S3 configuration with the CLI

ONTAP 9

NetApp
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Table of Contents

S3 configuration with the CLI

S3 configuration overview with the CLI

You can use ONTAP 9 CLI commands to configure S3 client access to objects contained in a bucket in an SVM. The procedures include examples and advanced configuration options.

You should use these procedures if you want to configure S3 object storage in the following way:

- You want to provide S3 object storage from an existing cluster running ONTAP.

  ONTAP deployment is appropriate if you want S3 capabilities on existing clusters without additional hardware and management. For deployments larger than 300TB, NetApp StorageGRID software continues to be the NetApp flagship solution for object storage.

- You want to use the command-line interface (CLI), not System Manager or an automated scripting tool.

  If you want the ability to specify which aggregates are used for buckets, you can only do so using the CLI.

- You want to use best practices, not explore every available option.

  Details about command syntax are available from CLI help and ONTAP man pages.

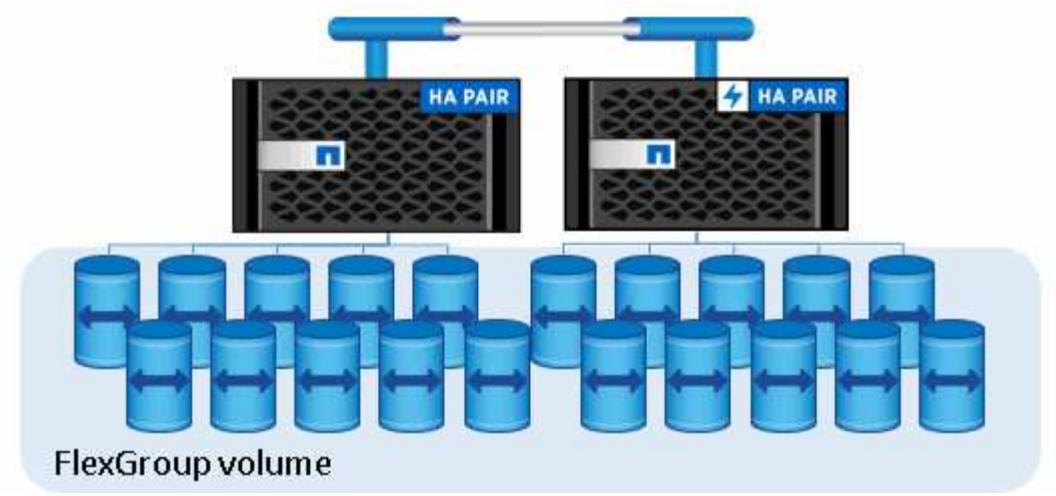
  Additional information about ONTAP technology and interaction with external services is available in the ONTAP Reference Library and in Technical Reports (TRs).

- You have cluster administrator privileges, not SVM administrator privileges.

S3 support in ONTAP 9

ONTAP S3 architecture and use cases

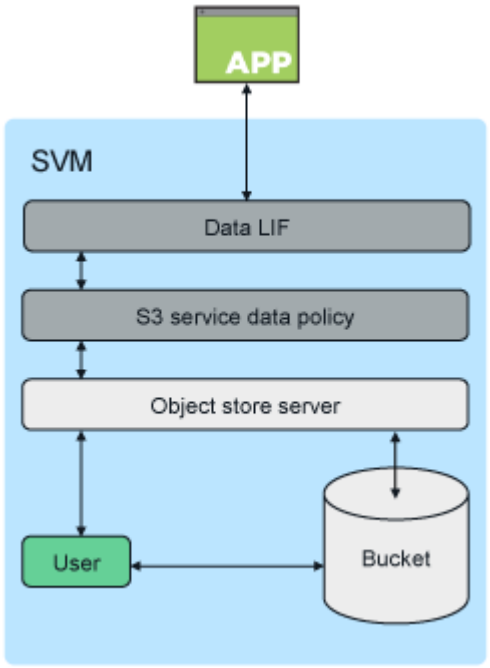
In ONTAP, the underlying architecture for a bucket is a FlexGroup volume—a single namespace that is made up of multiple constituent member volumes but is managed as a single volume.



Buckets are only limited by the physical maximums of the underlying hardware, architectural maximums could be higher. Buckets can take advantage of FlexGroup elastic sizing to automatically grow a constituent of a FlexGroup volume if it is running out of space. There is a limit of 1000 buckets per FlexGroup volume, or 1/3 of the FlexGroup volume's capacity (to account for data growth in buckets).

No NAS or SAN protocol access is permitted to the FlexGroup volume that contain S3 buckets.

Access to the bucket is provided through authorized users and client applications.



There are three primary use cases for client access to ONTAP S3 services:

- For ONTAP systems using ONTAP S3 as a remote FabricPool capacity (cloud) tier

  The S3 server and bucket containing the capacity tier (for *cold* data) is on a different cluster than the performance tier (for *hot* data).

- For ONTAP systems using ONTAP S3 as a local FabricPool tier

The S3 server and bucket containing the capacity tier is on the same cluster, but on a different HA pair, as the performance tier.

- For external S3 client apps

  ONTAP S3 serves S3 client apps run on non-NetApp systems.

It is a best practice to provide access to ONTAP S3 buckets using HTTPS. When HTTPS is enabled, security certificates are required for proper integration with SSL/TLS. Client users' access and secret keys are then required to authenticate the user with ONTAP S3 as well as authorizing the users' access permissions for operations within ONTAP S3. The client application should also have access to the root CA certificate (the ONTAP S3 server's signed certificate) to be able to authenticate the server and create a secure connection between client and server.

Users are created within the S3-enabled SVM, and their access permissions can be controlled at the bucket or SVM level; that is, they can be granted access to one or more buckets within the SVM.

HTTPS is enabled by default on ONTAP S3 servers. It is possible to disable HTTPS and enable HTTP for client access, in which case authentication using CA certificates is not required. However, when HTTP is enabled and HTTPS is disabled, all communication with the ONTAP S3 server are sent over the network in clear text.

For additional information, see Technical Report: S3 in ONTAP Best Practices

Related information

FlexGroup volumes management

ONTAP version support for S3 object storage

In ONTAP 9.7, S3 object storage was introduced as a public preview. That version was not intended for production environments and will no longer be updated as of ONTAP 9.8. Only ONTAP 9.8 and later releases support S3 object storage in production environments.

S3 buckets created with the 9.7 public preview can be used in ONTAP 9.8 and later, but cannot take advantage of feature enhancements. If you have buckets created with the 9.7 public preview, you should migrate the contents of those buckets to 9.8 buckets for feature support, security, and performance enhancements.

In ONTAP 9.9.1 and later releases, ONTAP S3 is supported with Cloud Volumes ONTAP for Azure, but not for AWS or Google Cloud.

ONTAP S3 supported actions

Bucket operations

Actions marked with an asterisk are supported by ONTAP, not S3 REST APIs

- DeleteBucket*
- DeleteBucketPolicy*
- GetBucketAcl
- HeadBucket

- ListBuckets
- PutBucket*

Object operations

Beginning with ONTAP 9.9.1, ONTAP S3 supports object metadata and tagging.

- PutObject and CreateMultipartUpload now include key-value pairs using `x-amz-meta-<key>.`

  For example: `x-amz-meta-project: ontap_s3`.

- GetObject. and HeadObject now return user-defined metadata.
- Unlike metadata, tags can be read independently of objects using:
  - PutObjectTagging
  - GetObjectTagging
  - DeleteObjectTagging

Supported object actions:

- PutObject
- PutObjectTagging (beginning with ONTAP 9.9.1)
- GetObject
- GetObjectAcl
- GetObjectTagging (beginning with ONTAP 9.9.1)
- DeleteObject
- DeleteObjectTagging (beginning with ONTAP 9.9.1)
- HeadObject
- ListObjects
- ListObjectsV2
- ListParts
- UploadPart
- AbortMultipartUpload
- CompleteMultipartUpload
- CreateMultipartUpload
- ListMultipartUpload

Group policies

These operations are not specific to S3 and are generally associated with Identity and Management (IAM) processes. ONTAP supports these commands but does not use the IAM REST APIs.

- Create Policy
- AttachGroup Policy

User management

These operations are not specific to S3 and are generally associated with IAM processes.

- CreateUser
- DeleteUser
- CreateGroup
- DeleteGroup

ONTAP S3 interoperability

The ONTAP S3 server interacts normally with other ONTAP functionality except as noted in this table.

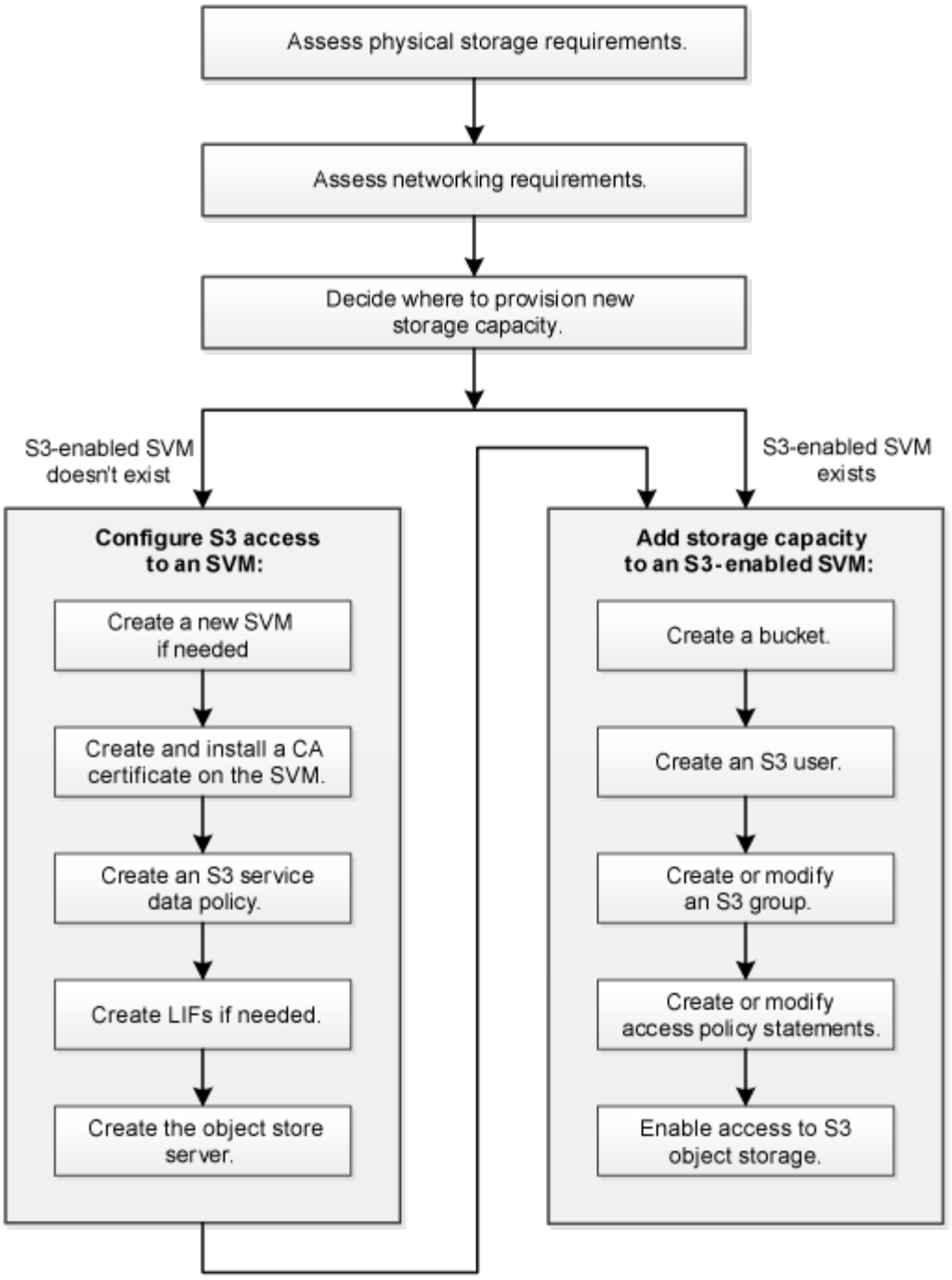
Feature area	Supported	Not supported
Cloud Volumes ONTAP	Azure clients in ONTAP 9.9.1 and later releases	Cloud Volumes ONTAP for any client in ONTAP 9.8 and earlier releases
Data protection	• Cloud Sync	• Erasure coding • Information lifecycle management • MetroCluster • NDMP • Object versioning • SMTape • SnapLock • SnapMirror • SnapMirror Cloud • SVM disaster recovery • SyncMirror • User-created Snapshot copies • WORM
Encryption	• NetApp Aggregate Encryption (NAE) • NetApp Volume Encryption (NVE) • NetApp Storage Encryption (NSE) • TLS/SSL	• SLAG

Feature area	Supported	Not supported
Storage efficiency	• Deduplication • Compression • Compaction	• Aggregate-level efficiencies • Volume clone of the FlexGroup volume containing ONTAP S3 buckets
Storage virtualization	-	NetApp FlexArray Virtualization
Quality of service (QoS)	• QoS maximums (ceilings) • QoS minimums (floors)	-
Additional features	-	• Audit • FlexCache volumes • FPolicy • Qtrees • Quotas

About the S3 configuration process

S3 configuration workflow

Configuring S3 involves assessing physical storage and networking requirements, and then choosing a workflow that is specific to your goal—configuring S3 access to a new or existing SVM, or adding a bucket and users to an existing SVM that is already fully configured for S3 access.



Assess physical storage requirements

Before provisioning S3 storage for clients, you must ensure that there is sufficient space in existing aggregates for the new object store. If there is not, you can add disks to existing aggregates or create new aggregates of the desired type.

About this task

When you create an S3 bucket in an S3-enabled SVM, a FlexGroup volume is automatically created to support the bucket. You can let ONTAP select the underlying aggregates and FlexGroup components automatically (the default) or you can select the underlying aggregates and FlexGroup components yourself.

If you decide to specify the aggregates and FlexGroup components — for example, if you have specific

performance requirements for the underlying disks — you should make sure that your aggregate configuration conforms to best practice guidelines for provisioning a FlexGroup volume.

FlexGroup volumes management

NetApp Technical Report 4571-a: NetApp ONTAP FlexGroup Volume Top Best Practices

You can use the ONTAP S3 server to create a local FabricPool capacity tier; that is, in the same cluster as the performance tier. This can be useful, for example, if you have SSD disks attached to one HA pair and you want to tier *cold* data to HDD disks in another HA pair. In this use case, the S3 server and the bucket containing the local capacity tier should therefore be in a different HA pair than the performance tier. Local tiering is not supported on one-node and two-node clusters.

Steps

1. Display available space in existing aggregates:

   ```
   storage aggregate show
   ```

   If there is an aggregate with sufficient space, record its name for your S3 configuration.

   ```
   cluster-1::> storage aggregate show
   Aggregate     Size Available Used% State   #Vols  Nodes  RAID Status
   --------- -------- --------- ----- ------- ------ ------ -----------
   aggr_0     239.0GB   11.13GB   95% online       1 node1  raid_dp,
                                                            normal
   aggr_1     239.0GB   11.13GB   95% online       1 node1  raid_dp,
                                                            normal
   aggr_2     239.0GB   11.13GB   95% online       1 node2  raid_dp,
                                                            normal
   aggr_3     239.0GB   11.13GB   95% online       1 node2  raid_dp,
                                                            normal
   aggr_4     239.0GB   238.9GB   95% online       5 node3  raid_dp,
                                                            normal
   aggr_5     239.0GB   239.0GB   95% online       4 node4  raid_dp,
                                                            normal
   6 entries were displayed.
   ```

2. If there are no aggregates with sufficient space, add disks to an existing aggregate by using the `storage aggregate add-disks` command, or create a new aggregate by using the `storage aggregate create` command.

Assess networking requirements

Before providing S3 storage to clients, you must verify that networking is correctly configured to meet the S3 provisioning requirements.

What you'll need

The following cluster networking objects must be configured:

- Physical and logical ports
- Broadcast domains
- Subnets (if required)
- IPspaces (as required, in addition to the default IPspace)
- Failover groups (as required, in addition to the default failover group for each broadcast domain)
- External firewalls

About this task

For remote FabricPool capacity (cloud) tiers and remote S3 clients, you must use a data SVM and configure data LIFs. For FabricPool cloud tiers, you must also configure intercluster LIFs; cluster peering is not required.

For local FabricPool capacity tiers, you must use the system SVM (called “Cluster”), but you have two options for LIF configuration:

- You can use the cluster LIFs.

  In this option, no further LIF configuration is required, but there will be an increase in traffic on the cluster LIFs. Also, the local tier will not be accessible to other clusters.

- You can use data and intercluster LIFs.

  This option requires additional configuration, including enabling the LIFs for the S3 protocol, but the local tier will also be accessible as a remote FabricPool cloud tier to other clusters.

Steps

1. Display the available physical and virtual ports:

   `network port show`

   - When possible, you should use the port with the highest speed for the data network.
   - All components in the data network must have the same MTU setting for best performance.
2. If you are planning to use a subnet name to allocate the IP address and network mask value for a LIF, verify that the subnet exists and has sufficient addresses available:

   `network subnet show`

   Subnets contain a pool of IP addresses that belong to the same layer 3 subnet. Subnets are created by using the `network subnet create` command.

3. Display available IPspaces:

   `network ipspace show`

   You can use the default IPspace or a custom IPspace.

4. If you want to use IPv6 addresses, verify that IPv6 is enabled on the cluster:

   `network options ipv6 show`

   If required, you can enable IPv6 by using the `network options ipv6 modify` command.

Decide where to provision new S3 storage capacity

Before you create a new S3 bucket, you must decide whether to place it in a new or existing SVM. This decision determines your workflow.

Choices

- If you want to provision a bucket in a new SVM or an SVM that is not enabled for S3, complete the steps in the following topics.

  Configuring S3 access to an SVM

  Adding storage capacity to an S3-enabled SVM

  Although S3 can coexist in an SVM with NFS and SMB, you might choose to create a new SVM if one of the following is true:

  - You are enabling S3 on a cluster for the first time.
  - You have existing SVMs in a cluster in which you do not want to enable S3 support.
  - You have one or more S3-enabled-SVMs in a cluster, and you want another S3 server with different performance characteristics. After enabling S3 on the SVM, proceed to provision a bucket.
- If you want to provision the initial bucket or an additional bucket on an existing S3-enabled SVM, complete the steps in the following topic.

  Adding storage capacity to an S3-enabled SVM

Configure S3 access to an SVM

Create an SVM for S3

Although S3 can coexist in an SVM with other protocols, you might want to create a new SVM to isolate the namespace and workload.

About this task

If you are only providing S3 object storage from this SVM, the S3 server does not require any DNS configuration. However, you might want to configure DNS on the SVM if other protocols are used.

Steps

1. Verify that S3 is licensed on your cluster:

   ```
   system license show -package s3
   ```

   If it is not, contact your sales representative.

2. Create an SVM:

   ```
   vserver create -vserver svm_name -rootvolume root_volume_name -aggregate
   aggregate_name -rootvolume-security-style unix -language C.UTF-8 -ipspace
   ipspace_name
   ```

   - Use the UNIX setting for the `-rootvolume-security-style` option.

- Use the default C.UTF-8 `-language` option.
- The `ipspace` setting is optional.

3. Verify the configuration and status of the newly created SVM:

   `vserver show -vserver svm_name`

   The `Vserver Operational State` field must display the `running` state. If it displays the `initializing` state, it means that some intermediate operation such as root volume creation failed, and you must delete the SVM and re-create it.

Examples

The following command creates an SVM for data access in the IPspace ipspaceA:

```
cluster-1::> vserver create -vserver svm1.example.com -rootvolume
root_svm1 -aggregate aggr1 -rootvolume-security-style unix -language
C.UTF-8 -ipspace ipspaceA

[Job 2059] Job succeeded:
Vserver creation completed
```

The following command shows that an SVM was created with a root volume of 1 GB, and it was started automatically and is in `running` state. The root volume has a default export policy that does not include any rules, so the root volume is not exported upon creation. By default, the vsadmin user account is created and is in the `locked` state. The vsadmin role is assigned to the default vsadmin user account.

```
cluster-1::> vserver show -vserver svm1.example.com
                                    Vserver: svm1.example.com
                               Vserver Type: data
                            Vserver Subtype: default
                               Vserver UUID: b8375669-19b0-11e5-b9d1-
00a0983d9736
                                Root Volume: root_svm1
                                  Aggregate: aggr1
                                NIS Domain: -
                  Root Volume Security Style: unix
                                 LDAP Client: -
               Default Volume Language Code: C.UTF-8
                             Snapshot Policy: default
                                    Comment:
                               Quota Policy: default
                 List of Aggregates Assigned: -
 Limit on Maximum Number of Volumes allowed: unlimited
                         Vserver Admin State: running
                   Vserver Operational State: running
   Vserver Operational State Stopped Reason: -
                          Allowed Protocols: nfs, cifs
                       Disallowed Protocols: -
                           QoS Policy Group: -
                                Config Lock: false
                               IPspace Name: ipspaceA
```

Create and install a CA certificate on the SVM

A Certificate Authority (CA) certificate is required to enable HTTPS traffic from S3 clients to the S3-enabled SVM.

About this task

Although it is possible to configure an S3 server to use HTTP only, and although it is possible to configure clients without a CA certificate requirement, it is a best practice to secure HTTPS traffic to ONTAP S3 servers with a CA certificate.

A CA certificate is not necessary for a local tiering use case, where IP traffic is going over cluster LIFs only.

The instructions in this procedure will create and install an ONTAP self-signed certificate. CA certificates from third-party vendors are also supported; see the administrator authentication documentation for more information.

Administrator authentication and RBAC

See the `security certificate` man pages for additional configuration options.

Steps

1. Create a self-signed digital certificate:

   `security certificate create -vserver svm_name -type root-ca -common-name ca_cert_name`

   The `-type root-ca` option creates and installs a self-signed digital certificate to sign other certificates by acting as a certificate authority (CA).

   The `-common-name` option creates the SVM's Certificate Authority (CA) name and will be used when generating the certificate's complete name.

   The default certificate size is 2048 bits.

   Example

   ```
   cluster-1::> security certificate create -vserver svm1.example.com -type
   root-ca -common-name svm1_ca

   The certificate's generated name for reference:
   svm1_ca_159D1587CE21E9D4_svm1_ca
   ```

   When the certificate's generated name is displayed; be sure to save it for later steps in this procedure.

2. Generate a certificate signing request:

   `security certificate generate-csr -common-name s3_server_name [additional_options]`

   The `-common-name` parameter for the signing request must be the S3 server name (FQDN).

   You can provide the location and other detailed information about the SVM if desired.

   You are prompted to keep a copy of your certificate request and private key for future reference.

3. Sign the CSR using SVM_CA to generate S3 Server's certificate:

   `security certificate sign -vserver svm_name -ca ca_cert_name -ca-serial ca_cert_serial_number [additional_options]`

   Enter the command options that you used in previous steps:

   - `-ca` — the common name of the CA that you entered in Step 1.
   - `-ca-serial` — the CA serial number from Step 1. For example, if the CA certificate name is svm1_ca_159D1587CE21E9D4_svm1_ca, the serial number is 159D1587CE21E9D4.

   By default, the signed certificate will expire in 365 days. You can select another value, and specify other signing details.

   When prompted, copy and enter the certificate request string you saved in Step 2.

   A signed certificate is displayed; save it for later use.

4. Install the signed certificate on the S3-enabled SVM:

   ```
   security certificate install -type server -vserver svm_name
   ```

   When prompted, enter the certificate and private key.

   You have the option to enter intermediate certificates if a certificate chain is desired.

   When the private key and the CA-signed digital certificate are displayed; save them for future reference.

5. Get the public key certificate:

   ```
   security certificate show -vserver svm_name -common-name ca_cert_name -type
   root-ca -instance
   ```

   Save the public key certificate for later client-side configuration.

   Example

```
cluster-1::> security certificate show -vserver svm1.example.com -common
-name svm1_ca -type root-ca  -instance

                      Name of Vserver: svm1.example.com
          FQDN or Custom Common Name: svm1_ca
         Serial Number of Certificate: 159D1587CE21E9D4
               Certificate Authority: svm1_ca
                 Type of Certificate: root-ca
     (DEPRECATED)-Certificate Subtype: -
             Unique Certificate Name: svm1_ca_159D1587CE21E9D4_svm1_ca
Size of Requested Certificate in Bits: 2048
              Certificate Start Date: Thu May 09 10:58:39 2020
          Certificate Expiration Date: Fri May 08 10:58:39 2021
               Public Key Certificate: -----BEGIN CERTIFICATE-----
MIIDZ ...==
-----END CERTIFICATE-----
                        Country Name: US
              State or Province Name:
                       Locality Name:
                   Organization Name:
                   Organization Unit:
Contact Administrator's Email Address:
                           Protocol: SSL
                    Hashing Function: SHA256
              Self-Signed Certificate: true
       Is System Internal Certificate: false
```

Create an S3 service data policy

You can create service policies for S3 data and management services. An S3 service data policy is required to enable S3 data traffic on LIFs.

About this task

An S3 service data policy is required if you are using data LIFs and intercluster LIFs. It is not required if you are using cluster LIFs for the local tiering use case.

When a service policy is specified for a LIF, the policy is used to construct a default role, failover policy, and data protocol list for the LIF.

Although multiple protocols can be configured for SVMs and LIFs, it is a best practice for S3 to be the only protocol when serving object data.

Steps

1. Change the privilege setting to advanced:

   ```
   set -privilege advanced
   ```

2. Create a service data policy:

   ```
   network interface service-policy create -vserver svm_name -policy policy_name
   -services data-core,data-s3-server
   ```

   The `data-core` and `data-s3-server` services are the only ones required to enable ONTAP S3, although other services can be included as needed.

Create data LIFs

If you created a new SVM, the dedicated LIFs you create for S3 access should be data LIFs.

What you'll need

- The underlying physical or logical network port must have been configured to the administrative `up` status.
- If you are planning to use a subnet name to allocate the IP address and network mask value for a LIF, the subnet must already exist.

  Subnets contain a pool of IP addresses that belong to the same layer 3 subnet. They are created using the `network subnet create` command.

- The LIF service policy must already exist.

About this task

- You can create both IPv4 and IPv6 LIFs on the same network port.
- If you have a large number of LIFs in your cluster, you can verify the LIF capacity supported on the cluster by using the `network interface capacity show` command and the LIF capacity supported on each node by using the `network interface capacity details show` command (at the advanced privilege level).
- If you are enabling remote FabricPool capacity (cloud) tiering, you must also configure intercluster LIFs.

Steps

1. Create a LIF:

   ```
   network interface create -vserver svm_name -lif lif_name -service-policy
   service_policy_names -home-node node_name -home-port port_name {-address
   IP_address -netmask IP_address | -subnet-name subnet_name} -firewall-policy
   data -auto-revert {true|false}
   ```

   - `-home-node` is the node to which the LIF returns when the `network interface revert` command is run on the LIF.

     You can also specify whether the LIF should automatically revert to the home-node and home-port with the `-auto-revert` option.

   - `-home-port` is the physical or logical port to which the LIF returns when the `network interface revert` command is run on the LIF.
   - You can specify an IP address with the `-address` and `-netmask` options, or you enable allocation from a subnet with the `-subnet_name` option.
   - When using a subnet to supply the IP address and network mask, if the subnet was defined with a gateway, a default route to that gateway is added automatically to the SVM when a LIF is created using that subnet.
   - If you assign IP addresses manually (without using a subnet), you might need to configure a default route to a gateway if there are clients or domain controllers on a different IP subnet. The `network route create` man page contains information about creating a static route within an SVM.
   - For the `-firewall-policy` option, use the same default `data` as the LIF role.

     You can create and add a custom firewall policy later if desired.

   - `-auto-revert` allows you to specify whether a data LIF is automatically reverted to its home node under circumstances such as startup, changes to the status of the management database, or when the network connection is made. The default setting is `false`, but you can set it to `false` depending on network management policies in your environment.
   - The `-service-policy` option specifies the data and management services policy you created and any other policies you need.

2. If you want to assign an IPv6 address in the `-address` option:

   a. Use the `network ndp prefix show` command to view the list of RA prefixes learned on various interfaces.

      The `network ndp prefix show` command is available at the advanced privilege level.

   b. Use the format `prefix:id` to construct the IPv6 address manually.

      `prefix` is the prefix learned on various interfaces.

      For deriving the `id`, choose a random 64-bit hexadecimal number.

3. Verify that the LIF was created successfully by using the `network interface show` command.
4. Verify that the configured IP address is reachable:

To verify an…	Use…
IPv4 address	`network ping`
IPv6 address	`network ping6`

Examples

The following command shows how to create an S3 data LIF that is assigned with the `my-S3-policy` service policy:

```
network interface create -vserver svm1.example.com -lif lif2 -home-node
node2 -homeport e0d -service-policy my-S3-policy -subnet-name ipspace1
```

The following command shows all the LIFs in cluster-1. Data LIFs datalif1 and datalif3 are configured with IPv4 addresses, and datalif4 is configured with an IPv6 address:

```
cluster-1::> network interface show

            Logical    Status     Network          Current      Current Is
Vserver     Interface  Admin/Oper Address/Mask     Node         Port
Home
----------- ---------- ---------- ---------------- ------------ -------
----
cluster-1
            cluster_mgmt up/up    192.0.2.3/24     node-1       e1a
true
node-1
            clus1        up/up    192.0.2.12/24    node-1       e0a
true
            clus2        up/up    192.0.2.13/24    node-1       e0b
true
            mgmt1        up/up    192.0.2.68/24    node-1       e1a
true
node-2
            clus1        up/up    192.0.2.14/24    node-2       e0a
true
            clus2        up/up    192.0.2.15/24    node-2       e0b
true
            mgmt1        up/up    192.0.2.69/24    node-2       e1a
true
vs1.example.com
            datalif1     up/down  192.0.2.145/30   node-1       e1c
true
vs3.example.com
            datalif3     up/up    192.0.2.146/30   node-2       e0c
true
            datalif4     up/up    2001::2/64       node-2       e0c
true
5 entries were displayed.
```

Create intercluster LIFs for remote FabricPool tiering

If you are enabling remote FabricPool capacity (cloud) tiering using ONTAP S3, you must configure intercluster LIFs. You can configure intercluster LIFs on ports shared with the data network. Doing so reduces the number of ports you need for intercluster networking.

What you'll need

- The underlying physical or logical network port must have been configured to the administrative `up` status.
- The LIF service policy must already exist.

About this task

Intercluster LIFs are not required for local Fabric pool tiering or for serving external S3 apps.

Steps

1. List the ports in the cluster:

   `network port show`

   The following example shows the network ports in `cluster01`:

```
cluster01::> network port show
                                                                 Speed
(Mbps)
Node   Port      IPspace      Broadcast Domain Link   MTU    Admin/Oper
------ --------- ------------ ---------------- ----- -------
------------
cluster01-01
       e0a       Cluster      Cluster          up     1500   auto/1000
       e0b       Cluster      Cluster          up     1500   auto/1000
       e0c       Default      Default          up     1500   auto/1000
       e0d       Default      Default          up     1500   auto/1000
cluster01-02
       e0a       Cluster      Cluster          up     1500   auto/1000
       e0b       Cluster      Cluster          up     1500   auto/1000
       e0c       Default      Default          up     1500   auto/1000
       e0d       Default      Default          up     1500   auto/1000
```

2. Create intercluster LIFs on the system SVM:

   `network interface create -vserver Cluster -lif LIF_name -service-policy default-intercluster -home-node node -home-port port -address port_IP -netmask netmask`

   The following example creates intercluster LIFs `cluster01_icl01` and `cluster01_icl02`:

```
cluster01::> network interface create -vserver Cluster -lif
cluster01_icl01 -service-
policy default-intercluster -home-node cluster01-01 -home-port e0c
-address 192.168.1.201
-netmask 255.255.255.0

cluster01::> network interface create -vserver Cluster -lif
cluster01_icl02 -service-
policy default-intercluster -home-node cluster01-02 -home-port e0c
-address 192.168.1.202
-netmask 255.255.255.0
```

3. Verify that the intercluster LIFs were created:

   `network interface show -service-policy default-intercluster`

```
cluster01::> network interface show -service-policy default-intercluster
            Logical    Status     Network            Current
Current Is
Vserver     Interface  Admin/Oper Address/Mask       Node          Port
Home
----------- ---------- ---------- ------------------ -------------
------- ----
cluster01
            cluster01_icl01
                       up/up      192.168.1.201/24   cluster01-01  e0c
true
            cluster01_icl02
                       up/up      192.168.1.202/24   cluster01-02  e0c
true
```

4. Verify that the intercluster LIFs are redundant:

   `network interface show –service-policy default-intercluster -failover`

   The following example shows that the intercluster LIFs `cluster01_icl01` and `cluster01_icl02` on the `e0c` port will fail over to the `e0d` port.

```
cluster01::> network interface show -service-policy default-intercluster
–failover
         Logical         Home                  Failover        Failover
Vserver  Interface       Node:Port             Policy          Group
-------- --------------- --------------------- --------------- --------
cluster01
         cluster01_icl01 cluster01-01:e0c   local-only
192.168.1.201/24
                            Failover Targets: cluster01-01:e0c,
                                              cluster01-01:e0d
         cluster01_icl02 cluster01-02:e0c   local-only
192.168.1.201/24
                            Failover Targets: cluster01-02:e0c,
                                              cluster01-02:e0d
```

Create the S3 object store server

The ONTAP object store server manages data as S3 objects, as opposed to file or block storage provided by ONTAP NAS and SAN servers.

What you'll need

You should have a self-signed CA certificate (created in previous steps) or a certificate signed by an external CA vendor. A CA certificate is not necessary for a local tiering use case, where IP traffic is going over cluster LIFs only.

About this task

When an object store server is created, a root user with UID 0 is created. No access key or secret key is generated for this root user. The ONTAP administrator must run the `object-store-server users regenerate-keys` command to set the access key and secret key for this user.

As a NetApp best practice, do not use this root user. Any client application that uses the access key or secret key of the root user has full access to all buckets and objects in the object store.

See the `vserver object-store-server` man pages for additional configuration and display options.

Steps

1. Create the S3 server:

   ```
   vserver object-store-server create -vserver svm_name -object-store-server
   s3_server_name -certificate-name ca_cert_name -comment text
   [additional_options]
   ```

   You can specify additional options when creating the S3 server or at any time later.

   - The SVM name can be either a data SVM or `Cluster` (the system SVM name) if you are configuring local tiering.
   - HTTPS is enabled by default on port 443. You can change the port number with the `-secure -listener-port` option.

     When HTTPS is enabled, CA certificates are required for proper integration with SSL/TLS.

   - HTTP is disabled by default; when enabled, the server listens on port 80. You can enable it with the `-is-http-enabled` option or change the port number with the `-listener-port` option.

     When HTTP is enabled, all the request and responses are sent over the network in clear text.

2. Verify that S3 is configured as desired:

   ```
   vserver object-store-server show
   ```

Example

The following command verifies the configuration values of all object storage servers:

```
cluster1::> vserver object-store-server show

            Vserver: vs1

                      Object Store Server Name: s3.example.com
                          Administrative State: up
                        Listener Port For HTTP: 80
                   Secure Listener Port For HTTPS: 443
                                  HTTP Enabled: false
                                 HTTPS Enabled: true
             Certificate for HTTPS Connections: svm1_ca
                                       Comment: Server comment
```

Add storage capacity to an S3-enabled SVM

Create a bucket

S3 objects are kept in *buckets*--they are not nested as files inside a directory inside other directories.

What you'll need

An SVM containing an S3 server must already exist.

About this task

When you create a bucket, you have two provisioning options:

- Let ONTAP select the underlying aggregates and FlexGroup components (default)
  - ONTAP creates and configures a FlexGroup volume for the first bucket by automatically selecting the aggregates. It will automatically select the highest service level available for your platform, or you can specify the storage service level. Any additional buckets you add later in the SVM will have the same underlying FlexGroup volume.
  - Alternatively, you can specify whether the bucket will be used for tiering, in which case ONTAP tries to select low-cost media with optimal performance for the tiered data.
- You select the underlying aggregates and FlexGroup components (requires advanced privilege command options)
  - You have the option to manually select the aggregates on which the bucket and containing FlexGroup volume must be created, and then specifying the number of constituents on each aggregate. When adding additional buckets:
    - If you specify aggregates and constituents for a new bucket, a new FlexGroup will be created for the new bucket.
    - If you do not specify aggregates and constituents for a new bucket, the new bucket will be added to an existing FlexGroup. See the FlexGroup documentation for more information.

    FlexGroup volumes management

  When you specify aggregates and constituents when creating a bucket, no QoS policy groups, default or

custom, are applied. You can do so later with the `vserver object-store-server bucket modify` command.

Storage service levels are predefined adaptive Quality of Service (QoS) policy groups, with *value*, *performance*, and *extreme* default levels. Instead of one of the default storage service levels, you can also define a custom QoS policy group and apply it to a bucket.

Storage service definitions

If you are configuring local capacity tiering, you create buckets and users in a data SVM, not in the system SVM where the S3 server is located.

Performance management

See the `vserver object-store-server bucket` man pages for additional configuration and display options.

Steps

1. If you plan to select aggregates and FlexGroup components yourself, set the privilege level to advanced (otherwise, admin privilege level is sufficient): `set -privilege advanced`
2. Create a bucket:

   `vserver object-store-server bucket create -vserver` *`svm_name`* `-bucket` *`bucket_name`* `[-size integer[KB|MB|GB|TB|PB]] [-comment text] [additional_options]`

   The SVM name can be either a data SVM or `Cluster` (the system SVM name) if you are configuring local tiering.

   If you specify no options, ONTAP creates a 5GB bucket with the service level set to the highest level available for your system.

   If you want ONTAP to create a bucket based on performance or usage, use one of the following options:

   - service level

     Include the `-storage-service-level` option with one of the following values: `value`, `performance`, or `extreme`.

   - tiering

     Include the `-used-as-capacity-tier true` option.

   If you want to specify the aggregates on which to create the underlying FlexGroup volume, use the following options:

   - The `-aggr-list` parameter specifies the list of aggregates to be used for FlexGroup volume constituents.

     Each entry in the list creates a constituent on the specified aggregate. You can specify an aggregate multiple times to have multiple constituents created on the aggregate.

     For consistent performance across the FlexGroup volume, all of the aggregates must use the same disk type and RAID group configurations.

- The `-aggr-list-multiplier` parameter specifies the number of times to iterate over the aggregates that are listed with the `-aggr-list` parameter when creating a FlexGroup volume.

  The default value of the `-aggr-list-multiplier` parameter is 4.

3. Add a QoS policy group if needed:

   ```
   vserver object-store-server bucket modify -bucket bucket_name -qos-policy
   -group qos_policy_group
   ```

4. Verify bucket creation:

   ```
   vserver object-store-server bucket show [-instance]
   ```

Example

The following example creates a bucket for SVM vs1 of size 1TB and specifying the aggregate:

```
cluster-1::*> vserver object-store-server bucket create -vserver
svm1.example.com -bucket testbucket -aggr-list aggr1 -size 1TB
```

Create an S3 user

User authorization is required on all ONTAP object stores in order to restrict connectivity to authorized clients.

What you'll need

An S3-enabled SVM must already exist.

About this task

An S3 user can be granted access to any bucket in an SVM but not in multiple SVMs.

When you create an S3 user, an access-key and a secret-key will be generated. They must be shared with the user along with the object store's FQDN and bucket name. S3 users' keys can be displayed with the `vserver object-store-server user show` command.

You can grant specific access permissions to S3 users in a bucket policy or an object server policy.

> When an object store server is created, a root user (UID 0) is created, a privileged user with access all buckets. Rather than administering ONTAP S3 as root user, it is a best practice to create an admin user role with specific privileges.

Step

1. Create an S3 user:

   ```
   vserver object-store-server user create -vserver svm_name -user user_name [-
   comment text]
   ```

Create or modify S3 groups

You can simplify bucket access by creating groups of users with appropriate access authorizations.

What you'll need

S3 users in an S3-enabled SVM must already exist.

About this task

Users in an S3 group can be granted access to any bucket in an SVM but not in multiple SVMs. Group access permissions can be configured in two ways:

- At the bucket level

  After creating a group of S3 users, you specify group permissions in bucket policy statements and they apply only to that bucket.

- At the SVM level

  After creating a group of S3 users, you specify object server policy names in the group definition. Those policies determine the buckets and access for the group members.

Step

1. Create an S3 group:

   ```
   vserver object-store-server group create -vserver svm_name -name group_name
   -users user_name\(s\) [-policies policy_names] [-comment text\]
   ```

   The `-policies` option can be omitted in configurations with only one bucket in an object store; the group name can be added to the bucket policy.

   The `-policies` option can be added later with the `vserver object-store-server group modify` command after object storage server policies are created.

Create or modify access policy statements

About bucket and object store server policies

User and group access to S3 resources is controlled by bucket and object store server policies. If you have a small number of users or groups, controlling access at the bucket level is probably sufficient, but if you have many users and groups, it is easier to control access at the object store server level.

Modify a bucket policy

You can add access rules to the default bucket policy. The scope of its access control is the containing bucket, so it is most appropriate when there is a single bucket.

What you'll need

An S3-enabled SVM containing an S3 server and a bucket must already exist.

About this task

You can add new statements for new users and groups, or you can modify the attributes of existing statements. For more options, see the `vserver object-store-server bucket policy` man pages.

Steps

1. Add a statement to a bucket policy:

   ```
   vserver object-store-server bucket policy add-statement -vserver svm_name
   -bucket bucket_name -effect {allow|deny} -action object_store_actions
   -principal user_and_group_names -resource object_store_resources [-sid text]
   [-index integer]
   ```

   The following parameters define access permissions:

`-effect`	The statement may allow or deny access
`-action`	You can specify `*` to mean all actions, or a list of one or more of the following: `GetObject`, `PutObject`, `DeleteObject`, `ListBucket`, `GetBucketAcl`,`GetObjectAcl`, `ListBucketMultipartUploads`, and `ListMultipartUploadParts`.
`-principal`	A list of one or more S3 users or groups. • A maximum of 10 users or groups can be specified. • If an S3 group is specified, it must be in the form `group/group_name`. • `*` can be specified to mean public access; that is, access without an access-key and secret-key. • If no principal is specified, all S3 users in the SVM are granted access.
`-resource`	The bucket and any object it contains. The wildcard characters `*` and `?` can be used to form a regular expression for specifying a resource.

   You can optionally specify a text string as comment with the `-sid` option.

Examples

The following example creates an object store server bucket policy statement for the SVM svm1.example.com and bucket1 which specifies allowed access to a readme folder for object store server user user1.

```
cluster1::> vserver object-store-server bucket policy statement create
-vserver svm1.example.com -bucket bucket1 -effect allow -action
GetObject,PutObject,DeleteObject,ListBucket -principal user1 -resource
bucket1/readme/* -sid "fullAccessToReadmeForUser1"
```

The following example creates an object store server bucket policy statement for the SVM svm1.example.com and bucket1 which specifies allowed access to all objects for object store server group group1.

```
cluster1::> vserver object-store-server bucket policy statement create
-vserver svm1.example.com -bucket bucket1 -effect allow -action
GetObject,PutObject,DeleteObject,ListBucket -principal group/group1
-resource bucket1/* -sid "fullAccessForGroup1"
```

Create or modify an object store server policy

You can create policies that can apply to one or more buckets in an object store. Object store server policies can be attached to groups of users, thereby simplifying the management of resource access across multiple buckets.

What you'll need

An S3-enabled SVM containing an S3 server and a bucket must already exist.

About this task

You can enable access policies at the SVM level by specifying a default or custom policy in an object storage server group. The policies do not take effect until they are specified in the group definition.

> When you use object storage server policies, you specify principals (that is, users and groups) in the group definition, not in the policy itself.

There are three read-only default policies for access to ONTAP S3 resources:

- FullAccess
- NoS3Access
- ReadOnlyAccess

You can also create new custom policies, then add new statements for new users and groups, or you can modify the attributes of existing statements. For more options, see the `vserver object-store-server policy` man pages.

Steps

1. Create an object storage server policy:

   ```
   vserver object-store-server policy create -vserver svm_name -policy
   policy_name [-comment text]
   ```

2. Create a statement for the policy:

```
vserver object-store-server policy statement create -vserver svm_name] -policy
policy_name -effect {allow|deny} -action object_store_actions -resource
object_store_resources [-sid text]
```

The following parameters define access permissions:

`-effect`	The statement may allow or deny access
`-action`	You can specify `*` to mean all actions, or a list of one or more of the following: `GetObject`, `PutObject`, `DeleteObject`, `ListBucket`,`GetBucketAcl`, `GetObjectAcl`, `ListAllMyBuckets`, `ListBucketMultipartUploads`, and `ListMultipartUploadParts`.
`-resource`	The bucket and any object it contains. The wildcard characters `*` and `?` can be used to form a regular expression for specifying a resource.

You can optionally specify a text string as comment with the `-sid` option.

By default, new statements are added to the end of the list of statements, which are processed in order. When you add or modify statements later, you have the option to modify the statement's `-index` setting to change the processing order.

Enable client access to S3 object storage

Enable ONTAP S3 access for remote FabricPool tiering

For ONTAP S3 to be used as a remote FabricPool capacity (cloud) tier, the ONTAP S3 administrator must provide information about the S3 server configuration to the remote ONTAP cluster administrator.

About this task

The following S3 server information is required to configure FabricPool cloud tiers:

- server name (FQDN)
- bucket name
- CA certificate
- access key
- password (secret access key)

In addition, the following networking configuration is required:

- There must be an entry for the remote ONTAP S3 server's hostname in the DNS server configured for the admin SVM, including the S3 server's FQDN name and the IP addresses on its LIFs.
- Intercluster LIFs must be configured on both local and remote clusters, although cluster peering is not

required.

See the FabricPool documentation about configuring ONTAP S3 as a cloud tier.

Managing Storage Tiers By Using FabricPool

Enable ONTAP S3 access for local FabricPool tiering

For ONTAP S3 to be used as a local FabricPool capacity tier, you must define an object store based on the bucket you created, and then attach the object store to a performance tier aggregate to create a FabricPool.

What you'll need

You must have the ONTAP S3 server name and a bucket name, and the S3 server must have been created using cluster LIFs (with the `-vserver Cluster` parameter).

About this task

The object-store configuration contains information about the local capacity tier, including the S3 server and bucket names and authentication requirements.

An object-store configuration once created must not be reassociated with a different object-store or bucket. You can create multiple buckets for local tiers, but you cannot create multiple object stores in a single bucket.

A FabricPool license is not required for a local capacity tier.

Steps

1. Create the object store for the local capacity tier:

   ```
   storage aggregate object-store config create -object-store-name store_name
   -ipspace Cluster -provider-type ONTAP_S3 -server S3_server_name -container
   -name bucket_name -access-key access_key -secret-password password
   ```

   - The `-container-name` is the S3 bucket you created.
   - The `-access-key` parameter authorizes requests to the ONTAP S3 server.
   - The `-secret-password` parameter (secret access key) authenticates requests to the ONTAP S3 server.
   - You can set the `-is-certificate-validation-enabled` parameter to `false` to disable certificate checking for ONTAP S3.

   ```
   cluster1::> storage aggregate object-store config create
   -object-store-name MyLocalObjStore -ipspace Cluster -provider-type
   ONTAP_S3 -server s3.example.com
   -container-name bucket1 -access-key myS3key -secret-password myS3pass
   ```

2. Display and verify the object store configuration information:

   ```
   storage aggregate object-store config show
   ```

3. Optional: To see how much data in a volume is inactive, follow the steps in Determining how much data in a volume is inactive by using inactive data reporting.

Seeing how much data in a volume is inactive can help you decide which aggregate to use for FabricPool local tiering.

4. Attach the object store to an aggregate:

   `storage aggregate object-store attach -aggregate aggr_name -object-store-name store_name`

   You can use the `allow-flexgroup` **`true`** option to attach aggregates that contain FlexGroup volume constituents.

   ```
   cluster1::> storage aggregate object-store attach
   -aggregate aggr1 -object-store-name MyLocalObjStore
   ```

5. Display the object store information and verify that the attached object store is available:

   `storage aggregate object-store show`

   ```
   cluster1::> storage aggregate object-store show

   Aggregate    Object Store Name    Availability State
   ---------    -----------------    ------------------
   aggr1        MyLocalObjStore      available
   ```

Enable client access from an S3 app

For S3 client apps to access the ONTAP S3 server, the ONTAP S3 administrator must provide configuration information to the S3 user.

What you'll need

The S3 client app must be capable of authenticating with the ONTAP S3 server using AWS Signature Version 4. Earlier signature versions are not supported by ONTAP S3.

The ONTAP S3 administrator must have created S3 users and granted them access permissions, as an individual users or as a group member, in the bucket policy or the object storage server policy.

The S3 client app must be capable of resolving the ONTAP S3 server name, which requires that ONTAP S3 administrator provide the S3 server name (FQDN) and IP addresses for the S3 server's LIFs.

About this task

To access an ONTAP S3 bucket, a user on the S3 client app enters information provided by the ONTAP S3 administrator.

Beginning with ONTAP 9.9.1, the ONTAP S3 server supports the following AWS client functionality:

- user-defined object metadata

  A set of key-value pairs can be assigned to objects as metadata when they are created using PUT (or POST). When a GET/HEAD operation is performed on the object, the user-defined metadata is returned

along with the system metadata.

- object tagging

  A separate set of key-value pairs can be assigned as tags for categorizing objects. Unlike metadata, tags are created and read with REST APIs independently of the object, and they implemented when objects are created or any time after.

> To enable clients to get and put tagging information, the actions `GetObjectTagging`, `PutObjectTagging`, and `DeleteObjectTagging` need to be allowed using the bucket or group policies.

For more information, see the AWS S3 documentation.

Steps

1. Authenticate the S3 client app with the ONTAP S3 server by entering the S3 server name and the CA certificate.
2. Authenticate a user on the S3 client app by entering the following information:
   - S3 server name (FQDN) and bucket name
   - the user's access key and secret key

Storage service definitions

ONTAP includes predefined storage services that are mapped to corresponding minimum performance factors.

The actual set of storage services available in a cluster or SVM is determined by the type of storage that makes up an aggregate in the SVM.

The following table shows how the minimum performance factors are mapped to the predefined storage services:

Storage service	Expected IOPS (SLA)	Peak IOPS (SLO)	Minimum volume IOPS	Estimated latency	Are expected IOPS enforced?
value	128 per TB	512 per TB	75	17 ms	On AFF: Yes Otherwise: No
performance	2048 per TB	4096 per TB	500	2 ms	Yes
extreme	6144 per TB	12288 per TB	1000	1 ms	Yes

The following table defines the available storage service level for each type of media or node:

Media or node	Available storage service level
Disk	value

Media or node	Available storage service level
Virtual machine disk	value
FlexArray LUN	value
Hybrid	value
Capacity-optimized Flash	value
Solid-state drive (SSD) - non-AFF	value
Performance-optimized Flash - SSD (AFF)	extreme, performance, value