



# Deploying NetApp HCI for Red Hat OpenShift on RHV

HCI

NetApp  
July 31, 2020

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# Deploying NetApp HCI for Red Hat OpenShift on RHV

## Deployment Summary: NetApp HCI for Red Hat OpenShift on RHV

The detailed steps provided in this section provide a validation for the minimum hardware and software configuration required to deploy and validate the NetApp HCI for Red Hat OpenShift on RHV solution.

Deploying Red Hat OpenShift Container Platform through IPI on Red Hat Virtualization consists of the following steps:

1. Create storage network VLAN
2. Download OpenShift installation files
3. Download CA cert from RHV
4. Register API/Apps in DNS
5. Generate and add SSH private key
6. Install OpenShift Container Platform
7. Access console/web console
8. Configure worker nodes to run storage services
9. Download and install Trident through Operator

## 1. Create Storage Network VLAN: NetApp HCI for Red Hat OpenShift on RHV

To create a storage network VLAN, complete the following steps:

To support Element storage access for NetApp Trident to attach persistent volumes to pods deployed in OpenShift, the machine network being used for each worker in the OCP deployment must be able to reach the storage resources. If the machine network cannot access the Element storage network by default, an additional network/VLAN can be created in the Element cluster to allow access:

1. Using any browser, log in to the Element Cluster at the cluster's MVIP.
2. Navigate to Cluster > Network and click Create VLAN.
3. Before you provide the details, reserve at least five IP addresses from the network that is reachable from the OCP network (one for the virtual network storage VIP and one for virtual network IP on

each storage node).

Enter a VLAN name of your choice, enter the VLAN ID, SVIP, and netmask, select the Enable VRF option, and enter the gateway IP for the network. In the IP address blocks, enter the starting IP of the other addresses reserved for the storage nodes. In this example, the size is four because there are four storage nodes in this cluster. Click Create VLAN.

### Create a New VLAN



VLAN Name

ocp\_storage

VLAN Tag

185

SVIP

10.61.185.205

Netmask

255.255.255.0

☒ Enable VRF

Gateway

10.61.185.1

Description

4

IP Address Blocks

Starting IP 10.61.185.201

Size 4

Add A Block

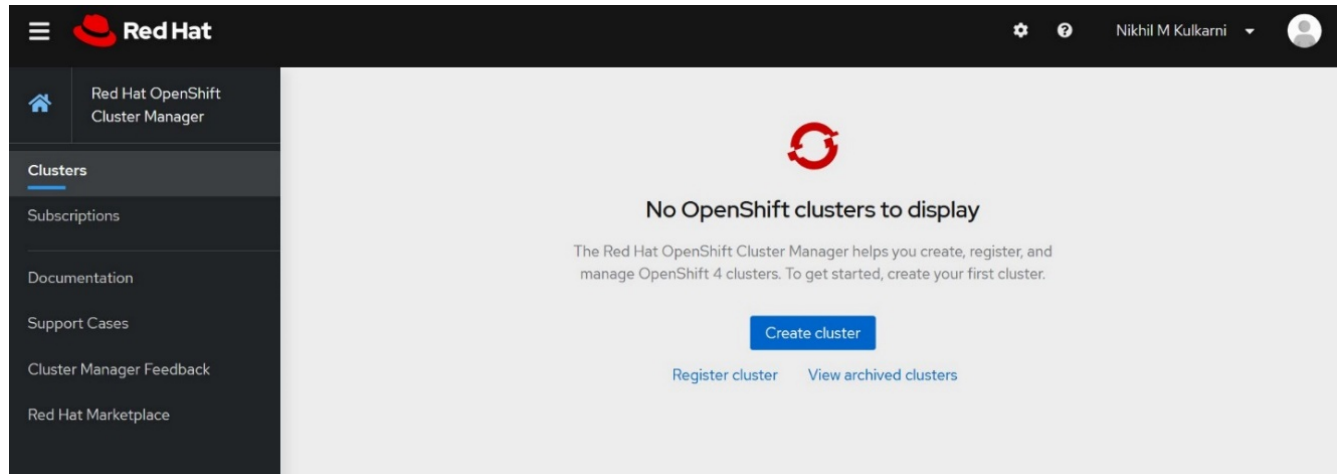
Create VLAN

Cancel

## 2. Download OpenShift Installation Files: NetApp HCI for Red Hat OpenShift on RHV

To download the OpenShift installation files, complete the following steps:

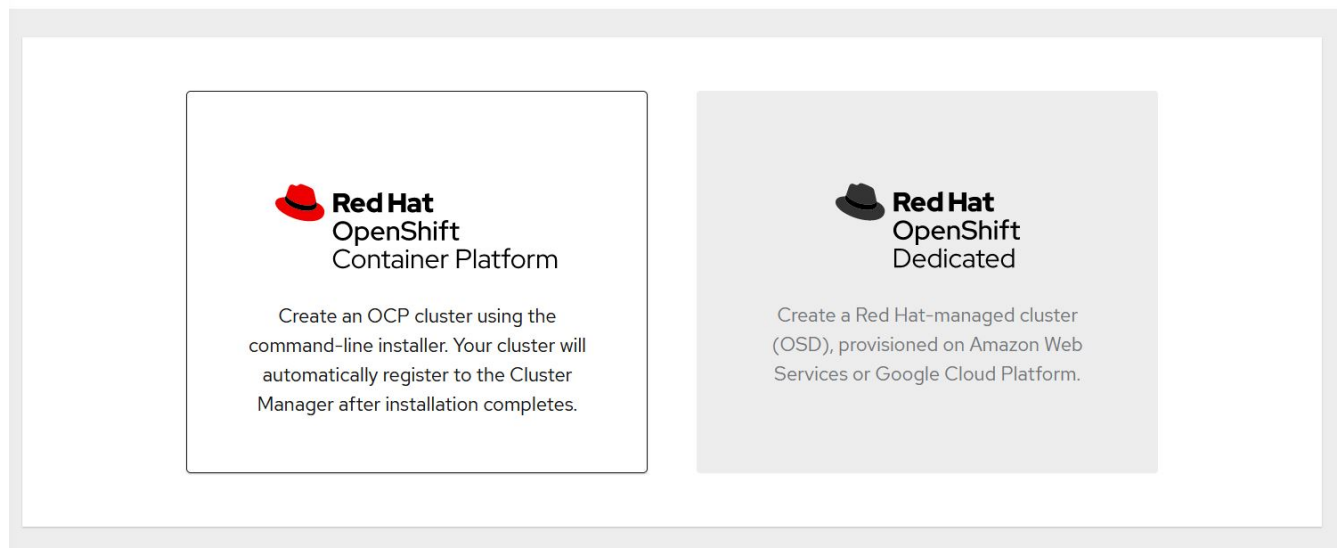
1. Go to the [Red Hat login page](#) and log in with your Red Hat credentials.
2. On the Clusters page, click Create Cluster.



3. Select OpenShift Container Platform.

[Clusters](#) > [Create](#)











### Create a Cluster to Get Started



4. Select Run on Red Hat Virtualization.

## Install OpenShift Container Platform 4

Select an infrastructure provider


 Run on Amazon Web Services	 Run on Microsoft Azure	 Run on Google Cloud Platform	 Run on VMware vSphere
 Run on Red Hat OpenStack	 Run on Red Hat Virtualization	 Run on Bare Metal	 Run on IBM Z
 Run on Power	 Run on Laptop <small>Powered by Red Hat CodeReady Containers</small>		

5. The next page allows you to download the OpenShift installer (available for Linux and MacOS), a unique pull secret that is required to create the `install-config` file and the `oc` command-line tools (available for Linux, Windows, and MacOS).


Download the files, transfer them to a RHEL administrative workstation from where you can run the OpenShift installation, or download these files directly using `wget` or `curl` on a RHEL administrative workstation.

**Downloads**


**OpenShift installer**  
Download and extract the install program for your operating system and place the file in the directory where you will store the installation configuration files. Note: The OpenShift install program is only available for Linux and macOS at this time.

Linux  [Download installer](#)

**Pull secret**  
Download or copy your pull secret. The install program will prompt you for your pull secret during installation.

[Download pull secret](#)  [Copy pull secret](#)

**Command-line interface**  
Download the OpenShift command-line tools and add them to your `PATH`.

Linux  [Download command-line tools](#)

When the installer is complete you will see the console URL and credentials for accessing your new cluster. A `kubeconfig` file will also be generated for you to use with the `oc` CLI tools you downloaded.

### 3. Download CA Certificate from RHV: NetApp HCI for Red Hat OpenShift on RHV

To download the CA certificate from RHV, complete the following steps:

1. In order to access the RHV manager from the RHEL machine during the deployment process, the CA certificate trust must be updated on the machine to trust connections to RHV-M. To download the RHV Manager's CA certificate, run the following commands:

```
sudo curl -k 'https://<engine-fqdn>/ovirt-engine/services/pki-resource?resource=ca-  
certificate&format=X509-PEM-CA' -o /tmp/ca.pem  
[user@rhel7 ~]$ sudo curl -k 'https://rhv-m.cie.netapp.com/ovirt-engine/services/pki-  
resource?resource=ca-certificate&format=X509-PEM-CA' -o /tmp/ca.pem  
% Total    % Received % Xferd  Average Speed   Time    Time     Time  Current  
           Dload  Upload   Total     Spent    Left     Speed  
100 1376 100 1376    0     0  9685      0 --:--:-- --:--:-- --:--:-- 9690
```

2. Copy the CA certificate to the directory for server certificates and update the CA trust.

```
[user@rhel7 ~]$ sudo cp /tmp/ca.pem /etc/pki/ca-trust/source/anchors/ca.pem  
[user@rhel7 ~]$ sudo update-ca-trust
```

### 4. Register API/Apps in DNS: NetApp HCI for Red Hat OpenShift on RHV

To register API/Apps in DNS, complete the following steps:

1. Reserve three static IP addresses from the network being used for OCP: the first IP address for OpenShift Container Platform REST API, the second IP address for pointing to the wildcard application ingress, and the third IP address for the internal DNS service. The first two IPs require an entry in the DNS server.



The default value of the `machineNetwork` subnet as created by IPI during OpenShift install is `10.0.0.0/16`. If the IPs you intend to use for your cluster's management network fall outside of this range, you might need to customize your deployment and edit these values before deploying the cluster. For more information, see the section [Use a Custom Install File for OpenShift Deployment](#).

2. Configure the API domain name by using the format `api.<openshift-cluster-name>.<base-domain>` pointing to the reserved IP.

New Host

Name (uses parent domain name if blank):  
api.rhv-ocp-cluster

Fully qualified domain name (FQDN):  
api.rhv-ocp-cluster.cie.netapp.com.

IP address:  
10.63.172.151

☒ Create associated pointer (PTR) record

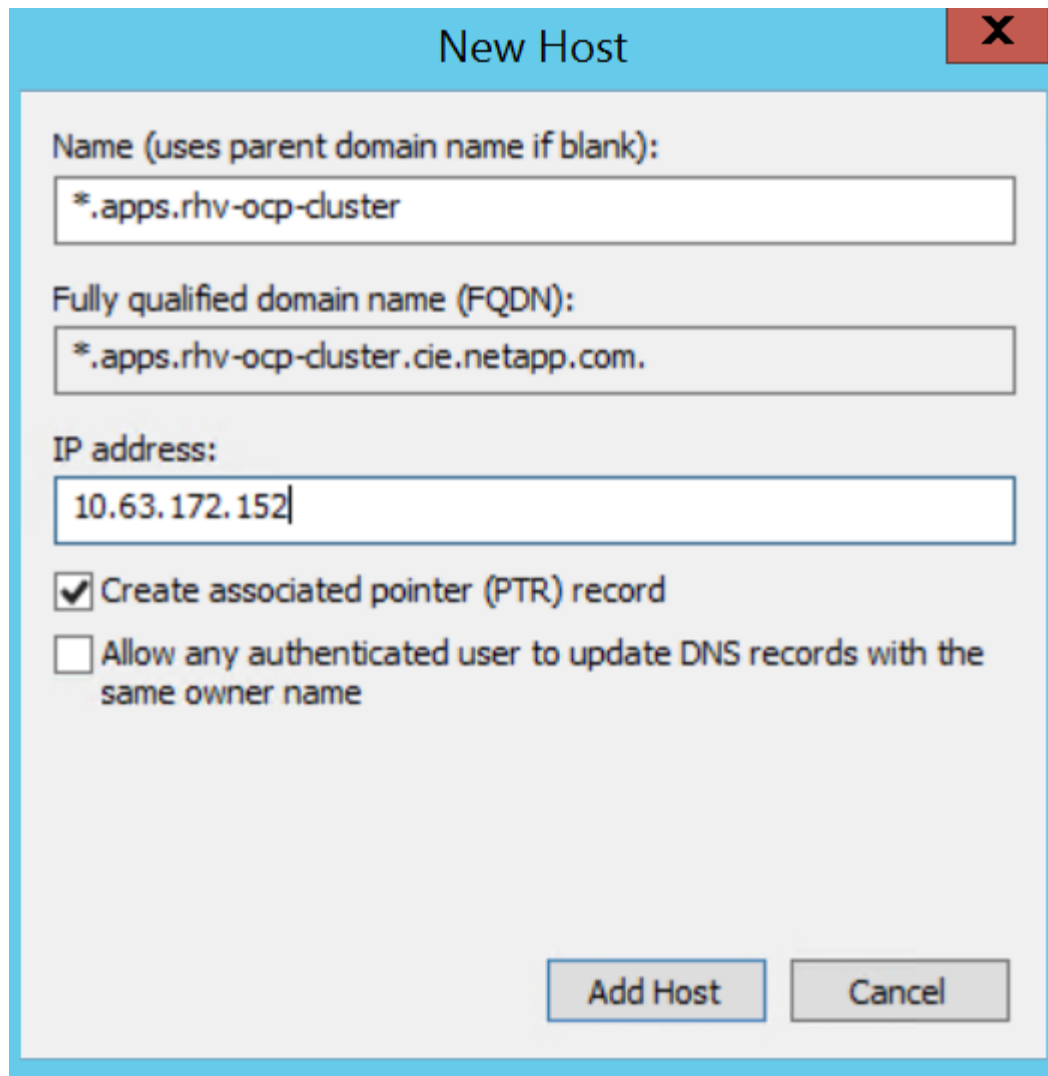
☐ Allow any authenticated user to update DNS records with the same owner name

Add Host

Cancel

3. Configure the wildcard application ingress domain name by using the format `*.apps.<openshift-cluster-name>.<base-domain>` pointing to the reserved IP.



A screenshot of a 'New Host' dialog box. The dialog has a light blue title bar with the text 'New Host' and a red close button with a white 'X'. The main area is light gray and contains three text input fields. The first field is labeled 'Name (uses parent domain name if blank):' and contains the text '\*.apps.rhv-ocp-cluster'. The second field is labeled 'Fully qualified domain name (FQDN):' and contains the text '\*.apps.rhv-ocp-cluster.cie.netapp.com.'. The third field is labeled 'IP address:' and contains the text '10.63.172.152'. Below the fields are two checkboxes: the first is checked and labeled 'Create associated pointer (PTR) record', and the second is unchecked and labeled 'Allow any authenticated user to update DNS records with the same owner name'. At the bottom right are two buttons: 'Add Host' and 'Cancel'.

## 5. Generate and Add SSH Private Key: NetApp HCI for Red Hat OpenShift on RHV

To generate and add an SSH private key, complete the following steps:

1. For the installation debugging or disaster recovery on the OpenShift cluster, you must provide an SSH key to both the **ssh-agent** and the installation program. Create an SSH key if one does not already exist for password-less authentication on the RHEL machine.

```
[user@rhel7 ~]$ ssh-keygen -t rsa -b 4096 -N '' -f ~/.ssh/id_rsa
```

2. Start the **ssh-agent** process and configure it as a background running task.

```
[user@rhel7 ~]$ eval "$(ssh-agent -s)"  
Agent pid 31874
```

3. Add the SSH private key that you created in step 2 to the **ssh-agent** , which enables you to SSH directly to the nodes without having to interactively pass the key.

```
[user@rhel7 ~]$ ssh-add ~/.ssh/id_rsa
```

## 6. Install OpenShift Container Platform: NetApp HCI for Red Hat OpenShift on RHV

To install OpenShift Container Platform, complete the following steps:

1. Create a directory for OpenShift installation and transfer the downloaded files to it. Extract the OpenShift installer files from the tar archive.

```
[user@rhel7 ~]$ mkdir openshift-deploy
[user@rhel7 ~]$ cd openshift-deploy
[user@rhel7 openshift-deploy]$ tar xvf openshift-install-linux.tar.gz
README.md
openshift-install
[user@rhel7 openshift-deploy]$ ls -la
total 453260
drwxr-xr-x.  2 user user    146 May 26 16:01 .
dr-xr-x---. 16 user user   4096 May 26 15:58 ..
-rw-r--r--.  1 user user 25249648 May 26 15:59 openshift-client-linux.tar.gz
-rwxr-xr-x.  1 user user 354664448 Apr 27 01:37 openshift-install
-rw-r--r--.  1 user user  84207215 May 26 16:00 openshift-install-linux.tar.gz
-rw-r--r--.  1 user user    2736 May 26 15:59 pull-secret.txt
-rw-r--r--.  1 user user    706 Apr 27 01:37 README.md
```



The installation program creates several files in the directory used for installation of the cluster. Both the installation program and the files created by the installation program must be kept even after the cluster is up.



The binary files that you previously downloaded, such as **openshift-install** or **oc**, can be copied to a directory that is in the user's path (for example, **/usr/local/bin**) to make them easier to run.

2. Create the cluster by running the **openshift-install create cluster** command and respond to the installation program prompts. Pass the SSH public key, select ovirt from the platform, provide the RHV infrastructure details, provide the three reserved IP addresses and the downloaded pull secret to the installation program prompts. After all the inputs are provided, the installation program creates and configures a bootstrap machine with a temporary Kubernetes control plane which then creates and configures the master VMs with the production Kubernetes control plane. The control

plane on the master nodes creates and configures the worker VMs.

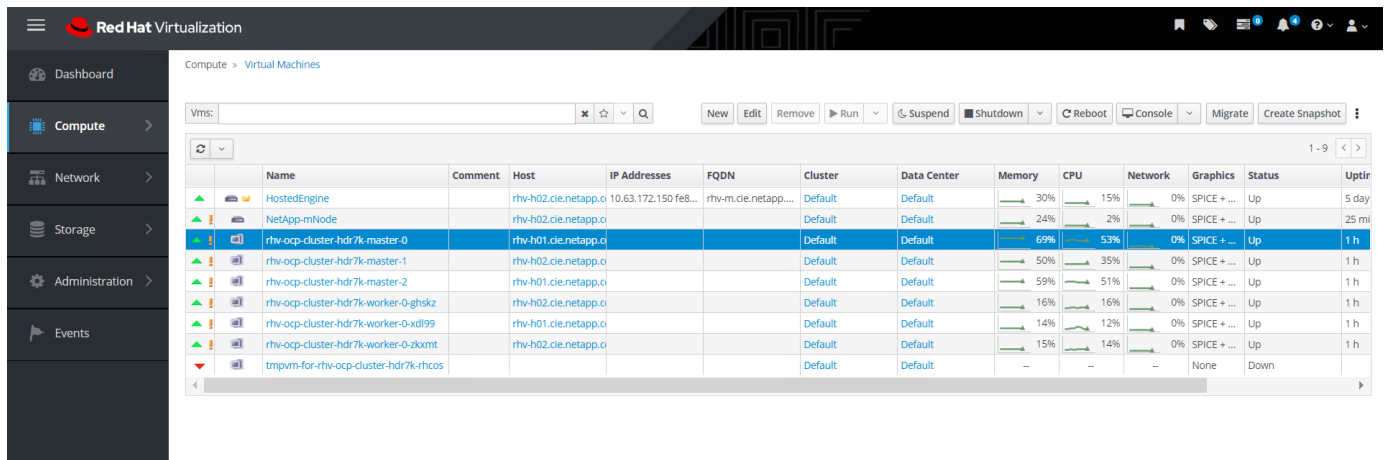
It can take approximately 30–45 minutes to get the complete cluster up and running.

```
[user@rhel7 openshift-deploy]$ ./openshift-install create cluster
--dir=/home/user/openshift-deploy --log-level=info           ? SSH Public Key
/home/user/.ssh/id_rsa.pub
? Platform ovirt
? oVirt cluster Default
? oVirt storage domain data_domain
? oVirt network ovirtmgmt
? Internal API virtual IP 10.63. 172.151
? Internal DNS virtual IP 10.63. 172.153
? Ingress virtual IP 10.63. 172.152
? Base Domain cie.netapp.com
? Cluster Name rhv-ocp-cluster
? Pull Secret [? for help]
*****
*****
*****
*****
INFO Obtaining RHCOS image file from 'https://releases-art-
rhcos.svc.ci.openshift.org/art/storage/releases/rhcos-4.4/44.81.202004250133-
0/x86_64/rhcos-44.81.202004250133-0-
openstack.x86_64.qcow2.gz?sha256=f8a44e0ea8cc45882dc22eb632a63afb90b414839b8aa92f3836e
de001dfe9cf'
INFO The file was found in cache: /home/user/.cache/openshift-
installer/image_cache/e263efbc53c0caf612bcfaad10e3dff0. Reusing...
INFO Creating infrastructure resources...
INFO Waiting up to 20m0s for the Kubernetes API at https://api.rhv-ocp-
cluster.cie.netapp.com:6443...
INFO API v1.17.1 up
INFO Waiting up to 40m0s for bootstrapping to complete...
INFO Destroying the bootstrap resources...
INFO Waiting up to 30m0s for the cluster at https://api.rhv-ocp-
cluster.cie.netapp.com:6443 to initialize...
INFO Waiting up to 10m0s for the openshift-console route to be created...
INFO Install complete!
INFO To access the cluster as the system:admin user when using 'oc', run 'export
KUBECONFIG=/home/user/openshift-deploy/auth/kubeconfig'
INFO Access the OpenShift web-console here: https://console-openshift-
console.apps.rhv-ocp-cluster.cie.netapp.com
INFO Login to the console with user: kubeadmin, password: NtsqU-p3qUb-8Hscu-JfAq7
```

3. When the cluster deployment is complete, the directions for accessing the OpenShift cluster, including a link to its web console and credentials for the kubeadmin user, are displayed. Make

sure to take a note of these details.

4. Log in to the RHV Manager and observe that the VMs relating to the OCP cluster are up and running.



Name	Comment	Host	IP Addresses	FQDN	Cluster	Data Center	Memory	CPU	Network	Graphics	Status	Uptime
HostedEngine		rhv-h02.cie.netapp.o	10.63.172.150 fe8...	rhv-m.cie.netapp...	Default	Default	30%	15%	0%	SPICE + ...	Up	5 day
NetApp-mNode		rhv-h02.cie.netapp.o			Default	Default	24%	2%	0%	SPICE + ...	Up	25 mi
rhv-ocp-cluster-hdr7k-master-0		rhv-h01.cie.netapp.o			Default	Default	69%	53%	0%	SPICE + ...	Up	1 h
rhv-ocp-cluster-hdr7k-master-1		rhv-h02.cie.netapp.o			Default	Default	50%	35%	0%	SPICE + ...	Up	1 h
rhv-ocp-cluster-hdr7k-master-2		rhv-h01.cie.netapp.o			Default	Default	59%	51%	0%	SPICE + ...	Up	1 h
rhv-ocp-cluster-hdr7k-worker-0-ghskz		rhv-h02.cie.netapp.o			Default	Default	16%	16%	0%	SPICE + ...	Up	1 h
rhv-ocp-cluster-hdr7k-worker-0-xdl99		rhv-h01.cie.netapp.o			Default	Default	14%	12%	0%	SPICE + ...	Up	1 h
rhv-ocp-cluster-hdr7k-worker-0-2kxmt		rhv-h02.cie.netapp.o			Default	Default	15%	14%	0%	SPICE + ...	Up	1 h
tmpvm-for-rhv-ocp-cluster-hdr7k-rhcos					Default	Default	--	--	--	None	Down	

## 7. Access Console/Web Console: NetApp HCI for Red Hat OpenShift on RHV

To access the console or web console, complete the following steps:

1. To access the OCP cluster through the CLI, extract the **oc** command-line tools tar file and place its content in a directory that is in the user's path.

```
[user@rhel7 openshift-deploy]$ tar xvf openshift-client-linux.tar.gz
README.md
oc
kubectl
[user@rhel7 openshift-deploy]$ echo $PATH
/usr/local/bin: /usr/local/sbin:/sbin:/bin:/usr/sbin:/usr/bin

[user@rhel7 openshift-deploy]$ cp oc /usr/local/bin
```

2. To interact with the cluster through the CLI, you can use the **kubeconfig** file provided by the IPI process located in the **/auth** directory inside the folder from where you launched the installation program. To easily interact with the cluster, export the file that is created in the directory. After a successful cluster deployment, the file location and the following command are displayed.

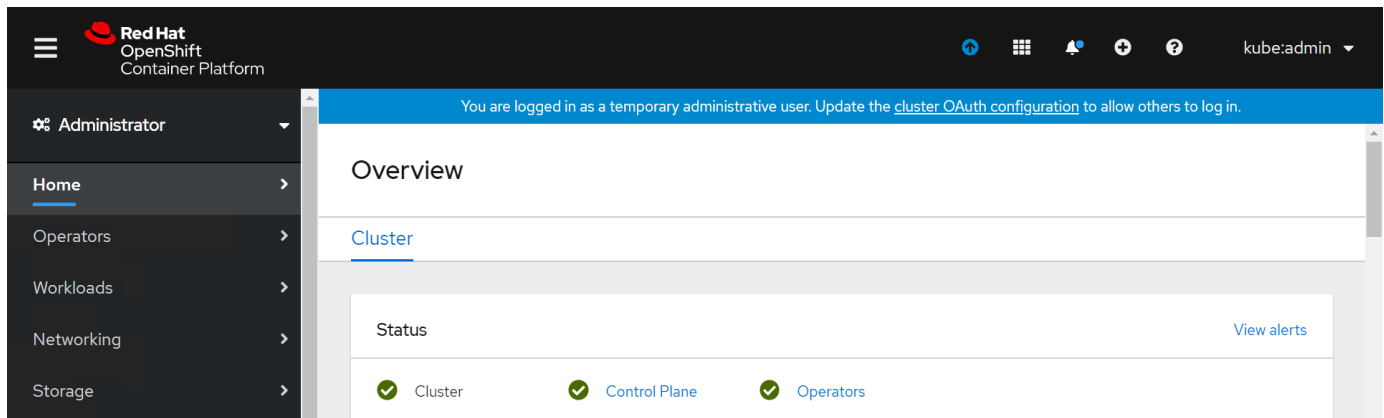
```
[user@rhel7 openshift-deploy]$ export KUBECONFIG=/home/user/openshift-
deploy/auth/kubeconfig
```

3. Verify whether you have access to the cluster and whether the nodes are in the Ready state.

```
[user@rhel7 openshift-deploy]$ oc get nodes
```

NAME	STATUS	ROLES	AGE	VERSION
rhv-ocp-cluster-hdr7k-master-0	Ready	master	93m	v1.17.1
rhv-ocp-cluster-hdr7k-master-1	Ready	master	93m	v1.17.1
rhv-ocp-cluster-hdr7k-master-2	Ready	master	93m	v1.17.1
rhv-ocp-cluster-hdr7k-worker-0-ghskz	Ready	worker	83m	v1.17.1
rhv-ocp-cluster-hdr7k-worker-0-xdl99	Ready	worker	86m	v1.17.1
rhv-ocp-cluster-hdr7k-worker-0-zkxmt	Ready	worker	85m	v1.17.1

4. Log in to the web console URL by using the credentials, both of which were provided after the successful deployment of the cluster, and then verify GUI access to the cluster.



## 8. Configure Worker Nodes to Run Storage Services: NetApp HCI for Red Hat OpenShift on RHV

To configure the worker nodes to run storage services, complete the following steps:


1. To access storage from the Element system, each of the worker nodes must have iSCSI available and running as a service. To create a machine configuration that can enable and start the iscsid service, log in to the OCP web console and navigate to Compute > Machine Configs and click Create Machine Config. Paste the YAML file and click Create.

# Create Machine Config

Create by manually entering YAML or JSON definitions, or by dragging and dropping a file into the editor.

[? View shortcuts](#)

```
1  apiVersion: machineconfiguration.openshift.io/v1
2  kind: MachineConfig
3  metadata:
4    labels:
5      machineconfiguration.openshift.io/role: worker
6    name: worker-iscsi-configuration
7  spec:
8    config:
9      ignition:
10       version: 2.2.0
11      systemd:
12        units:
13          - name: iscsid.service
14            enabled: true
15            state: started
16  osImageURL: ""
```

CreateCancel Download

2. After the configuration is created, it will take approximately 20–30 minutes to apply the configuration to the worker nodes and reload them. Verify whether the machine config is applied by using `oc get mcp` and make sure that the machine config pool for workers is updated. You can also log in to the worker nodes to confirm that the `iscsid` service is running.

```
[user@rhel7 openshift-deploy]$ oc get mcp
NAME      CONFIG                                UPDATED  UPDATING  DEGRADED
master    rendered-master-a520ae930e1d135e0dee7168  True     False     False
worker    rendered-worker-de321b36eeba62df41feb7bc  True     False     False
[user@rhel7 openshift-deploy]$ ssh core@10.63. 172.22 sudo systemctl status iscsid
❏ iscsid.service - Open-iSCSI
   Loaded: loaded (/usr/lib/systemd/system/iscsid.service; enabled; vendor preset: disabled)
   Active: active (running) since Tue 2020-05-26 13:36:22 UTC; 3 min ago
     Docs: man:iscsid(8)
           man:iscsiadm(8)
  Main PID: 1242 (iscsid)
    Status: "Ready to process requests"
     Tasks: 1
   Memory: 4.9M
      CPU: 9ms
   CGroup: /system.slice/iscsid.service
           └─1242 /usr/sbin/iscsid -f
```



It is also possible to confirm that the MachineConfig has been successfully applied and services have been started as expected by running the `oc debug` command with the appropriate flags.

## 9. Download and Install NetApp Trident: NetApp HCI for Red Hat OpenShift on RHV

To download and install NetApp Trident, complete the following steps:

1. Make sure that the user that is logged in to the OCP cluster has sufficient privileges for installing Trident.

```
[user@rhel7 openshift-deploy]$ oc auth can-i '*' '*' --all-namespaces
yes
```

2. Verify that you can download an image from the registry and access the MVIP of the NetApp Element cluster.

```
[user@rhel7 openshift-deploy]$ oc run -i --tty ping --image=busybox --restart=Never
--rm -- ping 10.63.172.140
If you don't see a command prompt, try pressing enter.
64 bytes from 10.63.172.140: seq=1 ttl=63 time=0.312 ms
64 bytes from 10.63.172.140: seq=2 ttl=63 time=0.271 ms
64 bytes from 10.63.172.140: seq=3 ttl=63 time=0.254 ms
64 bytes from 10.63.172.140: seq=4 ttl=63 time=0.309 ms
64 bytes from 10.63.172.140: seq=5 ttl=63 time=0.319 ms
64 bytes from 10.63.172.140: seq=6 ttl=63 time=0.303 ms
^C
--- 10.63.172.140 ping statistics ---
7 packets transmitted, 7 packets received, 0% packet loss
round-trip min/avg/max = 0.254/0.387/0.946 ms
pod "ping" deleted
```

3. Download the Trident installer bundle using the following commands and extract it to a directory.

```
[user@rhel7 ~]$ wget
[user@rhel7 ~]$ tar -xf trident-installer-20.04.0.tar.gz
[user@rhel7 ~]$ cd trident-installer
```

4. The Trident installer contains manifests for defining all the required resources. Using the appropriate manifests, create the TridentProvisioner custom resource definition.

```
[user@rhel7 trident-installer]$ oc create -f
deploy/crds/trident.netapp.io_tridentprovisioners_crd_post1.16.yaml

customresourcedefinition.apiextensions.k8s.io/tridentprovisioners.trident.netapp.io
created
```

5. Create a Trident namespace, which is required for the Trident operator.

```
[user@rhel7 trident-installer]$ oc create namespace trident
namespace/trident created
```

6. Create the resources required for the Trident operator deployment, such as a ServiceAccount for the operator, a ClusterRole and ClusterRoleBinding to the ServiceAccount, a dedicated PodSecurityPolicy, or the operator itself.



```
[user@rhel7 trident-installer]$ oc kustomize deploy/ > deploy/bundle.yaml
[user@rhel7 trident-installer]$ oc create -f deploy/bundle.yaml
serviceaccount/trident-operator created
clusterrole.rbac.authorization.k8s.io/trident-operator created
clusterrolebinding.rbac.authorization.k8s.io/trident-operator created
deployment.apps/trident-operator created
podsecuritypolicy.policy/tridentoperatorpods created
```

7. Verify that the Trident operator is deployed.

```
[user@rhel7 trident-installer]$ oc get deployment -n trident
NAME                READY   UP-TO-DATE   AVAILABLE   AGE
trident-operator    1/1     1             1           56s
[user@rhel7 trident-installer]$ oc get pods -n trident
NAME                                READY   STATUS    RESTARTS   AGE
trident-operator-564d7d66f-qrz7v    1/1     Running    0           71s
```

8. After the Trident operator is installed, install Trident using this operator. In this example, TridentProvisioner custom resource (CR) was created. The Trident installer comes with definitions for creating a TridentProvisioner CR. These can be modified based on the requirements.

```
[user@rhel7 trident-installer]$ oc create -f deploy/crds/tridentprovisioner_cr.yaml
tridentprovisioner.trident.netapp.io/trident created
```

9. Approve the Trident serving CSR certificates by using `oc get csr -o name | xargs oc adm certificate approve`.

```
[user@rhel7 trident-installer]$ oc get csr -o name | xargs oc adm certificate approve
certificatesigningrequest.certificates.k8s.io/csr-4b7zh approved
certificatesigningrequest.certificates.k8s.io/csr-4hkwc approved
certificatesigningrequest.certificates.k8s.io/csr-5bgh5 approved
certificatesigningrequest.certificates.k8s.io/csr-5g4d6 approved
certificatesigningrequest.certificates.k8s.io/csr-5j9hz approved
certificatesigningrequest.certificates.k8s.io/csr-5m8qb approved
certificatesigningrequest.certificates.k8s.io/csr-66hv2 approved
certificatesigningrequest.certificates.k8s.io/csr-6rdgg approved
certificatesigningrequest.certificates.k8s.io/csr-6t24f approved
certificatesigningrequest.certificates.k8s.io/csr-76wgv approved
certificatesigningrequest.certificates.k8s.io/csr-78qsq approved
certificatesigningrequest.certificates.k8s.io/csr-7r58n approved
certificatesigningrequest.certificates.k8s.io/csr-8ghmk approved
certificatesigningrequest.certificates.k8s.io/csr-8sn5q approved
```

10. Verify that Trident 20.04 is installed by using the TridentProvisioner CR, and verify that the pods related to Trident are.

```
[user@rhel7 trident-installer]$ oc get tprov -n trident
NAME      AGE
trident   9m49s

[user@rhel7 trident-installer]$ oc describe tprov trident -n trident
Name:          trident
Namespace:     trident
Labels:        <none>
Annotations:   <none>
API Version:   trident.netapp.io/v1
Kind:          TridentProvisioner
Metadata:
  Creation Timestamp:  2020-05-26T18:49:19Z
  Generation:         1
  Resource Version:    640347
  Self Link:
    /apis/trident.netapp.io/v1/namespaces/trident/tridentprovisioners/trident
  UID:                52656806-0414-4ed8-b355-fc123fafbf4e
Spec:
  Debug:  true
Status:
  Message: Trident installed
  Status:  Installed
  Version: v20.04
Events:
  Type      Reason      Age           From                      Message
  ----      -
  Normal    Installing  9m32s        trident-operator.netapp.io Installing
Trident
  Normal    Installed   3m47s (x5 over 8m56s)  trident-operator.netapp.io Trident
installed
[user@rhel7 trident-installer]$ oc get pods -n trident
NAME                                READY   STATUS    RESTARTS   AGE
trident-csi-7f769c7875-s6fmt        5/5     Running   0           10m
trident-csi-cp7wg                    2/2     Running   0           10m
trident-csi-hhx94                    2/2     Running   0           10m
trident-csi-l72bt                    2/2     Running   0           10m
trident-csi-xfl9d                    2/2     Running   0           10m
trident-csi-xrhqx                    2/2     Running   0           10m
trident-csi-zb7ws                    2/2     Running   0           10m
trident-operator-564d7d66f-qrz7v    1/1     Running   0           27m

[user@rhel7 trident-installer]$ ./tridentctl -n trident version
+-----+-----+

```

SERVER VERSION	CLIENT VERSION
20.04.0	20.04.0

11. Create a storage backend that will be used by Trident to provision volumes. The storage backend specifies the Element cluster in NetApp HCI. You also can specify sample bronze, silver, and gold types with corresponding QoS specs.

```
[user@rhel7 trident-installer]$ vi backend.json
{
  "version": 1,
  "storageDriverName": "solidfire-san",
  "Endpoint": "https://admin: admin- password@10.63.172.140/json-rpc/8.0",
  "SVIP": "10.61.185.205:3260",
  "TenantName": "trident",
  "Types": [{"Type": "Bronze", "Qos": {"minIOPS": 1000, "maxIOPS": 2000,
"burstIOPS": 4000}},
            {"Type": "Silver", "Qos": {"minIOPS": 4000, "maxIOPS": 6000,
"burstIOPS": 8000}},
            {"Type": "Gold", "Qos": {"minIOPS": 6000, "maxIOPS": 8000, "burstIOPS":
10000}}]
}
[user@rhel7 trident-installer]$ ./tridentctl -n trident create backend -f backend.json
+-----+-----+-----+-----+
+-----+-----+
|          NAME          | STORAGE DRIVER |          UUID          |
STATE | VOLUMES |
+-----+-----+-----+-----+
+-----+-----+
| solidfire_10.61.185.205 | solidfire-san  | 40f48d99-5d2e-4f6c-89ab-8aee2be71255 |
online |        0 |
+-----+-----+-----+-----+
+-----+-----+
```

Modify the `backend.json` to accommodate the details or requirements of your environment for the following values:

- Endpoint corresponds to the credentials and the MVIP of the NetApp HCI Element cluster.
- SVIP corresponds to the SVIP configured over the VM network in the section titled [Create Storage Network VLAN](#).
- Types corresponds to different QoS bands. New persistent volumes can be created with specific QoS settings by specifying the exact storage pool.

12. Create a StorageClass that specifies Trident as the provisioner and the storage backend as

solidfire-san.

```
[user@rhel7 trident-installer]$ vi storage-class-basic.yaml
apiVersion: storage.k8s.io/v1
kind: StorageClass
metadata:
  name: basic-csi
  annotations:
    storageclass.kubernetes.io/is-default-class: "true"
provisioner: csi.trident.netapp.io
parameters:
  backendType: "solidfire-san"
  provisioningType: "thin"

[user@rhel7 trident-installer]$ oc create -f storage-class-basic.yaml
storageclass.storage.k8s.io/basic created
```



In this example, the StorageClass created is set as a default, however an OpenShift administrator can define multiple storage classes corresponding to different QoS requirements and other factors based upon their applications. Trident selects a storage backend that can satisfy all the criteria specified in the parameters section in the storage class definition. End users can then provision storage as needed, without administrative intervention.

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