Red Hat
Training and
Certification

OpenShift Administration I - Managing Containers and Kubernetes

Travis Michette

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Credentials

UN/PW: **developer/developer**

or

UN/PW: **admin/redhatocp**

- **Web Console**: https://console-openshift-console.apps.ocp4.example.com
- **OpenShift API**: https://api.ocp4.example.com:6443

Listing 1. Developer Login

```
oc login -u developer -p developer https://api.ocp4.example.com:6443
```

Listing 2. Administrator Login

```
oc login -u admin -p redhatocp https://api.ocp4.example.com:6443
```

Example 1. DEMO: Navigating the OpenShift Web Console

1. Login to OCP WebUI

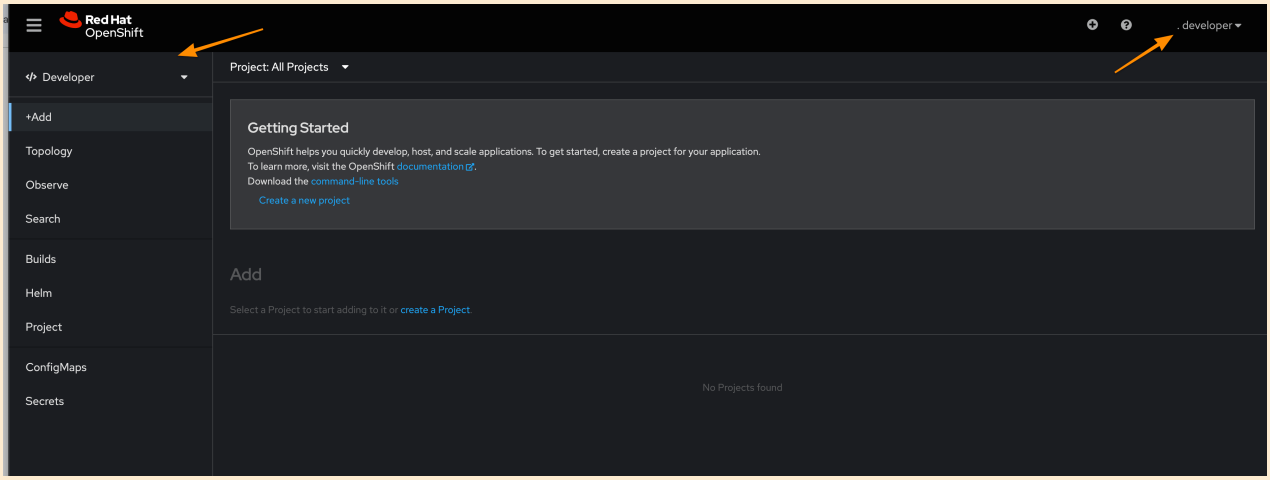


Figure 1. OpenShift Developer Console

2. Create a project (**Add** ⇒ **Create a Project**)

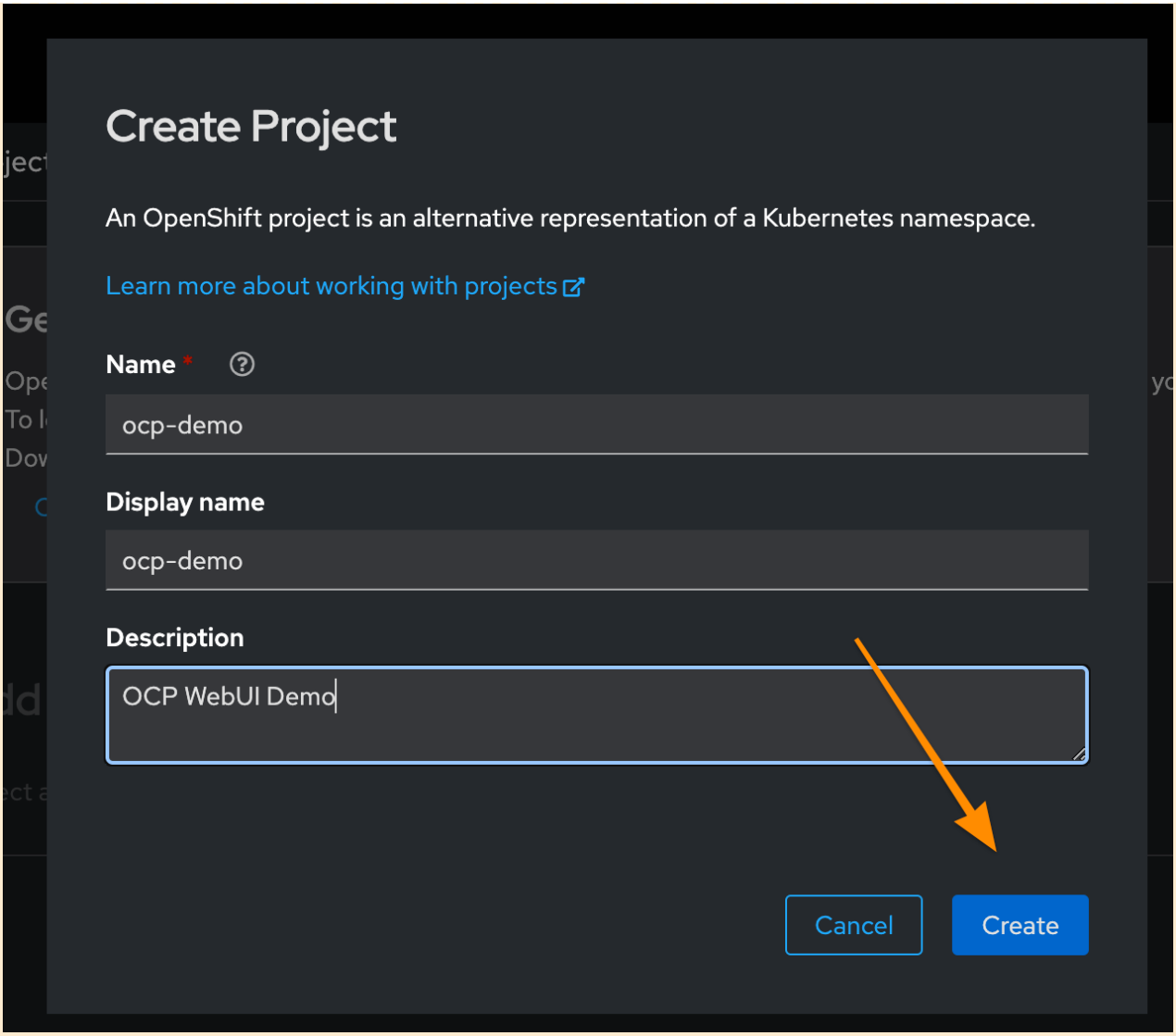
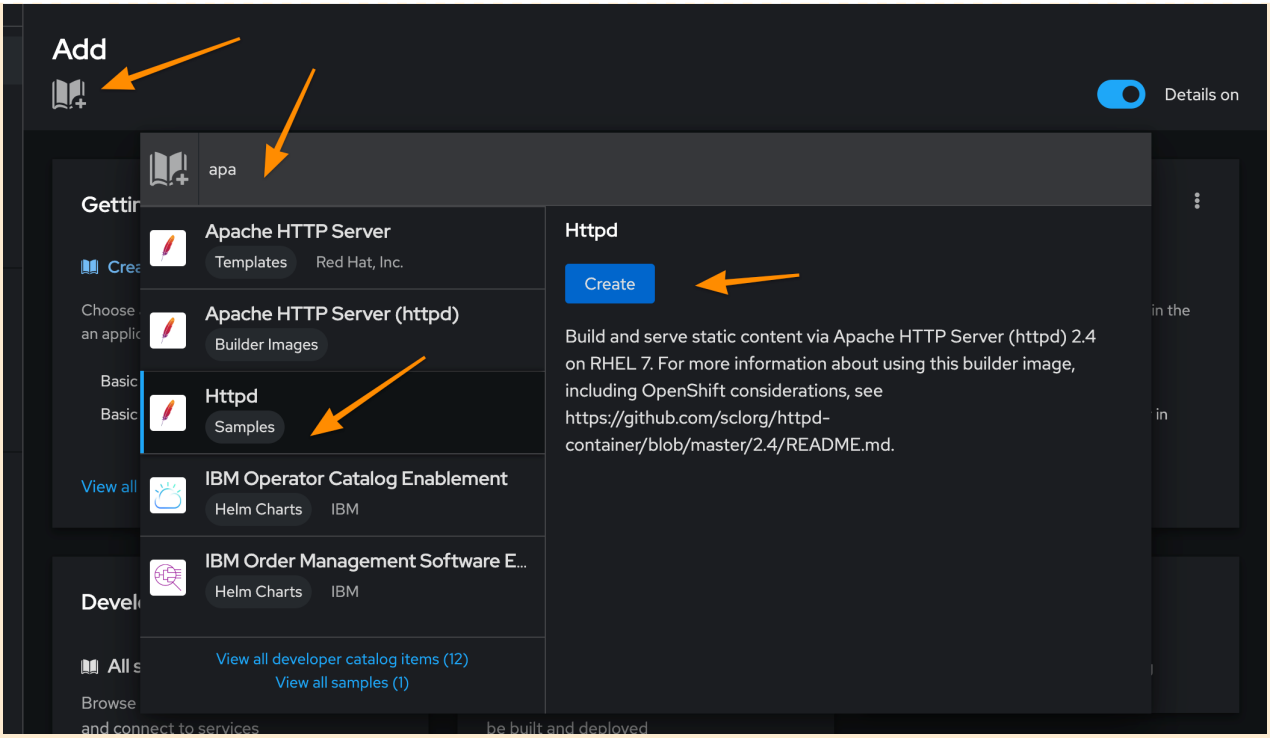
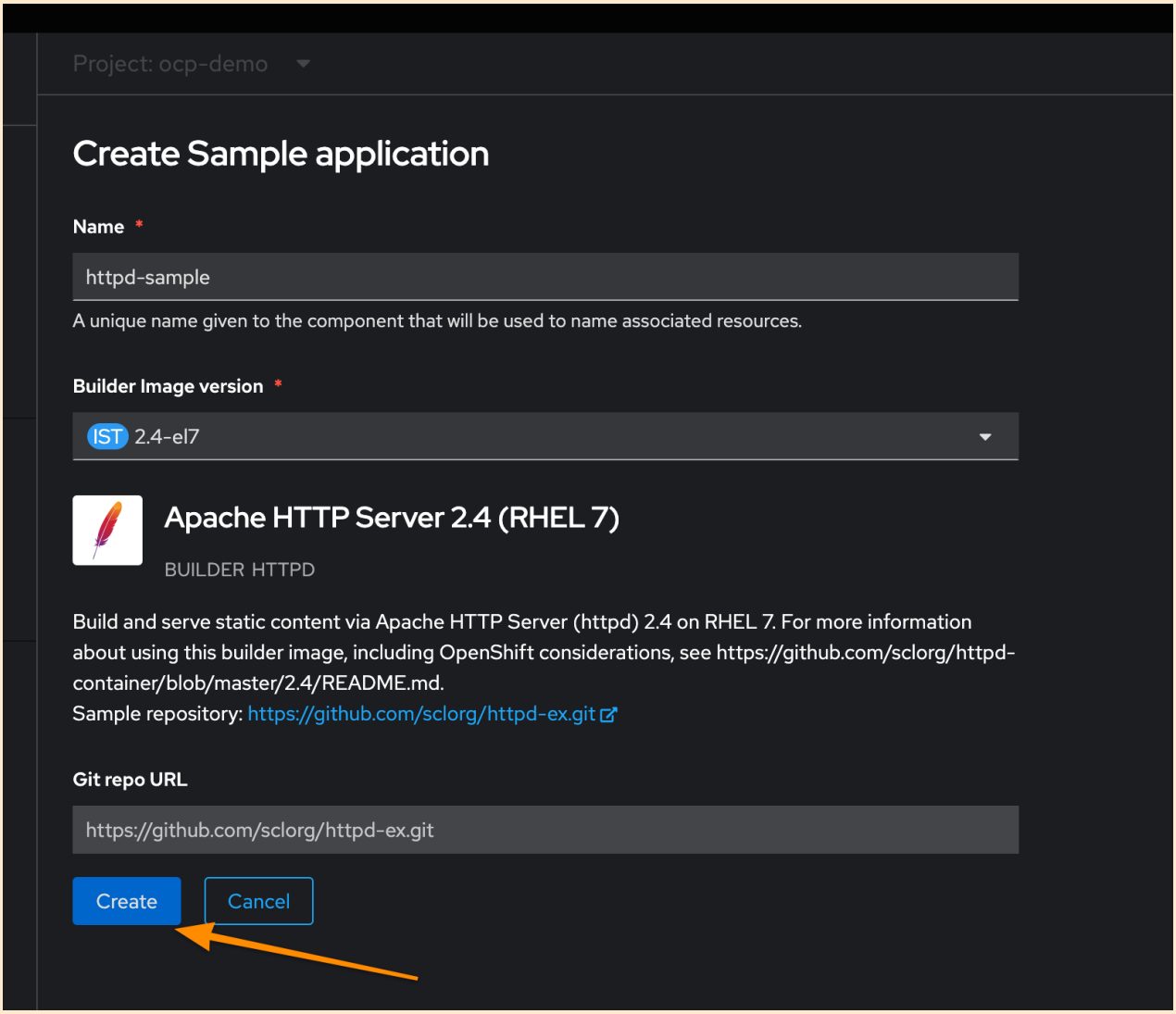


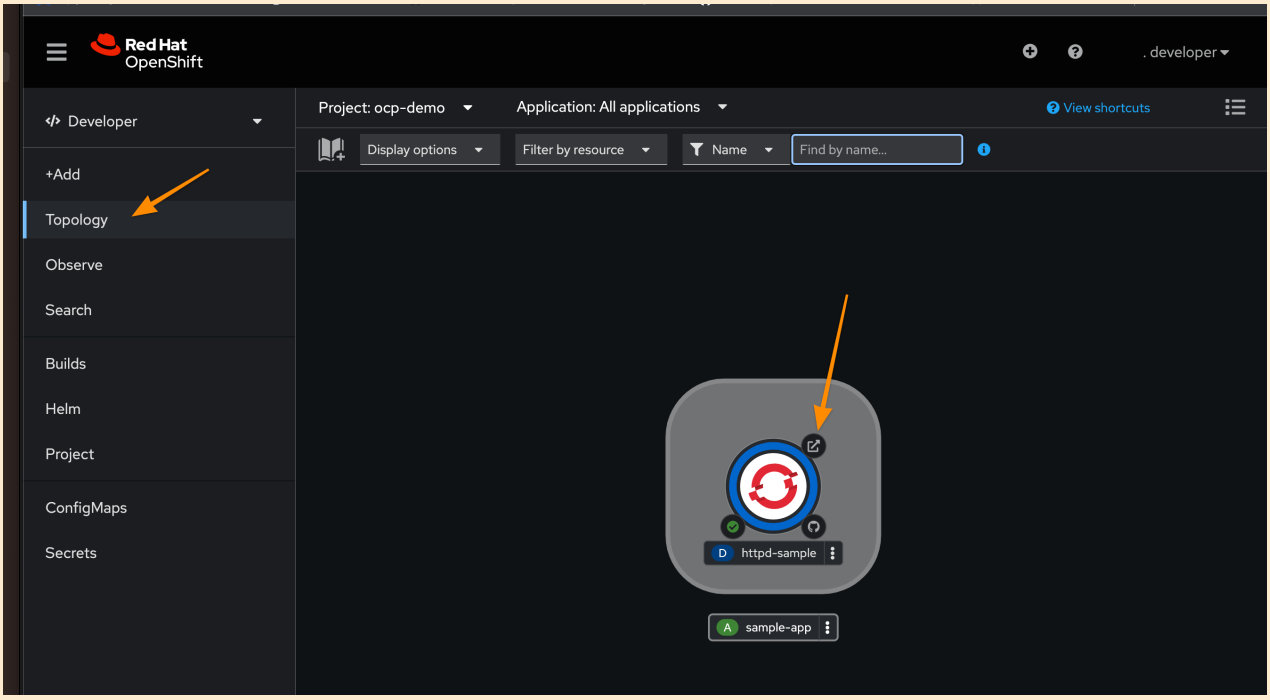
Figure 2. OpenShift New Project

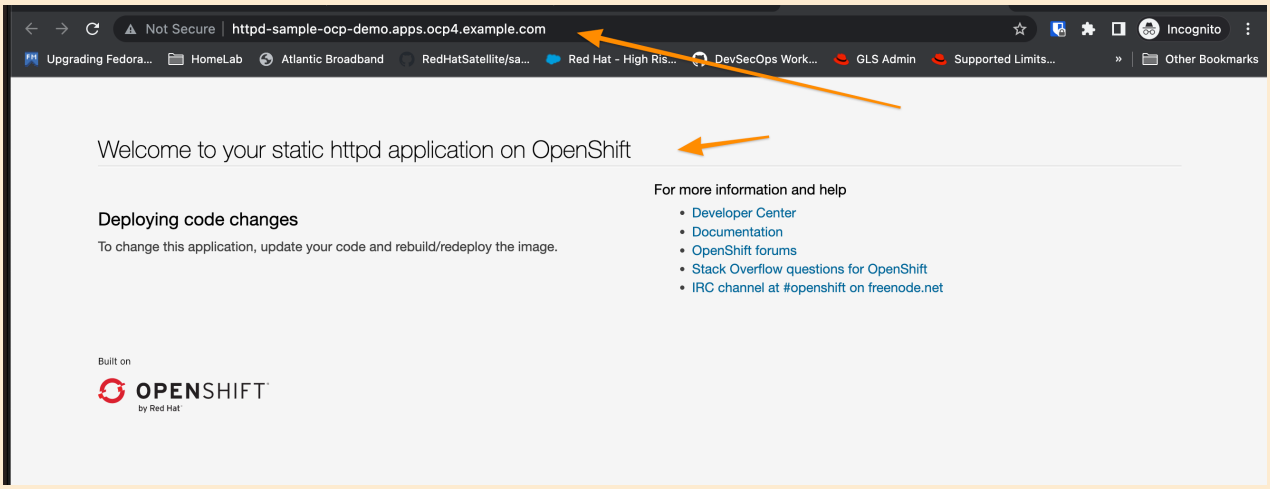
3. Click the "Add" then search for Apache. Select the **HTTPD Samples" and click *Create**


Add
Details on
apa
Apache HTTP Server
Templates
Red Hat, Inc.
Apache HTTP Server (httpd)
Builder Images
Httpd
Samples
IBM Operator Catalog Enablement
Helm Charts
IBM
IBM Order Management Software E...
Helm Charts
IBM
View all developer catalog items (12)
View all samples (1)
Httpd
Create
Build and serve static content via Apache HTTP Server (httpd) 2.4 on RHEL 7. For more information about using this builder image, including OpenShift considerations, see https://github.com/sclorg/httpd-container/blob/master/2.4/README.md.


Project: ocp-demo
Create Sample application
Name *
httpd-sample
A unique name given to the component that will be used to name associated resources.
Builder Image version *
IST 2.4-el7
Apache HTTP Server 2.4 (RHEL 7)
BUILDER HTTPD
Build and serve static content via Apache HTTP Server (httpd) 2.4 on RHEL 7. For more information about using this builder image, including OpenShift considerations, see https://github.com/sclorg/httpd-container/blob/master/2.4/README.md.
Sample repository: https://github.com/sclorg/httpd-ex.git
Git repo URL
https://github.com/sclorg/httpd-ex.git
Create
Cancel

4. Examine the new application and look at the website (from the **Topology** Section)





5. Examine other piece of OCP for the project (from Administrator Perspective)
   - Networking ⇒ Services
   - Networking ⇒ Routes

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1.6. DEMO: Monitoring and OCP Cluster

Credentials

UN/PW: **developer/developer**

or

UN/PW: **admin/redhatocp**

- **Web Console**: https://console-openshift-console.apps.ocp4.example.com
- **OpenShift API**: https://api.ocp4.example.com:6443

Listing 3. Developer Login

```
oc login -u developer -p developer https://api.ocp4.example.com:6443
```

Listing 4. Administrator Login

```
oc login -u admin -p redhatocp https://api.ocp4.example.com:6443
```

Example 2. DEMO: OCP Cluster Monitoring

1. Login to the OCP Cluster

```
[student@workstation ~]$ oc login -u developer -p developer
https://api.ocp4.example.com:6443
Login successful.
```

2. Obtain Console URL

```
[student@workstation ~]$ oc whoami --show-console
https://console-openshift-console.apps.ocp4.example.com
```

3. Login to the WebUI as an administrator and use the **Administrator** perspective to investigate monitoring capabilities.
   - Open **https://console-openshift-console.apps.ocp4.example.com** in Firefox
   - UN/PW: **admin/redhatocp**
4. Navigate to **Home** ⇒ **Overview** to see an overview of OCP Resources

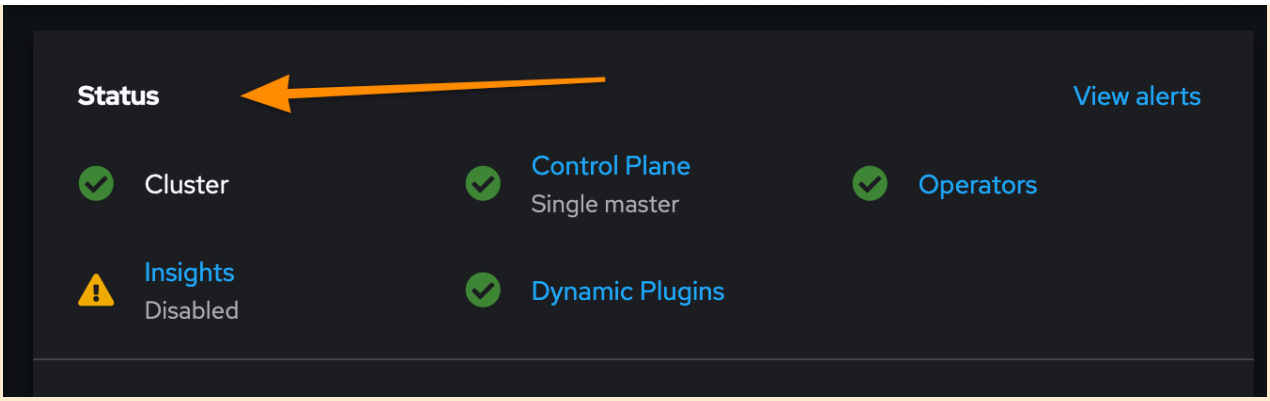

Figure 3. OCP Cluster Status

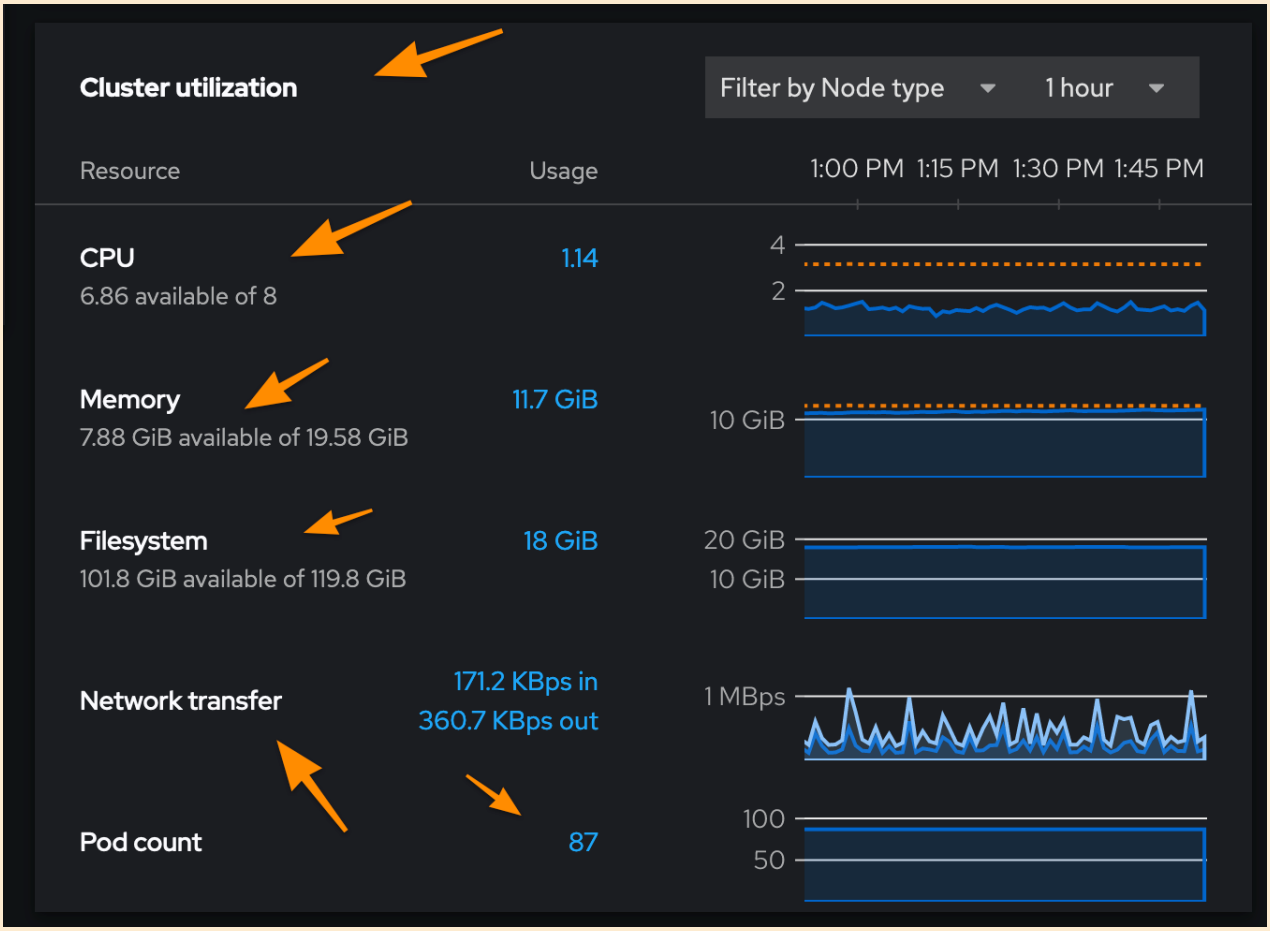

Figure 4. OCP Cluster Utilization

5. Look at and Monitor OCP Node from Terminal
   - **Compute** ⇒ **Nodes** ⇒ **Master01** then open **Terminal**

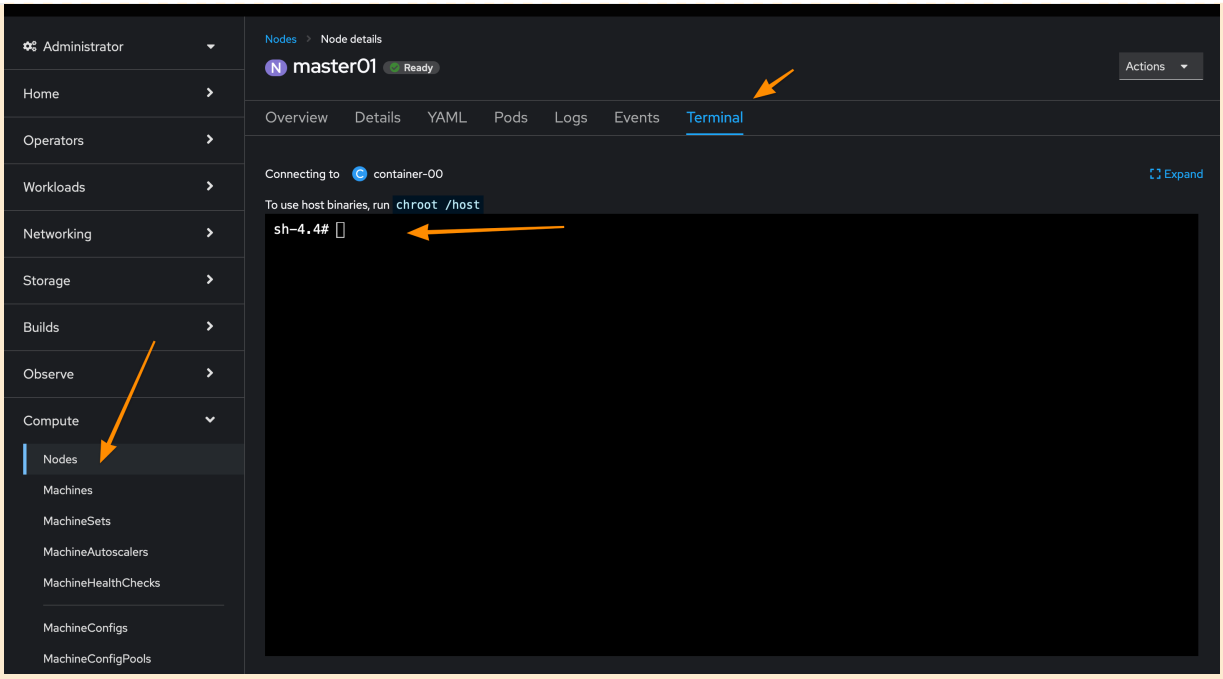

Figure 5. OCP Node Terminal

6. Analyze Node Services

Listing 5. Accessing Host Binaries

```
chroot /host
```

Listing 6. Getting Kublet Service Status

```
sh-4.4# systemctl status kubelet
● kubelet.service - Kubernetes Kubelet
   Loaded: loaded (/etc/systemd/system/kubelet.service; enabled; vendor preset:
disabled)
  Drop-In: /etc/systemd/system/kubelet.service.d
           └──01-kubens.conf, 10-mco-default-madv.conf, 20-logging.conf, 20-
nodenet.conf
   Active: active (running) since Wed 2023-04-26 16:05:04 UTC; 1h 54min ago
 Main PID: 3172 (kubelet)
    Tasks: 28 (limit: 127707)
   Memory: 387.5M
      CPU: 20min 41.675s
   CGroup: /system.slice/kubelet.service
```

Listing 7. Obtain CRI-O Container Runtime Service Information

```
sh-4.4# systemctl status crio
● crio.service - Container Runtime Interface for OCI (CRI-O)
   Loaded: loaded (/usr/lib/systemd/system/crio.service; disabled; vendor preset:
```

```
disabled)
  Drop-In: /etc/systemd/system/crio.service.d
           └──01-kubens.conf, 10-mco-default-madv.conf, 10-mco-profile-unix-
socket.conf, 20-nodenet.conf
   Active: active (running) since Wed 2023-04-26 16:05:03 UTC; 1h 55min ago
     Docs: https://github.com/cri-o/cri-o
 Main PID: 3134 (crio)
    Tasks: 99
   Memory: 5.8G
      CPU: 13min 33.874s
   CGroup: /system.slice/crio.service
           ├──  3134 /usr/bin/crio
```

7. Discuss the **Observe** Options
   - Alerting
   - Metrics
   - Dashboards

Chapter 2. Kubernetes and OpenShift Command-Line Interfaces and APIs

2.1. The Kubernetes and OpenShift Command-Line Interfaces

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2.1.1. The Kubernetes and OpenShift Command-Line Interfaces

2.1.1.1. Kubernetes Command-Line Tool

2.1.1.2. The OpenShift Command-Line Tool

2.1.1.3. Managing Resources at the Command Line

2.1.1.4. Authentication with OAuth

2.2. DEMO: Kubernetes and OpenShift Command-Line Interfaces

Credentials

UN/PW: **developer/developer**

or

UN/PW: **admin/redhatocp**

- **Web Console**: https://console-openshift-console.apps.ocp4.example.com
- **OpenShift API**: https://api.ocp4.example.com:6443

Listing 8. Developer Login

```
oc login -u developer -p developer https://api.ocp4.example.com:6443
```

Listing 9. Administrator Login

```
oc login -u admin -p redhatocp https://api.ocp4.example.com:6443
```

kubectl Cheatsheet

https://kubernetes.io/docs/reference/kubectl/_print/#pg-8aba901ac13f124e5782b90ddb166ee2

Example 3. DEMO: Using Kubernetes and OpenShift Command-Line Interfaces

1. Login to OCP Cluster as Administrator

```
[student@workstation ~]$ oc login -u admin -p redhatocp
https://api.ocp4.example.com:6443
Login successful.
```

2. Configure Command-Line Completion for Kubectl

```
[student@workstation ~]$ echo "source <(kubectl completion bash)" >> ~/.bashrc ①

[student@workstation ~]$ source ~/.bashrc ②
```

① Add **kubectl** Completion to BASHRC

② Source the BASHRC file to make it active

3. Test **kubectl** BASH completion and list the help

```
[student@workstation ~]$ kubectl
alpha          cluster-info   diff           label          run
annotate       completion     drain          logs           scale
api-resources  config         edit           options        set
api-versions   cordon         exec           patch          taint
apply          cp             explain        plugin         top
attach         create         expose         port-forward   uncordon
auth           debug          get            proxy          version
autoscale      delete         help           replace        wait
certificate    describe       kustomize      rollout
```

```
[student@workstation ~]$ kubectl help
kubectl controls the Kubernetes cluster manager.

 Find more information at: https://kubernetes.io/docs/reference/kubectl/

Basic Commands (Beginner):
  create          Create a resource from a file or from stdin
  expose          Take a replication controller, service, deployment or pod and
expose it as a new Kubernetes service
  run             Run a particular image on the cluster
  set             Set specific features on objects

Basic Commands (Intermediate):
  explain         Get documentation for a resource
  get             Display one or many resources
  edit            Edit a resource on the server
  delete          Delete resources by file names, stdin, resources and names, or
by resources and label selector

Deploy Commands:
  rollout         Manage the rollout of a resource
  scale           Set a new size for a deployment, replica set, or replication
controller
  autoscale       Auto-scale a deployment, replica set, stateful set, or
replication controller

Cluster Management Commands:
  certificate     Modify certificate resources.
  cluster-info    Display cluster information
  top             Display resource (CPU/memory) usage
  cordon          Mark node as unschedulable
```

```
  uncordon        Mark node as schedulable
  drain           Drain node in preparation for maintenance
  taint           Update the taints on one or more nodes

Troubleshooting and Debugging Commands:
  describe        Show details of a specific resource or group of resources
  logs            Print the logs for a container in a pod
  attach          Attach to a running container
  exec            Execute a command in a container
  port-forward    Forward one or more local ports to a pod
  proxy           Run a proxy to the Kubernetes API server
  cp              Copy files and directories to and from containers
  auth            Inspect authorization
  debug           Create debugging sessions for troubleshooting workloads and
nodes

Advanced Commands:
  diff            Diff the live version against a would-be applied version
  apply           Apply a configuration to a resource by file name or stdin
  patch           Update fields of a resource
  replace         Replace a resource by file name or stdin
  wait            Experimental: Wait for a specific condition on one or many
resources
  kustomize       Build a kustomization target from a directory or URL.

Settings Commands:
  label           Update the labels on a resource
  annotate        Update the annotations on a resource
  completion      Output shell completion code for the specified shell (bash,
zsh, fish, or powershell)

Other Commands:
  alpha           Commands for features in alpha
  api-resources   Print the supported API resources on the server
  api-versions    Print the supported API versions on the server, in the form of
"group/version"
  config          Modify kubeconfig files
  plugin          Provides utilities for interacting with plugins
  version         Print the client and server version information

Usage:
  kubectl [flags] [options]

Use "kubectl <command> --help" for more information about a given command.
Use "kubectl options" for a list of global command-line options (applies to all
commands).
```

4. Obtain Version information with **kubectl** and **oc** commands

```
[student@workstation ~]$ kubectl version --short
Flag --short has been deprecated, and will be removed in the future. The --short
output will become the default.
Client Version: v1.24.1
Kustomize Version: v4.5.7
Server Version: v1.25.4+77bec7a
```

```
[student@workstation ~]$ oc version
Client Version: 4.12.0
Kustomize Version: v4.5.7
Server Version: 4.12.0
Kubernetes Version: v1.25.4+77bec7a
```

Differences between kubectl and oc Commands

It should be noted that the **kubectl** command cannot display OpenShift specific information and can't act on OpenShift-only resources. The command can only act on the general Kubernetes resources and information and for anything OpenShift-specific, the **oc** command must be used.

5. Get Cluster Info using **oc** and **kubectl**

```
[student@workstation ~]$ kubectl cluster-info
Kubernetes control plane is running at https://api.ocp4.example.com:6443

To further debug and diagnose cluster problems, use 'kubectl cluster-info dump'.
```

```
[student@workstation ~]$ oc cluster-info
Kubernetes control plane is running at https://api.ocp4.example.com:6443

To further debug and diagnose cluster problems, use 'kubectl cluster-info dump'.
```

6. Obtain information about OCP Nodes

```
[student@workstation ~]$ kubectl get nodes
NAME       STATUS   ROLES                         AGE   VERSION
master01   Ready    control-plane,master,worker   22d   v1.25.4+77bec7a
```

```
[student@workstation ~]$ oc get nodes
```

```
NAME       STATUS   ROLES                          AGE   VERSION
master01   Ready    control-plane,master,worker    22d   v1.25.4+77bec7a
```

Available kubectl Commands and oc Commands

There are several more commands supported for OpenShift using the **oc** command vs. using the **kubectl** command.

Listing 10. kubectl Commands

```
[student@workstation ~]$ kubectl
alpha           autoscale      create         exec           logs
rollout         version
annotate        certificate    debug          explain        options
run             wait
api-resources   cluster-info   delete         expose         patch
scale
api-versions    completion     describe       get            plugin
set
apply           config         diff           help           port-
forward   taint
attach          cordon         drain          kustomize      proxy
top
auth            cp             edit           label          replace
uncordon
```

Listing 11. oc Commands

```
[student@workstation ~]$ oc
adm             cluster-info   edit           import-image   observe
proxy           secrets
annotate        completion     exec           kustomize      options
registry        set
api-resources   config         explain        label          patch
replace         start-build
api-versions    cp             expose         login          plugin
rollback        status
apply           create         extract        logout         policy
rollout         tag
attach          debug          get            logs           port-
forward   rsh             version
auth            delete         help           new-app        process
rsync           wait
autoscale       describe       idle           new-build      project
run             whoami
cancel-build    diff           image          new-project    projects
```

```
scale
```

2.3. Inspect Kubernetes Resources

Section Info Here

2.3.1. Kubernetes and OpenShift Resources

2.3.1.1. Structure of Resources

2.3.2. Command Outputs

2.3.2.1. YAML Output

2.3.2.2. JSON Output

2.3.2.3. Custom Output

2.4. DEMO: Inspect Kubernetes Resources

Credentials

UN/PW: **developer/developer**

or

UN/PW: **admin/redhatocp**

- **Web Console**: https://console-openshift-console.apps.ocp4.example.com
- **OpenShift API**: https://api.ocp4.example.com:6443

Listing 12. Developer Login

```
oc login -u developer -p developer https://api.ocp4.example.com:6443
```

Listing 13. Administrator Login

```
oc login -u admin -p redhatocp https://api.ocp4.example.com:6443
```

Example 4. DEMO: Inspect Kubernetes Resources

1. Ensure resources exist

```
[student@workstation ~]$ lab start cli-resources
```

2. Login and switch to correct OCP Project

```
[student@workstation ~]$ oc login -u developer -p developer
https://api.ocp4.example.com:6443
Login successful.
```

```
[student@workstation ~]$ oc project cli-resources
```

3. List running pods

```
[student@workstation ~]$ kubectl get pods
NAME                     READY   STATUS    RESTARTS   AGE
myapp-77fb5cd997-nbb27   1/1     Running   0          4m40s
```

```
[student@workstation ~]$ oc get pods
NAME                     READY   STATUS    RESTARTS   AGE
myapp-77fb5cd997-nbb27   1/1     Running   0          3m56s
```

4. Get details about pod using **describe** or **get** sub-command and format output as YAML

```
[student@workstation ~]$ kubectl describe pod myapp-77fb5cd997-nbb27
Name:             myapp-77fb5cd997-nbb27
Namespace:        cli-resources
Priority:         0
Service Account:  default
Node:             master01/192.168.50.10
```

Listing 14. kubectl get Command on Pod

```
[student@workstation ~]$ kubectl get pod myapp-77fb5cd997-nbb27 -o yaml
apiVersion: v1
kind: Pod
metadata:
  annotations:

... OUTPUT OMITTED ...

  hostIP: 192.168.50.10
  phase: Running
  podIP: 10.8.0.82
  podIPs:
  - ip: 10.8.0.82
  qosClass: BestEffort
  startTime: "2023-04-26T19:12:36Z"
```

Listing 15. oc get Command on Pod

```
[student@workstation ~]$ oc get pod myapp-77fb5cd997-nbb27 -o yaml
apiVersion: v1
kind: Pod
metadata:

... OUTPUT OMITTED ...

  hostIP: 192.168.50.10
  phase: Running
  podIP: 10.8.0.82
  podIPs:
```

```
  - ip: 10.8.0.82
  qosClass: BestEffort
  startTime: "2023-04-26T19:12:36Z"
```

5. Obtain Information on Deployments

```
[student@workstation ~]$ kubectl describe deployment myapp
Name:                   myapp
Namespace:              cli-resources
CreationTimestamp:      Wed, 26 Apr 2023 15:12:36 -0400
Labels:                 app=myapp
Annotations:            deployment.kubernetes.io/revision: 1
Selector:               app=myapp
Replicas:               1 desired | 1 updated | 1 total | 1 available | 0
unavailable
StrategyType:           RollingUpdate
MinReadySeconds:        0
RollingUpdateStrategy:  25% max unavailable, 25% max surge
Pod Template:
  Labels:  app=myapp
  Containers:
   myapp:
    Image:        registry.ocp4.example.com:8443/ubi8/httpd-24:1-215
    Port:         <none>
    Host Port:    <none>
    Environment:  <none>
    Mounts:       <none>
  Volumes:        <none>
Conditions:
  Type           Status  Reason
  ----           ------  ------
  Available      True    MinimumReplicasAvailable
  Progressing    True    NewReplicaSetAvailable
OldReplicaSets:  <none>
NewReplicaSet:   myapp-77fb5cd997 (1/1 replicas created)
Events:
  Type    Reason             Age   From                   Message
  ----    ------             ----  ----                   -------
  Normal  ScalingReplicaSet  14m   deployment-controller  Scaled up replica set
myapp-77fb5cd997 to 1
```

6. Cleanup Resources

```
[student@workstation ~]$ lab finish cli-resources
```

2.5. Assess the Health of an OpenShift Cluster

Section Info Here

2.5.1. Query Operator Conditions

Operator Lifecycle Manager (OLM) Operators

sdf

2.5.2. Examining Cluster Metrics

2.5.2.1. Viewing Cluster Metrics

2.5.2.2. Viewing Project Metrics

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2.5.2.4. Performing Prometheus Queries in the Web Console

2.5.3. Query Cluster Events and Alerts

2.5.3.1. Kubernetes Alerts

2.5.4. Check Node Status

2.5.4.1. Check Pod Status

2.5.5. Collect Information for Support Requests

2.6. DEMO: Assess the Health of an OpenShift Cluster

Credentials

UN/PW: **developer/developer**

or

UN/PW: **admin/redhatocp**

- **Web Console**: https://console-openshift-console.apps.ocp4.example.com
- **OpenShift API**: https://api.ocp4.example.com:6443

Listing 16. Developer Login

```
oc login -u developer -p developer https://api.ocp4.example.com:6443
```

Listing 17. Administrator Login

```
oc login -u admin -p redhatocp https://api.ocp4.example.com:6443
```

Example 5. DEMO: Assessing OCP Cluster Health

1. Prepare environment

```
[student@workstation ~]$ lab start cli-health
```

2. Login as Admin

```
[student@workstation ~]$ oc login -u admin -p redhatocp
https://api.ocp4.example.com:6443
Login successful.
```

3. View Operators

```
[student@workstation ~]$ kubectl get operators
NAME                                AGE
lvms-operator.openshift-storage     22d
metallb-operator.metallb-system     22d
```

4. View Cluster Operators

```
[student@workstation ~]$ kubectl get clusteroperators
NAME                                       VERSION   AVAILABLE   PROGRESSING
DEGRADED   SINCE   MESSAGE
authentication                             4.12.0    True        False
False      21m
baremetal                                  4.12.0    True        False
False      22d
cloud-controller-manager                   4.12.0    True        False
False      22d
cloud-credential                           4.12.0    True        False
False      22d
cluster-autoscaler                         4.12.0    True        False
False      22d
config-operator                            4.12.0    True        False
False      22d
console                                    4.12.0    True        False
False      22d
control-plane-machine-set                  4.12.0    True        False
False      22d
csi-snapshot-controller                    4.12.0    True        False
False      22d
dns                                        4.12.0    True        False
False      22d
etcd                                       4.12.0    True        False
False      22d
image-registry                             4.12.0    True        False
False      22d
ingress                                    4.12.0    True        False
False      22d
insights                                   4.12.0    True        False
False      106s
kube-apiserver                             4.12.0    True        False
False      22d
kube-controller-manager                    4.12.0    True        False
False      22d
kube-scheduler                             4.12.0    True        False
False      22d
kube-storage-version-migrator              4.12.0    True        False
False      22d
machine-api                                4.12.0    True        False
False      22d
machine-approver                           4.12.0    True        False
False      22d
machine-config                             4.12.0    True        False
False      22d
marketplace                                4.12.0    True        False
False      22d
```

```
monitoring                                 4.12.0    True        False
False      3h58m
network                                    4.12.0    True        False
False      22d
node-tuning                                4.12.0    True        False
False      22d
openshift-apiserver                        4.12.0    True        False
False      3h59m
openshift-controller-manager               4.12.0    True        False
False      3h56m
openshift-samples                          4.12.0    True        False
False      22d
operator-lifecycle-manager                 4.12.0    True        False
False      22d
operator-lifecycle-manager-catalog         4.12.0    True        False
False      22d
operator-lifecycle-manager-packageserver   4.12.0    True        False
False      3h59m
service-ca                                 4.12.0    True        False
False      22d
storage                                    4.12.0    True        False
False      22d
```

5. View **etcd** Pods

```
[student@workstation ~]$ kubectl top pods etcd-master01 -n openshift-etcd
--containers
POD             NAME           CPU(cores)   MEMORY(bytes)
etcd-master01   POD            0m           0Mi
etcd-master01   etcd           87m          1146Mi
etcd-master01   etcd-metrics   11m          25Mi
etcd-master01   etcd-readyz    6m           39Mi
etcd-master01   etcdctl        0m           0M
```

6. Check Node Status

```
[student@workstation ~]$ kubectl get nodes
NAME       STATUS   ROLES                         AGE   VERSION
master01   Ready    control-plane,master,worker   22d   v1.25.4+77bec7a
```

Listing 18. Detailed Node Information regarding CPU

```
[student@workstation ~]$ kubectl get node master01 -o jsonpath=\ 'Allocatable:
{.status.allocatable.cpu}{"\n"}''Capacity: {.status.capacity.cpu}{"\n"}'
 Allocatable: 7500m
```

```
Capacity: 8
```

7. Get Node Stats with **top** Command

```
[student@workstation ~]$ kubectl top node
NAME       CPU(cores)   CPU%   MEMORY(bytes)   MEMORY%
master01   1714m        22%    12770Mi         67%
```

8. Open a Debug shell to nodes

```
[student@workstation ~]$ oc debug node/master01
Temporary namespace openshift-debug-9h2p9 is created for debugging node...
Starting pod/master01-debug ...
To use host binaries, run `chroot /host`
Pod IP: 192.168.50.10
If you don't see a command prompt, try pressing enter.
sh-4.4#
```

```
sh-4.4# chroot /host
sh-4.4#
```

Node Console Session

Debug pods can open a console session just like we did earlier when in the WebUI where we accessed the Node console through the GUI. It is important to remember that access to the OCP Nodes can only be done through a Debug console and the WebUI console. You can't **normally** login to an OCP node through SSH unless you have the **CoreOS** SSH keys and known credentials for the **core** user.

9. Verify Services

Listing 19. Verifying CRI-O Service

```
sh-4.4# systemctl is-active crio
active
```

Listing 20. Verifying the Kublet Service

```
sh-4.4# systemctl is-active kubelet
active
```

10. Additional Verifications

Listing 21. Using crictl to Get Info

```
sh-4.4# crictl info
{
  "status": {
    "conditions": [
      {
        "type": "RuntimeReady",
        "status": true,
        "reason": "",
        "message": ""
      },
      {
        "type": "NetworkReady",
        "status": true,
        "reason": "",
        "message": ""
      }
    ]
  }
}
```

11. List Pods running on a Node

```
sh-4.4# crictl pods
POD ID              CREATED             STATE               NAME
NAMESPACE                                       ATTEMPT             RUNTIME
7a46b73b46311       6 minutes ago       Ready               master01-debug
openshift-debug-9h2p9                           0                   (default)
dc46f0c6e6381       14 minutes ago      NotReady            collect-profiles-
28042335-ktxhc                              openshift-operator-lifecycle-manager
0                   (default)
e9468576e3417       29 minutes ago      NotReady            collect-profiles-
28042320-m45fr

... OUTPUT OMITTED ...
```

12. Cleanup Lab environment

```
lab finish cli-health
```

Chapter 3. Run Applications as Containers and Pods

3.1. Introduction to Linux Containers and Kubernetes Pods

Section Info Here

3.1.1. Containers Overview

3.1.2. Kubernetes and Containers

3.1.3. Creating Containers and Pods

3.1.4. User and Group IDs Assignment

3.1.4.1. Pod Security

3.1.5. Execute Commands in Running Containers

3.1.6. Container Logs

3.1.7. Deleting Resources

3.1.8. The CRI-O Container Engine

3.2. DEMO: Introduction to Linux Containers and Kubernetes Pods

Credentials

UN/PW: **developer/developer**

or

UN/PW: **admin/redhatocp**

- **Web Console**: https://console-openshift-console.apps.ocp4.example.com
- **OpenShift API**: https://api.ocp4.example.com:6443

Listing 22. Developer Login

```
oc login -u developer -p developer https://api.ocp4.example.com:6443
```

Listing 23. Administrator Login

```
oc login -u admin -p redhatocp https://api.ocp4.example.com:6443
```

Example 6. DEMO: Linux Containers and Kubernetes Pods (Introduction)

1. Show Container Image Registry
   - **URL**: https://registry.ocp4.example.com:8443/repository/
   - **UN/PW Combination**: developer/developer

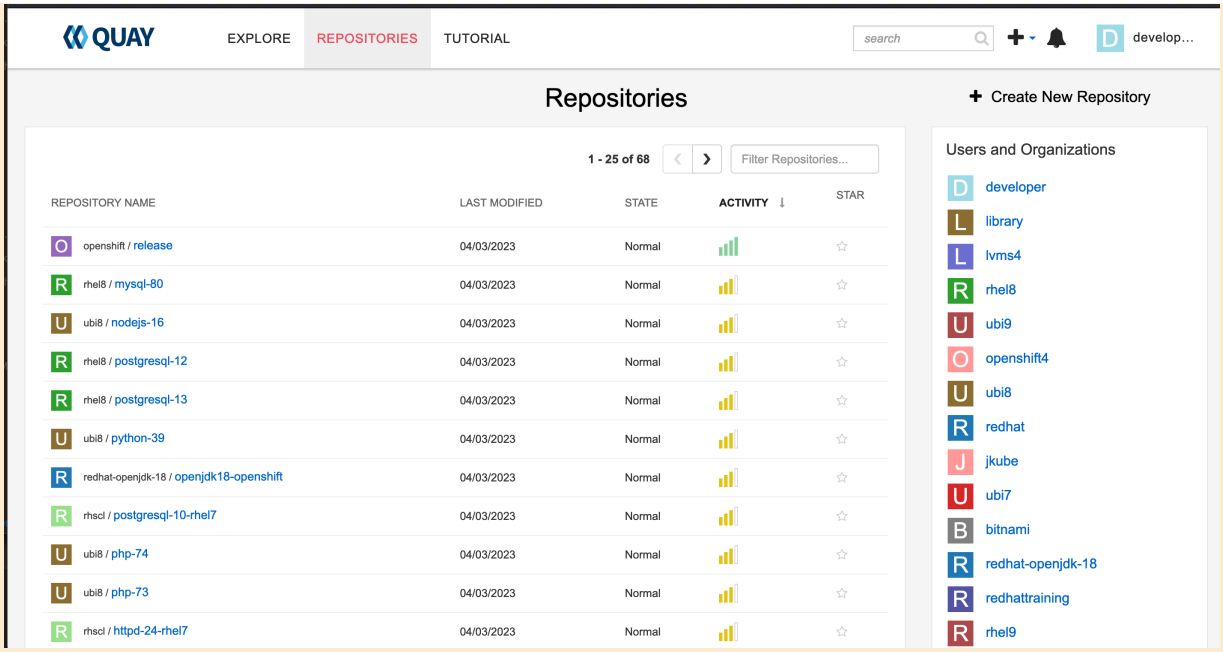


Figure 6. Internal Classroom Registry - Quay

2. Ensure Lab Environment is Ready

```
[student@workstation ~]$ lab start pods-containers
```

3. Login to OCP as a Developer

```
[student@workstation ~]$ oc login -u developer -p developer
https://api.ocp4.example.com:6443
Login successful
```

4. Create Demo Project

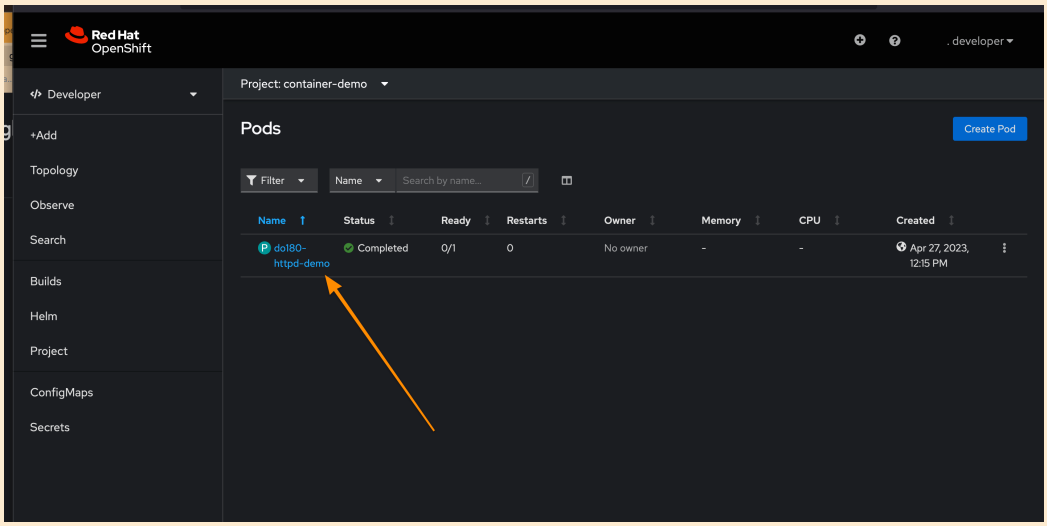
```
[student@workstation ~]$ oc new-project container-demo
```

5. Run a command from a container image

```
[student@workstation ~]$ oc run -it do180-httpd-demo --restart 'Never'  --image
registry.ocp4.example.com:8443/redhattraining/do180-httpd-app:v1 -- /bin/bash -c
"whoami && id && cat /etc/redhat-release"
1000710000
uid=1000710000(1000710000) gid=0(root) groups=0(root),1000710000
Red Hat Enterprise Linux release 8.7 (Ootpa)
```

View Container in OCP WebUI

The pod and container were running long enough for the BASH commands to execute and then the container completed, so the pod no longer has a running container.



6. Remove Pod

```
[student@workstation ~]$ oc delete pod do180-httpd-demo
```

7. Gain Interactive CLI Prompt in Container

```
[student@workstation ~]$ oc run -it do180-httpd-demo --restart 'Never'  --image
registry.ocp4.example.com:8443/redhattraining/do180-httpd-app:v1 -- /bin/bash
If you don't see a command prompt, try pressing enter
```

8. Test content of web directory

```
bash-4.4$ cat /var/www/html/index.php
<?php
$hostname = gethostname();
print "Welcome to Red Hat Training, from $hostname\r\n";
?>
```

9. Change content of web container and then exit the container shell.

```
bash-4.4$ echo "I'm welcoming you from Index.html" > /var/www/html/index.html

bash-4.4$ ls /var/www/html/
index.html  index.php
```

```
bash-4.4$ cat /var/www/html/index.html
I'm welcoming you from Index.html

bash-4.4$ exit
exit
[student@workstation ~]$
```

10. Remove existing container and restart container to show content is missing as the container storage is ephemeral.

```
[student@workstation ~]$ oc delete pod do180-httpd-demo
pod "do180-httpd-demo" deleted
```

```
[student@workstation ~]$ oc run -it do180-httpd-demo --restart 'Never'  --image
registry.ocp4.example.com:8443/redhattraining/do180-httpd-app:v1 -- /bin/bash
```

```
[student@workstation ~]$ oc run -it do180-httpd-demo --restart 'Never'  --image
registry.ocp4.example.com:8443/redhattraining/do180-httpd-app:v1 -- /bin/bash
If you don't see a command prompt, try pressing enter.

bash-4.4$ ls /var/www/html/
index.php
```

Ephemeral Storage

When launching a new pod (container) with the same image, it is easy to see that the index.html file created on the previous pod does not exist in this new instance. That is because running containers have ephemeral storage (unless persistent storage is added).

11. Run image and demonstrate **oc exec** Command

```
[student@workstation ~]$ oc run do180-httpd-demo --restart 'Never'  --image
registry.ocp4.example.com:8443/redhattraining/do180-httpd-app:v1
pod/do180-httpd-demo created
```

Listing 24. Verify Running Pods

```
[student@workstation ~]$ oc get pods
NAME              READY   STATUS    RESTARTS   AGE
do180-httpd-demo  1/1     Running   0          13s
```

Listing 25. Create Shell Into Pod with oc exec Command

```
[student@workstation ~]$ oc exec -it pods/do180-httpd-demo -- /bin/bash
bash-4.4$
```

Difference Between oc attach and oc exec

The **oc attach** command will drop the user into the existing processes and attempt to attach to a shell. Alternatively, the **oc exec** command will create a new shell process inside the container. This is often needed as some containers are running system services and processes and attach would place you in that same shell.

Listing 26. Demo of Running HTTPD Server on Container

```
bash-4.4$ curl localhost:8080
Welcome to Red Hat Training, from do180-httpd-demo
```

12. Clean up Project

```
[student@workstation ~]$ oc delete project container-demo
project.project.openshift.io "container-demo" deleted
```

3.3. Find and Inspect Container Images

Section Info Here

3.3.1. Container Image Overview

3.3.2. Container Image Registries

3.3.2.1. Red Hat Registry

3.3.2.2. Quay.io

3.3.2.3. Private Registries

3.3.3. Container Image Identifiers

3.3.4. Container Image Components

3.3.5. Container Image Instructions and Metadata

3.3.6. Base Images

3.3.7. Inspecting and Managing Container Images

3.3.7.1. Skopeo

3.3.7.2. Registry Credentials

3.3.7.3. Theoc imageCommand

3.3.8. Running Containers as Root

3.4. DEMO: Find and Inspect Container Images

Credentials

UN/PW: **developer/developer**

or

UN/PW: **admin/redhatocp**

- **Web Console**: https://console-openshift-console.apps.ocp4.example.com
- **OpenShift API**: https://api.ocp4.example.com:6443

Listing 27. Developer Login

```
oc login -u developer -p developer https://api.ocp4.example.com:6443
```

Listing 28. Administrator Login

```
oc login -u admin -p redhatocp https://api.ocp4.example.com:6443
```

Example 7. DEMO: Find and Inspect Container Images

1. Ensure Lab Environment is Ready

```
[student@workstation ~]$ lab start pods-images
```

2. Create a Project

```
[student@workstation ~]$ oc new-project pod-image-demo
```

3. Login to Container Image Registry

```
[student@workstation ~]$  skopeo login registry.ocp4.example.com:8443
Username: developer
Password:
Login Succeeded!
```

4. Use **skopeo** to list avaialble image tags

```
[student@workstation ~]$ skopeo list-tags
```

```
docker://registry.ocp4.example.com:8443/redhattraining/do180-httpd-app
{
    "Repository": "registry.ocp4.example.com:8443/redhattraining/do180-httpd-app",
    "Tags": [
        "v1"
    ]
}
```

Listing 29. Source Description

```
[student@workstation ~]$ skopeo inspect --config
docker://registry.ocp4.example.com:8443/redhattraining/do180-httpd-app:v1

... OUTPUT OMITTED ...

    "config": {
        "User": "1001", ①
        "ExposedPorts": {
            "8080/tcp": {} ②
        },
        "Env": [
            "PATH=/usr/local/sbin:/usr/local/bin:/usr/sbin:/usr/bin:/sbin:/bin",
            "container=oci"
        ],
        "Cmd": [
            "/bin/sh",
            "-c",
            "php-fpm -D ; httpd -D FOREGROUND" ③
        ],

... OUTPUT OMITTED ...
```

① Shows user that container image is using

② Shows the exposed ports in the image

③ Specifies the command to be run when a container is launched with this container image.

1. Gather image information using the **oc image info** command

```
[student@workstation ~]$ oc image info
registry.ocp4.example.com:8443/redhattraining/do180-httpd-app:v1
Name:          registry.ocp4.example.com:8443/redhattraining/do180-httpd-app:v1
Digest:
sha256:5d8b36a4a557215ccfc5e30af8665528c7bf96a6589009bc66041d7fae0e76f4
Media Type:    application/vnd.oci.image.manifest.v1+json

... OUTPUT OMITTED ...
```

```
Command:       /bin/sh -c php-fpm -D ; httpd -D FOREGROUND
User:          1001 ①
Exposes Ports: 8080/tcp ②

... OUTPUT OMITTED ...
```

④ Container image user

⑤ Container image exposed ports

1. Run the container image as a container

```
[student@workstation ~]$ oc run do180-httpd-demo --restart 'Never'  --image
registry.ocp4.example.com:8443/redhattraining/do180-httpd-app:v1
pod/do180-httpd-demo created
```

2. Obtain POD IP address

```
[student@workstation ~]$ oc get pods do180-httpd-demo -o json | jq
.status.podIP
"10.8.0.80"
```

3. Login as **administrator** user and open a Debug Pod on the Master01 node

```
[student@workstation ~]$ oc login -u admin -p redhatocp
https://api.ocp4.example.com:6443
```

```
[student@workstation ~]$ oc debug node/master01

sh-4.4# chroot /host
```

4. Verify the container network and website

```
sh-4.4# curl 10.8.0.80:8080
Welcome to Red Hat Training, from do180-httpd-demo
```

Compute Node and SDN Container Networking

Since we've switched to the compute node where the container is running, and we've launched a debug shell we have access to the SDN container network. It is possible to use the networking to check network services

from pods/containers.

5. Exit out of Debug Node Shell and Return to the Developer User

```
sh-4.4# exit
exit
sh-4.4# exit
exit

Removing debug pod ...
Temporary namespace openshift-debug-m49ll was removed.
```

```
[student@workstation ~]$ oc login -u developer -p developer
https://api.ocp4.example.com:6443
Login successful
```

6. Remove demo pods and project

```
[student@workstation ~]$ oc delete project pod-image-demo
project.project.openshift.io "pod-image-demo" deleted
```

3.5. Troubleshoot Containers and Pods

Section Info Here

3.5.1. Container Troubleshooting Overview

3.5.2. CLI Troubleshooting Tools

3.5.3. Editing Resources

3.5.4. Copy Files to and from Containers

3.5.5. Remote Container Access

3.5.6. Connect to Running Containers

3.5.7. Execute Commands in a Container

3.5.8. Container Events and Logs

3.5.9. Available Linux Commands in Containers

3.5.10. Troubleshooting from Inside the Cluster

3.6. DEMO: Troubleshoot Containers and Pods

Credentials

UN/PW: **developer/developer**

or

UN/PW: **admin/redhatocp**

- **Web Console**: https://console-openshift-console.apps.ocp4.example.com
- **OpenShift API**: https://api.ocp4.example.com:6443

Listing 30. Developer Login

```
oc login -u developer -p developer https://api.ocp4.example.com:6443
```

Listing 31. Administrator Login

```
oc login -u admin -p redhatocp https://api.ocp4.example.com:6443
```

Getting VIM as the editor and setting up guides for the oc edit command.

Listing 32. .vimrc File contents

```
setlocal ai ts=2 sw=2 et colorcolumn=3,5,7,9,11
```

Listing 33. Setting Environment Variables

```
[student@workstation ~]$ export OC_EDITOR=vim

[student@workstation ~]$ export EDITOR=vim
```

Example 8. DEMO: Troubleshoot Containers and Pods

1. Ensure environment is ready and login as a developer

```
[student@workstation ~]$ lab start pods-troubleshooting
```

```
[student@workstation ~]$ oc login -u developer -p developer
https://api.ocp4.example.com:6443
```

2. Create Troubleshooting Demo Project

```
[student@workstation ~]$ oc new-project troubleshooting-demo
```

3. Launch Container

```
[student@workstation ~]$ oc run do180-httpd-demo --restart 'Never'  --image
registry.ocp4.example.com:8443/redhattraining/do180-httpd-app
pod/do180-httpd-demo created
```

4. View Pod Status

```
[student@workstation ~]$ oc get pods
NAME               READY   STATUS         RESTARTS   AGE
do180-httpd-demo   0/1     ErrImagePull   0          33s
```

5. Get Events

```
[student@workstation ~]$ oc get events
LAST SEEN   TYPE      REASON           OBJECT                  MESSAGE
70s         Normal    Scheduled        pod/do180-httpd-demo   Successfully
assigned troubleshooting-demo/do180-httpd-demo to master01
70s         Normal    AddedInterface   pod/do180-httpd-demo   Add eth0
[10.8.0.83/23] from ovn-kubernetes
29s         Normal    Pulling          pod/do180-httpd-demo   Pulling image
"registry.ocp4.example.com:8443/redhattraining/do180-httpd-app"
29s         Warning   Failed           pod/do180-httpd-demo   Failed to pull image
"registry.ocp4.example.com:8443/redhattraining/do180-httpd-app": rpc error: code =
Unknown desc = reading manifest latest in
registry.ocp4.example.com:8443/redhattraining/do180-httpd-app: manifest unknown:
manifest unknown ①
```

① Showing that manifest is unknown and image isn't available

6. Look at Logs

```
[student@workstation ~]$ oc logs do180-httpd-demo
Error from server (BadRequest): container "do180-httpd-demo" in pod "do180-httpd-
demo" is waiting to start: trying and failing to pull image
```

7. Use the **skopeo** command to inspect images and the registry

```
[student@workstation ~]$ skopeo login registry.ocp4.example.com:8443
```

```
[student@workstation ~]$ skopeo list-tags
docker://registry.ocp4.example.com:8443/redhattraining/do180-httpd-app
{
    "Repository": "registry.ocp4.example.com:8443/redhattraining/do180-httpd-app",
    "Tags": [
        "v1" ①
    ]
}
```

① In this instance, the repository and container image are here, but there is no **LATEST** tag and only the **v1** tag

8. Inspect the image with the OC command and correct tag

```
[student@workstation ~]$ oc image info
registry.ocp4.example.com:8443/redhattraining/do180-httpd-app:v1
Name:          registry.ocp4.example.com:8443/redhattraining/do180-httpd-app:v1
Digest:
sha256:5d8b36a4a557215ccfc5e30af8665528c7bf96a6589009bc66041d7fae0e76f4
Media Type:    application/vnd.oci.image.manifest.v1+json
```

9. Edit the POD with the **oc edit** command and provide the correct tag to the image.

```
[student@workstation ~]$ oc edit pod/do180-httpd-demo

... OUTPUT OMITTED ...

spec:
  containers:
  - image: registry.ocp4.example.com:8443/redhattraining/do180-httpd-app:v1 ①
    imagePullPolicy: Always
    name: do180-httpd-demo
    resources: {}

... OUTPUT OMITTED ...


pod/do180-httpd-demo edited ②
```

① Locate the **image** and add the image tag using **:v1** to the end of the file.

② After saving the file, the **POD** definition will show as updated.

10. Get Pod status

```
[student@workstation ~]$ oc get pods
NAME               READY   STATUS    RESTARTS   AGE
do180-httpd-demo   1/1     Running   0          14m
```

11. Open an **rsh** connection into the container

```
[student@workstation ~]$ oc rsh do180-httpd-demo
sh-4.4$
```

12. Verify web services

```
sh-4.4$ curl localhost:8080
Welcome to Red Hat Training, from do180-httpd-demo
```

13. Exit **rsh** session

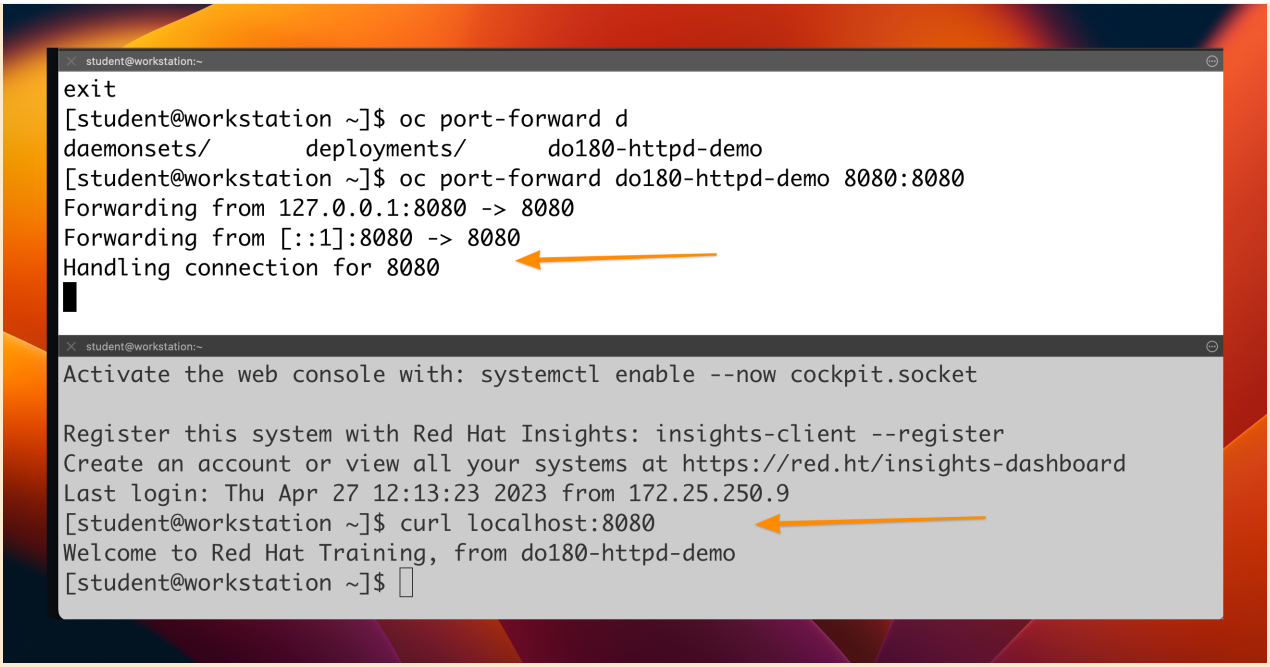
```
sh-4.4$ exit
exit
[student@workstation ~]$
```

14. Test Connectivity Into Container using **oc port-forward** to forward (localhost) port to container

```
[student@workstation ~]$ oc port-forward do180-httpd-demo 8080:8080
Forwarding from 127.0.0.1:8080 -> 8080
Forwarding from [::1]:8080 -> 8080
```

```
[student@workstation ~]$ curl localhost:8080 ①
Welcome to Red Hat Training, from do180-httpd-demo
```

① Perform curl from a second terminal



oc port-forward and Networking

The **oc port-forward** command is a way to check containers and networking. Actually using OCP networking and configuring networking for applications will be discussed in a later chapter.

15. Kill the **oc port-forward** and delete the project

```
[student@workstation ~]$ oc delete project troubleshooting-demo
project.project.openshift.io "troubleshooting-demo" deleted
```

Chapter 4. Deploy Managed and Networked Applications on Kubernetes

4.1. Deploy Applications from Images and Templates

Section Info Here

4.1.1. Deploying Applications

4.1.2. Resources and Resource Definitions

4.1.3. Managing Resources

4.1.4. Common Resource Types and Their Uses

4.1.4.1. Templates

4.1.4.2. Pod

4.1.4.3. Deployment Configurations

4.1.4.4. Deployment

4.1.4.5. Projects

4.1.4.6. Services

4.1.4.7. Persistent Volume Claims

4.1.4.8. Secrets

4.1.5. Managing Resources from the Command Line

4.1.5.1. Imperative Resource Management

4.1.5.2. Declarative Resource Management

4.1.6. Retrieving Resource Information

4.2. DEMO: Deploy Applications from Images and Templates

Credentials

UN/PW: **developer/developer**

or

UN/PW: **admin/redhatocp**

- **Web Console**: https://console-openshift-console.apps.ocp4.example.com
- **OpenShift API**: https://api.ocp4.example.com:6443

Listing 34. Developer Login

```
oc login -u developer -p developer https://api.ocp4.example.com:6443
```

Listing 35. Administrator Login

```
oc login -u admin -p redhatocp https://api.ocp4.example.com:6443
```

Example 9. DEMO: Using OpenShift Templates

1. Ensure lab environment is ready and login as the **developer** user.

```
[student@workstation ~]$ lab start deploy-newapp

[student@workstation ~]$ oc login -u developer -p developer
https://api.ocp4.example.com:6443
```

2. Create Demo project

```
[student@workstation ~]$ oc new-project demo-app-template
```

3. Look for Apache template (httpd) and use **oc describe** to get information about template.

```
[student@workstation ~]$ oc describe template httpd -n openshift
Name:       httpd-example
Namespace:  openshift
Created:    3 weeks ago
```

```
... OUPUT OMITTED ...

    Name:       SOURCE_REPOSITORY_URL
    Display Name:   Git Repository URL
    Description:    The URL of the repository with your application source code.
    Required:       true
    Value:      https://github.com/sclorg/httpd-ex.git

... OUTPUT OMITTED ...

    Name:       CONTEXT_DIR
    Display Name:   Context Directory
    Description:    Set this to the relative path to your project if it is not in
the root of your repository.
    Required:       false
    Value:      <none>

... OUTPUT OMITTED ...
```

4. Create a new application with the template

```
[student@workstation ~]$ oc new-app --template httpd-example -p
SOURCE_REPOSITORY_URL=https://github.com/tmichett/OCP_Demos.git -p
CONTEXT_DIR=/Web_HTML -p HTTPD_VERSION=2.4-el7
--> Deploying template "demo-app-template/httpd-example" to project demo-app-
template
```

5. Check Status and Builds

```
[student@workstation ~]$ oc status
In project demo-app-template on server https://api.ocp4.example.com:6443

http://httpd-example-demo-app-template.apps.ocp4.example.com (svc/httpd-example)
  dc/httpd-example deploys istag/httpd-example:latest <-
    bc/httpd-example source builds https://github.com/tmichett/OCP_Demos.git on
openshift/httpd:2.4-el7
    deployment #1 deployed about a minute ago - 1 pod

[student@workstation ~]$ oc get build
```

6. Check Deployed Pods

```
[student@workstation ~]$ oc get pods
NAME                    READY   STATUS      RESTARTS   AGE
```

```
httpd-example-1-build    0/1     Completed   0          2m10s
httpd-example-1-deploy   0/1     Completed   0          103s
httpd-example-1-lz58b    1/1     Running     0          99s
```

7. Check application services and routes

```
[student@workstation ~]$ oc get svc
NAME            TYPE        CLUSTER-IP      EXTERNAL-IP   PORT(S)    AGE
httpd-example   ClusterIP   172.30.55.134   <none>        8080/TCP   2m44s

[student@workstation ~]$ oc get route
NAME            HOST/PORT                                          PATH
SERVICES        PORT    TERMINATION   WILDCARD
httpd-example   httpd-example-demo-app-template.apps.ocp4.example.com
httpd-example   <all>                 None
```

8. Check running container exposed services

```
[student@workstation ~]$ curl  httpd-example-demo-app-
template.apps.ocp4.example.com
This is a test and demo for the Containerfile build.


<img src="images/rht_training_logo.png" width="50%" height="50%">
```

Figure 7. Website shown in Firefox

9. Clean-up Project

```
[student@workstation ~]$ oc delete project demo-app-template
project.project.openshift.io "demo-app-template" deleted
```

4.3. Manage Long-lived and Short-lived Applications Using the Kubernetes Workload API

Section Info Here

4.3.1. Kubernetes Workload Resources

4.3.1.1. Jobs

4.3.1.2. Cron Jobs

4.3.1.3. Deployments

4.3.1.4. Stateful Sets

4.4. DEMO: Manage Long-lived and Short-lived Applications Using the Kubernetes Workload API

Credentials

UN/PW: **developer/developer**

or

UN/PW: **admin/redhatocp**

- **Web Console**: https://console-openshift-console.apps.ocp4.example.com
- **OpenShift API**: https://api.ocp4.example.com:6443

Listing 36. Developer Login

```
oc login -u developer -p developer https://api.ocp4.example.com:6443
```

Listing 37. Administrator Login

```
oc login -u admin -p redhatocp https://api.ocp4.example.com:6443
```

Example 10. DEMO: Managing Applications using Kubernetes Workload API

1. Verify lab environment is ready

```
[student@workstation ~]$ lab start deploy-workloads
```

2. Login to OCP as a Developer and Create a Project

```
[student@workstation ~]$ oc login -u developer -p developer
https://api.ocp4.example.com:6443
```

```
[student@workstation ~]$ oc new-project demo-workloads
Now using project "demo-workloads" on server "https://api.ocp4.example.com:6443".
```

3. Create a deployment for a webserver (Apache/HTTPD)

Listing 38. Source Description

```
[student@workstation ~]$ oc create deployment demo-web --image
```

```
registry.ocp4.example.com:8443/redhattraining/do180-httpd-app:v1
```

4. Check Deployment and Pod status

```
[student@workstation ~]$ oc get deployment
NAME       READY   UP-TO-DATE   AVAILABLE   AGE
demo-web   1/1     1            1           40s
```

```
[student@workstation ~]$  oc get pods -o wide
NAME                        READY   STATUS    RESTARTS   AGE   IP          NODE
NOMINATED NODE   READINESS GATES
demo-web-776b5c97c5-h8v2f   1/1     Running   0          80s   10.8.0.41
master01   <none>           <none>
```

5. Delete the Pod create by the deployment

```
[student@workstation ~]$  oc delete pod -l app=demo-web
pod "demo-web-776b5c97c5-h8v2f" deleted
```

6. Verify that since the pod was deleted, the deployment caused a new pod to start.

```
[student@workstation ~]$ oc get pods -o wide
NAME                        READY   STATUS    RESTARTS   AGE   IP          NODE
NOMINATED NODE   READINESS GATES
demo-web-776b5c97c5-hbzft   1/1     Running   0          47s   10.8.0.43
master01   <none>           <none>
```

7. Clean-Up the Environment

```
[student@workstation ~]$ oc delete project demo-workloads
project.project.openshift.io "demo-workloads" deleted
```

4.5. Kubernetes Pod and Service Networks

Section Info Here

4.5.1. The Software-defined Network

4.5.2. Kubernetes Networking

4.5.2.1. Using Services

4.5.3. Kubernetes DNS for Service Discovery

4.5.4. Kubernetes Networking Drivers

4.5.4.1. The OpenShift Cluster Network Operator

4.6. DEMO: Kubernetes Pod and Service Networks

Credentials

UN/PW: **developer/developer**

or

UN/PW: **admin/redhatocp**

- **Web Console**: https://console-openshift-console.apps.ocp4.example.com
- **OpenShift API**: https://api.ocp4.example.com:6443

Listing 39. Developer Login

```
oc login -u developer -p developer https://api.ocp4.example.com:6443
```

Listing 40. Administrator Login

```
oc login -u admin -p redhatocp https://api.ocp4.example.com:6443
```

Example 11. DEMO: Using Kubernetes Pod and Service Networks

1. Verify lab environment is ready

```
[student@workstation ~]$ lab start deploy-workloads
```

2. Login to OCP as a Developer and Create a Project

```
[student@workstation ~]$ oc login -u developer -p developer
https://api.ocp4.example.com:6443
```

```
[student@workstation ~]$ oc new-project demo-services
Now using project "demo-services" on server "https://api.ocp4.example.com:6443".
```

3. Create a deployment and expose a service port

```
[student@workstation ~]$ oc create deployment demo-service-web --port 8080 --image
registry.ocp4.example.com:8443/redhattraining/do180-httpd-app:v1
```

4. Retrieve Pod and Deployment Information

```
[student@workstation ~]$ oc get  pods -o wide
NAME                                READY   STATUS    RESTARTS   AGE   IP
NODE       NOMINATED NODE   READINESS GATES
demo-service-web-79b45b9778-h2499   1/1     Running   0          26s   10.8.0.67
master01   <none>           <none>
```

```
[student@workstation ~]$ oc get deployment
NAME               READY   UP-TO-DATE   AVAILABLE   AGE
demo-service-web   1/1     1            1           64s
```

5. Verify no services exist

```
[student@workstation ~]$ oc get service demo-service-web
Error from server (NotFound): services "demo-service-web" not found
```

6. Create a and expose a service

```
[student@workstation ~]$ oc expose deployment/demo-service-web
service/demo-service-web exposed
```

7. View exposed service(s)

```
[student@workstation ~]$ oc get service demo-service-web -o wide
NAME               TYPE        CLUSTER-IP      EXTERNAL-IP   PORT(S)    AGE
SELECTOR
demo-service-web   ClusterIP   172.30.19.218   <none>        8080/TCP   32s
app=demo-service-web
```

8. View Endpoints

```
[student@workstation ~]$ oc get endpoints
NAME               ENDPOINTS        AGE
demo-service-web   10.8.0.68:8080   50s
```

9. Launch a shell using a UBI Container image

```
[student@workstation ~]$ oc run -it ubi9-shell --restart 'Never' --image
registry.ocp4.example.com:8443/ubi9/ubi -- /bin/bash
If you don't see a command prompt, try pressing enter.
```

```
bash-5.1$
```

10. Bring back the website from the other container

Listing 41. Using Container IP Address

```
bash-5.1$ curl 10.8.0.68:8080
Welcome to Red Hat Training, from demo-service-web-6694f6d566-mdmx5
```

Listing 42. Using Service IP Address

```
bash-5.1$ curl 172.30.19.218:8080
Welcome to Red Hat Training, from demo-service-web-6694f6d566-mdmx5
```

Connectivity (Service vs. Container Network)

Both the Service and Container OCP SDNs are avaialble to other running containers in the environment. However, the container network IP address changes each time a new pod is created/deployed.

11. Using a second terminal window, kill the pod and allow the deployment to create a new instance of the web server

```
[student@workstation ~]$ oc delete pod demo-service-web-6694f6d566-mdmx5
pod "demo-service-web-6694f6d566-mdmx5" deleted
```

12. Verify a new Pod has been created and the IP addresses associated with the new pod.

```
[student@workstation ~]$ oc get pods -o wide
NAME                                READY   STATUS    RESTARTS   AGE    IP
NODE       NOMINATED NODE   READINESS GATES
demo-service-web-6694f6d566-qdfhb   1/1     Running   0          47s    10.8.0.72
master01   <none>           <none> ①
ubi9-shell                          1/1     Running   0          6m9s   10.8.0.71
master01   <none>           <none>
```

① The IP address has changed now to **10.8.0.72**

13. Perform the same curl commands from the **ubi9-shell** Pod

```
bash-5.1$ curl 10.8.0.68:8080 ①
^C
bash-5.1$ curl 172.30.19.218:8080 ②
```

```
Welcome to Red Hat Training, from demo-service-web-6694f6d566-qdfhb
```

① It can no longer connect to the old webserver instance as the container IP address has changed.

② It can still connect to the demo-web-service as the **ServiceIP** address remains constant as part of the deployment and it just points to the new container IP address automatically.

14. Cleanup the Environment

```
[student@workstation ~]$ oc delete project demo-services
project.project.openshift.io "demo-services" deleted
```

4.7. Scale and Expose Applications to External Access

Section Info Here

4.7.1. IP Addresses for Pods and Services

4.7.2. Service Types

4.7.3. Using Routes for External Connectivity

4.7.4. Using Ingress Objects for External Connectivity

4.7.5. Sticky sessions

4.7.6. Load Balance and Scale Applications

4.7.6.1. Load Balance Pods

4.8. DEMO: Scale and Expose Applications to External Access

Credentials

UN/PW: **developer/developer**

or

UN/PW: **admin/redhatocp**

- **Web Console**: https://console-openshift-console.apps.ocp4.example.com
- **OpenShift API**: https://api.ocp4.example.com:6443

Listing 43. Developer Login

```
oc login -u developer -p developer https://api.ocp4.example.com:6443
```

Listing 44. Administrator Login

```
oc login -u admin -p redhatocp https://api.ocp4.example.com:6443
```

Example 12. DEMO: Scaling and Exposing Applications to External Access using OCP Routes

1. Ensure lab environment is ready and login as the **developer** user.

```
[student@workstation ~]$ lab start deploy-newapp

[student@workstation ~]$ oc login -u developer -p developer
https://api.ocp4.example.com:6443
```

2. Create Demo project

```
[student@workstation ~]$ oc new-project demo-routes
```

3. Create HTTPD (Apache) Deployment with a Service exposed on port 8080

Listing 45. Creating Deployment with Service to Expose

```
[student@workstation ~]$ oc create deployment demo-service-web --port 8080 --image
registry.ocp4.example.com:8443/redhattraining/do180-httpd-app:v1
```

Listing 46. Exposing the Service

```
[student@workstation ~]$ oc expose deployment demo-service-web
service/demo-service-web exposed
```

4. Get Services and Endpoints

```
[student@workstation ~]$ oc get services
NAME               TYPE        CLUSTER-IP      EXTERNAL-IP   PORT(S)    AGE
demo-service-web   ClusterIP   172.30.162.76   <none>        8080/TCP   11s
```

```
[student@workstation ~]$ oc get endpoints
NAME               ENDPOINTS         AGE
demo-service-web   10.8.0.79:8080    30s
```

5. Expose Route to the Service and Get the Route

```
[student@workstation ~]$ oc expose service demo-service-web
route.route.openshift.io/demo-service-web exposed
```

```
[student@workstation ~]$ oc get route
NAME               HOST/PORT                                          PATH
SERVICES           PORT   TERMINATION   WILDCARD
demo-service-web   demo-service-web-demo-routes.apps.ocp4.example.com
demo-service-web   8080                 None
```

6. View Website

```
[student@workstation ~]$ curl demo-service-web-demo-routes.apps.ocp4.example.com
Welcome to Red Hat Training, from demo-service-web-6694f6d566-26dj8
```

7. Scale out Application

```
[student@workstation ~]$ oc scale deployment demo-service-web --replicas 2
deployment.apps/demo-service-web scaled
```

8. Verify additional pods

```
[student@workstation ~]$ oc get pods -o wide
```

```
NAME                                READY   STATUS    RESTARTS   AGE    IP
NODE       NOMINATED NODE   READINESS GATES
demo-service-web-6694f6d566-26dj8   1/1     Running   0          6m1s   10.8.0.79
master01   <none>           <none>
demo-service-web-6694f6d566-6hkx6   1/1     Running   0          22s    10.8.0.80
master01   <none>           <none>
```

9. Use the **Curl** command on the routes to show it going to both systems

```
[student@workstation ~]$ curl demo-service-web-demo-routes.apps.ocp4.example.com
Welcome to Red Hat Training, from demo-service-web-6694f6d566-6hkx6 ①
[student@workstation ~]$ curl demo-service-web-demo-routes.apps.ocp4.example.com
Welcome to Red Hat Training, from demo-service-web-6694f6d566-26dj8 ②
```

① Shows it going to pod **6hkx6**

② Shows it going to pod **26dj8**

OCP Load Balancer

The OCP Load Balancer will send the traffic to all pods connected to the same route with the same service. It might be necessary to repeat the curl command a few times to show the load-balancer at work. It is possible to use things like cookies and other work-arounds to preserve or create session "stickyness"

10. Clean Up Environment

```
[student@workstation ~]$ oc delete project demo-routes
project.project.openshift.io "demo-routes" deleted
```

Chapter 5. Manage Storage for Application Configuration and Data

5.1. Externalize the Configuration of Applications

Section Info Here

5.1.1. Configuring Kubernetes Applications

5.1.2. Creating Secrets and Configuration Maps

5.1.3. Using Configuration Maps and Secrets to Initialize Environment Variables

5.1.4. Using Secrets and Configuration Maps as Volumes

5.1.5. Updating Secrets and Configuration Maps

5.1.6. Deleting Secrets and Configuration Maps

5.2. DEMO: Externalize the Configuration of Applications

Credentials

UN/PW: **developer/developer**

or

UN/PW: **admin/redhatocp**

- **Web Console**: https://console-openshift-console.apps.ocp4.example.com
- **OpenShift API**: https://api.ocp4.example.com:6443

Listing 47. Developer Login

```
oc login -u developer -p developer https://api.ocp4.example.com:6443
```

Listing 48. Administrator Login

```
oc login -u admin -p redhatocp https://api.ocp4.example.com:6443
```

Example 13. DEMO: Externally Configuring Applications

1. Ensure lab environment is ready and login as the **developer** user.

```
[student@workstation ~]$ lab start storage-configs

[student@workstation ~]$ oc login -u developer -p developer
https://api.ocp4.example.com:6443
```

2. Create Demo project

```
[student@workstation ~]$ oc new-project demo-storage-configs
```

3. Create a deployment with a service and a route exposed.

```
[student@workstation ~]$ oc create deployment demo-service-web --port 8080 --image
registry.ocp4.example.com:8443/redhattraining/do180-httpd-app:v1
```

Listing 49. Expose Service

```
[student@workstation ~]$ oc expose deployment demo-service-web
service/demo-service-web exposed
```

Listing 50. Expose the Route

```
[student@workstation ~]$ oc expose service demo-service-web
route.route.openshift.io/demo-service-web exposed
```

4. Get Route and **curl** the website

```
[student@workstation ~]$ oc get route
NAME               HOST/PORT
PATH   SERVICES           PORT   TERMINATION   WILDCARD
demo-service-web   demo-service-web-demo-storage-configs.apps.ocp4.example.com
demo-service-web   8080                 None
```

```
[student@workstation ~]$ curl demo-service-web-demo-storage-
configs.apps.ocp4.example.com
Welcome to Red Hat Training, from demo-service-web-6694f6d566-kk2m8
[student@workstation ~]$
```

5. Clone down repository for website soure.

```
[student@workstation ~]$ git clone https://github.com/tmichett/OCP_Demos.git
```

6. Create ConfigMaps for the website file (index.html) and the required image (penguin3.jpg).

Listing 51. Creating Directory Config Map

```
[student@workstation ~]$ oc create configmap website --from
-file=/home/student/OCP_Demos/DO188_Web
configmap/website created
```

7. Apply ConfigMaps to the deployment

Listing 52. Creating Volume for ConfigMap for Website Directory

```
[student@workstation ~]$ oc set volume deployment/demo-service-web --add --type
configmap --configmap-name website --mount-path /var/www/html/
info: Generated volume name: volume-ksv8p
```

8. Ensure new pod(s) are ready

```
[student@workstation ~]$ oc get pods
NAME                                READY   STATUS        RESTARTS   AGE
demo-service-web-5558d7cd7d-tvjqk   1/1     Terminating   0          91s
demo-service-web-6c9c56d74-jrs2p    1/1     Running       0          17s
```

9. Perform the **curl** command again and view in Firefox

```
[student@workstation ~]$ curl demo-service-web-demo-storage-
configs.apps.ocp4.example.com

... OUTPUT OMITTED ...
```

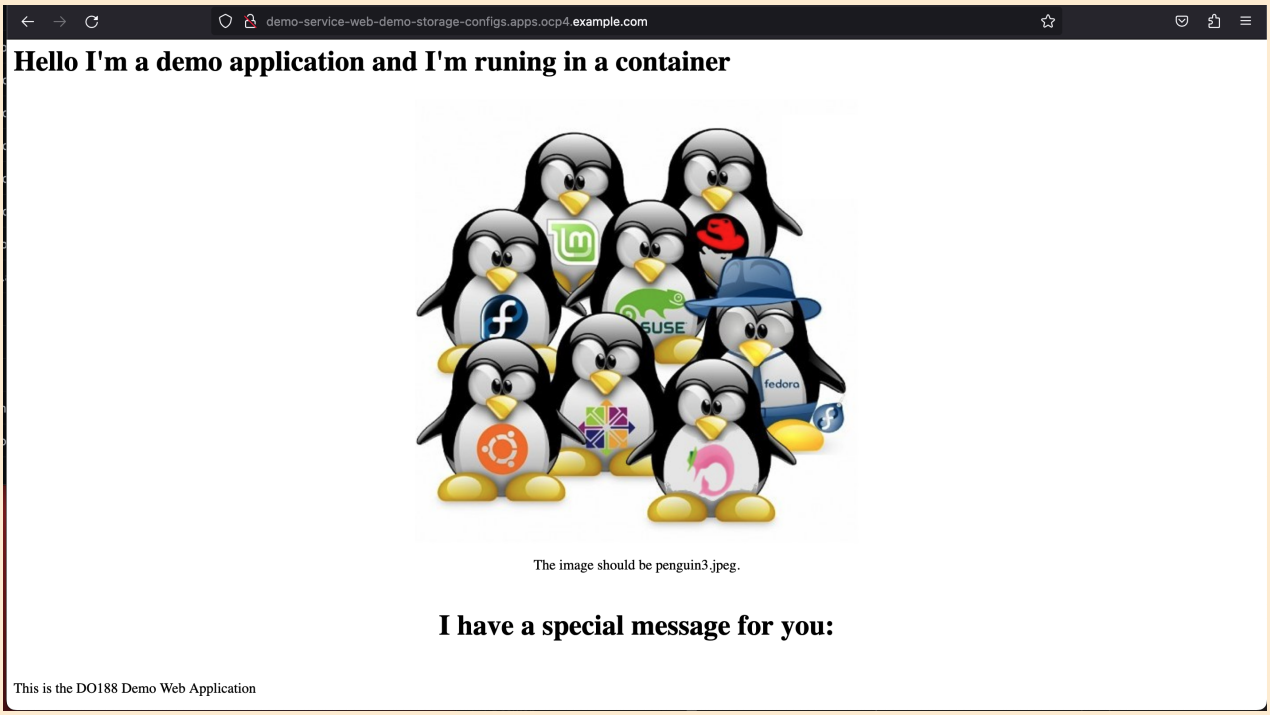


Figure 8. Website from Container ConfigMaps

10. Clean up environment

```
[student@workstation ~]$ oc delete project demo-storage-configs
project.project.openshift.io "demo-storage-configs" deleted
```

5.3. Provision Persistent Data Volumes

Section Info Here

5.3.1. Kubernetes Persistent Storage

5.3.2. Persistent Volumes

5.3.2.1. Volume Access Mode

5.3.2.2. Volume Modes

5.3.2.3. Manually Creating a PV

5.3.3. Persistent Volume Claims

5.3.3.1. Creating a PVC

5.3.3.2. Kubernetes Dynamic Provisioning

5.3.3.3. PV and PVC lifecycles

5.3.3.4. Deleting a Persistent Volume Claim

5.4. DEMO: Provision Persistent Data Volumes

Credentials

UN/PW: **developer/developer**

or

UN/PW: **admin/redhatocp**

- **Web Console**: https://console-openshift-console.apps.ocp4.example.com
- **OpenShift API**: https://api.ocp4.example.com:6443

Listing 53. Developer Login

```
oc login -u developer -p developer https://api.ocp4.example.com:6443
```

Listing 54. Administrator Login

```
oc login -u admin -p redhatocp https://api.ocp4.example.com:6443
```

Example 14. DEMO: Provisioning a Persistent Data Volume

1. Ensure lab environment is ready and login as the **developer** user.

```
[student@workstation ~]$ lab start storage-volumes

[student@workstation ~]$ oc login -u developer -p developer
https://api.ocp4.example.com:6443
```

2. Create Demo project

```
[student@workstation ~]$ oc new-project demo-storage-pvs
```

3. Determine available storage classes

```
[student@workstation ~]$ oc get storageclass
NAME                    PROVISIONER
RECLAIMPOLICY   VOLUMEBINDINGMODE      ALLOWVOLUMEEXPANSION   AGE
lvms-vg1                topolvm.io                                        Delete
WaitForFirstConsumer   true                   24d
nfs-storage (default)   k8s-sigs.io/nfs-subdir-external-provisioner   Delete
```

```
Immediate              false                  24d
```

4. Create a deployment, service, and route

```
[student@workstation ~]$ oc create deployment demo-service-web --port 8080 --image
registry.ocp4.example.com:8443/redhattraining/do180-httpd-app:v1
```

Listing 55. Expose Service

```
[student@workstation ~]$ oc expose deployment demo-service-web
service/demo-service-web exposed
```

Listing 56. Expose the Route

```
[student@workstation ~]$ oc expose service demo-service-web
route.route.openshift.io/demo-service-web exposed
```

5. Get route and verify application

```
[student@workstation ~]$ oc get route
NAME               HOST/PORT
PATH   SERVICES           PORT   TERMINATION   WILDCARD
demo-service-web   demo-service-web-demo-storage-configs.apps.ocp4.example.com
demo-service-web   8080                 None
```

```
[student@workstation ~]$ curl demo-service-web-demo-storage-
configs.apps.ocp4.example.com
Welcome to Red Hat Training, from demo-service-web-6694f6d566-kk2m8
[student@workstation ~]$
```

6. Create a persistent volume claim and apply it to the deployment

```
[student@workstation ~]$ oc set volumes deployment/demo-service-web --add --name
nfs-volume-storage --type pvc --claim-mode rwo --claim-size 1Gi --mount-path
/var/www/html --claim-name demo-service-web-pvc
```

7. Verify that PVC was created and bound

```
[student@workstation ~]$ oc get pvc
NAME                   STATUS   VOLUME
```

```
CAPACITY   ACCESS MODES   STORAGECLASS   AGE
demo-service-web-pvc   Bound    pvc-1a09dd19-d243-434f-824b-97c6aebf0c5b   1Gi
RWO            nfs-storage    48s
```

8. Verify the deployment

```
[student@workstation ~]$ oc get deployment/demo-service-web -o yaml
apiVersion: apps/v1
kind: Deployment
metadata:

... OUTPUT OMITTED ...

        volumeMounts:
        - mountPath: /var/www/html
          name: nfs-volume-storage ①

... OUTPUT OMITTED ...

      volumes:
      - name: nfs-volume-storage
        persistentVolumeClaim:
          claimName: demo-service-web-pvc ②

... OUTPUT OMITTED ...
```

① Persistent Volume Name

② Name of Persistent Volume Claim (PVC)

9. Copy files to persistent volume

```
[student@workstation ~]$ oc cp /home/student/OCP_Demos/DO188_Web/index.html demo-
service-web-555dbb644f-xjsnv:/var/www/html/

[student@workstation ~]$ oc cp /home/student/OCP_Demos/DO188_Web/penguin3.jpeg
demo-service-web-555dbb644f-xjsnv:/var/www/html/
```

10. Check web service

```
[student@workstation ~]$ curl demo-service-web-demo-storage-
pvs.apps.ocp4.example.com
```

11. Remove the volume from the deployment

```
[student@workstation ~]$ oc set volumes deployment/demo-service-web --remove
--name nfs-volume-storage
```

12. Perform **curl** command on deployment

```
[student@workstation ~]$ curl demo-service-web-demo-storage-
pvs.apps.ocp4.example.com
Welcome to Red Hat Training, from demo-service-web-6694f6d566-dxv6w ①
```

① Persistent volume was removed and container returned to original state

13. Verify that PVC exists

```
[student@workstation ~]$ oc get pvc
NAME                    STATUS   VOLUME
CAPACITY   ACCESS MODES   STORAGECLASS   AGE
demo-service-web-pvc    Bound    pvc-1a09dd19-d243-434f-824b-97c6aebf0c5b   1Gi
RWO            nfs-storage    9m32s
```

14. Create a new deployment, service, and route

```
[student@workstation ~]$ oc create deployment demo-service-web2 --port 8080
--image registry.ocp4.example.com:8443/redhattraining/do180-httpd-app:v1
```

Listing 57. Expose Service

```
[student@workstation ~]$ oc expose deployment demo-service-web2
service/demo-service-web exposed
```

Listing 58. Expose the Route

```
[student@workstation ~]$ oc expose service demo-service-web2
route.route.openshift.io/demo-service-web exposed
```

15. Retrieve route and verify content

```
[student@workstation ~]$ oc get route
NAME               HOST/PORT
PATH   SERVICES            PORT   TERMINATION   WILDCARD
demo-service-web    demo-service-web-demo-storage-pvs.apps.ocp4.example.com
demo-service-web    8080                None
```

```
demo-service-web2   demo-service-web2-demo-storage-pvs.apps.ocp4.example.com
demo-service-web2   8080                  None
```

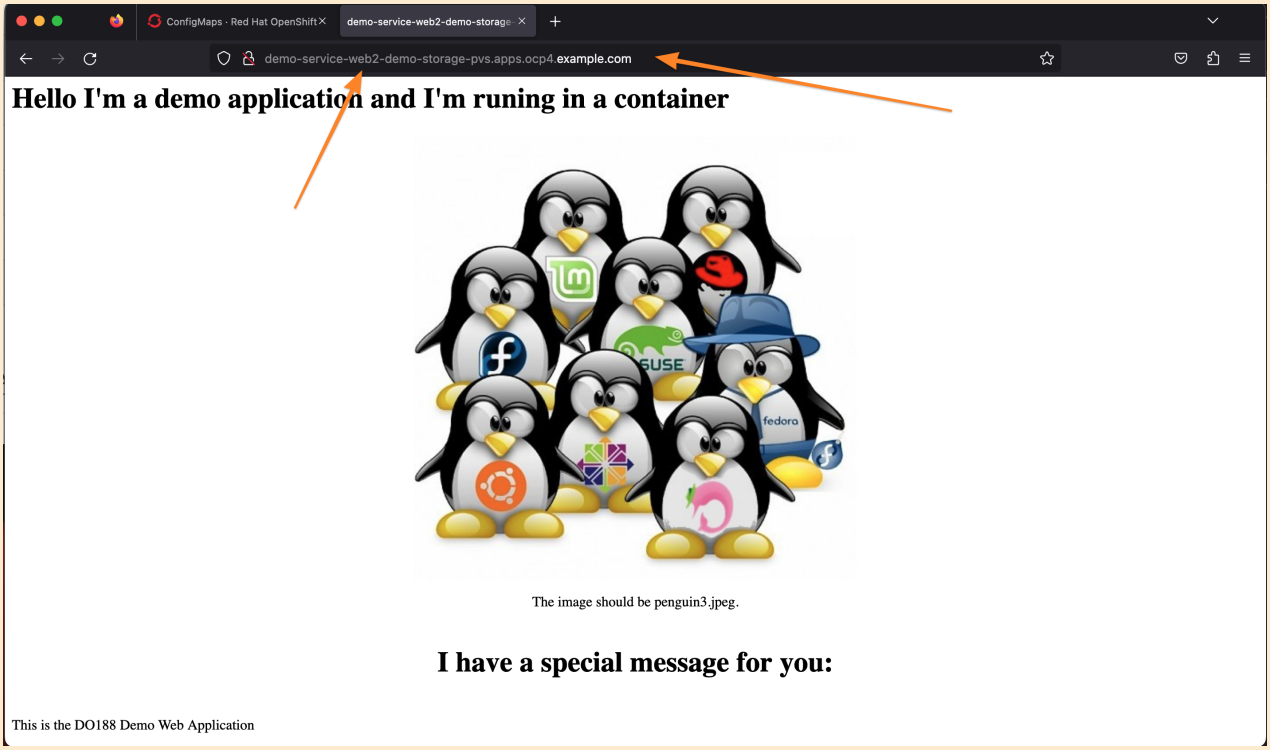
```
[student@workstation ~]$ curl demo-service-web2-demo-storage-
pvs.apps.ocp4.example.com
Welcome to Red Hat Training, from demo-service-web2-69ff6b796-hrgmb
```

16. Attach persistent storage volume to new deployment

```
[student@workstation ~]$ oc set volumes deployment/demo-service-web2 --add --type
pvc --mount-path /var/www/html --claim-name demo-service-web-pvc
```

17. Verify the volume has been mounted by looking at website content

```
[student@workstation ~]$ curl demo-service-web2-demo-storage-
pvs.apps.ocp4.example.com
```



18. Clean up environment

```
[student@workstation ~]$ oc delete project demo-storage-pvs
project.project.openshift.io "demo-storage-pvs" deleted
```

5.5. Select a Storage Class for an Application

Section Info Here

5.5.1. Storage Class Selection

5.5.1.1. Reclaim Policy

5.5.1.2. Kubernetes and Application Responsibilities

5.5.2. Use Cases for Storage Classes

5.5.3. Create a Storage Class

5.5.3.1. Cluster Storage Classes

5.5.4. Storage Class Usage

5.6. DEMO: Select a Storage Class for an Application

Credentials

UN/PW: **developer/developer**

or

UN/PW: **admin/redhatocp**

- **Web Console**: https://console-openshift-console.apps.ocp4.example.com
- **OpenShift API**: https://api.ocp4.example.com:6443

Listing 59. Developer Login

```
oc login -u developer -p developer https://api.ocp4.example.com:6443
```

Listing 60. Administrator Login

```
oc login -u admin -p redhatocp https://api.ocp4.example.com:6443
```

Example 15. DEMO: Selecting a Storage Class for an Application

This demo is meant to show different storage classes and selecting something other than the NFS default storage class. It also shows how to create an OCP Custom Resource Definition (CRD) for a persistent volume claim (PVC) and attach the resource to a deployment.

1. Ensure lab environment is ready and login as the **developer** user.

```
[student@workstation ~]$ lab start storage-classes

[student@workstation ~]$ oc login -u developer -p developer
https://api.ocp4.example.com:6443
```

2. Create Demo project

```
[student@workstation ~]$ oc new-project demo-storage-classes
```

3. Retrieve available storage classes

```
[student@workstation ~]$ oc get sc
```

```
NAME                    PROVISIONER
RECLAIMPOLICY   VOLUMEBINDINGMODE      ALLOWVOLUMEEXPANSION   AGE
lvms-vg1                topolvm.io                                    Delete
WaitForFirstConsumer   true                   24d
nfs-storage (default)   k8s-sigs.io/nfs-subdir-external-provisioner   Delete
Immediate              false                  24d
```

4. Retrieve information about the LVMS Storage class

```
[student@workstation ~]$ oc describe sc lvms-vg1
Name:                  lvms-vg1
IsDefaultClass:        No
Annotations:           description=Provides RWO and RWOP Filesystem & Block
volumes
Provisioner:           topolvm.io
Parameters:            csi.storage.k8s.io/fstype=xfs,topolvm.io/device-class=vg1
AllowVolumeExpansion:  True
MountOptions:          <none>
ReclaimPolicy:         Delete
VolumeBindingMode:     WaitForFirstConsumer
Events:                <none>
```

5. Create a PVC Resource File (vim lvms-pvc.yml)

```
apiVersion: v1
kind: PersistentVolumeClaim
metadata:
  name: lvms-pvc
spec:
  accessModes:
  - ReadWriteOnce
  resources:
    requests:
      storage: 1Gi
  storageClassName: lvms-vg1
```

6. Create the PVC resource from the CRD file

```
[student@workstation ~]$ oc create -f lvms-pvc.yml
persistentvolumeclaim/lvms-pvc created
```

7. Analyze the PVC that was created

```
[student@workstation ~]$ oc describe pvc lvms-pvc
Name:          lvms-pvc
Namespace:     demo-storage-classes
StorageClass:  lvms-vg1
Status:        Pending
Volume:
Labels:        <none>
Annotations:   <none>
Finalizers:    [kubernetes.io/pvc-protection]
Capacity:
Access Modes:
VolumeMode:    Filesystem
Used By:       <none>
Events:
  Type    Reason                Age               From
Message
  ----    ------                ----              ----
-------
  Normal  WaitForFirstConsumer  3s (x3 over 32s)  persistentvolume-controller
waiting for first consumer to be created before binding
```

8. Create deployment, attach the PVC, and open for web

```
[student@workstation ~]$ oc create deployment demo-service-web --port 8080 --image
registry.ocp4.example.com:8443/redhattraining/do180-httpd-app:v1
```

Listing 61. Expose Service

```
[student@workstation ~]$ oc expose deployment demo-service-web
service/demo-service-web exposed
```

Listing 62. Expose the Route

```
[student@workstation ~]$ oc expose service demo-service-web
route.route.openshift.io/demo-service-web exposed
```

Listing 63. Add the PV using PVC Claim Created Earlier

```
[student@workstation ~]$ oc set volumes deployment/demo-service-web --add --name
lvms-volume --claim-name lvms-pvc --mount-path /var/www/html
```

9. Add data to the PVC

```
[student@workstation ~]$ oc cp /home/student/OCP_Demos/DO188_Web/index.html demo-
service-web-555dbb644f-xjsnv:/var/www/html/

[student@workstation ~]$ oc cp /home/student/OCP_Demos/DO188_Web/penguin3.jpeg
demo-service-web-555dbb644f-xjsnv:/var/www/html/
```

10. Check data from the PVC exists in the application

```
[student@workstation ~]$ curl demo-service-web-demo-storage-
classes.apps.ocp4.example.com
```

11. Clean up environment

```
[student@workstation ~]$ oc delete project demo-storage-classes
project.project.openshift.io "demo-storage-classes" deleted
```

5.7. Manage non-Shared Storage with StatefulSets

Section Info Here

5.7.1. Application Clustering

5.7.2. Storage Services

5.7.3. Introduction to Stateful Sets

5.7.4. Working with Stateful Sets

5.8. DEMO: Manage non-Shared Storage with Stateful Sets

Credentials

UN/PW: **developer/developer**

or

UN/PW: **admin/redhatocp**

- **Web Console**: https://console-openshift-console.apps.ocp4.example.com
- **OpenShift API**: https://api.ocp4.example.com:6443

Listing 64. Developer Login

```
oc login -u developer -p developer https://api.ocp4.example.com:6443
```

Listing 65. Administrator Login

```
oc login -u admin -p redhatocp https://api.ocp4.example.com:6443
```

Example 16. DEMO: Manage non-Shared Storage with Stateful Sets

1. Ensure lab environment is ready and login as the **developer** user.

```
[student@workstation ~]$ lab start storage-statefulsets

[student@workstation ~]$ oc login -u developer -p developer
https://api.ocp4.example.com:6443
```

2. Create Demo project

```
[student@workstation ~]$ oc new-project demo-statefulsets
```

3. Change into the Github **OCP_Demo** Project

```
[student@workstation ~]$ cd /home/student/OCP_Demos/Stateful_Sets
[student@workstation Stateful_Sets]$
```

4. Create the OCP Resources from the CRD File

Listing 66. Examine Resource File

```
[student@workstation Stateful_Sets]$ cat statefulset-demo.yml
apiVersion: apps/v1
kind: StatefulSet
metadata:
  name: webserver
spec:
  selector:
    matchLabels:
      app: webserver
  replicas: 2
  template:
    metadata:
      labels:
        app: webserver
    spec:
      terminationGracePeriodSeconds: 10
      containers:
        - name: webserver
          image: registry.ocp4.example.com:8443/redhattraining/do180-httpd-app:v1
          ports:
            - name: webport
              containerPort: 8080
          volumeMounts:
            - name: webdata
              mountPath: /var/www/html
  volumeClaimTemplates:
    - metadata:
        name: webdata
      spec:
        accessModes: ["ReadWriteOnce"]
        storageClassName: "lvms-vg1"
        resources:
          requests:
            storage: 1Gi
```

Listing 67. Creating Systems

```
[student@workstation Stateful_Sets]$ oc create -f statefulset-demo.yml
statefulset.apps/webserver created
```

5. Verify Pods and PVCs

```
[student@workstation Stateful_Sets]$ oc get pods
NAME          READY   STATUS    RESTARTS   AGE
```

```
webserver-0   1/1     Running   0          6m8s
webserver-1   1/1     Running   0          6m6s
```

```
[student@workstation Stateful_Sets]$ oc get pvc
NAME                   STATUS   VOLUME                                     CAPACITY
ACCESS MODES   STORAGECLASS   AGE
webdata-webserver-0   Bound    pvc-237b855e-82da-4067-8311-c5dcc0fa2889   1Gi
RWO            lvms-vg1       6m36s
webdata-webserver-1   Bound    pvc-20cc7b66-7d68-4f9e-beec-e912846b9b9a   1Gi
RWO            lvms-vg1       6m34s
```

6. Run script to copy data, expose services, and expose routes

```
[student@workstation Stateful_Sets]$ ./create_web.sh
```

7. List the created routes

```
[student@workstation Stateful_Sets]$ oc get routes
NAME          HOST/PORT                                                PATH
SERVICES      PORT   TERMINATION   WILDCARD
webserver-0   webserver-0-demo-statefulsets.apps.ocp4.example.com
webserver-0   8080                 None
webserver-1   webserver-1-demo-statefulsets.apps.ocp4.example.com
webserver-1   8080                 None
```

8. Verify websites are different

```
[student@workstation Stateful_Sets]$ curl webserver-0-demo-
statefulsets.apps.ocp4.example.com
Hello from the stateful set - This is Webserver-0 and my hostname is webserver-0

[student@workstation Stateful_Sets]$ curl webserver-1-demo-
statefulsets.apps.ocp4.example.com
Hello from the stateful set - This is Webserver-1 and my hostname is webserver-1
```

9. Clean up environment

```
[student@workstation Stateful_Sets]$ oc delete project demo-statefulsets
project.project.openshift.io "demo-statefulsets" deleted
```

Chapter 6. Configure Applications for Reliability

6.1. Application High Availability with Kubernetes

Section Info Here

6.1.1. Concepts of Deploying Highly Available Applications

6.1.2. Writing Reliable Applications

6.1.3. Kubernetes Application Reliability

6.2. DEMO: Externalize the Configuration of Applications

Credentials

UN/PW: **developer/developer**

or

UN/PW: **admin/redhatocp**

- **Web Console**: https://console-openshift-console.apps.ocp4.example.com
- **OpenShift API**: https://api.ocp4.example.com:6443

Listing 68. Developer Login

```
oc login -u developer -p developer https://api.ocp4.example.com:6443
```

Listing 69. Administrator Login

```
oc login -u admin -p redhatocp https://api.ocp4.example.com:6443
```

Example 17. DEMO: Externally Configuring Applications

Listing 70. Ensure Lab Environment ready to begin

```
[student@workstation ~]$ lab start reliability-ha

[student@workstation ~]$ oc login -u developer -p developer
https://api.ocp4.example.com:6443
```

Listing 71. Switch to Project

```
[student@workstation ~]$ oc project reliability-ha
```

Listing 72. Open Directory from OCP_Demos Repository

```
[student@workstation ~]$ cd /home/student/OCP_Demos/DO180v412/CH6
```

Listing 73. Apply resource from file to build load pods

```
[student@workstation CH6]$ oc apply -f load_demo.yml
```

Listing 74. Observe Pods

```
[student@workstation CH6]$ oc get pods -o wide
```

Listing 75. Verify the health endpoint

```
[student@workstation CH6]$ oc exec load-demo -- curl -s localhost:3000/health
```

Listing 76. Force a Crash within Container and Pod

```
[student@workstation CH6]$ oc exec load-demo -- curl -s localhost:3000/destruct
command terminated with exit code 52
```

Listing 77. Verify that App Recovered with New Pod

```
[student@workstation CH6]$ oc get pods
NAME        READY   STATUS    RESTARTS      AGE
load-demo   1/1     Running   1 (51s ago)   2m53s ①
```

① Pod restarted

Listing 78. Cause Failure

```
[student@workstation CH6]$ oc exec load-demo-fail -- curl -s localhost:3000/destruct
command terminated with exit code 52
```

Listing 79. Verify Pod status of Error

```
[student@workstation CH6]$ oc get pods
NAME             READY   STATUS   RESTARTS   AGE
load-demo-fail   0/1     Error    0          91s
```

Listing 80. Cleanup Resources and Project

```
[student@workstation CH6]$ oc delete project reliability-ha
```

6.3. Application Health Probes

Section Info Here

6.3.1. Kubernetes Probes

6.3.2. Authoring Probe Endpoints

6.3.3. Probe Types

6.3.3.1. Readiness Probes

6.3.3.2. Liveness Probes

6.3.3.3. Startup Probes

6.3.4. Types of Tests

6.3.5. Timings and Thresholds

6.3.6. Adding Probes via YAML

6.3.7. Adding Probes via the CLI

Unresolved directive in Chapter6.adoc - include::Chapters/CH6/Section2Demo.adoc[] :pygments-style: tango :source-highlighter: pygments :toc: :toclevels: 7 :sectnums: :sectnumlevels: 6 :numbered: :chapter-label: :icons: font :icons: font :imagesdir: ./images/

6.4. Reserve Compute Capacity for Applications

Section Info Here

6.4.1. Kubernetes Pod Scheduling

6.4.2. Compute Resource Requests

6.4.3. Inspecting Cluster Compute Resources

6.5. Limit Compute Capacity for Applications

Section Info Here

6.5.1. Setting Memory Limits

6.5.2. Setting CPU Limits

6.5.3. Viewing Requests, Limits, and Actual Usage

6.6. Application Autoscaling

Section Info Here

Chapter 7. Manage Application Updates

7.1. Container Image Identity and Tags

Section Info Here

7.1.1. Kubernetes Image Tags

7.1.1.1. Floating Tag Issues

7.1.1.2. Using SHA Image ID

7.1.2. Selecting a Pull Policy

7.1.3. Pruning Images from Cluster Nodes

7.2. Update Application Image and Settings

Section Info Here

7.2.1. Application Code, Configuration, and Data

7.2.2. Deployment Strategies

7.2.2.1. Rolling Update Strategy

7.2.2.2. Recreate Strategy

7.2.3. Rolling Out Applications

7.2.3.1. Monitoring Replica Sets

7.2.3.2. Managing Rollout

7.3. Reproducible Deployments with OpenShift Image Streams

Section Info Here

7.3.1. Image Streams

7.3.1.1. Image Stream Tags

7.3.1.2. Image Names, Tags, and IDs

7.3.2. Creating Image Streams and Tags

7.3.2.1. Importing Image Stream Tags Periodically

7.3.2.2. Configuring Image Pull-through

7.3.3. Using Image Streams in Deployments

7.3.3.1. Enabling the Local Lookup Policy

7.3.3.2. Configuring Image Streams in Deployments

7.4. Automatic Image Updates with OpenShift Image Change Triggers

Section Info Here

7.4.1. Using Triggers to Manage Images

7.4.2. Configuring Image Trigger for Deployments

7.4.2.1. Rolling Out Deployments

7.4.2.2. Rolling Back Deployments

7.4.3. Managing Image Stream Tags