



ONTAP SAN drivers

Astra Trident

NetApp
February 12, 2024

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Configure a backend with ONTAP SAN drivers

Learn about configuring an ONTAP backend with ONTAP and Cloud Volumes ONTAP SAN drivers.

- [Preparation](#)
- [Configuration and examples](#)

Astra Control provides seamless protection, disaster recovery, and mobility (moving volumes between Kubernetes clusters) for volumes created with the `ontap-nas`, `ontap-nas-flexgroup`, and `ontap-san` drivers. See [Astra Control replication prerequisites](#) for details.



- You must use `ontap-nas` for production workloads that require data protection, disaster recovery, and mobility.
- Use `ontap-san-economy` when anticipated volume usage is expected to be much higher than what ONTAP supports.
- Use `ontap-nas-economy` only where anticipated volume usage is expected to be much higher than what ONTAP supports, and the `ontap-san-economy` driver cannot be used.
- Do not use `ontap-nas-economy` if you anticipate the need for data protection, disaster recovery, or mobility.

User permissions

Astra Trident expects to be run as either an ONTAP or SVM administrator, typically using the `admin` cluster user or a `vsadmin` SVM user, or a user with a different name that has the same role. For Amazon FSx for NetApp ONTAP deployments, Astra Trident expects to be run as either an ONTAP or SVM administrator, using the cluster `fsxadmin` user or a `vsadmin` SVM user, or a user with a different name that has the same role. The `fsxadmin` user is a limited replacement for the cluster admin user.



If you use the `limitAggregateUsage` parameter, cluster admin permissions are required. When using Amazon FSx for NetApp ONTAP with Astra Trident, the `limitAggregateUsage` parameter will not work with the `vsadmin` and `fsxadmin` user accounts. The configuration operation will fail if you specify this parameter.

While it is possible to create a more restrictive role within ONTAP that a Trident driver can use, we don't recommend it. Most new releases of Trident will call additional APIs that would have to be accounted for, making upgrades difficult and error-prone.

Prepare to configure backend with ONTAP SAN drivers

Learn about how to prepare to configure an ONTAP backend with ONTAP SAN drivers. For all ONTAP backends, Astra Trident requires at least one aggregate assigned to the SVM.

Remember that you can also run more than one driver, and create storage classes that point to one or the other. For example, you could configure a `san-dev` class that uses the `ontap-san` driver and a `san-default` class that uses the `ontap-san-economy` one.

All your Kubernetes worker nodes must have the appropriate iSCSI tools installed. See [here](#) for more details.

Authentication

Astra Trident offers two modes of authenticating an ONTAP backend.

- **Credential-based:** The username and password to an ONTAP user with the required permissions. It is recommended to use a pre-defined security login role, such as `admin` or `vsadmin` to ensure maximum compatibility with ONTAP versions.
- **Certificate-based:** Astra Trident can also communicate with an ONTAP cluster using a certificate installed on the backend. Here, the backend definition must contain Base64-encoded values of the client certificate, key, and the trusted CA certificate if used (recommended).

You can update existing backends to move between credential-based and certificate-based methods. However, only one authentication method is supported at a time. To switch to a different authentication method, you must remove the existing method from the backend configuration.



If you attempt to provide **both credentials and certificates**, backend creation will fail with an error that more than one authentication method was provided in the configuration file.

Enable credential-based authentication

Astra Trident requires the credentials to an SVM-scoped/cluster-scoped admin to communicate with the ONTAP backend. It is recommended to make use of standard, pre-defined roles such as `admin` or `vsadmin`. This ensures forward compatibility with future ONTAP releases that might expose feature APIs to be used by future Astra Trident releases. A custom security login role can be created and used with Astra Trident, but is not recommended.

A sample backend definition will look like this:

YAML

```
version: 1
backendName: ExampleBackend
storageDriverName: ontap-san
managementLIF: 10.0.0.1
svm: svm_nfs
username: vsadmin
password: password
```

JSON

```
{
  "version": 1,
  "backendName": "ExampleBackend",
  "storageDriverName": "ontap-san",
  "managementLIF": "10.0.0.1",
  "svm": "svm_nfs",
  "username": "vsadmin",
  "password": "password"
}
```

Keep in mind that the backend definition is the only place the credentials are stored in plain text. After the backend is created, usernames/passwords are encoded with Base64 and stored as Kubernetes secrets. The creation or update of a backend is the only step that requires knowledge of the credentials. As such, it is an admin-only operation, to be performed by the Kubernetes/storage administrator.

Enable certificate-based Authentication

New and existing backends can use a certificate and communicate with the ONTAP backend. Three parameters are required in the backend definition.

- `clientCertificate`: Base64-encoded value of client certificate.
- `clientPrivateKey`: Base64-encoded value of associated private key.
- `trustedCACertificate`: Base64-encoded value of trusted CA certificate. If using a trusted CA, this parameter must be provided. This can be ignored if no trusted CA is used.

A typical workflow involves the following steps.

Steps

1. Generate a client certificate and key. When generating, set Common Name (CN) to the ONTAP user to authenticate as.

```
openssl req -x509 -nodes -days 1095 -newkey rsa:2048 -keyout k8senv.key
-out k8senv.pem -subj "/C=US/ST=NC/L=RTP/O=NetApp/CN=admin"
```

2. Add trusted CA certificate to the ONTAP cluster. This might be already handled by the storage administrator. Ignore if no trusted CA is used.

```
security certificate install -type server -cert-name <trusted-ca-cert-name> -vserver <vserver-name>
ssl modify -vserver <vserver-name> -server-enabled true -client-enabled true -common-name <common-name> -serial <SN-from-trusted-CA-cert> -ca <cert-authority>
```

3. Install the client certificate and key (from step 1) on the ONTAP cluster.

```
security certificate install -type client-ca -cert-name <certificate-name> -vserver <vserver-name>
security ssl modify -vserver <vserver-name> -client-enabled true
```

4. Confirm the ONTAP security login role supports cert authentication method.

```
security login create -user-or-group-name admin -application ontapi -authentication-method cert
security login create -user-or-group-name admin -application http -authentication-method cert
```

5. Test authentication using certificate generated. Replace <ONTAP Management LIF> and <vserver name> with Management LIF IP and SVM name.

```
curl -X POST -Lk https://<ONTAP-Management-LIF>/servlets/netapp.servlets.admin.XMLrequest_filer --key k8senv.key --cert ~/k8senv.pem -d '<?xml version="1.0" encoding="UTF-8"?><netapp xmlns="http://www.netapp.com/filer/admin" version="1.21" vfiler="<vserver-name>"><vserver-get></vserver-get></netapp>'
```

6. Encode certificate, key and trusted CA certificate with Base64.

```
base64 -w 0 k8senv.pem >> cert_base64
base64 -w 0 k8senv.key >> key_base64
base64 -w 0 trustedca.pem >> trustedca_base64
```

7. Create backend using the values obtained from the previous step.

```
cat cert-backend.json
{
  "version": 1,
  "storageDriverName": "ontap-san",
  "backendName": "SanBackend",
  "managementLIF": "1.2.3.4",
  "svm": "vserver_test",
  "clientCertificate": "Faaaakkkkeeee...Vaaalllluuuuueeee",
  "clientPrivateKey": "LS0tFaKE...0VaLuES0tLS0K",
  "trustedCACertificate": "QNFinfO...SiqOyN",
  "storagePrefix": "myPrefix_"
}

tridentctl create backend -f cert-backend.json -n trident
+-----+-----+-----+-----+
+-----+-----+
|      NAME      | STORAGE DRIVER |                      UUID                      |
STATE | VOLUMES |
+-----+-----+-----+-----+
+-----+-----+
| SanBackend | ontap-san      | 586b1cd5-8cf8-428d-a76c-2872713612c1 |
online |         0 |
+-----+-----+-----+-----+
+-----+-----+
```

Update authentication methods or rotate credentials

You can update an existing backend to use a different authentication method or to rotate their credentials. This works both ways: backends that make use of username/password can be updated to use certificates; backends that utilize certificates can be updated to username/password based. To do this, you must remove the existing authentication method and add the new authentication method. Then use the updated backend.json file containing the required parameters to execute `tridentctl backend update`.

```
cat cert-backend-updated.json
{
  "version": 1,
  "storageDriverName": "ontap-san",
  "backendName": "SanBackend",
  "managementLIF": "1.2.3.4",
  "svm": "vserver_test",
  "username": "vsadmin",
  "password": "password",
  "storagePrefix": "myPrefix_"
}

#Update backend with tridentctl
tridentctl update backend SanBackend -f cert-backend-updated.json -n
trident

+-----+-----+-----+
+-----+-----+
| NAME | STORAGE DRIVER | UUID |
STATE | VOLUMES |
+-----+-----+-----+
+-----+-----+
| SanBackend | ontap-san | 586b1cd5-8cf8-428d-a76c-2872713612c1 |
online | 9 |
+-----+-----+-----+
+-----+-----+
```



When rotating passwords, the storage administrator must first update the password for the user on ONTAP. This is followed by a backend update. When rotating certificates, multiple certificates can be added to the user. The backend is then updated to use the new certificate, following which the old certificate can be deleted from the ONTAP cluster.

Updating a backend does not disrupt access to volumes that have already been created, nor impact volume connections made after. A successful backend update indicates that Astra Trident can communicate with the ONTAP backend and handle future volume operations.

Specify igroups

Astra Trident uses igroups to control access to the volumes (LUNs) that it provisions. Administrators have two options when it comes to specifying igroups for backends:

- Astra Trident can automatically create and manage an igroup per backend. If `igroupName` is not included in the backend definition, Astra Trident creates an igroup named `trident-<backend-UUID>` on the SVM. This will ensure each backend has a dedicated igroup and handle the automated addition/deletion of Kubernetes node IQNs.
- Alternatively, pre-created igroups can also be provided in a backend definition. This can be done using the `igroupName` config parameter. Astra Trident will add/delete Kubernetes node IQNs to the pre-existing igroup.

For backends that have `igroupName` defined, the `igroupName` can be deleted with a `tridentctl` backend update to have Astra Trident auto-handle igroups. This will not disrupt access to volumes that are already attached to workloads. Future connections will be handled using the igroup Astra Trident created.



Dedicating an igroup for each unique instance of Astra Trident is a best practice that is beneficial for the Kubernetes admin as well as the storage admin. CSI Trident automates the addition and removal of cluster node IQNs to the igroup, greatly simplifying its management. When using the same SVM across Kubernetes environments (and Astra Trident installations), using a dedicated igroup ensures that changes made to one Kubernetes cluster don't influence igroups associated with another. In addition, it is also important to ensure each node in the Kubernetes cluster has a unique IQN. As mentioned above, Astra Trident automatically handles the addition and removal of IQNs. Reusing IQNs across hosts can lead to undesirable scenarios where hosts get mistaken for one another and access to LUNs is denied.

If Astra Trident is configured to function as a CSI Provisioner, Kubernetes node IQNs are automatically added to/removed from the igroup. When nodes are added to a Kubernetes cluster, `trident-csi` DaemonSet deploys a pod (`trident-csi-xxxxx` in versions prior to 23.01 or `trident-node<operating system>-xxxxx` in 23.01 and later) on the newly added nodes and registers the new nodes it can attach volumes to. Node IQNs are also added to the backend's igroup. A similar set of steps handle the removal of IQNs when node(s) are cordoned, drained, and deleted from Kubernetes.

If Astra Trident does not run as a CSI Provisioner, the igroup must be manually updated to contain the iSCSI IQNs from every worker node in the Kubernetes cluster. IQNs of nodes that join the Kubernetes cluster will need to be added to the igroup. Similarly, IQNs of nodes that are removed from the Kubernetes cluster must be removed from the igroup.

Authenticate connections with bidirectional CHAP

Astra Trident can authenticate iSCSI sessions with bidirectional CHAP for the `ontap-san` and `ontap-san-economy` drivers. This requires enabling the `useCHAP` option in your backend definition. When set to `true`, Astra Trident configures the SVM's default initiator security to bidirectional CHAP and set the username and secrets from the backend file. NetApp recommends using bidirectional CHAP to authenticate connections. See the following sample configuration:

```
---
version: 1
storageDriverName: ontap-san
backendName: ontap_san_chap
managementLIF: 192.168.0.135
svm: ontap_iscsi_svm
useCHAP: true
username: vsadmin
password: password
igroupName: trident
chapInitiatorSecret: cl9qxIm36DKyawxy
chapTargetInitiatorSecret: rqxigXgkesIpwxyz
chapTargetUsername: iJF4heBRT0TCwxyz
chapUsername: uh2aNCLSD6cNwxyz
```



The `useCHAP` parameter is a Boolean option that can be configured only once. It is set to false by default. After you set it to true, you cannot set it to false.

In addition to `useCHAP=true`, the `chapInitiatorSecret`, `chapTargetInitiatorSecret`, `chapTargetUsername`, and `chapUsername` fields must be included in the backend definition. The secrets can be changed after a backend is created by running `tridentctl update`.

How it works

By setting `useCHAP` to true, the storage administrator instructs Astra Trident to configure CHAP on the storage backend. This includes the following:

- Setting up CHAP on the SVM:
 - If the SVM's default initiator security type is none (set by default) **and** there are no pre-existing LUNs already present in the volume, Astra Trident will set the default security type to CHAP and proceed to configuring the CHAP initiator and target username and secrets.
 - If the SVM contains LUNs, Astra Trident will not enable CHAP on the SVM. This ensures that access to LUNs that are already present on the SVM isn't restricted.
- Configuring the CHAP initiator and target username and secrets; these options must be specified in the backend configuration (as shown above).
- Managing the addition of initiators to the `igroupName` given in the backend. If unspecified, this defaults to `trident`.

After the backend is created, Astra Trident creates a corresponding `tridentbackend` CRD and stores the CHAP secrets and usernames as Kubernetes secrets. All PVs that are created by Astra Trident on this backend will be mounted and attached over CHAP.

Rotate credentials and update backends

You can update the CHAP credentials by updating the CHAP parameters in the `backend.json` file. This will require updating the CHAP secrets and using the `tridentctl update` command to reflect these changes.



When updating the CHAP secrets for a backend, you must use `tridentctl` to update the backend. Do not update the credentials on the storage cluster through the CLI/ONTAP UI as Astra Trident will not be able to pick up these changes.

```
cat backend-san.json
{
  "version": 1,
  "storageDriverName": "ontap-san",
  "backendName": "ontap_san_chap",
  "managementLIF": "192.168.0.135",
  "svm": "ontap_iscsi_svm",
  "useCHAP": true,
  "username": "vsadmin",
  "password": "password",
  "igroupName": "trident",
  "chapInitiatorSecret": "cl9qxUpDaTeD",
  "chapTargetInitiatorSecret": "rqxigXgkeUpDaTeD",
  "chapTargetUsername": "iJF4heBRT0TCwxyz",
  "chapUsername": "uh2aNCLSD6cNwxyz",
}

./tridentctl update backend ontap_san_chap -f backend-san.json -n trident
+-----+-----+-----+-----+
+-----+-----+
|  NAME          | STORAGE DRIVER |          UUID          |
STATE | VOLUMES |
+-----+-----+-----+-----+
+-----+-----+
| ontap_san_chap | ontap-san      | aa458f3b-ad2d-4378-8a33-1a472ffbeb5c |
online |      7 |
+-----+-----+-----+-----+
+-----+-----+
```

Existing connections will remain unaffected; they will continue to remain active if the credentials are updated by Astra Trident on the SVM. New connections will use the updated credentials and existing connections continue to remain active. Disconnecting and reconnecting old PVs will result in them using the updated credentials.

ONTAP SAN configuration options and examples

Learn about how to create and use ONTAP SAN drivers with your Astra Trident installation. This section provides backend configuration examples and details about how to map backends to StorageClasses.

Backend configuration options

See the following table for the backend configuration options:

Parameter	Description	Default
version		Always 1

Parameter	Description	Default
storageDriverName	Name of the storage driver	"ontap-nas", "ontap-nas-economy", "ontap-nas-flexgroup", "ontap-san", "ontap-san-economy"
backendName	Custom name or the storage backend	Driver name + "_" + dataLIF
managementLIF	<p>IP address of a cluster or SVM management LIF</p> <p>For seamless MetroCluster switchover, you must specify an SVM management LIF.</p> <p>A fully-qualified domain name (FQDN) can be specified.</p> <p>Can be set to use IPv6 addresses if Astra Trident was installed using the <code>--use-ipv6</code> flag. IPv6 addresses must be defined in square brackets, such as [28e8:d9fb:a825:b7bf:69a8:d02f:9e7b:3555].</p>	"10.0.0.1", "[2001:1234:abcd::fefe]"
dataLIF	<p>IP address of protocol LIF.</p> <p>Do not specify for iSCSI. Astra Trident uses ONTAP Selective LUN Map to discover the iSCSI LIFs needed to establish a multi path session. A warning is generated if dataLIF is explicitly defined.</p>	Derived by the SVM
useCHAP	<p>Use CHAP to authenticate iSCSI for ONTAP SAN drivers [Boolean].</p> <p>Set to <code>true</code> for Astra Trident to configure and use bidirectional CHAP as the default authentication for the SVM given in the backend. Refer to Prepare to configure backend with ONTAP SAN drivers for details.</p>	false
chapInitiatorSecret	CHAP initiator secret. Required if <code>useCHAP=true</code>	""
labels	Set of arbitrary JSON-formatted labels to apply on volumes	""
chapTargetInitiatorSecret	CHAP target initiator secret. Required if <code>useCHAP=true</code>	""

Parameter	Description	Default
chapUsername	Inbound username. Required if useCHAP=true	""
chapTargetUsername	Target username. Required if useCHAP=true	""
clientCertificate	Base64-encoded value of client certificate. Used for certificate-based auth	""
clientPrivateKey	Base64-encoded value of client private key. Used for certificate-based auth	""
trustedCACertificate	Base64-encoded value of trusted CA certificate. Optional. Used for certificate-based authentication.	""
username	Username needed to communicate with the ONTAP cluster. Used for credential-based authentication.	""
password	Password needed to communicate with the ONTAP cluster. Used for credential-based authentication.	""
svm	Storage virtual machine to use	Derived if an SVM managementLIF is specified
igroupName	Name of the igroup for SAN volumes to use. Refer to Details about igroupName for more information.	"trident-<backend-UUID>"
storagePrefix	Prefix used when provisioning new volumes in the SVM. Cannot be modified later. To update this parameter, you will need to create a new backend.	"trident"
limitAggregateUsage	Fail provisioning if usage is above this percentage. If you are using an Amazon FSx for NetApp ONTAP backend, do not specify limitAggregateUsage. The provided fsxadmin and vsadmin do not contain the permissions required to retrieve aggregate usage and limit it using Astra Trident.	"" (not enforced by default)

Parameter	Description	Default
limitVolumeSize	Fail provisioning if requested volume size is above this value. Also restricts the maximum size of the volumes it manages for qtrees and LUNs.	"" (not enforced by default)
lunsPerFlexvol	Maximum LUNs per Flexvol, must be in range [50, 200]	"100"
debugTraceFlags	Debug flags to use when troubleshooting. Example, {"api":false, "method":true} Do not use unless you are troubleshooting and require a detailed log dump.	null
useREST	Boolean parameter to use ONTAP REST APIs. Tech preview useREST is provided as a tech preview that is recommended for test environments and not for production workloads. When set to true, Astra Trident will use ONTAP REST APIs to communicate with the backend. This feature requires ONTAP 9.11.1 and later. In addition, the ONTAP login role used must have access to the <code>ontap</code> application. This is satisfied by the pre-defined <code>vsadmin</code> and <code>cluster-admin</code> roles. useREST is not supported with MetroCluster.	false

Details about igroupName

igroupName can be set to an igroup that is already created on the ONTAP cluster. If unspecified, Astra Trident automatically creates an igroup named `trident-<backend-UUID>`.

If providing a pre-defined igroupName, we recommend using one igroup per Kubernetes cluster, if the SVM is to be shared between environments. This is necessary for Astra Trident to automatically maintain IQN additions and deletions.

- igroupName can be updated to point to a new igroup that is created and managed on the SVM outside of Astra Trident.
- igroupName can be omitted. In this case, Astra Trident will create and manage an igroup named `trident-<backend-UUID>` automatically.

In both cases, volume attachments will continue to be accessible. Future volume attachments will use the updated igroup. This update does not disrupt access to volumes present on the backend.

Backend configuration options for provisioning volumes

You can control default provisioning using these options in the `defaults` section of the configuration. For an example, see the configuration examples below.

Parameter	Description	Default
<code>spaceAllocation</code>	Space-allocation for LUNs	<code>"true"</code>
<code>spaceReserve</code>	Space reservation mode; <code>"none"</code> (thin) or <code>"volume"</code> (thick)	<code>"none"</code>
<code>snapshotPolicy</code>	Snapshot policy to use	<code>"none"</code>
<code>qosPolicy</code>	<p>QoS policy group to assign for volumes created. Choose one of <code>qosPolicy</code> or <code>adaptiveQosPolicy</code> per storage pool/backend.</p> <p>Using QoS policy groups with Astra Trident requires ONTAP 9.8 or later. We recommend using a non-shared QoS policy group and ensuring the policy group is applied to each constituent individually. A shared QoS policy group will enforce the ceiling for the total throughput of all workloads.</p>	<code>""</code>
<code>adaptiveQosPolicy</code>	Adaptive QoS policy group to assign for volumes created. Choose one of <code>qosPolicy</code> or <code>adaptiveQosPolicy</code> per storage pool/backend	<code>""</code>
<code>snapshotReserve</code>	Percentage of volume reserved for snapshots <code>"0"</code>	If <code>snapshotPolicy</code> is <code>"none"</code> , else <code>""</code>
<code>splitOnClone</code>	Split a clone from its parent upon creation	<code>"false"</code>
<code>encryption</code>	<p>Enable NetApp Volume Encryption (NVE) on the new volume; defaults to <code>false</code>. NVE must be licensed and enabled on the cluster to use this option.</p> <p>If NAE is enabled on the backend, any volume provisioned in Astra Trident will be NAE enabled.</p> <p>For more information, refer to: How Astra Trident works with NVE and NAE.</p>	<code>"false"</code>

Parameter	Description	Default
luksEncryption	Enable LUKS encryption. Refer to Use Linux Unified Key Setup (LUKS) .	""
securityStyle	Security style for new volumes	unix
tieringPolicy	Tiering policy to use "none"	"snapshot-only" for pre-ONTAP 9.5 SVM-DR configuration

Volume provisioning examples

Here's an example with defaults defined:

```
---
version: 1
storageDriverName: ontap-san
managementLIF: 10.0.0.1
svm: trident_svm
username: admin
password: password
labels:
  k8scluster: dev2
  backend: dev2-sanbackend
storagePrefix: alternate-trident
igroupName: custom
debugTraceFlags:
  api: false
  method: true
defaults:
  spaceReserve: volume
  qosPolicy: standard
  spaceAllocation: 'false'
  snapshotPolicy: default
  snapshotReserve: '10'
```



For all volumes created using the `ontap-san` driver, Astra Trident adds an extra 10 percent capacity to the FlexVol to accommodate the LUN metadata. The LUN will be provisioned with the exact size that the user requests in the PVC. Astra Trident adds 10 percent to the FlexVol (shows as Available size in ONTAP). Users will now get the amount of usable capacity they requested. This change also prevents LUNs from becoming read-only unless the available space is fully utilized. This does not apply to `ontap-san-economy`.

For backends that define `snapshotReserve`, Astra Trident calculates the size of volumes as follows:


```
Total volume size = [(PVC requested size) / (1 - (snapshotReserve
percentage) / 100)] * 1.1
```

The 1.1 is the extra 10 percent Astra Trident adds to the FlexVol to accommodate the LUN metadata. For `snapshotReserve = 5%`, and `PVC request = 5GiB`, the total volume size is 5.79GiB and the available size is 5.5GiB. The `volume show` command should show results similar to this example:

Vserver	Volume	Aggregate	State	Type	Size	Available	Used%
		_pvc_89f1c156_3801_4de4_9f9d_034d54c395f4	online	RW	10GB	5.00GB	0%
		_pvc_e42ec6fe_3baa_4af6_996d_134adbbb8e6d	online	RW	5.79GB	5.50GB	0%
		_pvc_e8372153_9ad9_474a_951a_08ae15e1c0ba	online	RW	1GB	511.8MB	0%

3 entries were displayed.

Currently, resizing is the only way to use the new calculation for an existing volume.

Minimal configuration examples

The following examples show basic configurations that leave most parameters to default. This is the easiest way to define a backend.



If you are using Amazon FSx on NetApp ONTAP with Astra Trident, the recommendation is to specify DNS names for LIFs instead of IP addresses.

ontap-san driver with certificate-based authentication

This is a minimal backend configuration example. `clientCertificate`, `clientPrivateKey`, and `trustedCACertificate` (optional, if using trusted CA) are populated in `backend.json` and take the base64-encoded values of the client certificate, private key, and trusted CA certificate, respectively.

```
---
version: 1
storageDriverName: ontap-san
backendName: DefaultSANBackend
managementLIF: 10.0.0.1
svm: svm_iscsi
useCHAP: true
chapInitiatorSecret: cl9qxIm36DKyawxy
chapTargetInitiatorSecret: rqxigXgkesIpwxyz
chapTargetUsername: iJF4heBRT0TCwxyz
chapUsername: uh2aNCLSD6cNwxyz
igroupName: trident
clientCertificate: ZXR0ZXJwYXB...ICMgJ3BhcGVyc2
clientPrivateKey: vciwKIyAgZG...0cnksIGRlc2NyaX
trustedCACertificate: zcyBbaG...b3Igb3duIGNsYXNz
```

ontap-san **driver with bidirectional CHAP**

This is a minimal backend configuration example. This basic configuration creates an `ontap-san` backend with `useCHAP` set to `true`.

```
---
version: 1
storageDriverName: ontap-san
managementLIF: 10.0.0.1
svm: svm_iscsi
labels:
  k8scluster: test-cluster-1
  backend: testcluster1-sanbackend
useCHAP: true
chapInitiatorSecret: cl9qxIm36DKyawxy
chapTargetInitiatorSecret: rqxigXgkesIpwxyz
chapTargetUsername: iJF4heBRT0TCwxyz
chapUsername: uh2aNCLSD6cNwxyz
igroupName: trident
username: vsadmin
password: password
```

ontap-san-economy **driver**

```
---
version: 1
storageDriverName: ontap-san-economy
managementLIF: 10.0.0.1
svm: svm_iscsi_eco
useCHAP: true
chapInitiatorSecret: cl9qxIm36DKyawxy
chapTargetInitiatorSecret: rqxigXgkesIpwxyz
chapTargetUsername: iJF4heBRT0TCwxyz
chapUsername: uh2aNCLSD6cNwxyz
igroupName: trident
username: vsadmin
password: password
```

Examples of backends with virtual pools

In the sample backend definition file shown below, specific defaults are set for all storage pools, such as `spaceReserve` at `none`, `spaceAllocation` at `false`, and `encryption` at `false`. The virtual pools are defined in the `storage` section.

Astra Trident sets provisioning labels in the “Comments” field. Comments are set on the FlexVol. Astra Trident

copies all labels present on a virtual pool to the storage volume at provisioning. For convenience, storage administrators can define labels per virtual pool and group volumes by label.

In this example, some of the storage pool sets their own `spaceReserve`, `spaceAllocation`, and `encryption` values, and some pools overwrite the default values set above.

```

---
version: 1
storageDriverName: ontap-san
managementLIF: 10.0.0.1
svm: svm_iscsi
useCHAP: true
chapInitiatorSecret: cl9qxIm36DKyawxy
chapTargetInitiatorSecret: rqxigXgkesIpwxyz
chapTargetUsername: iJF4heBRT0TCwxyz
chapUsername: uh2aNCLSD6cNwxyz
igroupName: trident
username: vsadmin
password: password
defaults:
  spaceAllocation: 'false'
  encryption: 'false'
  qosPolicy: standard
labels:
  store: san_store
  kubernetes-cluster: prod-cluster-1
region: us_east_1
storage:
- labels:
  protection: gold
  creditpoints: '40000'
  zone: us_east_1a
  defaults:
    spaceAllocation: 'true'
    encryption: 'true'
    adaptiveQosPolicy: adaptive-extreme
- labels:
  protection: silver
  creditpoints: '20000'
  zone: us_east_1b
  defaults:
    spaceAllocation: 'false'
    encryption: 'true'
    qosPolicy: premium
- labels:
  protection: bronze
  creditpoints: '5000'
  zone: us_east_1c
  defaults:
    spaceAllocation: 'true'
    encryption: 'false'

```

Here is an iSCSI example for the `ontap-san-economy` driver:

```
---
version: 1
storageDriverName: ontap-san-economy
managementLIF: 10.0.0.1
svm: svm_iscsi_eco
useCHAP: true
chapInitiatorSecret: cl9qxIm36DKyawxy
chapTargetInitiatorSecret: rqxigXgkesIpwxyz
chapTargetUsername: iJF4heBRT0TCwxyz
chapUsername: uh2aNCLSD6cNwxyz
igroupName: trident
username: vsadmin
password: password
defaults:
  spaceAllocation: 'false'
  encryption: 'false'
labels:
  store: san_economy_store
region: us_east_1
storage:
- labels:
  app: oracledb
  cost: '30'
  zone: us_east_1a
  defaults:
    spaceAllocation: 'true'
    encryption: 'true'
- labels:
  app: postgresdb
  cost: '20'
  zone: us_east_1b
  defaults:
    spaceAllocation: 'false'
    encryption: 'true'
- labels:
  app: mysqldb
  cost: '10'
  zone: us_east_1c
  defaults:
    spaceAllocation: 'true'
    encryption: 'false'
```

Map backends to StorageClasses

The following StorageClass definitions refer to the above virtual pools. Using the `parameters.selector` field, each StorageClass calls out which virtual pool(s) can be used to host a volume. The volume will have the aspects defined in the chosen virtual pool.

- The first StorageClass (`protection-gold`) will map to the first, second virtual pool in the `ontap-nas-flexgroup` backend and the first virtual pool in the `ontap-san` backend. These are the only pool offering gold level protection.
- The second StorageClass (`protection-not-gold`) will map to the third, fourth virtual pool in `ontap-nas-flexgroup` backend and the second, third virtual pool in `ontap-san` backend. These are the only pools offering protection level other than gold.
- The third StorageClass (`app-mysqldb`) will map to the fourth virtual pool in `ontap-nas` backend and the third virtual pool in `ontap-san-economy` backend. These are the only pools offering storage pool configuration for `mysqldb` type app.
- The fourth StorageClass (`protection-silver-creditpoints-20k`) will map to the third virtual pool in `ontap-nas-flexgroup` backend and the second virtual pool in `ontap-san` backend. These are the only pools offering gold-level protection at 20000 creditpoints.
- The fifth StorageClass (`creditpoints-5k`) will map to the second virtual pool in `ontap-nas-economy` backend and the third virtual pool in `ontap-san` backend. These are the only pool offerings at 5000 creditpoints.

Astra Trident will decide which virtual pool is selected and will ensure the storage requirement is met.

```

apiVersion: storage.k8s.io/v1
kind: StorageClass
metadata:
  name: protection-gold
provisioner: netapp.io/trident
parameters:
  selector: "protection=gold"
  fsType: "ext4"
---
apiVersion: storage.k8s.io/v1
kind: StorageClass
metadata:
  name: protection-not-gold
provisioner: netapp.io/trident
parameters:
  selector: "protection!=gold"
  fsType: "ext4"
---
apiVersion: storage.k8s.io/v1
kind: StorageClass
metadata:
  name: app-mysqldb
provisioner: netapp.io/trident
parameters:
  selector: "app=mysqldb"
  fsType: "ext4"
---
apiVersion: storage.k8s.io/v1
kind: StorageClass
metadata:
  name: protection-silver-creditpoints-20k
provisioner: netapp.io/trident
parameters:
  selector: "protection=silver; creditpoints=20000"
  fsType: "ext4"
---
apiVersion: storage.k8s.io/v1
kind: StorageClass
metadata:
  name: creditpoints-5k
provisioner: netapp.io/trident
parameters:
  selector: "creditpoints=5000"
  fsType: "ext4"

```

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