



# **Using Cloud Volumes ONTAP as persistent storage for Kubernetes**

## **Cloud Manager**

Ben Cammett, Tom Onacki  
July 10, 2021

# Table of Contents

- Using Cloud Volumes ONTAP as persistent storage for Kubernetes. . . . . 1
  - Quick start . . . . . 1
  - Reviewing prerequisites . . . . . 1
  - Adding Kubernetes clusters . . . . . 4
  - Connecting a cluster to Cloud Volumes ONTAP . . . . . 4
  - Managing your clusters . . . . . 5

# Using Cloud Volumes ONTAP as persistent storage for Kubernetes

Cloud Manager can automate the deployment of NetApp Trident on Kubernetes clusters so you can use Cloud Volumes ONTAP as persistent storage for containers.

Trident is a fully-supported open source project maintained by NetApp. Trident integrates natively with Kubernetes and its Persistent Volume framework to seamlessly provision and manage volumes from systems running any combination of NetApp's storage platforms. [Learn more about Trident.](#)



The Kubernetes feature isn't supported with on-prem ONTAP clusters. It's supported with Cloud Volumes ONTAP only.

## Quick start

Get started quickly by following these steps or scroll down to the remaining sections for full details.



### Review prerequisites

Ensure that your environment can meet the prerequisites, which includes connectivity between Kubernetes clusters and Cloud Volumes ONTAP, connectivity between Kubernetes clusters and a Connector, a minimum Kubernetes version of 1.14, at least one worker node in a cluster, and more. [See the complete list.](#)



### Add your Kubernetes clusters to Cloud Manager

In Cloud Manager, click **K8s** and discover clusters directly from your cloud provider's managed service or import a cluster by providing a kubeconfig file.



### Connect your clusters to Cloud Volumes ONTAP

After you add a Kubernetes cluster, click **Connect to Working Environment** to connect the cluster to one or more Cloud Volumes ONTAP systems.



### Start provisioning Persistent Volumes

Request and manage Persistent Volumes using native Kubernetes interfaces and constructs. Cloud Manager creates NFS and iSCSI storage classes that you can use when provisioning Persistent Volumes.

[Learn more about provisioning your first volume with Trident for Kubernetes.](#)

## Reviewing prerequisites

Before you get started, ensure that your Kubernetes clusters and Connector meet specific requirements.

## Kubernetes cluster requirements

- Network connectivity is required between a Kubernetes cluster and the Connector and between a Kubernetes cluster and Cloud Volumes ONTAP.

Both the Connector and Cloud Volumes ONTAP need a connection to the Kubernetes API endpoint:

- For managed clusters, set up a route between a cluster's VPC and the VPC where the Connector and Cloud Volumes ONTAP reside.
  - For other clusters, the IP address of the primary node or load balancer (as listed in the kubeconfig file) must be reachable by the Connector and Cloud Volumes ONTAP, and it must present a valid TLS certificate.
- A Kubernetes cluster can be in any location that has the network connectivity listed above.
  - A Kubernetes cluster must be running version 1.14 at a minimum.

The maximum supported version is defined by Trident. [Click here to see the maximum supported Kubernetes version.](#)

- A Kubernetes cluster must have at least one worker node.
- For clusters running in Amazon Elastic Kubernetes Service (Amazon EKS), each cluster needs an IAM role added in order to resolve a permissions error. After you add the cluster, Cloud Manager will prompt you with the exact eksctl command that resolves the error.

[Learn about IAM permissions boundaries.](#)

- For clusters running in Azure Kubernetes Service (AKS), those clusters must be assigned the *Azure Kubernetes Service RBAC Cluster Admin* role. This is required so Cloud Manager can install Trident and configure storage classes on the cluster.
- For clusters running in Google Kubernetes Engine (GKE), those clusters must not use the default Container Optimized OS. You should switch them to use Ubuntu.

GKE defaults to using the Google [container-optimized image](#), which doesn't have the utilities that Trident needs to mount volumes.

## Connector requirements

Ensure that the following permissions are in place for the Connector.

### Required permissions to discover and manage EKS clusters

The Connector needs Admin permissions to discover and manage Kubernetes clusters running in Amazon Elastic Kubernetes Service (EKS):

```
{
  "Version": "2012-10-17",
  "Statement": [
    {
      "Sid": "VisualEditor0",
      "Effect": "Allow",
      "Action": "eks:*",
      "Resource": "*"
    }
  ]
}
```

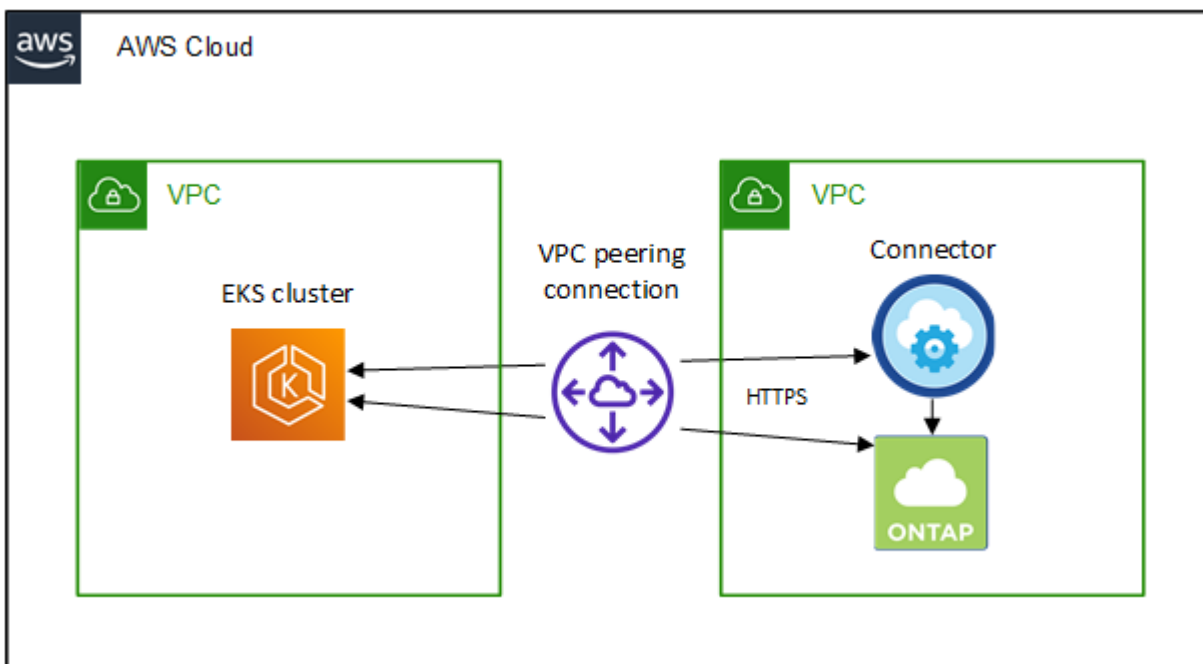
### Required permissions to discover and manage GKE clusters

The Connector needs the following permissions to discover and manage Kubernetes clusters running in Google Kubernetes Engine (GKE):

```
container.*
```

### Example setup

The following image shows an example of a Kubernetes cluster running in Amazon Elastic Kubernetes Service (Amazon EKS) and its connections to the Connector and Cloud Volumes ONTAP. In this example, VPC peering provides a connection between the VPC for the EKS cluster and the VPC for the Connector and Cloud Volumes ONTAP.



# Adding Kubernetes clusters

Add Kubernetes clusters to Cloud Manager by discovering the clusters running in your cloud provider's managed Kubernetes service or by importing a cluster's kubeconfig file.

## Steps

1. At the top of Cloud Manager, click **K8s**.
2. Click **Add Cluster**.
3. Choose one of the available options:
  - Click **Discover Clusters** to discover the managed clusters that Cloud Manager has access to based on permissions that you provided to the Connector.

For example, if your Connector is running in Google Cloud, Cloud Manager uses the permissions from the Connector's service account to discover clusters running in Google Kubernetes Engine (GKE).

- Click **Import Cluster** to import a cluster using a kubeconfig file.

After you upload the file, Cloud Manager verifies connectivity to the cluster and saves an encrypted copy of the kubeconfig file.

## Result

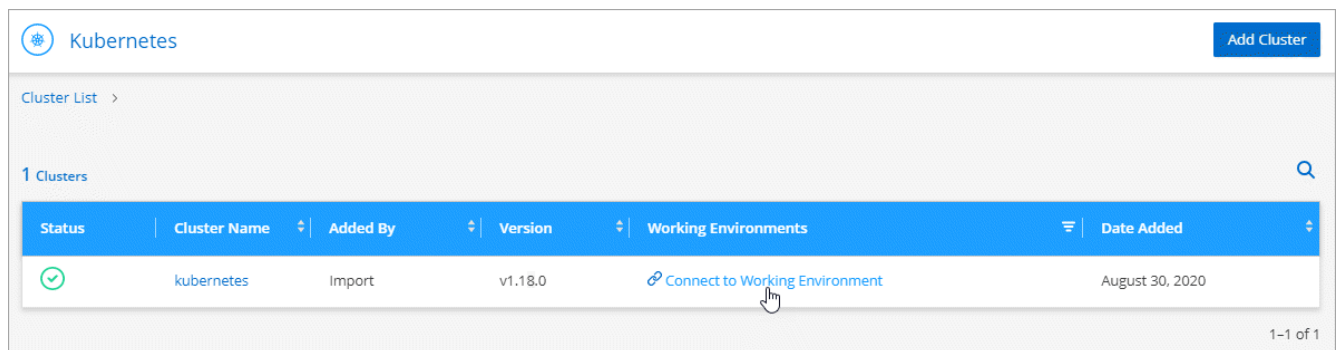
Cloud Manager adds the Kubernetes cluster. You can now connect the cluster to Cloud Volumes ONTAP.

# Connecting a cluster to Cloud Volumes ONTAP

Connect a Kubernetes cluster to Cloud Volumes ONTAP so you can use Cloud Volumes ONTAP as persistent storage for containers.

## Steps

1. At the top of Cloud Manager, click **K8s**.
2. Click **Connect to Working Environment** for the cluster that you just added.



3. Select a working environment and click **Continue**.
4. Choose the NetApp storage class to use as the default storage class for the Kubernetes cluster and click **Continue**.

When a user creates a persistent volume, the Kubernetes cluster can use this storage class as the backend storage by default.

5. Choose whether to use default auto export policies or whether to add a custom CIDR block.

**Kubernetes** Select Configure Confirm

### Select Storage Class Type

#### Working Environment Information

Name	ishai0ntap4k8
Connected Clusters	None
Region	asia-east1
Zones	asia-east1-a
High Availability	Not Supported
Storage Classes	NFS Single Node <b>Default</b> ISCSI Single Node

#### Export Policy Information

If you plan to use NFS volumes you will need to set an export policy to allow connectivity between your clusters and your volumes.

☒ Use the default auto-export policies. (Suitable for most cases.)

OR

General Network CIDR ①

0.0.0.0/0

6. Click **Add Working Environment**.

## Result

Cloud Manager connects the working environment to the cluster, which can take up to 15 minutes.

# Managing your clusters

Cloud Manager enables you to manage your Kubernetes clusters by changing the default storage class, upgrading Trident, and more.

## Changing the default storage class

Make sure that you've set a Cloud Volumes ONTAP storage class as the default storage class so clusters use Cloud Volumes ONTAP as the backend storage.

## Steps

1. At the top of Cloud Manager, click **K8s**.
2. Click the name of the Kubernetes cluster.
3. In the **Storage Classes** table, click the actions menu on the far right for the storage class that you'd like to set as the default.

**6 Storage Classes**

Storage Class ID	Provisioner	Volumes	Labels
Gp2	aws	0	...
NFS Single Node	NetApp	0	...
NFS High Availability <b>Default</b>	NetApp	0	...
ISCSI High Availability	NetApp	0	...
ISCSI Single Node	NetApp	0	...

Set as Default

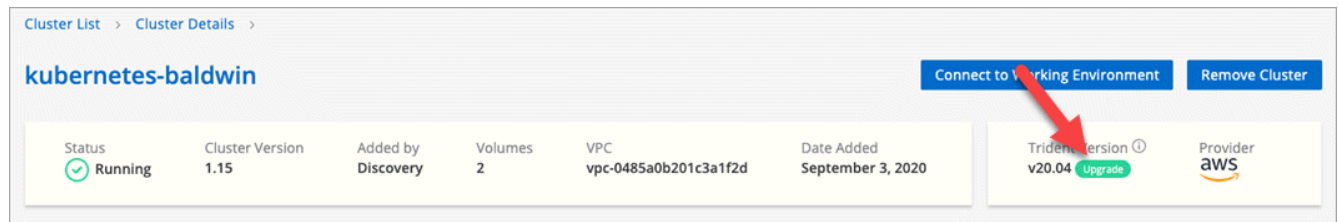
4. Click **Set as Default**.

## Upgrading Trident

You can upgrade Trident from Cloud Manager when a new version of Trident is available.

### Steps

1. At the top of Cloud Manager, click **K8s**.
2. Click the name of the Kubernetes cluster.
3. If a new version is available, click **Upgrade** next to the Trident version.



## Updating the kubeconfig file

If you added your cluster to Cloud Manager by importing the kubeconfig file, you can upload the latest kubeconfig file to Cloud Manager at any time. You might do this if you've updated the credentials, if you've changed users or roles, or if something changed that affects the cluster, user, namespaces, or authentication.

### Steps

1. At the top of Cloud Manager, click **K8s**.
2. Click the name of the Kubernetes cluster.
3. Click **Update Kubeconfig**.
4. When prompted through your web browser, select the updated kubeconfig file and click **Open**.

### Result

Cloud Manager updates information about the Kubernetes cluster based on the latest kubeconfig file.

## Disconnecting a cluster

When you disconnect a cluster from Cloud Volumes ONTAP, you can no longer use that Cloud Volumes ONTAP system as persistent storage for containers. Existing Persistent Volumes are not deleted.

### Steps

1. At the top of Cloud Manager, click **K8s**.
2. Click the name of the Kubernetes cluster.
3. In the **Working Environments** table, click the actions menu on the far right for the working environment that you want to disconnect.



Kubernetes

Cluster List > Cluster Details >

**kubernetes**

Update Kubeconfig Connect to Working Environment

Status	Cluster Version	Added by	Volumes	VPC	Date Added	Trident Version	Provider
Running	v1.18.0	Import	0	-	August 30, 2020	Unknown	-

1 Working Environments

Name	Provider	Region	Zone	Subnet	Capacity
ishai0ntap4k8	Google Cloud	asia-east1	asia-east1-a	10.140.0.0/20	0.00 used of 10 TB available

Disconnect

4. Click **Disconnect**.

## Result

Cloud Manager disconnects the cluster from the Cloud Volumes ONTAP system.

## Removing a cluster

Remove decommissioned clusters from Cloud Manager after you disconnect all working environments from the cluster.

### Steps

1. At the top of Cloud Manager, click **K8s**.
2. Click the name of the Kubernetes cluster.
3. Click **Remove Cluster**.

Working Environments Replication Backup Sync Kubernetes Cloud Compliance Monitoring Global File Cache View All Services (+3) ▾

Kubernetes

Cluster List > Cluster Details >

**k8sdemo**

Update Kubeconfig Connect to Working Environment Remove Cluster

Status	Cluster Version	Added by	Volumes	VPC	Date Added	Trident is not yet installed. Connect this cluster to a Working Environment.	Provider
Running	v1.16.11-gke.5	Import	0	-	September 1, 2020		Google Cloud

## Copyright Information

Copyright © 2021 NetApp, Inc. All rights reserved. Printed in the U.S. No part of this document covered by copyright may be reproduced in any form or by any means-graphic, electronic, or mechanical, including photocopying, recording, taping, or storage in an electronic retrieval system-without prior written permission of the copyright owner.

Software derived from copyrighted NetApp material is subject to the following license and disclaimer:

THIS SOFTWARE IS PROVIDED BY NETAPP "AS IS" AND WITHOUT ANY EXPRESS OR IMPLIED WARRANTIES, INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE, WHICH ARE HEREBY DISCLAIMED. IN NO EVENT SHALL NETAPP BE LIABLE FOR ANY DIRECT, INDIRECT, INCIDENTAL, SPECIAL, EXEMPLARY, OR CONSEQUENTIAL DAMAGES (INCLUDING, BUT NOT LIMITED TO, PROCUREMENT OF SUBSTITUTE GOODS OR SERVICES; LOSS OF USE, DATA, OR PROFITS; OR BUSINESS INTERRUPTION) HOWEVER CAUSED AND ON ANY THEORY OF LIABILITY, WHETHER IN CONTRACT, STRICT LIABILITY, OR TORT (INCLUDING NEGLIGENCE OR OTHERWISE) ARISING IN ANY WAY OUT OF THE USE OF THIS SOFTWARE, EVEN IF ADVISED OF THE POSSIBILITY OF SUCH DAMAGE.

NetApp reserves the right to change any products described herein at any time, and without notice. NetApp assumes no responsibility or liability arising from the use of products described herein, except as expressly agreed to in writing by NetApp. The use or purchase of this product does not convey a license under any patent rights, trademark rights, or any other intellectual property rights of NetApp.

The product described in this manual may be protected by one or more U.S. patents, foreign patents, or pending applications.

RESTRICTED RIGHTS LEGEND: Use, duplication, or disclosure by the government is subject to restrictions as set forth in subparagraph (c)(1)(ii) of the Rights in Technical Data and Computer Software clause at DFARS 252.277-7103 (October 1988) and FAR 52-227-19 (June 1987).

## Trademark Information

NETAPP, the NETAPP logo, and the marks listed at <http://www.netapp.com/TM> are trademarks of NetApp, Inc. Other company and product names may be trademarks of their respective owners.