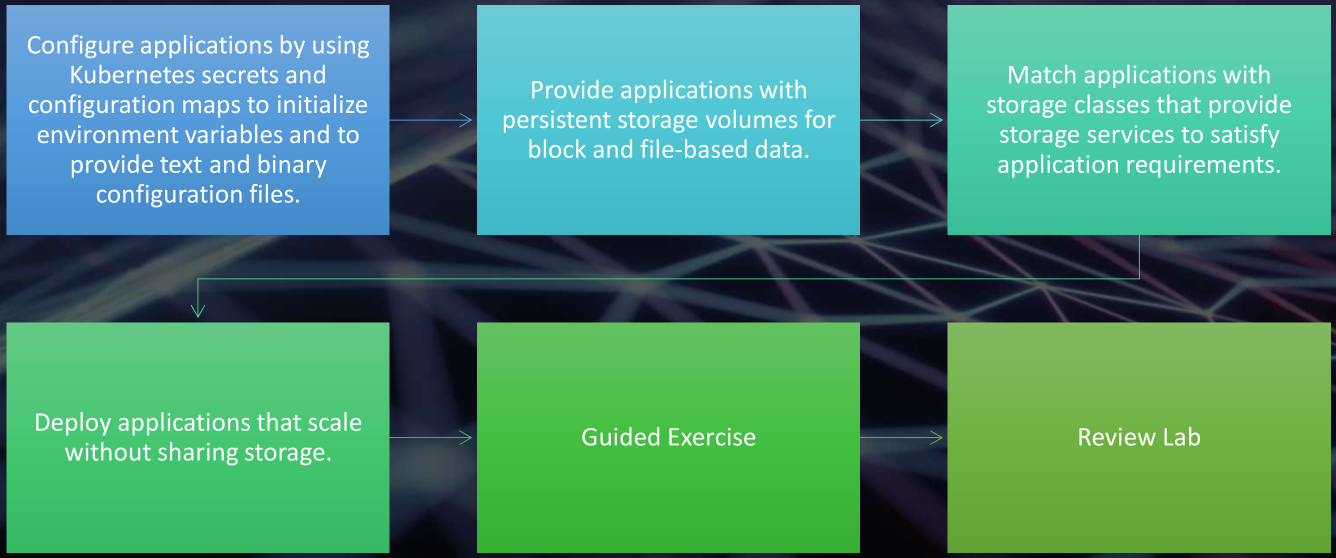
Module 5: Manage Storage for Application Configuration and Data

Lesson 1 : Externalize the Configuration of Applications

Configure applications by using Kubernetes secrets and configuration maps to initialize environment variables and to provide text and binary configuration files.

Chapter objectives



Configure applications by using Kubernetes secrets and configuration maps to initialize environment variables and to provide text and binary configuration files.

Provide applications with persistent storage volumes for block and file-based data.

Match applications with storage classes that provide storage services to satisfy application requirements.

Deploy applications that scale without sharing storage.

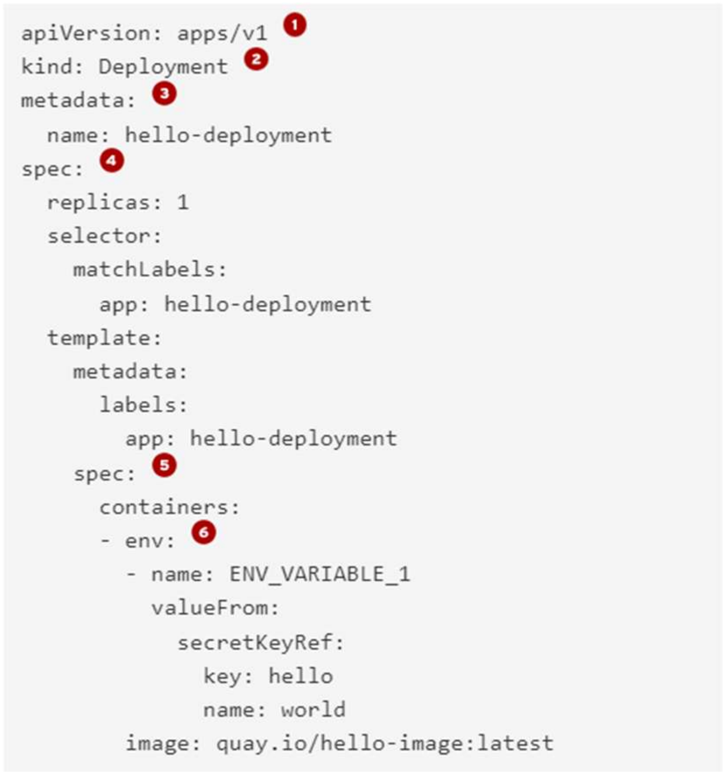
Guided Exercise

Review Lab

Configuring Kubernetes Applications

- Prebuilt image uses default configuration
- Customization needed
  - name of application
  - labels
  - image source
  - storage configuration
  - environment variables
- Format
  - YAML
  - JSON

The manifest file in YAML format



```
apiVersion: apps/v1 1
kind: Deployment 2
metadata: 3
  name: hello-deployment
spec: 4
  replicas: 1
  selector:
    matchLabels:
      app: hello-deployment
  template:
    metadata:
      labels:
        app: hello-deployment
    spec: 5
      containers:
      - env: 6
        - name: ENV_VARIABLE_1
          valueFrom:
            secretKeyRef:
              key: hello
              name: world
        image: quay.io/hello-image:latest
```

1 API version of the resource.

2 Deployment resource type.

3 In this section, you specify the metadata of your application, such as the name.

4 You can define the general configuration of the resource that is applied to the deployment, such as the number of replicas (pods), the selector label, and the template data.

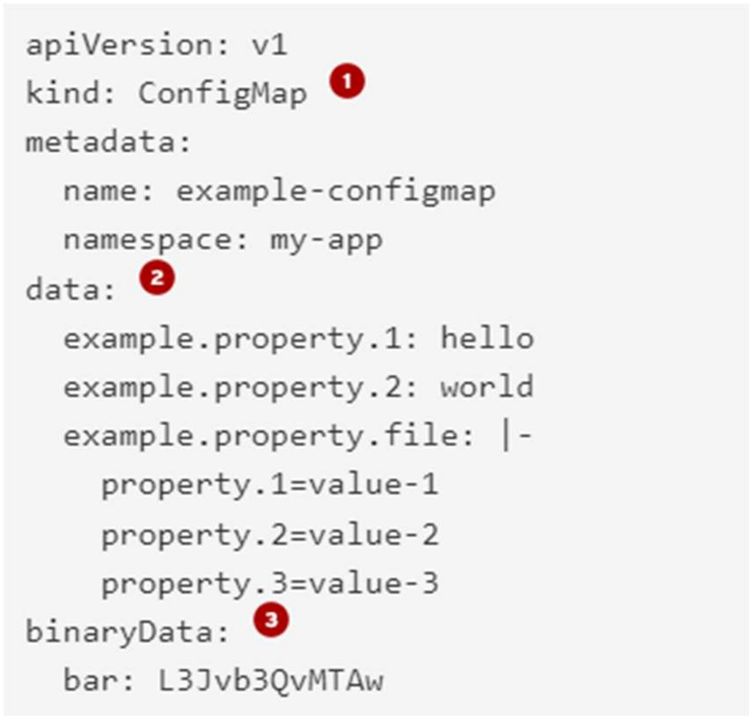
5 In this section, you specify the configuration for your application, such as the image name, the container name, ports, environment variables, and more.

6 You can define the environment variables to configure your application needs.

Configuration Maps

- API object
- Store configuration
- Accept key-value pairs
- Keep configuration files, environment variables or arguments
- Decouple configuration from image
- Keep containerized applications portable
- Alternative: **Secret** resource type

Configuration Map (cm) manifest in YAML

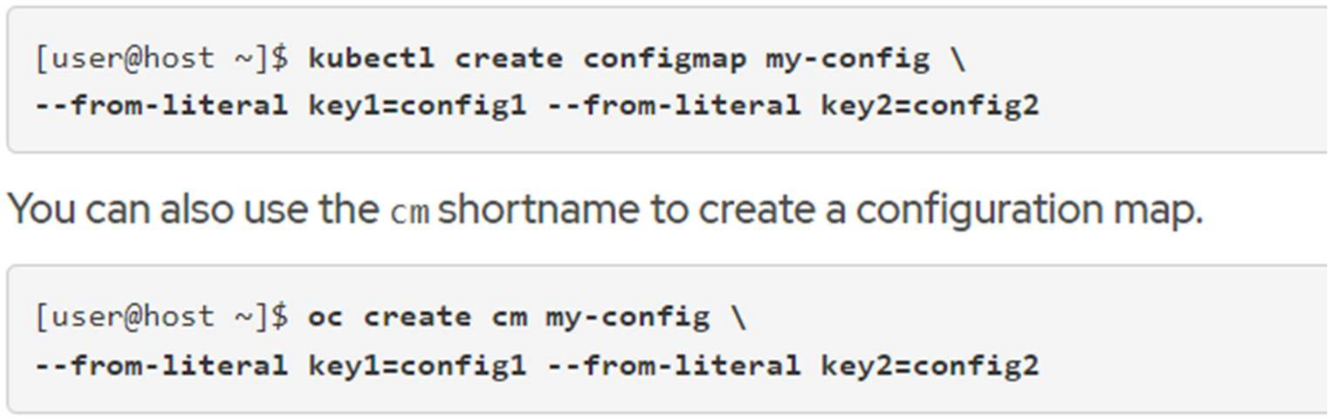


```yaml
apiVersion: v1
kind: ConfigMap
metadata:
  name: example-configmap
  namespace: my-app
data:
  example.property.1: hello
  example.property.2: world
  example.property.file: |-
    property.1=value-1
    property.2=value-2
    property.3=value-3
binaryData:
  bar: L3Jvb3QvMTAw
```

1. ConfigMap resource type.
2. Contains the configuration data.
3. Points to an encoded file in base64 that contains non-UTF-8 data, for example, a binary Java keystore file. Place a key followed by the encoded file.

Creating/Deleting Configuration Maps

- Creating CMs

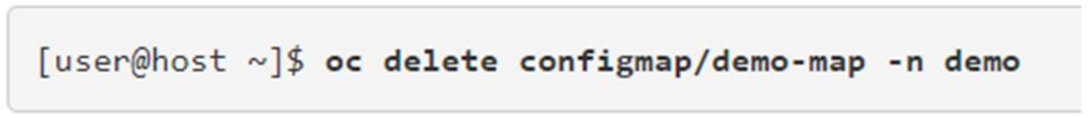


```
[user@host ~]$ kubectl create configmap my-config \
--from-literal key1=config1 --from-literal key2=config2
```

You can also use the `cm` shortname to create a configuration map.

```
[user@host ~]$ oc create cm my-config \
--from-literal key1=config1 --from-literal key2=config2
```

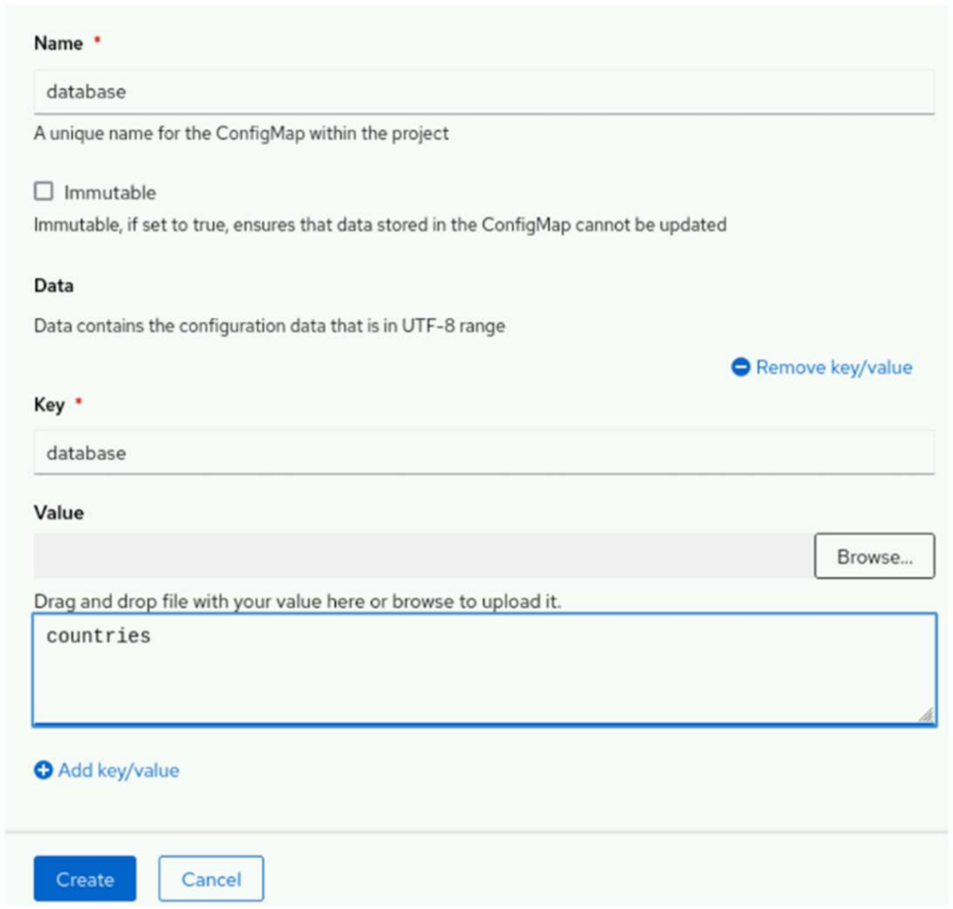
- Deleting CMs



```
[user@host ~]$ oc delete configmap/demo-map -n demo
```

Creating Secrets using web console

- From web console, click **Workloads** -> **ConfigMaps** menu
- Then click **Create ConfigMap**



Name *

database

A unique name for the ConfigMap within the project

☐ Immutable

Immutable, if set to true, ensures that data stored in the ConfigMap cannot be updated

Data

Data contains the configuration data that is in UTF-8 range

Key *

database

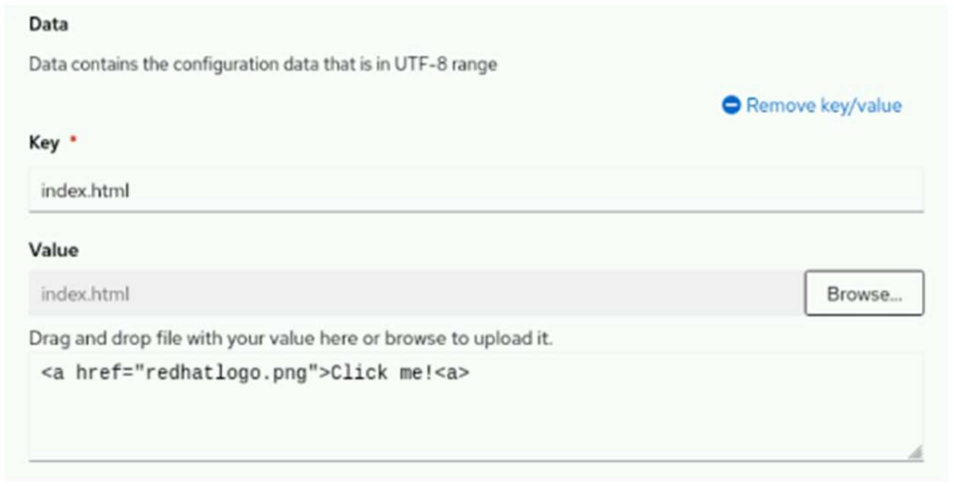
Value

Drag and drop file with your value here or browse to upload it.

```
countries
```

Creating Secrets using web console

- Click **Browse** -> **Value** field
- **Key** field : Specify any meaningful name
- **Value** field : Browse to the file



Data

Data contains the configuration data that is in UTF-8 range

Key *

index.html

Value

index.html

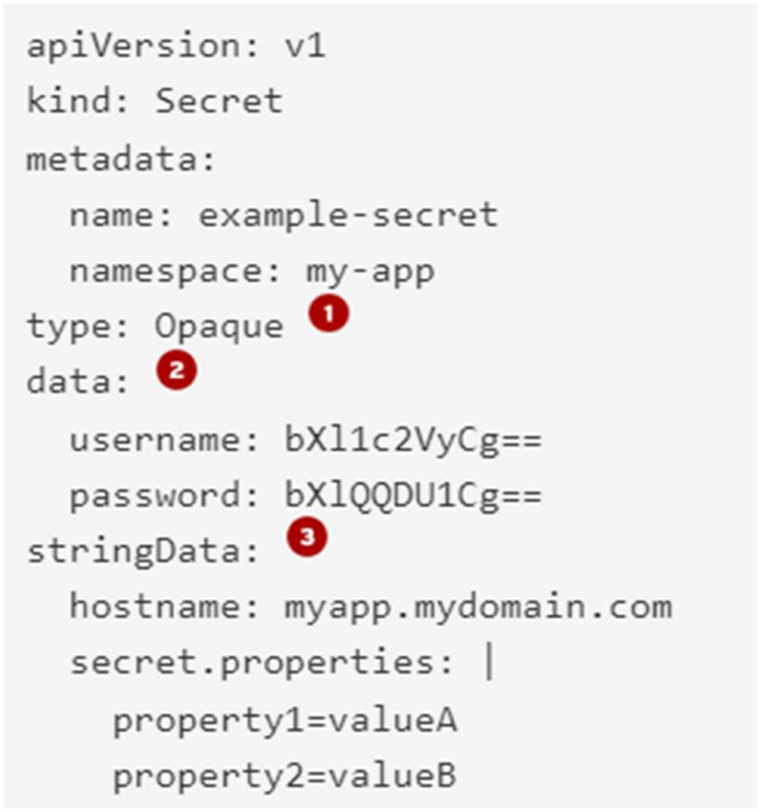
Drag and drop file with your value here or browse to upload it.

```
<a href="redhatlogo.png">Click me!<a>
```

Secrets

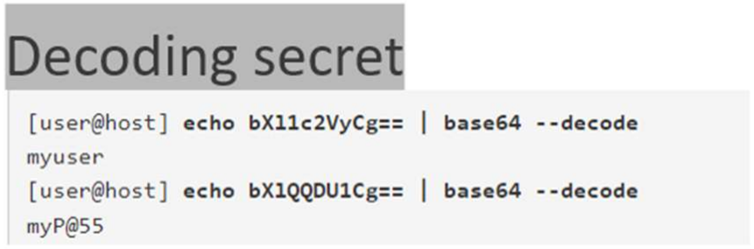
- API object
- Sensitive information stored in Base64-encoded format
- Case use:
  - Username and Passwords
  - Sensitive configuration files
  - Credentials to external source (SSH key or Oauth token)
  - TLS certificates
  - Docker configuration secrets (credential)
- To encrypt secrets or configmaps
  - encrypt the etcd database

Secrets manifest in YAML



```yaml
apiVersion: v1
kind: Secret
metadata:
  name: example-secret
  namespace: my-app
type: Opaque 1
data: 2
  username: bXl1c2VyCg==
  password: bXlQQDU1Cg==
stringData: 3
  hostname: myapp.mydomain.com
  secret.properties: |
    property1=valueA
    property2=valueB
```

1. Specifies the type of secret.
2. Specifies the encoded string and data.
3. Specifies the decoded string and data.



Decoding secret

```
[user@host] echo bXl1c2VyCg== | base64 --decode
myuser
[user@host] echo bXlQQDU1Cg== | base64 --decode
myP@55
```

Creating Secrets

Create a generic secret that contains key-value pairs from literal values that are typed on the command line:

```
[user@host ~]$ oc create secret generic secret_name \
--from-literal key1=secret1 \
--from-literal key2=secret2
```

Create a generic secret by using key names that are specified on the command line and values from files:

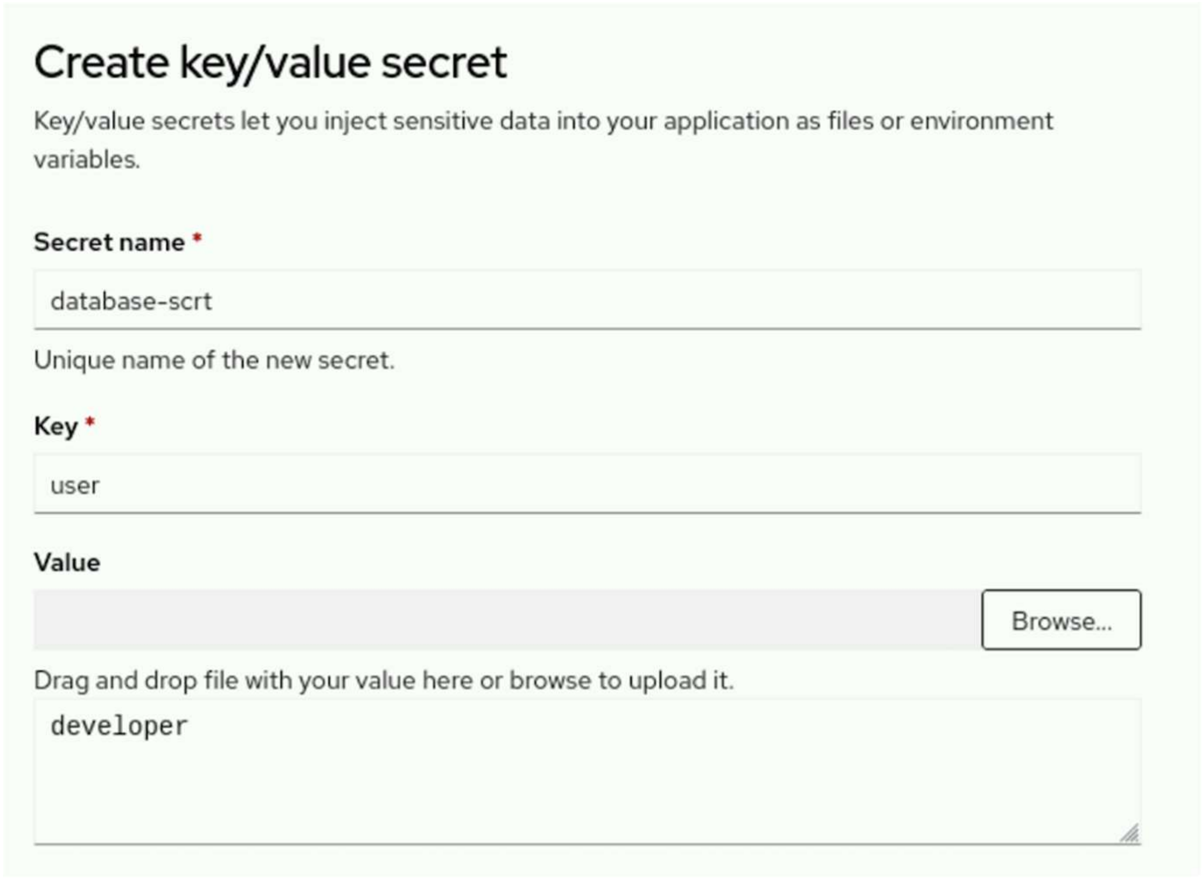
```
[user@host ~]$ kubectl create secret generic ssh-keys \
--from-file id_rsa=/path-to/id_rsa \
--from-file id_rsa.pub=/path-to/id_rsa.pub
```

Create a TLS secret that specifies a certificate and the associated key:

```
[user@host ~]$ oc create secret tls secret-tls \
--cert /path-to-certificate --key /path-to-key
```

Creating Secrets using web console

- From web console, click **Workloads** -> **Secrets** menu
- Then click **Create** → select **Key/value secret**



Create key/value secret

Key/value secrets let you inject sensitive data into your application as files or environment variables.

Secret name *

database-scrt

Unique name of the new secret.

Key *

user

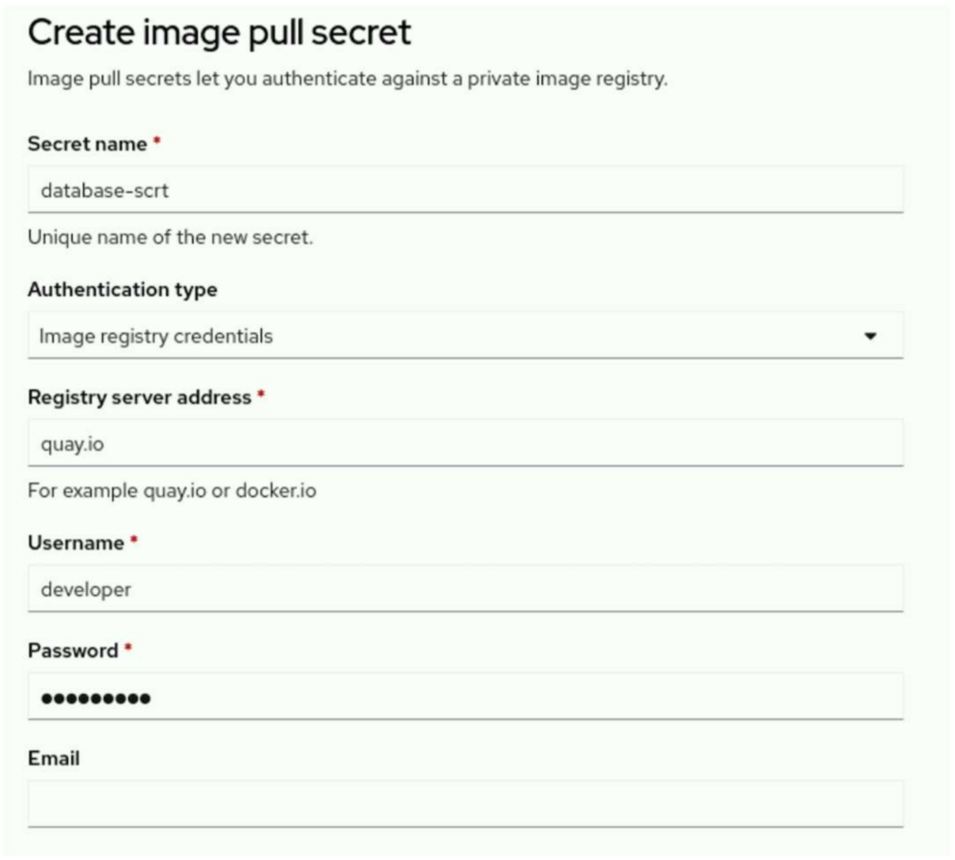
Value

Drag and drop file with your value here or browse to upload it.

```
developer
```

Creating Secrets to external source's credential

- From web console, click **Workloads** -> **Secrets** menu
- Then click **Create** → select **Image pull secret**



Create image pull secret

Image pull secrets let you authenticate against a private image registry.

Secret name *

database-scrt

Unique name of the new secret.

Authentication type

Image registry credentials

Registry server address *

quay.io

For example quay.io or docker.io

Username *

developer

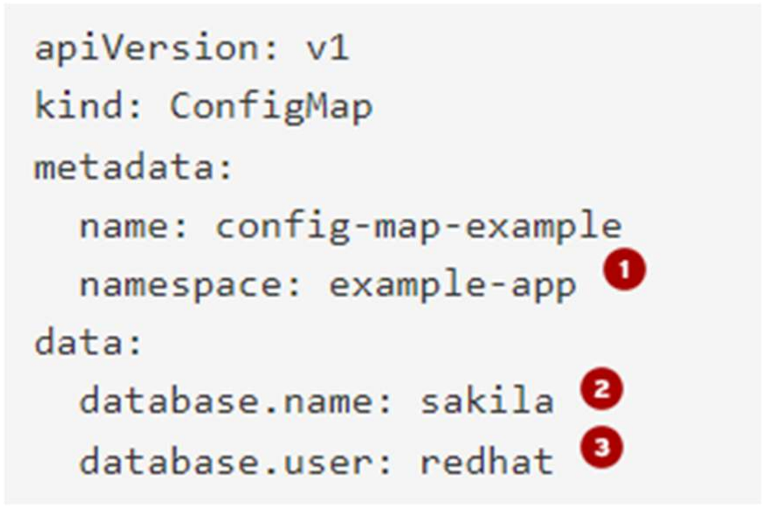
Password *

●●●●●●●●●

Email

Use ConfigMaps to initialize environment variable

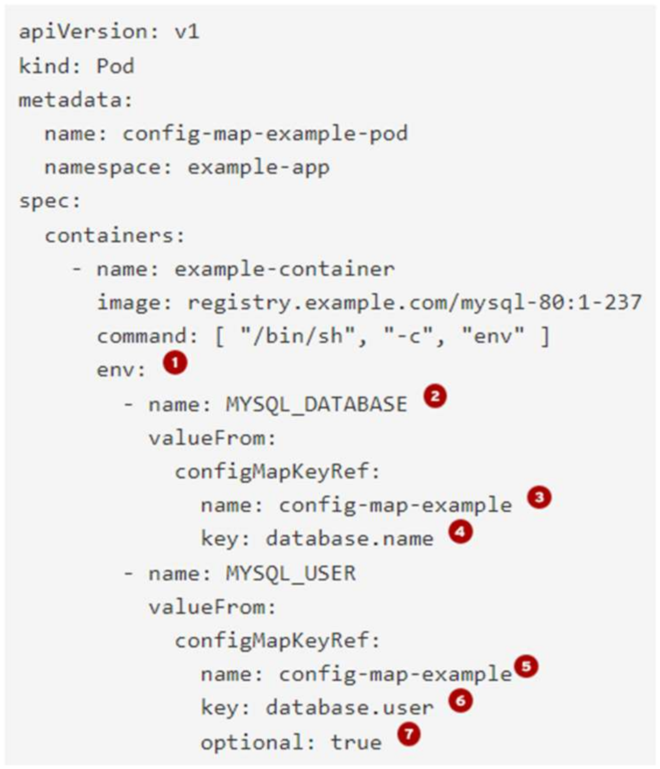
- Use environment variable to configure application
- Example:
  - Set database name
  - Customized user name



```
apiVersion: v1
kind: ConfigMap
metadata:
  name: config-map-example
  namespace: example-app  1
data:
  database.name: sakila  2
  database.user: redhat  3
```

1. The project where the configuration map resides. ConfigMap objects can be referenced only by pods in the same project.
2. Initializes the database.name variable to the sakila value.
3. Initializes the database.user variable to the redhat value.

Inject ConfigMaps to application



```
apiVersion: v1
kind: Pod
metadata:
  name: config-map-example-pod
  namespace: example-app
spec:
  containers:
    - name: example-container
      image: registry.example.com/mysql-80:1-237
      command: [ "/bin/sh", "-c", "env" ]
      env: [1]
        - name: MYSQL_DATABASE [2]
          valueFrom:
            configMapKeyRef:
              name: config-map-example [3]
              key: database.name [4]
        - name: MYSQL_USER
          valueFrom:
            configMapKeyRef:
              name: config-map-example [5]
              key: database.user [6]
              optional: true [7]
```

1 he attribute to specify environment variables for the pod.

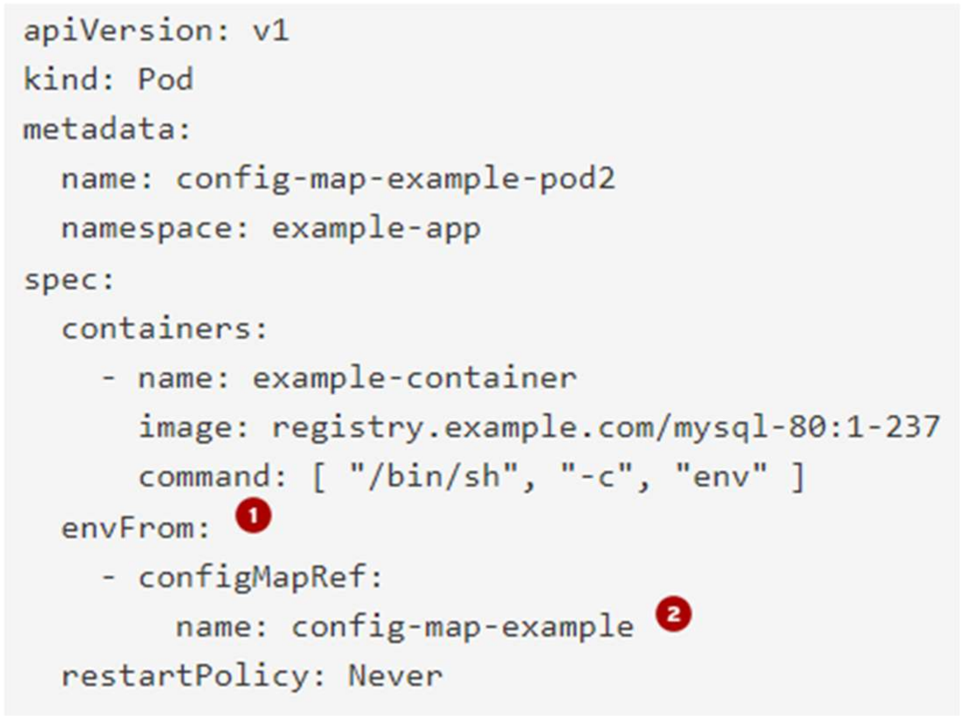
2 The name of a pod environment variable where you are populating a key's value.

3 5 Name of the ConfigMap object to pull the environment variables from.

4 6 The environment variable to pull from the the ConfigMap object.

7 Sets the environment variable as optional. The pod is started even if the specified ConfigMap object and keys do not exist.

Inject ConfigMaps to application

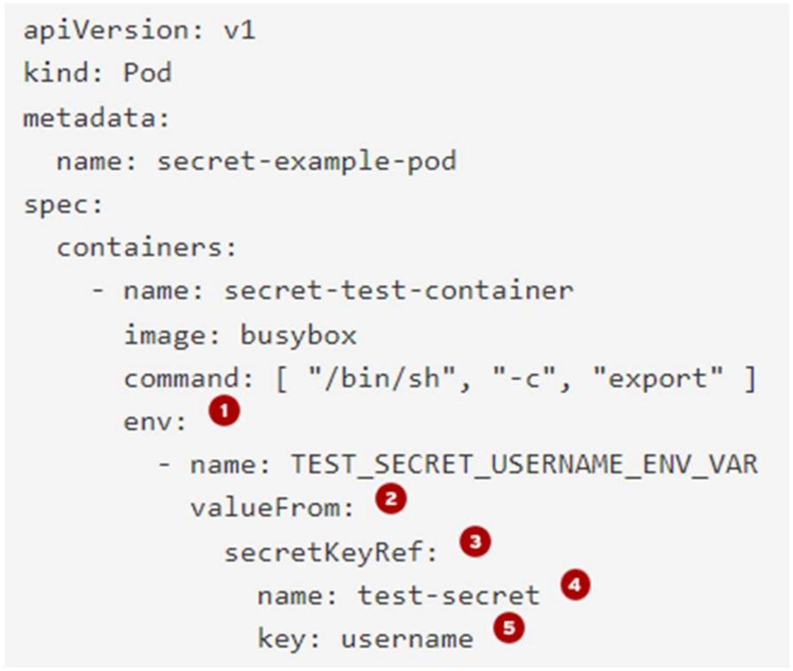


```
apiVersion: v1
kind: Pod
metadata:
  name: config-map-example-pod2
  namespace: example-app
spec:
  containers:
    - name: example-container
      image: registry.example.com/mysql-80:1-237
      command: [ "/bin/sh", "-c", "env" ]
  envFrom: 1
    - configMapRef:
        name: config-map-example  2
  restartPolicy: Never
```

1. The attribute to pull all environment variables from a ConfigMap object.

2. The name of the ConfigMap object to pull environment variables from.

Inject Secrets to application



```
apiVersion: v1
kind: Pod
metadata:
  name: secret-example-pod
spec:
  containers:
    - name: secret-test-container
      image: busybox
      command: [ "/bin/sh", "-c", "export" ]
      env: ❶
        - name: TEST_SECRET_USERNAME_ENV_VAR
          valueFrom: ❷
            secretKeyRef: ❸
              name: test-secret ❹
              key: username ❺
```

1. Specifies the environment variables for the pod.
2. Indicates the source of the environment variables.
3. The secretKeyRef source object of the environment variables.
4. Name of the secret, which must exist.
5. The key that is extracted from the secret is the username for authentication.

Inject ConfigMap as volume to deployment

```
[user@host ~]$ oc create configmap demo-map \
--from-file=config-files/httpd.conf
```

You can similarly add a configuration map as a volume by using the following command:

```
[user@host ~]$ oc set volume deployment/demo \
--add --type configmap \
--configmap-name demo-map \
--mount-path /app-secrets
```

To confirm that the volume is attached to the deployment, use the following command:

```
[user@host ~]$ oc set volume deployment/demo
 demo
  configMap/demo-map as volume-du9in
    mounted at /app-secrets
```

Inject Secrets as volume to deployment

```
[user@host ~]$ oc create secret generic demo-secret \
--from-literal user=demo-user \
--from-literal root_password=zT1KTgk
```

You can also create a generic secret by specifying key names on the command line and values from files:

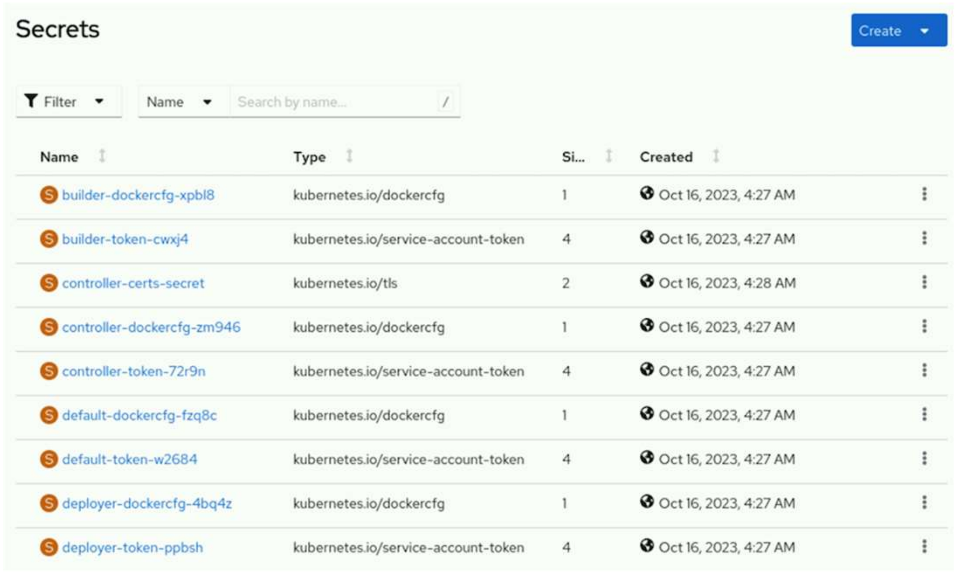
```
[user@host ~]$ oc create secret generic demo-secret \
--from-file user=/tmp/demo/user \
--from-file root_password=/tmp/demo/root_password
```

You can mount a secret to a directory within a pod. Kubernetes creates a file for each key in the secret that uses the name of the key. The content of each file is the decoded value of the secret. The following command shows how to mount secrets in a pod:

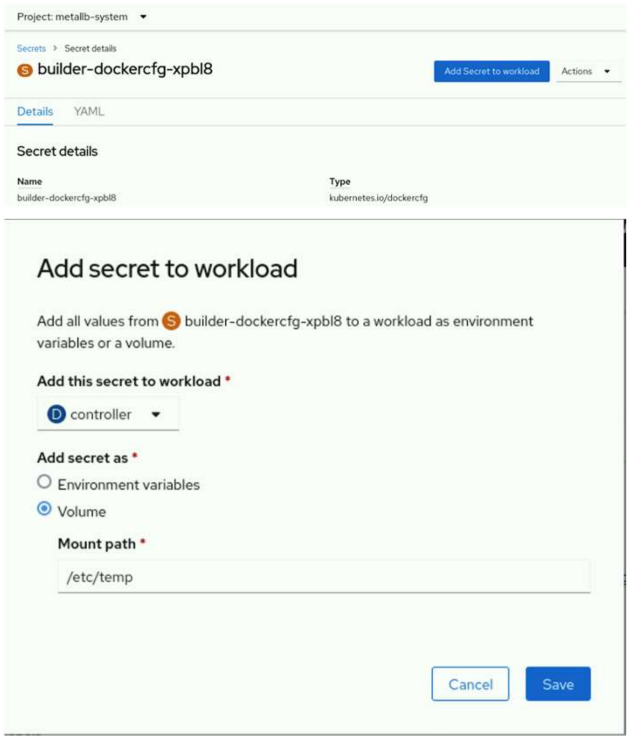
```
[user@host ~]$ oc set volume deployment/demo \ ❶
--add --type secret \ ❷
--secret-name demo-secret \ ❸
--mount-path /app-secrets ❹
```

Inject secret as volume to deployment using web console

- From web console, click **Workloads** -> **Secrets** menu
- Select a secret -> **Add Secret to Workload**



Name	Type	Si...	Created
builder-dockercfg-xpbl8	kubernetes.io/dockercfg	1	Oct 16, 2023, 4:27 AM
builder-token-cwxj4	kubernetes.io/service-account-token	4	Oct 16, 2023, 4:27 AM
controller-certs-secret	kubernetes.io/tls	2	Oct 16, 2023, 4:28 AM
controller-dockercfg-zm946	kubernetes.io/dockercfg	1	Oct 16, 2023, 4:27 AM
controller-token-72r9n	kubernetes.io/service-account-token	4	Oct 16, 2023, 4:27 AM
default-dockercfg-fzq8c	kubernetes.io/dockercfg	1	Oct 16, 2023, 4:27 AM
default-token-w2684	kubernetes.io/service-account-token	4	Oct 16, 2023, 4:27 AM
deployer-dockercfg-4bq4z	kubernetes.io/dockercfg	1	Oct 16, 2023, 4:27 AM
deployer-token-ppbsh	kubernetes.io/service-account-token	4	Oct 16, 2023, 4:27 AM



Secret details

Name: builder-dockercfg-xpbl8
Type: kubernetes.io/dockercfg

Add secret to workload

Add all values from builder-dockercfg-xpbl8 to a workload as environment variables or a volume.

Add this secret to workload *: controller

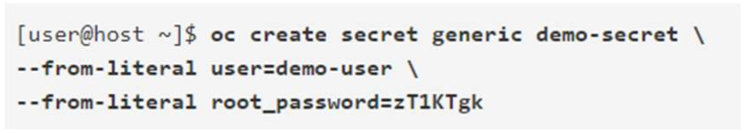
Add secret as *: Environment variables [✓ Volume]

Mount path *: /etc/temp

The oc set env Command

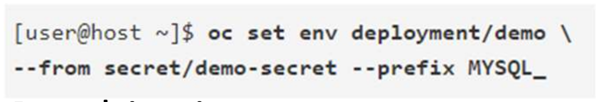
- Update secret / configmap
- Use --prefix option to prefix parameter
- Example

1. Create secret containing a user name and root password



```
[user@host ~]$ oc create secret generic demo-secret \
--from-literal user=demo-user \
--from-literal root_password=zT1KTgk
```

2. Inject the secret into deployment with the –prefix option



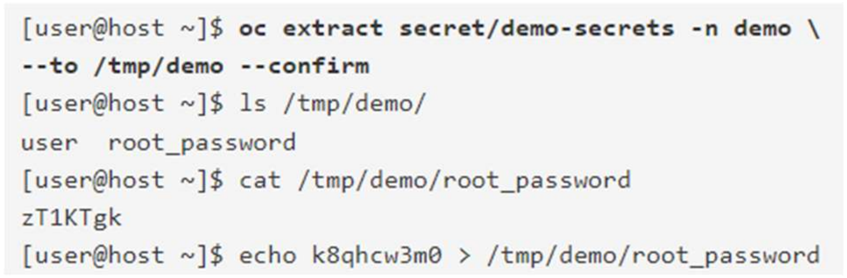
```
[user@host ~]$ oc set env deployment/demo \
--from secret/demo-secret --prefix MYSQL_
```

3. Resulting in
   - MYSQL_user=demo-user
   - MYSQL_root_password=zT1KTgk

Updating Secrets and Configuration Maps

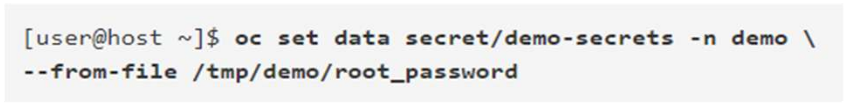
- Use **oc extract secret** to retrieve secrets into local system direcrory
- Use **--confirm** option to overwrite if file exists in the destination directory
- Example

1. Extracct the secrets into /tmp/demo



```
[user@host ~]$ oc extract secret/demo-secrets -n demo \
--to /tmp/demo --confirm
[user@host ~]$ ls /tmp/demo/
user  root_password
[user@host ~]$ cat /tmp/demo/root_password
zT1KTgk
[user@host ~]$ echo k8qhcw3m0 > /tmp/demo/root_password
```

2. Update the secret from another credential file



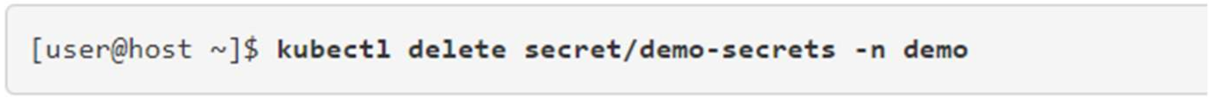
```
[user@host ~]$ oc set data secret/demo-secrets -n demo \
--from-file /tmp/demo/root_password
```

3. Restart pods to re-read the updated secrets

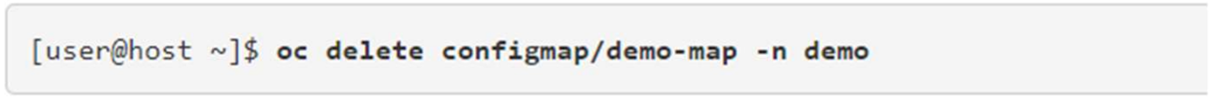
NOTE: If using volume, kubelet agent detect and propagate changes using eventually consistent approach

Deleting Secrets and Configuration Maps

- First remove secrets or config maps from deployment or pods



```
[user@host ~]$ kubectl delete secret/demo-secrets -n demo
```



```
[user@host ~]$ oc delete configmap/demo-map -n demo
```

Guided Exercise: Externalize the Configuration of Applications

You should be able to:

- Create a web application deployment.
- Expose the web application deployment to external access.
- Create a configuration map from two files.
- Mount the configuration map in the web application deployment.

Lab: Deploy Managed and Networked Applications on Kubernetes

You should be able to:

- Deploy a MySQL database from a container image.
- Deploy a web application from a container image.
- Configure environment variables for a deployment.
- Expose the web application for external access.

Summary

MANY RESOURCES IN KUBERNETES AND RHOCP CREATE OR AFFECT PODS.

RESOURCES ARE CREATED IMPERATIVELY OR DECLARATIVELY. THE IMPERATIVE STRATEGY INSTRUCTS THE CLUSTER WHAT TO DO. THE DECLARATIVE STRATEGY DEFINES THE STATE THAT THE CLUSTER MATCHES.

THE OC NEW-APP COMMAND CREATES RESOURCES THAT ARE DETERMINED VIA HEURISTICS.

THE MAIN WAY TO DEPLOY AN APPLICATION IS BY CREATING A DEPLOYMENT.

THE WORKLOAD API INCLUDES SEVERAL RESOURCES TO CREATE PODS. THE CHOICE BETWEEN RESOURCES DEPENDS ON FOR HOW LONG AND HOW OFTEN THE POD NEEDS TO RUN.

A *JOB* RESOURCE EXECUTES A ONE-TIME TASK ON THE CLUSTER VIA A POD. THE CLUSTER RETRIES THE JOB UNTIL IT SUCCEEDS, OR IT RETRIES A SPECIFIED NUMBER OF ATTEMPTS.

RESOURCES ARE ORGANIZED INTO PROJECTS AND ARE SELECTED VIA LABELS.

A *ROUTE* CONNECTS A PUBLIC-FACING IP ADDRESS AND A DNS HOSTNAME TO AN INTERNAL-FACING *SERVICE* IP ADDRESS. SERVICES PROVIDE NETWORK ACCESS BETWEEN PODS, WHEREAS ROUTES PROVIDE NETWORK ACCESS TO PODS FROM USERS AND APPLICATIONS OUTSIDE THE RHOCP CLUSTER.