.

Lesson 06 Demo 07

Configuring Multi-Container Pods with RWX Access Using PV and PVC

Objective: To configure multi-container pods with ReadWriteMany (RWX) access in Kubernetes using PersistentVolume (PV) and PersistentVolumeClaim (PVC) for shared storage and data operations

Tools required: kubeadm, kubectl, kubelet, and containerd

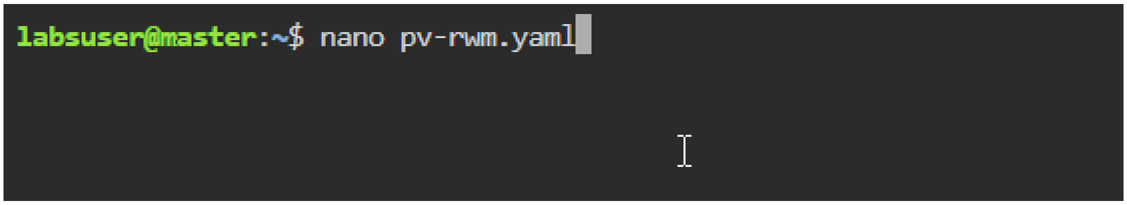
Prerequisites: A Kubernetes cluster should already be set up (refer to the steps provided in Lesson 02, Demo 01 for guidance).

Steps to be followed:

1. Create PersistentVolume
2. Create PersistentVolumeClaim
3. Deploy a pod in a new namespace
4. Demonstrate shared storage and data operations
5. Continue data operations

Step 1: Create PersistentVolume

1.1 Create the YAML file using the command below:
nano pv-rwm.yaml



```
labsuser@master:~$ nano pv-rwm.yaml
```

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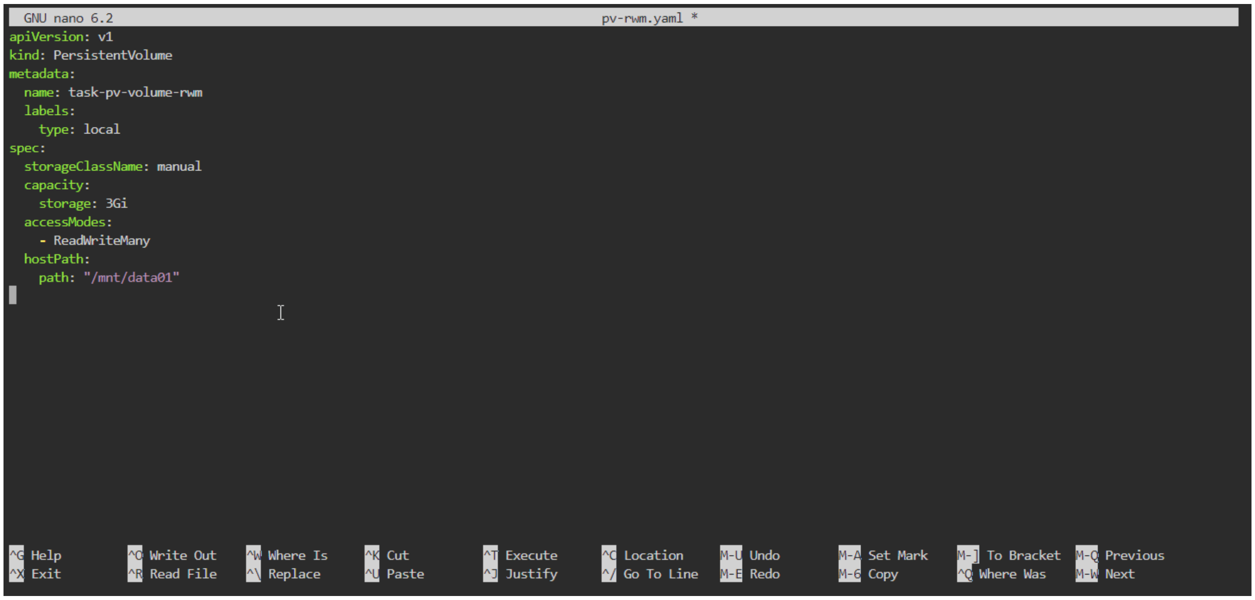
1.2 Add the following code to the **pv-rwm.yaml** file to create the pod:

```
apiVersion: v1
kind: PersistentVolume
metadata:
  name: task-pv-volume-rwm
  labels:
    type: local
spec:
  storageClassName: manual
  capacity:
    storage: 3Gi
  accessModes:
    - ReadWriteMany
  hostPath:
    path: "/mnt/data01"
```



```
apiVersion: v1
kind: PersistentVolume
metadata:
  name: task-pv-volume-rwm
  labels:
    type: local
spec:
  storageClassName: manual
  capacity:
    storage: 3Gi
  accessModes:
    - ReadWriteMany
  hostPath:
    path: "/mnt/data01"
```

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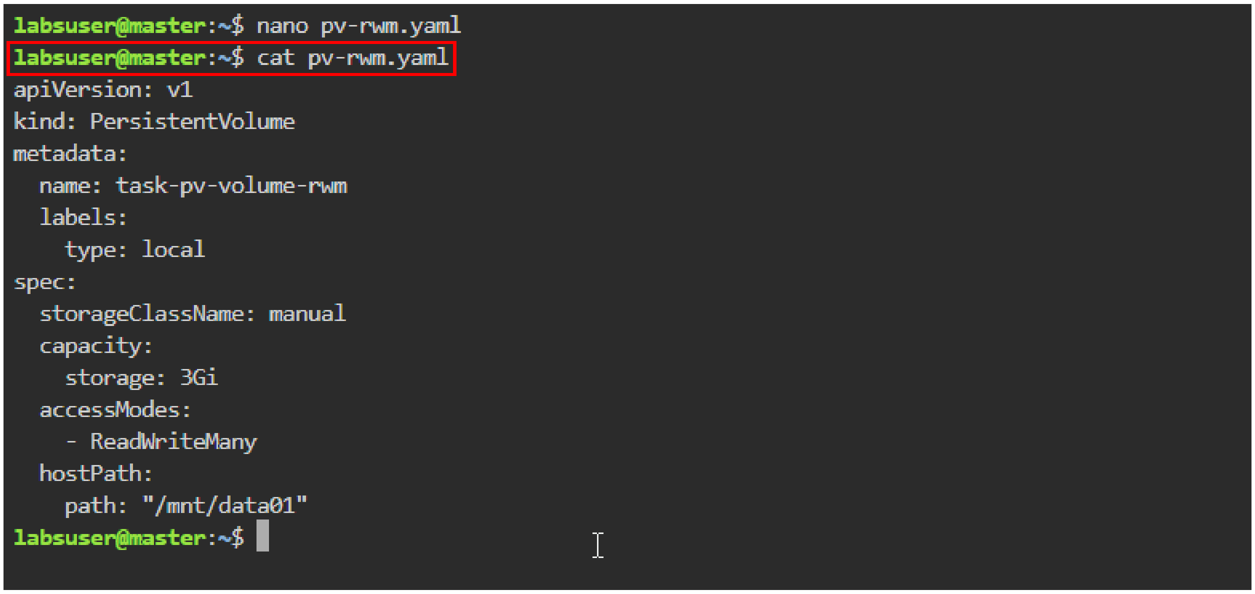
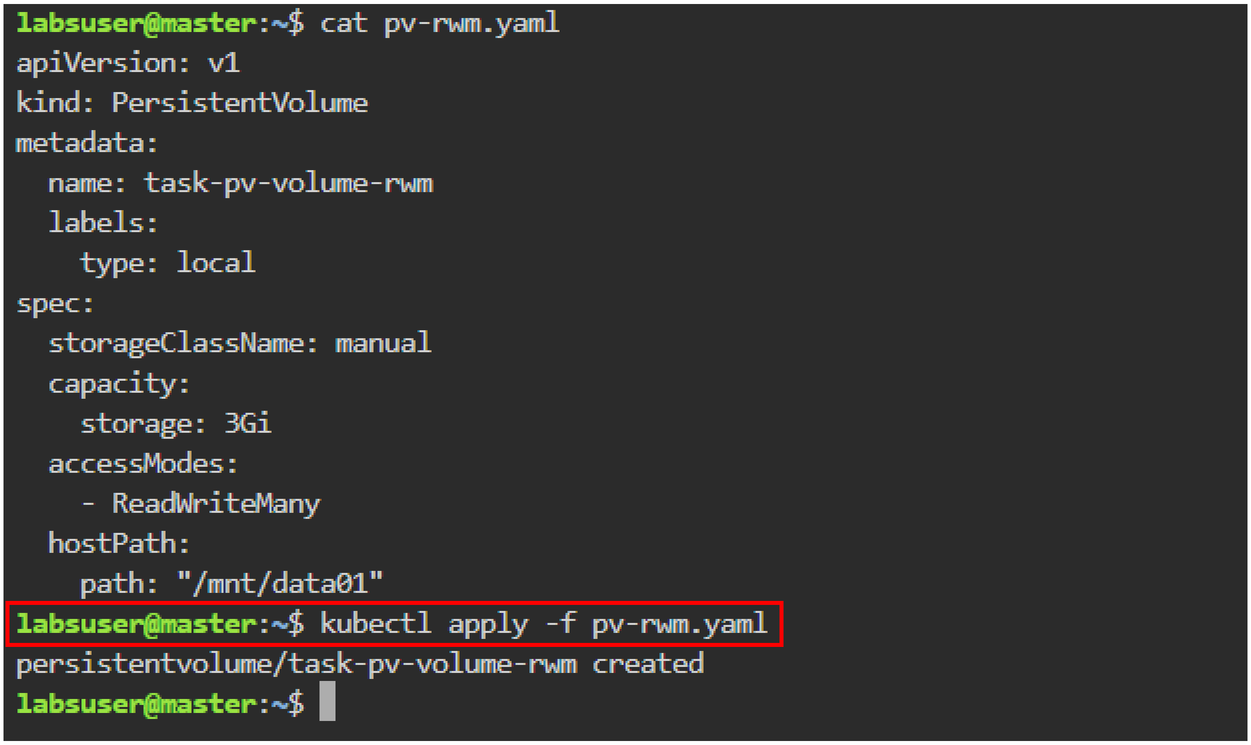
1.3 Use the **cat** command to validate the content of the **pv-rwm.yaml** file



```
labsuser@master:~$ nano pv-rwm.yaml
labsuser@master:~$ cat pv-rwm.yaml
apiVersion: v1
kind: PersistentVolume
metadata:
  name: task-pv-volume-rwm
  labels:
    type: local
spec:
  storageClassName: manual
  capacity:
    storage: 3Gi
  accessModes:
    - ReadWriteMany
  hostPath:
    path: "/mnt/data01"
labsuser@master:~$
```

1.4 Apply the configuration defined in **pv-rwm.yaml** using the following command:
kubectl apply -f pv-rwm.yaml



```
labsuser@master:~$ cat pv-rwm.yaml
apiVersion: v1
kind: PersistentVolume
metadata:
  name: task-pv-volume-rwm
  labels:
    type: local
spec:
  storageClassName: manual
  capacity:
    storage: 3Gi
  accessModes:
    - ReadWriteMany
  hostPath:
    path: "/mnt/data01"
labsuser@master:~$ kubectl apply -f pv-rwm.yaml
persistentvolume/task-pv-volume-rwm created
labsuser@master:~$
```

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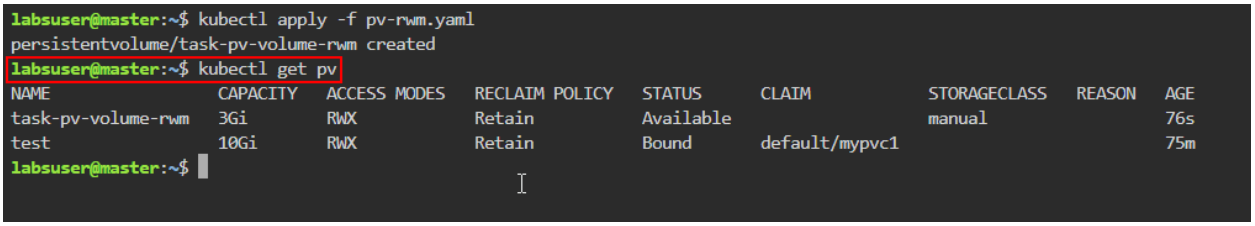
1.5 List all PVs in the Kubernetes cluster using the following command:

kubectl get pv

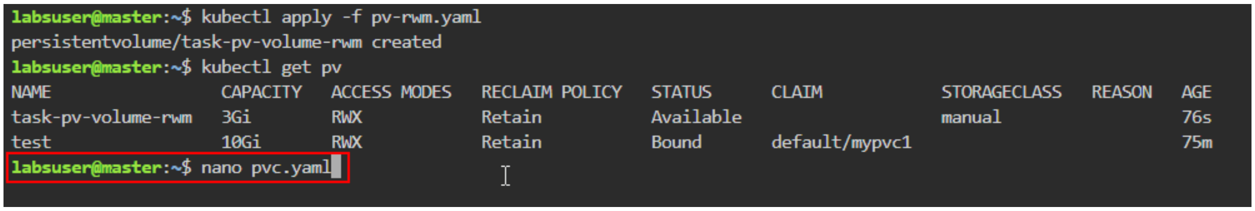


```
labsuser@master:~$ kubectl apply -f pv-rwm.yaml
persistentvolume/task-pv-volume-rwm created
labsuser@master:~$ kubectl get pv
NAME                 CAPACITY   ACCESS MODES   RECLAIM POLICY   STATUS      CLAIM             STORAGECLASS   REASON   AGE
task-pv-volume-rwm   3Gi        RWX            Retain           Available                     manual                  76s
test                 10Gi       RWX            Retain           Bound       default/mypvc1                            75m
labsuser@master:~$ 
```

Step 2: Create PersistentVolumeClaim

2.1 Create the YAML file using the following command:

nano pvc.yaml



```
labsuser@master:~$ kubectl apply -f pv-rwm.yaml
persistentvolume/task-pv-volume-rwm created
labsuser@master:~$ kubectl get pv
NAME                 CAPACITY   ACCESS MODES   RECLAIM POLICY   STATUS      CLAIM             STORAGECLASS   REASON   AGE
task-pv-volume-rwm   3Gi        RWX            Retain           Available                     manual                  76s
test                 10Gi       RWX            Retain           Bound       default/mypvc1                            75m
labsuser@master:~$ nano pvc.yaml
```

2.2 Add the following code to the **pvc.yaml** file:

```
apiVersion: v1
kind: PersistentVolumeClaim
metadata:
  name: task-pv-claim
spec:
  storageClassName: manual
  accessModes:
    - ReadWriteMany
  resources:
    requests:
      storage: 3Gi
```

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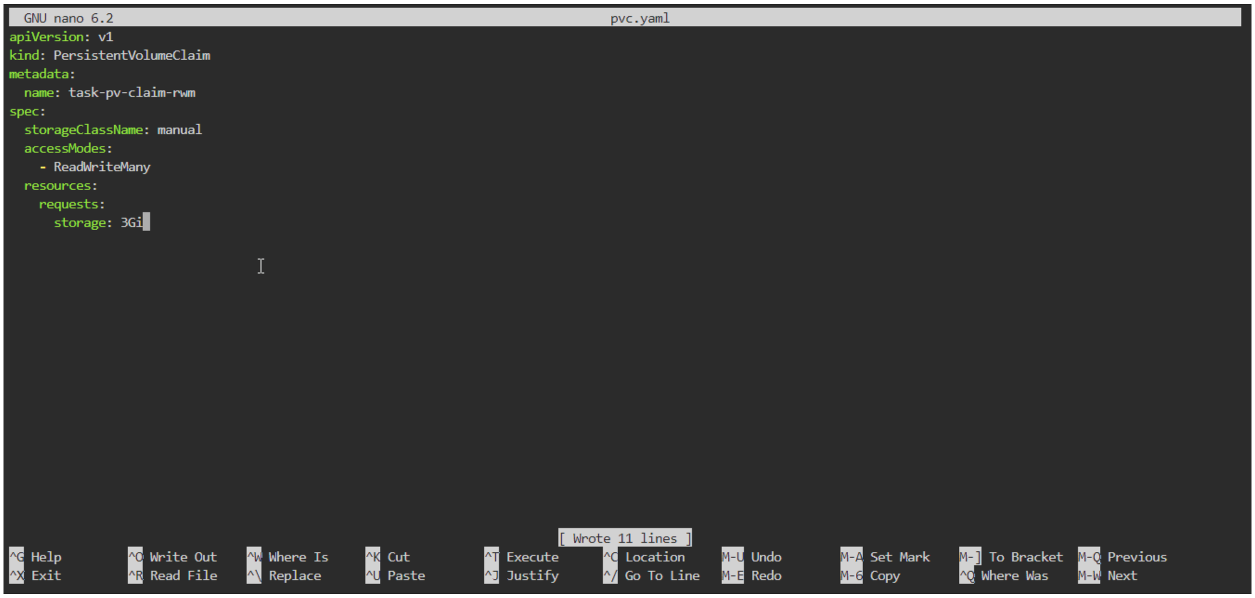
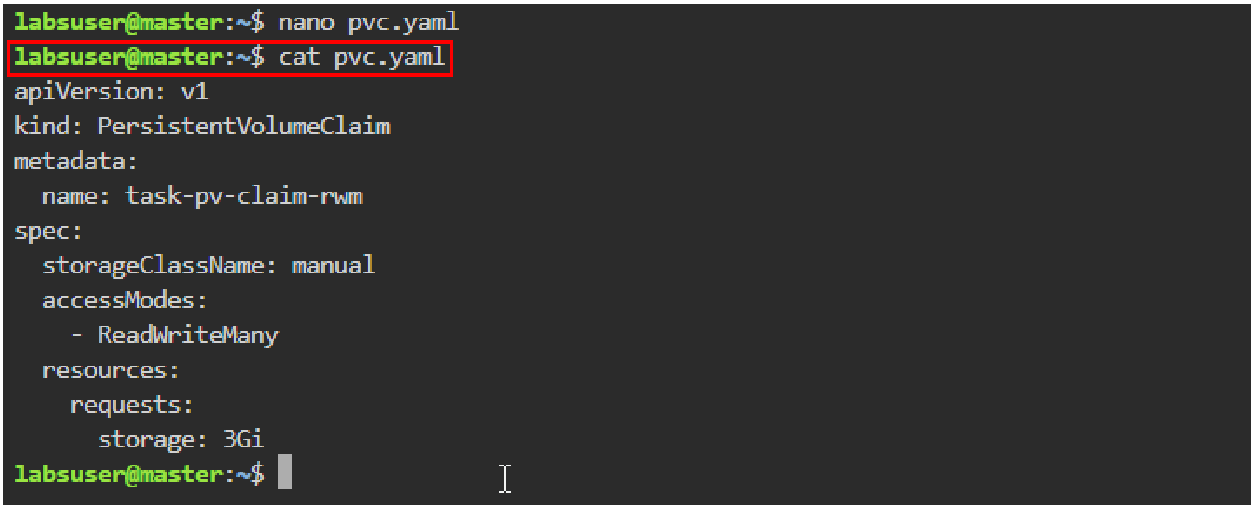


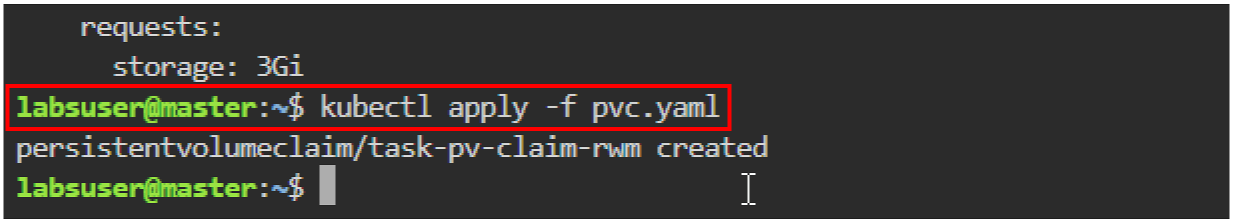
```
GNU nano 6.2                                         pvc.yaml
apiVersion: v1
kind: PersistentVolumeClaim
metadata:
  name: task-pv-claim-rwm
spec:
  storageClassName: manual
  accessModes:
    - ReadWriteMany
  resources:
    requests:
      storage: 3Gi
```

2.3 Use the **cat** command to validate the content of the **pvc.yaml** file



```
labsuser@master:~$ nano pvc.yaml
labsuser@master:~$ cat pvc.yaml
apiVersion: v1
kind: PersistentVolumeClaim
metadata:
  name: task-pv-claim-rwm
spec:
  storageClassName: manual
  accessModes:
    - ReadWriteMany
  resources:
    requests:
      storage: 3Gi
labsuser@master:~$
```

2.4 Apply the Kubernetes resource configuration defined in the **pvc.yaml** file to create the PVC using the following command:
kubectl apply -f pvc.yaml



```
    requests:
      storage: 3Gi
labsuser@master:~$ kubectl apply -f pvc.yaml
persistentvolumeclaim/task-pv-claim-rwm created
labsuser@master:~$
```

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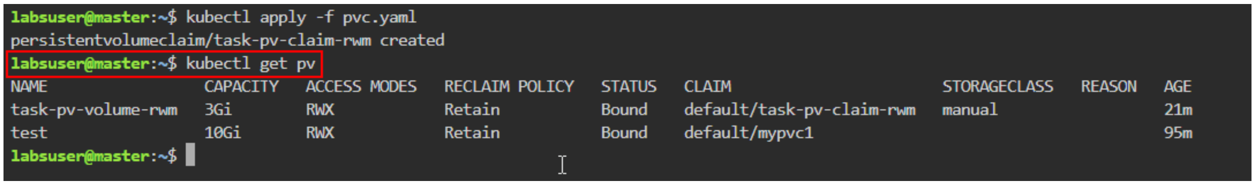
2.5 List all PVs in the Kubernetes cluster using the following command:

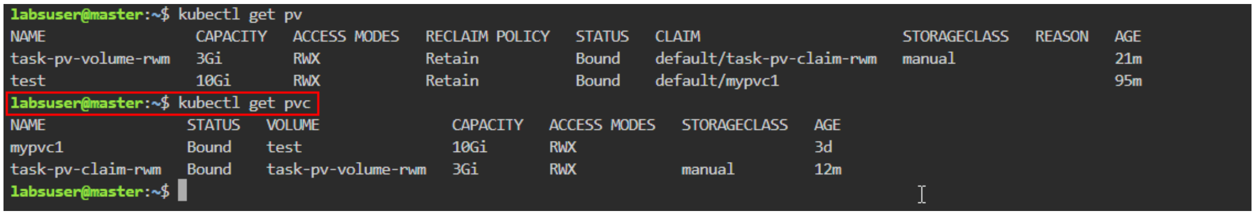
kubectl get pv



```
labsuser@master:~$ kubectl apply -f pvc.yaml
persistentvolumeclaim/task-pv-claim-rwm created
labsuser@master:~$ kubectl get pv
NAME               CAPACITY   ACCESS MODES   RECLAIM POLICY   STATUS   CLAIM                       STORAGECLASS   REASON   AGE
task-pv-volume-rwm   3Gi        RWX            Retain           Bound    default/task-pv-claim-rwm   manual                  21m
test               10Gi       RWX            Retain           Bound    default/mypvc1                                      95m
labsuser@master:~$
```

2.6 List all PVCs in the Kubernetes cluster using the following command:

kubectl get pvc

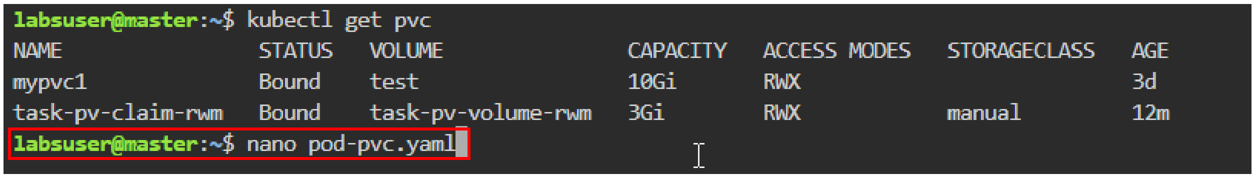


```
labsuser@master:~$ kubectl get pv
NAME                 CAPACITY   ACCESS MODES   RECLAIM POLICY   STATUS   CLAIM                       STORAGECLASS   REASON   AGE
task-pv-volume-rwm   3Gi        RWX            Retain           Bound    default/task-pv-claim-rwm   manual                  21m
test                 10Gi       RWX            Retain           Bound    default/mypvc1                                      95m
labsuser@master:~$ kubectl get pvc
NAME                STATUS   VOLUME               CAPACITY   ACCESS MODES   STORAGECLASS   AGE
mypvc1              Bound    test                 10Gi       RWX                           3d
task-pv-claim-rwm   Bound    task-pv-volume-rwm   3Gi        RWX            manual         12m
labsuser@master:~$
```

Step 3: Deploy a pod in a new namespace

3.1 Create the YAML file using the following command:

nano pod-pvc.yaml



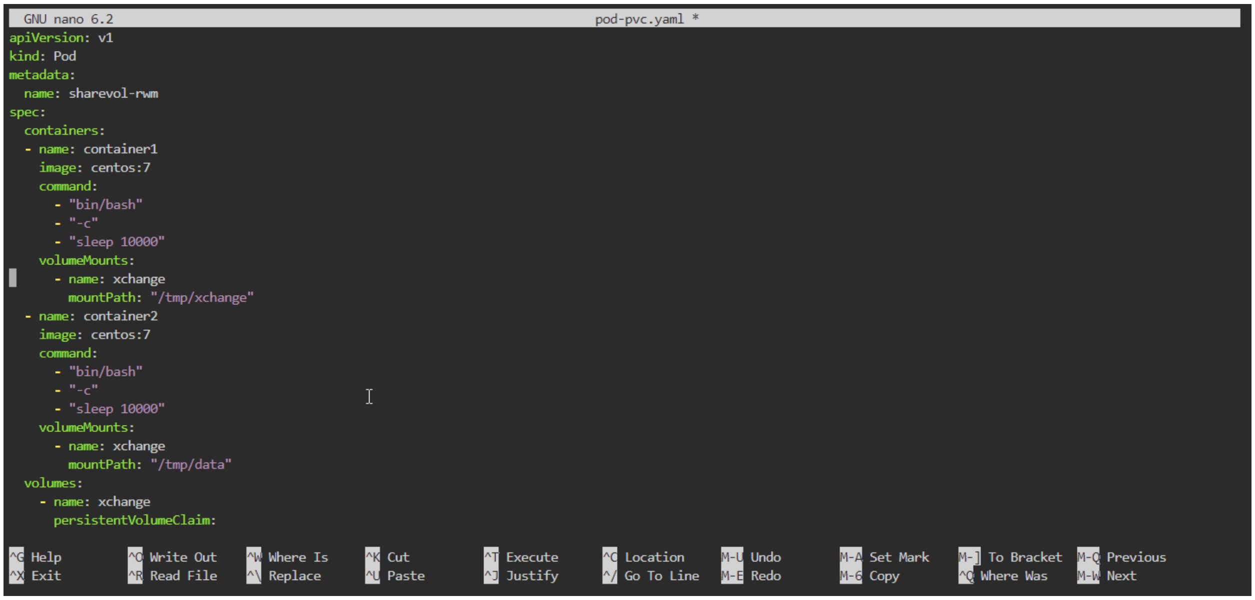
```
labsuser@master:~$ kubectl get pvc
NAME                STATUS   VOLUME               CAPACITY   ACCESS MODES   STORAGECLASS   AGE
mypvc1              Bound    test                 10Gi       RWX                           3d
task-pv-claim-rwm   Bound    task-pv-volume-rwm   3Gi        RWX            manual         12m
labsuser@master:~$ nano pod-pvc.yaml
```

3.2 Add the following code to the **pod-pvc.yaml** file:

```
apiVersion: v1
kind: Pod
metadata:
  name: sharevol-rwm
spec:
  containers:
  - name: container1
    image: centos:7
    command:
      - "bin/bash"
      - "-c"
```

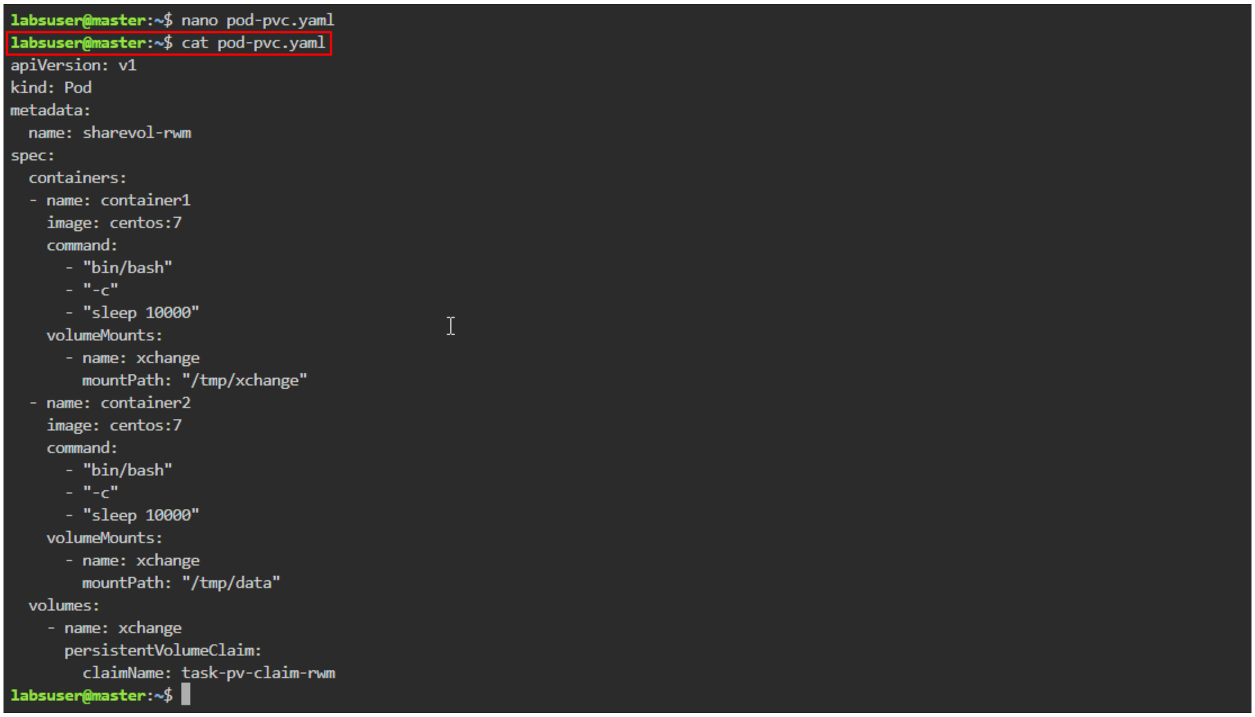
.

```
      - "sleep 10000"
    volumeMounts:
      - name: xchange
        mountPath: "/tmp/xchange"
  - name: container2
    image: centos:7
    command:
      - "bin/bash"
      - "-c"
      - "sleep 10000"
    volumeMounts:
      - name: xchange
        mountPath: "/tmp/data"
  volumes:
    - name: xchange
      persistentVolumeClaim:
        claimName: task-pv-claim-rwm
```



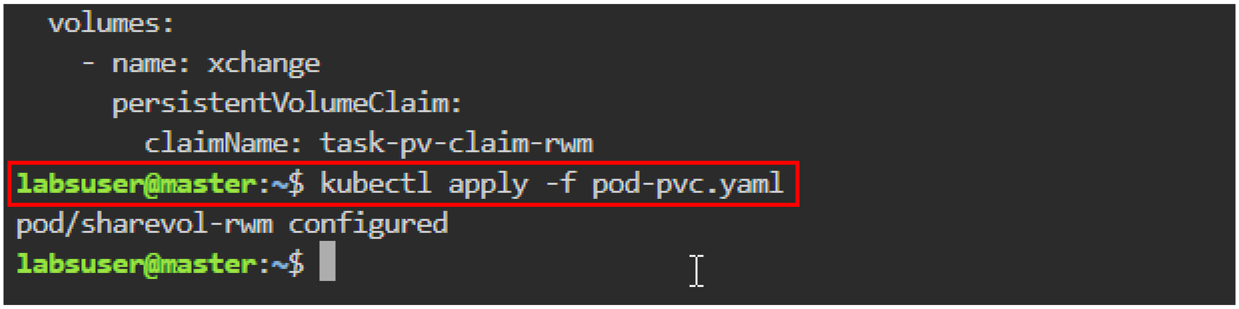
```
  GNU nano 6.2                                  pod-pvc.yaml *
apiVersion: v1
kind: Pod
metadata:
  name: sharevol-rwm
spec:
  containers:
  - name: container1
    image: centos:7
    command:
      - "bin/bash"
      - "-c"
      - "sleep 10000"
    volumeMounts:
      - name: xchange
        mountPath: "/tmp/xchange"
  - name: container2
    image: centos:7
    command:
      - "bin/bash"
      - "-c"
      - "sleep 10000"
    volumeMounts:
      - name: xchange
        mountPath: "/tmp/data"
  volumes:
    - name: xchange
      persistentVolumeClaim:

^G Help       ^O Write Out  ^W Where Is   ^K Cut        ^T Execute    ^C Location   M-U Undo      M-A Set Mark  M-] To Bracket M-Q Previous
^X Exit       ^R Read File  ^\ Replace    ^U Paste      ^J Justify    ^/ Go To Line M-E Redo      M-6 Copy      ^Q Where Was  M-W Next
```

3.3 Use the **cat** command to validate the content of the **pod-pvc.yaml** file



```
labsuser@master:~$ nano pod-pvc.yaml
labsuser@master:~$ cat pod-pvc.yaml
apiVersion: v1
kind: Pod
metadata:
  name: sharevol-rwm
spec:
  containers:
  - name: container1
    image: centos:7
    command:
      - "bin/bash"
      - "-c"
      - "sleep 10000"
    volumeMounts:
      - name: xchange
        mountPath: "/tmp/xchange"
  - name: container2
    image: centos:7
    command:
      - "bin/bash"
      - "-c"
      - "sleep 10000"
    volumeMounts:
      - name: xchange
        mountPath: "/tmp/data"
  volumes:
    - name: xchange
      persistentVolumeClaim:
        claimName: task-pv-claim-rwm
labsuser@master:~$
```

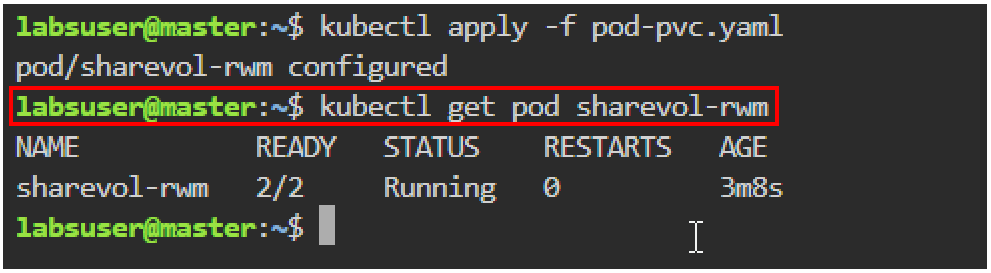
3.4 Apply the Kubernetes pod using the configuration defined in the **pod-pvc.yaml** file using the following command:
kubectl apply -f pod-pvc.yaml



```
  volumes:
    - name: xchange
      persistentVolumeClaim:
        claimName: task-pv-claim-rwm
labsuser@master:~$ kubectl apply -f pod-pvc.yaml
pod/sharevol-rwm configured
labsuser@master:~$
```

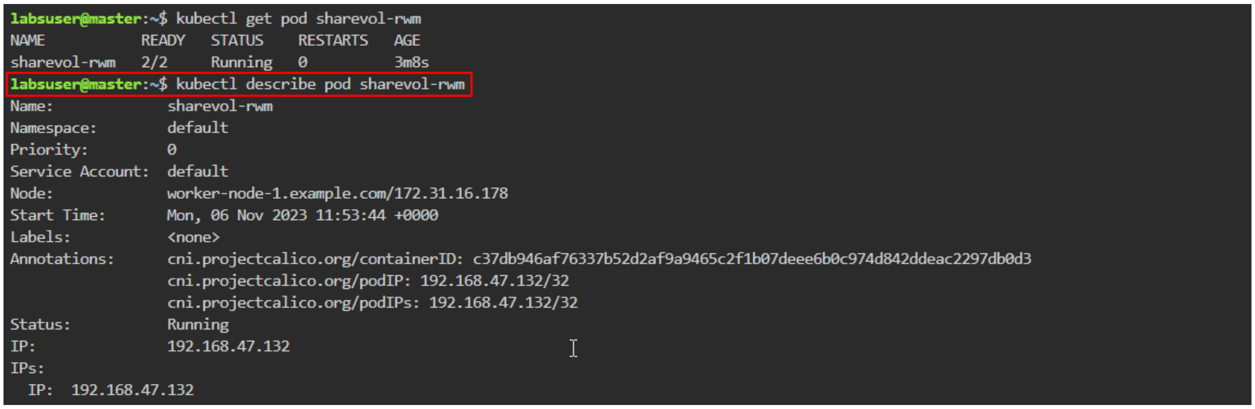
.

3.5 List all PVCs in the Kubernetes cluster using the following command:
kubectl get pod sharevol-rwm

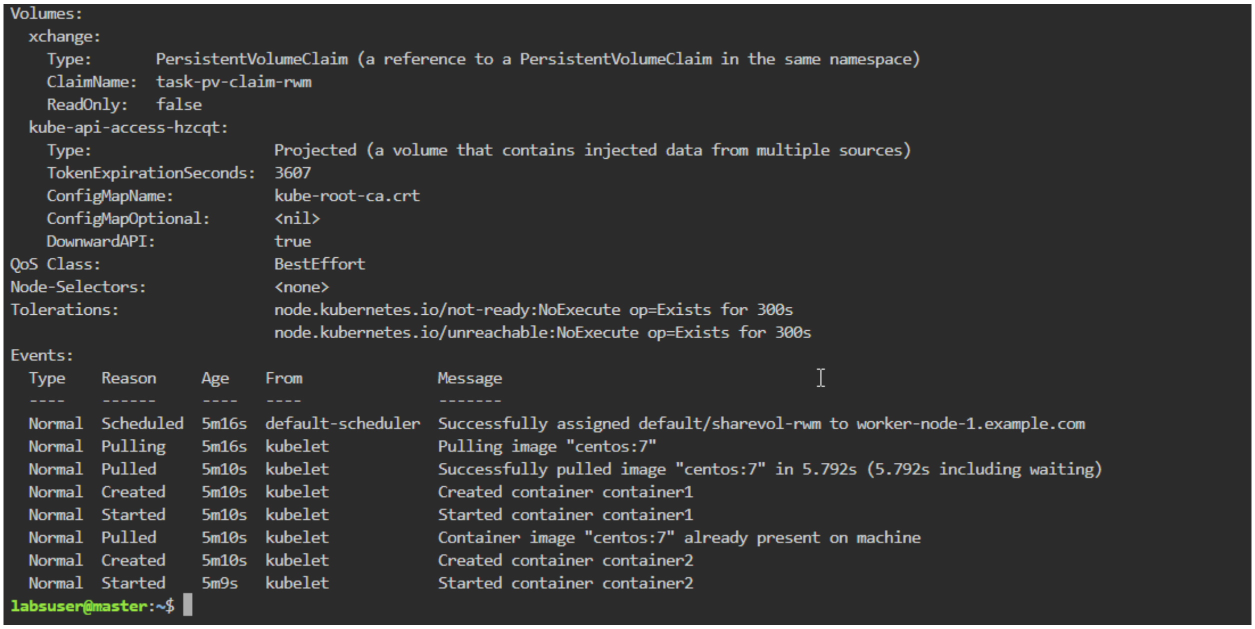


```
labsuser@master:~$ kubectl apply -f pod-pvc.yaml
pod/sharevol-rwm configured
labsuser@master:~$ kubectl get pod sharevol-rwm
NAME           READY   STATUS    RESTARTS   AGE
sharevol-rwm   2/2     Running   0          3m8s
labsuser@master:~$
```

3.6 Retrieve detailed information about the pod using the following command:
kubectl describe pod sharevol-rwm



```
labsuser@master:~$ kubectl get pod sharevol-rwm
NAME           READY   STATUS    RESTARTS   AGE
sharevol-rwm   2/2     Running   0          3m8s
labsuser@master:~$ kubectl describe pod sharevol-rwm
Name:             sharevol-rwm
Namespace:        default
Priority:         0
Service Account:  default
Node:             worker-node-1.example.com/172.31.16.178
Start Time:       Mon, 06 Nov 2023 11:53:44 +0000
Labels:           <none>
Annotations:      cni.projectcalico.org/containerID: c37db946af76337b52d2af9a9465c2f1b07deee6b0c974d842ddeac2297db0d3
                  cni.projectcalico.org/podIP: 192.168.47.132/32
                  cni.projectcalico.org/podIPs: 192.168.47.132/32
Status:           Running
IP:               192.168.47.132
IPs:
  IP:  192.168.47.132
```



```
Volumes:
  xchange:
    Type:       PersistentVolumeClaim (a reference to a PersistentVolumeClaim in the same namespace)
    ClaimName:  task-pv-claim-rwm
    ReadOnly:   false
  kube-api-access-hzcqt:
    Type:                    Projected (a volume that contains injected data from multiple sources)
    TokenExpirationSeconds:  3607
    ConfigMapName:           kube-root-ca.crt
    ConfigMapOptional:       <nil>
    DownwardAPI:             true
QoS Class:                   BestEffort
Node-Selectors:              <none>
Tolerations:                 node.kubernetes.io/not-ready:NoExecute op=Exists for 300s
                             node.kubernetes.io/unreachable:NoExecute op=Exists for 300s
Events:
  Type    Reason     Age    From               Message
  ----    ------     ----   ----               -------
  Normal  Scheduled  5m16s  default-scheduler  Successfully assigned default/sharevol-rwm to worker-node-1.example.com
  Normal  Pulling    5m16s  kubelet            Pulling image "centos:7"
  Normal  Pulled     5m10s  kubelet            Successfully pulled image "centos:7" in 5.792s (5.792s including waiting)
  Normal  Created    5m10s  kubelet            Created container container1
  Normal  Started    5m10s  kubelet            Started container container1
  Normal  Pulled     5m10s  kubelet            Container image "centos:7" already present on machine
  Normal  Created    5m10s  kubelet            Created container container2
  Normal  Started    5m9s   kubelet            Started container container2
labsuser@master:~$
```

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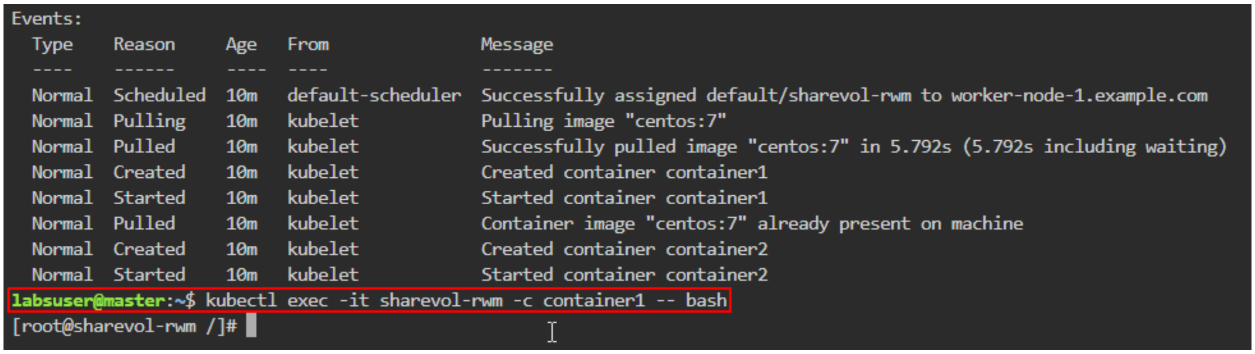
Step 4: Demonstrate shared storage and data operations

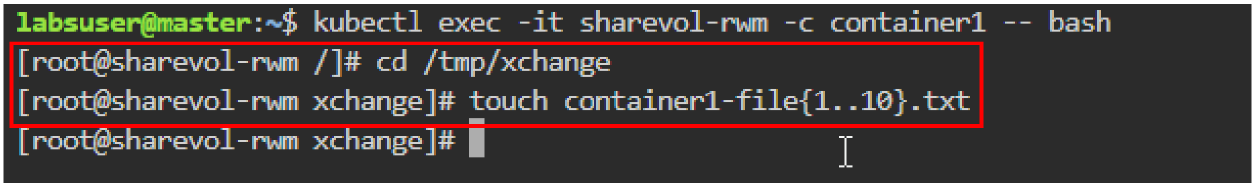
4.1 Access the **sharevol-rwm** pod with **container1** and open a bash shell inside it using the following command:
kubectl exec -it sharevol-rwm -c container1 -- bash



```
Events:
  Type    Reason     Age   From               Message
  ----    ------     ----  ----               -------
  Normal  Scheduled  10m   default-scheduler  Successfully assigned default/sharevol-rwm to worker-node-1.example.com
  Normal  Pulling    10m   kubelet            Pulling image "centos:7"
  Normal  Pulled     10m   kubelet            Successfully pulled image "centos:7" in 5.792s (5.792s including waiting)
  Normal  Created    10m   kubelet            Created container container1
  Normal  Started    10m   kubelet            Started container container1
  Normal  Pulled     10m   kubelet            Container image "centos:7" already present on machine
  Normal  Created    10m   kubelet            Created container container2
  Normal  Started    10m   kubelet            Started container container2
labsuser@master:~$ kubectl exec -it sharevol-rwm -c container1 -- bash
[root@sharevol-rwm /]#
```

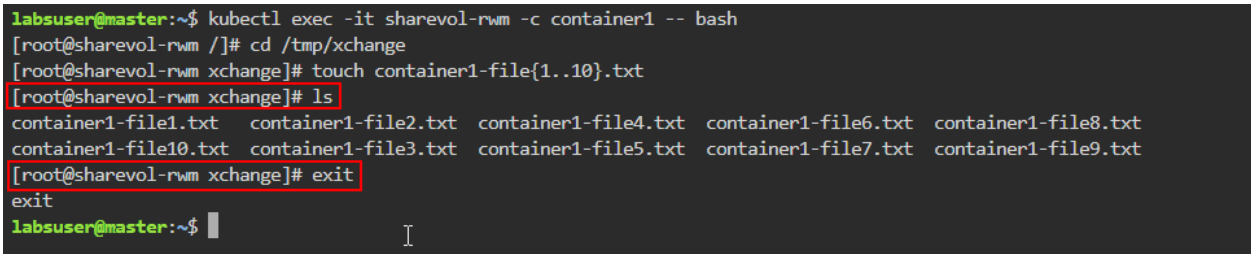
4.2 Navigate to the **/tmp/xchange** directory and create 10 text files named **container1-file1.txt** to **container1-file10.txt** using the following commands:

cd /tmp/xchange
touch container1-file{1..10}.txt



```
labsuser@master:~$ kubectl exec -it sharevol-rwm -c container1 -- bash
[root@sharevol-rwm /]# cd /tmp/xchange
[root@sharevol-rwm xchange]# touch container1-file{1..10}.txt
[root@sharevol-rwm xchange]#
```

4.3 List the contents of the current directory using the **ls** command



```
labsuser@master:~$ kubectl exec -it sharevol-rwm -c container1 -- bash
[root@sharevol-rwm /]# cd /tmp/xchange
[root@sharevol-rwm xchange]# touch container1-file{1..10}.txt
[root@sharevol-rwm xchange]# ls
container1-file1.txt   container1-file2.txt  container1-file4.txt  container1-file6.txt  container1-file8.txt
container1-file10.txt  container1-file3.txt  container1-file5.txt  container1-file7.txt  container1-file9.txt
[root@sharevol-rwm xchange]# exit
exit
labsuser@master:~$
```

Note: Type **exit** and press the **enter** key

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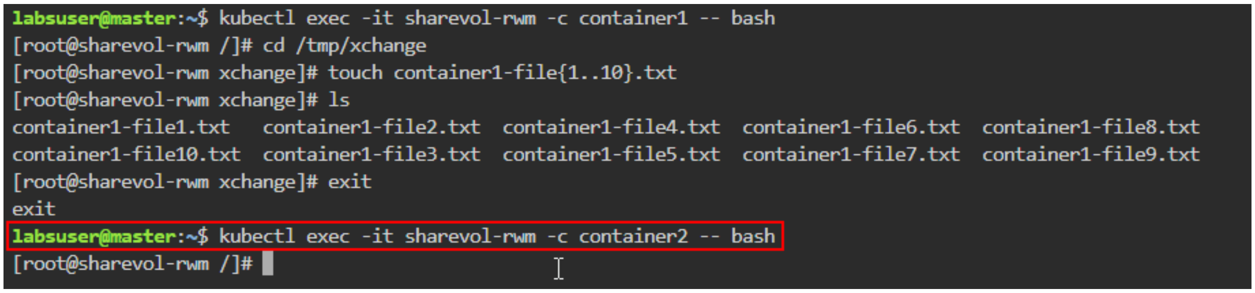
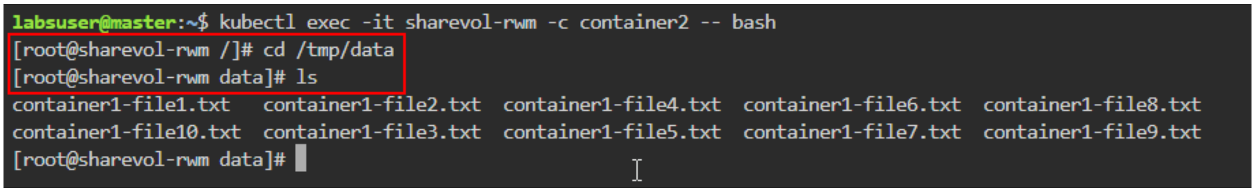
4.4 Access the **sharevol-rwm** pod with **container2** and open a bash shell inside it using the following command:
kubectl exec -it sharevol-rwm -c container2 – bash



```
labsuser@master:~$ kubectl exec -it sharevol-rwm -c container1 -- bash
[root@sharevol-rwm /]# cd /tmp/xchange
[root@sharevol-rwm xchange]# touch container1-file{1..10}.txt
[root@sharevol-rwm xchange]# ls
container1-file1.txt   container1-file2.txt  container1-file4.txt  container1-file6.txt  container1-file8.txt
container1-file10.txt  container1-file3.txt  container1-file5.txt  container1-file7.txt  container1-file9.txt
[root@sharevol-rwm xchange]# exit
exit
labsuser@master:~$ kubectl exec -it sharevol-rwm -c container2 -- bash
[root@sharevol-rwm /]#
```

4.5 Change the directory to **/tmp/data** and list the contents of that directory using the following commands:
cd /tmp/data
ls

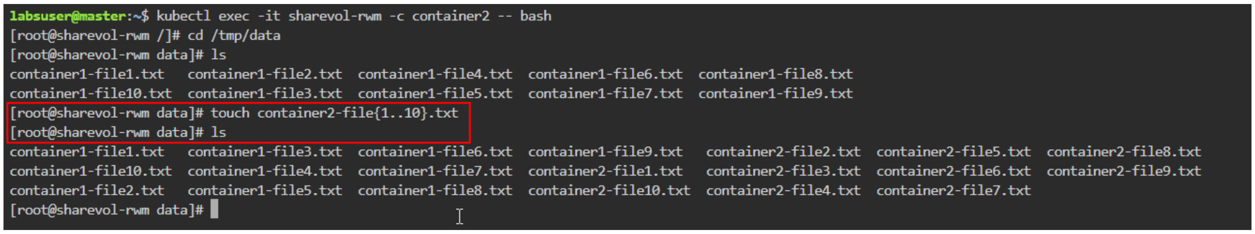


```
labsuser@master:~$ kubectl exec -it sharevol-rwm -c container2 -- bash
[root@sharevol-rwm /]# cd /tmp/data
[root@sharevol-rwm data]# ls
container1-file1.txt   container1-file2.txt  container1-file4.txt  container1-file6.txt  container1-file8.txt
container1-file10.txt  container1-file3.txt  container1-file5.txt  container1-file7.txt  container1-file9.txt
[root@sharevol-rwm data]#
```

Note: Stay in the same container without exiting

Step 5: Continue data operations

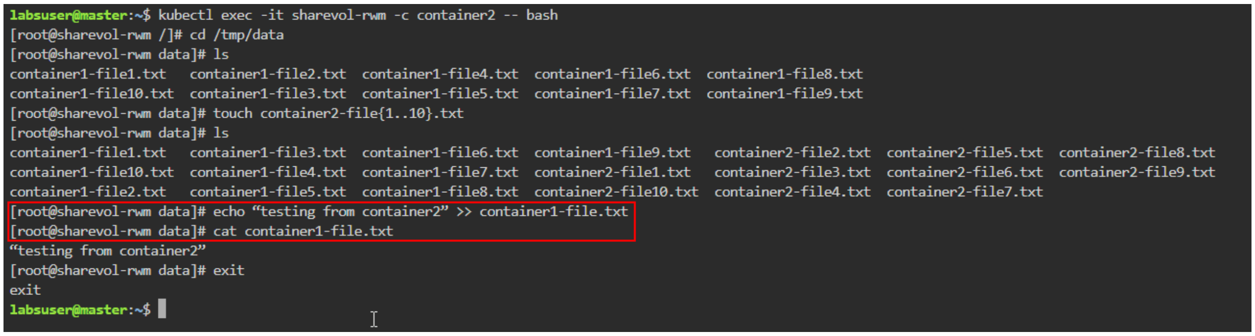
5.1 Create 10 text files named **container2-file1.txt** to **container2-file10.txt** and then list the contents of the directory using the following commands:
touch container2-file{1..10}.txt
ls



```
labsuser@master:~$ kubectl exec -it sharevol-rwm -c container2 -- bash
[root@sharevol-rwm /]# cd /tmp/data
[root@sharevol-rwm data]# ls
container1-file1.txt   container1-file2.txt  container1-file4.txt  container1-file6.txt  container1-file8.txt
container1-file10.txt  container1-file3.txt  container1-file5.txt  container1-file7.txt  container1-file9.txt
[root@sharevol-rwm data]# touch container2-file{1..10}.txt
[root@sharevol-rwm data]# ls
container1-file1.txt   container1-file3.txt  container1-file6.txt  container1-file9.txt   container2-file2.txt  container2-file5.txt  container2-file8.txt
container1-file10.txt  container1-file4.txt  container1-file7.txt  container2-file1.txt   container2-file3.txt  container2-file6.txt  container2-file9.txt
container1-file2.txt   container1-file5.txt  container1-file8.txt  container2-file10.txt  container2-file4.txt  container2-file7.txt
[root@sharevol-rwm data]#
```

.

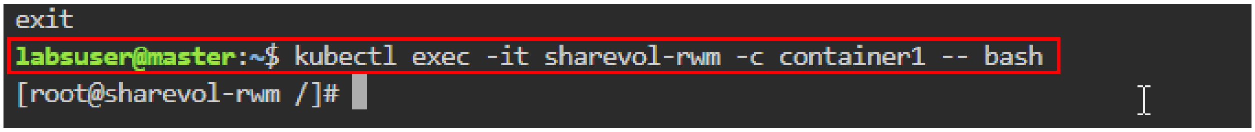
5.2 Append the text **testing from container2** to the **container1-file.txt** file and then display the contents of **container1-file.txt** using the following commands:
echo “testing from container2” >> container1-file.txt
cat container1-file.txt



```
labsuser@master:~$ kubectl exec -it sharevol-rwm -c container2 -- bash
[root@sharevol-rwm /]# cd /tmp/data
[root@sharevol-rwm data]# ls
container1-file1.txt   container1-file2.txt  container1-file4.txt  container1-file6.txt  container1-file8.txt
container1-file10.txt  container1-file3.txt  container1-file5.txt  container1-file7.txt  container1-file9.txt
[root@sharevol-rwm data]# touch container2-file{1..10}.txt
[root@sharevol-rwm data]# ls
container1-file1.txt   container1-file3.txt  container1-file6.txt  container1-file9.txt   container2-file2.txt  container2-file5.txt  container2-file8.txt
container1-file10.txt  container1-file4.txt  container1-file7.txt  container2-file1.txt   container2-file3.txt  container2-file6.txt  container2-file9.txt
container1-file2.txt   container1-file5.txt  container1-file8.txt  container2-file10.txt  container2-file4.txt  container2-file7.txt
[root@sharevol-rwm data]# echo “testing from container2” >> container1-file.txt
[root@sharevol-rwm data]# cat container1-file.txt
“testing from container2”
[root@sharevol-rwm data]# exit
exit
labsuser@master:~$
```

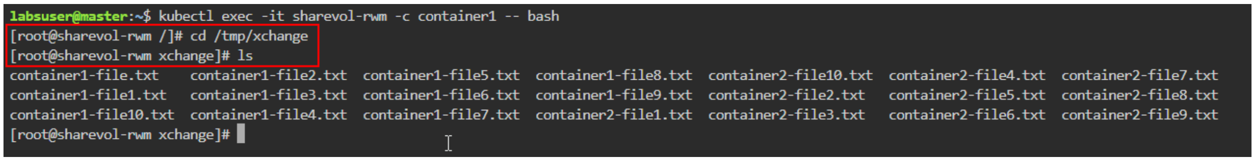
Note: Type **exit** and press the **enter** key

5.3 Access the **sharevol-rwm** pod with **container1** and open a bash shell inside it using the following command:
kubectl exec -it sharevol-rwm -c container1 -- bash



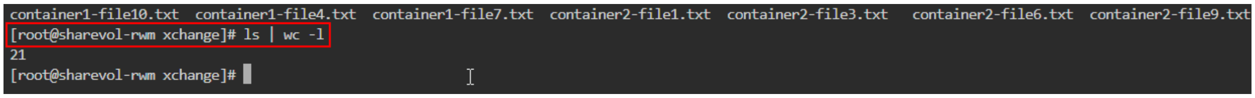
```
exit
labsuser@master:~$ kubectl exec -it sharevol-rwm -c container1 -- bash
[root@sharevol-rwm /]#
```

5.4 Change the directory to **/tmp/ xchange** and list the contents of that directory using the following commands:
cd /tmp/xchange
ls



```
labsuser@master:~$ kubectl exec -it sharevol-rwm -c container1 -- bash
[root@sharevol-rwm /]# cd /tmp/xchange
[root@sharevol-rwm xchange]# ls
container1-file.txt    container1-file2.txt  container1-file5.txt  container1-file8.txt  container2-file10.txt  container2-file4.txt  container2-file7.txt
container1-file1.txt   container1-file3.txt  container1-file6.txt  container1-file9.txt  container2-file2.txt   container2-file5.txt  container2-file8.txt
container1-file10.txt  container1-file4.txt  container1-file7.txt  container2-file1.txt  container2-file3.txt   container2-file6.txt  container2-file9.txt
[root@sharevol-rwm xchange]#
```

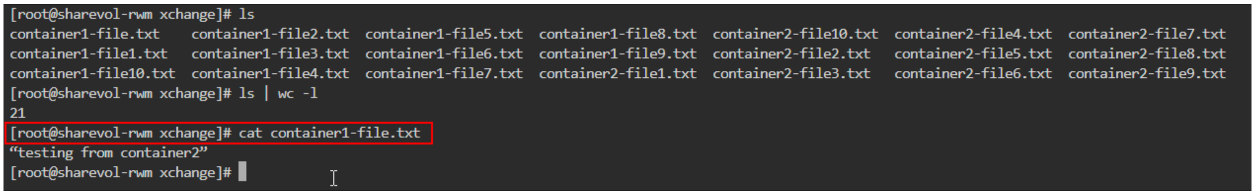
5.5 Count the number of files in the current directory using the following command:
ls | wc -l



```
container1-file10.txt  container1-file4.txt  container1-file7.txt  container2-file1.txt  container2-file3.txt   container2-file6.txt  container2-file9.txt
[root@sharevol-rwm xchange]# ls | wc -l
21
[root@sharevol-rwm xchange]#
```

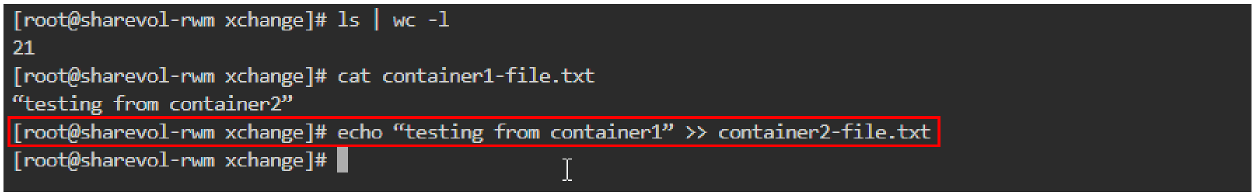
.

5.6 Display the contents of **container1-file.txt** using the following command:
cat container1-file.txt



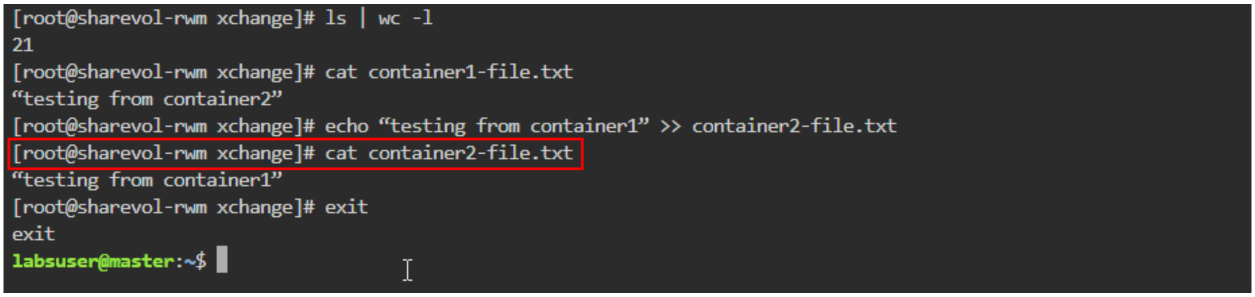
```
[root@sharevol-rwm xchange]# ls
container1-file.txt    container1-file2.txt  container1-file5.txt  container1-file8.txt  container2-file10.txt  container2-file4.txt  container2-file7.txt
container1-file1.txt   container1-file3.txt  container1-file6.txt  container1-file9.txt  container2-file2.txt   container2-file5.txt  container2-file8.txt
container1-file10.txt  container1-file4.txt  container1-file7.txt  container2-file1.txt  container2-file3.txt   container2-file6.txt  container2-file9.txt
[root@sharevol-rwm xchange]# ls | wc -l
21
[root@sharevol-rwm xchange]# cat container1-file.txt
"testing from container2"
[root@sharevol-rwm xchange]# 
```

5.7 Append the text **testing from container1** to the **container2-file.txt** file using the following command:
echo "testing from container1" >> container2-file.txt



```
[root@sharevol-rwm xchange]# ls | wc -l
21
[root@sharevol-rwm xchange]# cat container1-file.txt
"testing from container2"
[root@sharevol-rwm xchange]# echo "testing from container1" >> container2-file.txt
[root@sharevol-rwm xchange]# 
```

5.8 Display the contents of **container2-file.txt** using the following command:
cat container2-file.txt



```
[root@sharevol-rwm xchange]# ls | wc -l
21
[root@sharevol-rwm xchange]# cat container1-file.txt
"testing from container2"
[root@sharevol-rwm xchange]# echo "testing from container1" >> container2-file.txt
[root@sharevol-rwm xchange]# cat container2-file.txt
"testing from container1"
[root@sharevol-rwm xchange]# exit
exit
labsuser@master:~$ 
```

By following these steps, you have successfully set up a multi-container pod with RWX access in Kubernetes, demonstrating shared storage and data operations between containers.