Deploy Red Hat OpenShift 4.11 3-node compact cluster with Assisted Installer on Ampere Altra platform

This tutorial explains how to deploy Red Hat OpenShift Container Platform 4.11 with Assisted Installer on Ampere Altra Platform. We will install Rook Ceph Operator for block storage, shared filesystems, and Object storage. Estimated time to complete this tutorial: 1 hour.

Overview

Cloud native computing is an approach in software development that utilizes cloud computing to "build and run **scalable** applications in modern, dynamic environments such as public, private, and hybrid clouds".[1] It's growing rapidly on many kinds of workloads and use cases appearing in a large number of areas with all kinds of physical footprints. Developing and deploying applications in cloud native way is increasingly being adopted from small business to enterprises.

At Ampere, we observe the trend of infrastructure providers and application owners wanting a consistent workload lifecycle and predictable performance across their business. We offer Ampere Altra CPU family with the values for cloud native workloads with High Availability (HA).

- High core counts in single socket processors
- Predictability for less jitter and lower latency, while protecting against noisy neighbor effects in the processor
- Linear Scalability to maximize heavily loaded server performance
- The most sustainable, low power architecture for power sensitive edge locations and more efficient data centers
- Scale-out computational horsepower with optimized video codecs for high performance video transcoding

The combination of Ampere Altra processors and Red Hat OpenShift 3-node Compact Cluster will be a great match for the scenarios below:

- CDN Edge cloud
- Video Service Providers
- Digital Service Providers
- Small & Medium Business who develop cloud native applications
- 5G User Plane Function (UPF)

Network overview for OpenShift 3-node Compact cluster on Ampere Altra platform
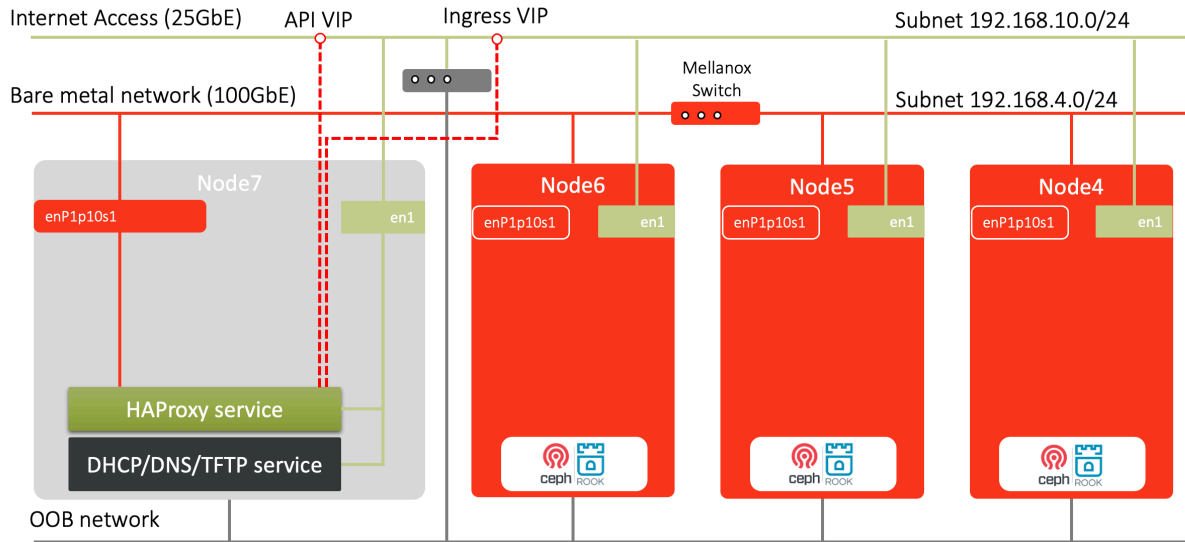
Prerequisites

- A DNS service like Bind (named) runing on the bastion node
- A HAProxy service as the external load balancer on the bastion node

📘 Instructions

The following is the step-by-step guide to install OpenShift Container Platform 4.11 with Assisted Installer on Ampere Altra Platform:

1. Login to http://cloud.redhat.com and click "OpenShift", then click "Data Center" for "Bare Metal (Arm64)", and "Create Cluster" for new cluster
2. Click "Assisted Installer"

3. Provide domain name, cluster name and IP addresses for each node (if the static IP address option was chosen) for the cluster details.
   a. We used a local DNS for managing domain names under "hhii.amp" and use "ocp4" as the cluster name.

Figure A-2

b. Enter the static IP address range, default gateway and DNS

Figure A-3

c. Enter all 3 hosts' MAC addresses and assigned IP addresses on the Internet-access NICs.

Figure A-4

d. When all 3 nodes' static network configurations are ready, click "Next" button to move to Step 3

Figure A-5

e. Click "Add host" on Step 3 Host discovery.

Figure A-6

f. The web console will prompt a diagram for generating Discovery ISO image for provisioning the target node. For provisioning bare metal, we choose "Full image file".

Figure A-7

g. Drag an SSH public key file or enter the content of an SSH public key from the bastion node to access the target node later.
    Then click "Generate Discovery ISO" button, the web console will embed the SSH key into the Discovery ISO image.

Figure A-8

h. The web console will prompt the ISO URL or the wget commend for downloading Discovery ISO image.
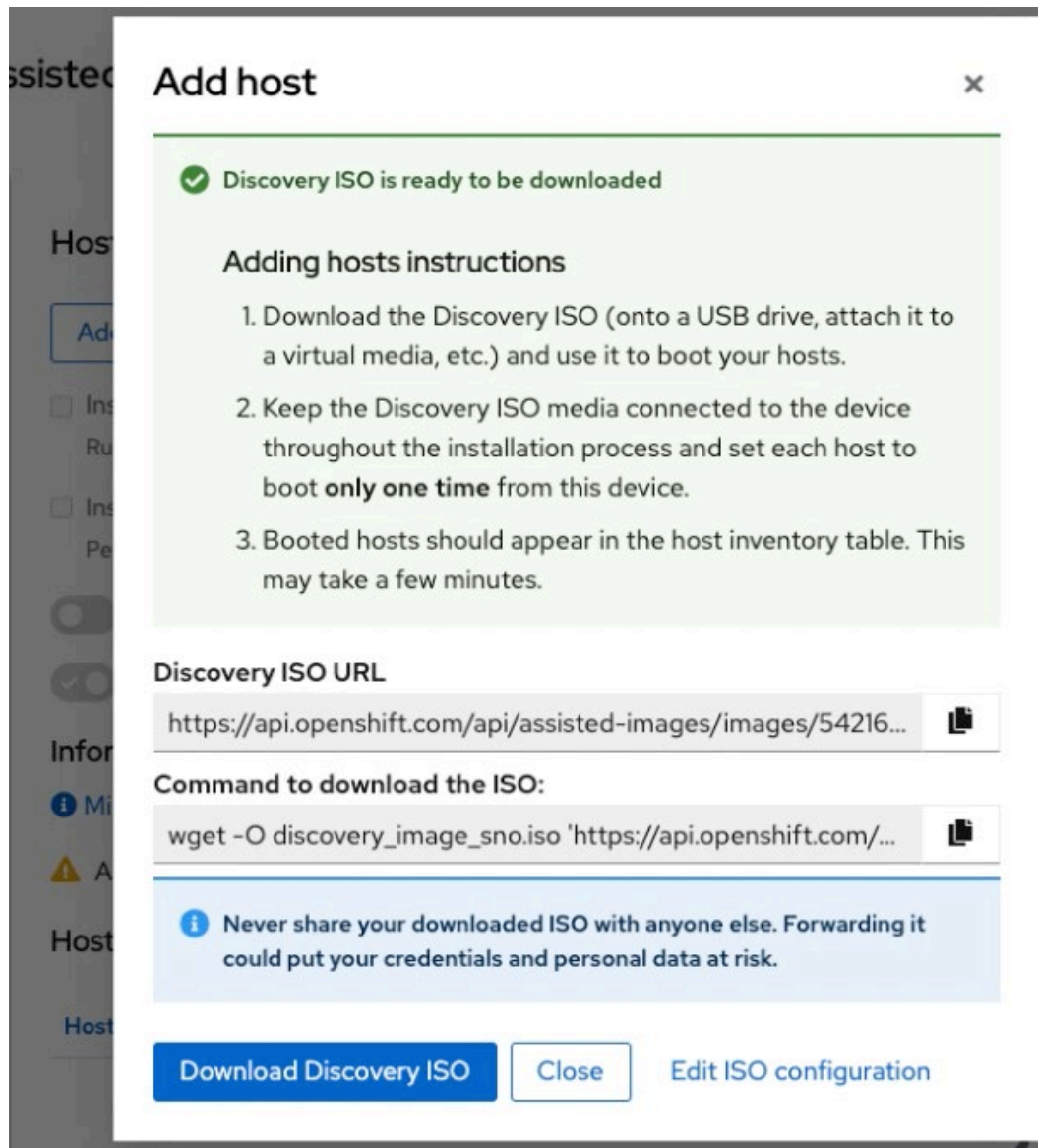
Figure A-9

4. Prepare and download Discovery ISO image for OCP 4.11

```
$ wget -O discovery_image_ocp4.iso 'https://api.openshift.com/api/assisted-images/images/[TOKEN1]?arch=arm64&image_token=[IMAGE_TOKEN]&type=full-iso&version=4.11'
```

5. Clean up the nodes for OCP 4.11 with Red Hat Enterprise Linux CoreOS Live CD. This step is optional but needed if your hardware has been used for other projects or provisioned with OS. Assume there are 9 NVMe drives (1x M.2 for OS and 8x U.2 for data storage) per node.

a. Download the live CD

```
$ wget "https://mirror.openshift.com/pub/openshift-v4/arm64/dependencies/rhcos/4.11/latest/rhcos-
4.11.0-aarch64-live.aarch64.iso"
```

b. Mount Live CD with KVM on BMC. Once the system is loaded, enter the script below to clean up the drives, then power-off the system.

```
$ for DISK in "/dev/nvme0n1" "/dev/nvme1n1" "/dev/nvme2n1" "/dev/nvme3n1"
"/dev/nvme4n1" "/dev/nvme5n1" "/dev/nvme6n1" "/dev/nvme7n1" "/dev/nvme8n1" ;
 do echo $DISK && \
 sgdisk --zap-all $DISK && \
 dd if=/dev/zero of="$DISK" bs=1M count=100 oflag=direct,dsync && \
 blkdiscard $DISK
done

$ poweroff
```

6. Mount the Discovery ISO image for OCP 4.11 with KVM on BMC on the target node.
   a. Click "Browser File" button on the top-right of KVM browser

Figure A-10. Mount Discovery ISO image

b. The KVM dialog will prompt a window dialog for the target ISO image in a directory, then choose discovery_image_sno.iso

Figure A-11. Choose the ISO image

c. Click "Start Media" button to mount ISO image to the target node

Figure A-12, Start to mount the ISO image

7. We use ipmitool SOL function to monitor the installation

```
ipmitool  -H [BMC IP address] -I lanplus -U [username] -P [password] sol activate
```


Figure A-13, IPMITool SOL function shows the node's states

8. When all 3 nodes are loaded with Red Hat Enterprise Linux CoreOS (RHCOS) and update their status to http://cloud.redhat.com , the Assisted Installer web page will also show the status for each phase on the cluster.

Figure A-14

9. The page will show all storage devices and select one of them as boot drive for RHCOS, then click "Next" button

Figure A-15

10. It shows the network information as "User-Managed Networking" including machine network. Click the "Next" button to move to the next step

Figure A-16

11. Review the OpenShift cluster configuration and then click "Install cluster" to start the Assisted Installation.

Install OpenShift with the Assisted Installer

1. Cluster details
2. Static network configurations >
3. Host discovery
4. Storage
5. Networking
6. Review and create

Review and create

Cluster address
ocp4.hhii.amp

OpenShift version
4.11.0

Stack type
IPv4

CPU architecture
arm64

0

Cluster summary

Hosts	3
Cores	240
Memory	1.50 TiB
Storage	95.06 TB

Cluster validations
✅ All validations passed

Host validations
✅ All validations passed

Cluster support level: Full
✅ Your installed cluster will be fully supported

[Install cluster] [Back] Cancel

Figure A-17

12. The Assisted Installer page shows the nodes are preparing for installation as the role of "Control Plane node, Worker", node5 also labels the role of "bootstrap"
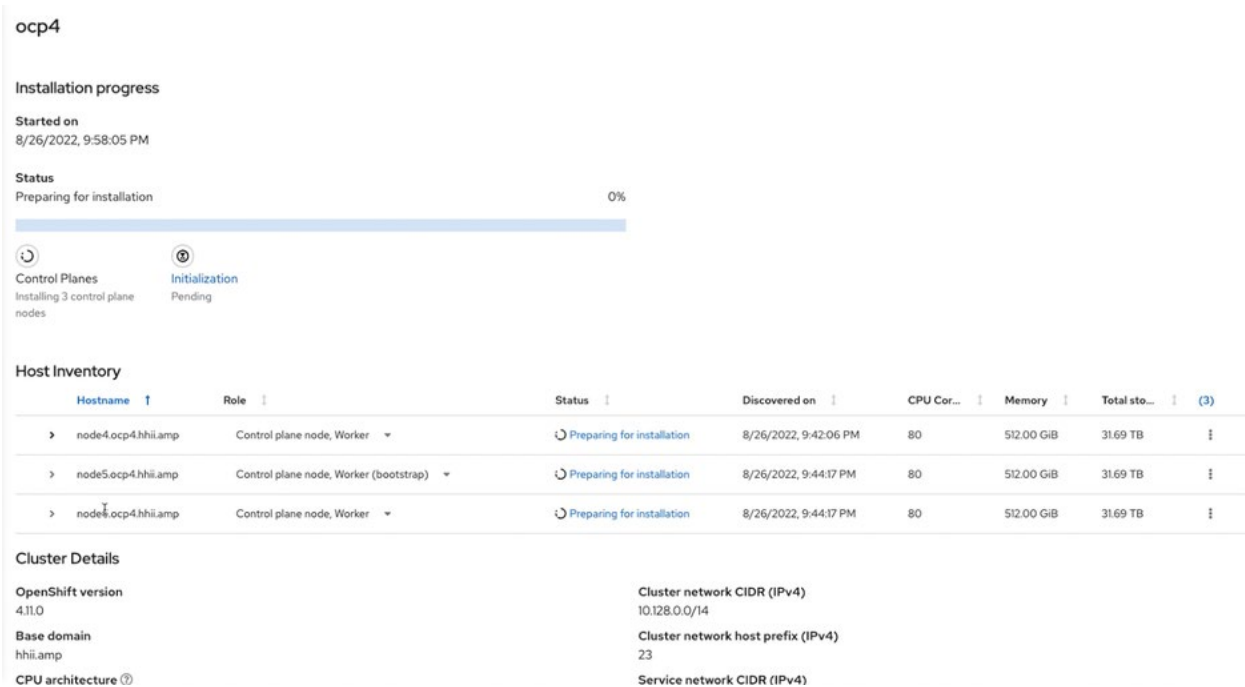
Figure A-18

13. You can click the link of "Status" to find out which step the Assisted Install is working on
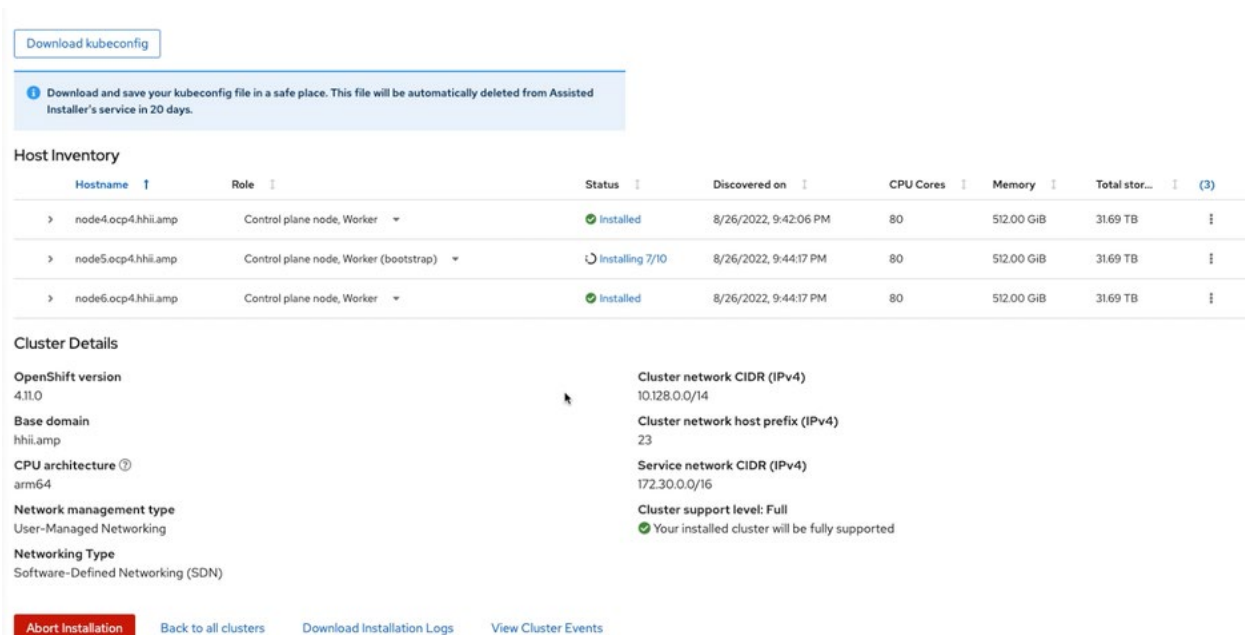

Figure A-19

14. After 35 ~ 65 minutes (depending on the Internet bandwidth), the OpenShift 4.11 3-node compact cluster is ready.

Figure A-20

15. You can access the OpenShift Console via the predefined URL: https://console-openshift-console.ocp4.hhii.amp

Figure A-21

Deploy Rook Ceph Operator

1. On the bastion node, use git to pull Rook Ceph Operator v.1.10.0

```
$ git clone --single-branch --branch v1.10.0 https://github.com/rook/rook.git
$ mv rook rook-v1.10.0
$ cd rook-1.10.0/deploy/examples/
```

2. Deploy CRDs, common, and operator yaml files

```
$ oc create -f crds.yaml -f common.yaml

$ oc create -f operator-openshift.yaml

$ oc create -f cluster.yaml

$ oc create -f toolbox.yaml

$ oc create -f csi/rbd/storageclass.yaml

$ oc create -f csi/rbd/snapshotclass.yaml
```

3. Set rook-ceph-block as the default StorageClass

```
$ oc patch storageclass  rook-ceph-block -p '{"metadata":
{"annotations":{"storageclass.kubernetes.io/is-default-class":"true"}}}'
```

4. After a few minutes, the Ceph cluster is ready on rook-ceph project (namespace).
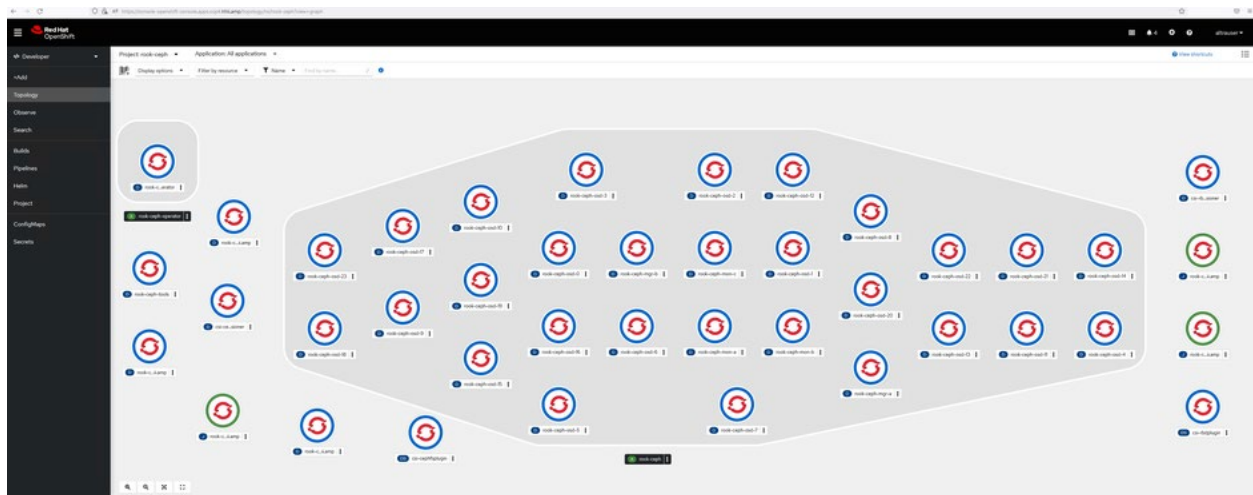
Figure A-22

5. When all OSDs are in ready status, create a YAML file (test-pvc.yaml) for a Persistent Volume Claim (PVC) under rook-ceph project (namespace) for testing Ceph block storage

```
kind: PersistentVolumeClaim
apiVersion: v1
```

```
metadata:
  name: test-pvc
  namespace: rook-ceph
spec:
  accessModes:
    - ReadWriteOnce
  resources:
    requests:
      storage: 10Gi
  storageClassName: rook-ceph-block
  volumeMode: Filesystem
```

6. Create a test PVC by CLI

```
$ oc create -f test-pvc.yaml
```

7. Or create a PVC on OpenShift Console

Figure A-23

8. Then verify its status and PVC details on OpenShift Console (Project →
PersistentVolumeClaim → test-pvc)

Figure A-24
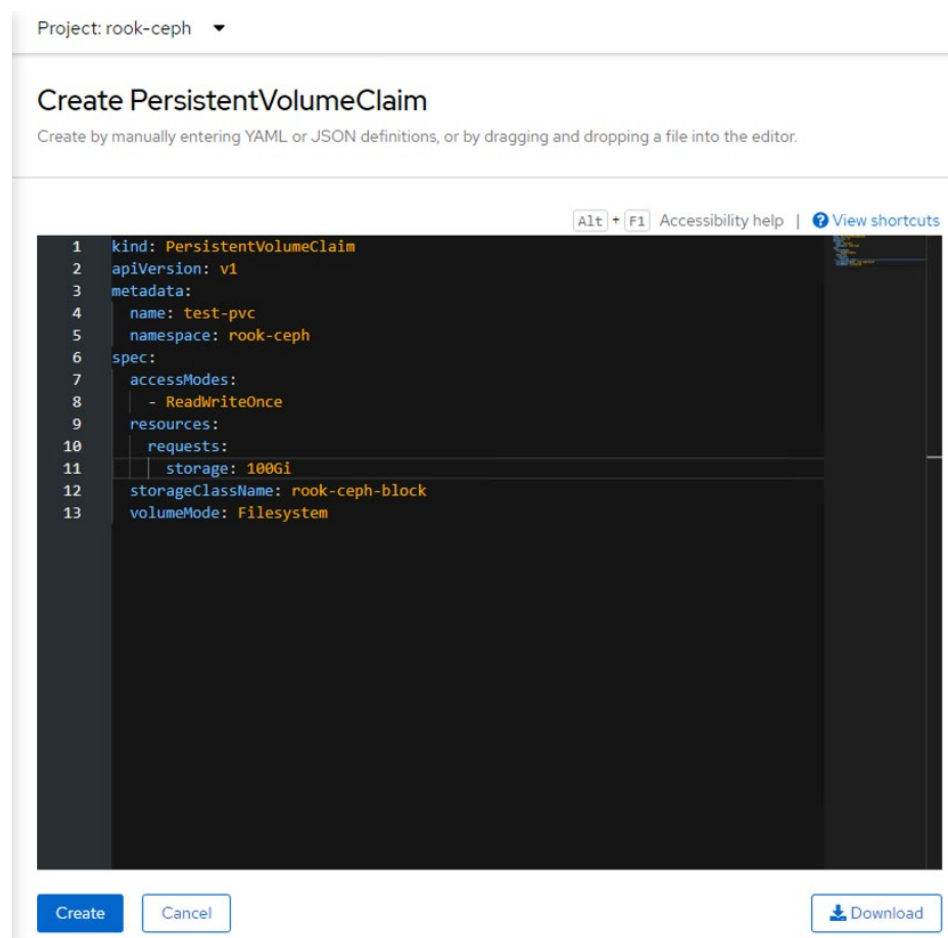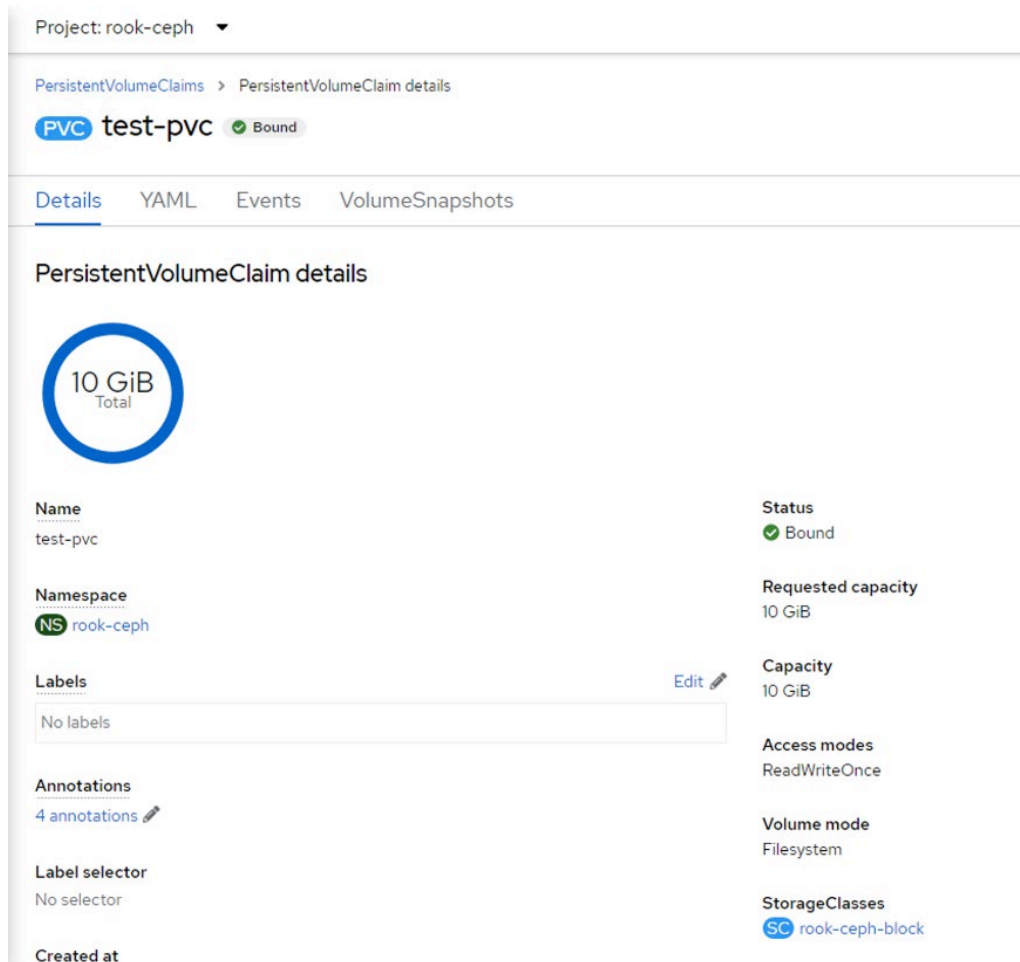
9. Use ceph-tool pod to verify Ceph cluster's healthiness on bastion node

```
$ oc -n rook-ceph exec -it $(oc -n rook-ceph get pod -o name | egrep rook-ceph-tools ) --
/bin/bash
bash-4.4$ ceph status
  cluster:
    id:     9b94ee02-a275-432d-bfef-fae1cf02a1aa
    health: HEALTH_OK

  services:
    mon: 3 daemons, quorum a,b,c (age 40h)
    mgr: a(active, since 40h), standbys: b
    osd: 24 osds: 24 up (since 40h), 24 in (since 40h)
    rgw: 1 daemon active (1 hosts, 1 zones)

  data:
    pools:   9 pools, 257 pgs
    objects: 411 objects, 928 KiB
    usage:   668 MiB used, 84 TiB / 84 TiB avail
    pgs:     257 active+clean
bash-4.4$ ceph health detail
HEALTH_OK
```

```
bash-4.4$ exit
```

10. Find the 3 YAML files, object-openshift.yaml, rgw-external.yaml, storageclass-bucket-delete.yaml, and change "my-store" to "object-store" in the 3 YAML files
11. Edit rgw-external.yaml for changing port number from 80 to 443 for OpenShift
12. Then deploy object storage related YAML files

```
$ oc create -f object-openshift.yaml
$ oc create -f storageclass-bucket-delete.yaml
$ oc create -f object-bucket-claim-delete.yaml
$ oc create -f rgw-external.yaml
```

13. The external URL Object storage service will be created like "http://rook-ceph-rgw-object-store-rook-ceph.apps.ocp4.hhii.amp/"
14. [Add the section for testing the access credential later]
15. Deploy service for Ceph dashboard

```
$ oc create -f  dashboard-loadbalancer.yaml
```

16. Create a route for the external access to Ceph Dashboard web UI under "Routes" section on OpenShift Console

Figure A-25

17. Check the Topology page again to review the external URLs for the endpoints of object-store pod and Ceph Cluster Dashboard (on rook-ceph-mgr-a pod)
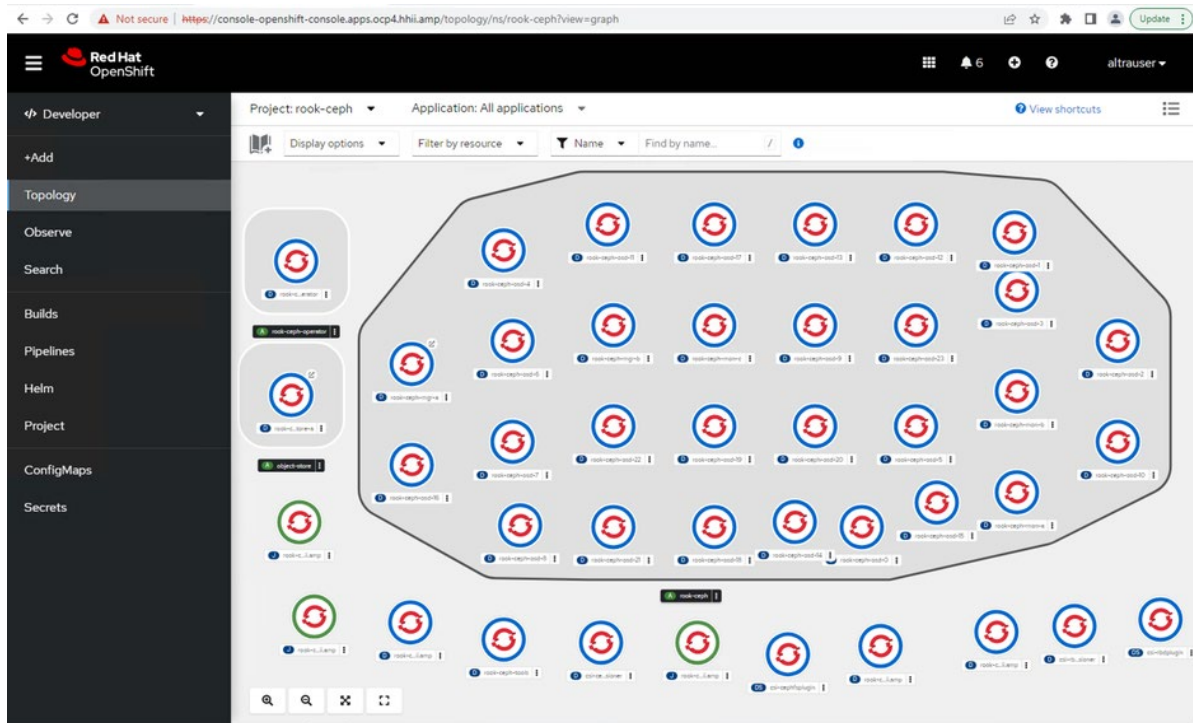

Figure A-26

18. Obtain the generated password for Ceph Dashboard via the command below

```
$ oc -n rook-ceph get secret rook-ceph-dashboard-password -o
jsonpath="{['data']['password']}" | base64 --decode && echo
aaabbb123xxxyyy
```

19. Click the link to access Ceph Dashboard with the credential for "admin", the web UI will look like the one below
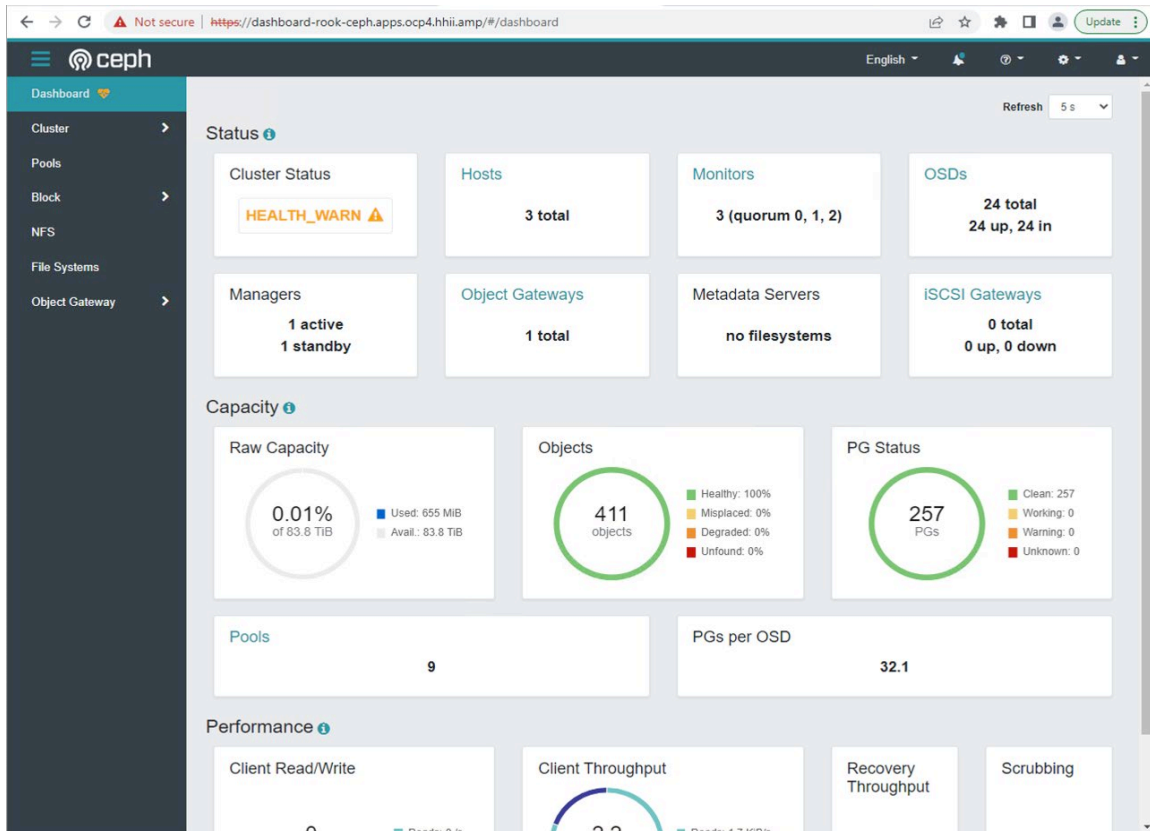
Figure A-27

20. The 3-node compact OpenShift Cluster with Ceph Block storage and Object storage is ready for your next project!