Deploying Applications in Kubernetes

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Course Overview

- **Module 0** - Introduction
- **Module 1** - Container Fundamentals
- **Module 2** - Kubernetes Architecture and API Objects
- **Lunch @ 12:00-12:45**
- **Module 3** - Interacting With Your Cluster
- **Module 4** - Deploying Applications in Kubernetes
- **Module 5** - Building and Deploying Container-based Applications in Kubernetes

Agenda

- **Deploying Applications in Kubernetes**
  - Namespaces
  - Labels
  - Services
  - Deployments

Organizing Objects in Kubernetes

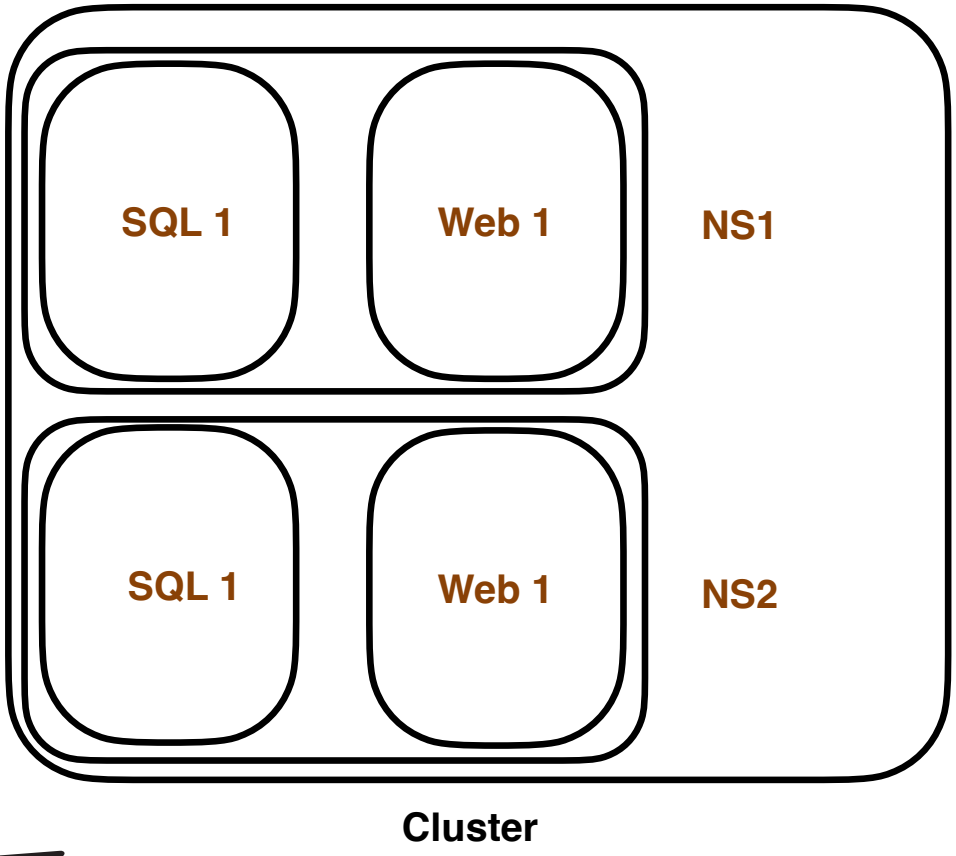
- **Namespaces**
- **Labels**
- **Annotations**

Namespaces

- Ability to subdivide a cluster and its resources
- Conceptually a “virtual cluster”
  - Resource isolation/organization
  - Security boundary for Role Based Access Controls
  - Naming boundary
- A resource can be in only one namespace
- Has nothing to do with the concept of a Linux namespace

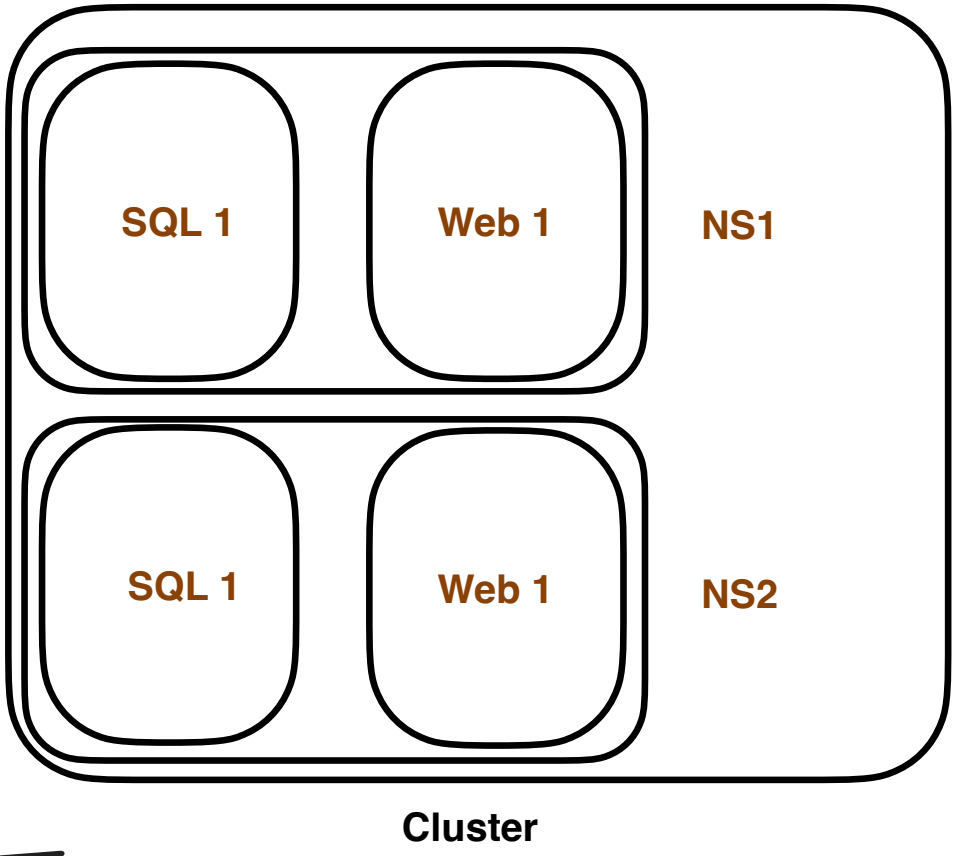
Working with Namespaces

- Create/Query/Delete
- Operate on objects in a Namespace
- Some objects are Namespaced… some aren't
  - Resources are Namespaces… Pods, Controllers, Services
  - Physical things are not… PersistentVolumes, Nodes



Working with Namespaces

- **`kube-public`**
- **`kube-system`**
- User Defined
  - Imperatively with **`kubectl`**
  - Declaratively in a Manifest in YAML



Labels

- Used to organize resources - Pods, Nodes and more
- Enables you to perform operations on a collection of resources…like Pods
- Influence internal operations of Kubernetes
- Non-hierarchical, key/value pair
- Have more than one label per resource
- Label Selectors
  - Used to select/query objects
  - Return collections of objects that satisfy search conditions

Working With Labels

- Creating resources with Labels
  - Imperatively with **`kubectl`**
  - Declaratively in a Manifest in YAML
- Editing existing resources' Labels
  - Assign a new Label
  - Overwriting an existing Label

Adding and Editing Labels

```
kubectl label pod nginx tier=PROD app=v1

kubectl label pod nginx tier=DEBUG app=v1 –overwrite

kubectl label pod nginx app-
```

```
apiVersion: v1
kind: Pod
metadata:
  name: nginx-pod
  labels:
    tier: PROD
    app: v1
spec:
  containers:
  - name: nginx
...
```

Querying Using Labels and Selectors

```
kubectl get pods --show-labels

kubectl get pods --selector tier=prod

kubectl get pods -l tier=prod

kubectl get pods -l 'tier in (prod,qa)'

kubectl get pods -l 'tier notin (prod,qa)'

kubectl get nodes --show-labels
```

How Kubernetes Uses Labels

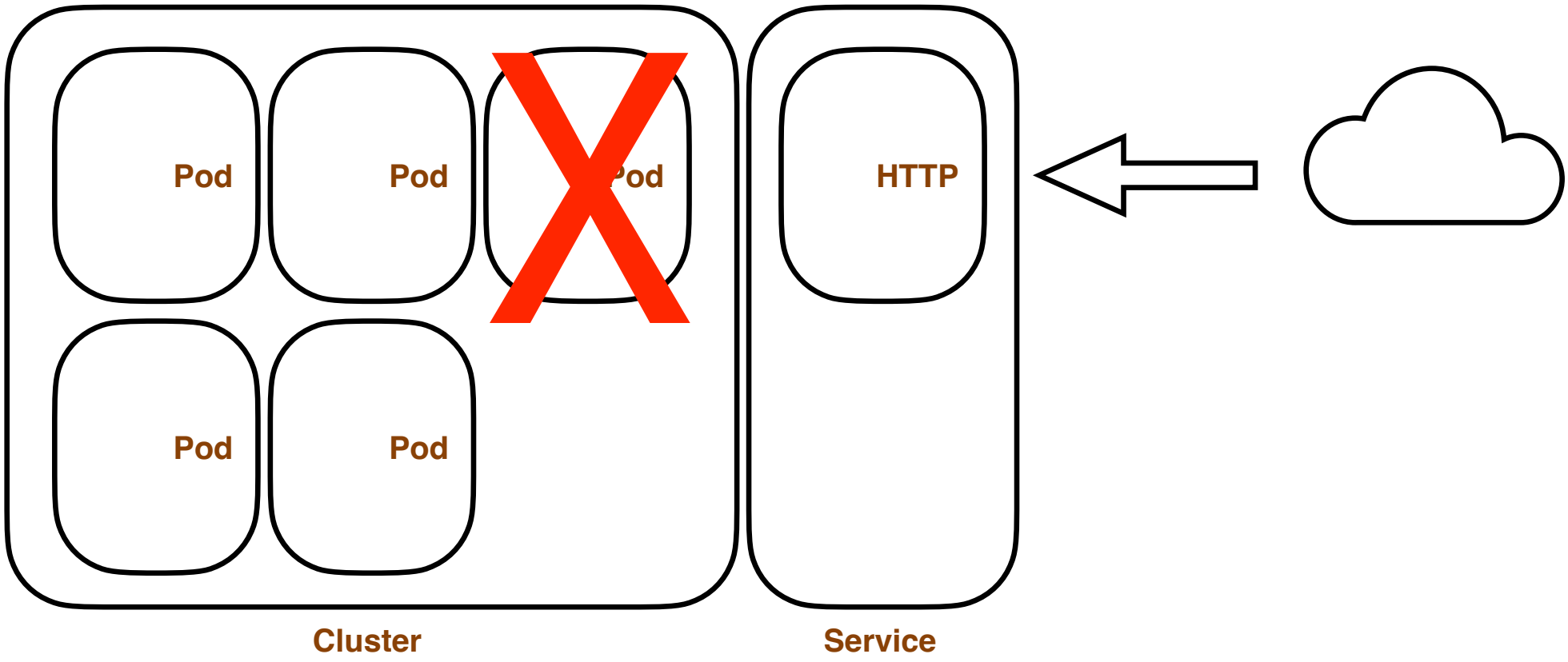
- **`Deployments`**, **`ReplicaSets`** and **`Services`** match Pods using selector labels
  - Pod Selector - **`matchLabels`** and **`matchExpressions`**

- Influencing Scheduling Pods based on labels
- Nodes (specifically for access to hardware, perhaps high speed disk or GPU, deploying around fault domains)
  - Specified Node name with **`nodeAffinity`**
  - Using a label selector with **`nodeSelector`**

Using Services

- Due to the ephemerality of Pods, ReplicaSets ability to add/remove Pods
- Provide persistent IP and DNS to Pod based applications
- Services use Label Selectors to “select” the Pods in a Service,
  - Registering the Endpoints in the Service (Pod IP and Port pair)
- Implemented in the kube-proxy on the Node in iptables (kernel mode)
- kube-proxy watches the API Server and the Endpoints

Using Services



Types of Services

- **`NodePort`** - available on the internal Cluster's IP/Port and on each Node
- **`ClusterIP -`** (default) - IP accessible only inside the cluster
- **`LoadBalancer`** - Cloud specific load balancer, redirects to Node services

Defining Services

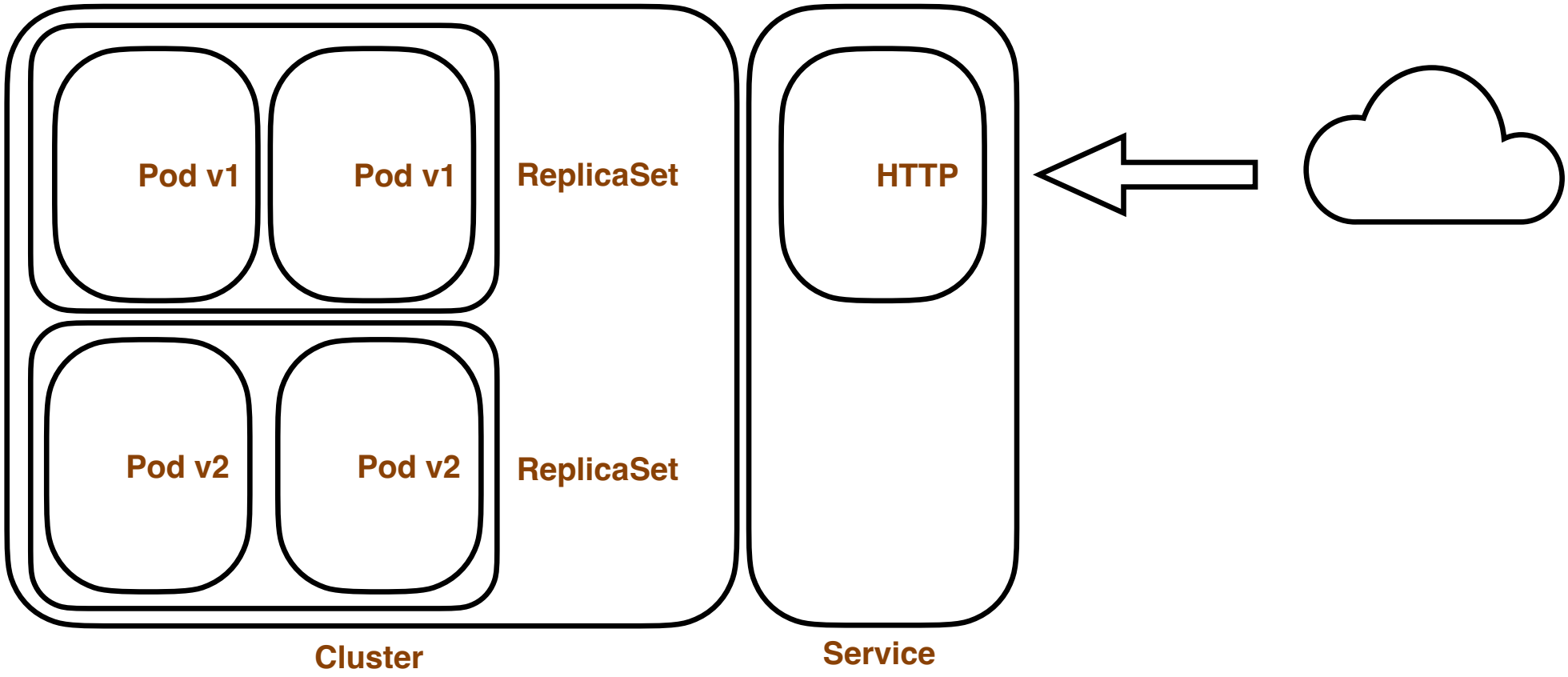
```
kubectl expose deployment hello-world --port=80 --target-port=8080
```

```yaml
apiVersion: v1
kind: Service
metadata:
  name: hello-world
spec:
  selector:
    app: hello-world
  ports:
  - port: 80
    protocol: TCP
    targetPort: 8080
```

Using Deployments

- **`Deployments`** are used to provide declarative updates to Pods and **`ReplicaSets`**
- We define the state and use the Deployment Controller to move towards that state
- **`Deployments`** are made of **`ReplicaSets`** and manage the transition between the **`ReplicaSets`**
  - The pod-template hash Label is used to differentiate between versions of **`ReplicaSets`**

Controller Operations - `Deployment`



Using Deployments

- Give you the controlled rollout of a new version of your application
  - Control the rate of deploying new Pods
    - **`Recreate`** vs. **`RollingUpdate`**
  - Control rollout with health checks
    - **`maxSurge`**
    - **`maxUnavailable`**
  - Rollback to an earlier version
  - Scale based on load
  - Pause to make corrections

Defining a Deployment

Deployment

Pod Template

```yaml
apiVersion: apps/v1
kind: Deployment
metadata:
  name: hello-world
spec:
  replicas: 2
  selector:
    matchLabels:
      app: hello-world
  template:
    metadata:
      labels:
        app: hello-world
    spec:
      containers:
      - image: psk8s.azurecr.io/hello-app:1.0
        name: hello-world
        ports:
        - containerPort: 80
```

Monitoring Application Health

- How do we know a Pod is up and ready to get new application connections?
- How do we know if an application has crashed and stopped responding?
- How do we know if a newly deployed Pod has started it's application properly and is ready for traffic?

Liveness and Readiness Probes

- **Liveness** - used to know when to restart a Container
  - Containers that are NOT live are **restarted** by the Container Runtime
- **Readiness** - use to know when a Container is ready to start accepting traffic
  - Endpoint Objects (Pod IP/Port) that are NOT ready are **removed** from Service load balancer
- Types of Probes
  - **Exec** - execute a command and look for an exit code of 0
  - **TCP** - completes a TCP connection to the defined port
  - **HTTP GET** - Retrieve a defined URL
    - looking for a Response Code >= 200 and < 400

Defining Liveness and Readiness Probes

```
kind: Pod
...
    spec:
      containers:
      - name: hello-world
        image: psk8s.azurecr.io/hello-app:1.0

        ports:
        - containerPort: 8080
        livenessProbe:
          httpGet:
            path: /
            port: 8080
          initialDelaySeconds: 10
          periodSeconds: 10
        readinessProbe:
          httpGet:
            path: /
            port: 8080
          initialDelaySeconds: 10
          periodSeconds: 10
```

Hands on Lab

- Working with Namespaces and Labels
- Using Services and Endpoints
- Using Deployments
  - Rollout
  - Changing an image
  - Rolling back
- Understanding how Kubernetes uses Labels in Controllers and Services
  - **`Deployments`**
  - **`ReplicaSets`**

Review

- **Deploying Applications in Kubernetes**
  - Namespaces
  - Labels
  - Services
  - Deployments