **Networking requirements for Cloud Volumes ONTAP in AWS**

Cloud Manager handles the set up of networking components for Cloud Volumes ONTAP, such as IP addresses, netmasks, and routes. You need to make sure that outbound internet access is available, that enough private IP addresses are available, that the right connections are in place, and more.

#### **General requirements**

The following requirements must be met in AWS.

#### **Outbound internet access for Cloud Volumes ONTAP nodes**

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

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

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

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

[Learn how to configure AutoSupport.](#)

#### **Outbound internet access for the HA mediator**

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



The manual option can be a NAT gateway or an interface VPC endpoint from the target subnet to the AWS EC2 service. For details about VPC endpoints, refer to [AWS Documentation: Interface VPC Endpoints \(AWS PrivateLink\)](#).

### **Private IP addresses**

Cloud Manager automatically allocates the required number of private IP addresses to Cloud Volumes ONTAP. You need to ensure that your networking has enough private IP addresses available.

The number of LIFs that Cloud Manager allocates for Cloud Volumes ONTAP depends on whether you deploy a single node system or an HA pair. A LIF is an IP address associated with a physical port.

### **IP addresses for a single node system**

Cloud Manager allocates 6 IP addresses to a single node system:

- Cluster management LIF
- Node management LIF
- Intercluster LIF
- NAS data LIF
- iSCSI data LIF
- Storage VM management LIF

A storage VM management LIF is used with management tools like SnapCenter.

### **IP addresses for HA pairs**

HA pairs require more IP addresses than a single node system does. These IP addresses are spread across different ethernet interfaces, as shown in the following image:



The number of private IP addresses required for an HA pair depends on which deployment model you choose. An HA pair deployed in a *single* AWS Availability Zone (AZ) requires 15 private IP addresses, while an HA pair deployed in *multiple* AZs requires 13 private IP addresses.

The following tables provide details about the LIFs that are associated with each private IP address.

#### LIFs for HA pairs in a single AZ

| LIF                | Interface | Node              | Purpose  |
|--------------------|-----------|-------------------|--|
| Cluster management | eth0      | node 1            | Administrative management of the entire cluster (HA pair). |
| Node management    | eth0      | node 1 and node 2 | Administrative management of a node.                       |
| Intercluster       | eth0      | node 1 and node 2 | Cross-cluster communication, backup, and replication.      |
| NAS data           | eth0      | node 1            | Client access over NAS protocols.                          |
| iSCSI data         | eth0      | node 1 and node 2 | Client access over the iSCSI protocol.                     |

| LIF                  | Interface | Node              | Purpose   |
|----------------------|-----------|-------------------|---|
| Cluster connectivity | eth1      | node 1 and node 2 | Enables the nodes to communicate with each other and to move data within the cluster.                               |
| HA connectivity      | eth2      | node 1 and node 2 | Communication between the two nodes in case of failover.  |
| RSM iSCSI traffic    | eth3      | node 1 and node 2 | RAID SyncMirror iSCSI traffic, as well as communication between the two Cloud Volumes ONTAP nodes and the mediator. |
| Mediator             | eth0      | Mediator          | A communication channel between the nodes and the mediator to assist in storage takeover and giveback processes.    |

### LIFs for HA pairs in multiple AZs

| LIF                  | Interface | Node              | Purpose   |
|----------------------|-----------|-------------------|---|
| Node management      | eth0      | node 1 and node 2 | Administrative management of a node.  |
| Intercluster         | eth0      | node 1 and node 2 | Cross-cluster communication, backup, and replication.   |
| iSCSI data           | eth0      | node 1 and node 2 | Client access over the iSCSI protocol. This LIF also manages the migration of floating IP addresses between nodes.  |
| Cluster connectivity | eth1      | node 1 and node 2 | Enables the nodes to communicate with each other and to move data within the cluster.                               |
| HA connectivity      | eth2      | node 1 and node 2 | Communication between the two nodes in case of failover.  |
| RSM iSCSI traffic    | eth3      | node 1 and node 2 | RAID SyncMirror iSCSI traffic, as well as communication between the two Cloud Volumes ONTAP nodes and the mediator. |
| Mediator             | eth0      | Mediator          | A communication channel between the nodes and the mediator to assist in storage takeover and giveback processes.    |



When deployed in multiple Availability Zones, several LIFs are associated with [floating IP addresses](#), which don't count against the AWS private IP limit.

### 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 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

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

### DNS and Active Directory for CIFS

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

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

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

### Requirements for HA pairs in multiple AZs

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

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.

A subnet should be available in each Availability Zone.

### 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.

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

system.

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

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

## AWS region



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

### Transit gateway to enable floating IP access from outside the VPC

If needed, [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 are then prompted to select the route tables that should include routes to the floating IP addresses. This enables client access to the HA pair.

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

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

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

## Connection to NetApp management tools

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

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

## Example HA configuration

The following image illustrates the networking components specific to an HA pair in multiple AZs: three Availability Zones, three subnets, floating IP addresses, and a route table.



## Requirements for the Connector

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



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

## Connection to target networks

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

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

#### Outbound internet access

The Connector requires outbound internet access to manage resources and processes within your public cloud environment.

| Endpoints                                | Purpose   |
|--|---|
| https://support.netapp.com               | To obtain licensing information and to send AutoSupport messages to NetApp support. |
| https://*.cloudmanager.cloud.netapp.com  | To provide SaaS features and services within Cloud Manager.                         |
| https://cloudmanagerinfraprod.azurecr.io | To upgrade the Connector and its Docker components.                                 |
| https://*.blob.core.windows.net          |   |

## 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. Associate the VPCs with the transit gateway route table.
  - a. In the **VPC** service, click **Transit Gateway Route Tables**.
  - b. Select the route table.
  - c. Click **Associations** and then select **Create association**.
  - d. Choose the attachments (the VPCs) to associate and then click **Create association**.
3. Create routes in the transit gateway's route table by specifying the HA pair's floating IP addresses.

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

## NFS & CIFS access from within the VPC using Floating IP

### Auto failover

Cluster Management : 172.23.0.1

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

### Access

SVM Management : 172.23.0.4

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

Transit Gateway Route Table: tgw-rtb-0ea8ee291c7aedd3

Details Associations Propagations **Routes** Tags

The table below will return a maximum of 1000 routes. Narrow the filter or use export routes to view more routes.

Create route Replace route Delete route

Filter by attributes or search by keyword

| <input type="checkbox"/> | CIDR          | Attachment   | Resource type         | Route type | Route state |
|--------------------------|---------------|--|-----------------------|------------|-------------|
| <input type="checkbox"/> | 10.100.0.0/16 | tgw-attach-05e77bd34e2ff91f8   vpc-0b2bc30e0dc8e0db1 | VPC2                  | propagated | active      |
| <input type="checkbox"/> | 10.160.0.0/20 | tgw-attach-00eba3eac3250d7db   vpc-673ae603          | VPC1                  | propagated | active      |
| <input type="checkbox"/> | 172.23.0.1/32 | tgw-attach-00eba3eac3250d7db   vpc-673ae603          | VPC                   | static     | active      |
| <input type="checkbox"/> | 172.23.0.2/32 | tgw-attach-00eba3eac3250d7db   vpc-673ae603          | VPC                   | static     | active      |
| <input type="checkbox"/> | 172.23.0.3/32 | tgw-attach-00eba3eac3250d7db   vpc-673ae603          | Floating IP Addresses | static     | active      |
| <input type="checkbox"/> | 172.23.0.4/32 | tgw-attach-00eba3eac3250d7db   vpc-673ae603          | Floating IP Addresses | static     | active      |

4. 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.

Route Table: rtb-0569a1bd740ed033f

Summary Routes Subnet Associations Route Propagation Tags

Edit routes

View All routes

| Destination   | Target                | Status | Propagated |
|---------------|-----------------------|--------|------------|
| 10.100.0.0/16 | local                 | active | No         |
| 0.0.0.0/0     | igw-07250bd01781e67df | active | No         |
| 10.160.0.0/20 | tgw-015b7c249661ac279 | active | No         |
| 172.23.0.1/32 | tgw-015b7c249661ac279 | active | No         |
| 172.23.0.2/32 | tgw-015b7c249661ac279 | active | No         |
| 172.23.0.3/32 | tgw-015b7c249661ac279 | active | No         |
| 172.23.0.4/32 | tgw-015b7c249661ac279 | active | No         |

VPC1

Floating IP Addresses

- 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.

Summary Routes Subnet Associations Route Propagation Tags

Edit routes

View All routes

| Destination   | Target                | Status |
|---|-----------------------|--------|
| 10.160.0.0/20   | local                 | active |
| pl-68a54001 (com.amazonaws.us-west-2.s3, 54.231.160.0/19, 52.218.128.0/17, 52.92.32.0/22) | vpce-cb51a0a2         | active |
| 0.0.0.0/0   | igw-b2182dd7          | active |
| 10.60.29.0/25   | pcx-589c3331          | active |
| 10.100.0.0/16   | tgw-015b7c249661ac279 | active |
| 10.129.0.0/20   | pcx-ff7e1396          | active |
| 172.23.0.1/32   | eni-0854d4715559c3cdb | active |
| 172.23.0.2/32   | eni-0854d4715559c3cdb | active |
| 172.23.0.3/32   | eni-0f76681216c3108ed | active |
| 172.23.0.4/32   | eni-0854d4715559c3cdb | active |

VPC2

Floating IP Addresses

- Mount volumes to clients using the floating IP address.

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

## Volumes

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



7. If you're mounting an NFS volume, configure the export policy to match the subnet of the client VPC.

[Learn how to edit a volume.](#)

### Related links

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

## Security group rules for AWS

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

### Rules for Cloud Volumes ONTAP

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

#### Inbound rules

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

| Protocol | Port | Purpose   |
|----------|------|---|
| All ICMP | All  | Pinging the instance  |
| HTTP     | 80   | HTTP access to the System Manager web console using the IP address of the cluster management LIF  |
| HTTPS    | 443  | HTTPS access to the System Manager web console using the IP address of the cluster management LIF |
| SSH      | 22   | SSH access to the IP address of the cluster management LIF or a node management LIF               |

| Protocol | Port    | Purpose  |
|----------|---------|--|
| 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                                   |
| UDP      | 4049    | NFS rquotad protocol   |

### Outbound rules

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

### Basic outbound rules

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

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

### Advanced outbound rules

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



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

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

| Service      | Protocol    | Port        | Source                                       | Destination                         | Purpose  |
|--------------|-------------|-------------|--|-------------------------------------|--|
| AutoSupport  | HTTPS       | 443         | Node management LIF                          | support.netapp.com                  | AutoSupport (HTTPS is the default)   |
|              | HTTP        | 80          | Node management LIF                          | support.netapp.com                  | AutoSupport (only if the transport protocol is changed from HTTPS to HTTP) |
| Backup to S3 | TCP         | 5010        | Intercluster LIF                             | Backup endpoint or restore endpoint | Back up and restore operations for the Backup to S3 feature                |
| Cluster      | All traffic | All traffic | All LIFs on one node                         | All LIFs on the other node          | Intercluster communications (Cloud Volumes ONTAP HA only)                  |
|              | TCP         | 3000        | Node management LIF                          | HA mediator                         | ZAPI calls (Cloud Volumes ONTAP HA only)                                   |
|              | ICMP        | 1           | Node management LIF                          | HA mediator                         | Keep alive (Cloud Volumes ONTAP HA only)                                   |
| DHCP         | UDP         | 68          | Node management LIF                          | DHCP                                | DHCP client for first-time setup   |
| DHCPs        | UDP         | 67          | Node management LIF                          | DHCP                                | DHCP server  |
| DNS          | UDP         | 53          | Node management LIF and data LIF (NFS, CIFS) | DNS                                 | DNS  |
| NDMP         | TCP         | 1860–18699  | 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 the Connector |

### Outbound rules

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

### Basic outbound rules

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

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

### Advanced outbound rules

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

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



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

## Rules for the HA mediator internal security group

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



### Inbound rules

The predefined security group includes the following inbound rules.

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

### Outbound rules

The predefined security group includes the following outbound rules.

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

### Rules for the Connector

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

#### Inbound rules

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

#### Outbound rules

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

#### Basic outbound rules

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

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

#### Advanced outbound rules

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



The source IP address is the Connector host.

| Service                   | Protocol | Port | Destination  | Purpose  |
|---------------------------|----------|------|--|--|
| API calls and AutoSupport | HTTPS    | 443  | Outbound internet and ONTAP cluster management LIF | API calls to AWS and ONTAP, to Cloud Data Sense, to the Ransomware service, and sending AutoSupport messages to NetApp |
| API calls                 | TCP      | 3000 | ONTAP HA mediator                                  | Communication with the ONTAP HA mediator   |
|                           | TCP      | 8088 | Backup to S3                                       | API calls to Backup to S3  |
| DNS                       | UDP      | 53   | DNS  | Used for DNS resolve by Cloud Manager  |
| Cloud Data Sense          | HTTP     | 80   | Cloud Data Sense instance                          | Cloud Data Sense for Cloud Volumes ONTAP   |

## Setting up the AWS KMS

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

### Steps

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

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

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

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

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

[AWS Documentation: Editing Keys](#)

3. If the CMK is in a different AWS account, complete the following steps:
  - 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 users in other accounts to use a KMS key](#).

4. If you are using a customer-managed CMK, modify the key policy for the CMK by adding the Cloud Volumes ONTAP IAM role as a *key user*.

This step is required if you enabled data tiering on Cloud Volumes ONTAP and want to encrypt the data

stored in the S3 bucket.

You'll need to perform this step *after* you deploy Cloud Volumes ONTAP because the IAM role is created when you create a working environment. (Of course, you do have the option to use an existing Cloud Volumes ONTAP IAM role, so it's possible to perform this step before.)

[AWS Documentation: Editing Keys](#)

## Launching Cloud Volumes ONTAP in AWS

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

### Before you get started

You need the following to create a working environment.

- A Connector that's up and running.
  - You should have a [Connector that is associated with your workspace](#).
  - [You should be prepared to leave the Connector running at all times](#).
- An understanding of the configuration that you want to use.

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](#).

- DNS and Active Directory for CIFS configurations.

For details, see [Networking requirements for Cloud Volumes ONTAP in AWS](#).

- An understanding of what's required to choose a specific licensing option in the Add Working Environment wizard. [Learn more about Cloud Volumes ONTAP licensing](#).

| Licensing option                  | Requirement   | How to meet the requirement   |
|-----------------------------------|---|---|
| Freemium                          | A Marketplace subscription or NetApp Support Site (NSS) account is required.  | You'll have the option to subscribe to your cloud provider's marketplace from the <b>Details &amp; Credentials</b> page.<br><br>You can enter your NSS account on the <b>Charging Methods and NSS Account</b> page.   |
| Professional or Essential package | A Marketplace subscription or capacity-based license (BYOL) is required.<br><br>A Marketplace subscription is recommended for capacity-based charging in the event that your account doesn't have a valid capacity-based license, or in the event that your provisioned capacity exceeds the licensed capacity. | You'll have the option to subscribe to your cloud provider's marketplace from the <b>Details &amp; Credentials</b> page.<br><br>If you want to use a capacity-based license (BYOL) that you purchased from NetApp, you must first add it to the <b>Digital Wallet</b> . <a href="#">Learn how to add capacity-based BYOL licenses</a> . |

| Licensing option           | Requirement   | How to meet the requirement   |
|----------------------------|---|---|
| Keystone Flex Subscription | Your account must be authorized and the subscription must be enabled for use with Cloud Volumes ONTAP.  | <ol style="list-style-type: none"> <li>1. <a href="#">Contact NetApp</a> to authorize your Cloud Manager user account with one or more Keystone Flex Subscriptions.</li> <li>2. After NetApp authorizes your account, <a href="#">link your subscriptions for use with Cloud Volumes ONTAP</a>.</li> <li>3. Select the Keystone Flex Subscription charging method when you create a Cloud Volumes ONTAP HA pair.</li> </ol> |
| Per node licensing         | A Marketplace subscription is required or you need to bring your own license (BYOL). This option is available for customers with existing subscriptions or existing licenses. It's not available for new customers. | <p>If you want to use a node-based license (BYOL) that you purchased from NetApp, you must first add it to the <b>Digital Wallet</b>. <a href="#">Learn how to add node-based BYOL licenses</a>.</p> <p>You can enter your NSS account on the <b>Charging Methods and NSS Account</b> page.</p>   |

## Launching a single-node Cloud Volumes ONTAP system in AWS

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

### About this task

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

### Steps

1. On the Canvas page, click **Add Working Environment** and follow the prompts.
2. **Choose a Location:** Select **Amazon Web Services** and **Cloud Volumes ONTAP Single Node**.
3. If you're prompted, [create a Connector](#).
4. **Details and Credentials:** Optionally change the AWS credentials and subscription, enter a working environment name, add tags if needed, and then enter a password.

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

| Field                    | Description  |
|--------------------------|--|
| Working Environment Name | Cloud Manager uses the working environment name to name both the Cloud Volumes ONTAP system and the Amazon EC2 instance. It also uses the name as the prefix for the predefined security group, if you select that option.   |
| Add tags                 | <p>AWS tags are metadata for your AWS resources. Cloud Manager adds the tags to the Cloud Volumes ONTAP instance and each AWS resource associated with the instance.</p> <p>You can add up to four tags from the user interface when creating a working environment, and then you can add more after its created. Note that the API does not limit you to four tags when creating a working environment.</p> <p>For information about tags, refer to <a href="#">AWS Documentation: Tagging your Amazon EC2 Resources</a>.</p> |
| User name and password   | These are the credentials for the Cloud Volumes ONTAP cluster administrator account. You can use these credentials to connect to Cloud Volumes ONTAP through System Manager or its CLI. Keep the default <i>admin</i> user name or change it to a custom user name.  |
| Edit Credentials         | <p>Choose the AWS credentials associated with the account where you want to deploy this system. You can also associate the AWS Marketplace subscription to use with this Cloud Volumes ONTAP system.</p> <p>Click <b>Add Subscription</b> to associate the selected credentials with a new AWS Marketplace subscription. The subscription can be for an annual contract or to pay for Cloud Volumes ONTAP at an hourly rate.</p> <p><a href="#">Learn how to add additional AWS credentials to Cloud Manager.</a></p>          |

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

► [https://docs.netapp.com/us-en/cloud-manager-cloud-volumes-ontap//media/video\\_subscribing\\_aws.mp4](https://docs.netapp.com/us-en/cloud-manager-cloud-volumes-ontap//media/video_subscribing_aws.mp4)

(video)

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



### Cloud Manager (for Cloud Volumes ONTAP)

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

**Having issues signing up for your product?**

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

Subscribe

You are already subscribed to this product

#### Pricing Details

Software Fees

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

- [Learn more about Cloud Data Sense.](#)
- [Learn more about Cloud Backup.](#)
- [Learn more about Monitoring.](#)

6. **Location & Connectivity:** Enter the network information that you recorded in the [AWS worksheet](#).

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

The following image shows the page filled out:

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

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

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



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



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

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

8. **Charging Methods and NSS Account:** Specify which charging option would you like to use with this system, and then specify a NetApp Support Site account.
- [Learn about these charging methods.](#)
  - [Learn what's required in the wizard for the licensing method that you want to use.](#)

9. **Cloud Volumes ONTAP Configuration** (annual AWS Marketplace contract only): Review the default configuration and click **Continue** or click **Change Configuration** to select your own configuration.

If you keep the default configuration, then you only need to specify a volume and then review and approve the configuration.

10. **Preconfigured Packages** (hourly or BYOL only): Select one of the packages to quickly launch Cloud Volumes ONTAP, or click **Change Configuration** to select your own configuration.

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

11. **IAM Role:** It's best to 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](#).

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

The screenshot shows the 'Licensing' configuration page in Cloud Manager. At the top, it says 'Cloud Volumes ONTAP version to deploy: ONTAP.ENG-9.7' with a 'Change version' link. Below this are three selectable options: 'Cloud Volumes ONTAP Explore' (with a magnifying glass icon), 'Cloud Volumes ONTAP Standard' (with a document icon and a blue border indicating it is selected), and 'Cloud Volumes ONTAP Premium' (with a ribbon icon). At the bottom, there are two dropdown menus: 'Instance Type' set to 'm5.2xlarge' and 'Instance Tenancy' set to 'Shared'.

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



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

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

Note the following:

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

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

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

[Learn how data tiering works.](#)

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

[Learn more about write speed.](#)

WORM can't be enabled if Cloud Backup was enabled or if data tiering was enabled.

[Learn more about WORM storage.](#)

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

[Learn about supported client protocols and versions.](#)

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

| Field  | Description  |
|--|--|
| Size   | The maximum size that you can enter largely depends on whether you enable thin provisioning, which enables you to create a volume that is bigger than the physical storage currently available to it.  |
| Access control (for NFS only)                  | An export policy defines the clients in the subnet that can access the volume. By default, Cloud Manager enters a value that provides access to all instances in the subnet.   |
| Permissions and Users / Groups (for CIFS only) | These fields enable you to control the level of access to a share for users and groups (also called access control lists or ACLs). You can specify local or domain Windows users or groups, or UNIX users or groups. If you specify a domain Windows user name, you must include the user's domain using the format domain\username.                                   |
| Snapshot Policy                                | A Snapshot copy policy specifies the frequency and number of automatically created NetApp Snapshot copies. A NetApp Snapshot copy is a point-in-time file system image that has no performance impact and requires minimal storage. You can choose the default policy or none. You might choose none for transient data: for example, tempdb for Microsoft SQL Server. |
| Advanced options (for NFS only)                | Select an NFS version for the volume: either NFSv3 or NFSv4.   |

| Field                                       | Description  |
|---|--|
| Initiator group and IQN<br>(for iSCSI only) | <p>iSCSI storage targets are called LUNs (logical units) and are presented to hosts as standard block devices.</p> <p>Initiator groups are tables of iSCSI host node names and control which initiators have access to which LUNs.</p> <p>iSCSI targets connect to the network through standard Ethernet network adapters (NICs), TCP offload engine (TOE) cards with software initiators, converged network adapters (CNAs) or dedicated host bus adapters (HBAs) and are identified by iSCSI qualified names (IQNs).</p> <p>When you create an iSCSI volume, Cloud Manager automatically creates a LUN for you. We've made it simple by creating just one LUN per volume, so there's no management involved. After you create the volume, <a href="#">use the IQN to connect to the LUN from your hosts</a>.</p> |

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

### Volume Details, Protection & Protocol

#### Details & Protection

Volume Name:

Size (GB):

Snapshot Policy:

Default Policy

#### Protocol

NFS **CIFS** iSCSI

Share name:

Permissions:

Users / Groups:

Valid users and groups separated by a semicolon

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

| Field                                     | Description   |
|---|---|
| DNS Primary and Secondary IP Address      | <p>The IP addresses of the DNS servers that provide name resolution for the CIFS server.</p> <p>The listed DNS servers must contain the service location records (SRV) needed to locate the Active Directory LDAP servers and domain controllers for the domain that the CIFS server will join.</p> |
| Active Directory Domain to join           | The FQDN of the Active Directory (AD) domain that you want the CIFS server to join.   |
| Credentials authorized to join the domain | The name and password of a Windows account with sufficient privileges to add computers to the specified Organizational Unit (OU) within the AD domain.  |
| CIFS server NetBIOS name                  | A CIFS server name that is unique in the AD domain.   |

| Field               | Description   |
|---------------------|---|
| Organizational Unit | The organizational unit within the AD domain to associate with the CIFS server. The default is CN=Computers.<br>If you configure AWS Managed Microsoft AD as the AD server for Cloud Volumes ONTAP, you should enter <b>OU=Computers,OU=corp</b> in this field.   |
| DNS Domain          | The DNS domain for the Cloud Volumes ONTAP storage virtual machine (SVM). In most cases, the domain is the same as the AD domain.   |
| NTP Server          | Select <b>Use Active Directory Domain</b> 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 <a href="#">Cloud Manager automation docs</a> for details.<br><br>Note that you can configure an NTP server only when creating a CIFS server. It's not configurable after you create the CIFS server. |

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

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

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

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

## Result

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

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

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

## After you finish

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

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

## Launching a Cloud Volumes ONTAP HA pair in AWS

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

## Limitation

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

## About this task

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

## Steps

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

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

| Field                    | Description  |
|--------------------------|--|
| Working Environment Name | Cloud Manager uses the working environment name to name both the Cloud Volumes ONTAP system and the Amazon EC2 instance. It also uses the name as the prefix for the predefined security group, if you select that option.   |
| Add tags                 | <p>AWS tags are metadata for your AWS resources. Cloud Manager adds the tags to the Cloud Volumes ONTAP instance and each AWS resource associated with the instance.</p> <p>You can add up to four tags from the user interface when creating a working environment, and then you can add more after its created. Note that the API does not limit you to four tags when creating a working environment.</p> <p>For information about tags, refer to <a href="#">AWS Documentation: Tagging your Amazon EC2 Resources</a>.</p> |
| User name and password   | These are the credentials for the Cloud Volumes ONTAP cluster administrator account. You can use these credentials to connect to Cloud Volumes ONTAP through System Manager or its CLI. Keep the default <i>admin</i> user name or change it to a custom user name.  |
| Edit Credentials         | <p>Choose the AWS credentials and marketplace subscription to use with this Cloud Volumes ONTAP system.</p> <p>Click <b>Add Subscription</b> to associate the selected credentials with a new AWS Marketplace subscription. The subscription can be for an annual contract or to pay for Cloud Volumes ONTAP at an hourly rate.</p> <p>If purchased a license directly from NetApp (BYOL), then an AWS subscription isn't required.</p> <p><a href="#">Learn how to add additional AWS credentials to Cloud Manager.</a></p>   |

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

► [https://docs.netapp.com/us-en/cloud-manager-cloud-volumes-ontap//media/video\\_subscribing\\_aws.mp4](https://docs.netapp.com/us-en/cloud-manager-cloud-volumes-ontap//media/video_subscribing_aws.mp4)

(video)



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

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

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

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

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

| Region & VPC          |                              |                                |
|-----------------------|------------------------------|--------------------------------|
| AWS Region            | VPC                          | Security group                 |
| US East   N. Virginia | vpc-a76d91c2 - 172.31.0.0/16 | Use a generated security group |
| <b>Node 1:</b>        | <b>Node 2:</b>               | <b>Mediator:</b>               |
| Availability Zone     | Availability Zone            | Availability Zone              |
| us-east-1a            | us-east-1b                   | us-east-1c                     |
| Subnet                | Subnet                       | Subnet                         |
| 172.31.8.0/24         | 172.31.9.0/24                | 172.31.2.0/24                  |

7. **Connectivity and SSH Authentication:** Choose connection methods for the HA pair and the mediator.
8. **Floating IPs:** If you chose multiple AZs, specify the floating IP addresses.

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

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

IP addresses.

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

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

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



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

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

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

11. **Charging Methods and NSS Account:** Specify which charging option would you like to use with this system, and then specify a NetApp Support Site account.

- [Learn about these charging methods.](#)
- [Learn what's required in the wizard for the licensing method that you want to use.](#)

12. **Cloud Volumes ONTAP Configuration** (annual AWS Marketplace contract only): Review the default configuration and click **Continue** or click **Change Configuration** to select your own configuration.

If you keep the default configuration, then you only need to specify a volume and then review and approve the configuration.

13. **Preconfigured Packages** (hourly or BYOL only): Select one of the packages to quickly launch Cloud Volumes ONTAP, or click **Change Configuration** to select your own configuration.

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

14. **IAM Role:** It's best to 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 and the HA mediator](#).

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

**Licensing**

Cloud Volumes ONTAP version to deploy: ONTAP.ENG-9.7. [Change version](#)



Cloud Volumes ONTAP Explore



Cloud Volumes ONTAP Standard



Cloud Volumes ONTAP Premium

[Cloud Volumes ONTAP Standard Instances](#)

Instance Type

m5.2xlarge

Instance Tenancy

Shared

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



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

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

Note the following:

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

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

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

[Learn how data tiering works.](#)

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

[Learn more about write speed.](#)

WORM can't be enabled if Cloud Backup was enabled or if data tiering was enabled.

[Learn more about WORM storage.](#)

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

[Learn about supported client protocols and versions.](#)



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

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

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

Volume Details, Protection & Protocol

---

### Details & Protection

Volume Name:  Size (GB):  ⓘ

Snapshot Policy:  ▼

ⓘ Default Policy

### Protocol

NFS
CIFS
iSCSI

Share name:  Permissions:  ▼

Users / Groups:

Valid users and groups separated by a semicolon

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

| Field                                     | Description   |
|---|---|
| DNS Primary and Secondary IP Address      | The IP addresses of the DNS servers that provide name resolution for the CIFS server.<br>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.<br>The default is CN=Computers.<br>If you configure AWS Managed Microsoft AD as the AD server for Cloud Volumes ONTAP, you should enter <b>OU=Computers,OU=corp</b> in this field.  |
| DNS Domain                                | The DNS domain for the Cloud Volumes ONTAP storage virtual machine (SVM). In most cases, the domain is the same as the AD domain.   |
| NTP Server                                | Select <b>Use Active Directory Domain</b> 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 <a href="#">Cloud Manager automation docs</a> for details.<br><br>Note that you can configure an NTP server only when creating a CIFS server. It's not configurable after you create the CIFS server. |

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

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

21. **Review & Approve:** 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.

## Get started with Cloud Volumes ONTAP in the AWS C2S environment

Similar to a standard AWS region, you can use Cloud Manager in the [AWS Commercial Cloud Services \(C2S\)](#) environment to deploy Cloud Volumes ONTAP, which provides enterprise-class features for your cloud storage. AWS C2S is a closed region specific to the U.S. Intelligence Community; the instructions on this page only apply to AWS C2S region users.

### Supported features in C2S

The following features are available from Cloud Manager in the C2S environment:

- Cloud Volumes ONTAP
- Data replication
- A timeline for auditing

For Cloud Volumes ONTAP, you can create a single node system or an HA pair. Both licensing options are available: pay-as-you-go and bring your own license (BYOL).

Data tiering to S3 is also supported with Cloud Volumes ONTAP in C2S.

### Limitations

None of NetApp's cloud services are available from Cloud Manager.

Because there's no internet access in the C2S environment, the following features aren't available either:

- Integration with NetApp Cloud Central
- Automated software upgrades from Cloud Manager
- NetApp AutoSupport
- AWS cost information for Cloud Volumes ONTAP resources

## Deployment overview

Getting started with Cloud Volumes ONTAP in C2S includes a few steps.

### 1. Preparing your AWS environment.

This includes setting up networking, subscribing to Cloud Volumes ONTAP, setting up permissions, and optionally setting up the AWS KMS.

### 2. Installing the Connector and setting up Cloud Manager.

Before you can start using Cloud Manager to deploy Cloud Volumes ONTAP, you'll need to create a *Connector*. The Connector enables Cloud Manager to manage resources and processes within your public cloud environment (this includes Cloud Volumes ONTAP).

You'll log in to Cloud Manager from the software that gets installed on the Connector instance.

### 3. Launching Cloud Volumes ONTAP from Cloud Manager.

Each of these steps are described below.

## Prepare your AWS environment

Your AWS environment must meet a few requirements.

### Set up your networking

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

#### Steps

1. Choose the VPC and subnets in which you want to launch the Connector instance and Cloud Volumes ONTAP instances.
2. Ensure that your VPC and subnets will support connectivity between the Connector and Cloud Volumes ONTAP.
3. 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.

### Subscribe to Cloud Volumes ONTAP

A Marketplace subscription is required to deploy Cloud Volumes ONTAP from Cloud Manager.

#### Steps

1. Go to the AWS Intelligence Community Marketplace and search for Cloud Volumes ONTAP.
2. Select the offering that you plan to deploy.
3. Review the terms and click **Accept**.
4. Repeat these steps for the other offerings, if you plan to deploy them.

You must use Cloud Manager to launch Cloud Volumes ONTAP instances. You must not launch Cloud Volumes ONTAP instances from the EC2 console.

## Set up permissions

Set up IAM policies and roles that provide Cloud Manager and Cloud Volumes ONTAP with the permissions that they need to perform actions in the AWS Commercial Cloud Services environment.

You need an IAM policy and IAM role for each of the following:

- The Connector instance
- Cloud Volumes ONTAP instances
- The Cloud Volumes ONTAP HA mediator instance (if you want to deploy HA pairs)

## Steps

1. Go to the AWS IAM console and click **Policies**.
2. Create a policy for the Connector instance.

```
{
  "Version": "2012-10-17",
  "Statement": [{
    "Effect": "Allow",
    "Action": [
      "ec2:DescribeInstances",
      "ec2:DescribeInstanceStatus",
      "ec2:RunInstances",
      "ec2:ModifyInstanceAttribute",
      "ec2:DescribeRouteTables",
      "ec2:DescribeImages",
      "ec2:CreateTags",
      "ec2:CreateVolume",
      "ec2:DescribeVolumes",
      "ec2:ModifyVolumeAttribute",
      "ec2>DeleteVolume",
      "ec2:CreateSecurityGroup",
      "ec2>DeleteSecurityGroup",
      "ec2:DescribeSecurityGroups",
      "ec2:RevokeSecurityGroupEgress",
      "ec2:RevokeSecurityGroupIngress",
      "ec2:AuthorizeSecurityGroupEgress",
      "ec2:AuthorizeSecurityGroupIngress",

```

```

        "ec2:CreateNetworkInterface",
        "ec2:DescribeNetworkInterfaces",
        "ec2:DeleteNetworkInterface",
        "ec2:ModifyNetworkInterfaceAttribute",
        "ec2:DescribeSubnets",
        "ec2:DescribeVpcs",
        "ec2:DescribeDhcpOptions",
        "ec2:CreateSnapshot",
        "ec2:DeleteSnapshot",
        "ec2:DescribeSnapshots",
        "ec2:GetConsoleOutput",
        "ec2:DescribeKeyPairs",
        "ec2:DescribeRegions",
        "ec2:DeleteTags",
        "ec2:DescribeTags",
        "cloudformation:CreateStack",
        "cloudformation:DeleteStack",
        "cloudformation:DescribeStacks",
        "cloudformation:DescribeStackEvents",
        "cloudformation:ValidateTemplate",
        "iam:PassRole",
        "iam:CreateRole",
        "iam:DeleteRole",
        "iam:PutRolePolicy",
        "iam:ListInstanceProfiles",
        "iam:CreateInstanceProfile",
        "iam:DeleteRolePolicy",
        "iam:AddRoleToInstanceProfile",
        "iam:RemoveRoleFromInstanceProfile",
        "iam:DeleteInstanceProfile",
        "s3:GetObject",
        "s3:ListBucket",
        "s3:GetBucketTagging",
        "s3:GetBucketLocation",
        "s3:ListAllMyBuckets",
        "kms:List*",
        "kms:Describe*",
        "ec2:AssociateIamInstanceProfile",
        "ec2:DescribeIamInstanceProfileAssociations",
        "ec2:DisassociateIamInstanceProfile",
        "ec2:DescribeInstanceAttribute",
        "ec2:CreatePlacementGroup",
        "ec2:DeletePlacementGroup"
    ],
    "Resource": "*"
},

```

```

{
  "Sid": "fabricPoolPolicy",
  "Effect": "Allow",
  "Action": [
    "s3:DeleteBucket",
    "s3:GetLifecycleConfiguration",
    "s3:PutLifecycleConfiguration",
    "s3:PutBucketTagging",
    "s3:ListBucketVersions"
  ],
  "Resource": [
    "arn:aws-iso:s3:::fabric-pool*"
  ]
},
{
  "Effect": "Allow",
  "Action": [
    "ec2:StartInstances",
    "ec2:StopInstances",
    "ec2:TerminateInstances",
    "ec2:AttachVolume",
    "ec2:DetachVolume"
  ],
  "Condition": {
    "StringLike": {
      "ec2:ResourceTag/WorkingEnvironment": "*"
    }
  },
  "Resource": [
    "arn:aws-iso:ec2:*:*:instance/*"
  ]
},
{
  "Effect": "Allow",
  "Action": [
    "ec2:AttachVolume",
    "ec2:DetachVolume"
  ],
  "Resource": [
    "arn:aws-iso:ec2:*:*:volume/*"
  ]
}
]
}

```

### 3. Create a policy for Cloud Volumes ONTAP.

```

{
  "Version": "2012-10-17",
  "Statement": [{
    "Action": "s3:ListAllMyBuckets",
    "Resource": "arn:aws-iso:s3:::*",
    "Effect": "Allow"
  }, {
    "Action": [
      "s3:ListBucket",
      "s3:GetBucketLocation"
    ],
    "Resource": "arn:aws-iso:s3:::fabric-pool-*",
    "Effect": "Allow"
  }, {
    "Action": [
      "s3:GetObject",
      "s3:PutObject",
      "s3>DeleteObject"
    ],
    "Resource": "arn:aws-iso:s3:::fabric-pool-*",
    "Effect": "Allow"
  }]
}

```

4. If you plan to deploy a Cloud Volumes ONTAP HA pair, create a policy for the HA mediator.

```

{
  "Version": "2012-10-17",
  "Statement": [{
    "Effect": "Allow",
    "Action": [
      "ec2:AssignPrivateIpAddresses",
      "ec2:CreateRoute",
      "ec2>DeleteRoute",
      "ec2:DescribeNetworkInterfaces",
      "ec2:DescribeRouteTables",
      "ec2:DescribeVpcs",
      "ec2:ReplaceRoute",
      "ec2:UnassignPrivateIpAddresses"
    ],
    "Resource": "*"
  }]
}

```



5. Create IAM roles with the role type Amazon EC2 and attach the policies that you created in the previous steps.

Similar to the policies, you should have one IAM role for the Connector, one for the Cloud Volumes ONTAP nodes, and one for the HA mediator (if you want to deploy HA pairs).

You must select the Connector IAM role when you launch the Connector instance.

You can select the IAM roles for Cloud Volumes ONTAP and the HA mediator when you create a Cloud Volumes ONTAP working environment from Cloud Manager.

## Set up the AWS KMS

If you want to use Amazon encryption with Cloud Volumes ONTAP, ensure that requirements are met for the AWS Key Management Service.

### Steps

1. Ensure that an active Customer Master Key (CMK) exists in your account or in another AWS account.

The CMK can be an AWS-managed CMK or a customer-managed CMK.

2. If the CMK is in an AWS account separate from the account where you plan to deploy Cloud Volumes ONTAP, then you need to obtain the ARN of that key.

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

3. Add the IAM role for the Cloud Manager instance to the list of key users for a CMK.

This gives Cloud Manager permissions to use the CMK with Cloud Volumes ONTAP.

## Install and set up Cloud Manager

Before you can launch Cloud Volumes ONTAP systems in AWS, you must first launch the Connector instance from the AWS Marketplace and then log in and set up Cloud Manager.

### Steps

1. Obtain a root certificate signed by a certificate authority (CA) in the Privacy Enhanced Mail (PEM) Base-64 encoded X.509 format. Consult your organization's policies and procedures for obtaining the certificate.

You'll need to upload the certificate during the setup process. Cloud Manager uses the trusted certificate when sending requests to AWS over HTTPS.

2. Launch the Connector instance:
  - a. Go to the AWS Intelligence Community Marketplace page for Cloud Manager.
  - b. On the Custom Launch tab, choose the option to launch the instance from the EC2 console.
  - c. Follow the prompts to configure the instance.

Note the following as you configure the instance:

- We recommend t3.xlarge.
- You must choose the IAM role that you created when preparing your AWS environment.

- You should keep the default storage options.
  - The required connection methods for the Connector are as follows: SSH, HTTP, and HTTPS.
3. Set up Cloud Manager from a host that has a connection to the Connector instance:
    - a. Open a web browser and enter the following URL: <http://ipaddress:80>
    - b. Specify a proxy server for connectivity to AWS services.
    - c. Upload the certificate that you obtained in step 1.
    - d. Complete the steps in the Setup wizard to set up Cloud Manager.
      - **System Details:** Enter a name for this instance of Cloud Manager and provide your company name.
      - **Create User:** Create the Admin user that you'll use to administer Cloud Manager.
      - **Review:** Review the details and approve the end user license agreement.
    - e. To complete installation of the CA-signed certificate, restart the Connector instance from the EC2 console.
  4. After the Connector restarts, log in using the administrator user account that you created in the Setup wizard.

## Launch Cloud Volumes ONTAP

You can launch Cloud Volumes ONTAP instances in the AWS Commercial Cloud Services environment by creating new working environments in Cloud Manager.

### What you'll need

- If you purchased a license, you must have the license file that you received from NetApp. The license file is a .NLF file in JSON format.
- A key pair is required to enable key-based SSH authentication to the HA mediator.

### Steps

1. On the Working Environments page, click **Add Working Environment**.
2. Under Create, select Cloud Volumes ONTAP or Cloud Volumes ONTAP HA.
3. Complete the steps in the wizard to launch the Cloud Volumes ONTAP system.

Note the following as you complete the wizard:

- If you want to deploy Cloud Volumes ONTAP HA in multiple Availability Zones, deploy the configuration as follows because only two AZs were available in the AWS Commercial Cloud Services environment at the time of publication:
  - Node 1: Availability Zone A
  - Node 2: Availability Zone B
  - Mediator: Availability Zone A or B
- You should leave the default option to use a generated security group.

The predefined security group includes the rules that Cloud Volumes ONTAP needs to operate successfully. If you have a requirement to use your own, you can refer to the security group section below.

- You must choose the IAM role that you created when preparing your AWS environment.
- The underlying AWS disk type is for the initial Cloud Volumes ONTAP volume.

You can choose a different disk type for subsequent volumes.

- The performance of AWS disks is tied to disk size.

You should choose the disk size that gives you the sustained performance that you need. Refer to AWS documentation for more details about EBS performance.

- The disk size is the default size for all disks on the system.



If you need a different size later, you can use the Advanced allocation option to create an aggregate that uses disks of a specific size.

- Storage efficiency features can improve storage utilization and reduce the total amount of storage that you need.

## Result

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

## Security group rules

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

### Security group for the Connector

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

#### Inbound rules

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

#### Outbound rules

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

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

### Security group for Cloud Volumes ONTAP

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

## Inbound rules

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

| Protocol | Port    | Purpose   |
|----------|---------|---|
| All ICMP | All     | Pinging the instance  |
| HTTP     | 80      | HTTP access to the System Manager web console using the IP address of the cluster management LIF  |
| HTTPS    | 443     | HTTPS access to the System Manager web console using the IP address of the cluster management LIF |
| SSH      | 22      | SSH access to the IP address of the cluster management LIF or a node management LIF               |
| TCP      | 111     | Remote procedure call for NFS   |
| TCP      | 139     | NetBIOS service session for CIFS  |
| TCP      | 161-162 | Simple network management protocol  |
| TCP      | 445     | Microsoft SMB/CIFS over TCP with NetBIOS framing  |
| TCP      | 635     | NFS mount   |
| TCP      | 749     | Kerberos  |
| TCP      | 2049    | NFS server daemon   |
| TCP      | 3260    | iSCSI access through the iSCSI data LIF   |
| TCP      | 4045    | NFS lock daemon   |
| TCP      | 4046    | Network status monitor for NFS  |
| TCP      | 10000   | Backup using NDMP   |
| TCP      | 11104   | Management of intercluster communication sessions for SnapMirror                                  |
| TCP      | 11105   | SnapMirror data transfer using intercluster LIFs  |
| UDP      | 111     | Remote procedure call for NFS   |
| UDP      | 161-162 | Simple network management protocol  |
| UDP      | 635     | NFS mount   |
| UDP      | 2049    | NFS server daemon   |
| UDP      | 4045    | NFS lock daemon   |
| UDP      | 4046    | Network status monitor for NFS  |
| UDP      | 4049    | NFS rquotad protocol  |

## Outbound rules

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

| Protocol | Port | Purpose              |
|----------|------|----------------------|
| All ICMP | All  | All outbound traffic |

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

### External security group for the HA mediator

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 traffic from the VPC where the Connector resides.

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

#### Outbound rules

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

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

### Internal security group for the HA mediator

The predefined internal security group for the Cloud Volumes ONTAP HA mediator includes the following rules. Cloud Manager always creates this security group. You don't 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 |

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