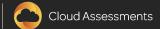# Certified Kubernetes Administrator Prep

Volumes and Their Access Modes

Volumes and Their Access Modes

- PersistentVolume -- API for users that abstracts implementation details of storage

- PersistentVolumeClaim -- Method for users to claim durable storage regardless of implementation details
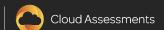
PersistentVolume (PV)

- Provisioned storage in the cluster

- Cluster resource

- Volume plugins (as discussed in the previous lesson) have independent lifecycle from pods

- Volumes share the lifecycle of the pod; PersistentVolumes do *not*

- API object (YAML) details the implementation
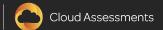
PersistentVolumeClaim (PVC)

- Request for storage

- Pods consume node resources; PVCs consume PV resources.

- Pods can request specific CPU and memory; PVCs can request specific size and access modes.
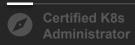
PVs and PVCs

- Users and applications do not share identical requirements

- Administrators should offer a variety of PVs without users worrying about the implementation details

- PVs are cluster resources, PVCs are requests for the cluster resource

- PVCs also act as a "claim check" on a resource

- PVs and PVCs have a set lifecycle
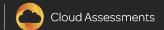
  - Provision

  - Bind

  - Reclaim

Provisioning

- **Static**
  - Creates PVs
  - In the K8S API and available for consumption

- **Dynamic**
  - Used when none of the static PVs match the PVC
  - Based on StorageClasses
  - PVC must request a created and configured storage class
  - Claims requesting nameless class disable dynamic provisioning

To enable dynamic storage provisioning, DefaultStorageClass admission controller on the API server must be enabled.
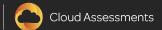
Certified K8s
Administrator

Binding

- User creates PVC

- Master watches for new PVCs and matches them to PVs

- Master binds PVC to PV

- Volume may be more than the request

- Binds are exclusive

- PVC -> PV mapping is always 1:1

- Claims not matched will remain unbound indefinitely

Certified K8s
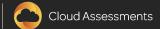Administrator

Pod Uses Volume

- Pods treat PVCs as volumes

- Cluster checks claim, mounts appropriate volume to pod

Persistent Volume Claim Protection

- Alpha feature as of K8s 1.9

- Ensures PVCs actively in use do not get removed from the system

- PVC considered active when:

  ○ The pod status is Pending and the pod is assigned to a node

  ○ The pod status is Running

- If a user deletes a PVC in use, removal is postponed until PVC is not in use by any pod

Persistent Volume Claim Protection

```
$> kubectl describe pvc hostpath

Name:          hostpath

Namespace:     default

StorageClass:  example-hostpath

Status:        Terminating

Volume:

Labels:        <none>

Annotations:   volume.beta.kubernetes.io/storage-class=example-hostpath


volume.beta.kubernetes.io/storage-provisioner=example.com/hostpath

Finalizers:    [kubernetes.io/pvc-protection]
```
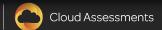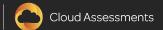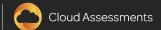
Reclaiming

- User can delete PVC objects

- Reclaim policy for a PV tells the cluster what to do with the volume

- Policies:

  - Retain

  - Recycle

  - Delete

- Policies allow for manual reclamation of a resource.

  - PVC deleted

  - PV still exists; volume is "released"

  - Not yet available because the data is still present

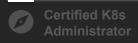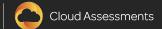 - Admin can manually reclaim the volume

Reclaiming

- Administrator can configure custom recycler pod template

- Must contain a volumes specification

- Volume plugs that support Delete reclaim policy

  - Removes the PersistentVolume object from K8s

  - Associated storage assets in the infrastructure

  - Dynamically provisioned volumes inherit reclaim policy of their StorageClass

- Administrator should configure StorageClass according to expectations

Capacity

- PVs have a specific storage capacity

- Set using "capacity" attribute

- Storage size is the only resource that can be set or requested

- Future attribute plans:
  - IOPS
  - Throughput
  - ???

- Prior to K8s v1.9, default behavior for all volume plugins was to create a filesystem

- As of 1.9, however, user can specify volumeMode
  - Raw Block Devices -- "Block"
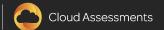 - File systems -- "Filesystem" (default)

Access Modes

- Must be supported by storage resource provider

- ReadWriteOnce -- Can be mounted as read/write by one node only (RWO)

- ReadOnlyMany -- Can be mounted read-only by many nodes (ROX)

- ReadWriteMany -- Can be mounted read/write by many nodes (RWX)

A volume can only be mounted using one access mode at a time, regardless of the modes that are supported.

Certified K8s
Administrator

Conclusion

- PVC vs PV

- Storage object lifecycle

- Access modes

Certified K8s
Administrator