Overview

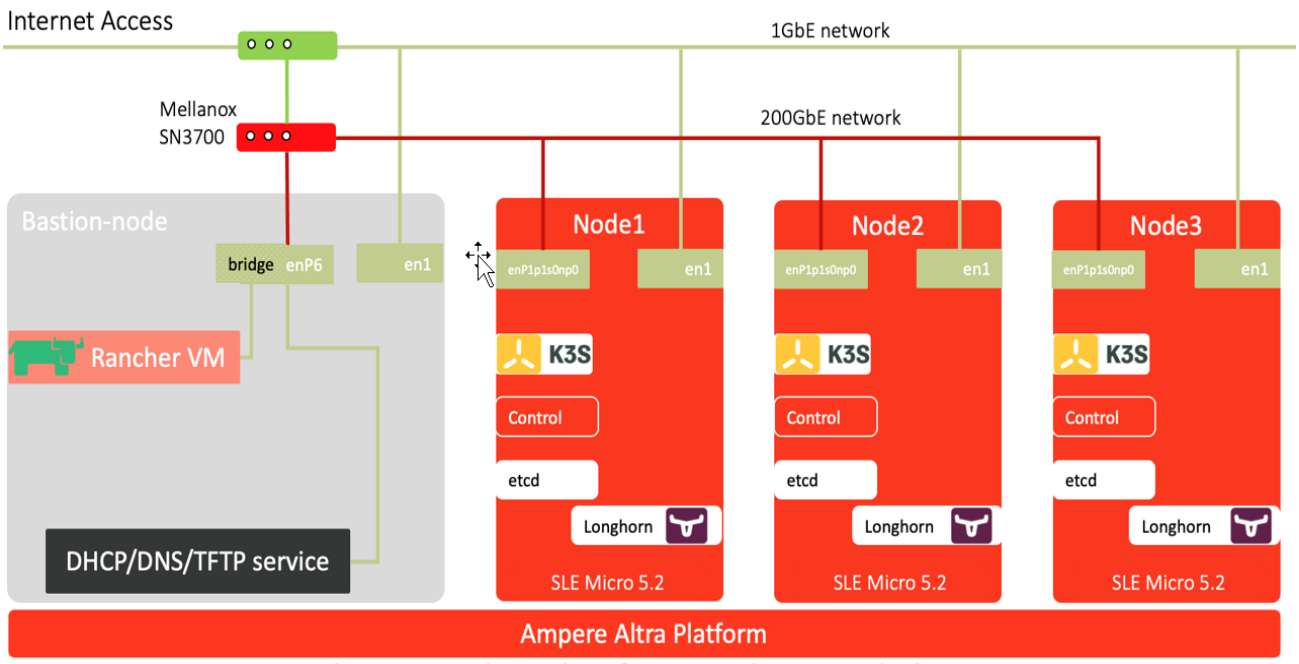
This tutorial guide intends to explain the deployment of SUSE K3s 3-node compact cluster on the Ampere® Altra® platform. The installation of Rancher for K3s cluster management, Longhorn for block storage, Nginx Ingress Controller for ingress, and Prometheus and Grafana for collecting and presenting metrics are described in the following sections.

K3s is a CNCF sandbox project that delivers a lightweight certified Kubernetes distribution. There is SUSE Rancher for managing and running production workloads across the cluster.

The diagram below shows the network overview with four nodes: K3s 3-node cluster and a bastion node.

For running Video-on-Demand service workload on the cluster, use Nginx Ingress Controller instead of Traefik as the ingress service, and the named (from BIND) is deployed on the bastion node for the ingress endpoints of two pods of the Nginx web server and Nginx VOD container.

Figure 1: Network Overview of SUSE Rancher K3 3-node Cluster



Prerequisite:

A DNS service like BIND (named) runs on the bastion node.

Setup Instructions

Refer to the following steps to install K3s without Traefik:

1. For the servers provisioned with SUSE Linux Enterprise (SLE) Micro 5.2, ensure the drives for NICs are up to date.

   If you want to deploy K3s on other Linux distributions, refer to https://www.suse.com/suse-rancher/support-matrix/all-supported-versions/rancher-v2-6-5/ for the Rancher K3s support matrix.

2. Deploy K3s on the first node (node1) and disable “traefik.”
   Based on the support matrix, choose K3s version 1.23.6+k3s1.

```
node1 ~$ export INSTALL_K3S_EXEC=”server --no-deploy traefik --cluster-init --write-kubeconfig-
mode=644”
node1 ~$ export K3s_VERSION="v1.23.6+k3s1"
node1 ~$ curl -sfL https://get.k3s.io | \
INSTALL_K3S_VERSION=${K3s_VERSION} \
INSTALL_K3S_EXEC=${INSTALL_K3S_EXEC} \
sh -s -
```

3. For the servers provisioned with SLE Micro 5.1 or later, reboot the system when the K3s installer shell script completes the installation.

```
$ sudo reboot
```

4. Retrieve the access token for the K3s cluster when the system is up and running.

```
node1 ~$ sudo cat /var/lib/rancher/k3s/server/node-token
xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx::server:xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
```

5. On the other two nodes (e.g., node2 and node3), clean up the previous installation of K3s, if any.

```
node2 ~$ sudo /usr/local/bin/k3s-uninstall.sh
node2 ~$ sudo reboot
```

6. Add NODE_TOKEN and FIRST_SERVER in the script to include the two nodes into the cluster with the first node. Install K3s on the other node.

```
node2 ~$ export INSTALL_K3S_EXEC="server --no-deploy traefik"
node2 ~$ export FIRST_SERVER_IP="10.76.85.101"
node2 ~$ export
NODE_TOKEN="xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx::server:xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
"
node2 ~$ export K3s_VERSION="v1.23.6+k3s1"

node2 ~$ curl -sfL https://get.k3s.io | \
 INSTALL_K3S_VERSION=${K3s_VERSION} \
 K3S_URL=https://${FIRST_SERVER_IP}:6443 \
 K3S_TOKEN=${NODE_TOKEN} \
 K3S_KUBECONFIG_MODE="644" INSTALL_K3S_EXEC=${INSTALL_K3S_EXEC} \
 sh -
```

7. Repeat step 3 (for the servers provisioned with SLE Micro 5.1 or later, reboot the system when the K3s installer shell script completes the installation). Otherwise, the cluster should be up and running.

```
node2 ~$ sudo reboot
```

8. Execute `kubectl` to check the nodes' readiness. If their status is "Ready," a 3-node compact cluster is ready!

```
node1 ~$ kubectl get nodes
NAME    STATUS     ROLES                        AGE   VERSION
node1   Ready      control-plane,etcd,master    55m   v1.23.6+k3s1
node2   Ready      control-plane,etcd,master    31m   v1.23.6+k3s1
node3   Ready      control-plane,etcd,master    10m   v1.23.6+k3s1
```

9. To access the k3s cluster from the bastion node, the `k3s.yaml` is under **/etc/rancher/k3s**. Replicate it under your home directory as **~/.kube/config.**

```
node1 ~$ cp /etc/rancher/k3s/k3s.yaml ~/kubeconfig
node1 ~$ scp ~/kubeconfig altrauser@10.76.85.104:./.kube/config
node1 ~$ ssh altrauser@10.76.85.104
[altrauser@mtsnow ~]$ kubectl get node
NAME    STATUS   ROLES                        AGE     VERSION
node1   Ready    control-plane,etcd,master    6h15m   v1.23.6+k3s1
node2   Ready    control-plane,etcd,master    5h39m   v1.23.6+k3s1
node3   Ready    control-plane,etcd,master    5h26m   v1.23.6+k3s1
```

Install Nginx Ingress Controller on K3s

1. Since there is no Traefik as an ingress controller, choose the right version of the Nginx Ingress Controller for supporting K3s.

   In this PoC, it is version 1.1.0. It will create an ingress-nginx namespace. Also, you will need a patch for this deployment using a DNS load balancer.

```
$ kubectl apply -f https://raw.githubusercontent.com/kubernetes/ingress-nginx/controller-
v1.1.0/deploy/static/provider/baremetal/deploy.yaml

$ cat > ingress.yaml <<EOF
spec:
template:
spec:
hostNetwork: true
EOF
$ kubectl patch deployment ingress-nginx-controller -n ingress-nginx --patch "$(cat
ingress.yaml)"
deployment.apps/ingress-nginx-controller patched
```

2. In the DNS load balancer use case, increase the number of ingress-nginx-controller pods to 3 by editing the "replicas" to 3.

```
$ kubectl get deployment -n ingress-nginx
NAME                        READY   UP-TO-DATE   AVAILABLE   AGE
ingress-nginx-controller    1/1     1            1           19s
$ kubectl edit deployment ingress-nginx-controller -n ingress-nginx
...
#
apiVersion: apps/v1
```

```
  kind: Deployment
  metadata:
    annotations:
      deployment.kubernetes.io/revision: "2"
  ..
    generation: 8
    labels:
      app.kubernetes.io/component: controller
      app.kubernetes.io/instance: ingress-nginx
      app.kubernetes.io/managed-by: Helm
      app.kubernetes.io/name: ingress-nginx
      app.kubernetes.io/version: 1.1.0
      helm.sh/chart: ingress-nginx-4.0.10
    name: ingress-nginx-controller
    namespace: ingress-nginx
  ..
  spec:
    progressDeadlineSeconds: 600
    replicas: 3      #### <--- here
    revisionHistoryLimit: 10
    selector:
      matchLabels:
        app.kubernetes.io/component: controller
        app.kubernetes.io/instance: ingress-nginx
        app.kubernetes.io/name: ingress-nginx
    strategy:
      rollingUpdate:
        maxSurge: 25%
        maxUnavailable: 25%
      type: RollingUpdate
    template:
      metadata:
        creationTimestamp: null
        labels:
          app.kubernetes.io/component: controller
          app.kubernetes.io/instance: ingress-nginx
          app.kubernetes.io/name: ingress-nginx
```

3. Verify the deployment update is complete and ensure an ingress-nginx-controller is on each node.

```
$ kubectl get deployment -n ingress-nginx
NAME                        READY   UP-TO-DATE   AVAILABLE   AGE
ingress-nginx-controller    3/3     3            3           1m
$ kubectl get pods -n ingress-nginx
NAME                                        READY   STATUS      RESTARTS   AGE
ingress-nginx-admission-create-jm5nd        0/1     Completed   0          1m
ingress-nginx-admission-patch-c8wt8         0/1     Completed   1          1m
ingress-nginx-controller-7b8496bf47-59r5q   1/1     Running     0          50s
ingress-nginx-controller-7b8496bf47-ltp6r   1/1     Running     0          50s
```

```
ingress-nginx-controller-7b8496bf47-vm5hs   1/1     Running     0          1m
$ kubectl get pods -n ingress-nginx -o wide
NAME                                READY   STATUS     RESTARTS   AGE    IP          NODE
NOMINATED NODE   READINESS GATES
ingress-nginx-admission-create-jm5nd        0/1     Completed   0          2m   10.42.2.4
node3.k3s.hhii.amp   <none>           <none>
ingress-nginx-admission-patch-c8wt8         0/1     Completed   1          2m   10.42.2.5
node3.k3s.hhii.amp   <none>           <none>
ingress-nginx-controller-7b8496bf47-59r5q   1/1     Running     0          1m   10.76.85.101
node1.k3s.hhii.amp   <none>           <none>
ingress-nginx-controller-7b8496bf47-ltp6r   1/1     Running     0          1m   10.76.85.102
node2.k3s.hhii.amp   <none>           <none>
ingress-nginx-controller-7b8496bf47-vm5hs   1/1     Running     0          2m   10.76.85.103
node3.k3s.hhii.amp   <none>           <none>
```

Note: For other instructions, create a new namespace like nginx-ingress for all namespaces or pre-defined namespaces. In this case, the ingress-nginx namespace is created and used.

Install Rancher

In this instruction, use docker to run the rancher v2.6.4 container image on ports 443 and 80 by referring to the following steps.

Note: A bootstrap password is required to access the Rancher web UI.

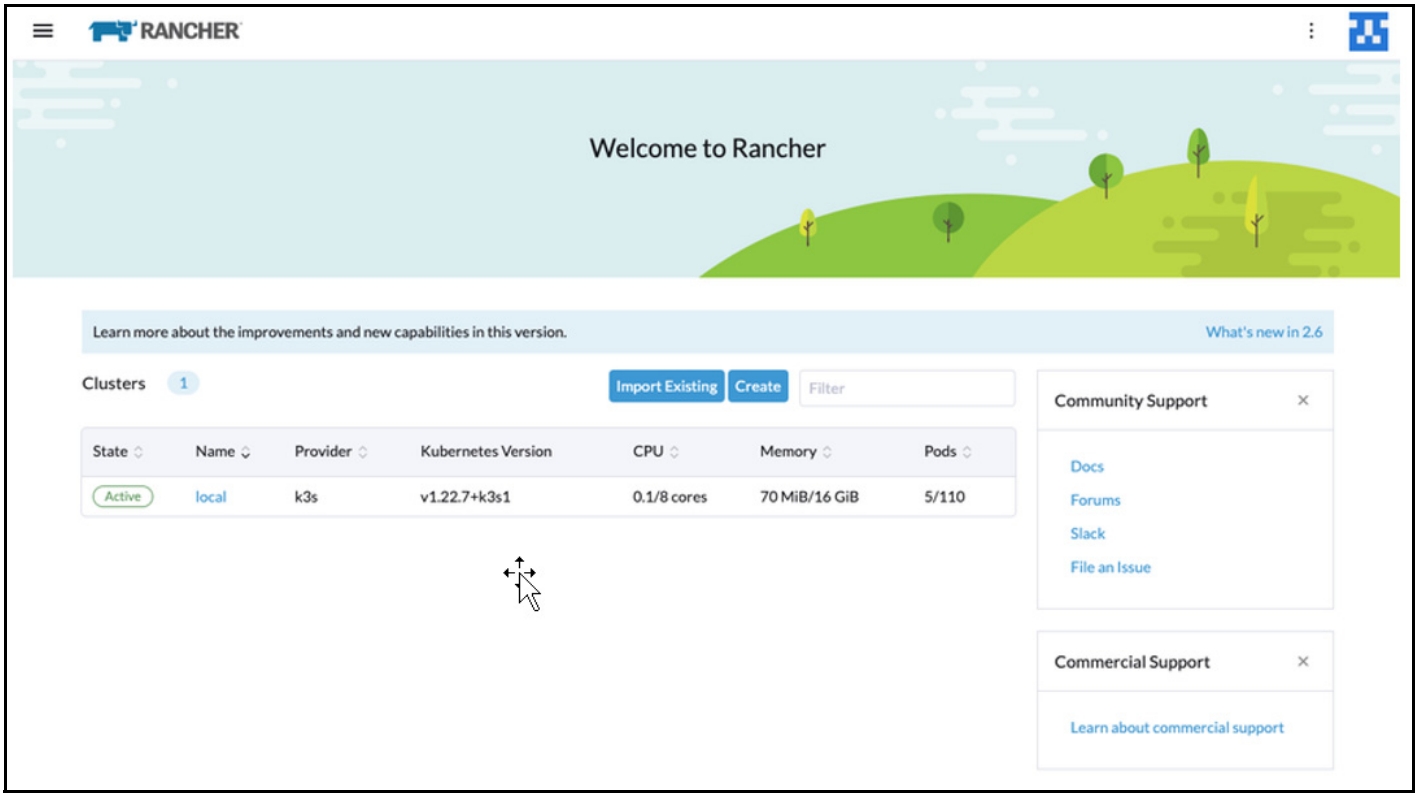
For the production, run Rancher on a 3-node K8s cluster for High Availability (HA) instead of a single node or VM with docker.

```
$ sudo docker run -d --restart=unless-stopped   -p 80:80 -p 443:443 --name rancher26  --
privileged   rancher/rancher:latest
$ docker ps
CONTAINER ID  IMAGE         COMMAND     CREATED    STATUS    PORTS
NAMES
fbf6db201863   rancher/rancher:latest   "entrypoint.sh"   2 minutes ago   Up 2 minutes
0.0.0.0:80->80/tcp, :::80->80/tcp, 0.0.0.0:443->443/tcp, :::443->443/tcp   rancher26
$ docker logs rancher26 2>&1 | grep "Bootstrap Password"
2022/05/11 03:47:24 [INFO] Bootstrap Password: xxxxxxxxxxxxxxxxxxxx
```

Import K3s Cluster to Rancher

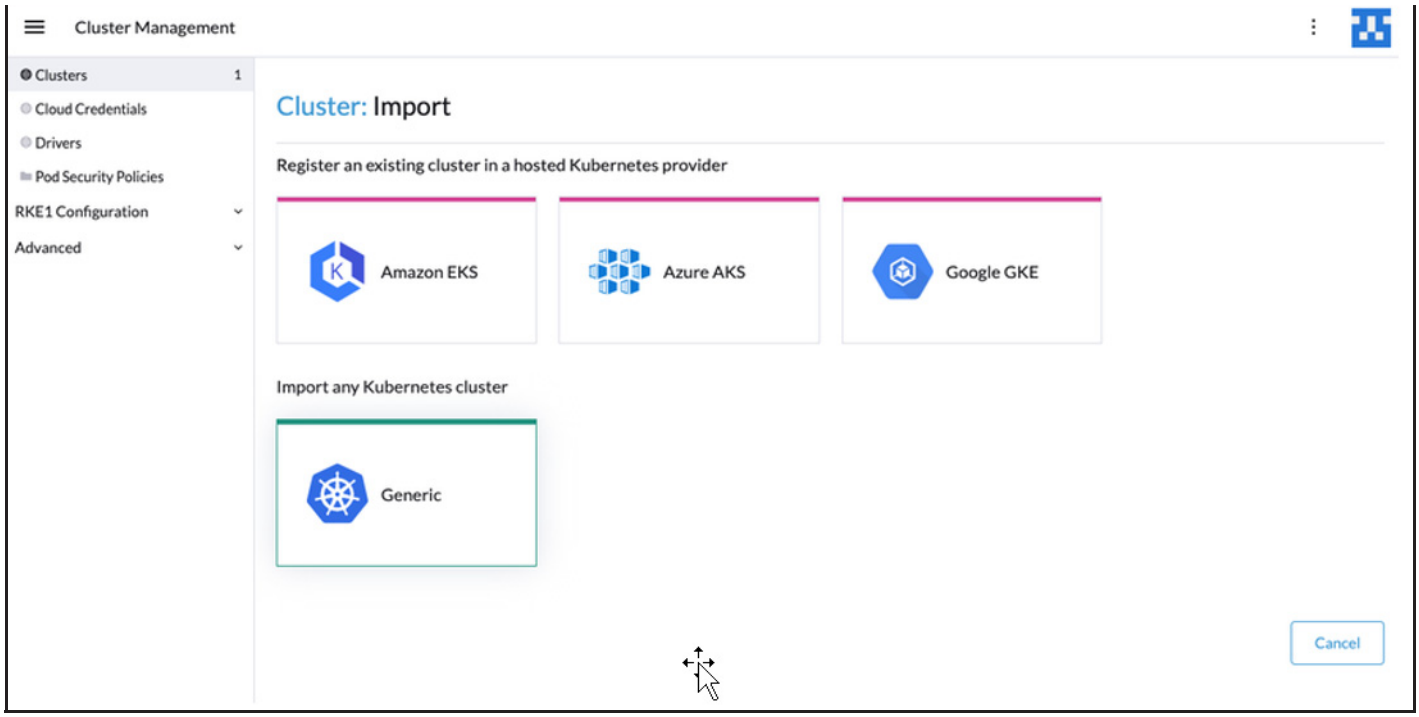
1. Login to Rancher web UI. Click Import Existing.

Figure 2: Rancher - Dashboard of Clusters



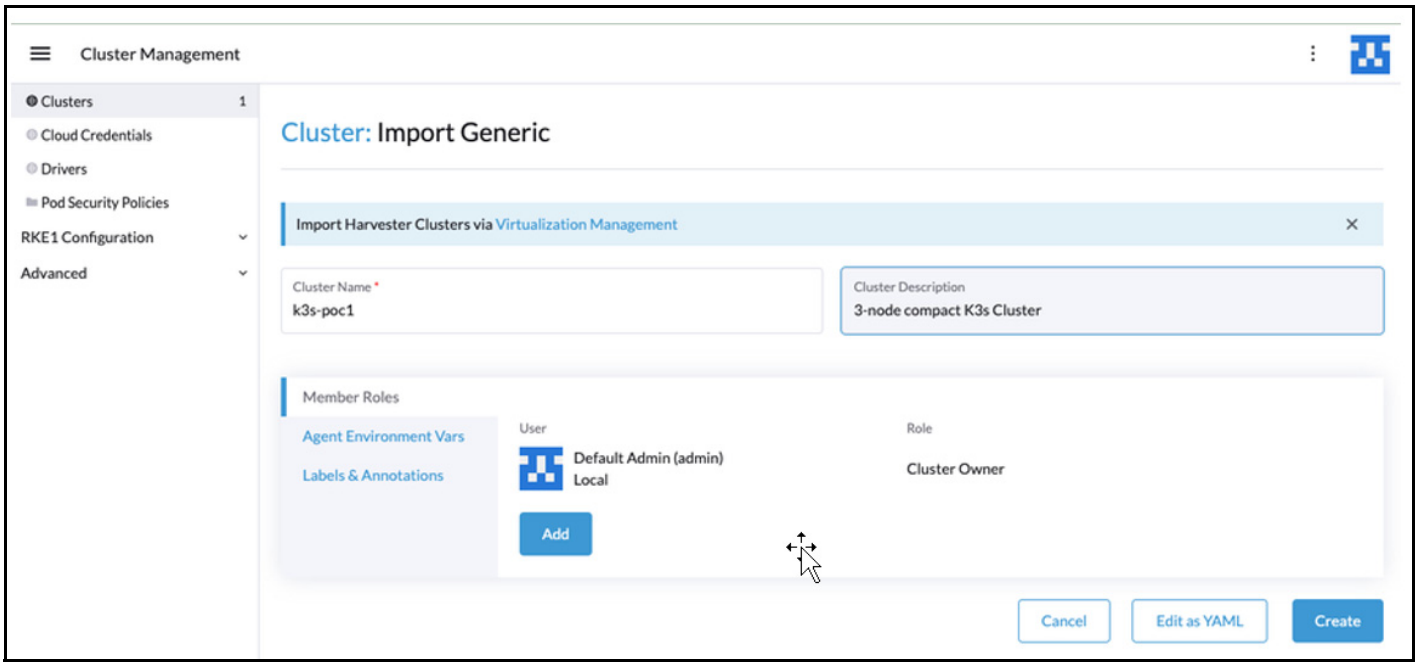
2. Click Generic.

Figure 3: Import K3s as a Generic Kubernetes to Rancher



3. Enter the **Cluster Name** and **Description**.

Figure 4: Import Generic Information

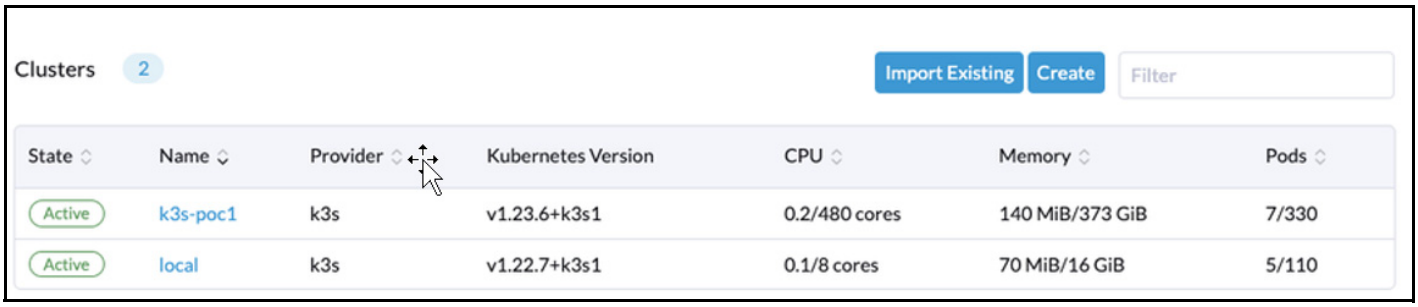


4. Refer to the following command to import k3s cluster to the Rancher:

```
$ curl --insecure -sfL https://10.76.85.165/v3/import/
xxxxx7wq6rrrpjft4gvzblksc9xzjchvl22xxxx_c-m-9xrzlsg4.yaml | kubectl apply -f -
clusterrole.rbac.authorization.k8s.io/proxy-clusterrole-kubeapiserver created
clusterrolebinding.rbac.authorization.k8s.io/proxy-role-binding-kubernetes-master created
namespace/cattle-system created
serviceaccount/cattle created
clusterrolebinding.rbac.authorization.k8s.io/cattle-admin-binding created
secret/cattle-credentials-b36fb99 created
clusterrole.rbac.authorization.k8s.io/cattle-admin created
Warning:
spec.template.spec.affinity.nodeAffinity.requiredDuringSchedulingIgnoredDuringExecution.nodeSel
ectorTerms[0].matchExpressions[0].key: beta.kubernetes.io/os is deprecated since v1.14; use
"kubernetes.io/os" instead
deployment.apps/cattle-cluster-agent created
service/cattle-cluster-agent created
```

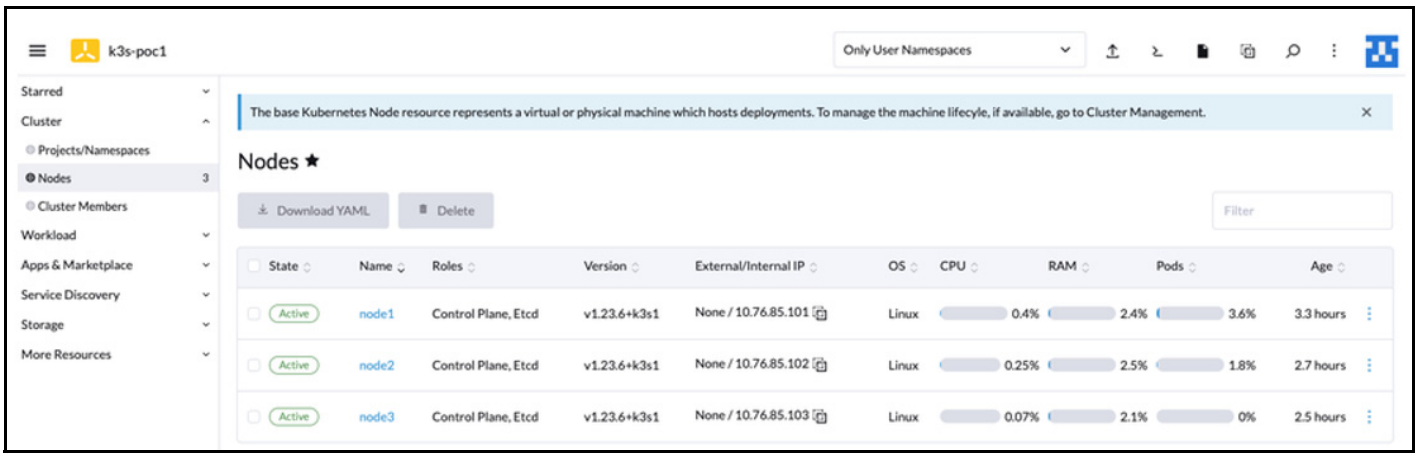
5. After a few minutes, the cluster appears on the dashboard.

Figure 5: List of Clusters on the Dashboard



6. In the cluster view, there are 3 nodes with the Kubernetes version 1.23.6+k3s1.

Figure 6: Nodes Page



Install Longhorn for Block Storage

1. For a clean deployment, clean up the target storage(s) for the Longhorn storage cluster using the following script with root permission.

Note: You can add more storage devices in the loop if needed.

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

2. Make partitions on target storage(s) and format the partitions in xfs.

```
$ sudo fdisk /dev/nvme1n1
$ sudo fdisk /dev/nvme2n1
$ sudo mkfs.xfs /dev/nvme1n1p1 -f
$ sudo mkfs.xfs /dev/nvme2n1p1 -f
```

3. Create mount points and edit **/etc/fstab** for the mount points.

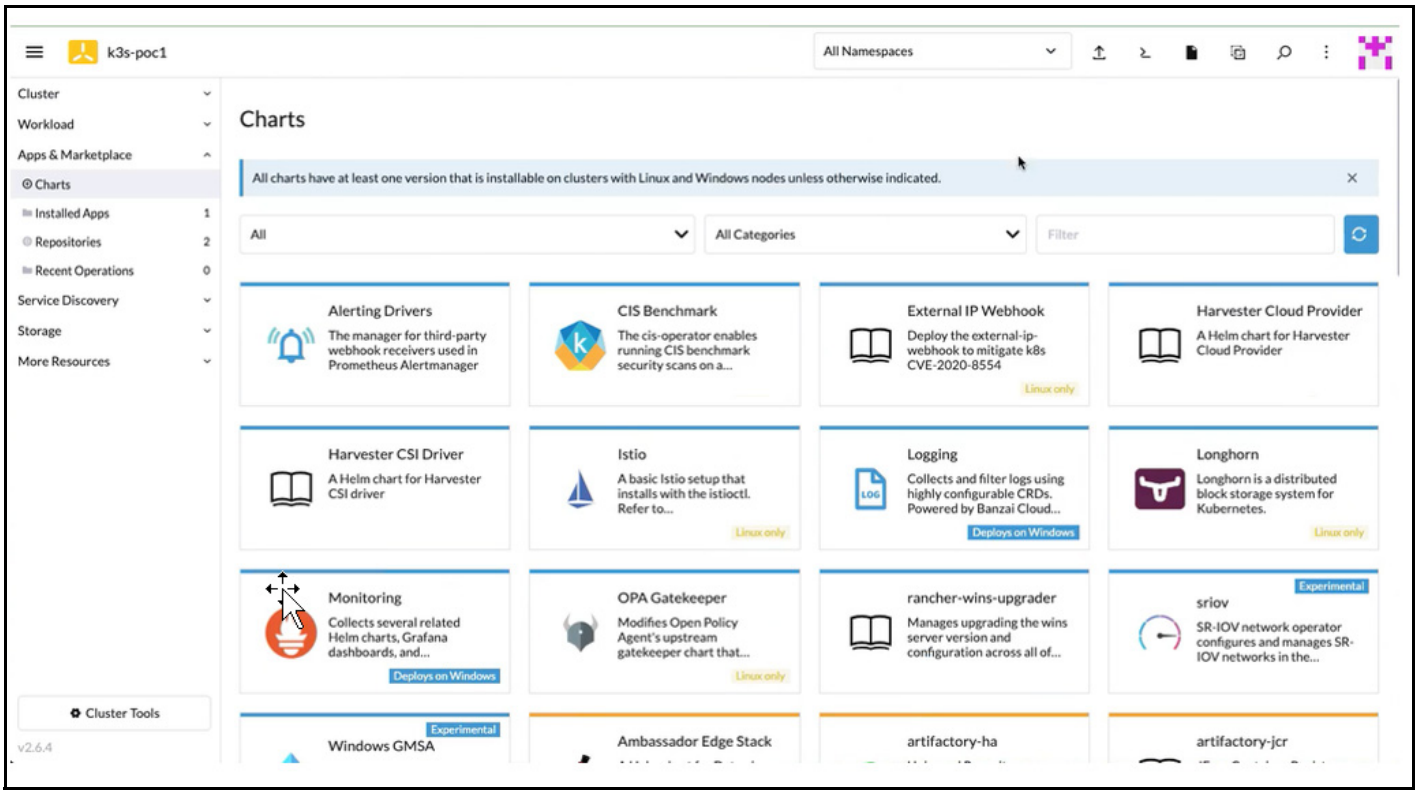
```
$ sudo mkdir -p /var/lib/longhorn
$ sudo mkdir -p /var/lib/longhorn2

$ sudo vi /etc/fstab
##add the line below
/dev/nvme1n1p1 /var/lib/longhorn xfs defaults 0 1
/dev/nvme2n1p1 /var/lib/longhorn2 xfs defaults 0 1
## save the file and quit vi editor
```

4. Mount the storage devices to the mount points.

```
$ sudo mount /var/lib/longhorn/
$ sudo mount /var/lib/longhorn2/
```

5. Click **Longhorn** from **Apps & Marketplace** > **Charts** to install Longhorn charts for block storage.

Figure 7: Charts Tab



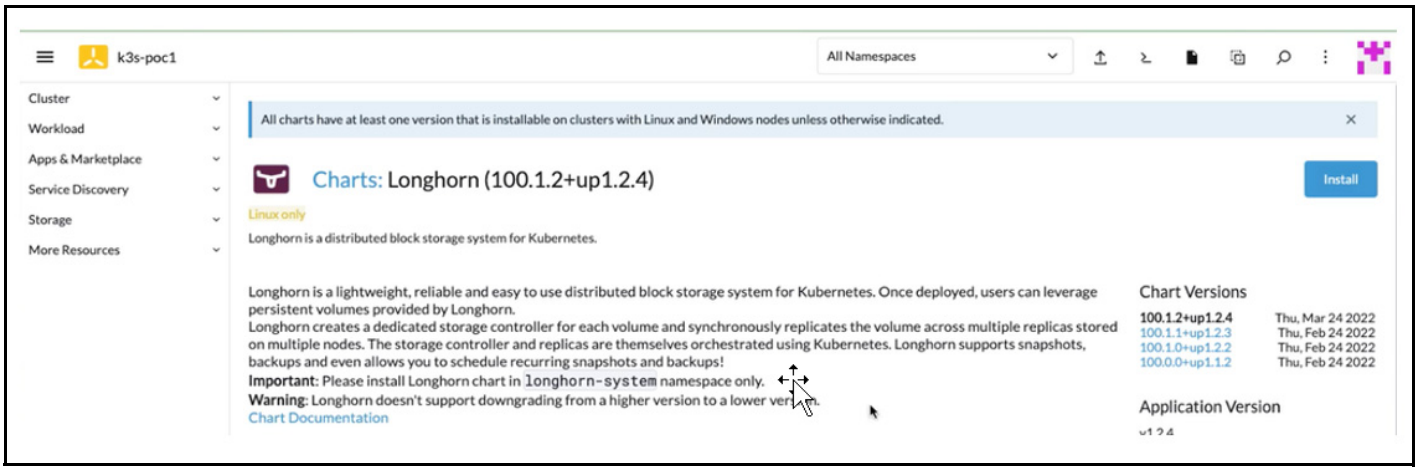
6. For servers provisioned with SLE Micro,
   - Ensure open-iscsi has been installed.
   - iscsid daemon is running on all nodes of the Kubernetes cluster.

   If not, execute the following command to install:

```
$ sudo transactional-update pkg install  open-iscsi
## after installation complete
$ sudo reboot
```

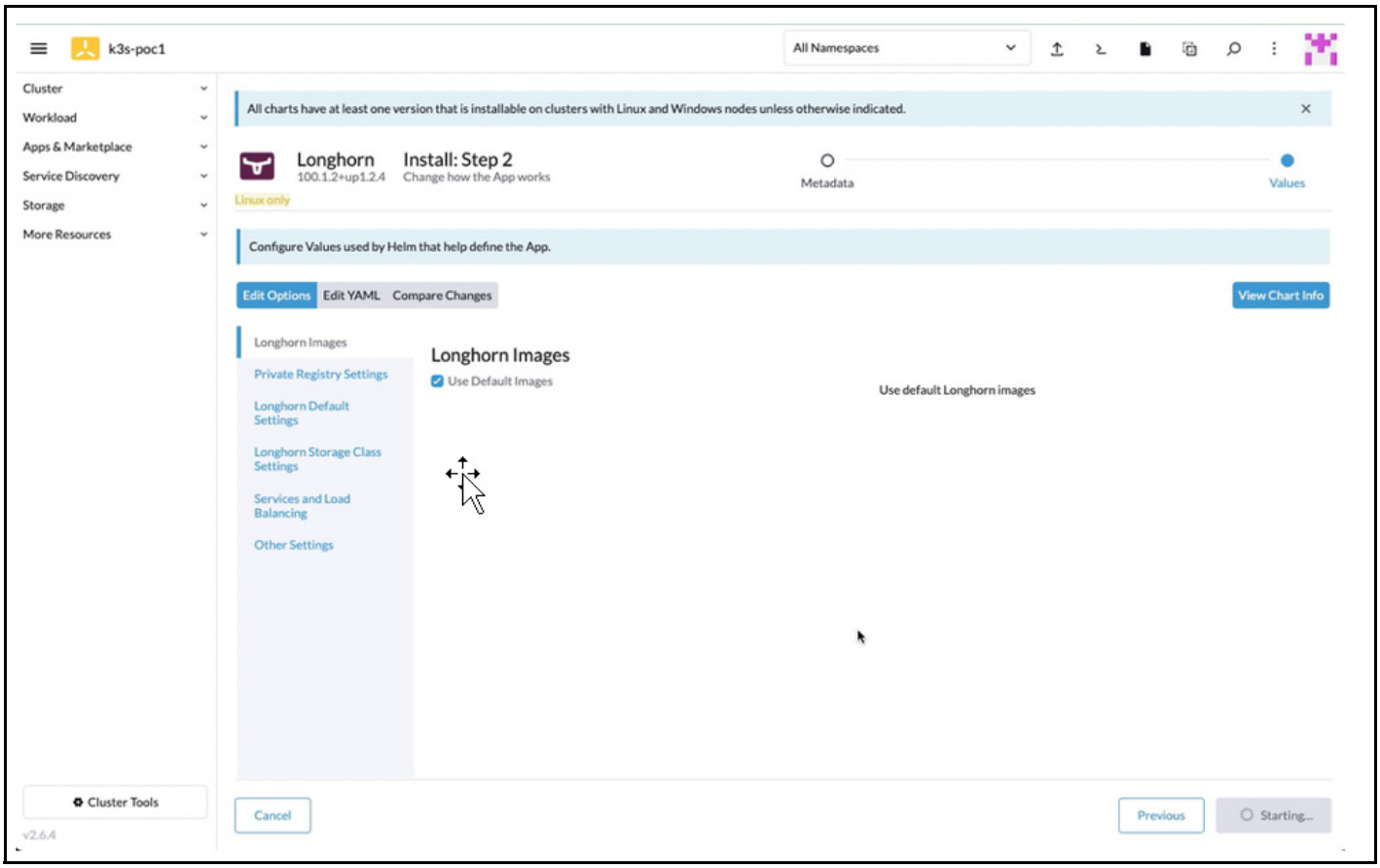
7. Click **Install** to deploy the Longhorn charts.

Figure 8: Longhorn Charts Deployment



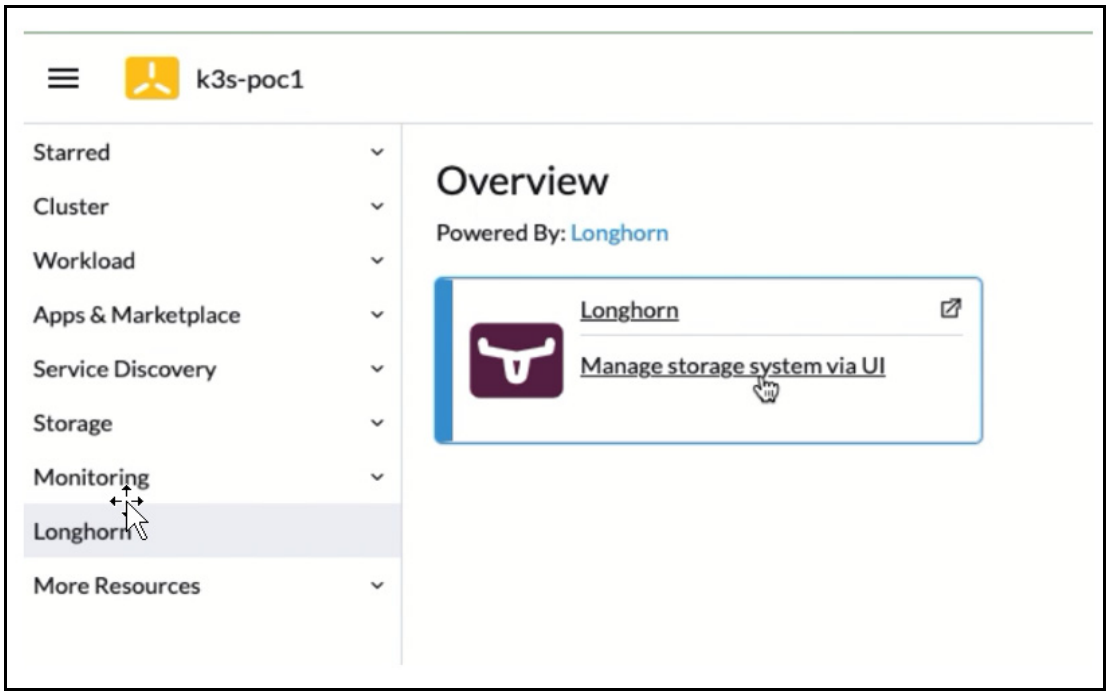
8. After choosing the preferred customization on **Step 2** page, click **Install** to complete the deployment. There will be a chart console showing up the deployment process on Rancher.

Figure 9: Longhorn Charts Deployment: Step 2



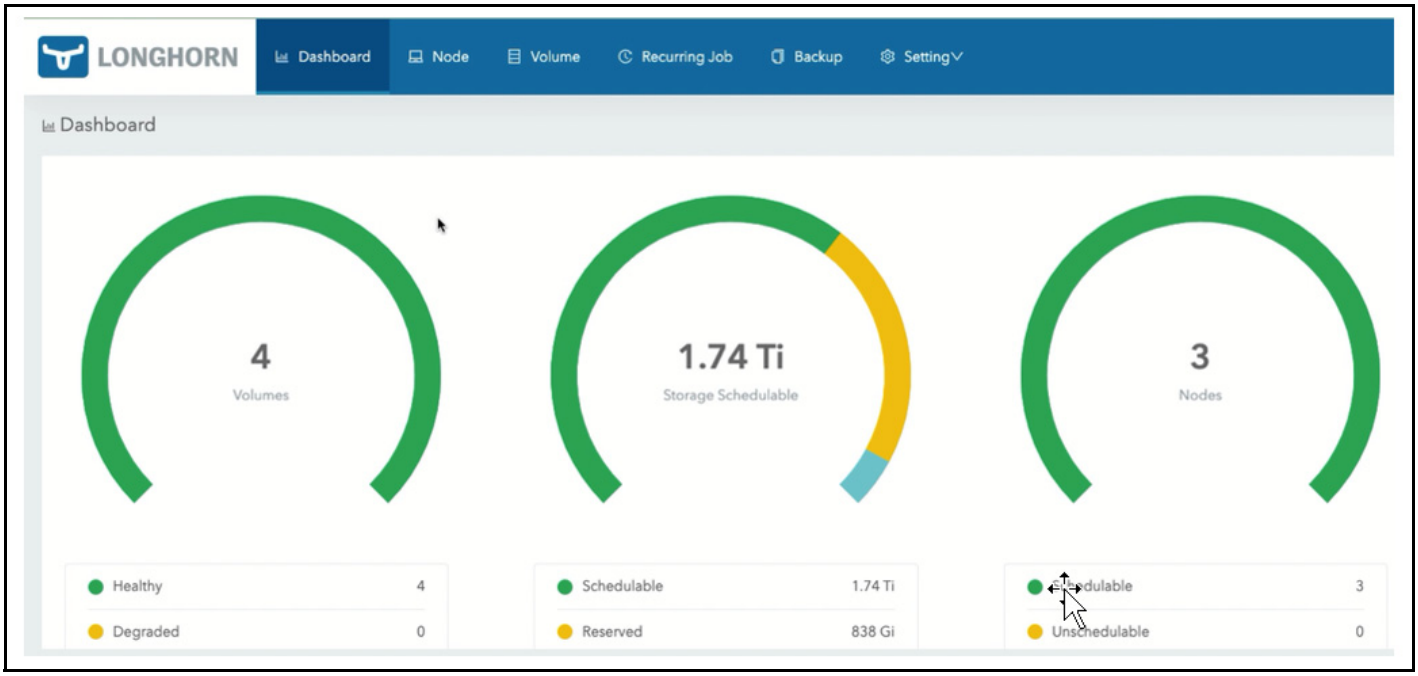
9. Once the deployment is completed, the Longhorn page appears on the left-side navigation bar. Click **Longhorn**.

Figure 10: Longhorn Overview Page



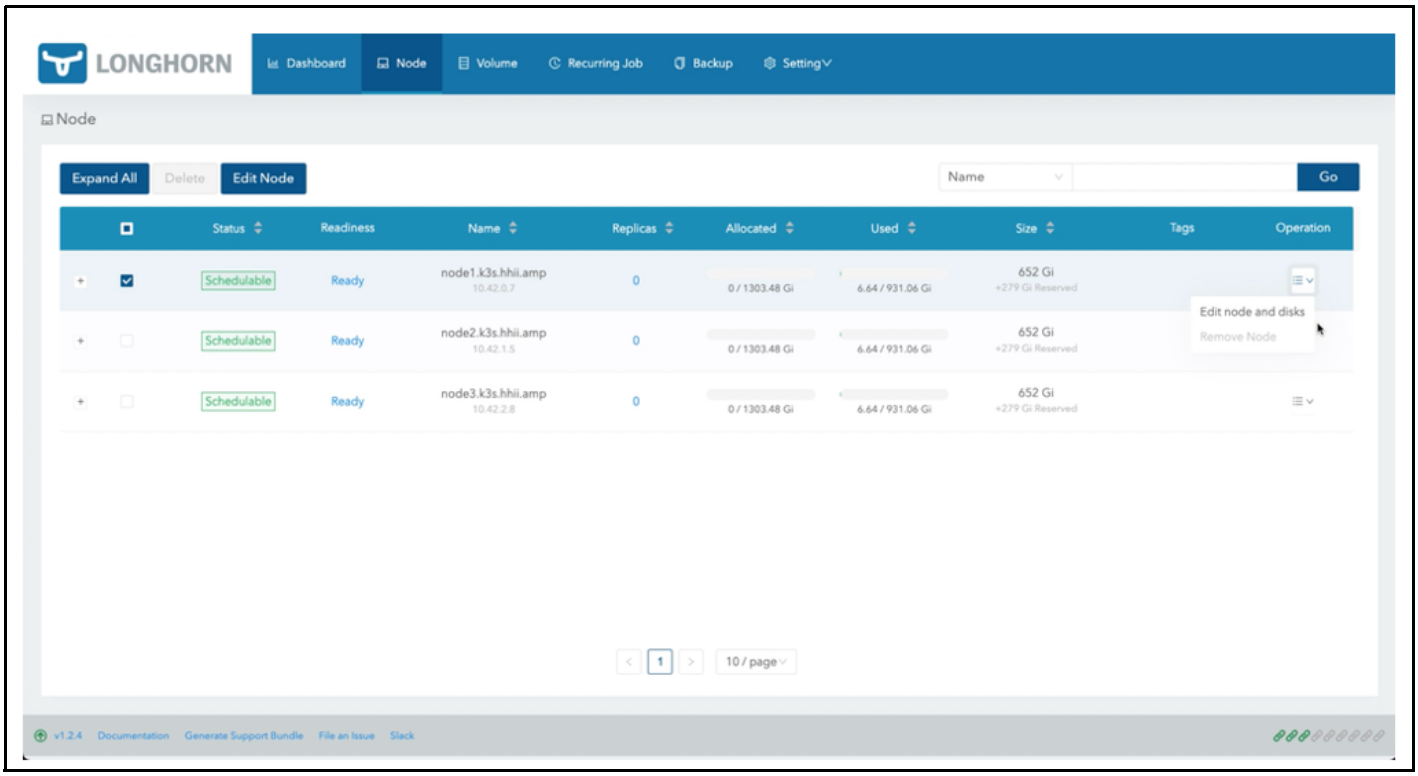
10. The Longhorn storage console opens on another tab. Click **Node** for adding the drives to the Longhorn cluster.

Figure 11: Dashboard Tab of the Longhorn Console



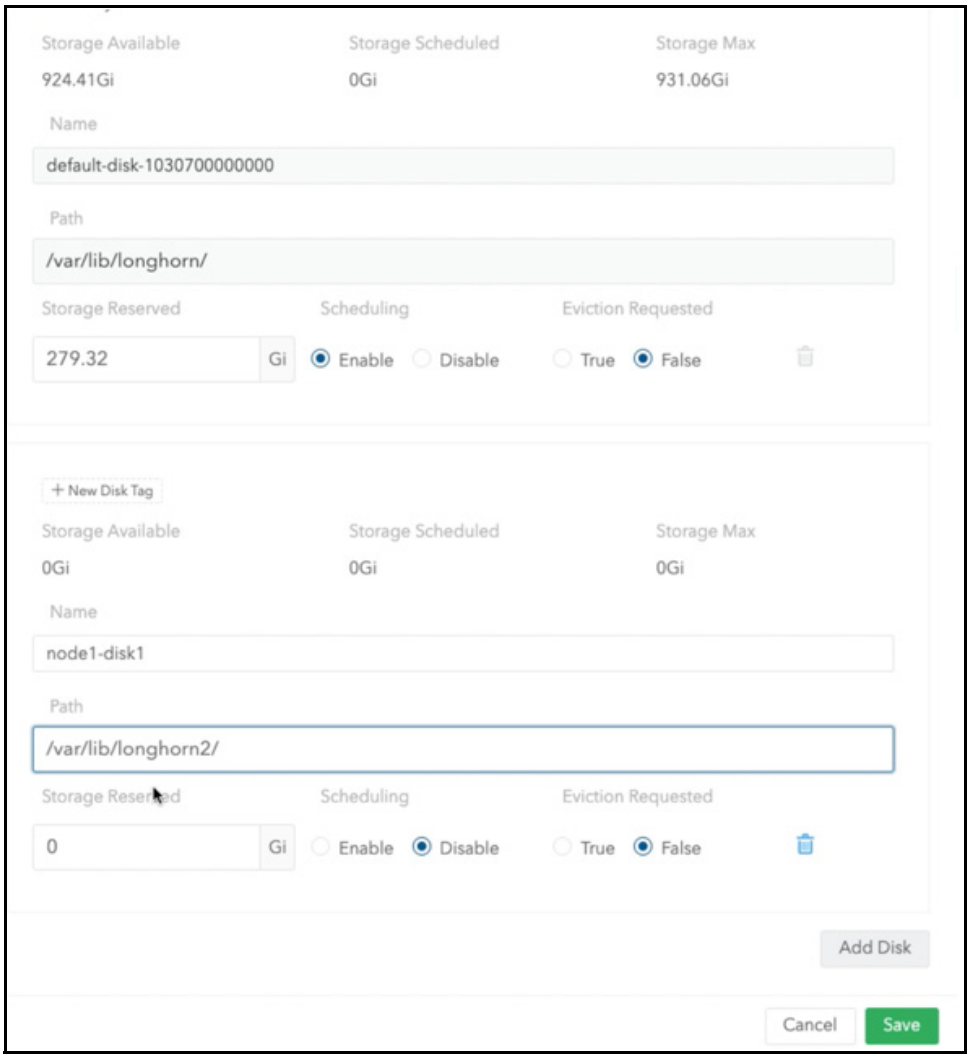
11. For node 1 from the **Operation** column drop-down, click **Edit node and disks** to add the second drive on each to the Longhorn cluster.

Figure 12: Node Tab of the Longhorn Console



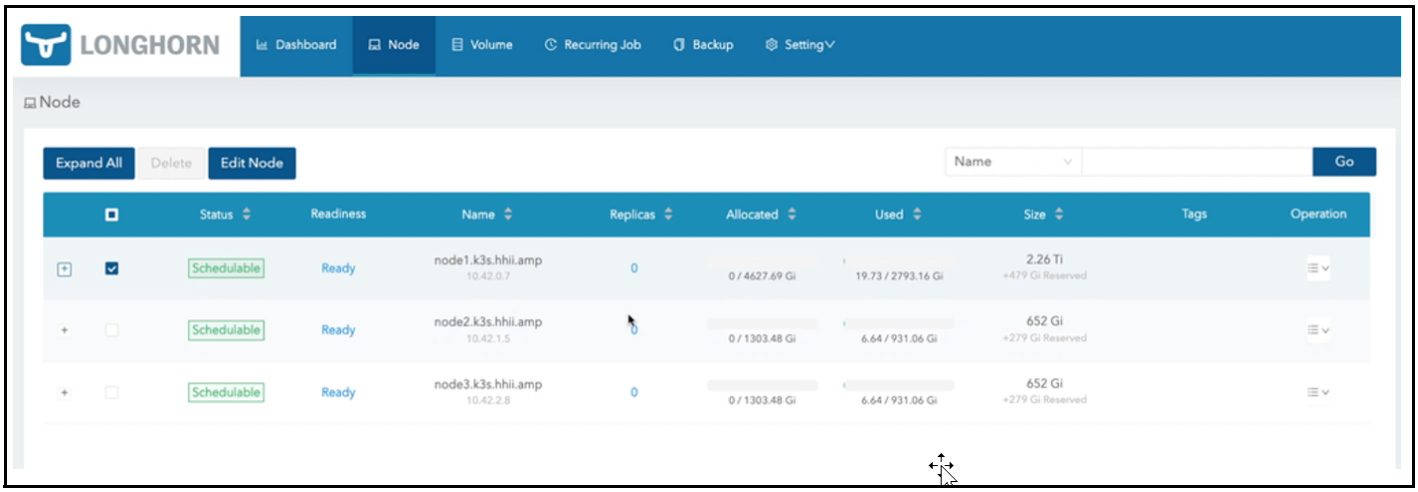
12. A dialog window appears for the node.
    a. Click **Add Disk.**
    b. Enter the name of the disk. For example, node1-disk1.
    c. Enter the path (**/var/lib/longhorn2/**) for the new drive mounted.
    d. Select **Enable** under **Scheduling** to make the new drive functional in the cluster.
    e. Click **Save**.

Figure 13: Dialog Window for the Node



13. Once it saves the new drive information, the **Node** tab displays the updated node's capacity.

Figure 14: Node Tab of the Longhorn Console with the Updated Node's Capacity



14. Repeat steps 11- 13 for the other nodes.

Figure 15: Dialog Window for Other Node

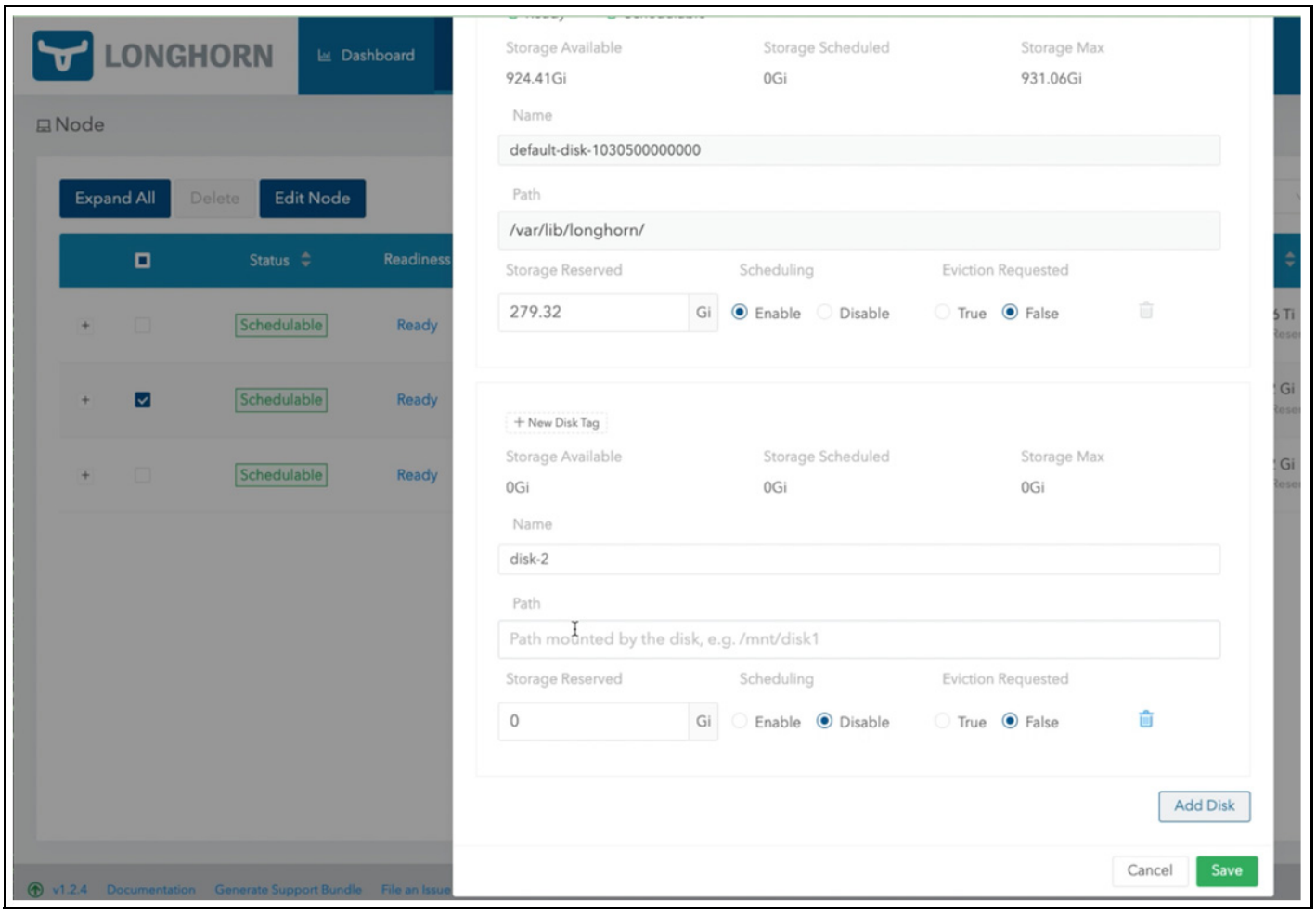
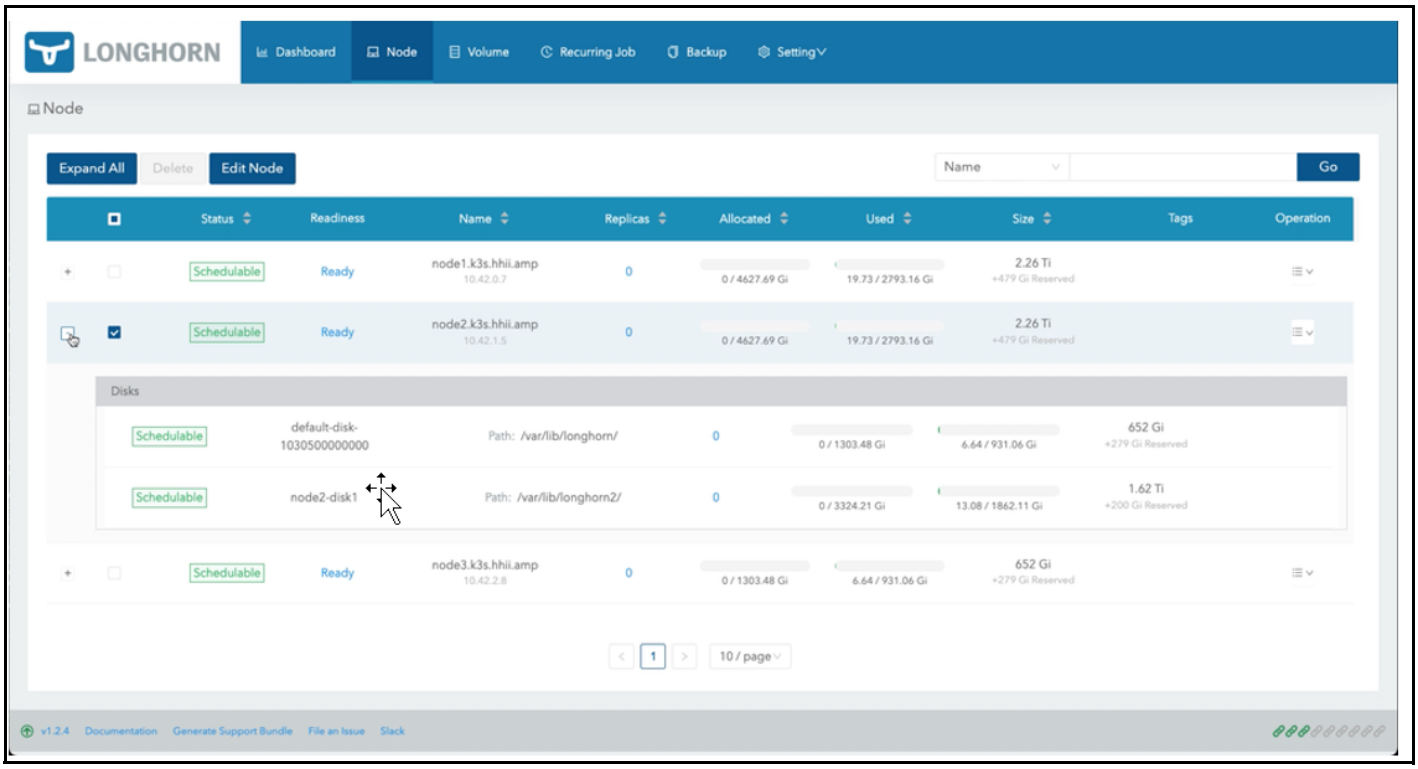
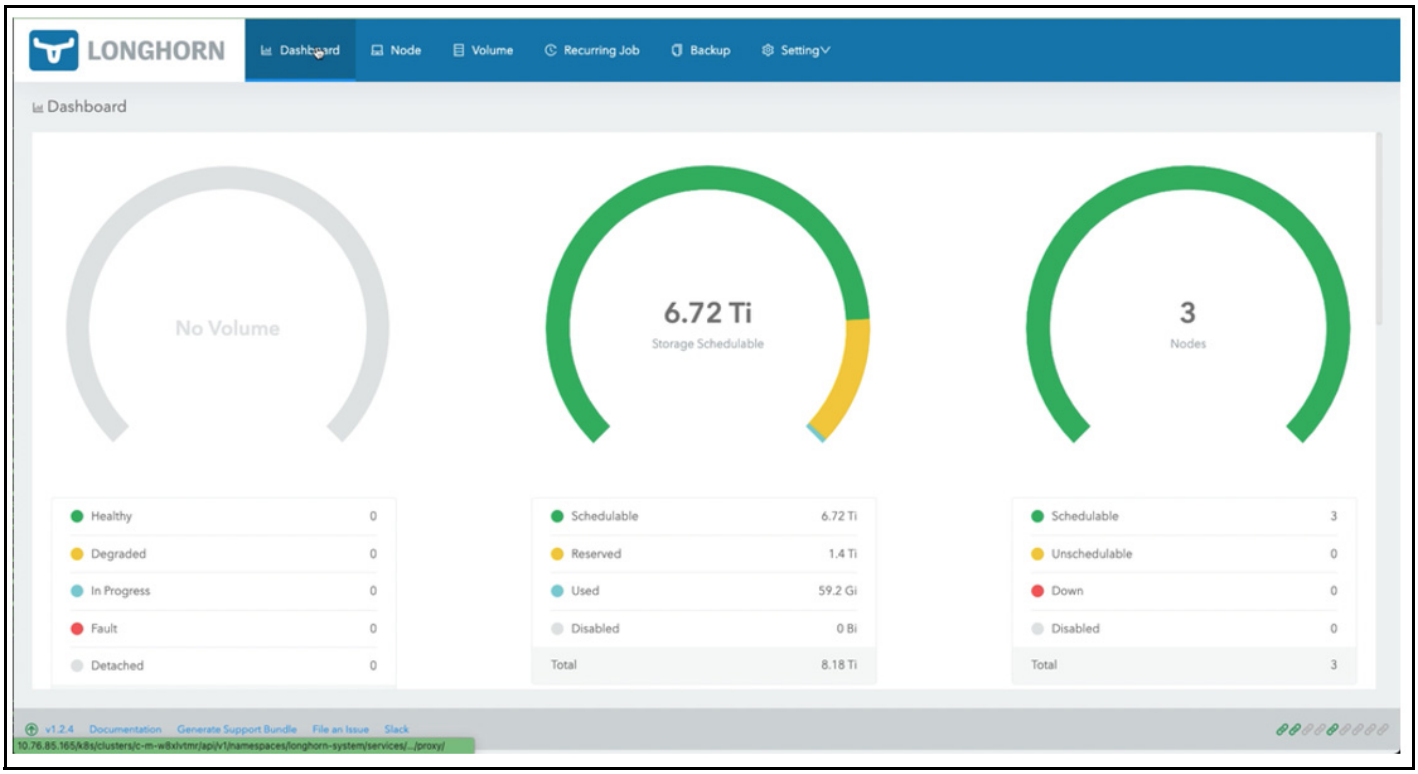


Figure 16: Node Tab of the Longhorn Console with the Updated Node's Capacity



15. Once the new drives are added to the cluster, the Dashboard displays the total storage capacity to be scheduled in the Longhorn cluster.

Figure 17: Dashboard Tab of the Longhorn Console with the Total Storage Capacity



16. If you add new drives for each node later, mount them on **/var/lib/longhorn3** and repeat steps 11- 13 to extend the storage capacity.

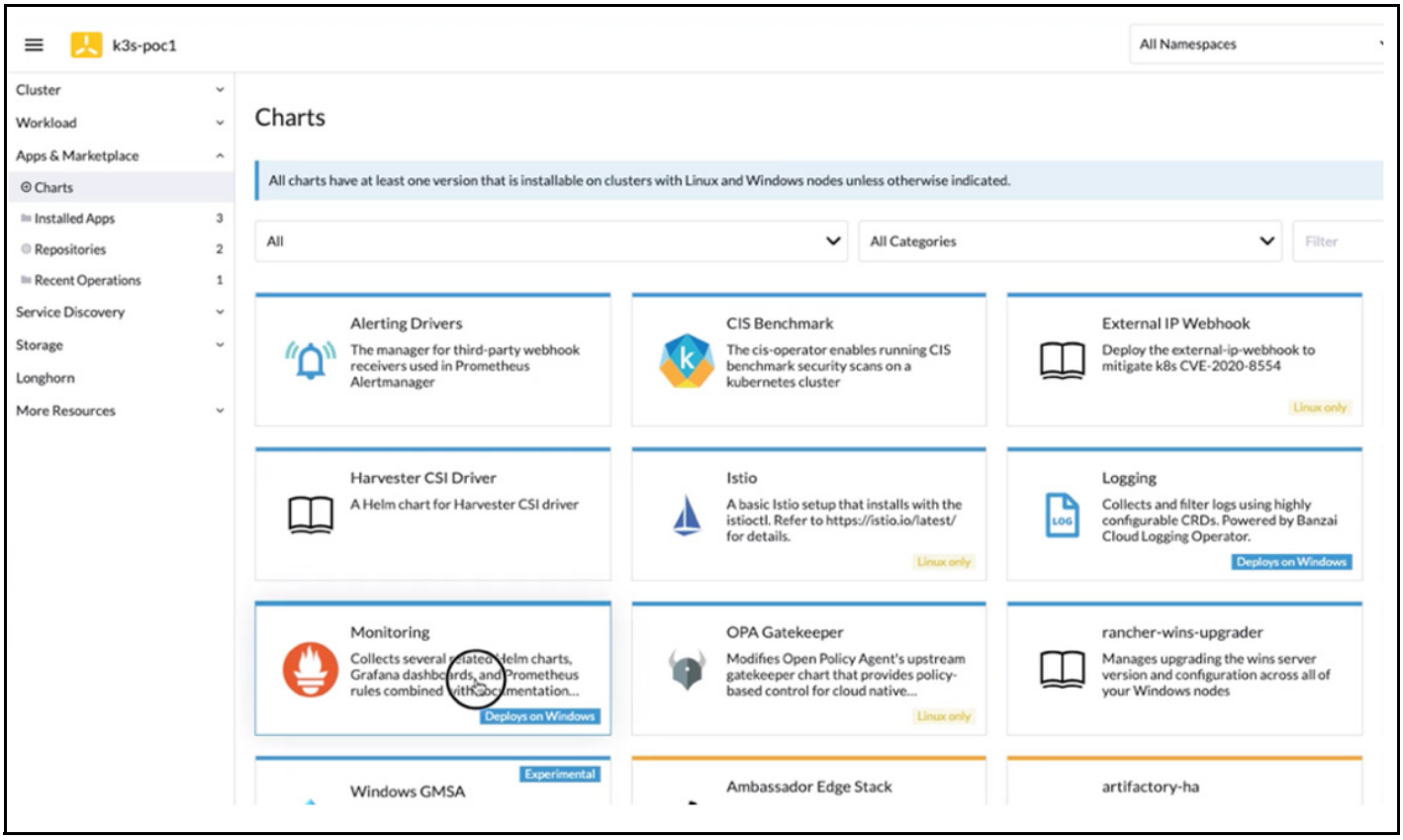
Install Prometheus and Grafana with PVC

Prerequisite:

Ensure Longhorn service is up and running to enable persistent volumes for Prometheus and Grafana.

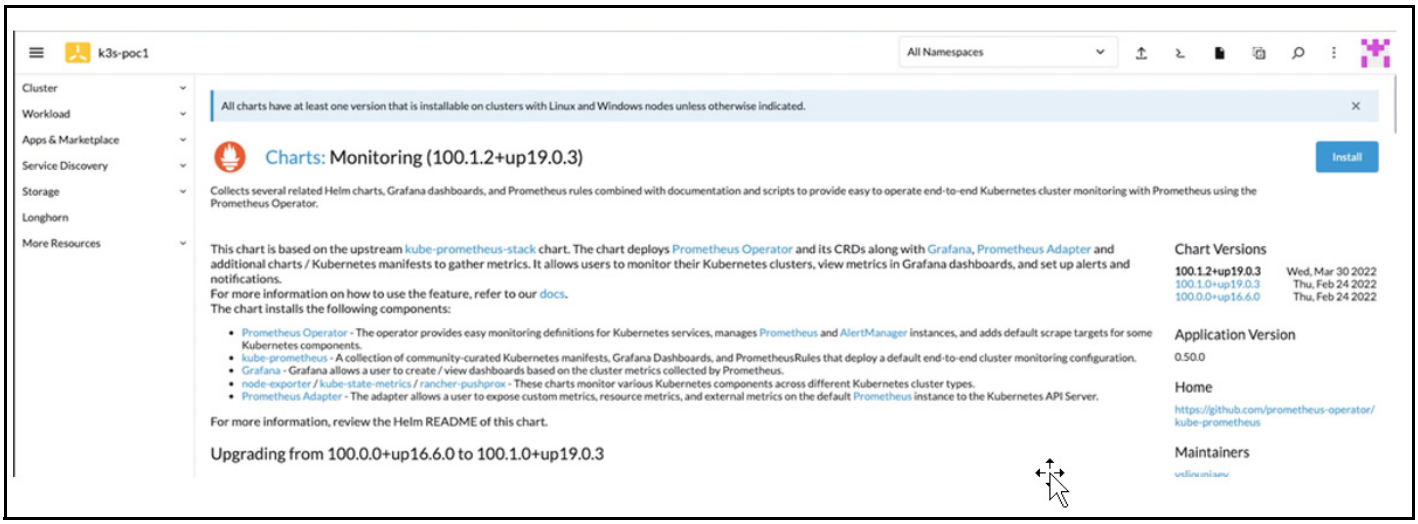
1. Click **Monitoring** from **Apps & Marketplace** > **Charts** to install Monitoring charts.

Figure 18: Charts Tab to Install Monitoring



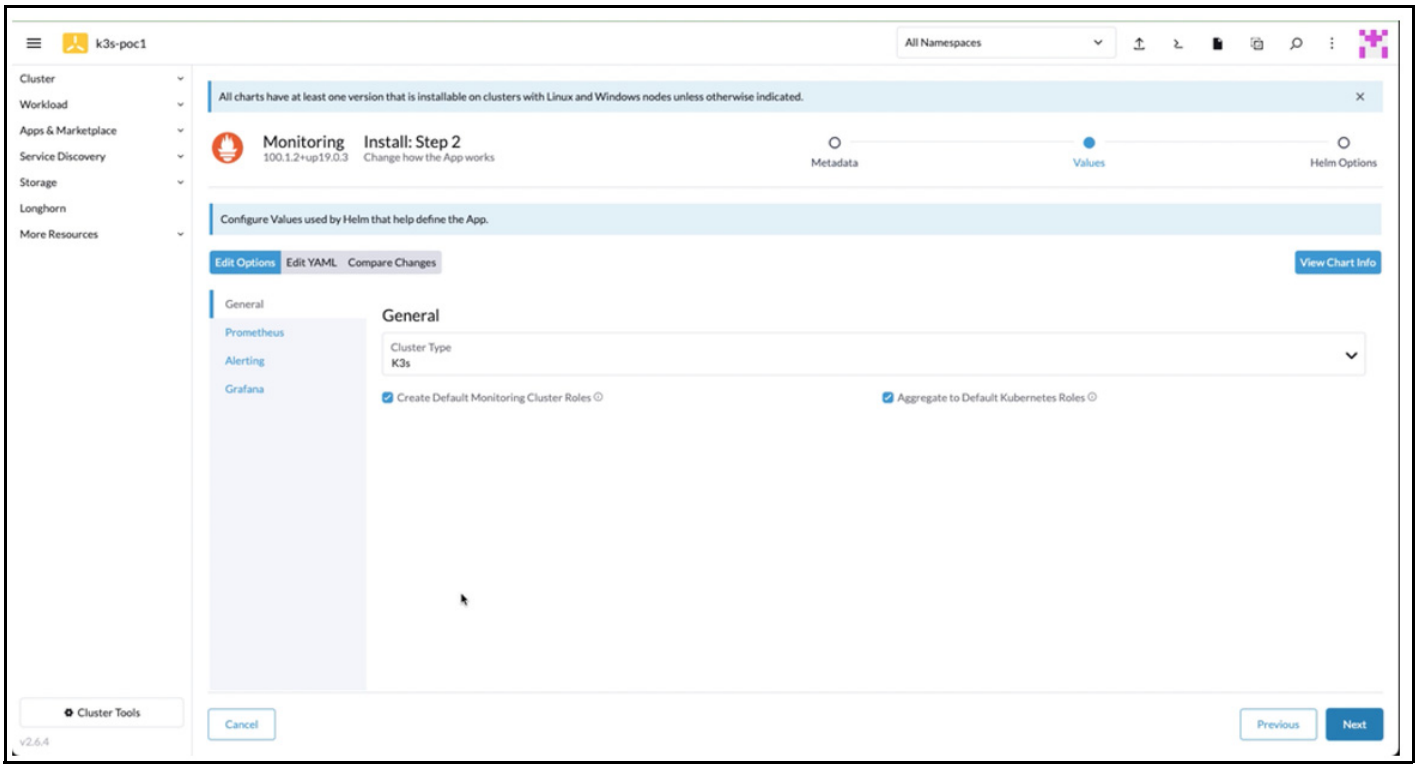
2. Click **Install** to deploy the Monitoring charts.

Figure 19: Monitoring Charts Deployment



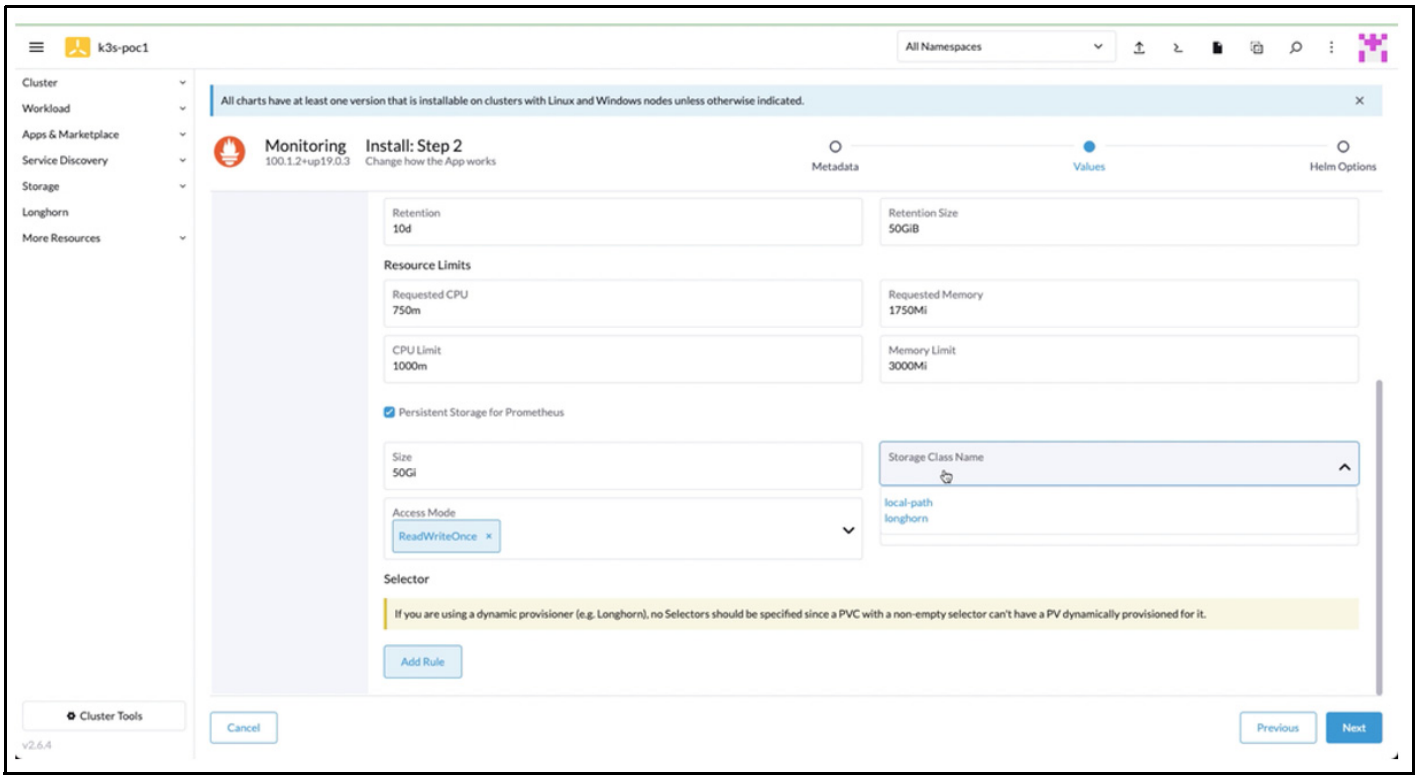
3. Under **Edit Options** tab enter the preferred customization on **Step 2** page. Click **Install** to complete the deployment.

Figure 20: Monitoring Charts Deployment: Step 2



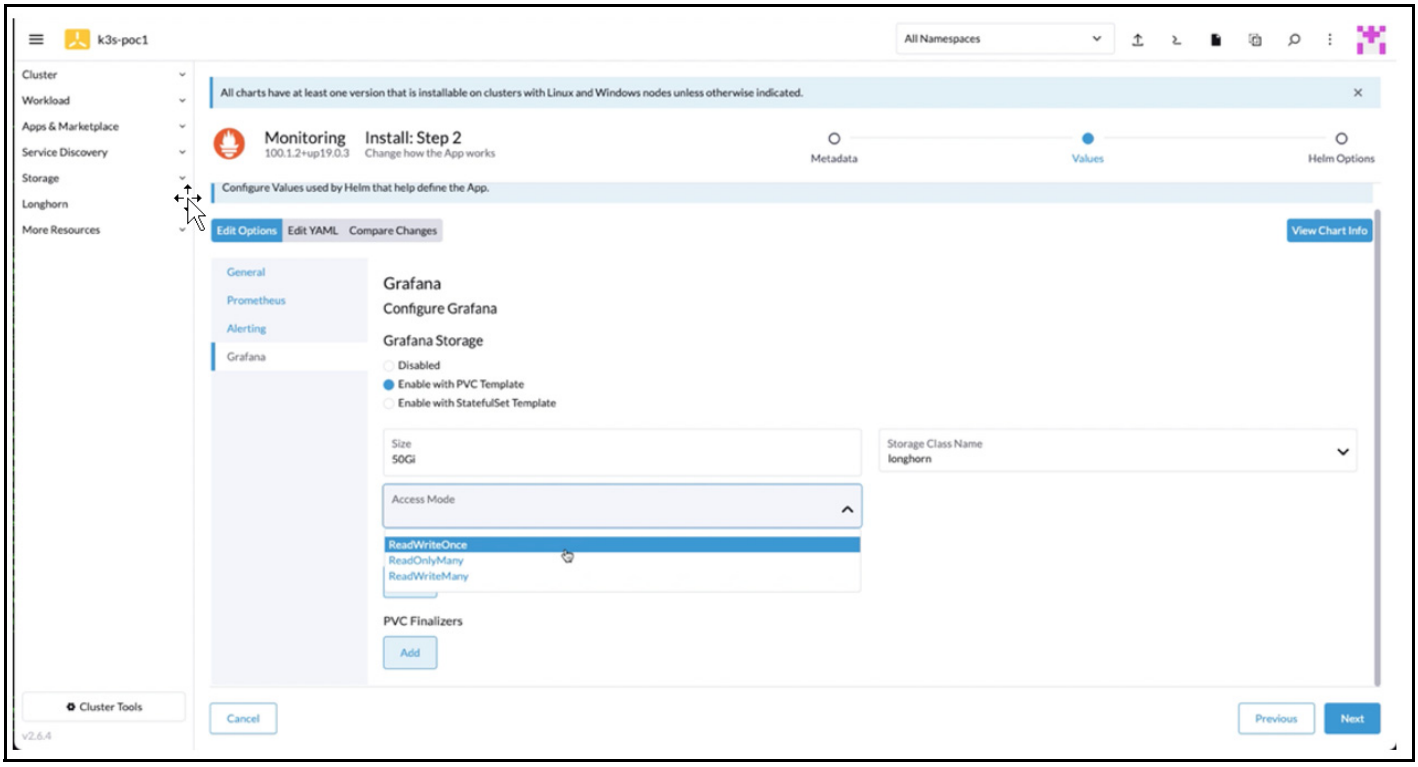
4. To configure Prometheus option,
   a. Check **Persistent Storage for Prometheus**.
   b. Choose **longhorn** from the **Storage Class Name** drop-down.

Figure 21: Prometheus Configuration



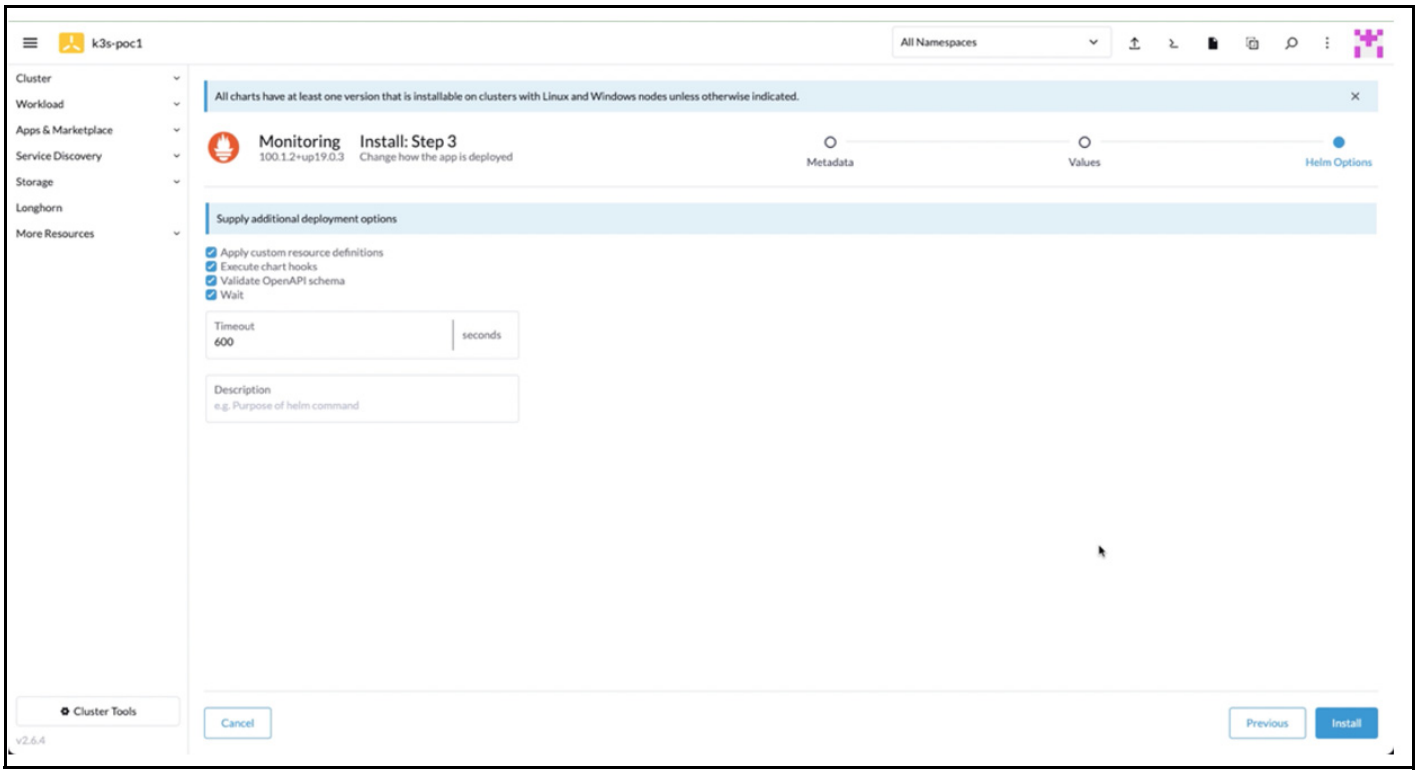
5. To configure Grafana option,
   a. Check **Enable with PVC Template**.
   b. Enter **50Gi** as the **Size** field.
   c. Choose **longhorn** from the **Storage Class Name** drop-down.
   d. Choose **ReadWriteOnce**" from the **Access Mode** drop-down.
   e. Click **Next** to Step 3.

Figure 22: Grafana Configuration



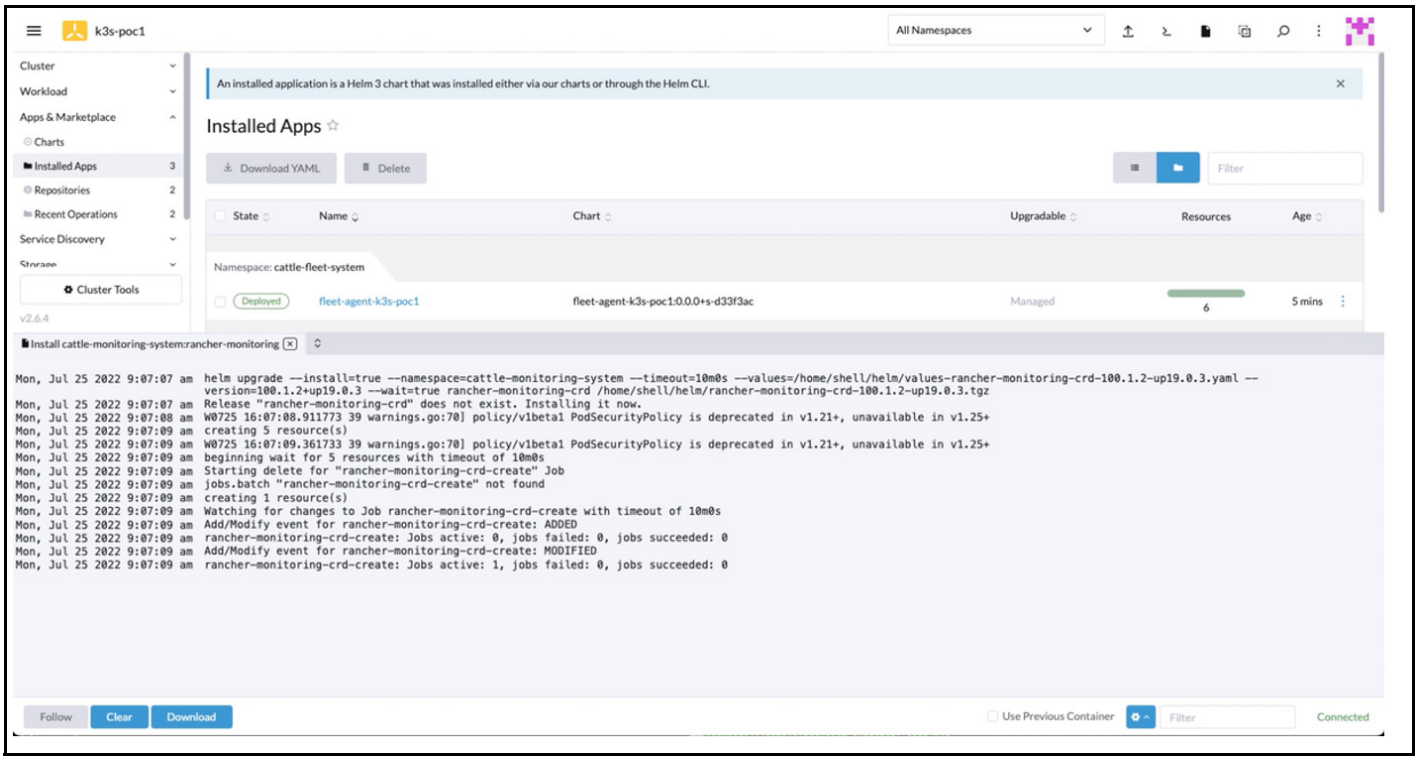
6. On Step 3, review the check boxes for additional deployment options and the timeout option. Click **Install**.

Figure 23: Additional Deployment Options



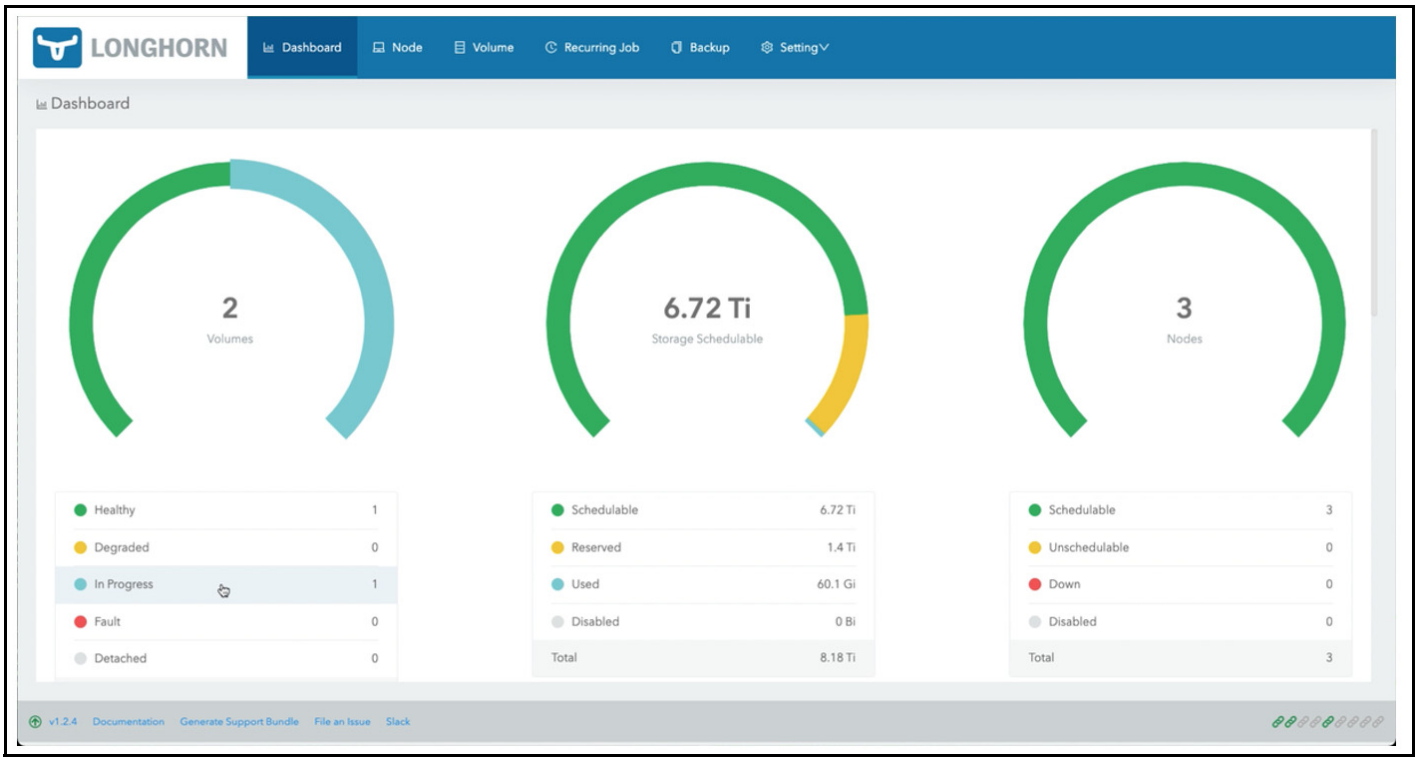
7. During installation, the **Installed Apps** page appears with the installation status.

Figure 24: Installed Apps Page with Installation Status



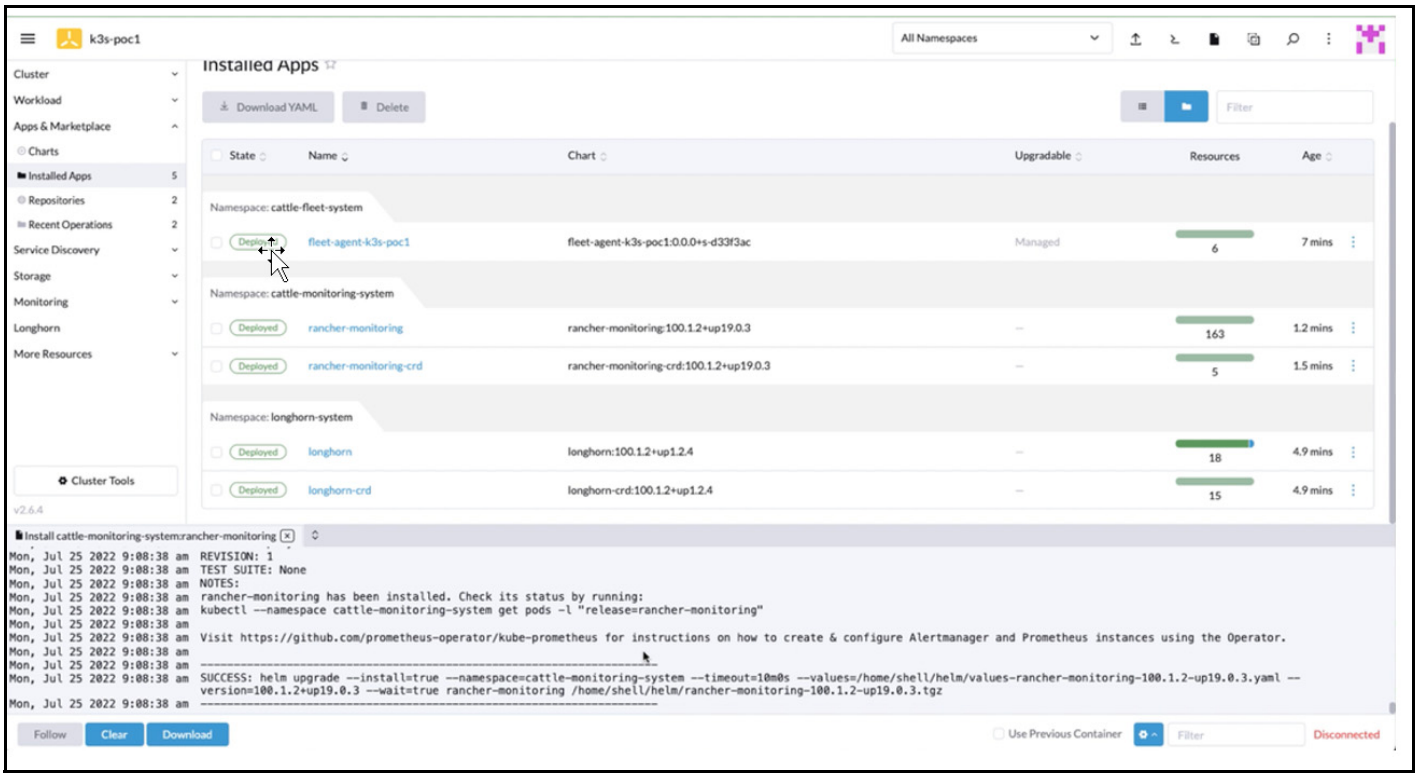
a. Check Longhorn **Dashboard**, you will see 2 volumes **In Progress**.

Figure 25: Longhorn Dashboard


LONGHORN
Dashboard
Node
Volume
Recurring Job
Backup
Setting
Dashboard
2
Volumes
6.72 Ti
Storage Schedulable
3
Nodes
Healthy 1
Degraded 0
In Progress 1
Fault 0
Detached 0
Schedulable 6.72 Ti
Reserved 1.4 Ti
Used 60.1 Gi
Disabled 0 Bi
Total 8.18 Ti
Schedulable 3
Unschedulable 0
Down 0
Disabled 0
Total 3
v1.2.4
Documentation
Generate Support Bundle
File an Issue
Slack

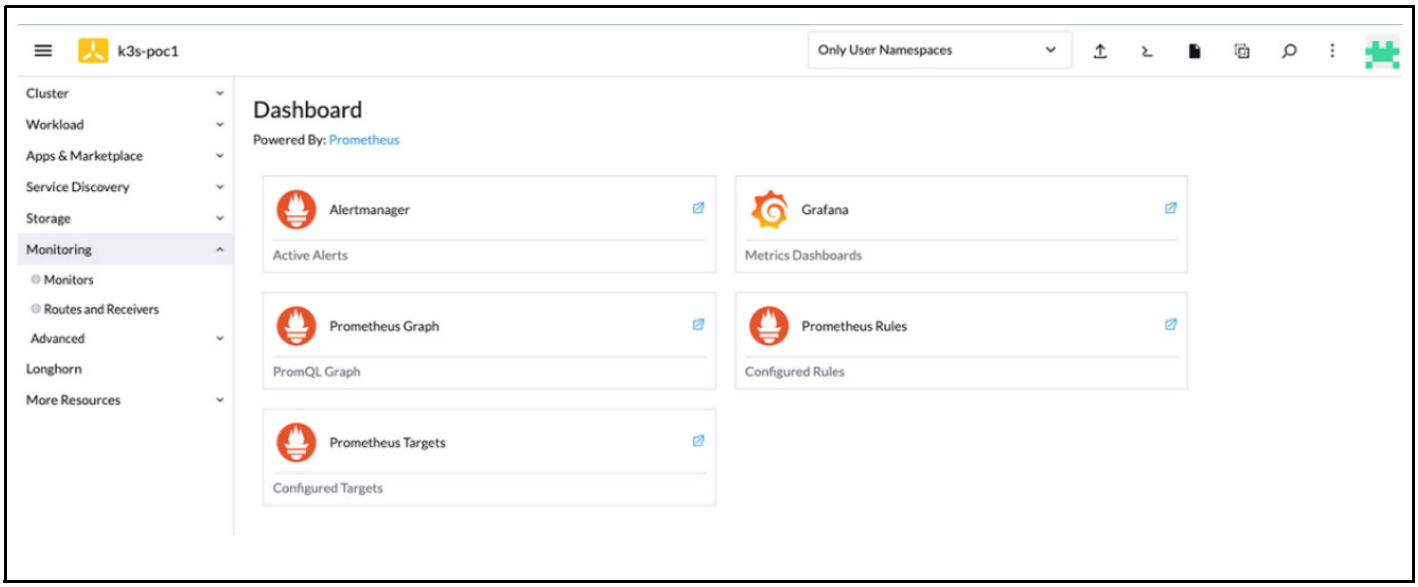
8. When the installation is complete, a SUCCESS message appears on the Installed Apps page.

Figure 26: Installed Apps Page with the Success Message



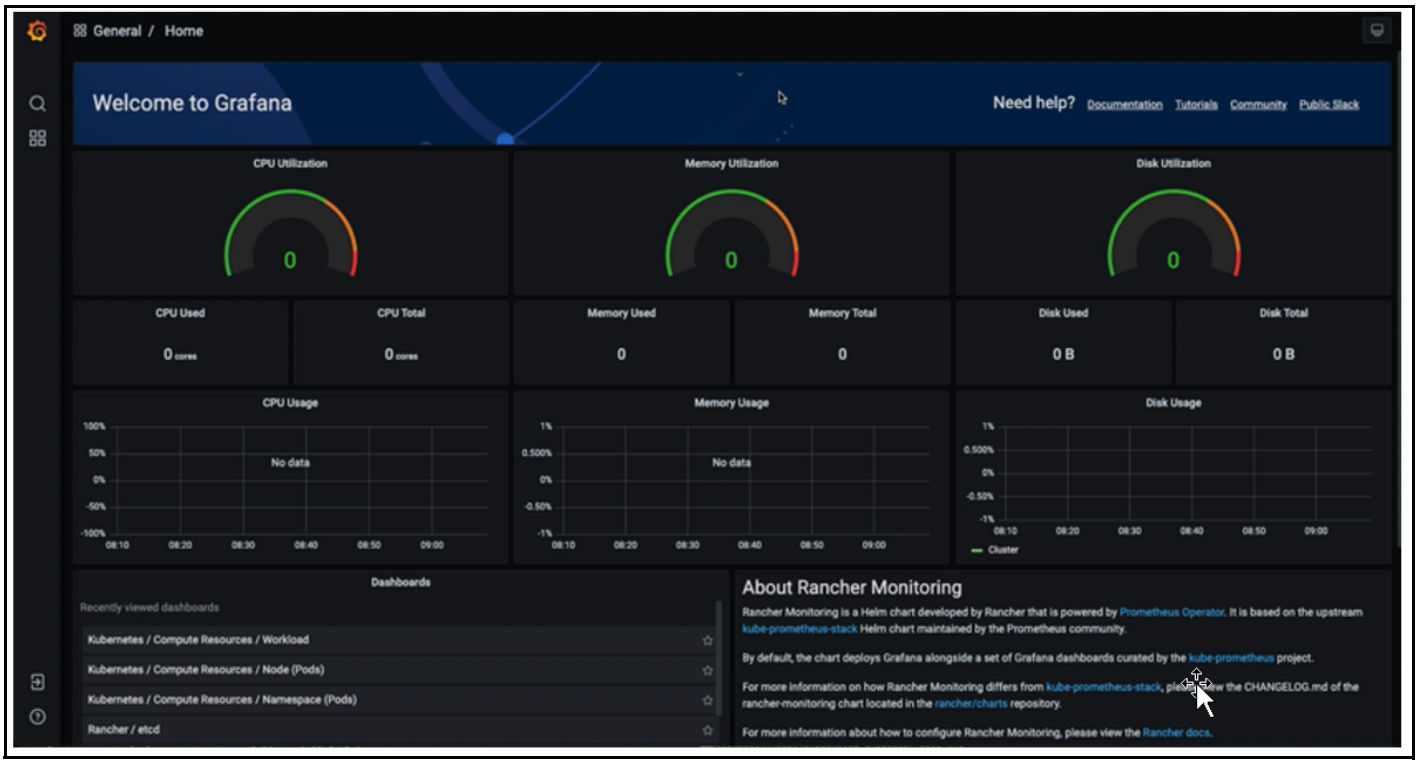
9. The Monitoring page appears on the left-side navigation bar. Click Monitoring to access the Dashboard.

Figure 27: Dashboard of Monitoring



10. Click **Grafana**.
11. The **Grafana** web application opens on a new tab of the browser.

Figure 28: Grafana Web Console



12. After a few minutes, the charts display the history of telemetries and utilizations.

Figure 29: Grafana Charts with Telemetries and Utilizations Data

Notes:

- If you want to re-install K3s on any node, clean up the node by uninstalling K3s and the drives for Longhorn storage service:

```
$ sudo su -
$ /usr/local/bin/k3s-uninstall.sh
$ umount /dev/nvme1n1 /dev/nvme2n1 /dev/nvme3n1
$ for DISK in "/dev/nvme1n1" "/dev/nvme2n1" "/dev/nvme3n1" ;
 do echo $DISK && \
 sgdisk --zap-all $DISK && \
 dd if=/dev/zero of="$DISK" bs=1M count=100 oflag=direct,dsync && \
 blkdiscard $DISK
done
```

- If you install K3s on SLE Micro v5.1 or later, reboot the system to complete the transaction update.

```
$ reboot
```

- The cluster is gracefully shutdown by the following steps:
  a. Login to the nodes through SSH or cockpit web console.

b. For root privileges, execute the sudo command.

```
$ sudo su -
#
```

c. Shutdown K3s on each node.

```
# k3s-killall.sh
```

d. Wait for the script to complete its jobs.

e. Shutdown the nodes by entering:

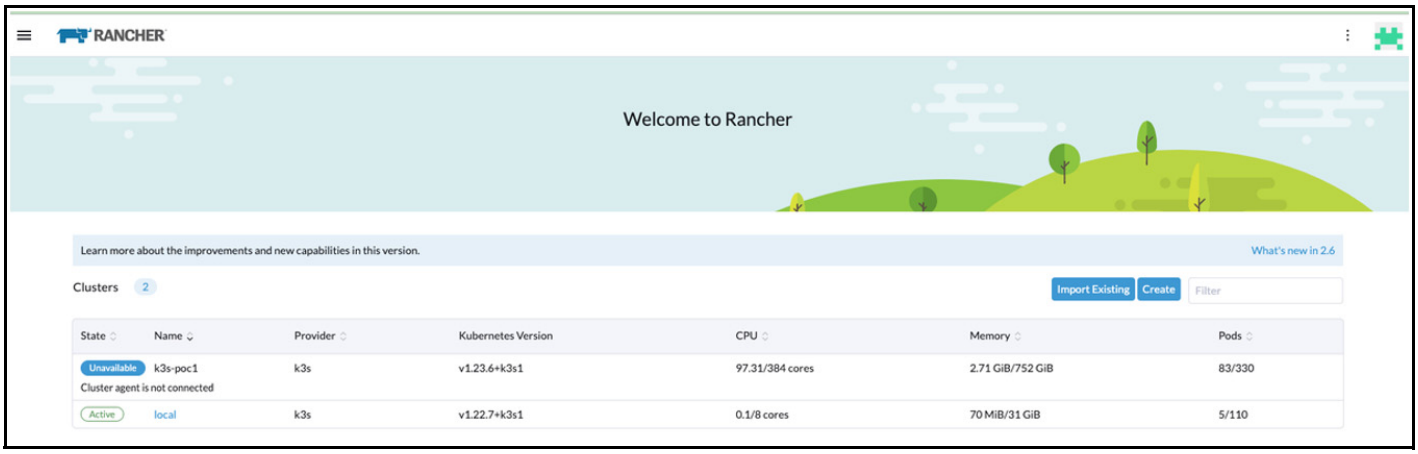
```
# poweroff
```

or

```
# shutdown -h now
```

The rancher console displays the state of the cluster is Unavailable.

Figure 30: Rancher Console



Document Revision History

ISSUE	DATE	DESCRIPTION
1.00	November 7, 2022	Initial release.

November 7, 2022

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