



# **Security and data encryption**

## **Cloud Volumes ONTAP**

NetApp

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# Table of Contents

- Security and data encryption ..... 1
  - Encrypting volumes with NetApp encryption solutions. .... 1
  - Manage keys with AWS Key Management Service ..... 1
  - Manage keys with Azure Key Vault ..... 2
  - Manage keys with Google’s Cloud Key Management Service. .... 10
  - Improving protection against ransomware ..... 12

# Security and data encryption

## Encrypting volumes with NetApp encryption solutions

Cloud Volumes ONTAP supports NetApp Volume Encryption (NVE) and NetApp Aggregate Encryption (NAE). NVE and NAE are software-based solutions that enable FIPS 140-2–compliant data-at-rest encryption of volumes. [Learn more about these encryption solutions.](#)

Both NVE and NAE are supported with an external key manager.

If you use NVE, you have the option to use your cloud provider's key vault to protect ONTAP encryption keys:

- AWS Key Management Service (beginning in 9.12.0)
- Azure Key Vault (AKV)
- Google Cloud Key Management Service

New aggregates will have NAE enabled by default after you set up an external key manager. New volumes that aren't part of an NAE aggregate will have NVE enabled by default (for example, if you have existing aggregates that were created before setting up an external key manager).

Cloud Volumes ONTAP doesn't support onboard key management.

### What you'll need

Your Cloud Volumes ONTAP system should be registered with NetApp support. A NetApp Volume Encryption license is automatically installed on each Cloud Volumes ONTAP system that is registered with NetApp Support.

- [Adding NetApp Support Site accounts to BlueXP](#)
- [Registering pay-as-you-go systems](#)



BlueXP doesn't install the NVE license on systems that reside in the China region.

### Steps

1. Review the list of supported key managers in the [NetApp Interoperability Matrix Tool](#).



Search for the **Key Managers** solution.

2. [Connect to the Cloud Volumes ONTAP CLI](#).
3. Configure external key management.
  - AWS: [AWS Key Management Service](#)
  - Azure: [Azure Key Vault \(AKV\)](#)
  - Google Cloud: [Google Cloud Key Management Service](#)

## Manage keys with AWS Key Management Service

You can use [AWS's Key Management Service \(KMS\)](#) to protect your ONTAP encryption

keys in an AWS-deployed application.

Key management with the AWS KMS can be enabled with the CLI or the ONTAP REST API.

When using the KMS, be aware that by default a data SVM's LIF is used to communicate with the cloud key management endpoint. A node management network is used to communicate with AWS's authentication services. If the cluster network is not configured correctly, the cluster will not properly utilize the key management service.

#### Before you begin

- Cloud Volumes ONTAP must be running version 9.12.0 or later
- You must have installed the Volume Encryption (VE) license and
- You must have installed the Multi-tenant Encryption Key Management (MTEKM) license installed.
- You must be a cluster or SVM administrator
- You must have an active AWS subscription



You can only configure keys for a data SVM.

## Configuration

### AWS

1. You must create a [grant](#) for the AWS KMS key that will be used by the IAM role managing encryption. The IAM role must include a policy that allows the following operations:
  - DescribeKey
  - Encrypt
  - DecryptTo create a grant, refer to [AWS documentation](#).
2. [Add a policy to the appropriate IAM role](#). The policy should support the DescribeKey, Encrypt, and Decrypt operations.

### Cloud Volumes ONTAP

1. Switch to your Cloud Volumes ONTAP environment.
2. Switch to the advanced privilege level:  

```
set -privilege advanced
```
3. Enable the AWS key manager:  

```
security key-manager external aws enable -vserver data_svm_name -region AWS_region -key-id key_ID -encryption-context encryption_context
```
4. When prompted, enter the secret key.
5. Confirm the AWS KMS was configured correctly:  

```
security key-manager external aws show -vserver svm_name
```

## Manage keys with Azure Key Vault

You can use [Azure Key Vault \(AKV\)](#) to protect your ONTAP encryption keys in an Azure-deployed application.

AKV can be used to protect [NetApp Volume Encryption \(NVE\) keys](#) only for data SVMs.

Key management with AKV can be enabled with the CLI or the ONTAP REST API.

When using AKV, be aware that by default a data SVM LIF is used to communicate with the cloud key management endpoint. A node management network is used to communicate with the cloud provider's authentication services (login.microsoftonline.com). If the cluster network is not configured correctly, the cluster will not properly utilize the key management service.

### Before you begin

- Cloud Volumes ONTAP must be running version 9.10.1 or later
- Volume Encryption (VE) license installed (NetApp Volume Encryption license is automatically installed on each Cloud Volumes ONTAP system that is registered with NetApp Support)
- You must have a Multi-tenant Encryption Key Management (MT\_EK\_MGMT) license
- You must be a cluster or SVM administrator
- An Active Azure subscription

### Limitations

- AKV can only be configured on a data SVM
- NAE can not be used using AKV. NAE requires an external-supported KMIP server.

## Configuration process

The outlined steps capture how to register your Cloud Volumes ONTAP configuration with Azure and how to create an Azure Key Vault and keys. If you have already completed these steps, ensure you have the correct configuration settings, particularly in [Create an Azure Key Vault](#), and then proceed to [Cloud Volumes ONTAP configuration](#).

- [Azure Application Registration](#)
- [Create Azure client secret](#)
- [Create an Azure Key Vault](#)
- [Create encryption key](#)
- [Create an Azure Active Directory Endpoint \(HA only\)](#)
- [Cloud Volumes ONTAP configuration](#)

### Azure Application Registration

1. You must first register your application in the Azure subscription that you want the Cloud Volumes ONTAP to use for access the Azure Key Vault. Within the Azure portal, select **App registrations**.
2. Select **New registration**.
3. Provide a name for your application and select a supported application type. The default single tenant suffices for Azure Key Vault usage. Select **Register**.
4. In the Azure Overview window, select the application you have registered. Copy the **application (client) ID** and the **directory (tenant) ID** to a secure location. They will be required later in the registration process.

### Create Azure client secret

1. In the Azure portal for your Azure Key Vault app registration, select the **Certificates & secrets** pane.
2. Select **New client secret**. Enter a meaningful name for your client secret. NetApp recommends a 24-

month expiration period; however, your specific cloud governance policies may require a different setting.

3. Click **Add** to create the client secret. Copy the secret string listed in the **Value** column and store it in a secure location for use later in [Cloud Volumes ONTAP configuration](#). The secret value will not be displayed again after you navigate away from the page.

### Create an Azure Key Vault

1. If you have an existing Azure Key Vault, you can connect it to your Cloud Volumes ONTAP configuration; however, you must adapt the access policies to the settings in this process.
2. In the Azure portal, navigate to the **Key Vaults** section.
3. Click **+Create** and enter the required information including resource group, region, and pricing tier. In addition, enter the number of days to retain deleted vaults and select **Enable purge protection** on the key vault.
4. Select **Next** to choose an access policy.
5. Select the following options:
  - a. Under **Access configuration**, select the **Vault access policy**.
  - b. Under **Resource access**, select **Azure Disk Encryption for volume encryption**.
6. Select **+Create** to add an access policy.
7. Under **Configure from a template**, click the drop-down menu and then select the **Key, Secret, and Certificate Management** template.
8. Choose each of the drop-down permissions menus (key, secret, certificate) and then **Select all** at the top of the menu list to select all the permissions available. You should have:
  - **Key permissions:** 20 selected
  - **Secret permissions:** 8 selected
  - **Certificate permissions:** 16 selected

# Create an access policy



- 1 Permissions   2 Principal   3 Application (optional)   4 Review + create

Configure from a template

Key, Secret, & Certificate Management

## Key permissions

### Key Management Operations

- ☒ Select all
- ☒ Get
- ☒ List
- ☒ Update
- ☒ Create
- ☒ Import
- ☒ Delete
- ☒ Recover
- ☒ Backup
- ☒ Restore

### Cryptographic Operations

- ☒ Select all
- ☒ Decrypt
- ☒ Encrypt
- ☒ Unwrap Key
- ☒ Wrap Key
- ☒ Verify
- ☒ Sign

### Privileged Key Operations

- ☒ Select all
- ☒ Purge
- ☒ Release

### Rotation Policy Operations

- ☒ Select all
- ☒ Rotate
- ☒ Get Rotation Policy
- ☒ Set Rotation Policy

## Secret permissions

### Secret Management Operations

- ☒ Select all
- ☒ Get
- ☒ List
- ☒ Set
- ☒ Delete
- ☒ Recover
- ☒ Backup
- ☒ Restore

### Privileged Secret Operations

- ☒ Select all
- ☒ Purge

## Certificate permissions

### Certificate Management Operations

- ☒ Select all
- ☒ Get
- ☒ List
- ☒ Update
- ☒ Create
- ☒ Import
- ☒ Delete
- ☒ Recover
- ☒ Backup
- ☒ Restore
- ☒ Manage Contacts
- ☒ Manage Certificate Authorities
- ☒ Get Certificate Authorities
- ☒ List Certificate Authorities
- ☒ Set Certificate Authorities
- ☒ Delete Certificate Authorities

### Privileged Certificate Operations

- ☒ Select all
- ☒ Purge

Previous

Next

- Click **Next** to select the **Principal** Azure registered application you created in [Azure Application Registration](#). Select **Next**.



Only one principal can be assigned per policy.

### Create an access policy

Permissions **Principal** Application (optional) Review + create

Only 1 principal can be assigned per access policy.  
Use the new embedded experience to select a principal. The previous popup experience can be accessed here. [Select a principal](#)

**Selected item**  
No item selected

Previous **Next**

- Click **Next** two times until you arrive at **Review and create**. Then, click **Create**.
- Select **Next** to advance to **Networking** options.
- Choose the appropriate network access method or select **All networks** and **Review + Create** to create the key vault. (Network access method may be prescribed by a governance policy or your corporate cloud security team.)
- Record the Key Vault URI: In the key vault you created, navigate to the Overview menu and copy the **Vault URI** from the right-hand column. You need this for a later step.

#### Create encryption key

- In the menu for the Key Vault you have created for Cloud Volumes ONTAP, navigate to the **Keys** option.
- Select **Generate/import** to create a new key.
- Leave the default option set to **Generate**.
- Provide the following information:
  - Encryption key name



- Key type: RSA
- RSA key size: 2048
- Enabled: Yes

5. Select **Create** to create the encryption key.
6. Return to the **Keys** menu and select the key you just created.
7. Select the key ID under **Current version** to view the key properties.
8. Locate the **Key Identifier** field. Copy the URI up to but not including the hexadecimal string.

#### **Create an Azure Active Directory Endpoint (HA only)**

1. This process is only required if you are configuring Azure Key Vault for an HA Cloud Volumes ONTAP Working Environment.
2. In the Azure portal navigate to **Virtual Networks**.
3. Select the Virtual Network where you deployed the Cloud Volumes ONTAP working environment and select the **Subnets** menu on the left side of the page.
4. Select the subnet name for you Cloud Volumes ONTAP deployment from the list.
5. Navigate to the **Service Endpoints** heading. In the drop-down menu, select the following:
  - **Microsoft.AzureActiveDirectory**
  - **Microsoft.KeyVault**
  - **Microsoft.Storage** (optional)

### SERVICE ENDPOINTS

Create service endpoint policies to allow traffic to specific azure resources from your virtual network over service endpoints. [Learn more](#)

Services ⓘ

3 selected

Service	Status	
Microsoft.Storage	Succeeded	
Microsoft.AzureActiveDirectory	Succeeded	
Microsoft.KeyVault	Succeeded	

Service endpoint policies

0 selected

### SUBNET DELEGATION

Delegate subnet to a service ⓘ

None

### NETWORK POLICY FOR PRIVATE ENDPOINTS

The network policy affects all private endpoints in this subnet. To use network security groups, application security groups, or user defined routes to control traffic going to a private endpoint, set the private endpoint network policy to enabled. [Learn more](#)

Private endpoint network policy

Disabled

Save

Cancel

6. Select **Save** to capture your settings.

#### Cloud Volumes ONTAP configuration

1. Connect to the cluster management LIF with your preferred SSH client.
2. Enter the advanced privilege mode in ONTAP:

```
set advanced -con off
```

3. Identify the desired data SVM and verify its DNS configuration:

```
vserver services name-service dns show
```

- a. If a DNS entry for the desired data SVM exists and it contains an entry for the Azure DNS, then no action is required. If it does not, add a DNS server entry for the data SVM that points to the Azure DNS, private DNS, or on-premise server. This should match the entry for the cluster admin SVM:

```
vserver services name-service dns create -vserver SVM_name -domains domain
-name-servers IP_address
```

- b. Verify the DNS service has been created for the data SVM:

```
vserver services name-service dns show
```

4. Enable Azure Key Vault using the client ID and tenant ID saved after the application registration:

```
security key-manager external azure enable -vserver SVM_name -client-id
Azure_client_ID -tenant-id Azure_tenant_ID -name key_vault_URI -key-id
full_key_URI
```



The `_full_key_URI` value must utilize the `<https:// <key vault host name>/keys/<key label>` format.

5. Upon successful enablement of the Azure Key Vault, enter the `client secret` value when prompted.

6. Check the status of the key manager:

```
security key-manager external azure check
```

The output will look like:

```
::*> security key-manager external azure check
```

```
Vserver: data_svm_name
```

```
Node: akvlab01-01
```

```
Category: service_reachability
```

```
Status: OK
```

```
Category: ekvip_server
```

```
Status: OK
```

```
Category: kms_wrapped_key_status
```

```
Status: UNKNOWN
```

```
Details: No volumes created yet for the vserver. Wrapped KEK status
will be available after creating encrypted volumes.
```

```
3 entries were displayed.
```

If the `service_reachability` status is not OK, the SVM cannot reach the Azure Key Vault service with all the required connectivity and permissions. Ensure that your Azure network policies and routing don't block your private vNet from reaching the Azure KeyVault Public endpoint. If they do, consider using an Azure Private endpoint to access the Key vault from within the vNet. You may also need to add a static hosts entry on your SVM to resolve the private IP address for your endpoint.

The `kms_wrapped_key_status` will report UNKNOWN at initial configuration. Its status will change to OK after the first volume is encrypted.

7. OPTIONAL: Create a test volume to verify the functionality of NVE.

```
vol create -vserver SVM_name -volume volume_name -aggregate aggr -size size  
-state online -policy default
```

If configured correctly, Cloud Volumes ONTAP will automatically create the volume and enable volume encryption.

8. Confirm the volume was created and encrypted correctly. If it is, the `-is-encrypted` parameter will display as `true`.

```
vol show -vserver SVM_name -fields is-encrypted
```

## Manage keys with Google's Cloud Key Management Service

You can use [Google Cloud Platform's Key Management Service \(Cloud KMS\)](#) to protect your ONTAP encryption keys in a Google Cloud Platform-deployed application.

Key management with Cloud KMS can be enabled with the CLI or the ONTAP REST API.

When using Cloud KMS, be aware that by default a data SVM's LIF is used to communicate with the cloud key management endpoint. A node management network is used to communicate with the cloud provider's authentication services ([oauth2.googleapis.com](#)). If the cluster network is not configured correctly, the cluster will not properly utilize the key management service.

### Before you begin

- Cloud Volumes ONTAP must be running version 9.10.1 or later
- Volume Encryption (VE) license installed
- Multi-tenant Encryption Key Management (MTEKM) license installed, starting with Cloud Volumes ONTAP 9.12.1 GA.
- You must be a cluster or SVM administrator
- An active Google Cloud Platform subscription

### Limitations

- Cloud KMS can only be configured on a data SVM

## Configuration

### Google Cloud

1. In your Google Cloud environment, [create a symmetric GCP key ring and key](#).
2. Create a custom role for your Cloud Volumes ONTAP service account.

```
gcloud iam roles create kmsCustomRole
  --project=<project_id>
  --title=<kms_custom_role_name>
  --description=<custom_role_description>

  --permissions=cloudkms.cryptoKeyVersions.get,cloudkms.cryptoKeyVersions.
list,cloudkms.cryptoKeyVersions.useToDecrypt,cloudkms.cryptoKeyVersions.
useToEncrypt,cloudkms.cryptoKeys.get,cloudkms.keyRings.get,cloudkms.loca
tions.get,cloudkms.locations.list,resourceManager.projects.get
  --stage=GA
```

3. Assign the custom role to the Cloud KMS key and Cloud Volumes ONTAP service account:

```
gcloud kms keys add-iam-policy-binding key_name --keyring key_ring_name
--location key_location --member serviceAccount:_service_account_Name_ --role
projects/customer_project_id/roles/kmsCustomRole
```

4. Download service account JSON key:

```
gcloud iam service-accounts keys create key-file --iam-account=sa-name
@project-id.iam.gserviceaccount.com
```

## Cloud Volumes ONTAP

1. Connect to the cluster management LIF with your preferred SSH client.

2. Switch to the advanced privilege level:

```
set -privilege advanced
```

3. Create a DNS for the data SVM.

```
dns create -domains c.<project>.internal -name-servers server_address -vserver
SVM_name
```

4. Create CMEK entry:

```
security key-manager external gcp enable -vserver SVM_name -project-id project
-key-ring-name key_ring_name -key-ring-location key_ring_location -key-name
key_name
```

5. When prompted, enter the service account JSON key from your GCP account.

6. Confirm the enabled process succeeded:

```
security key-manager external gcp check -vserver svm_name
```

7. OPTIONAL: Create a volume to test encryption `vol create volume_name -aggregate aggregate -vserver vserver_name -size 10G`

## Troubleshoot

If you need to troubleshoot, you can tail the raw REST API logs in the final two steps above:

1. `set d`
2. `systemshell -node node -command tail -f /mroot/etc/log/mlog/kmip2_client.log`

# Improving protection against ransomware









Ransomware attacks can cost a business time, resources, and reputation. BlueXP enables you to implement two NetApp solutions for ransomware: Protection from common ransomware file extensions and Autonomous Ransomware Protection (ARP). These solutions provide effective tools for visibility, detection, and remediation.

## Protection from common ransomware file extensions

Available through BlueXP, the Ransomware Protection setting allows you to utilize the ONTAP FPolicy functionality to guard against common ransomware file extension types.

### Steps

1. On the Canvas page, double-click the name of the system you configure to ransomware protection.
2. On the Overview tab, click the Features panel and then click the pencil icon next to **Ransomware Protection**.

Information		Features
Working Environment Tags		Tags 
Scheduled Downtime		Off 
S3 Storage Classes	Standard-Infrequent Access	
Instance Type	m5.xlarge	
Write Speed	Normal	
Ransomware Protection	Off	
Support Registration	Not Registered	
CIFs Setup		

3. Implement the NetApp solution for ransomware:

- Click **Activate Snapshot Policy**, if you have volumes that do not have a Snapshot policy enabled.

NetApp Snapshot technology provides the industry's best solution for ransomware remediation. The key to a successful recovery is restoring from uninfected backups. Snapshot copies are read-only, which prevents ransomware corruption. They can also provide the granularity to create images of a single file copy or a complete disaster recovery solution.

- b. Click **Activate FPolicy** to enable ONTAP's FPolicy solution, which can block file operations based on a file's extension.

This preventative solution improves protection from ransomware attacks by blocking common ransomware file types.

The default FPolicy scope blocks files that have the following extensions:

micro, encrypted, locked, crypto, crypt, crinf, r5a, XRNT, XTBL, R16M01D05, pzdc, good, LOL!, OMG!, RDM, RRK, encryptedRS, crjoker, EnCiPhErEd, LeChiffre



BlueXP creates this scope when you activate FPolicy on Cloud Volumes ONTAP. The list is based on common ransomware file types. You can customize the blocked file extensions by using the `vserver fpolicy policy scope` commands from the Cloud Volumes ONTAP CLI.

### Ransomware Protection

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

#### 1 Enable Snapshot Copy Protection ⓘ

50 %  
Protection

1 Volumes without a Snapshot Policy

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

Activate Snapshot Policy

#### 2 Block Ransomware File Extensions ⓘ

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

View Denied File Names ⓘ

Activate FPolicy

## Autonomous Ransomware Protection

Cloud Volumes ONTAP supports the Autonomous Ransomware Protection (ARP) feature, which performs analyses on workloads to proactively detect and warn about abnormal activity that might indicate a ransomware attack.

Separate from the file extension protections provided through the [ransomware protection setting](#), the ARP feature uses workload analysis to alert the user on potential attacks based on detected “abnormal activity”. Both the ransomware protection setting and the ARP feature can be used in conjunction for comprehensive ransomware protection.

The ARP feature is available for use with BYOL licenses only (1 to 36 month terms) on both node-based and capacity-based licensing models. You must contact your NetApp sales representative to purchase a new, separate, add-on license for use with the ARP feature in Cloud Volumes ONTAP.

The ARP license is considered a "floating" license, which means it is not bound to a single Cloud Volumes ONTAP instance and can be applied to multiple Cloud Volumes ONTAP environments.





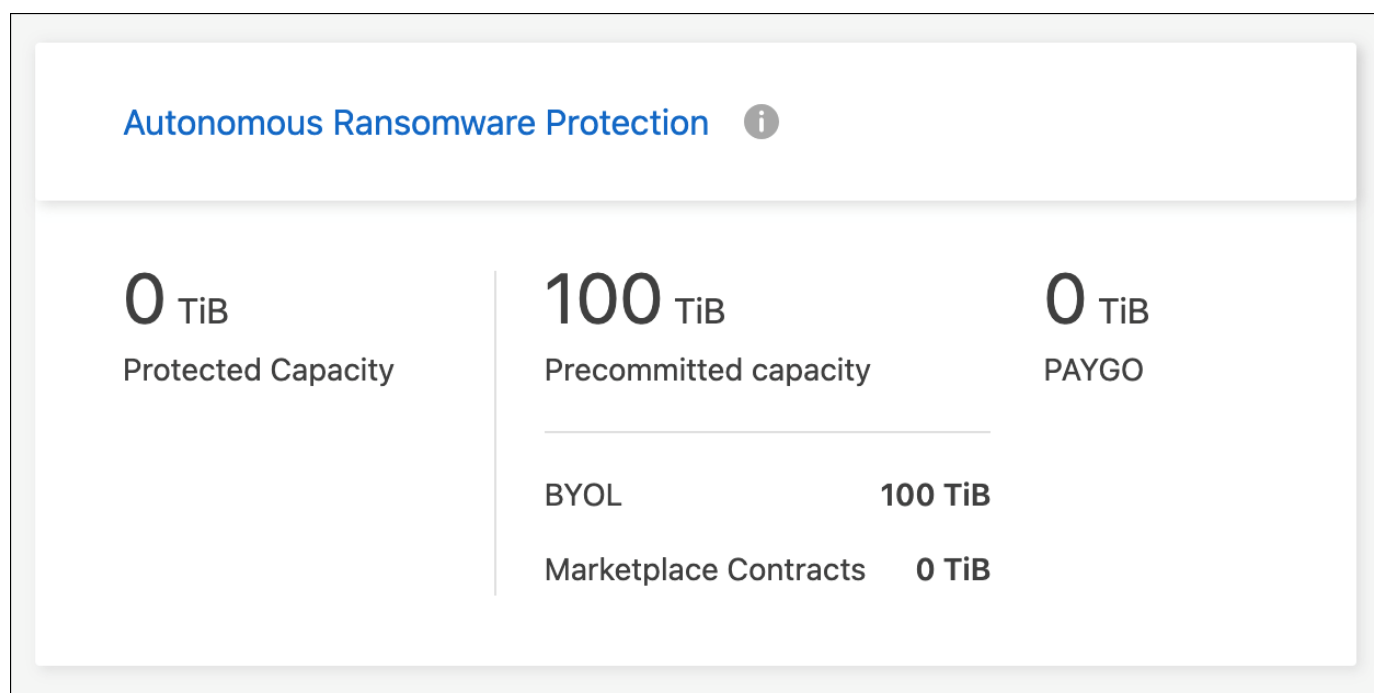
The usage of the ARP feature with node-based Cloud Volumes ONTAP licenses is not currently reflected in Digital Wallet. The ability to view node-based ARP usage will be available under Digital Wallet in a future release.

Upon purchase of an add-on license and adding it to the Digital Wallet, you can enable ARP on a per volume basis with Cloud Volumes ONTAP. Charging for ARP is metered at a volume level, according to the total provisioned capacity of volumes with the ARP feature enabled. The minimum license capacity is 1TB. However, there is no minimum capacity charging for the ARP feature.

ARP enabled volumes have a designated state of "Learning mode" or "Active". Any volume with an ARP state of "Disabled" is excluded from charging. For example, a Cloud Volumes ONTAP environment with 30 TiB of provisioned capacity can elect to have only a subset of 15 TiB volumes with ARP enabled.

Configuration of ARP for volumes is performed through ONTAP System Manager and ONTAP CLI.

For more information on how to enable ARP with ONTAP System Manager and CLI, see [Enable Autonomous Ransomware Protection](#).



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