



Kubernetes: Persistent Storage with Rook

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Revision

Version	Date	Author	Changes
0.1.0	08/24/2018	Anubhav Sharma	Initial Draft



Rook Introduction

Rook is a CNCF open-source project built to deliver storage solution for Kubernetes leveraging battle-tested open-source storage technologies including Ceph, which has years of production deployments and runs some of the worlds largest clusters. Rook is available under Apache 2.0 license.

As containers are ephemeral by nature, without a persistent storage solution, you can lose your data as container dies. This problem is solved through persistent storage solutions that can be accessed by Kubernetes applications and deliver scale, performance and availability required for large data stores for cloud native environment.

Rook is a great fit to solve the persistent storage problem for containers and this paper, we demonstrate an easy integration of rook with Nirmata platform and provisioning of highly available replicated storage.

With Rook you can either build dedicated storage clusters or hyper-converged clusters where your apps run alongside storage. Rook integrates Ceph with multiple storage presentations including object storage (compatible with S3 and swift), block storage, and POSIX-compliant shared file system.

Rook efficiently distributes and replicates your data across your cluster to minimize the risk of data loss. With snapshots, cloning and versioning, no more losing sleep over your data.

Prerequisites

- 1. Nirmata Cluster with Kubernetes 1.7+, minimum 3 nodes in a cluster (We are using Kubernetes version 1.9.4 with 4 nodes).
- 2. Flex Volume Configuration: Enabled by default with Nirmata (Directory: "/opt/nirmata/volume-plugins")
- 3. kubectl: 1.9+ (for setting rook cluster)
- dataDirHostPath Storage: Path on VM node(host) to store config and data for rook services (enough to meet container persistent storage requirements); default is /var/lib/rook
- 5. Linux packages: rbd-fuse, ceph-fs-common



Install Linux packages

On Ubuntu, run these 2 commands as root (or sudo) on each node VM

- apt-get install rbd-fuse
- apt-get install ceph-fs-common

anubhav@anubhav-k8s-hg-86496:~\$ sudo apt-get install rbd-fuse anubhav@anubhav-k8s-hg-86496:~\$ sudo apt-get install ceph-fs-common

Setup your Kubernetes Cluster through Nirmata

- 1. Setup your <u>Cloud-provider</u>.
- 2. Setup your container <u>Hostgroup</u>.
- 3. Setup your Kubernetes <u>Cluster</u>.

Your Kubernetes cluster will look as below -

Dashboards	<	1.000	hubhav-k8	3s-clu	ster																					¢.
Activity		Ready	managed / v1.9.4																			Created 4	hours ag	o by anub	hav⊗ni	irmata.com
Alarms	5	Overview	Persistent Volume	s 9= R	oles																	Activity	ai	Analytics		🖸 Tasks
🗙 Catalog	<	_																								
Environments		Sin	Availability noe 4 hours ago		:40 12:50	13:00	13:10 1	13:20 13:3	0 13:40	13:50 1	4:00 14	14:10 14:20 14:30 14:40 14:50 1			15:00	5:00 15:10 15:20 15:30 15:40		15:40	15:50 16:00		16:10	16:10 16:20 16:		16:40		
Policies	<		100%	P REA	DY		1 1			1 1								1		1	1	1		1		
Clusters		Resource:	is								no alarms									Memory						
Host Groups	<		9										no	o alarms	5											
Cloud Providers			Pods					no volum	es																	
Image Registries		5						3																		
o ⁰ Settings	<	Namespaces						Storageclass	<u>es</u>			No application CPU usage														
		«\$ Compone	ents							View Detz	ils							oppilo	earan ei e aange							
		Name								State																
		controller-ma	anager							Health	2															
		etcd-0								Health																
		scheduler								Health		4														
		te Nodes								View Deta	alls															
		Name			Pods	CF	PU .	Memory		State							No a	pplicati	ion mer	mory us	sage					
		anubhav-k8s	s-hg-38899							Read																
		anubhav-k8s	s-hg-59479							Read																
		anubhav-k8s	s-hg-67991							Read																
		anubhav-k8s	s-hg-86496							Read																

Configure and deploy operator.yaml

To work with Nirmata version 2.1.0, you need make couple of configuration changes to operator.yaml file.

Full yaml file is available here - operator.yaml

Modify following parameters in operator.yaml -

Using extensions instead of apps -



apiVersion: extensions/v1beta1 kind: Deployment

Configure flex-volume path for ceph volume-plugins.

```
- name: FLEXVOLUME_DIR_PATH
value: "/opt/nirmata/volume-plugins/"
```

Apply operator.yaml to your cluster through "Apply YAML" option in cluster pulldown menu on top right -

Overview Persistent Volumes Te Roles	Disable Cluster Resize Cluster
	Launch Terminal
Availability Pri 24 August Sinee Abroustago 1220 1240 1250 1300 1310 1320 1330 1340 1350 4400 1410 1420 1430 1440 1450 1500 1510 1520 1530 1540 1550 1600 1et 100%	Apply YAML Download Controller Y Download Kubeconfig

Drop your operator.yaml file here or select the file from directory -



iste	Apply YAML	×		
Roles				
ust 12:40 1	Drop Kubernetes YAML file here or click to select a file The selected file must be a YAML file.		15:00	15:10
ADY				
	Cancel Apply			
	View Details State			

Use Nirmata shell and run Kubectl command to verify that operator, discover and agent pods are up and running.

Ready manage	ed / v1.9.4																						0	Created 4	Edit Cluster Disable Cluster
	Persistent Volumes	1	Roles																				0 /	Activity	
																									→_ Launch Terminal
Availab Since 4 hor	urs ago	Fri 24 Au 12:30	ugust 12:40	12:50	13:00	13:10	13:20	13:30	13:40	13:50	14:00	14:10	14:20	14:30	14:40	14:50	15:00	15:10	15:20	15:30	15:40	15:50	16:00	16:10	Apply YAML Download Controller YA
100%		f	READY		i.						i.			į.											 Download Kubeconfig F Delete Cluster
Resources																					CPU				Memory
Resources															no ala	irms					CPU				



🗘 /anubhav-k8s-cluster.kubectl.39092

Command: sh

# kubectl get po	odsall-namespaces				
IAMESPACE	NAME	READY	STATUS	RESTARTS	AGE
Ingress-nginx	default-http-backend-55c6c69b88-rstfx	1/1	Running	0	4h
Ingress-nginx	nginx-ingress-controller-8b995b966-j9dzg	1/1	Running	0	4h
ube-system	kube-dns-5b8b94cdcc-8q5x9	3/3	Running	0	4h
ube-system	metrics-server-59bf98bf47-jm8dd	1/1	Running	0	4h
nirmata	nirmata-cni-installer-6vggw	1/1	Running	0	4h
nirmata	nirmata-cni-installer-nflsc	1/1	Running	0	4h
nirmata	nirmata-cni-installer-nh7rl	1/1	Running	0	4h
nirmata	nirmata-cni-installer-whx5q	1/1	Running	0	4h
nirmata	nirmata-kube-controller-8cb95c7f6-dwpth	1/1	Running	0	4h
cook-ceph-system	rook-ceph-agent-514ps	1/1	Running	0	2 m
cook-ceph-system	rook-ceph-agent-7dtfv	1/1	Running	0	2 m
cook-ceph-system	rook-ceph-agent-p7s8p	1/1	Running	0	2 m
cook-ceph-system	rook-ceph-agent-tsxft	1/1	Running	0	2 m
cook-ceph-system	rook-ceph-operator-6cbb486c46-vtt9m	1/1	Running	0	2 m
cook-ceph-system	rook-discover-g8wff	1/1	Running	0	2 m
cook-ceph-system	rook-discover-n157j	1/1	Running	0	2 m
cook-ceph-system	rook-discover-pdm4z	1/1	Running	0	2 m
rook-ceph-system	rook-discover-xlvxk	1/1	Running	0	2m

Configure and deploy cluster.yaml

We modify cluster.yaml for deployment in Nirmata. Cluster.yaml will install in roo-ceph namespace. Nirmata has construct of environments for applications. All applications are deployed in an environment. For application level isolation application namespace is "applicationname-environmentname" and for shared namespace within an environment, it "environmentname".

For our purpose, we will deploy cluster.yaml as an application in rook-ceph environment. You can do that with following steps -

1. Create rook-ceph environment with shared namespace isolation level.



Add Environment		×
Name*		
rook-ceph		
Cluster*		
anubhav-k8s-cluster	-	
Isolation Level*		
Namespace per Application		
Namespace per Application		
Shared Namespace		
Cancel	Ade	d

Once setup, your environment will look as below -

Environments		
Q search		
Environment	Cluster	Applications
aks-cluster	aks-demo2	GG
🌲 🚿 baremetal	diamanti-cluster	G
🌲 🖋 rook-ceph	anubhav-k8s-cluster	no applications

2. Create application "rook-cluster" in application catalog using cluster.yaml as shown below -

Cluster.yaml file spec -

```
apiVersion: ceph.rook.io/vlbetal
kind: Cluster
metadata:
   name: rook-ceph
spec:
   dataDirHostPath: /var/lib/rook
```



```
# The service account under which to run the daemon pods in this cluster if
the default account is not sufficient (OSDs)
  serviceAccount: rook-ceph-cluster
  # set the amount of mons to be started
  mon:
    count: 3
   allowMultiplePerNode: true
  # enable the ceph dashboard for viewing cluster status
  dashboard:
    enabled: true
  network:
    # toggle to use hostNetwork
    hostNetwork: false
# The requests and limits set here, allow the mgr pod to use half of one CPU
core and 1 gigabyte of memory
#
    mgr:
#
      limits:
        cpu: "500m"
#
        memory: "1024Mi"
#
#
      requests:
        cpu: "500m"
#
        memory: "1024Mi"
#
# The above example requests/limits can also be added to the mon and osd
components
#
    mon:
#
    osd:
  storage: # cluster level storage configuration and selection
    useAllNodes: true
    useAllDevices: false
    deviceFilter:
    location:
    config:
      # The default and recommended storeType is dynamically set to bluestore
for devices and filestore for directories.
      # Set the storeType explicitly only if it is required not to use the
default.
      # storeType: bluestore
      databaseSizeMB: "1024" # this value can be removed for environments with
normal sized disks (100 GB or larger)
      journalSizeMB: "1024" # this value can be removed for environments with
normal sized disks (20 GB or larger)
# Cluster level list of directories to use for storage. These values will be
set for all nodes that have no `directories` set.
    directories:
#
    - path: /rook/storage-dir
#
# Individual nodes and their config can be specified as well, but 'useAllNodes'
above must be set to false. Then, only the named
# nodes below will be used as storage resources. Each node's 'name' field
should match their 'kubernetes.io/hostname' label.
    nodes:
#
     - name: "172.17.4.101"
#
#
      directories: # specific directories to use for storage can be specified
for each node
       - path: "/rook/storage-dir"
#
#
      resources:
#
         limits:
#
          cpu: "500m"
          memory: "1024Mi"
#
#
         requests:
#
           cpu: "500m"
           memory: "1024Mi"
#
```



# # node	- name: "172.17.4.201" devices: # specific devices to use for storage can be specified for each
#	- name: "sdb"
#	- name: "sdc"
#	config: # configuration can be specified at the node level which
overr	rides the cluster level config
#	storeType: filestore
#	- name: "172.17.4.301"
#	deviceFilter: "^sd."

Create a cluster application in the catalog using above cluster.yaml file -

()nirmata			
Control Con	Catalog		
Activity	32 Q search		
Alarms 5			[
🗙 Catalog 🗸 🗸	1	guestbook 3 Running	helloworld
Applications	Ŧ	3 WORKLOADS 3 SERVICES	1 WORKLOAD 1 SERVICE
Helm Charts beta	Add Application	Created 4 months ago by ritesh@nirmata.com	Created 3 months ago by jim@nirmata.com
Environments	kafka-cp-dep	kafka-single	kafka-test
Policies <			
Clusters	2 workLoads 2 services	2 WORKLOADS 3 SERVICES	3 WORKLOADS 5 SERVICES
Host Groups <	Created a month ago by ritesh@nirmata.com	Created 24 days ago by ritesh@nirmata.com	Created a day ago by ritesh@nirmata.com
Catalog	Create Application		×
32 Q search	Name*		
Add A kafka-cp-dep		ort application manifests click or drop files here The selected files must be in YAML format.	kafka-cj 2 worku #:- # kafka-zj
2 WORKLOADS	2 Cancel	s	Create 2 WORKL

3. Run cluster application in rook-ceph environment and apply role-binding -

Go to environment rook-ceph and click on run an application tab -



()nirmata		docs	support	Anubhav Sharn	a Nirmata
«	« Return to environments list				
Ø Dashboards	Environment rook-ceph				٥.
 Activity 	Cluster Connected X anubhar-kits-cluster O Notify		Created 20 m	inutes ago by anubha	
Alarms 5	Applications Activity				o ^o Settings
🗙 Catalog					
Environments					
Policies	< +				
Clusters	Run an application in this environment				
Host Groups	<				

Choose the rook-cluster application

Run the Application in rook-ceph	×
the rook-ceph No applications no descriptions.	
Run name*	
Catalog Application* rook-cluster	~
Cancel	Run Application

And click "Run Application".

Import role-bindings into the application -

Here is sample yaml for role-binding and Service Account definitions -

```
apiVersion: v1
kind: ServiceAccount
metadata:
 name: rook-ceph-cluster
 namespace: rook-ceph
___
kind: Role
apiVersion: rbac.authorization.k8s.io/v1beta1
metadata:
 name: rook-ceph-cluster
 namespace: rook-ceph
rules:
- apiGroups: [""]
 resources: ["configmaps"]
 verbs: [ "get", "list", "watch", "create", "update", "delete" ]
___
# Allow the operator to create resources in this cluster's namespace
```



```
kind: RoleBinding
apiVersion: rbac.authorization.k8s.io/v1beta1
metadata:
 name: rook-ceph-cluster-mgmt
 namespace: rook-ceph
roleRef:
 apiGroup: rbac.authorization.k8s.io
 kind: ClusterRole
 name: rook-ceph-cluster-mgmt
subjects:
- kind: ServiceAccount
name: rook-ceph-system
namespace: rook-ceph-system
___
# Allow the pods in this namespace to work with configmaps
kind: RoleBinding
apiVersion: rbac.authorization.k8s.io/v1beta1
metadata:
 name: rook-ceph-cluster
 namespace: rook-ceph
roleRef:
 apiGroup: rbac.authorization.k8s.io
 kind: Role
 name: rook-ceph-cluster
subjects:
- kind: ServiceAccount
 name: rook-ceph-cluster
```

Import the above yaml into the application using menu below -

unning Applica	tion cluster							0
Executing 01	Pending Create X rook-cluste	er				Cr	eated a m	E Import to Application
Workloads	Discovery & Routing	Config & Storage	9= Access Control			Activity	ai A	 ⇒ Export Application Clone Application ✓ Download Kubeconfig File
Q search			Kind	Pods	Services		_	 Edit Access Control Delete Application State



ister –	Import YAML to Application rook-cluster	×	
onfig	To import application manifests click or drop files here		
	The selected files must be in YAML (.yml) format.		
		1	Servio
	Cancel	t	

> cluster		
	Import YAML to Application rook-cluster	×
🖴 Config	1.1 KB	
	rookcluster-r	
	Remove file	
	Cancel	
	Cancel	

Verify that mon and mgr pods are getting deployed. You can verify by checking events and tasks and by going to cluster shell and running kubectl commands -

Output from Application events and tasks tab -



🕽 nirmata				a docs 🕒 support 🖾 🕒	Anubhav Sharma Nirr
*	SuccessfulCreate	ReplicaSet rook-ceph-mon4	1	08/26/18, 08:53:19	Normal
Dashboards <	Started	Pod rook-ceph-osd-id-3-7884dbf846-2 7kg	4	08/26/18, 08:52:34	Normal
a and the c	Pulled	Pod rook-ceph-osd-id-3-7884dbf846-2j7kg	1	08/26/18, 08:52:33	Normal
Activity	Created	Pod rook-ceph-osd-id-3-7884dbf846-2]7kg	1	08/26/18, 08:52:33	Normal
Alarms (5)	Pulled	Pod rook-ceph-osd-id-3-7884dbf846-2]7kg	1	08/26/18, 08:52:31	Normal
Catalog <	Created	Pod rook-ceph-osd-id-3-7884dbf846-2j7kg	1	08/26/18, 08:52:31	Normal
Catalog	Started	Pod rook-ceph-osd-id-3-7884dbf846-2]7kg	1	08/26/18, 08:52:31	Normal
Environments	Scheduled	Pod rook-ceph-osd-id-3-7884dbf846-2j7kg	1	08/26/18, 08:52:30	Normal
Policies <	SuccessfulMountVolume	Pod rook-ceph-osd-id-3-7884dbf846-2j7kg	1	08/26/18, 08:52:30	Normal
T Officies (SuccessfulMountVolume	Pod rook-ceph-osd-id-3-7884dbf846-2]7kg	1	08/26/18, 08:52:30	Normal
Clusters	SuccessfulMountVolume	Pod rook-ceph-osd-id-3-7884dbf846-2j7kg	3	08/26/18, 08:52:30	Normal
Host Groups <	SuccessfulCreate	ReplicaSet rook-ceph-osd-id-3-7884dbf846	1	08/26/18, 08:52:30	Normal
nose aroups	ScalingReplicaSet	Deployment rook-ceph-osd-id-3	1	08/26/18, 08:52:30	Normal
Cloud Providers	Pulled	Pod rook-ceph-osd-id-2-648f88c6fb-rdcmp	1	08/26/18, 08:52:28	Normal
Image Registries	Created	Pod rook-ceph-osd-id-2-648f88c6fb-rdcmp	1	08/26/18, 08:52:28	Normal
	- Started	Pod rook-ceph-osd-id-2-648f88c6fb-rdcmp	1	08/26/18, 08:52:28	Normal
Settings <	Pulled	Pod rook-ceph-osd-id-1-f68667d87-r94wr	1	08/26/18, 08:52:27	Normal
	Created	Pod rook-ceph-osd-ld-1-f68667d87-r94wr	1	08/26/18, 08:52:27	Normal
	Started	Pod rook-ceph-osd-id-1-f68667d87-r94wr	1	08/26/18, 08:52:27	Normal
	Created	Pod rook-ceph-osd-id-2-648f88c6fb-rdcmp	1	08/26/18, 08:52:27	Normal
	Started	Pod rock-ceph-osd-id-2-648f88c6fb-rdcmp	1	08/26/18, 08:52:27	Normal
	Pulled	Pod rook-ceph-osd-kl-0-685cf6658-m7hhl	1	08/26/18, 08:52:26	Normal
	Created	Pod rock-ceph-osd-id-0-685cf6658-m7hhl	1	08/26/18, 08:52:26	Normal
	Started	Pod rook-ceph-osd-kl-0-685cf6658-m7hhl	1	08/26/18, 08:52:26	Normal
	Created	Pod rook-ceph-osd-id-1-f68667d87-r94wr	4	08/26/18, 08:52:26	Normal
	Started	Pod rook-ceph-osd-ld/1-f68667d87-r94wr	1	08/26/18, 08:52:26	Normal
	SuccessfulMountVolume	Pod rook-ceph-osd-id-2-648f88c6fb-rdcmp	1	08/26/18, 08:52:26	Normal
	SuccessfulMountVolume	Pod rook-ceph-osd-id-2-648f88c6fb-rdcmp	1	08/26/18, 08:52:26	Normal
	SuccessfulMountVolume	Pod rook-ceph-osd-id-2-648f88c5fb-rdcmp	1	08/26/18, 08:52:26	Normal
	Pulled	Pod rook-ceph-osd-id-2-648/88c6fb-rdcmp	1	08/26/18, 08:52:26	Normal
	Created	Pod rook-ceph-osd-id-0-685cf6658-m7nhl	1	08/26/18, 08:52:25	Normal
	Started	Pod rock-ceph-osd-id-0-685cf6658-m7hhl	1	08/26/18.08.52:25	Normal

	«	Environments Environment rook-cep	h cluster						
Dashboards	<								o.
Activity		Running Application Cluster	or					ated 15 minutes as	o by anubhav@nirmata.co
Alarms	5								
Catalog	<	& Workloads 😳 Discovery & Routing	🚨 Config & Storage	9= Access Control			Activity	analytics	Events & Tasks
		Q search						×) Cle	ar All Events & Tasks
Environments									
Policies	<	System Tasks							Clear Failed Tasks
Clusters		Task		Resource	Duration		Start at		State
		Create Resource		ServiceAccount rook-ceph-cluster	243ms		08/24/18, 05:36:10		Completed
Host Groups	<	Create Resource		RoleBinding rook-ceph-cluster	120ms		08/24/18, 05:36:10		Completed
Cloud Providers		Create Resource		RoleBinding rook-ceph-cluster-mgm	314ms		08/24/18, 05:36:10		Cleared
Image Registries		Create Resource		Role rook-ceph-duster	168ms		08/24/18, 05:36:10		Completed
inage Registries		Run Application 9 subtasks		Application rook-cluster	5282ms		08/24/18, 05:33:35		Completed
Settings	<								
		🚡 Events							
		Reason		Resource		Count	Last Seen		Туре
		SuccessfulCreate		ReplicaSet rook-ceph-mon0		1	08/24/18, 05:36:11		Normal
		SuccessfulMountVolume		Pod rook-ceph-mon0-hmlcj		1	08/24/18, 05:36:11		Normal
		SuccessfulMountVolume		Pod rook-ceph-mon0-hmlcj		1	08/24/18, 05:36:11		Normal
		Scheduled		Pod rook-ceph-mon0-hmlcj		1	08/24/18, 05:36:11		Normal
		SuccessfulMountVolume		Pod rook-ceph-mon0-hmlcj		1	08/24/18, 05:36:11		Normal
		Created		Pod rook-ceph-mon0-hmlcj		1	08/24/18, 05:36:12		Normal
		Started		Pod rook-ceph-mon0-hmicj		1	08/24/18, 05:36:12		Normal
		Pulled		Pod rook-ceph-mon0-hmlcj		1	08/24/18, 05:36:12		Normal
		SuccessfulMountVolume		Pod rook-ceph-mon1-5ww9m		1	08/24/18, 05:36:15		Normal

Output through Nirmata shell into cluster



🐧 /anubhav-k8s-cluster.kubectl.39092

Command: sh

/ #					
	odsall-namespaces				
NAMESPACE	NAME	READY	STATUS	RESTARTS	AGE
ingress-nginx	default-http-backend-55c6c69b88-rstfx	1/1	Running	0	2d
ingress-nginx	nginx-ingress-controller-8b995b966-j9dzg	1/1	Running	0	2d
kube-system	kube-dns-5b8b94cdcc-8q5x9	3/3	Running	0	2d
kube-system	kube-flannel-ds-amd64-7dg17	1/1	Running	0	7m
kube-system	kube-flannel-ds-amd64-b4vg8	1/1	Running	0	7m
kube-system	kube-flannel-ds-amd64-xqm4s	1/1	Running	0	7m
kube-system	kube-flannel-ds-amd64-z5jn4	1/1	Running	0	7m
kube-system	metrics-server-59bf98bf47-jm8dd	1/1	Running	0	2d
nirmata	nirmata-cni-installer-6vggw	1/1	Running	0	2d
nirmata	nirmata-cni-installer-nflsc	1/1	Running	0	2d
nirmata	nirmata-cni-installer-nh7rl	1/1	Running	0	2d
nirmata	nirmata-cni-installer-whx5q	1/1	Running	0	2d
nirmata	nirmata-kube-controller-8cb95c7f6-dwpth	1/1	Running	0	2d
rook-ceph-system	rook-ceph-agent-252v2	1/1	Running	0	12m
rook-ceph-system	rook-ceph-agent-8hkwq	1/1	Running	0	12m
rook-ceph-system	rook-ceph-agent-tpdzd	1/1	Running	0	12m
rook-ceph-system	rook-ceph-agent-xrtxk	1/1	Running	0	12m
rook-ceph-system	rook-ceph-operator-6cbb486c46-j4t9b	1/1	Running	0	12m
rook-ceph-system	rook-discover-2x8d4	1/1	Running	0	12m
rook-ceph-system	rook-discover-c59qb	1/1	Running	0	12m
rook-ceph-system	rook-discover-kpx2j	1/1	Running	0	12m
rook-ceph-system	rook-discover-kwfgg	1/1	Running	0	12m
rook-ceph	rook-ceph-mgr-a-55cc96f574-dnvlh	1/1	Running	0	6m
rook-ceph	rook-ceph-mon0-qj6z5	1/1	Running	0	9m
rook-ceph	rook-ceph-mon1-wqlkr	1/1	Running	0	9m
rook-ceph	rook-ceph-mon4-zl4nr	1/1	Running	0	5m
rook-ceph	rook-ceph-osd-id-0-685cf6658-m7hhl	1/1	Running	0	6m
rook-ceph	rook-ceph-osd-id-1-f68667d87-r94wr	1/1	Running	0	6m
rook-ceph	rook-ceph-osd-id-2-648f88c6fb-rdcmp	1/1	Running	0	6m
rook-ceph / #	rook-ceph-osd-id-3-7884dbf846-2j7kg	1/1	Running	0	6m

Setup storage-class and replica pool -

Use the storage-class yaml for block storage -

```
apiVersion: storage.k8s.io/v1
kind: StorageClass
metadata:
    name: rook-ceph-block
provisioner: ceph.rook.io/block
parameters:
    pool: replicapool
    # Specify the namespace of the rook cluster from which to create volumes.
    # If not specified, it will use `rook` as the default namespace of the
cluster.
    # This is also the namespace where the cluster will be
    clusterNamespace: rook-ceph
    # Specify the filesystem type of the volume. If not specified, it will use
`ext4`.
# fstype: xfs
```

Apply the storageclass.yaml to your Kubernetes cluster -



« Return to clust	ters list																		
Cluster ar	nubhav-k8	s-cluste	er																¢ -
Ready	managed / v1.9.4																	Created	do concentrater
Overview	Persistent Volumes	?≡ Roles																Activity	Disable Cluster Resize Cluster
×																			>_ Launch Terminal
	Availability nce 6 hours ago	Fri 24 August 12:30 12:45	13:00 1	3:15 13:30	13:45	14:00	14:15	14:30	14:45	15:00	15:15	15:30	15:45	16:00	16:15	16:30	16:45	17:00 1	Apply YAML Apply YAML Apply Optimized Controller YAML
	100%	I READY	j T	i.	i.	I,	T	Ť.	1	1	1	1	i. I	ī.	i.		i.	1 1	Download Kubeconfig File Delete Cluster
Resource	s														2	CPU			Memory

Import replica-pool setting into your cluster application in rook-ceph environment using YAML manifest below -

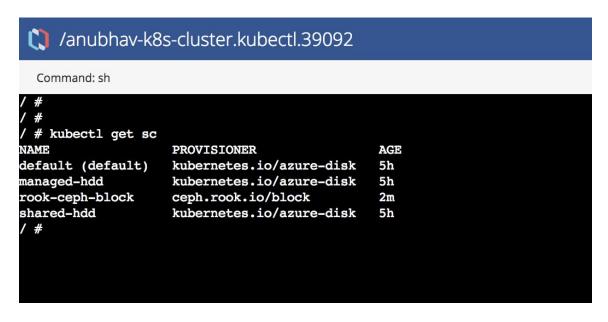
```
apiVersion: ceph.rook.io/vlbetal
kind: Pool
metadata:
   name: replicapool
   namespace: rook-ceph
spec:
   failureDomain: host
   replicated:
        size: 2
```

🕻 nirmata						ad da	ics 🕓 supp	ort	Anubhav Sharma	Nirmata	0
«	D Enviro	nments (Environment) rook-cep	oh 🖉 cluster								
Dashboards	Dunning									٥.	
Activity		Pending Create X rook-clus	ter				Create	d 41 mi	E Import to Application	-	
Alarms 5	& Work	loads 😳 Discovery & Routing	Config & Storage	9= Access Control			 Activity 	ai A	E+ Export Application		
🗙 Catalog									Download Kubecor	nfig File	
Environments		Q, search							9= Edit Access Control x Delete Application		
🛧 Policies	Resou	irce		Kind	Pods	Services			State		
Clusters	rook-c	eph		Cluster	xioni						



ister						
	Import	YAML to Applic	ation rook-clus	er		×
						_
onfig		0.2 KB				
		rook-pool.ya				
		тоок-роот.уа				
		Remove file				
						-
	Cancel				Im	port

Verify that storage-class is configured on the cluster through NIrmata shell -



Verify the pool is setup with replication size of 2 -



		ool replicapool -n rook-ceph
Name:	replicap	
Namespace:	rook-cep	n.
Labels:	<none></none>	
Annotations:		
API Version:	-	k.io/vlbetal
Kind:	Pool	
Metadata:		
Cluster Nam		
Creation Ti	mestamp:	2018-08-25T01:14:49Z
Resource Ve	rsion:	13250
Self Link:		/apis/ceph.rook.io/v1beta1/namespaces/rook-ceph/pools/replicapool
UID:		43636340-a804-11e8-9dfc-000d3a3ecda7
Spec:		
Failure Dom	ain: hos	
Replicated:		
Size: 2		
Svents: <n< td=""><td>one></td><td></td></n<>	one>	
/ #		

Create a new environment and run your application

Choose Environment menu and create a new environment to run your application -

Name*	
anu-devtest	
Cluster*	
anubhav-k8s-cluster	•
Isolation Level*	
Namespace per Application	•
Namespace	
Cancel	Add



In this example, we will use mysql application with following yaml -

```
apiVersion: v1
kind: Service
metadata:
 name: wordpress-mysql
 labels:
   app: wordpress
spec:
 ports:
   - port: 3306
  selector:
   app: wordpress
   tier: mysql
 clusterIP: None
apiVersion: v1
kind: PersistentVolumeClaim
metadata:
 name: mysql-pv-claim
 labels:
   app: wordpress
spec:
 storageClassName: rook-ceph-block
 accessModes:
  - ReadWriteOnce
 resources:
   requests:
     storage: 20Gi
___
apiVersion: apps/v1beta1
kind: Deployment
metadata:
 name: wordpress-mysql
 labels:
   app: wordpress
spec:
 strategy:
   type: Recreate
  template:
   metadata:
      labels:
       app: wordpress
       tier: mysql
    spec:
      containers:
      - image: mysql:5.6
       name: mysql
       env:
        - name: MYSQL ROOT PASSWORD
         value: changeme
        ports:
        - containerPort: 3306
         name: mysql
        volumeMounts:
        - name: mysql-persistent-storage
         mountPath: /var/lib/rook
      volumes:
```



-	<pre>name: mysql-persistent-storage</pre>
	persistentVolumeClaim:
	claimName: mysql-pv-claim

Name*				
rook-my	ysql			
	1.1 KB			
	mysql.yaml			
	Remove file			
				 ate

Create an application in the catalog using the above yaml -

Run it in your environment -

					_
	Run the Applica	tion in anu-devtest		×	
evt					
w-k8s-c		anu-devtest			
		No applications			
		no descriptions.			
	Run name*				
	anu-sql				
	Catalog Applicatio	on*			
	rook-mysql			-	
ſ				Run Application	
l	Cancel			Run Application	

Verify that application is running using persistent volumes -



Qnirr	Ŋnirmata								
		«	Environments	Environment anu-devi	test anu-sql				
Ø Dashbo	oards	<	Running Applic	ation anu-sql					
Activity	()								
Alarms	5		🍓 Workloads	Discovery & Routing	🖴 Config & Storage	9= Access Control			
🗙 Catalog	5	<			-				
Enviror	nments		Persistent	Volume Claims				•	
Policies	5	<	Name	Stora		Access Modes		hase	
Cluster	s		mysql-pv-claim	rook	-ceph-block	ReadWriteOnce		Bound 🖊 🗙	
Host G	roups	<							

Verify workload status -

								Support Anubhav Sharma Nim	
	Environments / Environment anu-dev	test Application anu-sql / i	vordpress-mysql-55b46bcfd7-n47kp						
Dashboards <	Running Pod wordpress-myso	al-55h46hcfd7-n47	kn					0	
 Activity 	Running	1 555 1050107 1117	nþ.					Created 4 minutes ago by Nirma	
Alarms 5									
🗙 Catalog 🧹 <	0	0	0.0		16.06 %	0 B		0 B	
Environments	Alarms	Restar	LS CF	U	Memory	Bytes In		Bytes Out	
🕈 Policies 🧹	# Pod Status								
V Clusters				Weddeed Sector Rev				B Control Incontrol Incontrol	
		Phase: Running tart Time: 2018-08-27T04:17:20Z		Workload Controller	Name: wordpress-m	and		Expose controller as a Service	
Host Groups <	Host IP: 165.0.0.4				Kind: Deployment	i ante			
 Cloud Providers 	Pod IP: 165.8.0.10 QOS Class: BettEffort			State: Running Pods: 1 of 1					
M Image Registries	ų	US Class: BestEffort			1002.1011				
of Settings <	Condition	Reason	Update On	Running Services					
	✓ Initialized		4 minutes ago	Name		CPU	Memory	State	
	✓ PodScheduled		4 minutes ago	wordpress-mysql		0.05 %	16.06 %	Running 🗙	
	✓ Ready		3 minutes ago	Running Containers					
				Name	Image	Restart	s	State	
				mysql	mysqt:5.6	0		Running 📰 📷	
	Pod Spec		Restart Policy Termination Grace Period (seconds) Service Account Name Service Account Hostname Scheduler Name	30 default default				Wew Pod Template	
	Pod Spec		Restart Policy Termination Grace Period (seconds) Service Account Name Service Account Hostname Scheduler Name	Always 30 default default default-scheduler	Image	Ports		New Pod Template	
	Labels	=s-mval	Restart Policy Termination Grace Period (seconds) Service Account Name Service Account Hostname Scheduler Name	Always 30 default default default-scheduler ClusterFirst	image mpq15.6	Pors mysel	3306/TCP	New Pod Template	
	Labels approximate bytestigneer, name-scorego minate bytestigneer, name-scorego		Restart Policy Termination Grace Period (seconds) Service Account Name Service Account Hostname Scheduler Name	Always 30 default defaultscheduler ClusterFinst Containers			3306/TCP Properties	Constant and the second s	
	Labels apprendpress mmala.biddeplyment.name-wordpr	vtest	Restart Policy Termination Grace Period (seconds) Service Account Name Service Account Hostname Scheduler Name	Alvays odefault default defaultscheduler ClusterFirst Containers mysql	mysql:5.6			faat toisen (37m	

Verify persistent volume info

	ubhav-k8s-c	luster		\$
Ready ma	anaged / v1.9.4		Crea	ted 2 days ago by anubhav@nirmata.co
Overview	Persistent Volumes	?= Roles	Activity	analytics 🖸 Tasks 1
1 Q sean	ch			×
lame			Labels	State
vc-14c62676-a9b	0-11e8-9dfc-000d3a3ecda7		1 Label	Bound

Verify pod status from Nirmata shell -



-		Reconnect Discor
Command: sh		Reconnect Discor
# Kubect1 des	cribe pods wordpress-mysql-55b46bofd7-n47kp -n anu-sql-anu-devtes	
une :	wordpress-mysgl=55b46bcfd7-n47kp	
unespace: de:	anu-agi-anu-devteat	
art Time:	amunaw-kes-ng-o/91/105/0/04	
bels:		
	nimata.io/application.name=rook-mysql	
	nirmata.io/application.run=anu-sql	
	nlmata.io/componentnwordpress-sysql	
	himata, 10/agicymant.maneworogress-mysgi	
	hirasta io/envicumente.imaneanu-uuvveut	
	fiormysql	
notations:	<pre><pre>sone></pre></pre>	
atus:	Running	
ntrolled Bre	155.8.0.10 ReplicaSet/wordpress-sysgl-55b46bcfd7	
ontainers:	xeptodeor wordsteele addressed addressed addressed addressed addressed addressed addressed addressed addressed	
mysql:		
Container 1	D: docker://2046ca2a49757c5c236194dfbb485b09e391ef8d8233d54a689814e3d3a1c84c	
Image:	mysgl:5.6	
Image ID: Port:	dockxr-pullable//myzql&sha256:2048836690b841604890c369aal74fc1f73c125363d94d99cfd08115f45130c9 3306/rcm	
State:	3.00/TCP Running	
Started:	Mon, 27 Aug 2018 04:17:56 +0000	
Ready:	True	
Restart Con		
Environment		
MysqL_Roc Mounts:	7_PASSWORD: changeme	
	rook from mysql-persistent-storage (rw)	
	secrets/kubernetes.io/serviceaccount from default-token-t57fm (ro)	
onditions		
Type Initialized	Status	
Initialized Ready	frue Tue	
PodScheduled		
lumes:		
mysql-persist		
Type:	FersistentVolumeClaim (a reference to a FersistentVolumeClaim in the same namespace)	
ClaimName: ReadOnly:	nysel-py-olain	
default-toker		
Type:	Secret (a volume populated by a Secret)	
SecretNane	default-token-t57fm	
Optional:		
S Class:	BestEffort	
de-Selectors: lerations:	<pre><non>> node.kubernetes.io/not-ready:NoExecute for 300s</non></pre>	
10101010101	node.kubernetes.jovnot-zeadyinozkecute for JUUs node.kubernetes.jovnot-zeadyinozkecute for JUUs	

Verify data persistence across replication with host failure scenario -

- Navigate to Environments→*Environment Name*→*Application*→*Pod Name* Click the container name (mysql) under Running Containers
 Click the Gear Icon on top right→Launch Terminal

nning Container	mysql					
unning					Crea	View Logs
						Launch Termii
O Restarts		3 %	14.59 % Memory	O B Bytes In		0 B Bytes Out
Container Statu	2					
Ready:	true		State			
Image:	mysql:5.6		State	Contraction of the second s		
	mysql:5.6 docker-	fba52c3e670.8fd				
Image:	mysql:5.6		State	Contraction of the second s		

4. Leave sh as Command, click Connect Terminal



Change terminal settings	
Command	
sh	

5. In the terminal window, enter mysql command to connect to mysql database as root user

mysql -u root -pchangeme

🜔 mysql
Command: sh
<pre># mysql -u root -pchangeme Warning: Using a password on the command line interface can be insecure. Welcome to the MySQL monitor. Commands end with ; or \g. Your MySQL connection id is 1 Server version: 5.6.40 MySQL Community Server (GPL)</pre>
Copyright (c) 2000, 2018, Oracle and/or its affiliates. All rights reserved.
Oracle is a registered trademark of Oracle Corporation and/or its affiliates. Other names may be trademarks of their respective owners.
Type 'help;' or '\h' for help. Type '\c' to clear the current input statement.
mysql>

6. Create new database mysql> create database testrook; Query OK, 1 row affected (0.00 sec)

7. Verify mysql> show databases; +-----+ | Database | +----+



1	information_schema	1
1	#mysql50#lost+found	1
/	mysql	1
/	performance_schema	1
	testrook	1
+•		+
5	rows in set (0.01 se	c)

8. Connect to new database mysql> use testrook; Database changed

 Create new table
 mysql> create table employee (id INT AUTO_INCREMENT PRIMARY KEY, name varchar(20), dept varchar(10), salary int(10));

Query OK, 0 rows affected (0.12 sec)

10. Insert few records in the new table

mysql> insert into employee values(100,'Thomas','Sales',5000); Query OK, 1 row affected (0.08 sec)

mysql> insert into employee values(200,'Jason','Technology',5500); Query OK, 1 row affected (0.11 sec)

mysql> insert into employee values(300,'Mayla','Technology',7000); Query OK, 1 row affected (0.06 sec)

mysql> insert into employee values(400,'Nisha','Marketing',9500); Query OK, 1 row affected (0.05 sec)

mysql> ;

Query OK, 1 row affected (0.05 sec)

11. Verify

mysql> select * from employee;

+	+	+	++
id	name	dept	salary
+	+	+	++
200 300 400		Sales Technology Technology Marketing Technology	5000 5500 7000 9500 6000



5 rows in set (0.00 sec)

12. Exit from mysql and terminal mysql> exit

Disable host running the current pod

 Find the Host where the Pod is running by navigating to Environments→*Environment Name*→*Application*→*Pod Name* (Host IP shown under Pod Status)

	Phase: Running Start Time: 2018-08-2 Host IP: 165.0.0.6 Pod IP: 165.8.2.14 QOS Class: BestEffort		Workload Controller	Name: Kind: State: Pods:	wordpress-mysql Deployment Running 1 of 1		Expose controller as a Se	vice
Condition	Reason	Update On	Running Services		CPU	Memory	State	
Initialized		15 hours ago	wordpress-mysql		0.06 %	15.63 %		×
PodScheduled		15 hours ago	wordpreasiniyaqı		0.00 %	15.05 %	Kurining	^
rouseneouleo								
Ready		15 hours ago	Running Containers					

2. As an admin user, go to Clusters→*Cluster Name (running this environment)*. Click View details in Node box, click the gear icon next to the Host running the Pod, click Disable Node

4 Q search			×		↔ >.
Name	Labels	IP Addresses	Connection State	Cluster State	r
anubhav-k8s-hg-59479	15 Labels	40.122.71.94, 165.0.0.5	Connected	Ready	۰ م
anubhav-k8s-hg-38899	15 Labels	40.122.31.24, 165.0.0.6	Connected	Ready	۰ م
				🕼 Manage L	

4.Click Disable Node to confirm



h	Disable Node ×	
	Disable Node anubhav-k8s-hg-38899? All pods on this node will be rescheduled on other nodes.	
	Air pous off this houe will be rescheduled off other houes.	
	Cancel Disable Node	
	15 Lobala 40 112 200 218 455 0.0 4	

Connected							Created 3 days ag	go by anubhav@nir	mata.co
106 Contain	ners	4 of 4 Hos	ts Used		5% CPU Us	ed	37% м	emory Used	
Name	Labels	Instance Id	Agent	Docker	IP Addresses	Memory (MB)	Containers	State	
anubhav-k8s-hg-59479	15 Labels	anubhav-k8s-hg-59479	1.2.3	17.06.0-ce	40.122.71.94 165.0.0.5	3441	31	Connected	۰. م
anubhav-k8s-hg-38899	15 Labels	anubhav-k8s-hg-38899	1.2.3	17.06.0-ce	40.122.31.24 165.0.0.6	3441	29	Disabled	۰ م
anubhav-k8s-hg-67991	15 Labels	anubhav-k8s-hg-67991	1.2.3	17.06.0-ce	40.113.200.218 165.0.0.4	3441	27	Connected	٥.
anubhav-k8s-hg-86496	15 Labels	anubhav-k8s-hg-86496	1.2.3	17.06.0-ce	40.113.236.5 165.0.0.7	3441	19	Connected	φ

Verify data in the new Pod

On disabling the node where the original Pod was running, Kubernetes will reschedule the Pod on another available host in the cluster. Pod name will be different from the original one. Verify by navigating to Environments \rightarrow *Environment Name* \rightarrow *Application* \rightarrow *Pod Name*



φ.-

Running Pod wordpress-mysql-5dbdf49975-6b4xh

inning							Created a minute ago by №
0 Alarms	C		CPU	 Memory		 Bytes In	Bytes Out
Pod Status	Phase: Running Start Time: 2018-08-27T Host IP: 165.0.0.4 Pod IP: 165.8.0.17 QOS Class: BestEffort	20:02:01Z	Workload C	Name: Kind: State:	wordpress-mysq Deployment Running 1 of 1	I	Expose controller as a Servic
 Condition PodScheduled Initialized 	Reason	Update On 2 minutes ago 2 minutes ago	Running Ser Name wordpress-m		CPU 0.06 %	Memory 15.63 %	State Running ×
 Ready 		a minute ago	Running Con	ntainers Image		Restarts	State
				0			

Login to mysql database

1. Navigate to Environments→*Environment Name*→*Application*→*Pod Name*→mysql (under Running containers). Click the gear icon on top right→Launch Terminal

Environments	Environment UAT-DC-Env01 Application n	nysql-rook-repl-app Pod word	press-mysql-7567dcd89b-8wtj2 mysql	ö-
Running	ттузчі		Cr	-
O Restarts	0.03 % cpu	11.66 % Memory	0 B Bytes In	O B Bytes Out
Container Statu	5			
Ready: Image:	true mysql:5.6	State State		
Image ID:	docker- pullable://mysql@sha256:29e32fba52c3e6708fd c8a7678287debe3554febced25ade8686a63d440 9ceda	Start a	t: 2018-07-25103:23:322	
Container ID:	docker://4b1660048c3fa94cfcafc7bdce96c51bdd 814ee621d1f05eee8bf1f1c4186c68			

1. Leave sh as Command, click Connect Terminal



Change terminal settings	
Command	
sh	

2. In the terminal window, enter mysql command to connect to mysql database as root user

mysql -u root -pchangeme

🐧 mysql
Command: sh
<pre># mysql -u root -pchangeme Warning: Using a password on the command line interface can be insecure. Welcome to the MySQL monitor. Commands end with ; or \g. Your MySQL connection id is 1 Server version: 5.6.40 MySQL Community Server (GPL)</pre>
Copyright (c) 2000, 2018, Oracle and/or its affiliates. All rights reserved.
Oracle is a registered trademark of Oracle Corporation and/or its affiliates. Other names may be trademarks of their respective owners.
Type 'help;' or '\h' for help. Type '\c' to clear the current input statement.
mysql>

3. Verify "testrook" database

mysql> show databases;

+.		. +
İ	Database	
+ · 	information_schema	·+
1	#mysql50#lost+found	1
	mysql	1



	performance_schema testrook					
+ •					+	
5	rows	in	set	(0.01	sec)	

4. Connect to testrook database

mysql> use testrook;

```
Reading table information for completion of table and column names
You can turn off this feature to get a quicker startup with -A
```

Database changed

5. Verify records in employee table

mysql> select * from employee;

•	+ name	•	++ salary
100 200 300 400	Thomas Jason MayLa Nisha		5000 5500 7000 9500 6000

5 rows in set (0.00 sec)

6. Exit from mysql and terminal mysql>*exit;*