NetApp Trident Deployment and Configuration

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This section describes the tasks that you must complete to install and configure NetApp Trident in your Kubernetes cluster.

Prerequisites

Before you perform the deployment exercise that is outlined in this section, we assume that you have already performed the following tasks:

1. You already have a working Kubernetes cluster, and you are running a version of Kubernetes that is supported by Trident. For a list of supported versions, see the Trident documentation.
2. You already have a working NetApp storage appliance, software-defined instance, or cloud storage service, that is supported by Trident.

Install Trident

To install and configure NetApp Trident in your Kubernetes cluster, perform the following tasks from the deployment jump host:

1. Deploy Trident using one of the following methods:
    - If you used NVIDIA DeepOps to deploy your Kubernetes cluster, you can also use NVIDIA DeepOps to deploy Trident in your Kubernetes cluster. To deploy Trident with DeepOps, follow the Trident deployment instructions on the NVIDIA DeepOps GitHub site.
    - If you did not use NVIDIA DeepOps to deploy your Kubernetes cluster or if you simply prefer to deploy Trident manually, you can deploy Trident by following the deployment instructions in the Trident documentation. Be sure to create at least one Trident Backend and at least one Kubernetes StorageClass, for more information about how to configure Backends and StorageClasses see the linked subsections at NetApp Docs.

If you are deploying the NetApp AI Control Plane solution on an ONTAP AI pod, see Example Trident Backends for ONTAP AI Deployments for some examples of different Trident Backends that you might want to create and Example Kubernetes Storageclasses for ONTAP AI Deployments for some examples of different Kubernetes StorageClasses that you might want to create.

Next: Example Trident Backends for ONTAP AI Deployments.

NetApp Trident Deployment and Configuration

This section describes the tasks that you must complete to install and configure NetApp Trident in your Kubernetes cluster.

Prerequisites

Before you perform the deployment exercise that is outlined in this section, we assume that you have already performed the following tasks:

1. You already have a working Kubernetes cluster, and you are running a version of Kubernetes that is supported by Trident. For a list of supported versions, see the Trident documentation.
2. You already have a working NetApp storage appliance, software-defined instance, or cloud storage service, that is supported by Trident.

Install Trident

To install and configure NetApp Trident in your Kubernetes cluster, perform the following tasks from the deployment jump host:

1. Deploy Trident using one of the following methods:
   - If you used NVIDIA DeepOps to deploy your Kubernetes cluster, you can also use NVIDIA DeepOps to deploy Trident in your Kubernetes cluster. To deploy Trident with DeepOps, follow the Trident deployment instructions on the NVIDIA DeepOps GitHub site.
   - If you did not use NVIDIA DeepOps to deploy your Kubernetes cluster or if you simply prefer to deploy Trident manually, you can deploy Trident by following the deployment instructions in the Trident documentation. Be sure to create at least one Trident Backend and at least one Kubernetes StorageClass, for more information about how to configure Backends and StorageClasses see the linked subsections at NetApp Docs.

If you are deploying the NetApp AI Control Plane solution on an ONTAP AI pod, see Example Trident Backends for ONTAP AI Deployments for some examples of different Trident Backends that you might want to create and Example Kubernetes Storageclasses for ONTAP AI Deployments for some examples of different Kubernetes StorageClasses that you might want to create.

Next: Example Trident Backends for ONTAP AI Deployments.

Example Trident Backends for ONTAP AI Deployments

Before you can use Trident to dynamically provision storage resources within your Kubernetes cluster, you must create one or more Trident Backends. The examples that follow represent different types of Backends that you might want to create if you are deploying the NetApp AI Control Plane solution on an ONTAP AI pod. For more information about Backends, see the Trident documentation.

1. NetApp recommends creating a FlexGroup-enabled Trident Backend for each data LIF (logical network interface that provides data access) that you want to use on your NetApp AFF system. This will allow you to balance volume mounts across LIFs

   The example commands that follow show the creation of two FlexGroup-enabled Trident Backends for two different data LIFs that are associated with the same ONTAP storage virtual machine (SVM). These Backends use the `ontap-nas-flexgroup` storage driver. ONTAP supports two main data volume types: FlexVol and FlexGroup. FlexVol volumes are size-limited (as of this writing, the maximum size depends on the specific deployment). FlexGroup volumes, on the other hand, can scale linearly to up to 20PB and 400 billion files, providing a single namespace that greatly simplifies data management. Therefore, FlexGroup volumes are optimal for AI and ML workloads that rely on large amounts of data.

   If you are working with a small amount of data and want to use FlexVol volumes instead of FlexGroup volumes, you can create Trident Backends that use the `ontap-nas` storage driver instead of the `ontap-`

`nas-flexgroup` storage driver.

```
$ cat << EOF > ./trident-backend-ontap-ai-flexgroups-iface1.json
{
    "version": 1,
    "storageDriverName": "ontap-nas-flexgroup",
    "backendName": "ontap-ai-flexgroups-iface1",
    "managementLIF": "10.61.218.100",
    "dataLIF": "192.168.11.11",
    "svm": "ontapai_nfs",
    "username": "admin",
    "password": "ontapai"
}
EOF
$ tridentctl create backend -f ./trident-backend-ontap-ai-flexgroups-
iface1.json -n trident
+----------------------------+--------------------
+---------------------------------------+--------+---------+
|            NAME            |   STORAGE DRIVER    |
UUID                  | STATE  | VOLUMES |
+----------------------------+--------------------
+---------------------------------------+--------+---------+
| ontap-ai-flexgroups-iface1 | ontap-nas-flexgroup | b74cbddb-e0b8-40b7-
b263-b6da6dec0bdd | online |       0 |
+----------------------------+--------------------
+---------------------------------------+--------+---------+
$ cat << EOF > ./trident-backend-ontap-ai-flexgroups-iface2.json
{
    "version": 1,
    "storageDriverName": "ontap-nas-flexgroup",
    "backendName": "ontap-ai-flexgroups-iface2",
    "managementLIF": "10.61.218.100",
    "dataLIF": "192.168.12.12",
    "svm": "ontapai_nfs",
    "username": "admin",
    "password": "ontapai"
}
EOF
$ tridentctl create backend -f ./trident-backend-ontap-ai-flexgroups-
iface2.json -n trident
+----------------------------+--------------------
+---------------------------------------+--------+---------+
|            NAME            |   STORAGE DRIVER    |
UUID                  | STATE  | VOLUMES |
+----------------------------+--------------------
+---------------------------------------+--------+---------+
```

```
| ontap-ai-flexgroups-iface2 | ontap-nas-flexgroup | 61814d48-c770-436b-
9cb4-cf7ee661274d | online |       0 |
+----------------------------+---------------------
+--------------------------------------+--------+---------+
$ tridentctl get backend -n trident
+----------------------------+---------------------
+--------------------------------------+--------+---------+
|            NAME            |   STORAGE DRIVER    |
UUID                 | STATE  | VOLUMES |
+----------------------------+---------------------
+--------------------------------------+--------+---------+
| ontap-ai-flexgroups-iface1 | ontap-nas-flexgroup | b74cbddb-e0b8-40b7-
b263-b6da6dec0bdd | online |       0 |
| ontap-ai-flexgroups-iface2 | ontap-nas-flexgroup | 61814d48-c770-436b-
9cb4-cf7ee661274d | online |       0 |
+----------------------------+---------------------
+--------------------------------------+--------+---------+
```

2. NetApp also recommends creating one or more FlexVol- enabled Trident Backends. If you use FlexGroup volumes for training dataset storage, you might want to use FlexVol volumes for storing results, output, debug information, and so on. If you want to use FlexVol volumes, you must create one or more FlexVol-enabled Trident Backends. The example commands that follow show the creation of a single FlexVol-enabled Trident Backend that uses a single data LIF.

```
$ cat << EOF > ./trident-backend-ontap-ai-flexvols.json
{
    "version": 1,
    "storageDriverName": "ontap-nas",
    "backendName": "ontap-ai-flexvols",
    "managementLIF": "10.61.218.100",
    "dataLIF": "192.168.11.11",
    "svm": "ontapai_nfs",
    "username": "admin",
    "password": "ontapai"
}
EOF
$ tridentctl create backend -f ./trident-backend-ontap-ai-flexvols.json -n
trident
+----------------------------+--------------------
+--------------------------------------+--------+---------+
|            NAME            |   STORAGE DRIVER    |                 UUID
| STATE  | VOLUMES |
+----------------------------+--------------------
+--------------------------------------+--------+---------+
| ontap-ai-flexvols          | ontap-nas           | 52bdb3b1-13a5-4513-
a9c1-52a69657fabe | online |       0 |
+----------------------------+--------------------
+--------------------------------------+--------+---------+
$ tridentctl get backend -n trident
+----------------------------+--------------------
+--------------------------------------+--------+---------+
|            NAME            |   STORAGE DRIVER    |                 UUID
| STATE  | VOLUMES |
+----------------------------+--------------------
+--------------------------------------+--------+---------+
| ontap-ai-flexvols          | ontap-nas           | 52bdb3b1-13a5-4513-
a9c1-52a69657fabe | online |       0 |
| ontap-ai-flexgroups-iface1 | ontap-nas-flexgroup | b74cbddb-e0b8-40b7-
b263-b6da6dec0bdd | online |       0 |
| ontap-ai-flexgroups-iface2 | ontap-nas-flexgroup | 61814d48-c770-436b-
9cb4-cf7ee661274d | online |       0 |
+----------------------------+--------------------
+--------------------------------------+--------+---------+
```

Next: Example Kubernetes Storageclasses for ONTAP AI Deployments.

Example Kubernetes StorageClasses for ONTAP AI Deployments

Before you can use Trident to dynamically provision storage resources within your Kubernetes cluster, you must create one or more Kubernetes StorageClasses. The examples that follow represent different types of StorageClasses that you might want to create if you are deploying the NetApp AI Control Plane solution on an ONTAP AI pod. For more information about StorageClasses, see the Trident documentation.

1. NetApp recommends creating a separate StorageClass for each FlexGroup-enabled Trident Backend that you created in the section Example Trident Backends for ONTAP AI Deployments, step 1. These granular StorageClasses enable you to add NFS mounts that correspond to specific LIFs (the LIFs that you specified when you created the Trident Backends) as a particular Backend that is specified in the StorageClass spec file. The example commands that follow show the creation of two StorageClasses that correspond to the two example Backends that were created in the section Example Trident Backends for ONTAP AI Deployments, step 1. For more information about StorageClasses, see the Trident documentation.

   So that a persistent volume isn't deleted when the corresponding PersistentVolumeClaim (PVC) is deleted, the following example uses a `reclaimPolicy` value of `Retain`. For more information about the `reclaimPolicy` field, see the official Kubernetes documentation.

```
$ cat << EOF > ./storage-class-ontap-ai-flexgroups-retain-iface1.yaml
apiVersion: storage.k8s.io/v1
kind: StorageClass
metadata:
  name: ontap-ai-flexgroups-retain-iface1
provisioner: netapp.io/trident
parameters:
  backendType: "ontap-nas-flexgroup"
  storagePools: "ontap-ai-flexgroups-iface1:.*"
reclaimPolicy: Retain
EOF
$ kubectl create -f ./storage-class-ontap-ai-flexgroups-retain-
iface1.yaml
storageclass.storage.k8s.io/ontap-ai-flexgroups-retain-iface1 created
$ cat << EOF > ./storage-class-ontap-ai-flexgroups-retain-iface2.yaml
apiVersion: storage.k8s.io/v1
kind: StorageClass
metadata:
  name: ontap-ai-flexgroups-retain-iface2
provisioner: netapp.io/trident
parameters:
  backendType: "ontap-nas-flexgroup"
  storagePools: "ontap-ai-flexgroups-iface2:.*"
reclaimPolicy: Retain
EOF
$ kubectl create -f ./storage-class-ontap-ai-flexgroups-retain-
iface2.yaml
storageclass.storage.k8s.io/ontap-ai-flexgroups-retain-iface2 created
$ kubectl get storageclass
NAME                                 PROVISIONER          AGE
ontap-ai-flexgroups-retain-iface1    netapp.io/trident    0m
ontap-ai-flexgroups-retain-iface2    netapp.io/trident    0m
```

2. NetApp also recommends creating a StorageClass that corresponds to the FlexVol-enabled Trident Backend that you created in the section Example Trident Backends for ONTAP AI Deployments, step 2. The example commands that follow show the creation of a single StorageClass for FlexVol volumes.

   In the following example, a particular Backend is not specified in the StorageClass definition file because only one FlexVol-enabled Trident backend was created. When you use Kubernetes to administer volumes that use this StorageClass, Trident attempts to use any available backend that uses the `ontap-nas` driver.

```
$ cat << EOF > ./storage-class-ontap-ai-flexvols-retain.yaml
apiVersion: storage.k8s.io/v1
kind: StorageClass
metadata:
  name: ontap-ai-flexvols-retain
provisioner: netapp.io/trident
parameters:
  backendType: "ontap-nas"
reclaimPolicy: Retain
EOF
$ kubectl create -f ./storage-class-ontap-ai-flexvols-retain.yaml
storageclass.storage.k8s.io/ontap-ai-flexvols-retain created
$ kubectl get storageclass
NAME                                  PROVISIONER         AGE
ontap-ai-flexgroups-retain-iface1   netapp.io/trident   1m
ontap-ai-flexgroups-retain-iface2   netapp.io/trident   1m
ontap-ai-flexvols-retain            netapp.io/trident   0m
```

3. NetApp also recommends creating a generic StorageClass for FlexGroup volumes. The following example commands show the creation of a single generic StorageClass for FlexGroup volumes.

   Note that a particular backend is not specified in the StorageClass definition file. Therefore, when you use Kubernetes to administer volumes that use this StorageClass, Trident attempts to use any available backend that uses the `ontap-nas-flexgroup` driver.

```
$ cat << EOF > ./storage-class-ontap-ai-flexgroups-retain.yaml
apiVersion: storage.k8s.io/v1
kind: StorageClass
metadata:
  name: ontap-ai-flexgroups-retain
provisioner: netapp.io/trident
parameters:
  backendType: "ontap-nas-flexgroup"
reclaimPolicy: Retain
EOF
$ kubectl create -f ./storage-class-ontap-ai-flexgroups-retain.yaml
storageclass.storage.k8s.io/ontap-ai-flexgroups-retain created
$ kubectl get storageclass
NAME                                 PROVISIONER         AGE
ontap-ai-flexgroups-retain          netapp.io/trident   0m
ontap-ai-flexgroups-retain-iface1   netapp.io/trident   2m
ontap-ai-flexgroups-retain-iface2   netapp.io/trident   2m
ontap-ai-flexvols-retain            netapp.io/trident   1m
```

Next: Kubeflow Deployment Overview.