# NetApp

# Get started

## Cloud Volumes ONTAP

NetApp
March 14, 2023

# Table of Contents

# Get started

## Learn about Cloud Volumes ONTAP

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

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

- Storage efficiencies

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

- High availability

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

- Data protection

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

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

  Learn more about Cloud Backup

- Data tiering

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

- Application consistency

  Ensure consistency of NetApp Snapshot copies using NetApp SnapCenter.

  Learn more about SnapCenter

- Data security

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

- Privacy compliance controls

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

  Learn more about Cloud Data Sense

> ⓘ  Licenses for ONTAP features are included with Cloud Volumes ONTAP.

View supported Cloud Volumes ONTAP configurations

# Supported versions for new deployments

BlueXP enables you to choose from several different ONTAP versions when you create a new Cloud Volumes ONTAP working environment.

All other Cloud Volumes ONTAP versions are not supported with new deployments.

## Google Cloud

**Single node**
- 9.13.0
- 9.12.1 GA
- 9.12.1 RC1
- 9.12.0 P1
- 9.11.1 P3
- 9.10.1
- 9.9.1 P6
- 9.8
- 9.7 P5

**HA pair**
- 9.13.0
- 9.12.1 GA
- 9.12.1 RC1
- 9.12.0 P1
- 9.11.1 P3
- 9.10.1
- 9.9.1 P6
- 9.8

# Get started in Google Cloud

**Quick start for Cloud Volumes ONTAP in Google Cloud**

Get started with Cloud Volumes ONTAP for Google Cloud 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 Google Cloud

Note that if you want to deploy Cloud Volumes ONTAP in a subnet where no internet access is available, then

you need to manually install the Connector and access the BlueXP user interface that's running on that Connector. Learn how to manually install the Connector in a location without internet access

**2** **Plan your configuration**

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

Learn more about planning your configuration.

**3** **Set up your networking**

a. Ensure that your VPC and subnets will support connectivity between the Connector and Cloud Volumes ONTAP.

b. If you plan to enable data tiering, configure the Cloud Volumes ONTAP subnet for Private Google Access.

c. If you're deploying an HA pair, ensure that you have four VPCs, each with their own subnet.

d. If you're using a shared VPC, provide the *Compute Network User* role to the Connector service account.

e. Enable outbound internet access from the target VPC for NetApp AutoSupport.

   This step isn't required if you're deploying Cloud Volumes ONTAP in a location where no internet access is available.

Learn more about networking requirements.

**4** **Set up a service account**

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

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

Read step-by-step instructions.

**5** **Enable Google Cloud APIs**

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

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

## 6 Launch Cloud Volumes ONTAP using BlueXP

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 BlueXP
- Installing the Connector software on a Linux host
- What BlueXP does with Google Cloud permissions

## Plan your Cloud Volumes ONTAP configuration in Google Cloud

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

### Choose a Cloud Volumes ONTAP 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
- Learn how to set up licensing

### Choose a supported region

Cloud Volumes ONTAP is supported in most Google Cloud regions. View the full list of supported regions.

### Choose a supported machine type

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

Supported configurations for Cloud Volumes ONTAP in GCP

### Understand 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 GCP

### Size your system in GCP

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

### Machine type

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

Refer to the following for more details:

- Google Cloud documentation: N1 standard machine types
- Google Cloud documentation: Performance

**GCP disk type**

When you create volumes for Cloud Volumes ONTAP, you need to choose the underlying cloud storage that Cloud Volumes ONTAP uses for a disk. The disk type can be any of the following:

- *Zonal SSD persistent disks*: SSD persistent disks are best for workloads that require high rates of random IOPS.
- *Zonal Balanced persistent disks*: These SSDs balance performance and cost by providing lower IOPS per GB.
- *Zonal Standard persistent disks* : Standard persistent disks are economical and can handle sequential read/write operations.

  For more details, see Google Cloud documentation: Zonal Persistent disks (Standard and SSD).

**GCP disk size**

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

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

  Refer to the following for more details:

  ◦ Google Cloud documentation: Zonal Persistent disks (Standard and SSD)
  ◦ Google Cloud documentation: Optimizing Persistent Disk and Local SSD Performance

**View default system disks**

In addition to the storage for user data, BlueXP 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 Google Cloud.
- Google Cloud docs: Resource quotas

  Google Cloud Compute Engine enforces quotas on resource usage so you should ensure that you haven't reached your limit before you deploy Cloud Volumes ONTAP.

> The Connector also requires a system disk. View details about the Connector's default configuration.

## Collect networking information

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

### Network information for a single-node system

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

### Network information for an HA pair in multiple zones

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

### Network information for an HA pair in a single zone

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

**Choose a write speed**

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

**Choose 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 BlueXP, you can choose a profile that enables these features or a profile that disables them. You should learn more about these features to help you decide which profile to use.

NetApp storage efficiency features provide the following benefits:

**Thin provisioning**

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

**Deduplication**

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

**Compression**

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

## Networking requirements for Cloud Volumes ONTAP in Google Cloud

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

If you want to deploy an HA pair, you should learn how HA pairs work in Google Cloud.

### Requirements for Cloud Volumes ONTAP

The following requirements must be met in Google Cloud.

#### Requirements specific to single node systems

If you want to deploy a single node system, ensure that your networking meets the following requirements.

#### One VPC

One Virtual Private Cloud (VPC) is required for a single node system.

#### Private IP addresses

BlueXP allocates 3 or 4 private IP addresses to a single node system in Google Cloud.

You can skip creation of the storage VM (SVM) management LIF if you deploy Cloud Volumes ONTAP using the API and specify the following flag:

```
skipSvmManagementLif: true
```

> (i)   A LIF is an IP address associated with a physical port. A storage VM (SVM) management LIF is
> required for management tools like SnapCenter.

**Requirements specific to HA pairs**

If you want to deploy an HA pair, ensure that your networking meets the following requirements.

## One or multiple zones

You can ensure the high availability of your data by deploying an HA configuration across multiple or in a single
zone. BlueXP will prompt you to choose multiple zones or a single zone when you create the HA pair.

- Multiple zones (recommended)

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

- Single zone

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

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

## Four Virtual Private Clouds

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

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

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

**Subnets**

A private subnet is required for each VPC.

If you place the Connector in VPC-0, then you will need to enable Private Google Access on the subnet to access the APIs and to enable data tiering.

The subnets in these VPCs must have distinct CIDR ranges. They can't have overlapping CIDR ranges.

**Private IP addresses**

BlueXP allocates 14 or 15 private IP addresses to an HA pair in Google Cloud:

- 7 or 8 private IP addresses for VPC-0

  You can skip creation of the storage VM (SVM) management LIF if you deploy Cloud Volumes ONTAP using the API and specify the following flag:

  ```
  skipSvmManagementLif: true
  ```

- Two private IP addresses for VPC-1

- Two private IP addresses for VPC-2
- Three private IP addresses for VPC-3

**Internal load balancers**

BlueXP automatically creates four Google Cloud internal load balancers (TCP/UDP) that manage incoming traffic to the Cloud Volumes ONTAP HA pair. No setup is required from your end. We've listed this as a requirement simply to inform you of the network traffic and to mitigate any security concerns.

One load balancer is for cluster management, one is for storage VM (SVM) management, one is for NAS traffic to node 1, and the last is for NAS traffic to node 2.

The setup for each load balancer is as follows:

- One shared private IP address
- One global health check

  By default, the ports used by the health check are 63001, 63002, and 63003.

- One regional TCP backend service
- One regional UDP backend service
- One TCP forwarding rule
- One UDP forwarding rule
- Global access is disabled

  Even though global access is disabled by default, enabling it post deployment is supported. We disabled it because cross region traffic will have significantly higher latencies. We wanted to ensure that you didn't have a negative experience due to accidental cross region mounts. Enabling this option is specific to your business needs.

**Shared VPCs**

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

For a single node system, the VPC can be either a shared VPC or a standalone VPC.

For an HA pair, four VPCs are required. Each of those VPCs can be either shared or standalone. For example, VPC-0 could be a shared VPC, while VPC-1, VPC-2, and VPC-3 could be standalone VPCs.

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

Review the required shared VPC permissions covered in Connector deployment

**Packet mirroring in VPCs**

Packet mirroring must be disabled in the Google Cloud VPC in which you deploy Cloud Volumes ONTAP. Cloud Volumes ONTAP can't operate properly if packet mirroring is enabled.

**Outbound internet access**

Cloud Volumes ONTAP requires outbound internet access for NetApp AutoSupport, which proactively monitors the health of your system and sends messages to NetApp technical support.

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

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

If an outbound internet connection isn't available to send AutoSupport messages, BlueXP automatically configures your Cloud Volumes ONTAP systems to use the Connector as a proxy server. The only requirement is to ensure that the Connector's firewall allows *inbound* connections over port 3128. You'll need to open this port after you deploy the Connector.

If you defined strict outbound rules for Cloud Volumes ONTAP, then you'll also need to ensure that the Cloud Volumes ONTAP firewall allows *outbound* connections over port 3128.

After you've verified that outbound internet access is available, you can test AutoSupport to ensure that it can send messages. For instructions, refer to ONTAP docs: Set up AutoSupport.

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

If BlueXP notifies you that AutoSupport messages can't be sent, troubleshoot your AutoSupport configuration.

**Connection to Google Cloud Storage for data tiering**

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

For additional steps required to set up data tiering in BlueXP, see Tiering cold data to low-cost object storage.

**Connections to ONTAP systems in other networks**

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

For instructions, refer to Google Cloud documentation: Cloud VPN overview.

**Firewall rules**

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

The firewall rules for Cloud Volumes ONTAP requires both inbound and outbound rules. If you're deploying an HA configuration, these are the firewall rules for Cloud Volumes ONTAP in VPC-0.

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

- One set of rules for HA components in VPC-0. These rules enable data access to Cloud Volumes ONTAP.

- Another set of rules for HA components in VPC-1, VPC-2, and VPC-3. These rules are open for inbound & outbound communication between the HA components. VPC-2, and VPC-3,Learn more.

> 💡 Looking for information about the Connector? View firewall rules for the Connector

**Inbound rules**

When you create a working environment, you can choose the source filter for the predefined firewall policy during deployment:

- **Selected VPC only**: the source filter for inbound traffic is the subnet range of the VPC for the Cloud Volumes ONTAP system and the subnet range of the VPC where the Connector resides. This is the recommended option.
- **All VPCs**: the source filter for inbound traffic is the 0.0.0.0/0 IP range.

If you use your own firewall policy, ensure that you add all networks that need to communicate with Cloud Volumes ONTAP, but also ensure to add both address ranges to allow the internal Google Load Balancer to function correctly. These addresses are 130.211.0.0/22 and 35.191.0.0/16. For more information, refer to Google Cloud documentation: Load Balancer Firewall Rules.

| 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 | Connectivity with the Connector and 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 |

| Protocol | Port | Purpose |
|----------|------|---------|
| TCP | 63001-63050 | Load balance probe ports to determine which node is healthy (required for HA pairs only) |
| UDP | 111 | Remote procedure call for NFS |
| UDP | 161-162 | Simple network management protocol |
| UDP | 635 | NFS mount |
| UDP | 2049 | NFS server daemon |
| UDP | 4045 | NFS lock daemon |
| UDP | 4046 | Network status monitor for NFS |
| UDP | 4049 | NFS rquotad protocol |

**Outbound rules**

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

**Basic outbound rules**

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

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

**Advanced outbound rules**

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

> (i) 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) |
| | TCP | 3128 | Node management LIF | Connector | Sending AutoSupport messages through a proxy server on the Connector, if an outbound internet connection isn't available |
| Cluster | All traffic | All traffic | All LIFs on one node | All LIFs on the other node | Intercluster communications (Cloud Volumes ONTAP HA only) |
| DHCP | UDP | 68 | Node management LIF | DHCP | DHCP client for first-time setup |
| DHCPS | UDP | 67 | Node management LIF | DHCP | DHCP server |
| DNS | UDP | 53 | Node management LIF and data LIF (NFS, CIFS) | DNS | DNS |
| NDMP | TCP | 18600–18699 | Node management LIF | Destination servers | NDMP copy |
| SMTP | TCP | 25 | Node management LIF | Mail server | SMTP alerts, can be used for AutoSupport |
| SNMP | TCP | 161 | Node management LIF | Monitor server | Monitoring by SNMP traps |
| | UDP | 161 | Node management LIF | Monitor server | Monitoring by SNMP traps |
| | TCP | 162 | Node management LIF | Monitor server | Monitoring by SNMP traps |
| | UDP | 162 | Node management LIF | Monitor server | Monitoring by SNMP traps |
| SnapMirror | TCP | 11104 | Intercluster LIF | ONTAP intercluster LIFs | Management of intercluster communication sessions for SnapMirror |
| | TCP | 11105 | Intercluster LIF | ONTAP intercluster LIFs | SnapMirror data transfer |
| Syslog | UDP | 514 | Node management LIF | Syslog server | Syslog forward messages |

**Rules for VPC-1, VPC-2, and VPC-3**

In Google Cloud, an HA configuration is deployed across four VPCs. The firewall rules needed for the HA configuration in VPC-0 are listed above for Cloud Volumes ONTAP.

Meanwhile, the predefined firewall rules that BlueXP creates for instances in VPC-1, VPC-2, and VPC-3 enables ingress communication over *all* protocols and ports. These rules enable communication between HA nodes.

Communication from the HA nodes to the HA mediator takes place over port 3260 (iSCSI).

> To enable high write speed for new Google Cloud HA pair deployments, a maximum transmission unit (MTU) of at least 8,896 bytes is required for VPC-1, VPC-2, and VPC-3. If you choose to upgrade existing VPC-1, VPC-2, and VPC-3 to an MTU of 8,896 bytes, you must shutdown all existing HA systems using these VPCs during the configuration process.

**Requirements for the Connector**

If you haven't created a Connector yet, you should review networking requirements for the Connector as well.

- View networking requirements for the Connector
- Firewall rules in Google Cloud

## Planning for VPC Service Controls in GCP

When choosing to lock down your Google Cloud environment with VPC Service Controls, you should understand how BlueXP and Cloud Volumes ONTAP interact with the Google Cloud APIs, as well as how to configure your service perimeter to deploy BlueXP and Cloud Volumes ONTAP.

VPC Service Controls enable you to control access to Google-managed services outside of a trusted perimeter, to block data access from untrusted locations, and to mitigate unauthorized data transfer risks. Learn more about Google Cloud VPC Service Controls.

**How NetApp services communicate with VPC Service Controls**

BlueXP communicates directly with the Google Cloud APIs. This is either triggered from an external IP address outside of Google Cloud (for example, from api.services.cloud.netapp.com), or within Google Cloud from an internal address assigned to the BlueXP Connector.

Depending on the deployment style of the Connector, certain exceptions may have to be made for your service perimeter.

**Images**

Both Cloud Volumes ONTAP and BlueXP use images from a project within GCP that is managed by NetApp. This can affect the deployment of the BlueXP Connector and Cloud Volumes ONTAP, if your organization has a policy that blocks the use of images that are not hosted within the organization.

You can deploy a Connector manually using the manual installation method, but Cloud Volumes ONTAP will also need to pull images from the NetApp project. You must provide an allowed list in order to deploy a Connector and Cloud Volumes ONTAP.

**Deploying a Connector**

The user who deploys a Connector needs to be able to reference an image hosted in the projectId *netapp-cloudmanager* and the project number *14190056516*.

**Deploying Cloud Volumes ONTAP**

- The BlueXP service account needs to reference an image hosted in the projectId *netapp-cloudmanager* and the project number *14190056516* from the service project.

- The service account for the default Google APIs Service Agent needs to reference an image hosted in the projectId *netapp-cloudmanager* and the project number *14190056516* from the service project.

Examples of the rules needed for pulling these images with VPC Service Controls are defined below.

**VPC Service Controls perimeter policies**

Policies allow exceptions to the VPC Service Controls rule sets. For more information about policies, please visit the GCP VPC Service Controls Policy Documentation.

To set the policies that BlueXP requires, navigate to your VPC Service Controls Perimeter within your organization and add the following policies. The fields should match the options given in the VPC Service Controls policy page. Also note that **all** rules are required and the **OR** parameters should be used in the rule set.

**Ingress rules**

**Rule 1**

```
From:
    Identities:
        [User Email Address]
    Source > All sources allowed
To:
    Projects =
        [Service Project]
    Services =
        Service name: iam.googleapis.com
          Service methods: All actions
        Service name: compute.googleapis.com
          Service methods:All actions
```

OR

**Rule 2**

```
From:
    Identities:
        [User Email Address]
    Source > All sources allowed
To:
    Projects =
        [Host Project]
    Services =
        Service name: compute.googleapis.com
          Service methods: All actions
```

OR

**Rule 3**

```
From:
    Identities:
        [Service Project Number]@cloudservices.gserviceaccount.com
    Source > All sources allowed
To:
    Projects =
        [Service Project]
        [Host Project]
    Services =
        Service name: compute.googleapis.com
        Service methods: All actions
```

**Egress rules**

**Rule 1:**

```
From:
    Identities:
        [Service Project Number]@cloudservices.gserviceaccount.com
To:
    Projects =
        14190056516
    Service =
        Service name: compute.googleapis.com
        Service methods: All actions
```

> The project number outlined above is the project *netapp-cloudmanager* used by NetApp to store images for the Connector and for Cloud Volumes ONTAP.

## Create a service account for data tiering and backups

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

Cloud Volumes ONTAP uses the service account to access and manage one bucket for tiered data and another bucket for backups.

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

**Steps**

1. In the Google Cloud console, go to the Service accounts page.

2. Select your project.

3. Click **Create service account** and provide the required information.

   a. **Service account details**: Enter a name and description.

   b. **Grant this service account access to project**: Select the **Storage Admin** role.

c. **Grant users access to this service account**: Add the Connector service account as a *Service Account User* to this new service account.

This step is required for data tiering only. It's not required for the Cloud Backup Service.

**What's next?**

You'll need to select the service account later when you create a Cloud Volumes ONTAP working environment.

## Using customer-managed encryption keys with Cloud Volumes ONTAP

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

**Steps**

1. Ensure that the BlueXP Connector service account has the correct permissions at the project level, in the project where the key is stored.

   The permissions are provided in the Connector service account permissions by default, but may not be applied if you use an alternate project for the Cloud Key Management Service.

   The permissions are as follows:

   ```
    - cloudkms.cryptoKeyVersions.useToEncrypt
    - cloudkms.cryptoKeys.get
    - cloudkms.cryptoKeys.list
    - cloudkms.keyRings.list
   ```

2. Ensure that the service account for the Google Compute Engine Service Agent has Cloud KMS Encrypter/Decrypter permissions on the key.

The name of the service account uses the following format: "service-[service_project_number]@compute-system.iam.gserviceaccount.com".

[Google Cloud Documentation: Using IAM with Cloud KMS - Granting roles on a resource](#)

3. Obtain the "id" of the key by invoking the get command for the `/gcp/vsa/metadata/gcp-encryption-keys` API call or by choosing "Copy Resource Name" on the key in the GCP console.

4. If using customer-managed encryption keys and tiering data to object storage, BlueXP attempts to utilize the same keys that are used to encrypt the persistent disks. But you'll first need to enable Google Cloud Storage buckets to use the keys:

   a. Find the Google Cloud Storage service agent by following the [Google Cloud Documentation: Getting the Cloud Storage service agent](#).

   b. Navigate to the encryption key and assign the Google Cloud Storage service agent with Cloud KMS Encrypter/Decrypter permissions.

   For more information, refer to [Google Cloud Documentation: Using customer-managed encryption keys](#)

5. Use the "GcpEncryption" parameter with your API request when creating a working environment.

   **Example**

   ```
   "gcpEncryptionParameters": {
       "key": "projects/project-1/locations/us-east4/keyRings/keyring-1/cryptoKeys/generatedkey1"
     }
   ```

Refer to the [BlueXP automation docs](#) for more details about using the "GcpEncryption" parameter.

## Set up licensing for Cloud Volumes ONTAP in Google Cloud

After you decide which licensing option you want to use with Cloud Volumes ONTAP, a few steps are required before you can choose that licensing option when creating a new working environment.

### Freemium

Select the Freemium offering to use Cloud Volumes ONTAP free of charge with up to 500 GiB of provisioned capacity. [Learn more about the Freemium offering](#).

**Steps**

1. From the left navigation menu, select **Storage > Canvas**.

2. On the Canvas page, click **Add Working Environment** and follow the steps in BlueXP.

   a. On the **Details and Credentials** page, click **Edit Credentials > Add Subscription** and then follow the prompts to subscribe to the pay-as-you-go offering in the Google Cloud Marketplace.

   You won't be charged through the marketplace subscription unless you exceed 500 GiB of provisioned capacity, at which time the system is automatically converted to the [Essentials package](#).

b. After you return to BlueXP, select **Freemium** when you reach the charging methods page.



[View step-by-step instructions to launch Cloud Volumes ONTAP in Google Cloud](#).

**Capacity-based license**

Capacity-based licensing enables you to pay for Cloud Volumes ONTAP per TiB of capacity. Capacity-based licensing is available in the form of a *package*: the Essentials package or the Professional package.

The Essentials and Professional packages are available with the following consumption models:

  • A license (BYOL) purchased from NetApp
  • An hourly, pay-as-you-go (PAYGO) subscription from the Google Cloud Marketplace
  • An annual contract

[Learn more about capacity-based licensing](#).

The following sections describe how to get started with each of these consumption models.

**BYOL**

Pay upfront by purchasing a license (BYOL) from NetApp to deploy Cloud Volumes ONTAP systems in any cloud provider.

**Steps**
  1. [Contact NetApp Sales to obtain a license](#)
  2. [Add your NetApp Support Site account to BlueXP](#)

     BlueXP automatically queries NetApp's licensing service to obtain details about the licenses associated with your NetApp Support Site account. If there are no errors, BlueXP automatically adds the licenses to the Digital Wallet.
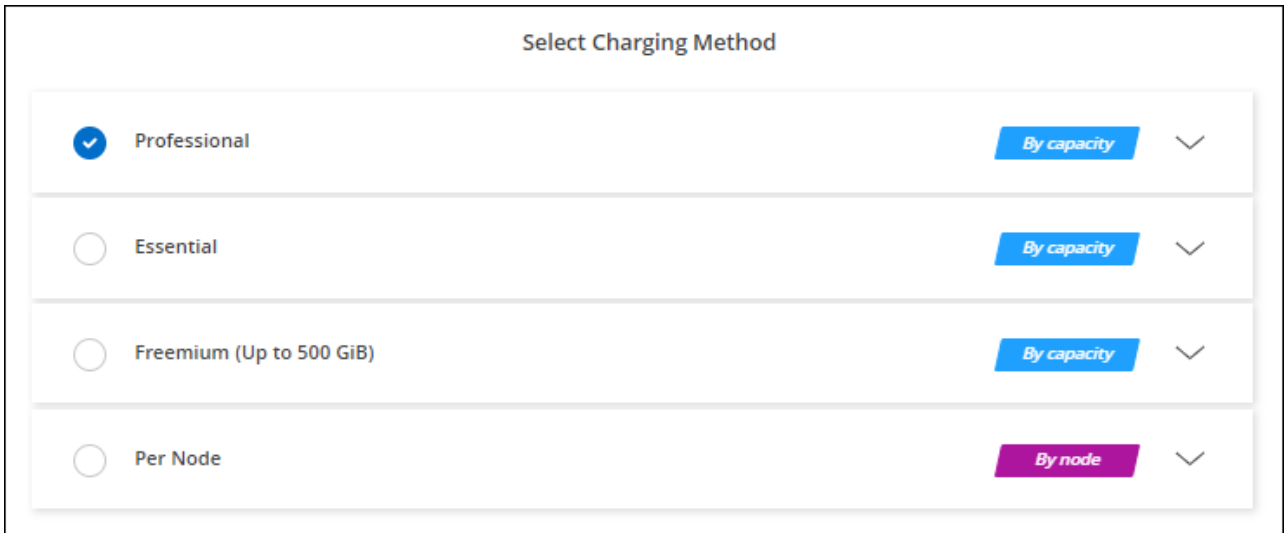
     Your license must be available from the Digital Wallet before you can use it with Cloud Volumes ONTAP. If needed, you can [manually add the license to the Digital Wallet](#).

  3. On the Canvas page, click **Add Working Environment** and follow the steps in BlueXP.

a. On the **Details and Credentials** page, click **Edit Credentials > Add Subscription** and then follow the prompts to subscribe to the pay-as-you-go offering in the Google Cloud Marketplace.

The license that you purchased from NetApp is always charged first, but you'll be charged from the hourly rate in the marketplace if you exceed your licensed capacity or if the term of your license expires.

b. After you return to BlueXP, select a capacity-based package when you reach the charging methods page.



View step-by-step instructions to launch Cloud Volumes ONTAP in Google Cloud.

**PAYGO subscription**

Pay hourly by subscribing to the offer from your cloud provider's marketplace.

When you create a Cloud Volumes ONTAP working environment, BlueXP prompts you to subscribe to the agreement that's available in the Google Cloud Marketplace. That subscription is then associated with the working environment for charging. You can use that same subscription for additional working environments.

**Steps**
1. From the left navigation menu, select **Storage > Canvas**.
2. On the Canvas page, click **Add Working Environment** and follow the steps in BlueXP.
   a. On the **Details and Credentials** page, click **Edit Credentials > Add Subscription** and then follow the prompts to subscribe to the pay-as-you-go offering in the Google Cloud Marketplace.
   b. After you return to BlueXP, select a capacity-based package when you reach the charging methods page.

[View step-by-step instructions to launch Cloud Volumes ONTAP in Google Cloud](#).

> 💡 You can manage the Google Cloud Marketplace subscriptions associated with your accounts from the Settings > Credentials page. [Learn how to manage your Google Cloud credentials and subscriptions](#)

**Annual contract**

Pay for Cloud Volumes ONTAP annually by purchasing an annual contract.

**Steps**

1. Contact your NetApp sales representative to purchase an annual contract.

   The contract is available as a *private* offer in the Google Cloud Marketplace.

   After NetApp shares the private offer with you, you can select the annual plan when you subscribe from the Google Cloud Marketplace during working environment creation.

2. On the Canvas page, click **Add Working Environment** and follow the steps in BlueXP.

   a. On the **Details and Credentials** page, click **Edit Credentials > Add Subscription** and then follow the prompts to subscribe to the annual plan in the Google Cloud Marketplace.

   b. In Google Cloud, select the annual plan that was shared with your account and then click **Subscribe**.

   c. After you return to BlueXP, select a capacity-based package when you reach the charging methods page.

View step-by-step instructions to launch Cloud Volumes ONTAP in Google Cloud.

**Keystone Flex Subscription**

A Keystone Flex Subscription is a pay-as-you-grow subscription-based service. Learn more about Keystone Flex Subscriptions.

**Steps**

1. If you don't have a subscription yet, contact NetApp

2. Contact NetApp to authorize your BlueXP user account with one or more Keystone Flex Subscriptions.

3. After NetApp authorizes your account, link your subscriptions for use with Cloud Volumes ONTAP.

4. On the Canvas page, click **Add Working Environment** and follow the steps in BlueXP.

   a. Select the Keystone Flex Subscription charging method when prompted to choose a charging method.

[View step-by-step instructions to launch Cloud Volumes ONTAP in Google Cloud](#).

## Launching Cloud Volumes ONTAP in Google Cloud

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

**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](#).
  - The service account associated with the Connector [should have the required permissions](#)
- An understanding of the configuration that you want to use.

  You should have prepared by choosing a configuration and by obtaining Google Cloud networking information from your administrator. For details, see [Planning your Cloud Volumes ONTAP configuration](#).

- An understanding of what's required to set up licensing for Cloud Volumes ONTAP.

  [Learn how to set up licensing](#).

- Google Cloud APIs should be enabled in your project:
  - Cloud Deployment Manager V2 API
  - Cloud Logging API
  - Cloud Resource Manager API
  - Compute Engine API
  - Identity and Access Management (IAM) API

**Launching a single-node system in Google Cloud**

Create a working environment in BlueXP to launch Cloud Volumes ONTAP in Google Cloud.

**Steps**

1. From the left navigation menu, select **Storage > Canvas**.
2. On the Canvas page, click **Add Working Environment** and follow the prompts.
3. **Choose a Location**: Select **Google Cloud** and **Cloud Volumes ONTAP**.
4. If you're prompted, create a Connector.
5. **Details & Credentials**: Select a project, specify a cluster name, optionally select a service account, optionally add labels, and then specify credentials.

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

| Field | Description |
|---|---|
| Working Environment Name | BlueXP uses the working environment name to name both the Cloud Volumes ONTAP system and the Google Cloud VM instance. It also uses the name as the prefix for the predefined security group, if you select that option. |
| Service Account Name | If you plan to use data tiering or Cloud Backup with Cloud Volumes ONTAP, then you need to enable **Service Account** and select a service account that has the predefined Storage Admin role. Learn how to create a service account. |
| Add Labels | Labels are metadata for your Google Cloud resources. BlueXP adds the labels to the Cloud Volumes ONTAP system and Google Cloud resources associated with the system.<br><br>You can add up to four labels from the user interface when creating a working environment, and then you can add more after its created. Note that the API does not limit you to four labels when creating a working environment.<br><br>For information about labels, refer to Google Cloud Documentation: Labeling Resources. |
| 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 *admin* user name or change it to a custom user name. |

| Field | Description |
|---|---|
| Edit Project | Select the project where you want Cloud Volumes ONTAP to reside. The default project is the project where BlueXP resides.<br><br>If you don't see any additional projects in the drop-down list, then you haven't yet associated the BlueXP service account with other projects. Go to the Google Cloud console, open the IAM service, and select the project. Add the service account with the BlueXP role to that project. You'll need to repeat this step for each project.<br><br>ⓘ  This is the service account that you set up for BlueXP, as described on this page.<br><br>Click **Add Subscription** to associate the selected credentials with a subscription.<br><br>To create a pay-as-you-go Cloud Volumes ONTAP system, you need to select a Google Cloud project that's associated with a subscription to Cloud Volumes ONTAP from the Google Cloud Marketplace. |

The following video shows how to associate a pay-as-you-go Marketplace subscription to your Google Cloud project. Alternatively, follow the steps to subscribe located in the Associating a Marketplace subscription with Google Cloud credentials section.

► https://docs.netapp.com/us-en/cloud-manager-cloud-volumes-ontap//media/video_subscribing_gcp.mp4

*(video)*

6. **Services**: Select the services that you want to use on this system. In order to select Cloud Backup, or to use Tiering, you must have specified the Service Account in step 3.

> 💡 If you would like to utilize WORM and data tiering, you must disable Cloud Backup and deploy a Cloud Volumes ONTAP working environment with version 9.8 or above.

7. **Location & Connectivity**: Select a location, choose a firewall policy, and confirm network connectivity to Google Cloud storage for data tiering.

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

| Field | Description |
|---|---|
| Connectivity verification | To tier cold data to a Google Cloud Storage bucket, the subnet in which Cloud Volumes ONTAP resides must be configured for Private Google Access. For instructions, refer to Google Cloud Documentation: Configuring Private Google Access. |
| Generated firewall policy | If you let BlueXP generate the firewall policy for you, you need to choose how you'll allow traffic:<br><br>• If you choose **Selected VPC only**, the source filter for inbound traffic is the subnet range of the selected VPC and the subnet range of the VPC where the Connector resides. This is the recommended option.<br><br>• If you choose **All VPCs**, the source filter for inbound traffic is the 0.0.0.0/0 IP range. |
| Use existing firewall policy | If you use an existing firewall policy, ensure that it includes the required rules. Learn about firewall rules for Cloud Volumes ONTAP. |

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 licensing options for Cloud Volumes ONTAP.
   - Learn how to set up licensing.

9. **Preconfigured Packages**: Select one of the packages to quickly deploy a Cloud Volumes ONTAP system, or click **Create my own configuration**.

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

10. **Licensing**: Change the Cloud Volumes ONTAP version as needed and select a machine type.

> ⓘ If a newer Release Candidate, General Availability, or patch release is available for the selected version, then BlueXP updates the system to that version when creating the working environment. For example, the update occurs if you select Cloud Volumes ONTAP 9.10.1 and 9.10.1 P4 is available. The update does not occur from one release to another—for example, from 9.6 to 9.7.

11. **Underlying Storage Resources**: Choose settings for the initial aggregate: a disk type and the size for each disk.

The disk type is for the initial volume. You can choose a different disk type for subsequent volumes.

The disk size is for all disks in the initial aggregate and for any additional aggregates that BlueXP 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 Google Cloud.

12. **Write Speed & WORM**:

    a. Choose **Normal** or **High** write speed, if desired.

       Learn more about write speed.

    b. Activate write once, read many (WORM) storage, if desired.

       WORM can't be enabled if data tiering was enabled for Cloud Volumes ONTAP versions 9.7 and below. Reverting or downgrading to Cloud Volumes ONTAP 9.8 is blocked after enabling WORM and tiering.

       Learn more about WORM storage.

    c. If you activate WORM storage, select the retention period.

13. **Data Tiering in Google Cloud Platform**: Choose whether to enable data tiering on the initial aggregate, choose a storage class for the tiered data, and then either select a service account that has the predefined Storage Admin role (required for Cloud Volumes ONTAP 9.7 or later), or select a Google Cloud account (required for Cloud Volumes ONTAP 9.6).

    Note the following:

    ◦ BlueXP sets the service account on the Cloud Volumes ONTAP instance. This service account provides permissions for data tiering to a Google Cloud Storage bucket. Be sure to add the Connector service account as a user of the tiering service account, otherwise, you can't select it from BlueXP

    ◦ For help with adding a Google Cloud account, see Setting up and adding Google Cloud accounts for data tiering with 9.6.

    ◦ You can choose a specific volume tiering policy when you create or edit a volume.

    ◦ If you disable data tiering, you can enable it on subsequent aggregates, but you'll need to turn off the system and add a service account from the Google Cloud console.

       Learn more about data tiering.

14. **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. |

| Field | Description |
| --- | --- |
| Access control (for NFS only) | An export policy defines the clients in the subnet that can access the volume. By default, BlueXP 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) | iSCSI storage targets are called LUNs (logical units) and are presented to hosts as standard block devices.<br><br>Initiator groups are tables of iSCSI host node names and control which initiators have access to which LUNs.<br><br>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 bust adapters (HBAs) and are identified by iSCSI qualified names (IQNs).<br><br>When you create an iSCSI volume, BlueXP automatically creates a LUN for you. We've made it simple by creating just one LUN per volume, so there's no management involved. After you create the volume, use the IQN to connect to the LUN from your hosts. |

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



Volume Details, Protection & Protocol

Details & Protection

Volume Name:
vol

Size (GB):
250

Snapshot Policy:
default

ⓘ Default Policy

Protocol

NFS    CIFS    iSCSI

Share name:
vol_share

Permissions:
Full Control

Users / Groups:
engineering

Valid users and groups separated by a semicolon

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

| Field | Description |
|---|---|
| DNS Primary and Secondary IP Address | The IP addresses of the DNS servers that provide name resolution for the CIFS server.<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.<br><br>If you're configuring Google Managed Active Directory, AD can be accessed by default with the 169.254.169.254 IP address. |
| Active Directory Domain to join | The FQDN of the Active Directory (AD) domain that you want the CIFS server to join. |
| Credentials authorized to join the domain | The name and password of a Windows account with sufficient privileges to add computers to the specified Organizational Unit (OU) within the AD domain. |
| CIFS server NetBIOS name | A CIFS server name that is unique in the AD domain. |
| Organizational Unit | The organizational unit within the AD domain to associate with the CIFS server. The default is CN=Computers.<br><br>To configure Google Managed Microsoft AD as the AD server for Cloud Volumes ONTAP, enter **OU=Computers,OU=Cloud** in this field.<br><br>Google Cloud Documentation: Organizational Units in Google Managed Microsoft AD |
| DNS Domain | The DNS domain for the Cloud Volumes ONTAP storage virtual machine (SVM). In most cases, the domain is the same as the AD domain. |
| NTP Server | Select **Use Active Directory Domain** to configure an NTP server using the Active Directory DNS. If you need to configure an NTP server using a different address, then you should use the API. See the BlueXP automation docs 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. |

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

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

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

    a. Review details about the configuration.

    b. Click **More information** to review details about support and the Google Cloud resources that BlueXP will purchase.

    c. Select the **I understand…** check boxes.

    d. Click **Go**.

**Result**

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

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

For additional help, go to NetApp Cloud Volumes ONTAP Support.

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

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

**Launching an HA pair in Google Cloud**

Create a working environment in BlueXP to launch Cloud Volumes ONTAP in Google Cloud.

**Steps**
1. From the left navigation menu, select **Storage > Canvas**.
2. On the Canvas page, click **Add Working Environment** and follow the prompts.
3. **Choose a Location**: Select **Google Cloud** and **Cloud Volumes ONTAP HA**.
4. **Details & Credentials**: Select a project, specify a cluster name, optionally select a Service Account, optionally add labels, and then specify credentials.

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

| Field | Description |
|---|---|
| Working Environment Name | BlueXP uses the working environment name to name both the Cloud Volumes ONTAP system and the Google Cloud VM instance. It also uses the name as the prefix for the predefined security group, if you select that option. |
| Service Account Name | If you plan to use the Tiering or Cloud Backup services, you need to enable the **Service Account** switch and then select the Service Account that has the predefined Storage Admin role. |
| Add Labels | Labels are metadata for your Google Cloud resources. BlueXP adds the labels to the Cloud Volumes ONTAP system and Google Cloud resources associated with the system.<br><br>You can add up to four labels from the user interface when creating a working environment, and then you can add more after its created. Note that the API does not limit you to four labels when creating a working environment.<br><br>For information about labels, refer to Google Cloud Documentation: Labeling Resources. |
| 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 *admin* user name or change it to a custom user name. |

| Field | Description |
| --- | --- |
| Edit Project | Select the project where you want Cloud Volumes ONTAP to reside. The default project is the project where BlueXP resides.<br><br>If you don't see any additional projects in the drop-down list, then you haven't yet associated the BlueXP service account with other projects. Go to the Google Cloud console, open the IAM service, and select the project. Add the service account with the BlueXP role to that project. You'll need to repeat this step for each project.<br><br>ⓘ   This is the service account that you set up for BlueXP, as described on this page.<br><br>Click **Add Subscription** to associate the selected credentials with a subscription.<br><br>To create a pay-as-you-go Cloud Volumes ONTAP system, you need to select a Google Cloud project that's associated with a subscription to Cloud Volumes ONTAP from the Google Cloud Marketplace. |

The following video shows how to associate a pay-as-you-go Marketplace subscription to your Google Cloud project. Alternatively, follow the steps to subscribe located in the Associating a Marketplace subscription with Google Cloud credentials section.

► https://docs.netapp.com/us-en/cloud-manager-cloud-volumes-ontap//media/video_subscribing_gcp.mp4

*(video)*

5. **Services**: Select the services that you want to use on this system. In order to select Cloud Backup, or to use Tiering, you must have specified the Service Account in step 3.

> 💡 If you would like to utilize WORM and data tiering, you must disable Cloud Backup and deploy a Cloud Volumes ONTAP working environment with version 9.8 or above.

6. **HA Deployment Models**: Choose multiple zones (recommended) or a single zone for the HA configuration. Then select a region and zones.

   Learn more about HA deployment models.

7. **Connectivity**: Select four different VPCs for the HA configuration, a subnet in each VPC, and then choose a firewall policy.

   Learn more about networking requirements.

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

| Field | Description |
|---|---|
| Generated policy | If you let BlueXP generate the firewall policy for you, you need to choose how you'll allow traffic:<br><br>• If you choose **Selected VPC only**, the source filter for inbound traffic is the subnet range of the selected VPC and the subnet range of the VPC where the Connector resides. This is the recommended option.<br><br>• If you choose **All VPCs**, the source filter for inbound traffic is the 0.0.0.0/0 IP range. |
| Use existing | If you use an existing firewall policy, ensure that it includes the required rules. Learn about firewall rules for Cloud Volumes ONTAP. |

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 licensing options for Cloud Volumes ONTAP.
   - Learn how to set up licensing.

9. **Preconfigured Packages**: Select one of the packages to quickly deploy a Cloud Volumes ONTAP system, or click **Create my own configuration**.

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

10. **Licensing**: Change the Cloud Volumes ONTAP version as needed and select a machine type.

> ℹ️ If a newer Release Candidate, General Availability, or patch release is available for the selected version, then BlueXP updates the system to that version when creating the working environment. For example, the update occurs if you select Cloud Volumes ONTAP 9.10.1 and 9.10.1 P4 is available. The update does not occur from one release to another—for example, from 9.6 to 9.7.

11. **Underlying Storage Resources**: Choose settings for the initial aggregate: a disk type and the size for each disk.

    The disk type is for the initial volume. You can choose a different disk type for subsequent volumes.

    The disk size is for all disks in the initial aggregate and for any additional aggregates that BlueXP 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 Google Cloud.

12. **Write Speed & WORM**:

    a. Choose **Normal** or **High** write speed, if desired.

       Learn more about write speed.

       > (i) *Flash Cache*, high write speed, and a higher maximum transmission unit (MTU) of 8,896 bytes are available through the **High** write speed option with the n2-standard-16, n2-standard-32, n2-standard-48, and n2-standard-64 instance types. In addition, the higher MTU of 8,896 requires the selection of VPC-1, VPC-2 and VPC-3 for the deployment. *Flash Cache*, high write speed, and an MTU of 8,896 are feature-dependent and cannot be disabled individually within a configured instance. For more information on VPC-1, VPC-2, and VPC-3, see Rules for VPC-1, VPC-2, and VPC-3.

    b. Activate write once, read many (WORM) storage, if desired.

       WORM can't be enabled if data tiering was enabled for Cloud Volumes ONTAP versions 9.7 and below. Reverting or downgrading to Cloud Volumes ONTAP 9.8 is blocked after enabling WORM and tiering.

       Learn more about WORM storage.

    c. If you activate WORM storage, select the retention period.

13. **Data Tiering in Google Cloud**: Choose whether to enable data tiering on the initial aggregate, choose a storage class for the tiered data, and then select a service account that has the predefined Storage Admin role.

    Note the following:

    ◦ BlueXP sets the service account on the Cloud Volumes ONTAP instance. This service account provides permissions for data tiering to a Google Cloud Storage bucket. Be sure to add the Connector service account as a user of the tiering service account, otherwise, you can't select it from BlueXP.

    ◦ You can choose a specific volume tiering policy when you create or edit a volume.

    ◦ If you disable data tiering, you can enable it on subsequent aggregates, but you'll need to turn off the system and add a service account from the Google Cloud console.

       Learn more about data tiering.

14. **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, BlueXP 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) | iSCSI storage targets are called LUNs (logical units) and are presented to hosts as standard block devices.<br><br>Initiator groups are tables of iSCSI host node names and control which initiators have access to which LUNs.<br><br>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 bust adapters (HBAs) and are identified by iSCSI qualified names (IQNs).<br><br>When you create an iSCSI volume, BlueXP automatically creates a LUN for you. We've made it simple by creating just one LUN per volume, so there's no management involved. After you create the volume, use the IQN to connect to the LUN from your hosts. |

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

**Volume Details, Protection & Protocol**

**Details & Protection**

Volume Name:
vol

Size (GB): ⓘ
250

Snapshot Policy:
default ▾
ⓘ Default Policy

**Protocol**

NFS  CIFS  iSCSI

Share name:
vol_share

Permissions:
Full Control ▾

Users / Groups:
engineering
Valid users and groups separated by a semicolon

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

| Field | Description |
| --- | --- |
| DNS Primary and Secondary IP Address | The IP addresses of the DNS servers that provide name resolution for the CIFS server.<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.<br><br>If you're configuring Google Managed Active Directory, AD can be accessed by default with the 169.254.169.254 IP address. |
| Active Directory Domain to join | The FQDN of the Active Directory (AD) domain that you want the CIFS server to join. |
| Credentials authorized to join the domain | The name and password of a Windows account with sufficient privileges to add computers to the specified Organizational Unit (OU) within the AD domain. |
| CIFS server NetBIOS name | A CIFS server name that is unique in the AD domain. |
| Organizational Unit | The organizational unit within the AD domain to associate with the CIFS server. The default is CN=Computers.<br><br>To configure Google Managed Microsoft AD as the AD server for Cloud Volumes ONTAP, enter **OU=Computers,OU=Cloud** in this field.<br><br>Google Cloud Documentation: Organizational Units in Google Managed Microsoft AD |
| DNS Domain | The DNS domain for the Cloud Volumes ONTAP storage virtual machine (SVM). In most cases, the domain is the same as the AD domain. |

| Field | Description |
|-------|-------------|
| NTP Server | Select **Use Active Directory Domain** to configure an NTP server using the Active Directory DNS. If you need to configure an NTP server using a different address, then you should use the API. See the BlueXP automation docs 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. |

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

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

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

    a. Review details about the configuration.

    b. Click **More information** to review details about support and the Google Cloud resources that BlueXP will purchase.

    c. Select the **I understand…** check boxes.

    d. Click **Go**.

**Result**

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

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

For additional help, go to NetApp Cloud Volumes ONTAP Support.

**After you finish**

• If you provisioned a CIFS share, give users or groups permissions to the files and folders and verify that those users can access the share and create a file.

• If you want to apply quotas to volumes, use System Manager or the CLI.

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

## Google Cloud Platform Image Verification

### Google Cloud image verification overview

Google Cloud image verification complies with enhanced NetApp security requirements. Changes have been made to the script generating the images to sign the image along the way using private keys specifically generated for this task. You can verify the integrity of the GCP image by using the signed digest and public certificate for Google Cloud which can be downloaded via NSS for a specific release.

> ⓘ Google Cloud image verification is supported on Cloud Volumes ONTAP software version 9.13.0 or greater.

**Convert image to raw format on Google Cloud**

The image being used to deploy new instances, upgrades, or being used in existing images will be shared with the clients through the NetApp Support Site (NSS). The signed digest, and the certificates will be available to download through the NSS portal. Make sure you are downloading the digest and certificates for the right release corresponding to the image shared by NetApp Support. For instance, 9.13.0 images will have a 9.13.0 signed digest and certificates available on NSS.

**Why is this step needed?**

The images from Google Cloud cannot be downloaded directly. In order to verify the image against the signed digest and the certificates, you need to have a mechanism to compare the two files and download the image. To do so, you must export/convert the image into a disk.raw format and save the results in a storage bucket on Google Cloud. The disk.raw file is tarred and gzipped in the process.

The user/service-account will need privileges to perform the following:

- Access to Google storage bucket
- Write to Google Storage bucket
- Create cloud build jobs (used during export process)
- Access to the desired image
- Create export image tasks

To verify the image, it must be converted to a disk.raw format and then downloaded.

**Use Google Cloud command line to export Google Cloud image**

The preferred way to export an image to Cloud Storage is to use the gcloud compute images export command. This command takes the provided image and converts it to a disk.raw file which gets tarred and gzipped. The generated file is saved at the destination URL and can then be downloaded for verification.

The user/account must have privileges to access and write to the desired bucket, export the image, and cloud builds (used by Google to export the image) to execute this operation.

**Export Google Cloud image using gcloud**

**Click to display the script**

```
$ gcloud compute images export \
    --destination-uri DESTINATION_URI \
    --image IMAGE_NAME

# For our example:
$ gcloud compute images export \
    --destination-uri gs://vsa-dev-bucket1/example-user-exportimage-
gcp-demo \
    --image example-user-20230120115139


## DEMO ##
# Step 1 - Optional: Checking access and listing objects in the
destination bucket
$ gsutil ls gs://example-user-export-image-bucket/

# Step 2 - Exporting the desired image to the bucket
$ gcloud compute images export --image example-user-export-image-demo
--destination-uri gs://example-user-export-image-bucket/export-
demo.tar.gz
Created [https://cloudbuild.googleapis.com/v1/projects/example-demo-
project/locations/us-central1/builds/xxxxxxxxxxxx].
Logs are available at [https://console.cloud.google.com/cloud-
build/builds;region=us-central1/xxxxxxxxxxxx?project=xxxxxxxxxxxx].
[image-export]: 2023-01-25T18:13:48Z Fetching image "example-user-
export-image-demo" from project "example-demo-project".
[image-export]: 2023-01-25T18:13:49Z Validating workflow
[image-export]: 2023-01-25T18:13:49Z Validating step "setup-disks"
[image-export]: 2023-01-25T18:13:49Z Validating step "image-export-
export-disk"
[image-export.image-export-export-disk]: 2023-01-25T18:13:49Z
Validating step "setup-disks"
[image-export.image-export-export-disk]: 2023-01-25T18:13:49Z
Validating step "run-image-export-export-disk"
[image-export.image-export-export-disk]: 2023-01-25T18:13:50Z
Validating step "wait-for-inst-image-export-export-disk"
[image-export.image-export-export-disk]: 2023-01-25T18:13:50Z
Validating step "copy-image-object"
[image-export.image-export-export-disk]: 2023-01-25T18:13:50Z
Validating step "delete-inst"
[image-export]: 2023-01-25T18:13:51Z Validation Complete
[image-export]: 2023-01-25T18:13:51Z Workflow Project: example-demo-
project
[image-export]: 2023-01-25T18:13:51Z Workflow Zone: us-central1-c
```

```
[image-export]: 2023-01-25T18:13:51Z Workflow GCSPath: gs://example-
demo-project-example-bkt-us/
[image-export]: 2023-01-25T18:13:51Z Example scratch path:
https://console.cloud.google.com/storage/browser/example-demo-project-
example-bkt-us/example-image-export-20230125-18:13:49-r88px
[image-export]: 2023-01-25T18:13:51Z Uploading sources
[image-export]: 2023-01-25T18:13:51Z Running workflow
[image-export]: 2023-01-25T18:13:51Z Running step "setup-disks"
(CreateDisks)
[image-export.setup-disks]: 2023-01-25T18:13:51Z CreateDisks: Creating
disk "disk-image-export-image-export-r88px".
[image-export]: 2023-01-25T18:14:02Z Step "setup-disks" (CreateDisks)
successfully finished.
[image-export]: 2023-01-25T18:14:02Z Running step "image-export-export-
disk" (IncludeWorkflow)
[image-export.image-export-export-disk]: 2023-01-25T18:14:02Z Running
step "setup-disks" (CreateDisks)
[image-export.image-export-export-disk.setup-disks]: 2023-01-
25T18:14:02Z CreateDisks: Creating disk "disk-image-export-export-disk-
image-export-image-export--r88px".
[image-export.image-export-export-disk]: 2023-01-25T18:14:02Z Step
"setup-disks" (CreateDisks) successfully finished.
[image-export.image-export-export-disk]: 2023-01-25T18:14:02Z Running
step "run-image-export-export-disk" (CreateInstances)
[image-export.image-export-export-disk.run-image-export-export-disk]:
2023-01-25T18:14:02Z CreateInstances: Creating instance "inst-image-
export-export-disk-image-export-image-export--r88px".
[image-export.image-export-export-disk]: 2023-01-25T18:14:08Z Step
"run-image-export-export-disk" (CreateInstances) successfully finished.
[image-export.image-export-export-disk.run-image-export-export-disk]:
2023-01-25T18:14:08Z CreateInstances: Streaming instance "inst-image-
export-export-disk-image-export-image-export--r88px" serial port 1
output to https://storage.cloud.google.com/example-demo-project-
example-bkt-us/example-image-export-20230125-18:13:49-r88px/logs/inst-
image-export-export-disk-image-export-image-export--r88px-serial-
port1.log
[image-export.image-export-export-disk]: 2023-01-25T18:14:08Z Running
step "wait-for-inst-image-export-export-disk" (WaitForInstancesSignal)
[image-export.image-export-export-disk.wait-for-inst-image-export-
export-disk]: 2023-01-25T18:14:08Z WaitForInstancesSignal: Instance
"inst-image-export-export-disk-image-export-image-export--r88px":
watching serial port 1, SuccessMatch: "ExportSuccess", FailureMatch:
["ExportFailed:"] (this is not an error), StatusMatch: "GCEExport:".
[image-export.image-export-export-disk.wait-for-inst-image-export-
export-disk]: 2023-01-25T18:14:29Z WaitForInstancesSignal: Instance
"inst-image-export-export-disk-image-export-image-export--r88px":
```

StatusMatch found: "GCEExport: <serial-output key:'source-size-gb' value:'10'>"
[image-export.image-export-export-disk.wait-for-inst-image-export-export-disk]: 2023-01-25T18:14:29Z WaitForInstancesSignal: Instance "inst-image-export-export-disk-image-export-image-export--r88px": StatusMatch found: "GCEExport: Running export tool."
[image-export.image-export-export-disk.wait-for-inst-image-export-export-disk]: 2023-01-25T18:14:29Z WaitForInstancesSignal: Instance "inst-image-export-export-disk-image-export-image-export--r88px": StatusMatch found: "GCEExport: Disk /dev/sdb is 10 GiB, compressed size will most likely be much smaller."
[image-export.image-export-export-disk.wait-for-inst-image-export-export-disk]: 2023-01-25T18:14:29Z WaitForInstancesSignal: Instance "inst-image-export-export-disk-image-export-image-export--r88px": StatusMatch found: "GCEExport: Beginning export process..."
[image-export.image-export-export-disk.wait-for-inst-image-export-export-disk]: 2023-01-25T18:14:29Z WaitForInstancesSignal: Instance "inst-image-export-export-disk-image-export-image-export--r88px": StatusMatch found: "GCEExport: Copying \"/dev/sdb\" to gs://example-demo-project-example-bkt-us/example-image-export-20230125-18:13:49-r88px/outs/image-export-export-disk.tar.gz."
[image-export.image-export-export-disk.wait-for-inst-image-export-export-disk]: 2023-01-25T18:14:29Z WaitForInstancesSignal: Instance "inst-image-export-export-disk-image-export-image-export--r88px": StatusMatch found: "GCEExport: Using \"/root/upload\" as the buffer prefix, 1.0 GiB as the buffer size, and 4 as the number of workers."
[image-export.image-export-export-disk.wait-for-inst-image-export-export-disk]: 2023-01-25T18:14:29Z WaitForInstancesSignal: Instance "inst-image-export-export-disk-image-export-image-export--r88px": StatusMatch found: "GCEExport: Creating gzipped image of \"/dev/sdb\"."
[image-export.image-export-export-disk.wait-for-inst-image-export-export-disk]: 2023-01-25T18:14:29Z WaitForInstancesSignal: Instance "inst-image-export-export-disk-image-export-image-export--r88px": StatusMatch found: "GCEExport: Read 1.0 GiB of 10 GiB (212 MiB/sec), total written size: 992 MiB (198 MiB/sec)"
[image-export.image-export-export-disk.wait-for-inst-image-export-export-disk]: 2023-01-25T18:14:59Z WaitForInstancesSignal: Instance "inst-image-export-export-disk-image-export-image-export--r88px": StatusMatch found: "GCEExport: Read 8.0 GiB of 10 GiB (237 MiB/sec), total written size: 1.5 GiB (17 MiB/sec)"
[image-export.image-export-export-disk.wait-for-inst-image-export-export-disk]: 2023-01-25T18:15:19Z WaitForInstancesSignal: Instance "inst-image-export-export-disk-image-export-image-export--r88px": StatusMatch found: "GCEExport: Finished creating gzipped image of \"/dev/sdb\" in 48.956433327s [213 MiB/s] with a compression ratio of 6."

```
[image-export.image-export-export-disk.wait-for-inst-image-export-
export-disk]: 2023-01-25T18:15:19Z WaitForInstancesSignal: Instance
"inst-image-export-export-disk-image-export-image-export--r88px":
StatusMatch found: "GCEExport: Finished export in  48.957347731s"
[image-export.image-export-export-disk.wait-for-inst-image-export-
export-disk]: 2023-01-25T18:15:19Z WaitForInstancesSignal: Instance
"inst-image-export-export-disk-image-export-image-export--r88px":
StatusMatch found: "GCEExport: <serial-output key:'target-size-gb'
value:'2'>"
[image-export.image-export-export-disk.wait-for-inst-image-export-
export-disk]: 2023-01-25T18:15:19Z WaitForInstancesSignal: Instance
"inst-image-export-export-disk-image-export-image-export--r88px":
SuccessMatch found "ExportSuccess"
[image-export.image-export-export-disk]: 2023-01-25T18:15:19Z Step
"wait-for-inst-image-export-export-disk" (WaitForInstancesSignal)
successfully finished.
[image-export.image-export-export-disk]: 2023-01-25T18:15:19Z Running
step "copy-image-object" (CopyGCSObjects)
[image-export.image-export-export-disk]: 2023-01-25T18:15:19Z Running
step "delete-inst" (DeleteResources)
[image-export.image-export-export-disk.delete-inst]: 2023-01-
25T18:15:19Z DeleteResources: Deleting instance "inst-image-export-
export-disk".
[image-export.image-export-export-disk]: 2023-01-25T18:15:19Z Step
"copy-image-object" (CopyGCSObjects) successfully finished.
[image-export.image-export-export-disk]: 2023-01-25T18:15:34Z Step
"delete-inst" (DeleteResources) successfully finished.
[image-export]: 2023-01-25T18:15:34Z Step "image-export-export-disk"
(IncludeWorkflow) successfully finished.
[image-export]: 2023-01-25T18:15:34Z Serial-output value -> source-
size-gb:10
[image-export]: 2023-01-25T18:15:34Z Serial-output value -> target-
size-gb:2
[image-export]: 2023-01-25T18:15:34Z Workflow "image-export" cleaning
up (this may take up to 2 minutes).
[image-export]: 2023-01-25T18:15:35Z Workflow "image-export" finished
cleanup.

# Step 3 - Validating the image was successfully exported
$ gsutil ls gs://example-user-export-image-bucket/
gs://example-user-export-image-bucket/export-demo.tar.gz


# Step 4 - Download the exported image
$ gcloud storage cp gs://BUCKET_NAME/OBJECT_NAME SAVE_TO_LOCATION
```

```
$ gcloud storage cp gs://example-user-export-image-bucket/export-
demo.tar.gz CVO_GCP_Signed_Digest.tar.gz
Copying gs://example-user-export-image-bucket/export-demo.tar.gz to
file://CVO_GCP_Signed_Digest.tar.gz
  Completed files 1/1 | 1.5GiB/1.5GiB | 185.0MiB/s

Average throughput: 213.3MiB/s
$ ls -l
total 1565036
-rw-r--r-- 1 example-user example-user 1602589949 Jan 25 18:44
CVO_GCP_Signed_Digest.tar.gz
```

**Extract zipped files**

```
# Extracting files from the digest
$ tar -xf CVO_GCP_Signed_Digest.tar.gz
```

> ⓘ   See Google Cloud doc on Exporting an image for more information on how to export an image
>     through Google Cloud.

**Image signature verification**

**Verify Google Cloud signed images**

To verify the exported Google Cloud signed image, you must download the image digest
file from the NSS to validate the disk.raw file and digest file contents.

**Signed image verification workflow summary**

The following is an overview of the Google Cloud signed image verification workflow process.

- From the NSS, download the Google Cloud archive containing the following files:
  - Signed digest (.sig)
  - Certificate containing the public key (.pem)
  - Certificate chain (.pem)

Cloud Volumes ONTAP 9.13.0

Date Posted:

**Restrictions on Encryption Technology**

NetApp Volume Encryption (available with ONTAP 9.1 and later releases) provides for data-at-rest encryption that requires authorizations, permits, or licenses to import, export, re-export or use this software.

A state license for importing encryption equipment is required to import ONTAP 9.1 (or later) with NetApp Volume Encryption into Member States of the Eurasian Economic Union: Russia, Belarus, Kazakhstan, Armenia and Kyrgyzstan. Moreover, in certain cases, an end-user customer must have a valid state encryption license to this software.

Consult your legal advisor on this matter.

| Cloud Volumes ONTAP | Cloud Volumes ONTAP | Cloud Volumes ONTAP |
|---|---|---|
| Non-Restricted Countries | Restricted Countries | Google Image Digest Files |
| If you are upgrading to ONTAP 9.13.0, and you are in "Non-restricted Countries", please download the image with NetApp Volume Encryption. | If you are unsure whether your company complied with all applicable legal requirements on encryption technology, download the image without NetApp Volume Encryption. | DOWNLOAD GCP-X-9-13-0_PKG.TAR.GZ [7.52 KB] <br> View and download checksums <br> Azure Image Digest File |
| DOWNLOAD 9130_V_IMAGE.TGZ [2.58 GB] <br> View and download checksums | DOWNLOAD 9130_V_NODAR_IMAGE.TGZ [2.58 GB] <br> View and download checksums | DOWNLOAD AZURE-9.13.0_PKG.TAR.GZ [7.55 KB] <br> View and download checksums |
| DOWNLOAD 9130_V_IMAGE.TGZ.PEM [451 B] <br> View and download checksums | DOWNLOAD 9130_V_NODAR_IMAGE.TGZ.PEM [451 B] <br> View and download checksums | |
| DOWNLOAD 9130_V_IMAGE.TGZ.SIG [256 B] <br> View and download checksums | DOWNLOAD 9130_V_NODAR_IMAGE.TGZ.SIG [256 B] <br> View and download checksums | |

- Download the converted disk.raw file
- Validate the certificate using the certificate chain
- Validate the signed digest using the certificate contain the public key
  - Decrypt the signed digest using the public key to extract the digest of the image file
  - Create a digest of the downloaded disk.raw file
  - Compare the two digest file for validation



**Verification of disk.raw file and digest file contents using OpenSSL**

You can verify the Google Cloud downloaded disk.raw file against the digest file contents available through the NSS using OpenSSL.

> ⓘ The OpenSSL commands to validate the image are compatible with Linux, Mac OS, and Windows machines.

**Steps**

1. Verify the certificate using OpenSSL.

**Click to display the script**

```
# Step 1 - Optional, but recommended: Verify the certificate using
OpenSSL

# Step 1.1 - Copy the Certificate and certificate chain to a
directory
$ openssl version
LibreSSL 3.3.6
$ ls -l
total 48
-rw-r--r--@ 1 example-user  engr  8537 Jan 19 15:42 Certificate-
Chain-GCP-CVO-20230119-0XXXXX.pem
-rw-r--r--@ 1 example-user  engr  2365 Jan 19 15:42 Certificate-GCP-
CVO-20230119-0XXXXX.pem

# Step 1.2 - Get the OSCP URL
$ oscp_url=$(openssl x509 -noout -ocsp_uri -in <Certificate-
Chain.pem>)
$ oscp_url=$(openssl x509 -noout -ocsp_uri -in Certificate-Chain-
GCP-CVO-20230119-0XXXXX.pem)
$ echo $oscp_url
http://ocsp.entrust.net

# Step 1.3 - Generate an OCSP request for the certificate
$ openssl ocsp -issuer <Certificate-Chain.pem> -CAfile <Certificate-
Chain.pem> -cert <Certificate.pem> -reqout <request.der>
$ openssl ocsp -issuer Certificate-Chain-GCP-CVO-20230119-0XXXXX.pem
-CAfile Certificate-Chain-GCP-CVO-20230119-0XXXXX.pem -cert
Certificate-GCP-CVO-20230119-0XXXXX.pem -reqout req.der

# Step 1.4 - Optional: Check the new file "req.der" has been
generated
$ ls -l
total 56
-rw-r--r--@ 1 example-user  engr  8537 Jan 19 15:42 Certificate-
Chain-GCP-CVO-20230119-0XXXXX.pem
-rw-r--r--@ 1 example-user  engr  2365 Jan 19 15:42 Certificate-GCP-
CVO-20230119-0XXXXX.pem
-rw-r--r--  1 example-user  engr   120 Jan 19 16:50 req.der

# Step 1.5 - Connect to the OCSP Manager using openssl to send the
OCSP request
$ openssl ocsp -issuer <Certificate-Chain.pem> -CAfile <Certificate-
Chain.pem> -cert <Certificate.pem> -url ${ocsp_url} -resp_text
-respout <response.der>
```

```
$ openssl ocsp -issuer Certificate-Chain-GCP-CVO-20230119-0XXXXX.pem
-CAfile Certificate-Chain-GCP-CVO-20230119-0XXXXX.pem -cert
Certificate-GCP-CVO-20230119-0XXXXX.pem  -url ${ocsp_url} -resp_text
-respout resp.der
OCSP Response Data:
    OCSP Response Status: successful (0x0)
    Response Type: Basic OCSP Response
    Version: 1 (0x0)
    Responder Id: C = US, O = "Entrust, Inc.", CN = Entrust Extended
Validation Code Signing CA - EVCS2
    Produced At: Jan 19 15:14:00 2023 GMT
    Responses:
    Certificate ID:
      Hash Algorithm: sha1
      Issuer Name Hash: 69FA640329AB84E27220FE0927647B8194B91F2A
      Issuer Key Hash: CE894F8251AA15A28462CA312361D261FBF8FE78
      Serial Number: 5994B3D01D26D594BD1D0FA7098C6FF5
    Cert Status: good
    This Update: Jan 19 15:00:00 2023 GMT
    Next Update: Jan 26 14:59:59 2023 GMT

    Signature Algorithm: sha512WithRSAEncryption
         0b:b6:61:e4:03:5f:98:6f:10:1c:9a:f7:5f:6f:c7:e3:f4:72:
         f2:30:f4:86:88:9a:b9:ba:1e:d6:f6:47:af:dc:ea:e4:cd:31:
         af:e3:7a:20:35:9e:60:db:28:9c:7f:2e:17:7b:a5:11:40:4f:
         1e:72:f7:f8:ef:e3:23:43:1b:bb:28:1a:6f:c6:9c:c5:0c:14:
         d3:5d:bd:9b:6b:28:fb:94:5e:8a:ef:40:20:72:a4:41:df:55:
         cf:f3:db:1b:39:e0:30:63:c9:c7:1f:38:7e:7f:ec:f4:25:7b:
         1e:95:4c:70:6c:83:17:c3:db:b2:47:e1:38:53:ee:0a:55:c0:
         15:6a:82:20:b2:ea:59:eb:9c:ea:7e:97:aa:50:d7:bc:28:60:
         8c:d4:21:92:1c:13:19:b4:e0:66:cb:59:ed:2e:f8:dc:7b:49:
         e3:40:f2:b6:dc:d7:2d:2e:dd:21:82:07:bb:3a:55:99:f7:59:
         5d:4a:4d:ca:e7:8f:1c:d3:9a:3f:17:7b:7a:c4:57:b2:57:a8:
         b4:c0:a5:02:bd:59:9c:50:32:ff:16:b1:65:3a:9c:8c:70:3b:
         9e:be:bc:4f:f9:86:97:b1:62:3c:b2:a9:46:08:be:6b:1b:3c:
         24:14:59:28:c6:ae:e8:d5:64:b2:f8:cc:28:24:5c:b2:c8:d8:
         5a:af:9d:55:48:96:f6:3e:c6:bf:a6:0c:a4:c0:ab:d6:57:03:
         2b:72:43:b0:6a:9f:52:ef:43:bb:14:6a:ce:66:cc:6c:4e:66:
         17:20:a3:64:e0:c6:d1:82:0a:d7:41:8a:cc:17:fd:21:b5:c6:
         d2:3a:af:55:2e:2a:b8:c7:21:41:69:e1:44:ab:a1:dd:df:6d:
         15:99:90:cc:a0:74:1e:e5:2e:07:3f:50:e6:72:a6:b9:ae:fc:
         44:15:eb:81:3d:1a:f8:17:b6:0b:ff:05:76:9d:30:06:40:72:
         cf:d5:c4:6f:8b:c9:14:76:09:6b:3d:6a:70:2c:5a:c4:51:92:
         e5:cd:84:b6:f9:d9:d5:bc:8d:72:b7:7c:13:9c:41:89:a8:97:
         6f:4a:11:5f:8f:b6:c9:b5:df:00:7e:97:20:e7:29:2e:2b:12:
         77:dc:e2:63:48:87:42:49:1d:fc:d0:94:a8:8d:18:f9:07:85:
```

```
                    e4:d0:3e:9a:4a:d7:d5:d0:02:51:c3:51:1c:73:12:96:2d:75:
                    22:83:a6:70:5a:4a:2b:f2:98:d9:ae:1b:57:53:3d:3b:58:82:
                    38:fc:fa:cb:57:43:3f:3e:7e:e0:6d:5b:d6:fc:67:7e:07:7e:
                    fb:a3:76:43:26:8f:d1:42:d6:a6:33:4e:9e:e0:a0:51:b4:c4:
                    bc:e3:10:0d:bf:23:6c:4b
WARNING: no nonce in response
Response Verify OK
Certificate-GCP-CVO-20230119-0XXXXX.pem: good
    This Update: Jan 19 15:00:00 2023 GMT
    Next Update: Jan 26 14:59:59 2023 GMT

# Step 1.5 - Optional: Check the response file "response.der" has
been generated. Verify its contents.
$ ls -l
total 64
-rw-r--r--@ 1 example-user  engr  8537 Jan 19 15:42 Certificate-
Chain-GCP-CVO-20230119-0XXXXX.pem
-rw-r--r--@ 1 example-user  engr  2365 Jan 19 15:42 Certificate-GCP-
CVO-20230119-0XXXXX.pem
-rw-r--r--  1 example-user  engr   120 Jan 19 16:50 req.der
-rw-r--r--  1 example-user  engr   806 Jan 19 16:51 resp.der

# Step 1.6 - Verify the chain of trust and expiration dates against
the local host
$ openssl version -d
OPENSSLDIR: "/private/etc/ssl"
$ OPENSSLDIR=$(openssl version -d | cut -d '"' -f2)
$ echo $OPENSSLDIR
/private/etc/ssl

$ openssl verify -untrusted <Certificate-Chain.pem> -CApath <OpenSSL
dir> <Certificate.pem>
$ openssl verify -untrusted Certificate-Chain-GCP-CVO-20230119-
0XXXXX.pem -CApath ${OPENSSLDIR} Certificate-GCP-CVO-20230119-
0XXXXX.pem
Certificate-GCP-CVO-20230119-0XXXXX.pem: OK
```

2. Place the downloaded disk.raw file, the signature, and certificates in a directory.

3. Extract the public key from the certificate using OpenSSL.

4. Decrypt the signature using the extracted public key and verify the contents of the downloaded disk.raw file.

```
# Step 1 - Place the downloaded disk.raw, the signature and the
certificates in a directory
$ ls -l
-rw-r--r--@ 1 example-user  staff  Jan 19 15:42 Certificate-Chain-
GCP-CVO-20230119-0XXXXX.pem
-rw-r--r--@ 1 example-user  staff  Jan 19 15:42 Certificate-GCP-CVO-
20230119-0XXXXX.pem
-rw-r--r--@ 1 example-user  staff  Jan 19 15:42 GCP_CVO_20230119-
XXXXXX_digest.sig
-rw-r--r--@ 1 example-user  staff  Jan 19 16:39 disk.raw

# Step 2 - Extract the public key from the certificate
$ openssl x509 -pubkey -noout -in (certificate.pem) >
(public_key.pem)
$ openssl x509 -pubkey -noout -in Certificate-GCP-CVO-20230119-
0XXXXX.pem > CVO-GCP-pubkey.pem

$ ls -l
-rw-r--r--@ 1 example-user  staff  Jan 19 15:42 Certificate-Chain-
GCP-CVO-20230119-0XXXXX.pem
-rw-r--r--@ 1 example-user  staff  Jan 19 15:42 Certificate-GCP-CVO-
20230119-0XXXXX.pem
-rw-r--r--@ 1 example-user  staff  Jan 19 17:02 CVO-GCP-pubkey.pem
-rw-r--r--@ 1 example-user  staff  Jan 19 15:42 GCP_CVO_20230119-
XXXXXX_digest.sig
-rw-r--r--@ 1 example-user  staff  Jan 19 16:39 disk.raw

# Step 3 - Decrypt the signature using the extracted public key and
verify the contents of the downloaded disk.raw
$ openssl dgst -verify (public_key) -keyform PEM -sha256 -signature
(signed digest) -binary (downloaded or obtained disk.raw)
$ openssl dgst -verify CVO-GCP-pubkey.pem -keyform PEM -sha256
-signature GCP_CVO_20230119-XXXXXX_digest.sig -binary disk.raw
Verified OK

# A failed response would look like this
$ openssl dgst -verify CVO-GCP-pubkey.pem -keyform PEM -sha256
-signature GCP_CVO_20230119-XXXXXX_digest.sig -binary
../sample_file.txt
Verification Failure
```