



NetApp Trident Overview

NetApp Solutions

NetApp
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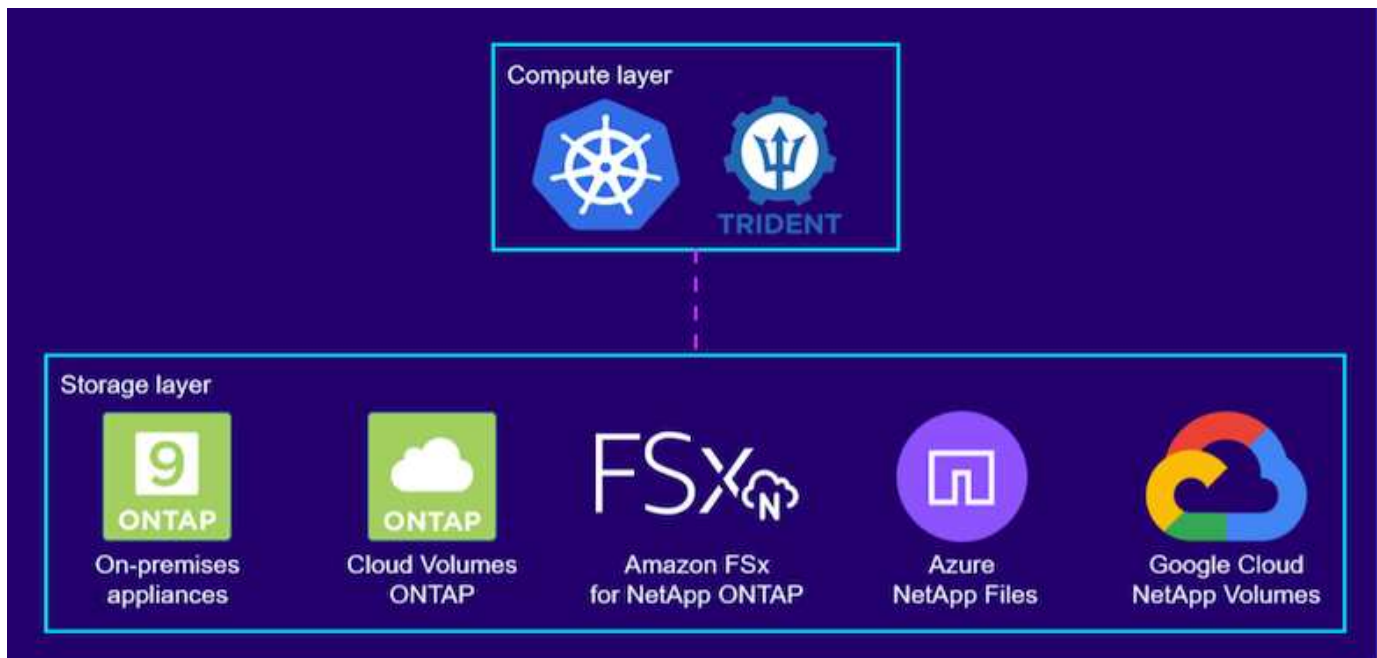
NetApp Trident Overview

Trident overview

Trident is an open-source and fully-supported storage orchestrator for containers and Kubernetes distributions, including VMware Tanzu.

Trident is an open-source, fully supported storage orchestrator for containers and Kubernetes distributions like Red Hat OpenShift, VMware Tanzu, Anthos by Google Cloud, Rancher etc. Trident works with the entire NetApp storage portfolio, including the NetApp ONTAP and Element storage systems, and it also supports NFS and iSCSI connections. Trident accelerates the DevOps workflow by allowing end users to provision and manage storage from their NetApp storage systems without requiring intervention from a storage administrator.

An administrator can configure a number of storage backends based on project needs and storage system models that enable advanced storage features, including compression, specific disk types, or QoS levels that guarantee a certain level of performance. After they are defined, these backends can be used by developers in their projects to create persistent volume claims (PVCs) and to attach persistent storage to their containers on demand.



Trident has a rapid development cycle and, like Kubernetes, is released four times a year.

The latest version of Trident is 22.04 released in April 2022. A support matrix for what version of Trident has been tested with which Kubernetes distribution can be found [here](#).

Starting with the 20.04 release, Trident setup is performed by the Trident operator. The operator makes large scale deployments easier and provides additional support, including self healing for pods that are deployed as a part of the Trident install.

With the 21.01 release, a Helm chart was made available to ease the installation of the Trident Operator.

Deploy Trident operator using Helm

1. First set the location of the user cluster's `kubeconfig` file as an environment variable so that you don't have to reference it, because Trident has no option to pass this file.

```
[netapp-user@rhel7]$ export KUBECONFIG=~/.tanzu-install/auth/kubeconfig
```

2. Add the NetApp Trident helm repository.

```
[netapp-user@rhel7]$ helm repo add netapp-trident
https://netapp.github.io/trident-helm-chart
"netapp-trident" has been added to your repositories
```

3. Update the helm repositories.

```
[netapp-user@rhel7]$ helm repo update
Hang tight while we grab the latest from your chart repositories...
...Successfully got an update from the "netapp-trident" chart repository
...Successfully got an update from the "bitnami" chart repository
Update Complete. ☐Happy Helming!☐
```

4. Create a new namespace for the installation of Trident.

```
[netapp-user@rhel7]$ kubectl create ns trident
```

5. Create a secret with DockerHub credentials to download the Trident images.

```
[netapp-user@rhel7]$ kubectl create secret docker-registry docker-
registry-cred --docker-server=docker.io --docker-username=netapp
-solutions-tme --docker-password=xxxxxxx -n trident
```

6. For user or workload clusters managed by TKGS (vSphere with Tanzu) or TKG with management cluster deployments, complete the following procedure to install Trident:

- a. Ensure that the logged in user has the permissions to create service accounts in trident namespace and that the service accounts in trident namespace have the permissions to create pods.
- b. Run the below helm command to install Trident operator in the namespace created.

```
[netapp-user@rhel7]$ helm install trident netapp-trident/trident-
operator -n trident --set imagePullSecrets[0]=docker-registry-cred
```

7. For a user or workload cluster managed by TKG deployments, run the following helm command to install

Trident operator in the namespace created.

```
[netapp-user@rhel7]$ helm install trident netapp-trident/trident-operator -n trident --set imagePullSecrets[0]=docker-registry-cred,kubeletDir="/var/vcap/data/kubelet"
```

8. Verify that the Trident pods are up and running.

```
NAME                                READY   STATUS    RESTARTS
AGE
trident-csi-6vv62                   2/2    Running   0
14m
trident-csi-cfd844bcc-sqhcg        6/6    Running   0
12m
trident-csi-dfcmz                   2/2    Running   0
14m
trident-csi-pb2n7                   2/2    Running   0
14m
trident-csi-qsw6z                   2/2    Running   0
14m
trident-operator-67c94c4768-xw978  1/1    Running   0
14m
```

```
[netapp-user@rhel7]$ ./tridentctl -n trident version
+-----+-----+
| SERVER VERSION | CLIENT VERSION |
+-----+-----+
| 22.04.0        | 22.04.0        |
+-----+-----+
```

Create storage-system backends

After completing the Trident Operator install, you must configure the backend for the specific NetApp storage platform you are using. Follow the links below to continue the setup and configuration of Trident.

- [NetApp ONTAP NFS](#)
- [NetApp ONTAP iSCSI](#)

NetApp ONTAP NFS configuration

To enable Trident integration with the NetApp ONTAP storage system via NFS, you must create a backend that enables communication with the storage system. We configure a basic backend in this solution, but if you are looking for more customized options, visit the documentation [here](#).

Create an SVM in ONTAP

1. Log into ONTAP System Manager, navigate to Storage > Storage VMs, and click Add.
2. Enter a name for the SVM, enable the NFS protocol, check the Allow NFS Client Access checkbox, and add the subnets that your worker nodes are on in the export policy rules for allowing the volumes to be mounted as PVs in your workload clusters.

Add Storage VM ✕

STORAGE VM NAME

trident_svm

Access Protocol

SMB/CIFS, NFS, S3

iSCSI

Enable SMB/CIFS

Enable NFS

Allow NFS client access

Add at least one rule to allow NFS clients to access volumes in this storage VM. [?](#)

EXPORT POLICY

Default

RULES

Rule Index	Clients	Access Protocols	Read-Only Rule	Read/Wr
	0.0.0.0/0	Any	Any	Any



If you are using NAT'ed deployment of user clusters or workload clusters with NSX-T, you need to add the Egress subnet (in the case of TKGS0 or the Floating IP subnet (in the case of TKGI) to the export policy rules.

3. Provide the details for data LIFs and the details for SVM administration account, and then click Save.

NETWORK INTERFACE

Use multiple network interfaces when client traffic is high.

K8s-Ontap-01

IP ADDRESS

172.21.252.180

SUBNET MASK

24

GATEWAY

172.21.252.1 X

BROADCAST DOMAIN

Default v

Storage VM Administration

Manage administrator account

USER NAME

vsadmin

PASSWORD

.....

CONFIRM PASSWORD

.....

Add a network interface for storage VM management.

4. Assign the aggregates to an SVM. Navigate to Storage > Storage VMs, click the ellipsis next to the newly created SVM and then click Edit. Check the Limit Volume Creation to Preferred Local Tiers checkbox and attach the required aggregates to it.

Edit Storage VM



STORAGE VM NAME

trident_svm

DEFAULT LANGUAGE

c.utf_8



DELETED VOLUME RETENTION PERIOD 

12

HOURS

Resource Allocation

Limit volume creation to preferred local tiers

LOCAL TIERS

K8s_Ontap_01_SSD_1 

Cancel

Save

5. In case of NAT'ed deployments of user or workload clusters on which Trident is to be installed, the storage mount request might arrive from a non-standard port due to SNAT. By default, ONTAP only allows the volume mount requests when originated from root port. Thus, log into ONTAP CLI and modify the setting to

allow mount requests from non-standard ports.

```
ontap-01> vserver nfs modify -vserver tanzu_svm -mount-rootonly disabled
```

Create backends and StorageClasses

1. For NetApp ONTAP systems serving NFS, create a backend config file on the jumphost with the backendName, managementLIF, dataLIF, svm, username, password, and other details.

```
{
  "version": 1,
  "storageDriverName": "ontap-nas",
  "backendName": "ontap-nas+10.61.181.221",
  "managementLIF": "172.21.224.201",
  "dataLIF": "10.61.181.221",
  "svm": "trident_svm",
  "username": "admin",
  "password": "password"
}
```



It is a best practice to define the custom backendName value as a combination of the storageDriverName and the dataLIF that is serving NFS for easy identification.

2. Create the Trident backend by running the following command.

```
[netapp-user@rhel7]$ ./tridentctl -n trident create backend -f backend-ontap-nas.json
+-----+-----+
+-----+-----+-----+-----+
|          NAME          | STORAGE DRIVER |          UUID          |
| STATE | VOLUMES | |
+-----+-----+-----+-----+
+-----+-----+-----+-----+
| ontap-nas+10.61.181.221 | ontap-nas      | be7a619d-c81d-445c-b80c-5c87a73c5b1e |
| online |         0 |
+-----+-----+-----+-----+
+-----+-----+-----+-----+
```

3. With the backend created, you must next create a storage class. The following sample storage class definition highlights the required and basic fields. The parameter backendType should reflect the storage driver from the newly created Trident backend.

```
apiVersion: storage.k8s.io/v1
kind: StorageClass
metadata:
  name: ontap-nfs
provisioner: csi.trident.netapp.io
parameters:
  backendType: "ontap-nas"
```

4. Create the storage class by running the kubectl command.

```
[netapp-user@rhel7 trident-installer]$ kubectl create -f storage-class-nfs.yaml
storageclass.storage.k8s.io/ontap-nfs created
```

5. With the storage class created, you must then create the first persistent volume claim (PVC). A sample PVC definition is given below. Make sure that the `storageClassName` field matches the name of the storage class just created. The PVC definition can be further customized as required depending upon the workload to be provisioned.

```
kind: PersistentVolumeClaim
apiVersion: v1
metadata:
  name: basic
spec:
  accessModes:
    - ReadWriteOnce
  resources:
    requests:
      storage: 1Gi
  storageClassName: ontap-nfs
```

6. Create the PVC by issuing the kubectl command. Creation can take some time depending on the size of the backing volume being created, so you can watch the process as it completes.

```
[netapp-user@rhel7 trident-installer]$ kubectl create -f pvc-basic.yaml
persistentvolumeclaim/basic created
```

```
[netapp-user@rhel7 trident-installer]$ kubectl get pvc
NAME      STATUS    VOLUME                                     CAPACITY
ACCESS MODES  STORAGECLASS  AGE
basic      Bound      pvc-b4370d37-0fa4-4c17-bd86-94f96c94b42d  1Gi
RWO                ontap-nfs      7s
```

NetApp ONTAP iSCSI configuration

To integrate NetApp ONTAP storage system with VMware Tanzu Kubernetes clusters for persistent volumes via iSCSI, the first step is to prepare the nodes by logging into each node and configuring the iSCSI utilities or packages to mount iSCSI volumes. To do so, follow the procedure laid out in this [link](#).



NetApp does not recommend this procedure for NAT'ed deployments of VMware Tanzu Kubernetes clusters.



TKGI uses Bosh VMs as nodes for Tanzu Kubernetes clusters that run immutable configuration images, and any manual changes of iSCSI packages on Bosh VMs do not remain persistent across reboots. Therefore, NetApp recommends using NFS volumes for persistent storage for Tanzu Kubernetes clusters deployed and operated by TKGI.

After the cluster nodes are prepared for iSCSI volumes, you must create a backend that enables communication with the storage system. We configured a basic backend in this solution, but, if you are looking for more customized options, visit the documentation [here](#).

Create an SVM in ONTAP

To create an SVM in ONTAP, complete the following steps:

1. Log into ONTAP System Manager, navigate to Storage > Storage VMs, and click Add.
2. Enter a name for the SVM, enable the iSCSI protocol, and then provide details for the data LIFs.

Add Storage VM



STORAGE VM NAME

Access Protocol

SMB/CIFS, NFS, S3 iSCSI

Enable iSCSI

NETWORK INTERFACE

K8s-Ontap-01

IP ADDRESS	SUBNET MASK	GATEWAY	BROADCAST DOMAIN
<input type="text" value="10.61.181.231"/>	<input type="text" value="24"/>	<input type="text" value="10.61.181.1 X"/>	<input type="text" value="Defa..."/>

Use the same subnet mask, gateway, and broadcast domain for all of the following interfaces

IP ADDRESS	SUBNET MASK	GATEWAY	BROADCAST DOMAIN
<input type="text" value="10.61.181.232"/>	<input type="text" value="24"/>	<input type="text" value="10.61.181.1 X"/>	<input type="text" value="Defa..."/>

3. Enter the details for the SVM administration account, and then click Save.

Storage VM Administration

Manage administrator account

USER NAME

vsadmin

PASSWORD

.....

CONFIRM PASSWORD

.....

Add a network interface for storage VM management.

Save

Cancel

4. To assign the aggregates to the SVM, navigate to Storage > Storage VMs, click the ellipsis next to the newly created SVM, and then click Edit. Check the Limit Volume Creation to Preferred Local Tiers checkbox, and attach the required aggregates to it.

Edit Storage VM



STORAGE VM NAME

DEFAULT LANGUAGE

DELETED VOLUME RETENTION PERIOD 

HOURS

Resource Allocation

Limit volume creation to preferred local tiers

LOCAL TIERS

K8s_Ontap_01_SSD_1 

Cancel

Create backends and StorageClasses

1. For NetApp ONTAP systems serving NFS, create a backend config file on the jumphost with the backendName, managementLIF, dataLIF, svm, username, password, and other details.

```
{
  "version": 1,
  "storageDriverName": "ontap-san",
  "backendName": "ontap-san+10.61.181.231",
  "managementLIF": "172.21.224.201",
  "dataLIF": "10.61.181.231",
  "svm": "trident_svm_iscsi",
  "username": "admin",
  "password": "password"
}
```

2. Create the Trident backend by running the following command.

```
[netapp-user@rhel7 trident-installer]$ ./tridentctl -n trident create
backend -f backend-ontap-san.json
+-----+-----+
+-----+-----+-----+-----+
|           NAME           | STORAGE DRIVER |                               UUID
| STATE | VOLUMES |
+-----+-----+-----+-----+
+-----+-----+-----+-----+
| ontap-san+10.61.181.231 | ontap-san      | 6788533c-7fea-4a35-b797-
fb9bb3322b91 | online |          0 |
+-----+-----+-----+-----+
+-----+-----+-----+-----+
```

3. After you create a backend, you must next create a storage class. The following sample storage class definition highlights the required and basic fields. The parameter `backendType` should reflect the storage driver from the newly created Trident backend. Also note the name-field value, which must be referenced in a later step.

```
apiVersion: storage.k8s.io/v1
kind: StorageClass
metadata:
  name: ontap-iscsi
provisioner: csi.trident.netapp.io
parameters:
  backendType: "ontap-san"
```



There is an optional field called `fsType` that is defined in this file. In iSCSI backends, this value can be set to a specific Linux filesystem type (XFS, ext4, and so on) or can be deleted to allow Tanzu Kubernetes clusters to decide what filesystem to use.

4. Create the storage class by running the kubectl command.

```
[netapp-user@rhel7 trident-installer]$ kubectl create -f storage-class-iscsi.yaml
storageclass.storage.k8s.io/ontap-iscsi created
```

5. With the storage class created, you must then create the first persistent volume claim (PVC). A sample PVC definition is given below. Make sure that the `storageClassName` field matches the name of the storage class just created. The PVC definition can be further customized as required depending upon the workload to be provisioned.

```
kind: PersistentVolumeClaim
apiVersion: v1
metadata:
  name: basic
spec:
  accessModes:
    - ReadWriteOnce
  resources:
    requests:
      storage: 1Gi
  storageClassName: ontap-iscsi
```

6. Create the PVC by issuing the kubectl command. Creation can take some time depending on the size of the backing volume being created, so you can watch the process as it completes.

```
[netapp-user@rhel7 trident-installer]$ kubectl create -f pvc-basic.yaml
persistentvolumeclaim/basic created
```

```
[netapp-user@rhel7 trident-installer]$ kubectl get pvc
```

NAME	STATUS	VOLUME	CAPACITY
		ACCESS MODES	STORAGECLASS
		AGE	
basic	Bound	pvc-7ceac1ba-0189-43c7-8f98-094719f7956c	1Gi
RWO		ontap-iscsi	3s

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