OpenEBS

Architecture and Design

v0.5 - Oct 2017

Prerequisites

- **Docker and Kubernetes - Namespaces, RBAC, Storage Classes, CRD, Dashboard**
- **Running Stateful Workloads with PV, PVC and Dynamic Provisioner**
- **Introduction to OpenEBS - Container Native Storage**
- **Prometheus, Node Exporter, Grafana**
- **Opentracing - Jaeger**

Design Goals and Constraints

Storage optimized for Containerized Applications

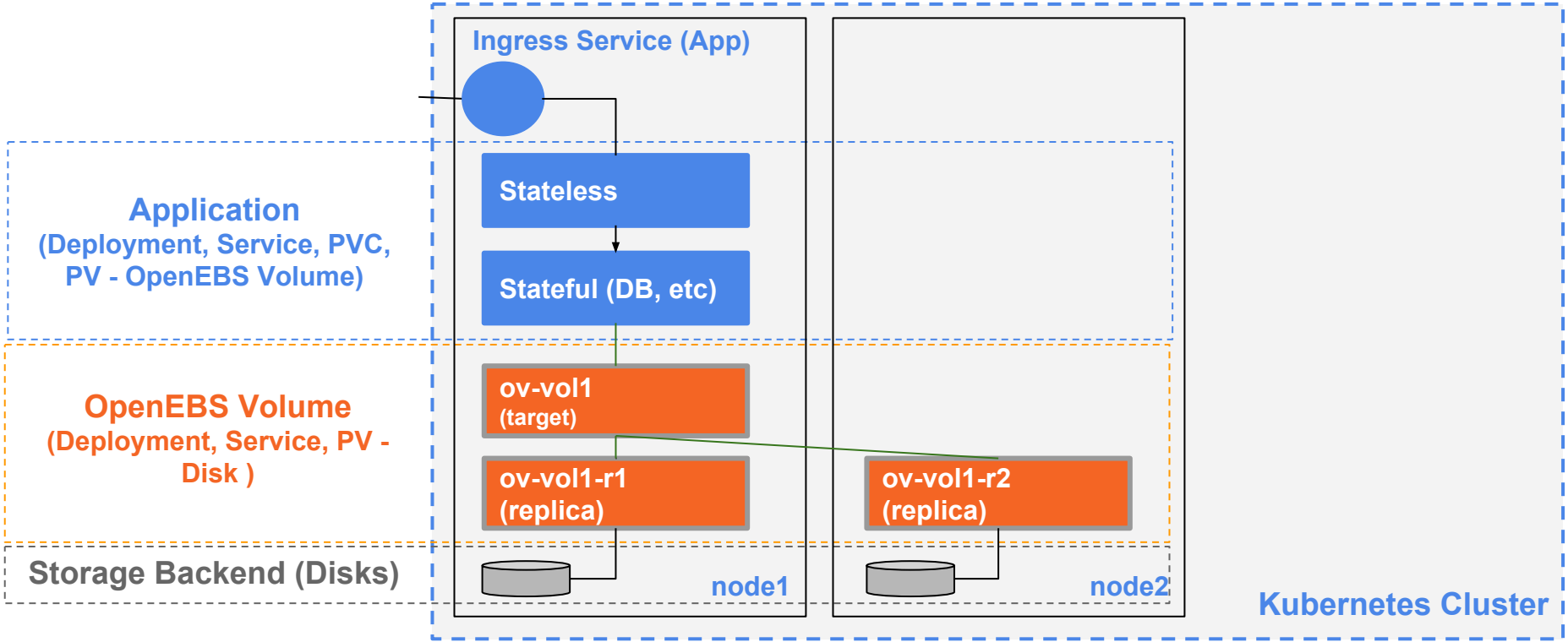
Stable, Secure and Scalable - Horizontally scalable to millions of Containers, Fault tolerant and Secure by default

Seamless integration into any private and public cloud environments. Vendor independent.

Non-disruptive software upgrades

Easy to setup. Low entry barrier. Developer and Operators Friendly.

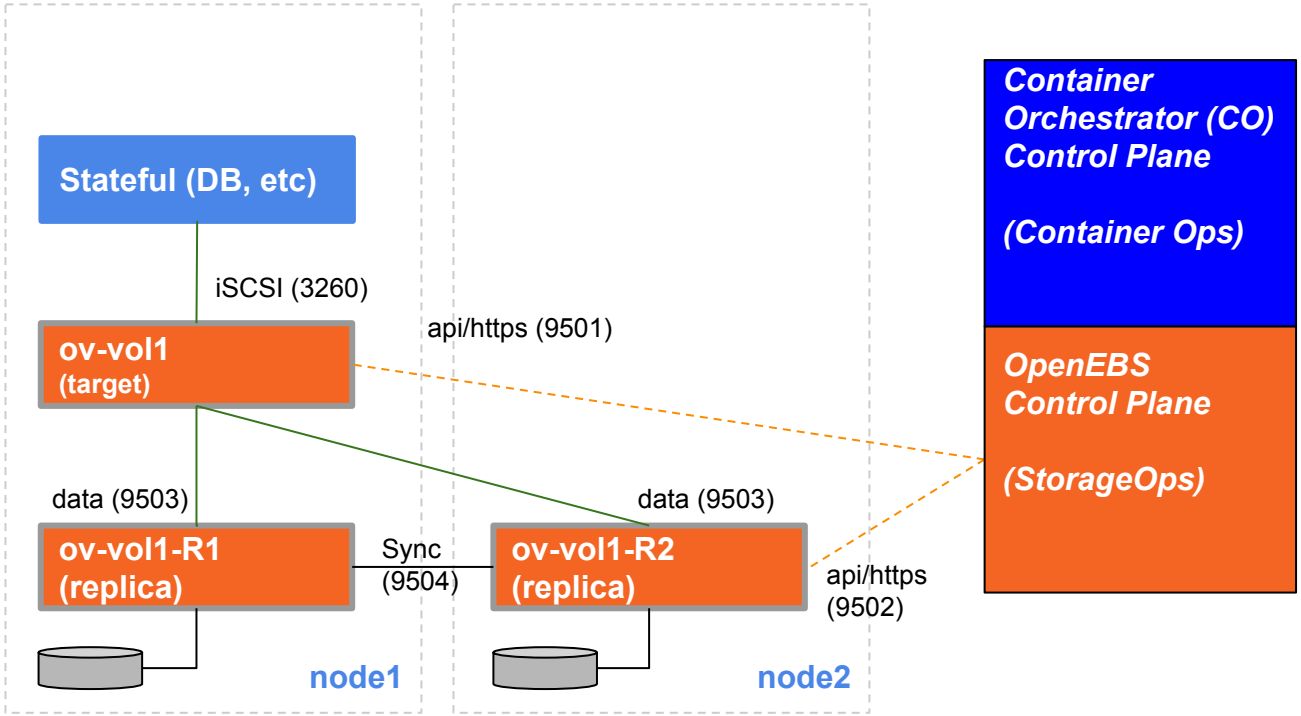
Stateful Apps using OpenEBS Volumes



OpenEBS Control Plane

OpenEBS Volume (ov) containers will be managed by:

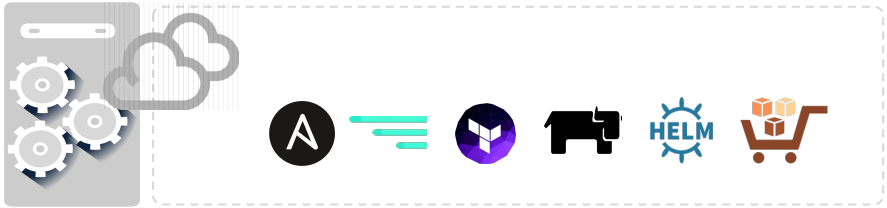
- Container Orchestrators like K8s and
- OpenEBS control plane services that specialize in storage operations.



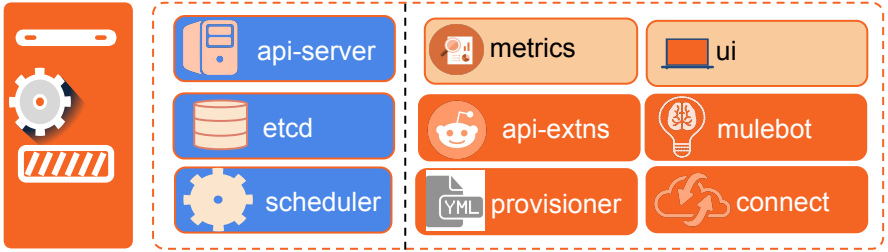
The source code for the volume containers -- target and replica also known as frontend and backend is located under ***openebs/jiva***

OpenEBS Control Plane Architecture

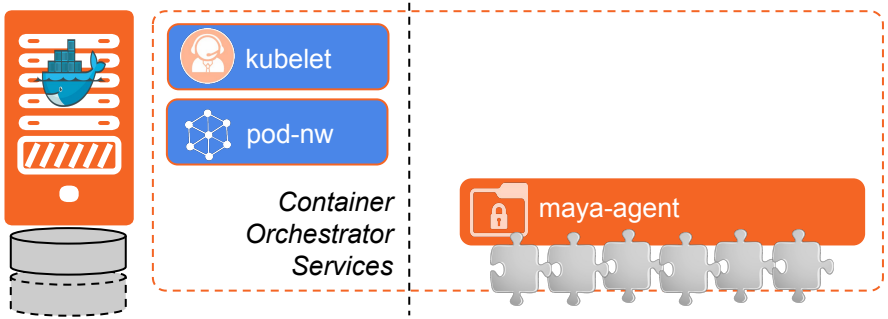
(1) Integrators

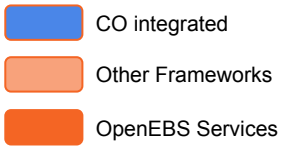


(2) Control Plane
(Cluster Services)
(aka. K8s master)

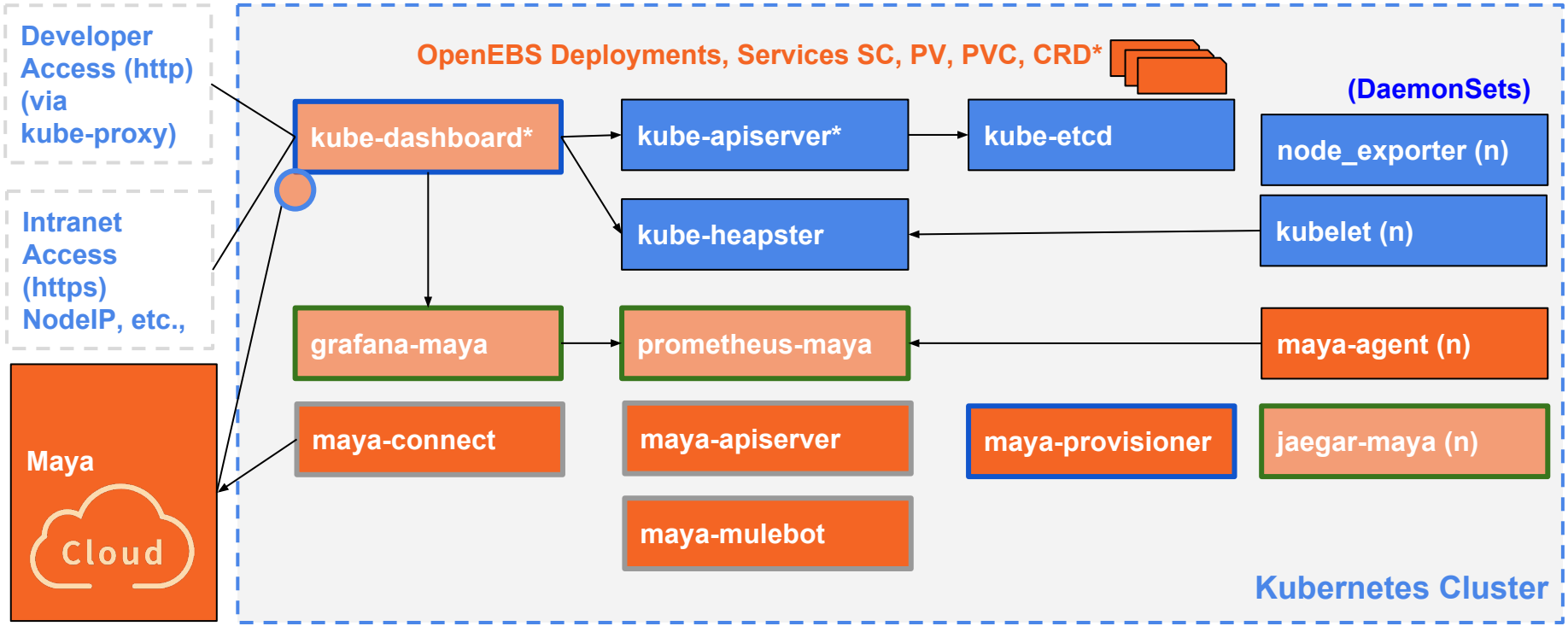


(3) Control Plane
(Node Agents)
(aka K8s DaemonSets)





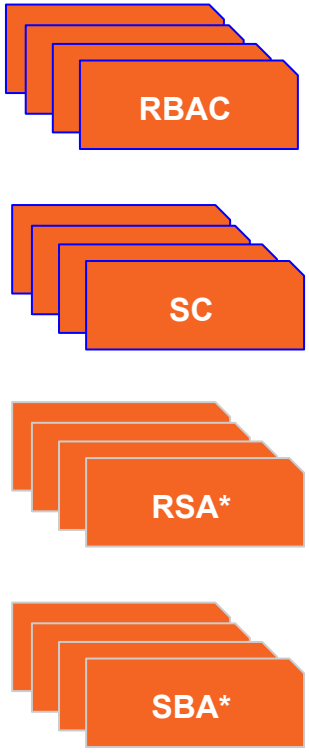
OpenEBS Control Plane converged K8s Cluster



The source code for the control plane components is located in mainly **openebs/maya** repository

OpenEBS Initialization

1. Load Configuration



2. Launch - Cluster Services

- maya-apiserver
- maya-provisioner
- maya-mulebot
- maya-connect
- prometheus-maya
- grafana-maya
- kube-dashboard*

3. Launch - Node Services

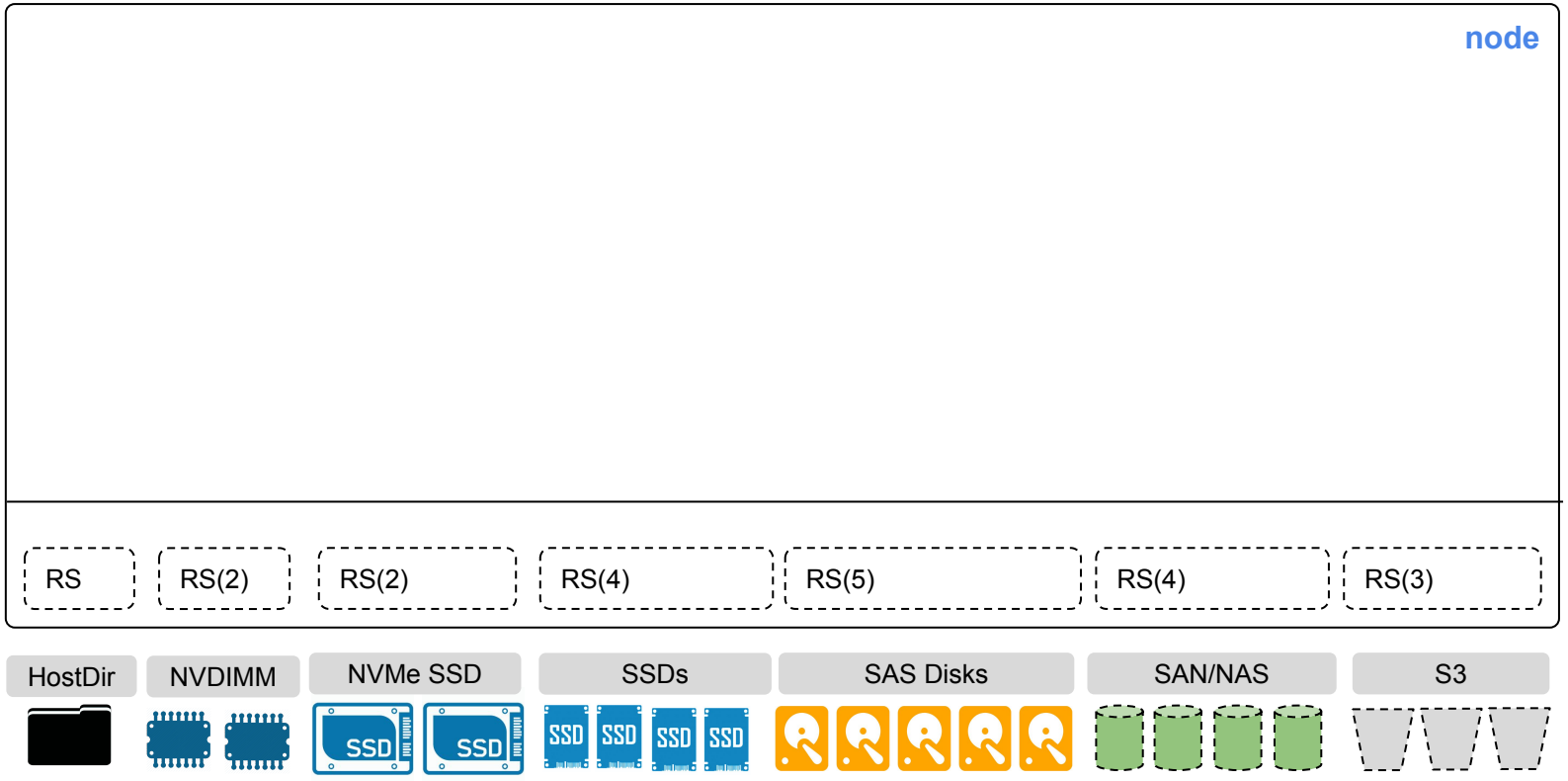
- node_exporter (n)
- maya-agent (n)
- jaegar-maya (n)

4. Verify Status via

- mayactl

Storage Schema - Raw Storage

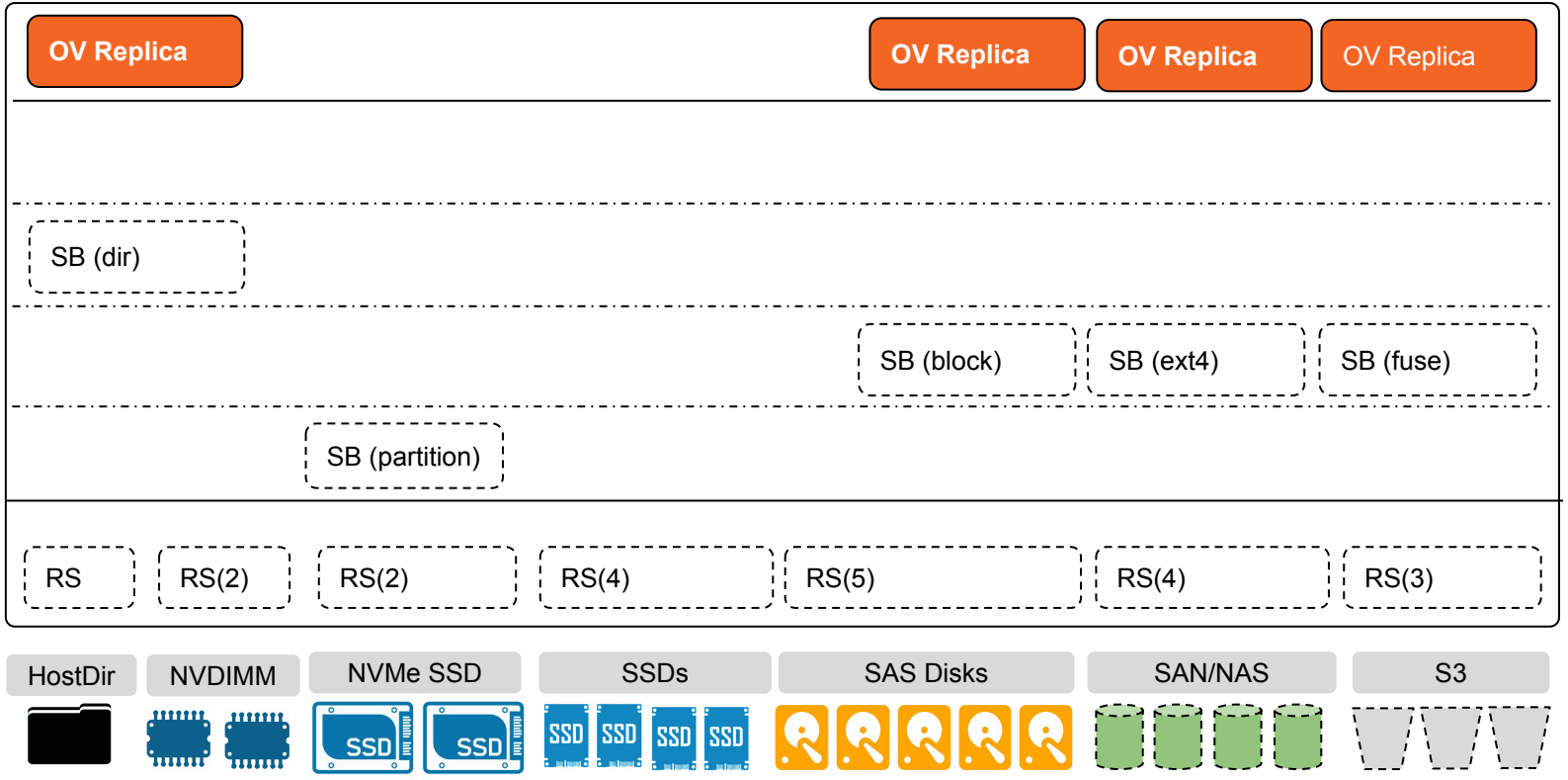
Raw Storage (RS), logical representation of the underlying storage attached to a node.



Storage Schema - Storage Backend

Storage Backend (SB) represents a carved/partitioned unit of storage that will is allocated to OpenEBS Volume Replica.

Raw Storage (RS), representing a single instance of the underlying storage type.



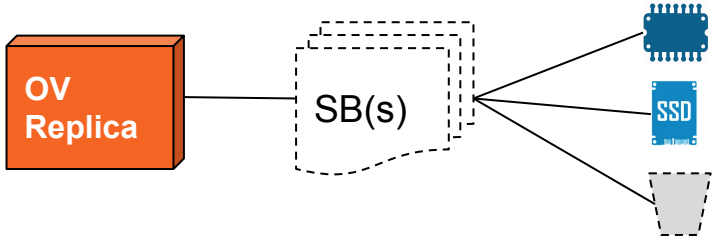
Storage Schema - Usage

1. DevOps admin creates the SBA and RSA yaml files and feeds into the K8s DB.

2. maya-agent will look for the RSA that are assigned to it and initializes the adaptor discovery logic.

3. For the discovered disks, maya-agent will create the RS and may also create some SBs (like nvmedimm namespaces) using the SBAs (zpool, lvm)

4. In K8s/maya-apiserver will convert SBs into PVs before attaching to the OV replica containers.



Storage Backend (**SB**)

- **Name**
- **Node** - where it is currently attached (local disks) or mounted (remote -disks).
- **Type** - local disks, iscsi-disk, gpd, aws, nvme, nvdimm
- **ParentSB** (none - or is this accessed as partition)
- **AccessLayerType : ext4, zvol, raw-block.**
- **Params** specific to type
- **UsedBy**

YAML

Storage Backend Adaptors (**SBA**)

- **Name**
- **Node Filter** - which nodes does this apply to
- **Type** - local disks, ext4, zpool, lvm
- **Params** specific to type:

Raw (RS) -- actual disk entity or a partition -- raw storage that needs managed per node

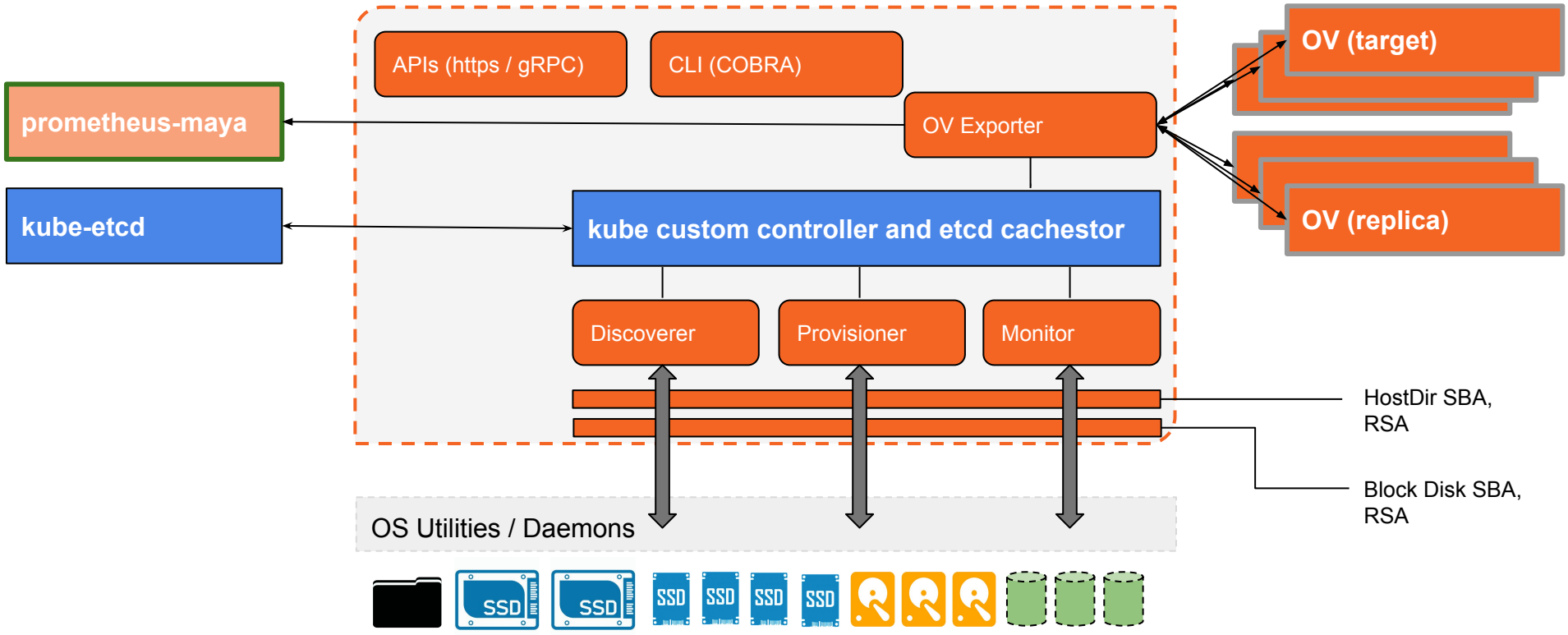
---

YAML

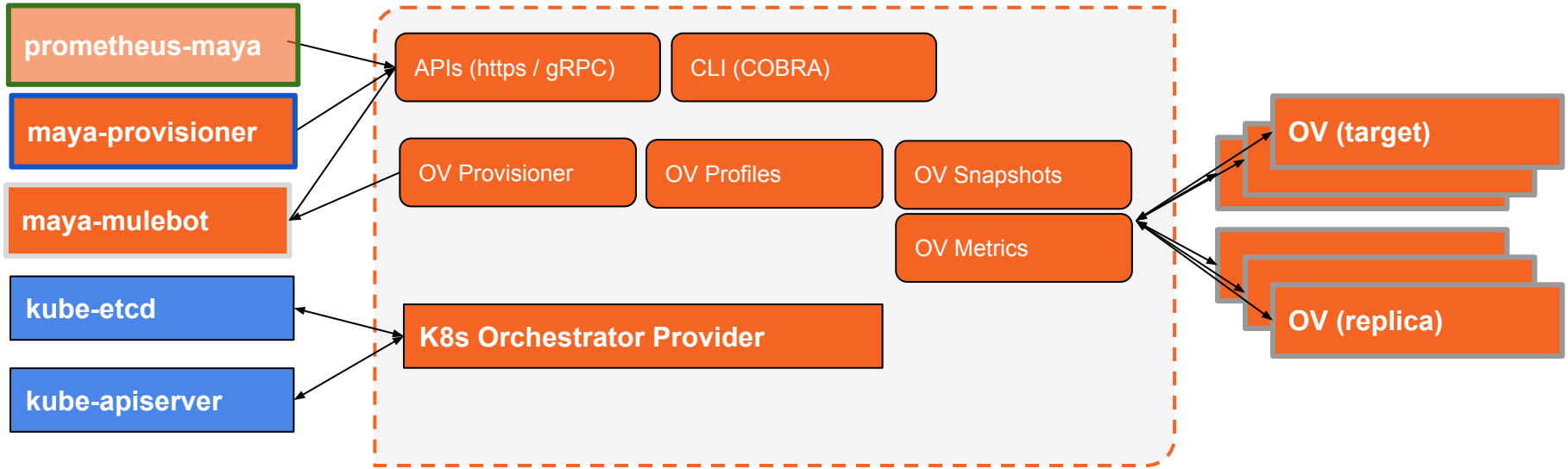
Raw Storage Adaptor (**RSA**)

- **Name**
- **Node** - where it is required
- **Type** - nvme, nvdimm, aws etc.,
- Paramaeters:
  - Filesystem (with directory like /var/openebs)
  - local disks
    - Block device filters
  - K8s - local disk manager
  - OpenEBS iSCSI - peer node disks (?)
  - Auto Provisioner-gpd, aws, external SAN
    - Credentials
    - Zonal

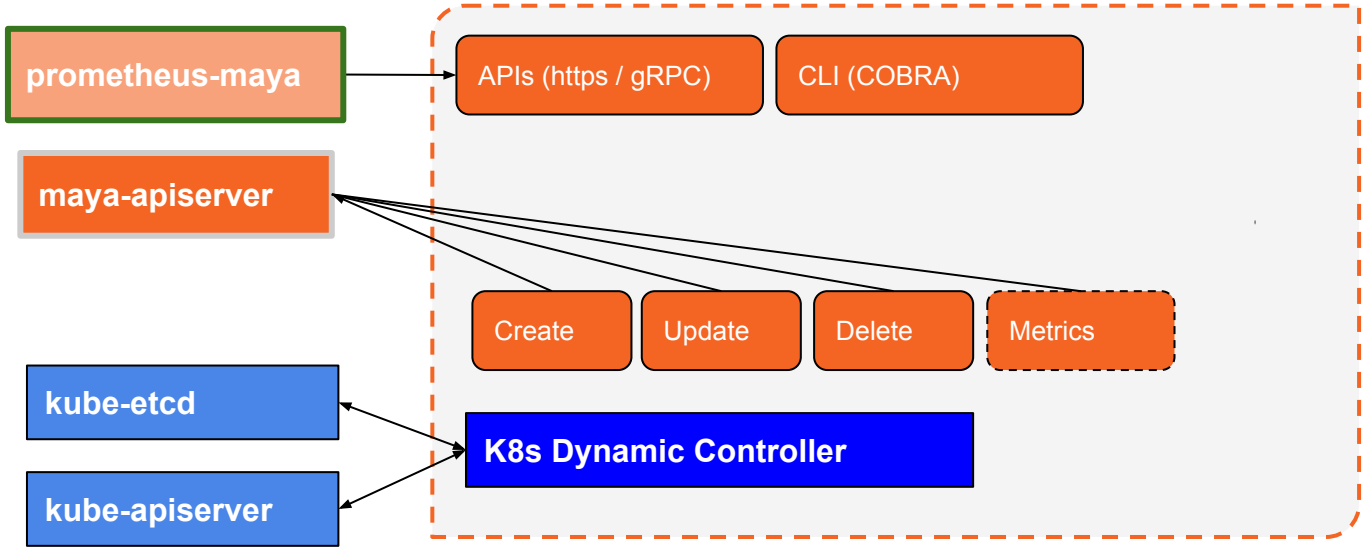
maya-agent


APIs (https / gRPC)
CLI (COBRA)
prometheus-maya
OV Exporter
OV (target)
OV (replica)
kube-etcd
kube custom controller and etcd cachestor
Discoverer
Provisioner
Monitor
HostDir SBA, RSA
Block Disk SBA, RSA
OS Utilities / Daemons
SSD
SSD
SSD
SSD
SSD
SSD

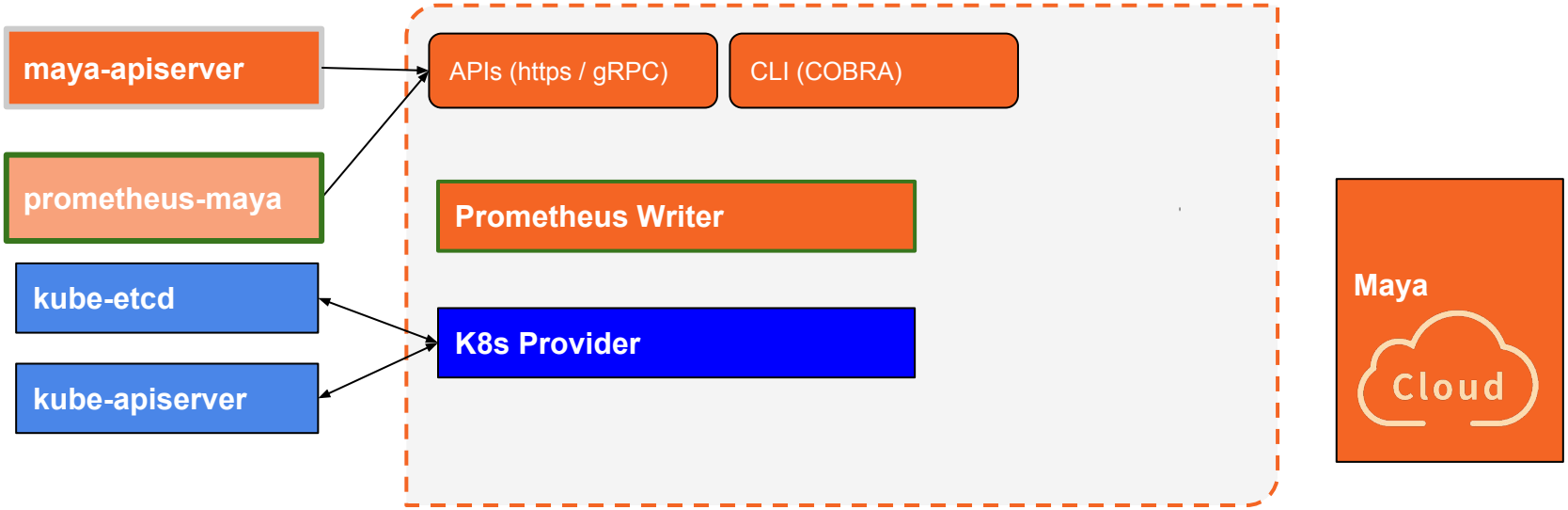
maya-apiserver



maya-provisioner



maya-connect (TBD)



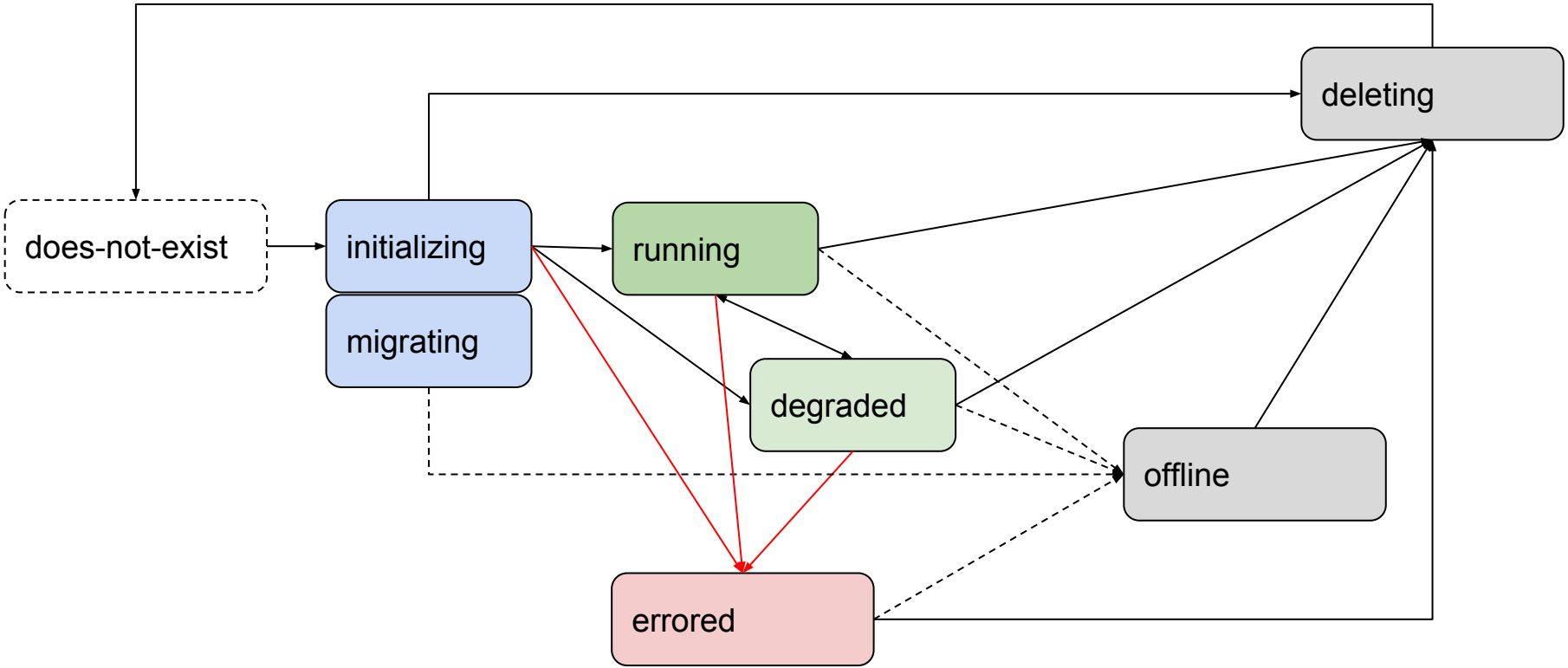
maya-mulebot (TBD)

Workflow

State Diagrams

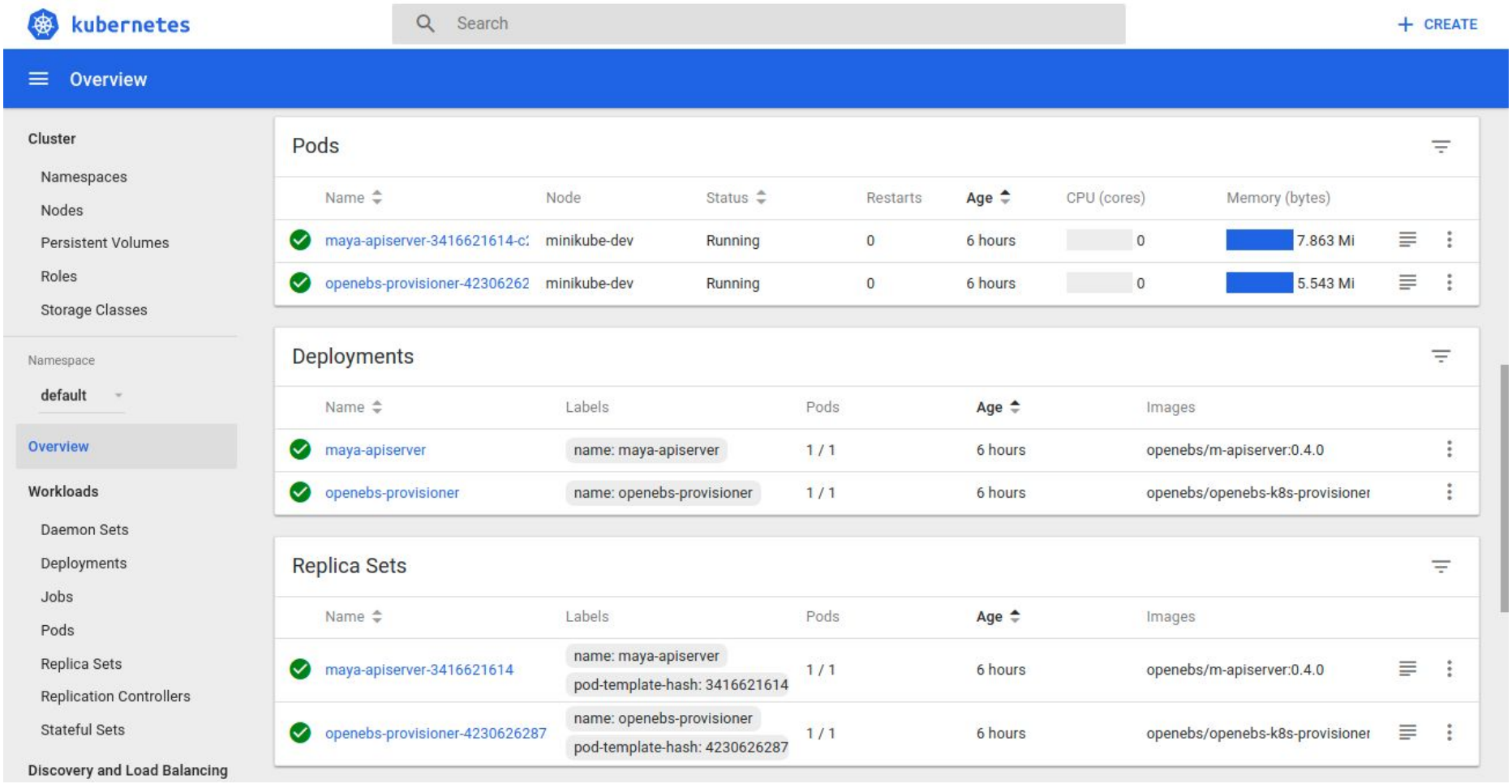
Sequence Diagrams

OpenEBS Volume - State Diagram



User Interface

Kubernetes Dashboard Extensions


kubernetes
Search
+ CREATE
Overview
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Deployments
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Discovery and Load Balancing
Pods
Name
Node
Status
Restarts
Age
CPU (cores)
Memory (bytes)
maya-apiserver-3416621614-c
minikube-dev
Running
0
6 hours
0
7.863 Mi
openebs-provisioner-42306262
minikube-dev
Running
0
6 hours
0
5.543 Mi
Deployments
Name
Labels
Pods
Age
Images
maya-apiserver
name: maya-apiserver
1 / 1
6 hours
openebs/m-apiserver:0.4.0
openebs-provisioner
name: openebs-provisioner
1 / 1
6 hours
openebs/openebs-k8s-provisioner
Replica Sets
Name
Labels
Pods
Age
Images
maya-apiserver-3416621614
name: maya-apiserver
pod-template-hash: 3416621614
1 / 1
6 hours
openebs/m-apiserver:0.4.0
openebs-provisioner-4230626287
name: openebs-provisioner
pod-template-hash: 4230626287
1 / 1
6 hours
openebs/openebs-k8s-provisioner

kubernetes

Search

+ CREATE

Workloads > Pods > maya-apiserver-3416621614-c2116

EXEC LOGS EDIT DELETE

Cluster

- Namespaces
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- Storage Classes

Namespace

default

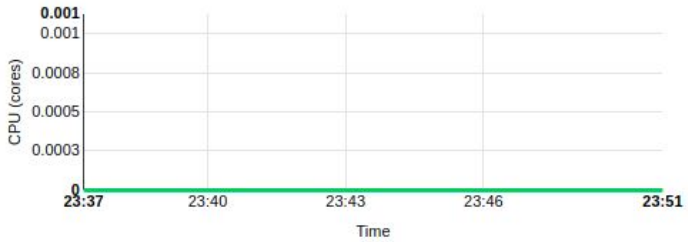
Overview

Workloads

- Daemon Sets
- Deployments
- Jobs
- Pods
- Replica Sets
- Replication Controllers
- Stateful Sets

Discovery and Load Balancing

CPU usage



Memory usage

Details

Name: maya-apiserver-3416621614-c2116

Namespace: default

Labels: name: maya-apiserver pod-template-hash: 3416621614

Annotations: Created by: ReplicaSet maya-apiserver-3416621614

Creation time: 2017-10-12T11:46

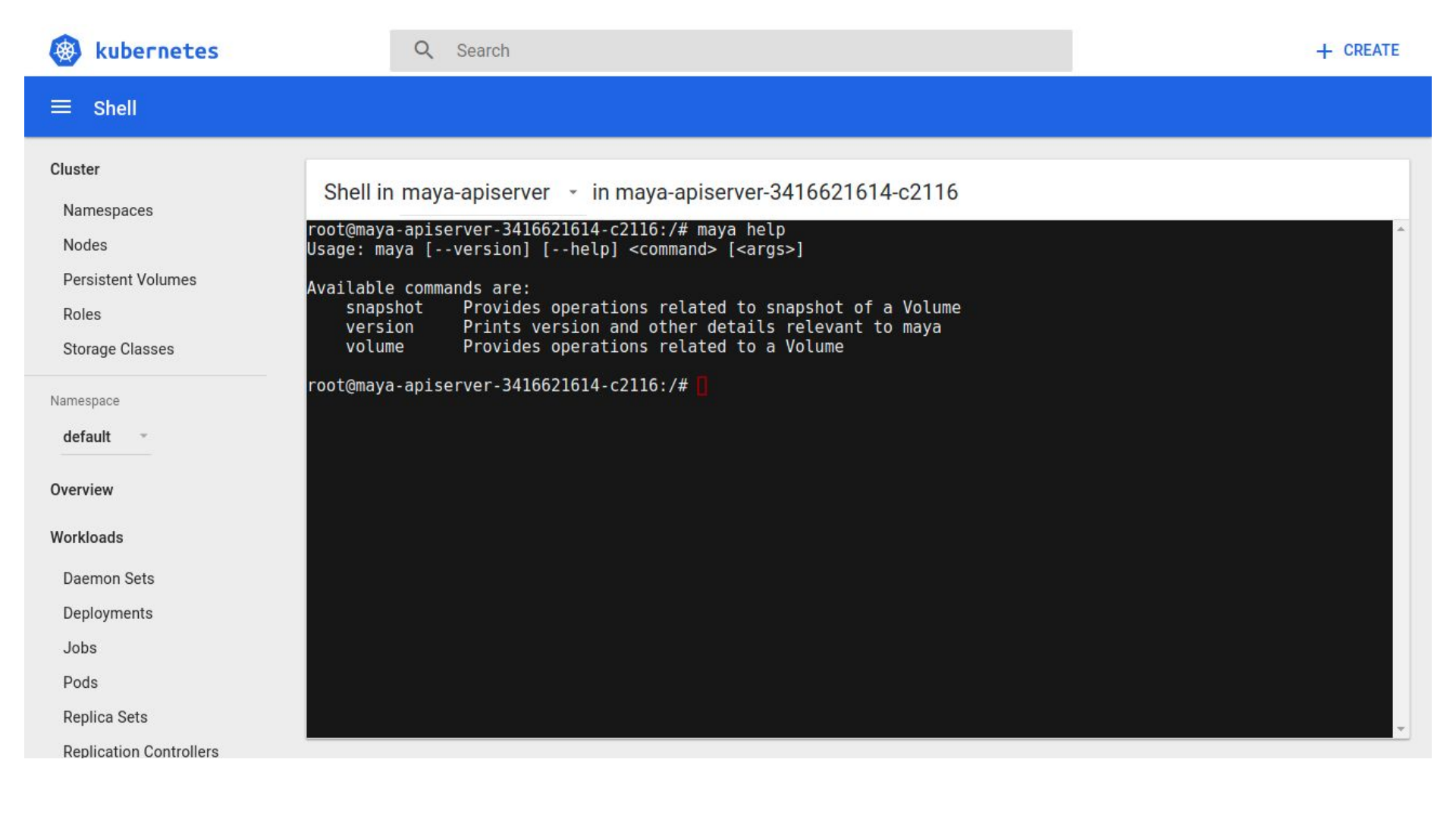
Status: Running

Network

Node: minikube-dev

IP: 172.17.0.6

Containers


kubernetes
Search
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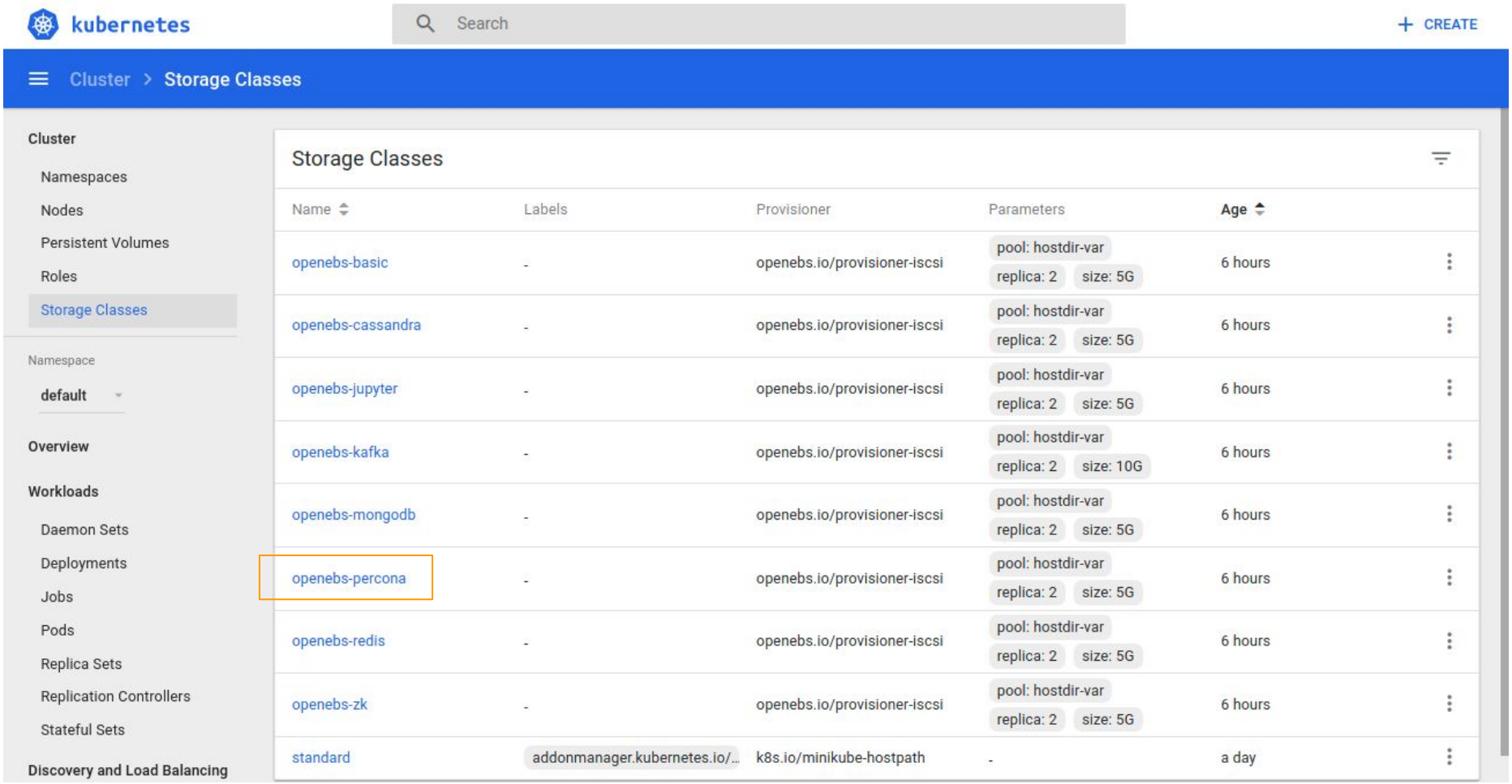
Replication Controllers
Shell in maya-apiserver in maya-apiserver-3416621614-c2116
root@maya-apiserver-3416621614-c2116:/# maya help
Usage: maya [--version] [--help] <command> [<args>]
Available commands are:
snapshot Provides operations related to snapshot of a Volume
version Prints version and other details relevant to maya
volume Provides operations related to a Volume
root@maya-apiserver-3416621614-c2116:/#


kubernetes
Search
+ CREATE
Cluster > Storage Classes
Cluster
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Daemon Sets
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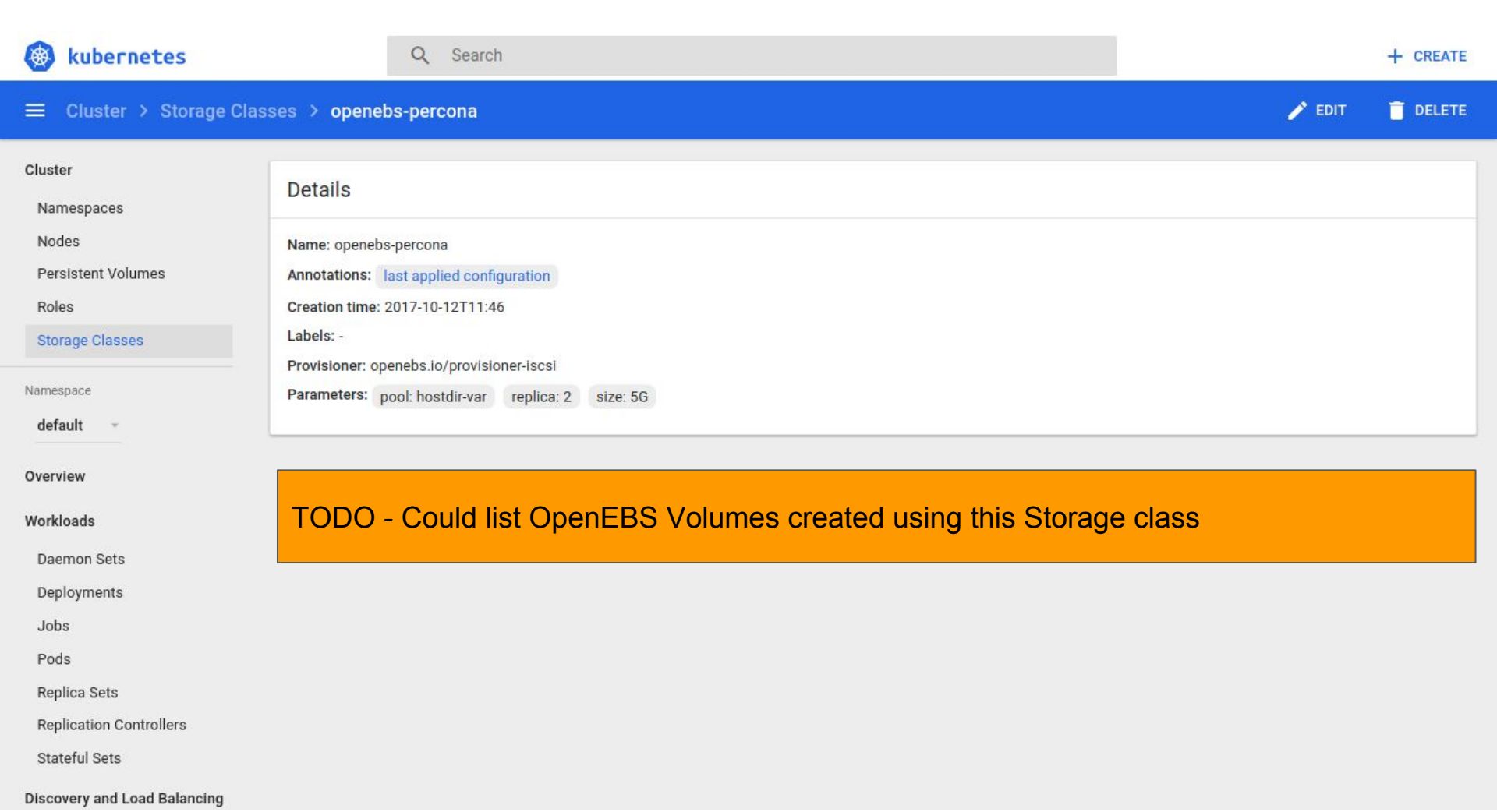
Replica Sets
Replication Controllers
Stateful Sets
Discovery and Load Balancing
Storage Classes
Name
Labels
Provisioner
Parameters
Age
openebs-basic - openebs.io/provisioner-iscsi pool: hostdir-var replica: 2 size: 5G 6 hours
openebs-cassandra - openebs.io/provisioner-iscsi pool: hostdir-var replica: 2 size: 5G 6 hours
openebs-jupyter - openebs.io/provisioner-iscsi pool: hostdir-var replica: 2 size: 5G 6 hours
openebs-kafka - openebs.io/provisioner-iscsi pool: hostdir-var replica: 2 size: 10G 6 hours
openebs-mongodb - openebs.io/provisioner-iscsi pool: hostdir-var replica: 2 size: 5G 6 hours
openebs-percona - openebs.io/provisioner-iscsi pool: hostdir-var replica: 2 size: 5G 6 hours
openebs-redis - openebs.io/provisioner-iscsi pool: hostdir-var replica: 2 size: 5G 6 hours
openebs-zk - openebs.io/provisioner-iscsi pool: hostdir-var replica: 2 size: 5G 6 hours
standard addonmanager.kubernetes.io/... k8s.io/minikube-hostpath - a day


kubernetes
Search
CREATE
Cluster > Storage Classes > openebs-percona
EDIT
DELETE
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default
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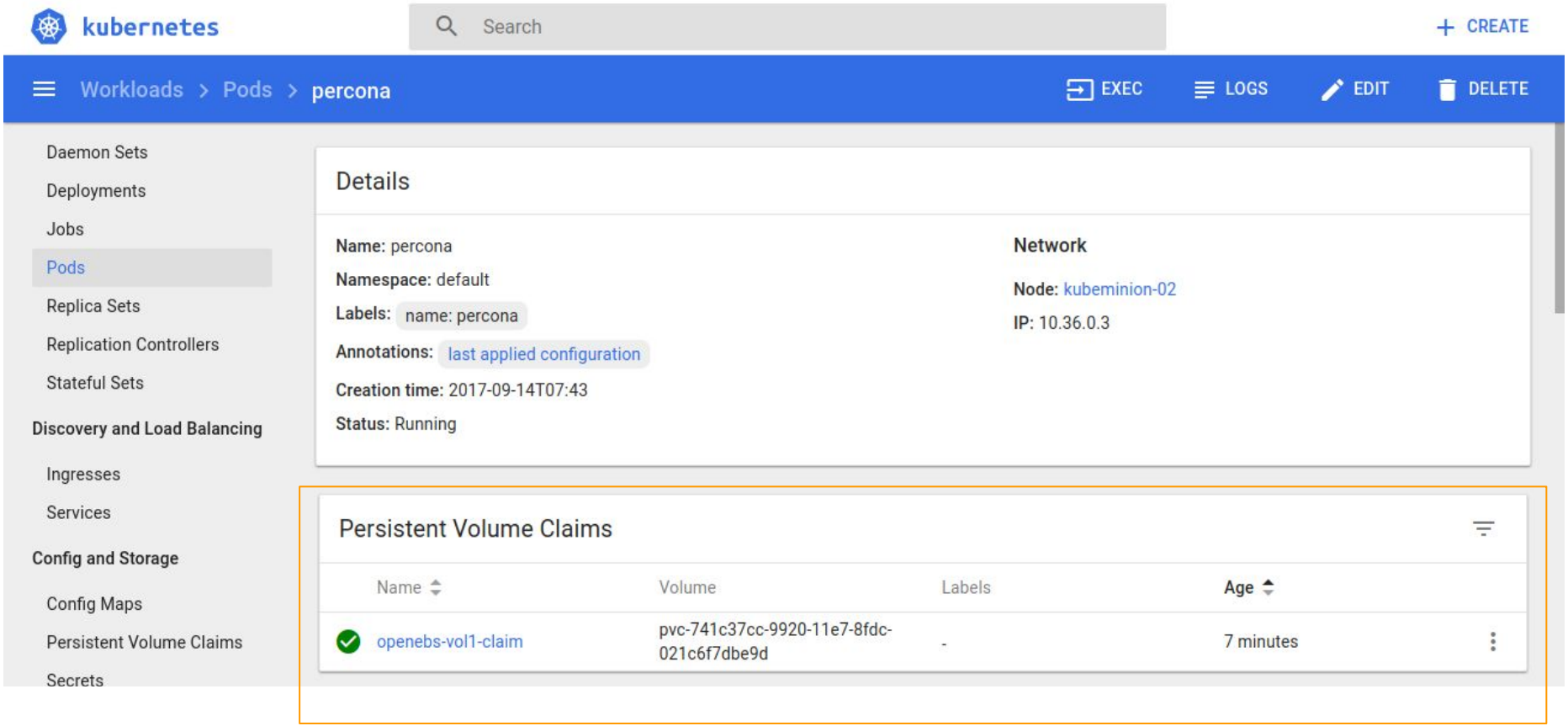
Discovery and Load Balancing
Details
Name: openebs-percona
Annotations: last applied configuration
Creation time: 2017-10-12T11:46
Labels: -
Provisioner: openebs.io/provisioner-iscsi
Parameters: pool: hostdir-var replica: 2 size: 5G
TODO - Could list OpenEBS Volumes created using this Storage class


kubernetes
Search
CREATE
Workloads > Pods > percona
EXEC
LOGS
EDIT
DELETE
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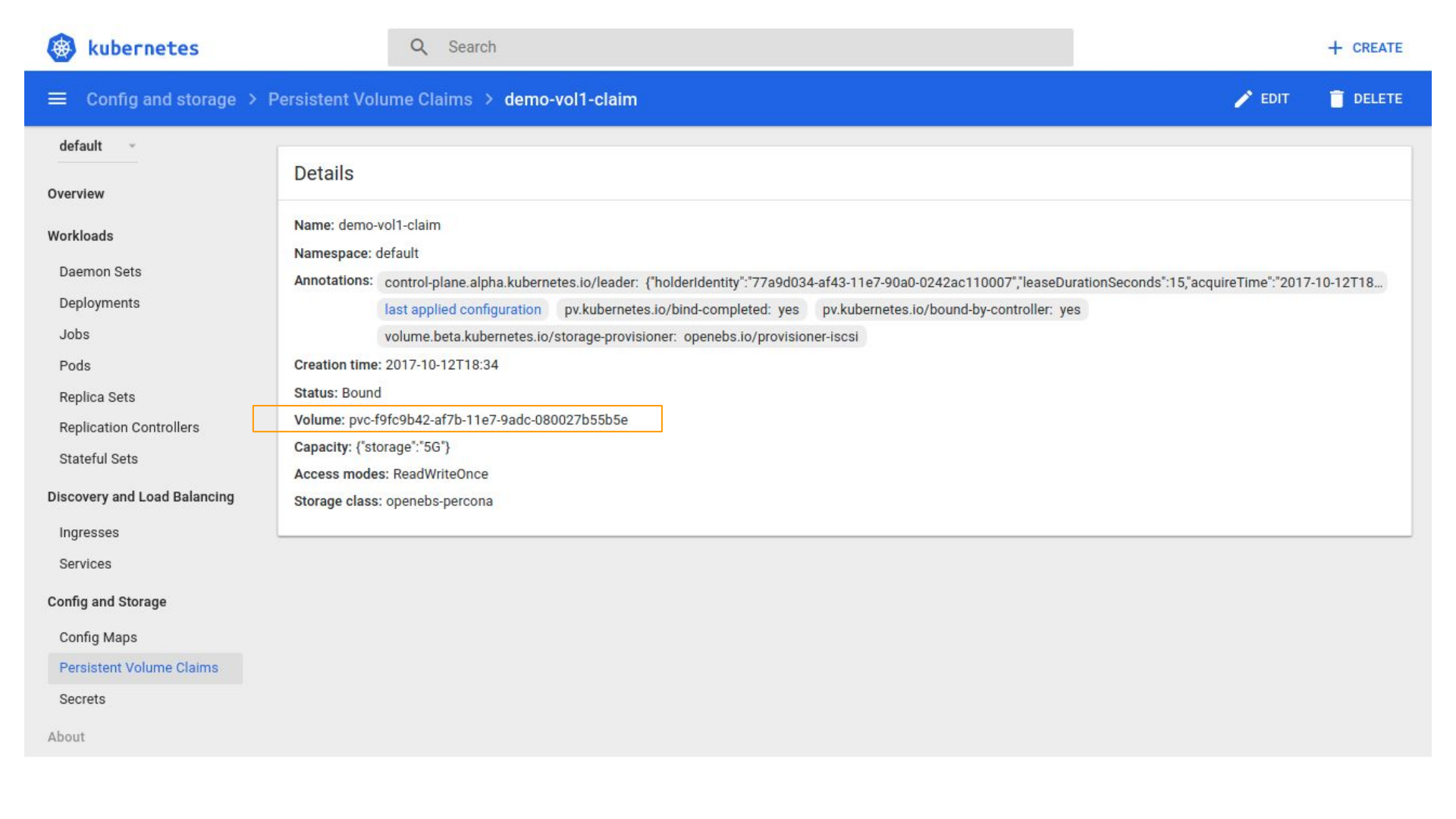
Replica Sets
Replication Controllers
Stateful Sets
Discovery and Load Balancing
Ingresses
Services
Config and Storage
Config Maps
Persistent Volume Claims
Secrets
Details
Name: percona
Namespace: default
Labels: name: percona
Annotations: last applied configuration
Creation time: 2017-09-14T07:43
Status: Running
Network
Node: kubeminion-02
IP: 10.36.0.3
Persistent Volume Claims
Name
Volume
Labels
Age
openebs-vol1-claim
pvc-741c37cc-9920-11e7-8fdc-021c6f7dbe9d
-
7 minutes


kubernetes
Search
CREATE
Config and storage > Persistent Volume Claims > demo-vol1-claim
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DELETE
default
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Stateful Sets
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Ingresses
Services
Config and Storage
Config Maps
Persistent Volume Claims
Secrets
About
Details
Name: demo-vol1-claim
Namespace: default
Annotations: control-plane.alpha.kubernetes.io/leader: {"holderIdentity":"77a9d034-af43-11e7-90a0-0242ac110007","leaseDurationSeconds":15,"acquireTime":"2017-10-12T18...
last applied configuration
pv.kubernetes.io/bind-completed: yes
pv.kubernetes.io/bound-by-controller: yes
volume.beta.kubernetes.io/storage-provisioner: openebs.io/provisioner-iscsi
Creation time: 2017-10-12T18:34
Status: Bound
Volume: pvc-f9fc9b42-af7b-11e7-9adc-080027b55b5e
Capacity: {"storage":"5G"}
Access modes: ReadWriteOnce
Storage class: openebs-percona

kubernetes

Search

+ CREATE

Cluster > Persistent Volumes > pvc-741c37cc-9920-11e7-8fdc-021c6f7dbe9d

EDIT DELETE

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default

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Workloads

- Daemon Sets
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- Replica Sets
- Replication Controllers
- Stateful Sets

Allocated resources

CPU

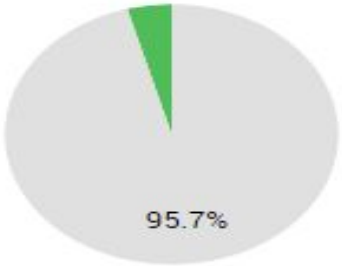
Memory

Up Time

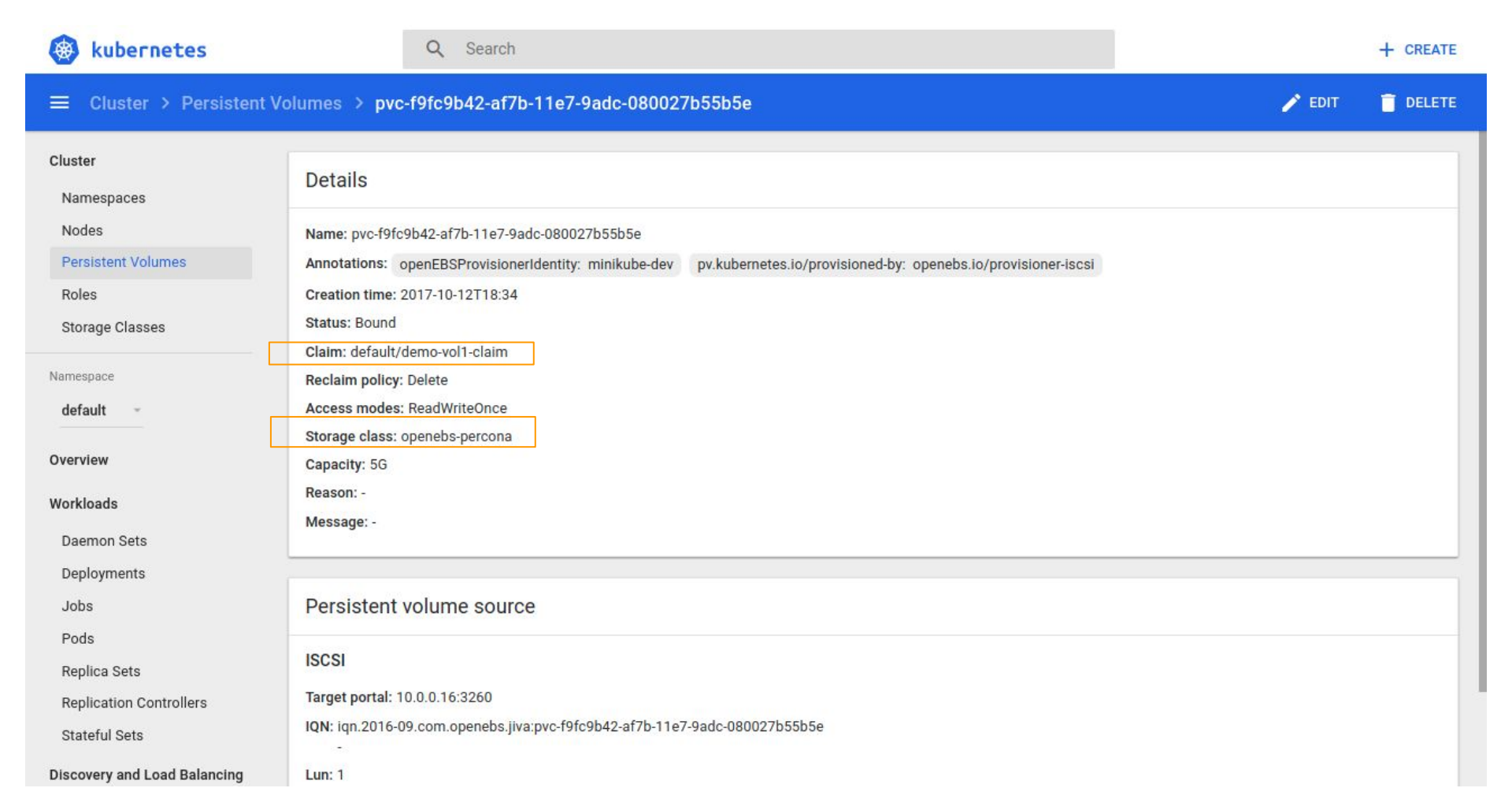
Since:
2017 Sep 14 14:56 IST
(1 hour 21 minutes)

Current Time: 4:17 PM

Storage Capacity



Should include outstanding alerts at the top of the page.


kubernetes
Search
CREATE
Cluster > Persistent Volumes > pvc-f9fc9b42-af7b-11e7-9adc-080027b55b5e
EDIT
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Cluster
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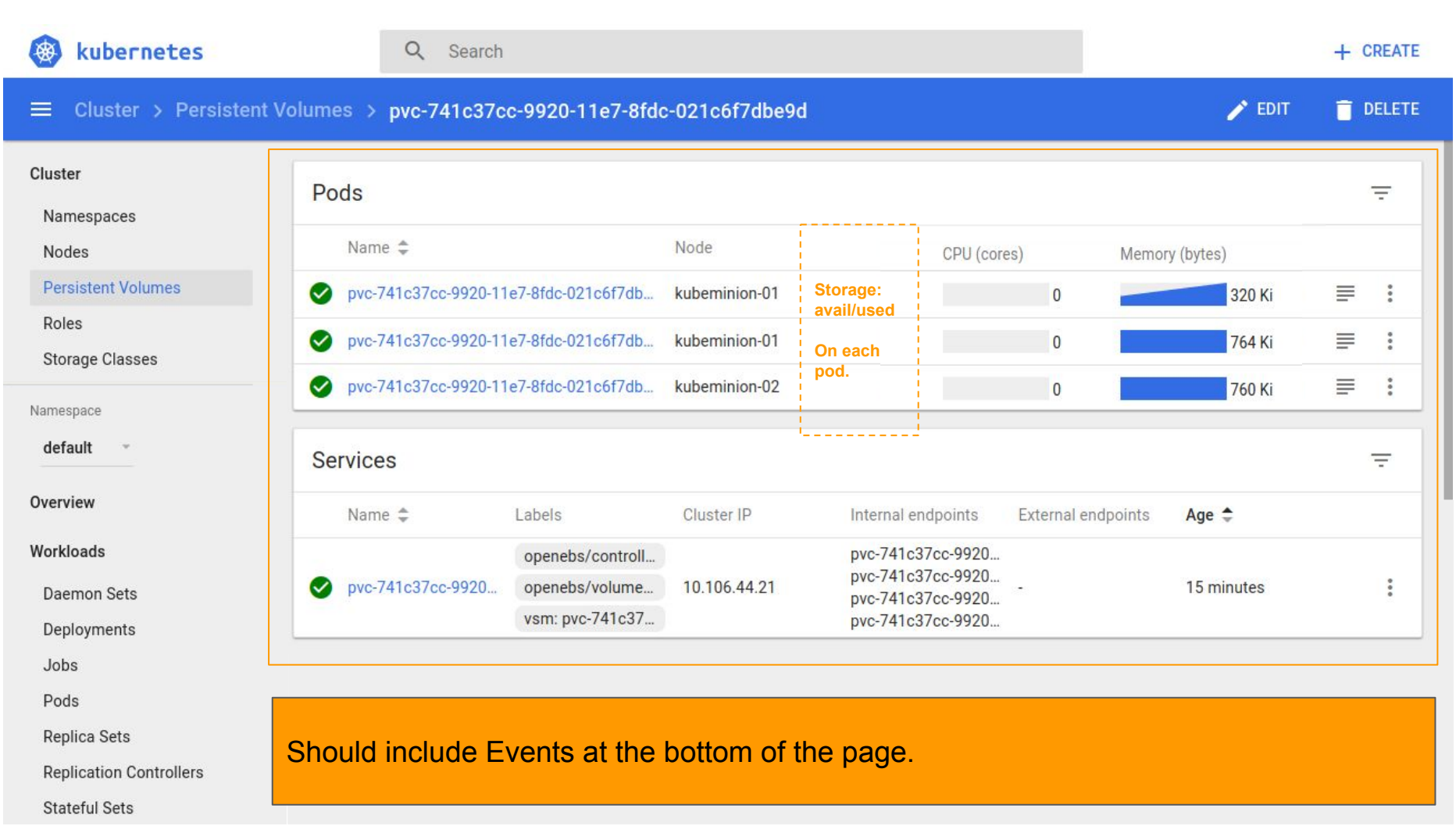
Details
Name: pvc-f9fc9b42-af7b-11e7-9adc-080027b55b5e
Annotations: openEBSProvisionerIdentity: minikube-dev
pv.kubernetes.io/provisioned-by: openebs.io/provisioner-iscsi
Creation time: 2017-10-12T18:34
Status: Bound
Claim: default/demo-vol1-claim
Reclaim policy: Delete
Access modes: ReadWriteOnce
Storage class: openebs-percona
Capacity: 5G
Reason: -
Message: -
Persistent volume source
ISCSI
Target portal: 10.0.0.16:3260
IQN: iqn.2016-09.com.openebs.jiva:pvc-f9fc9b42-af7b-11e7-9adc-080027b55b5e
Lun: 1


kubernetes
Search
CREATE
Cluster > Persistent Volumes > pvc-741c37cc-9920-11e7-8fdc-021c6f7dbe9d
EDIT
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Stateful Sets
Pods
Name
Node
CPU (cores)
Memory (bytes)
pvc-741c37cc-9920-11e7-8fdc-021c6f7db...
kubeminion-01
0
320 Ki
pvc-741c37cc-9920-11e7-8fdc-021c6f7db...
kubeminion-01
0
764 Ki
pvc-741c37cc-9920-11e7-8fdc-021c6f7db...
kubeminion-02
0
760 Ki
Storage: avail/used
On each pod.
Services
Name
Labels
Cluster IP
Internal endpoints
External endpoints
Age
pvc-741c37cc-9920...
openebs/controll...
openebs/volume...
vsm: pvc-741c37...
10.106.44.21
pvc-741c37cc-9920...
pvc-741c37cc-9920...
pvc-741c37cc-9920...
pvc-741c37cc-9920...
-
15 minutes
Should include Events at the bottom of the page.

kubernetes

Search

+ CREATE

Workloads > Pods > pvc-f9fc9b42-af7b-11e7-9adc-080027b55b5e-rep-1715657804-r0bhq

EXEC LOGS EDIT DELETE

Cluster

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default

Overview

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- Deployments
- Jobs
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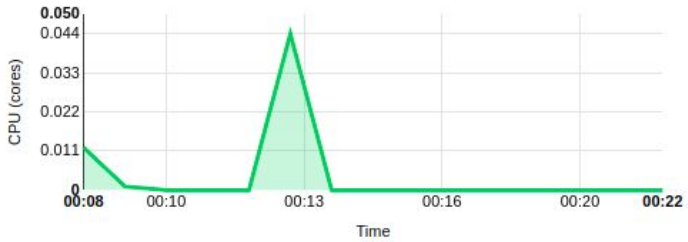
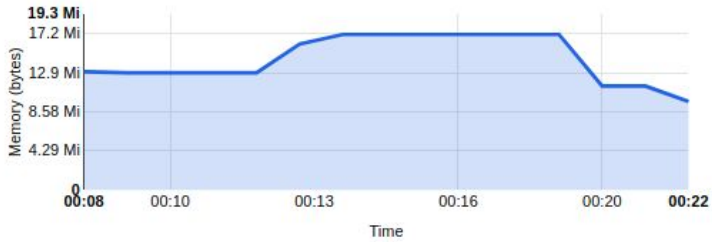
- Replica Sets
- Replication Controllers
- Stateful Sets

Discovery and Load Balancing

CPU usage



Memory usage



Details

Name: pvc-f9fc9b42-af7b-11e7-9adc-080027b55b5e-rep-1715657804-r0bhq

Namespace: default

Labels: openebs/replica: jiva-replica | pod-template-hash: 1715657804 | vsm: pvc-f9fc9b42-af7b-11e7-9adc-080027b55b5e

Annotations: Created by: ReplicaSet pvc-f9fc9b42-af7b-11e7-9adc-080027b55b5e-rep-1715657804

Creation time: 2017-10-12T18:34

Status: Running

Network

Node: minikube-dev

IP: 172.17.0.8

Containers

Cluster

Namespaces

Nodes

Persistent Volumes

Roles

Storage Classes

Namespace

default

Overview

Workloads

Daemon Sets

Deployments

Jobs

Pods

Replica Sets

Replication Controllers

Stateful Sets

Discovery and Load Balancing

Containers

pvc-f9fc9b42-af7b-11e7-9adc-080027b55b5e-rep-con

Image: openebs/jiva:0.4.0

Environment variables: -

Commands: launch

Args: replica
--frontendIP
10.0.0.16
--size
5G
/openebs

Conditions

Type	Status	Last heartbeat time	Last transition time	Reason	Message
Initialized	True	-	21 minutes	-	-
Ready	True	-	19 minutes	-	-
PodScheduled	True	-	21 minutes	-	-