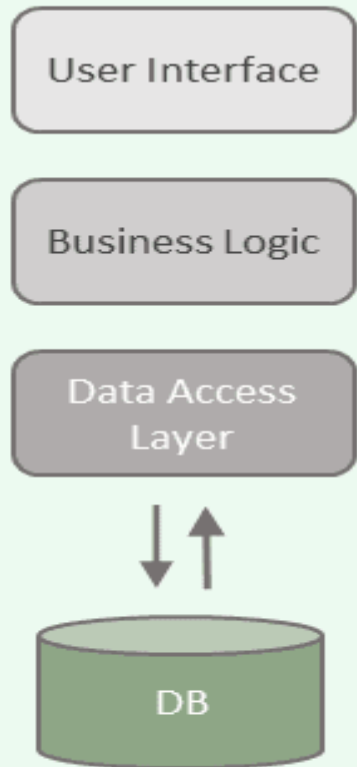
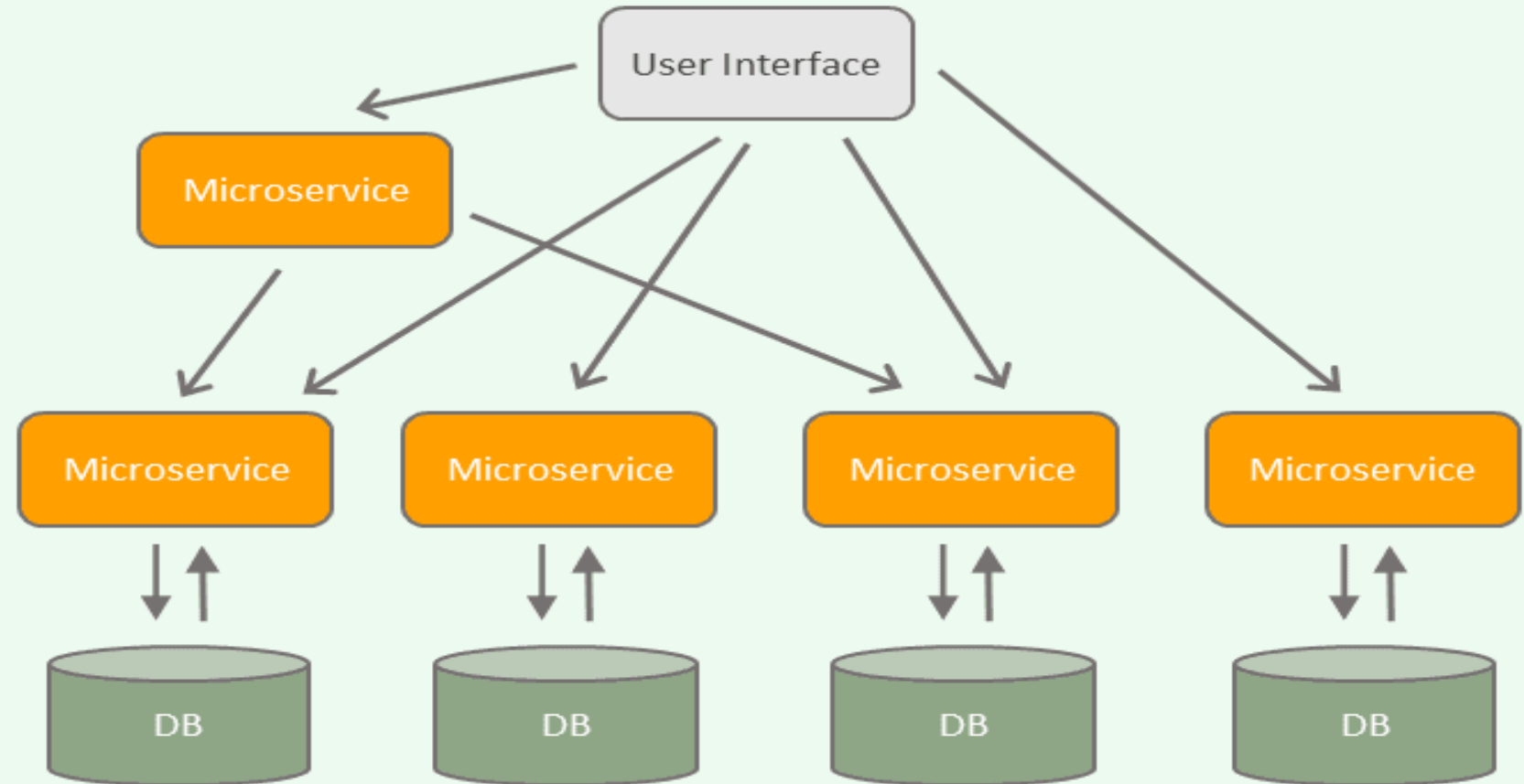


MONOLITHIC ARCHITECTURE



MICROSERVICES ARCHITECTURE



Container Orchestration

Containers Limitation?

High Availability?

Overlay Network?

Versioning of Application – Rollout, Rollback?

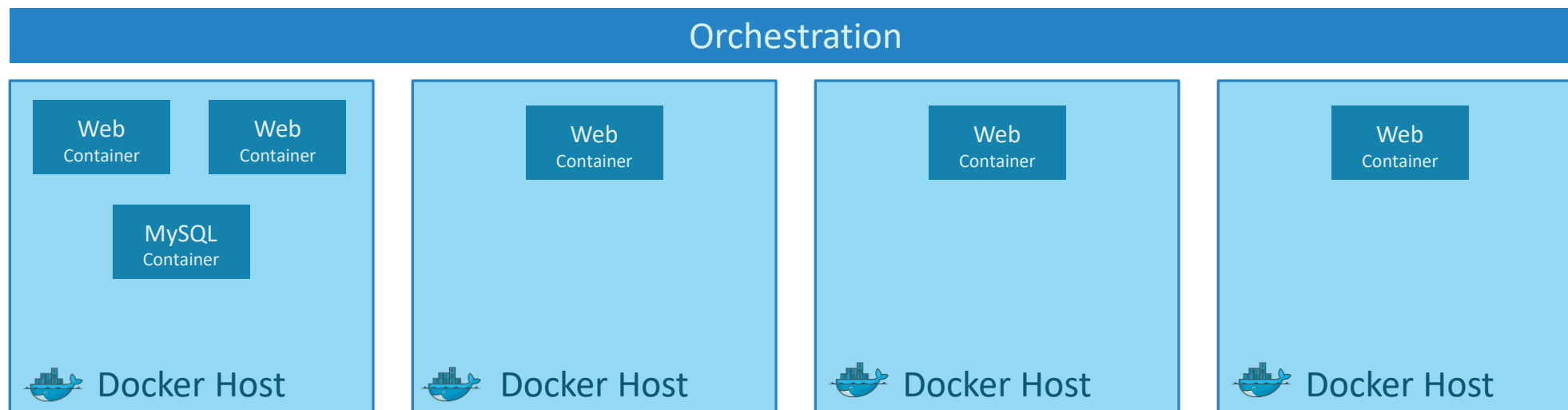
Scaling?

Autoscaling?

Monitoring?

Dependency between containers?

Container orchestration



Orchestration Technologies



Docker Swarm



kubernetes



MESOS

What is Kubernetes?

The Kubernetes project was started by Google in 2014.

Kubernetes builds upon a decade and a half of experience that Google has with running production workloads at scale.

Kubernetes can run on a range of platforms, from your laptop, to VMs on a cloud provider, to rack of bare metal servers.

Kubernetes is an open-source platform for automating deployment, scaling, and operations of application containers across clusters of hosts, providing container-centric infrastructure.

portable: with all public, private, hybrid, community cloud

self-healing: auto-placement, auto-restart, auto-replication, auto-scaling

Why Kubernetes

Kubernetes can schedule and run application containers on clusters of physical or virtual machines.

host-centric infrastructure to a **container-centric** infrastructure.

Orchestrator

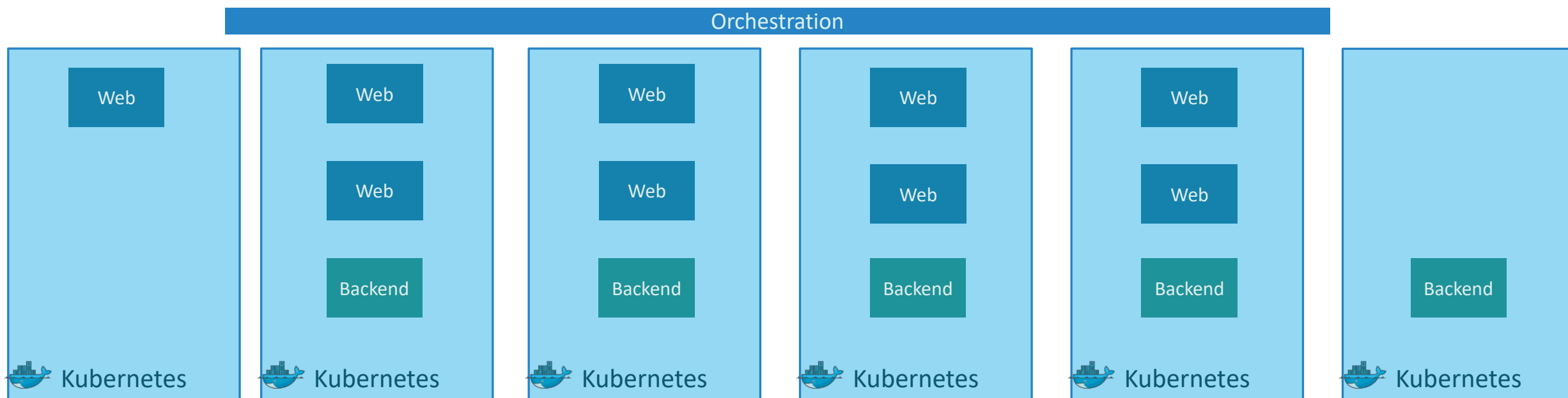
Load balancing

Auto Scaling

Application Health checks

Rolling updates

Kubernetes Advantage



And that is **kubernetes**..

Setup

Raman



Minikube



Kubeadm



Google Cloud Platform



Amazon Web Services

play-with-k8s.com

Setup Kubernetes

Setup - kubeadm

Kubernetes Cluster

A Kubernetes cluster consists of two types of resources:

Master: Which coordinates with the cluster

The Master is responsible for managing the cluster. The master coordinates all activities in your cluster, such as scheduling applications, maintaining applications' desired state, scaling applications, and rolling out new updates.

Nodes: Are the workers that run application

A node is a VM or a physical computer that serves as a worker machine in a Kubernetes cluster.

Masters manage the cluster and the nodes are used to host the running applications.

The nodes communicate with the master using the Kubernetes API, which the master exposes.

kube-
apiserver



Master

Manages, Plans, Schedules, Monitors Nodes

kubelet



Worker Nodes

Host Application as Containers

Controller-
Manager

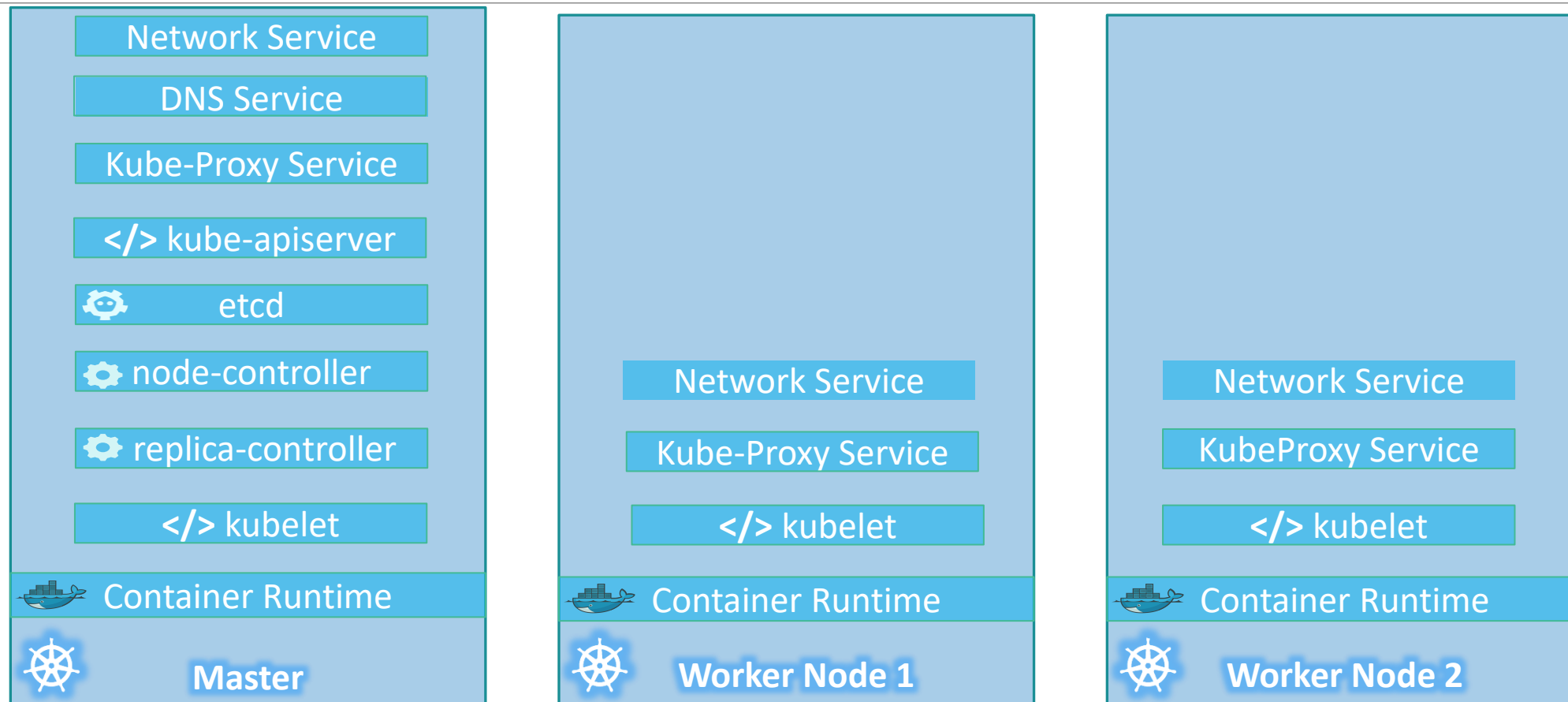
ETCD
CLUSTER

kube-scheduler

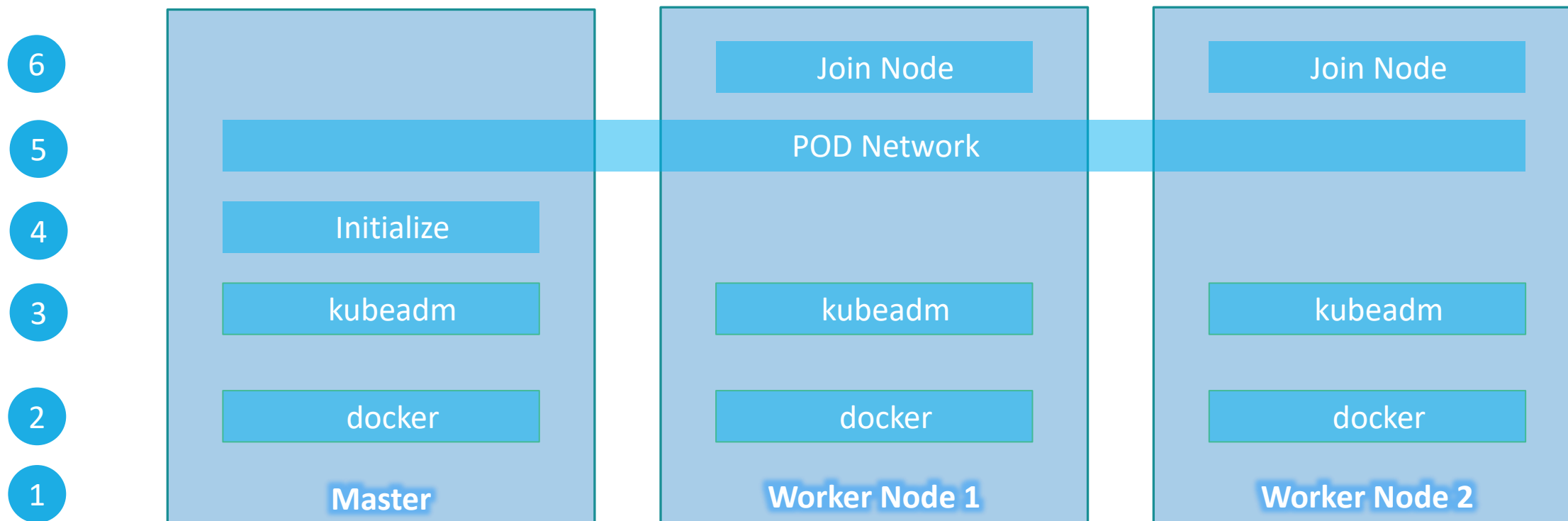
Kube-
proxy

Container Runtime Engine
docker rkt

kubeadm



Steps



POD

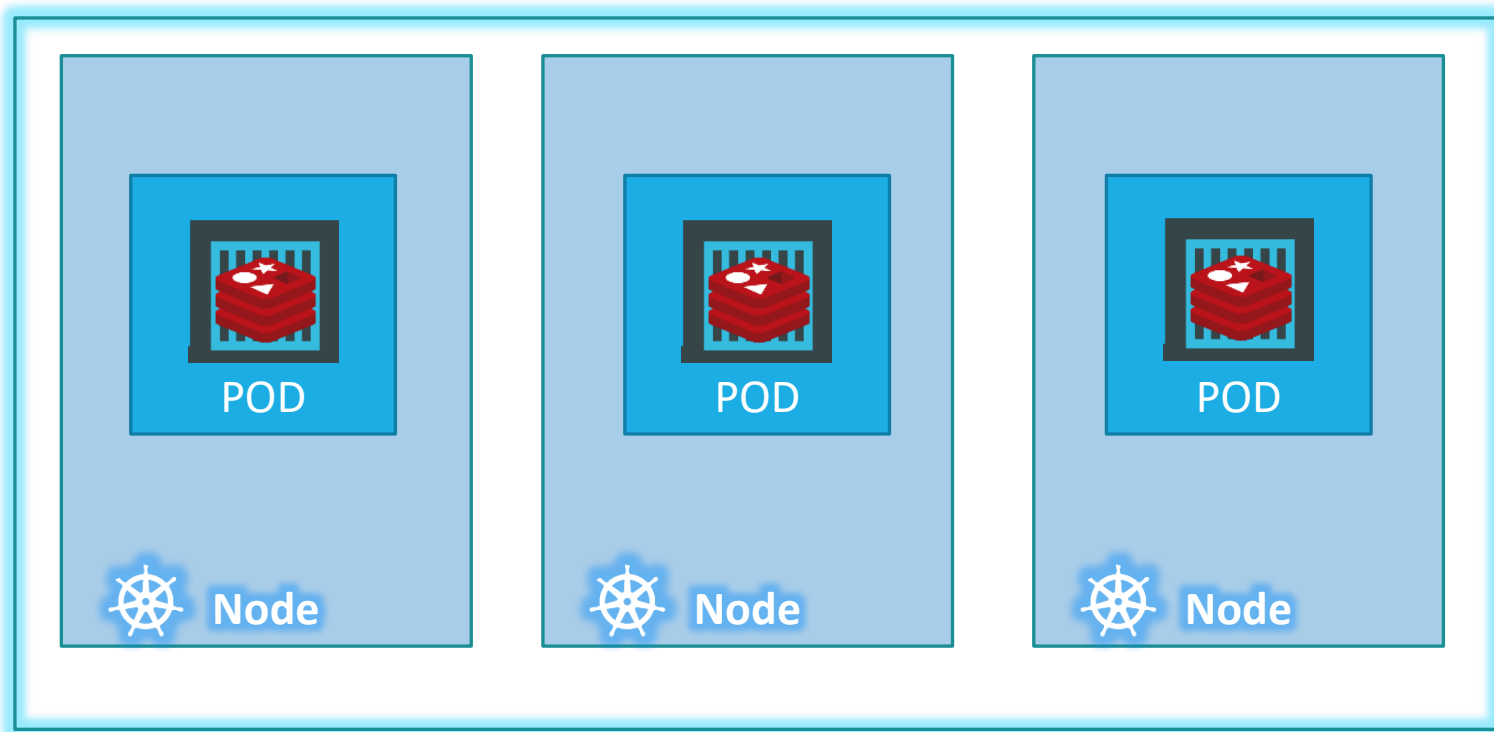
Raman

Assumptions

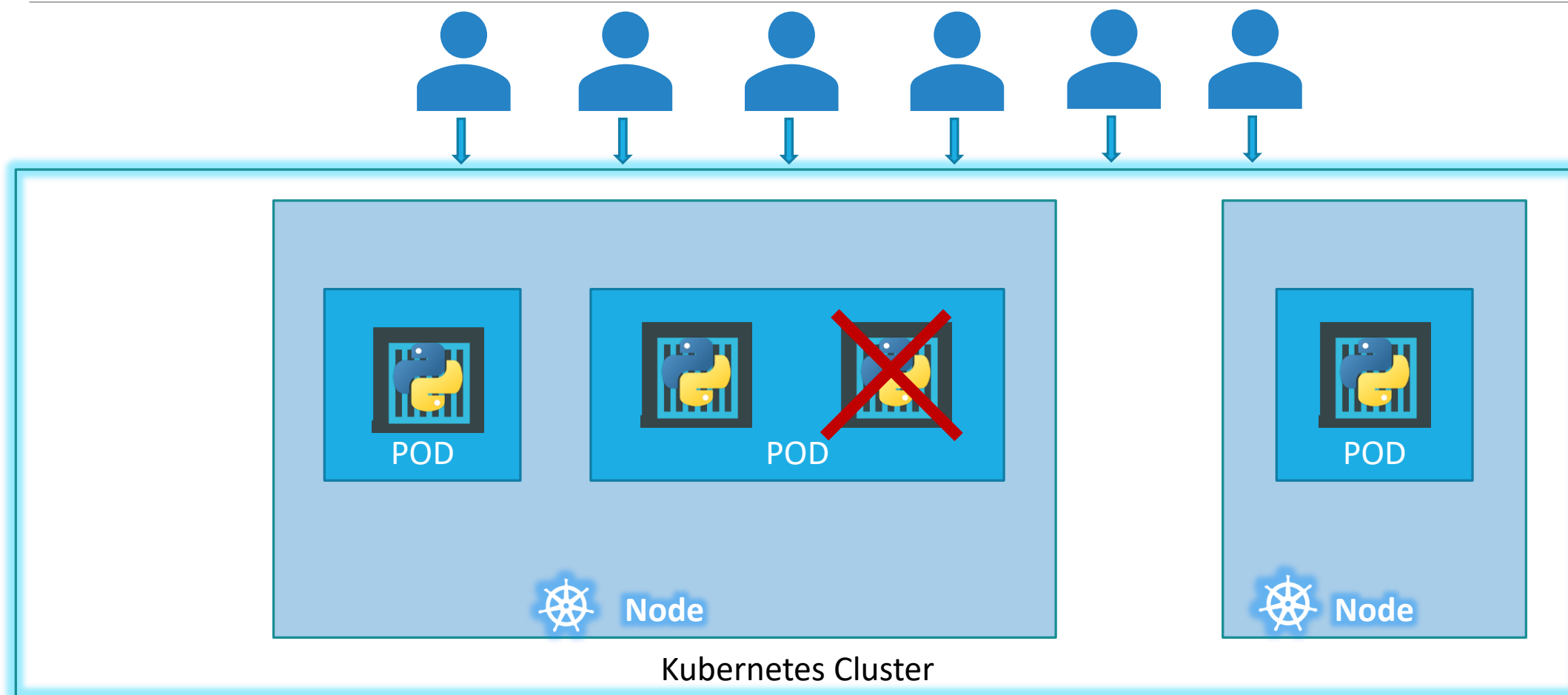
Docker Image

Kubernetes Cluster

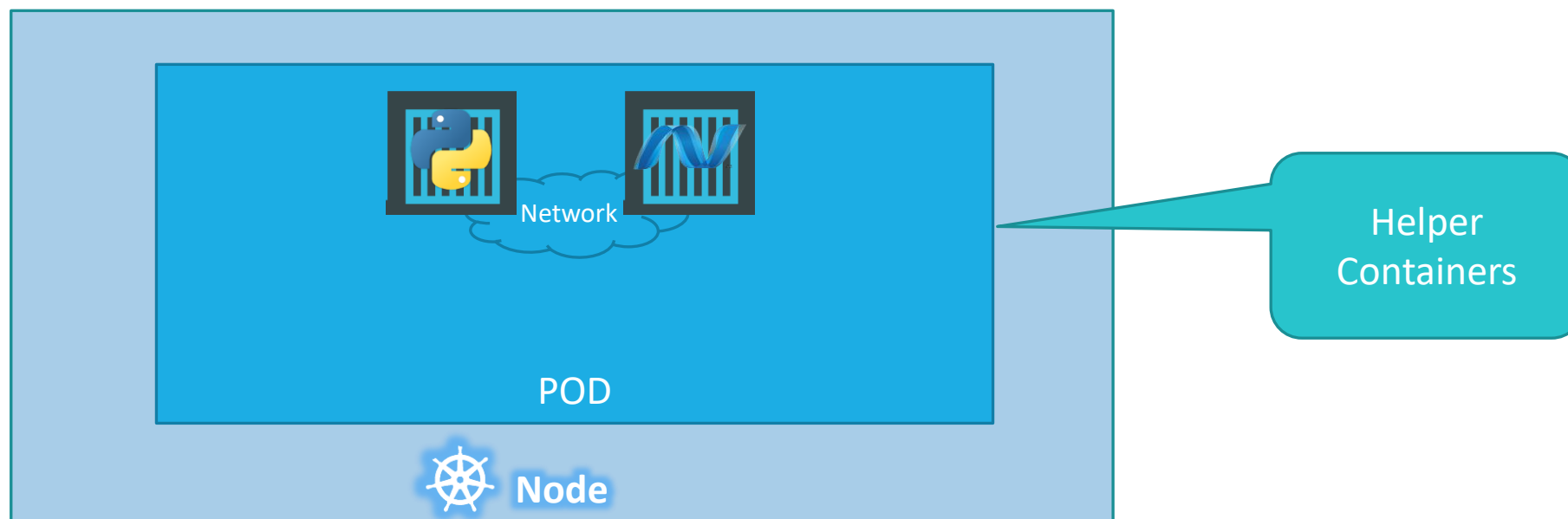
POD



POD



Multi-Container PODs



PODs Again!



Note: I am avoiding networking and load balancing details to keep explanation simple.

kubectl

```
kubectl run nginx --image nginx
```

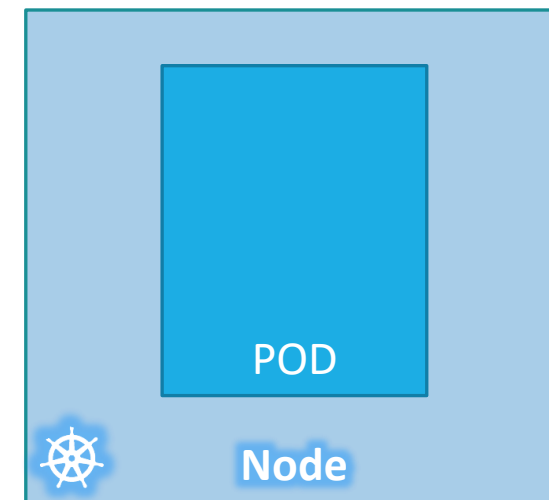
```
kubectl get pods
```

```
C:\Kubernetes>kubectl get pods
```

| NAME | READY | STATUS | RESTARTS | AGE |
|----------------------|-------|-------------------|----------|-----|
| nginx-8586cf59-whssr | 0/1 | ContainerCreating | 0 | 3s |

```
C:\Kubernetes>kubectl get pods
```

| NAME | READY | STATUS | RESTARTS | AGE |
|----------------------|-------|---------|----------|-----|
| nginx-8586cf59-whssr | 1/1 | Running | 0 | 8s |



YAML

Introduction

POD

With YAML

YAML in Kubernetes

pod-definition.yml

```
apiVersion: v1      String
kind: Pod           String
```

```
metadata:
  name: myapp-pod
  labels:
    app: myapp
```



```
spec:
  containers:        List/Array
  - name: nginx-container
    image: nginx
```

1st Item in List

```
kubectl create -f pod-definition.yml
```

| Kind | Version |
|------------|---------|
| POD | v1 |
| Service | v1 |
| ReplicaSet | apps/v1 |
| Deployment | apps/v1 |
| | |

Commands

```
> kubectl get pods
```

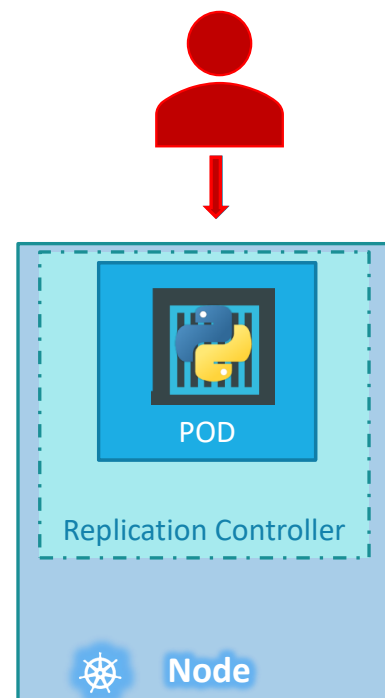
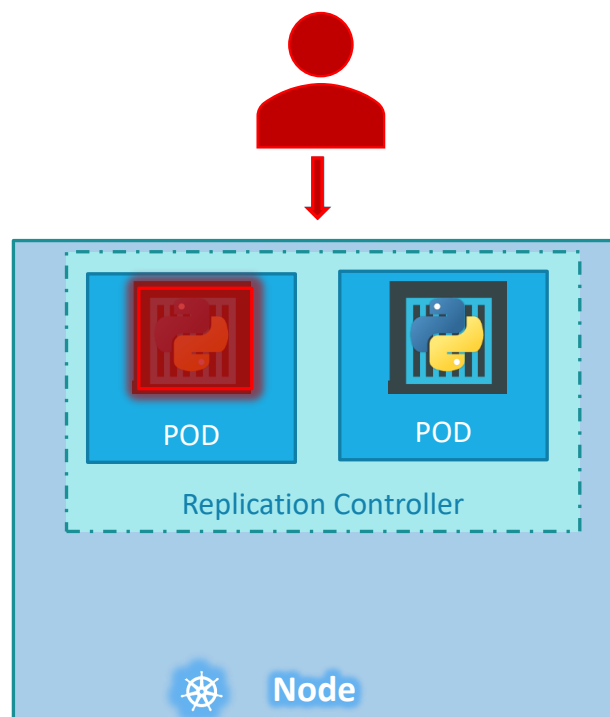
| NAME | READY | STATUS | RESTARTS | AGE |
|-----------|-------|---------|----------|-----|
| myapp-pod | 1/1 | Running | 0 | 20s |

```
> kubectl describe pod myapp-pod
```

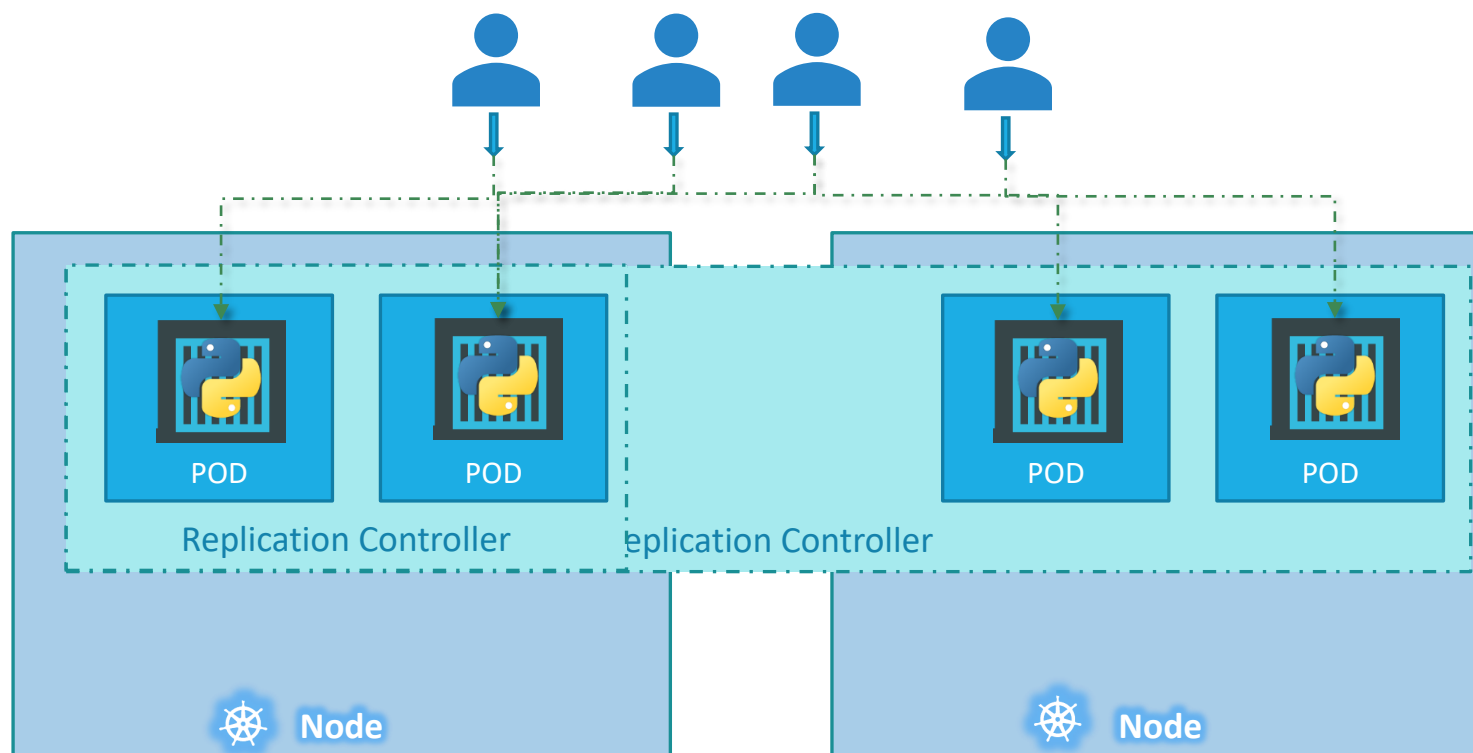
```
Name:          myapp-pod
Namespace:     default
Node:          minikube/192.168.99.100
Start Time:    Sat, 03 Mar 2018 14:26:14 +0800
Labels:        app=myapp
               name=myapp-pod
Annotations:   <none>
Status:        Running
IP:            10.244.0.24
Containers:
  nginx:
    Container ID:  docker://830bb56c8c42a86b4bb70e9c1488fae1bc38663e4918b6c2f5a783e7688b8c9d
    Image:         nginx
    Image ID:      docker-pullable://nginx@sha256:4771d09578c7c6a65299e110b3ee1c0a2592f5ea2618d23e4ffe7a4cab1ce5de
    Port:          <none>
    State:         Running
      Started:     Sat, 03 Mar 2018 14:26:21 +0800
    Ready:         True
    Restart Count: 0
    Environment:   <none>
    Mounts:
      /var/run/secrets/kubernetes.io/serviceaccount from default-token-x95w7 (ro)
Conditions:
  Type            Status
  Initialized     True
  Ready           True
  PodScheduled    True
Events:
  Type    Reason            Age   From          Message
  ----    -
  Normal  Scheduled         34s   default-scheduler  Successfully assigned myapp-pod to minikube
  Normal  SuccessfulMountVolume 33s   kubelet, minikube  MountVolume.SetUp succeeded for volume "default-token-x95w7"
  Normal  Pulling           33s   kubelet, minikube  pulling image "nginx"
  Normal  Pulled            27s   kubelet, minikube  Successfully pulled image "nginx"
  Normal  Created           27s   kubelet, minikube  Created container
  Normal  Started           27s   kubelet, minikube  Started container
```

Replication Controller

High Availability



Load Balancing & Scaling



Replication Controller



Replica Set

A solid blue horizontal bar at the bottom of the slide.



rc-definition.yml

```
apiVersion: v1
kind: ReplicationController
metadata:
  name: myapp-rc
  labels:
    app: myapp
    type: front-end
spec:
  template:
    POD
    POD
    POD
  replicas: 3
```

pod-definition.yml

```
apiVersion: v1
kind: Pod
metadata:
  name: myapp-pod
  labels:
    app: myapp
    type: front-end
spec:
  containers:
    - name: nginx-container
      image: nginx
```

```
> kubectl create -f rc-definition.yml
```

```
replicationcontroller "myapp-rc" created
```

```
> kubectl get replicationcontroller
```

| NAME | DESIRED | CURRENT | READY | AGE |
|----------|---------|---------|-------|-----|
| myapp-rc | 3 | 3 | 3 | 19s |

```
> kubectl get pods
```

| NAME | READY | STATUS | RESTARTS | AGE |
|----------------|-------|---------|----------|-----|
| myapp-rc-4lvk9 | 1/1 | Running | 0 | 20s |
| myapp-rc-mc2mf | 1/1 | Running | 0 | 20s |
| myapp-rc-px9pz | 1/1 | Running | 0 | 20s |

replicaset-definition.yml

```

apiVersion: apps/v1
kind: ReplicaSet
metadata:
  name: myapp-repl
  labels:
    app: myapp
    type: front-end
spec:
  template:

POD

replicas: 3
  selector:
    matchLabels:
      type: front-end

```

error: unable to recognize "replicaset-definition.yml": no matches for /, Kind=ReplicaSet

pod-definition.yml

```

apiVersion: v1
kind: Pod
labels:
  app: myapp
  type: front-end
spec:
  containers:
    - name: nginx-container
      image: nginx

```

```
> kubectl create -f replicaset-definition.yml
```

```
replicaset "myapp-replicaset" created
```

```
> kubectl get replicaset
```

| NAME | DESIRED | CURRENT | READY | AGE |
|------------------|---------|---------|-------|-----|
| myapp-replicaset | 3 | 3 | 3 | 19s |

```
> kubectl get pods
```

| NAME | READY | STATUS | RESTARTS | AGE |
|------------------------|-------|---------|----------|-----|
| myapp-replicaset-9ddl9 | 1/1 | Running | 0 | 45s |
| myapp-replicaset-9jtpx | 1/1 | Running | 0 | 45s |
| myapp-replicaset-hq84m | 1/1 | Running | 0 | 45s |

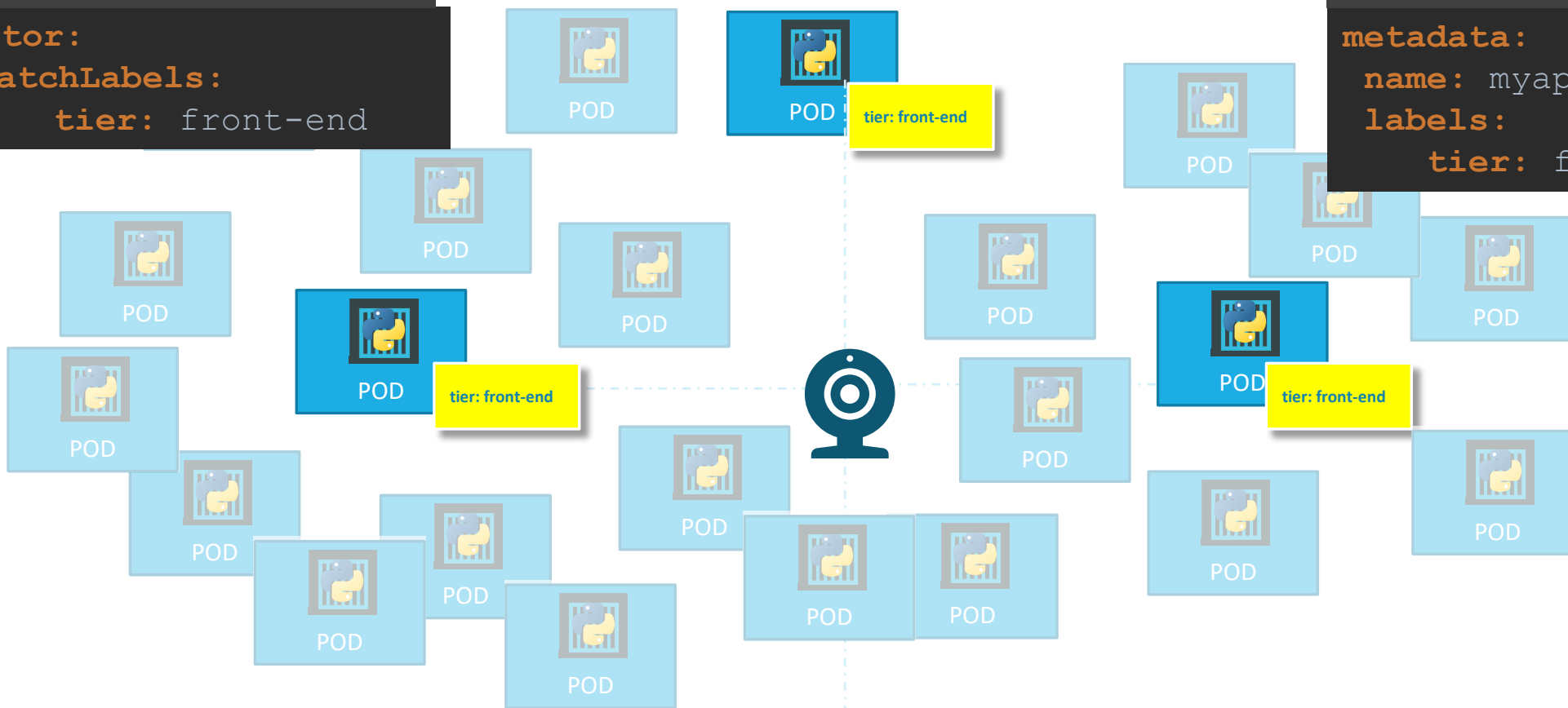
Labels and Selectors

```
replicaset-definition.yml
```

```
selector:  
  matchLabels:  
    tier: front-end
```

```
pod-definition.yml
```

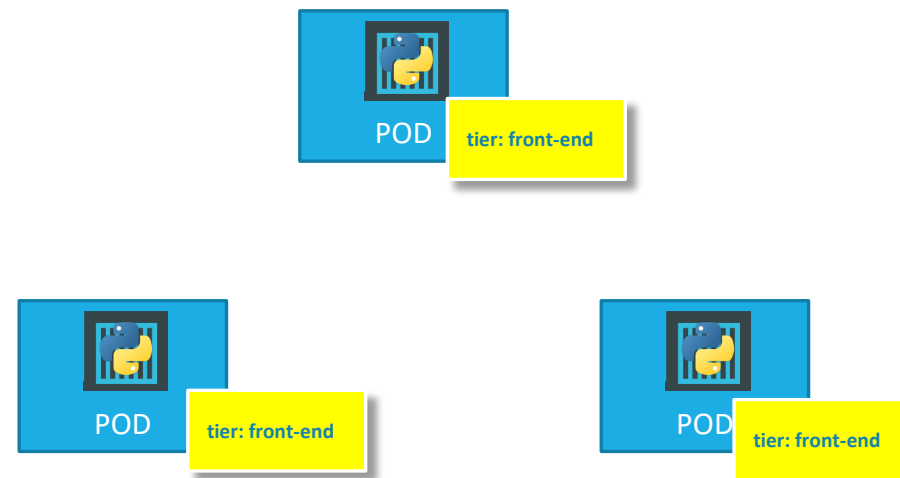
```
metadata:  
  name: myapp-pod  
  labels:  
    tier: front-end
```



replicaset-definition.yml

```
apiVersion: apps/v1
kind: ReplicaSet
metadata:
  name: myapp-replicaset
  labels:
    app: myapp
    type: front-end
spec:
  template:
    metadata:
      name: myapp-pod
      labels:
        app: myapp
        type: front-end
    spec:
      containers:
        - name: nginx-container
          image: nginx
  replicas: 3
  selector:
    matchLabels:
      type: front-end
```

Template



Scale

```
> kubectl replace -f replicaset-definition.yml
```

```
> kubectl scale --replicas=6 -f replicaset-definition.yml
```

```
> kubectl scale --replicas=6 replicaset myapp-replicaset
```

↓
TYPE

↓
NAME

replicaset-definition.yml

```
apiVersion: apps/v1
kind: ReplicaSet
metadata:
  name: myapp-replicaset
  labels:
    app: myapp
    type: front-end
spec:
  template:
    metadata:
      name: myapp-pod
      labels:
        app: myapp
        type: front-end
    spec:
      containers:
        - name: nginx-container
          image: nginx
replicas: 6
selector:
  matchLabels:
    type: front-end
```

commands

```
> kubectl create -f replicaset-definition.yml
```

```
> kubectl get replicaset
```

```
> kubectl delete replicaset myapp-replicaset
```

*Also deletes all underlying PODs

```
> kubectl replace -f replicaset-definition.yml
```

```
> kubectl scale --replicas=6 -f replicaset-definition.yml
```

Demo

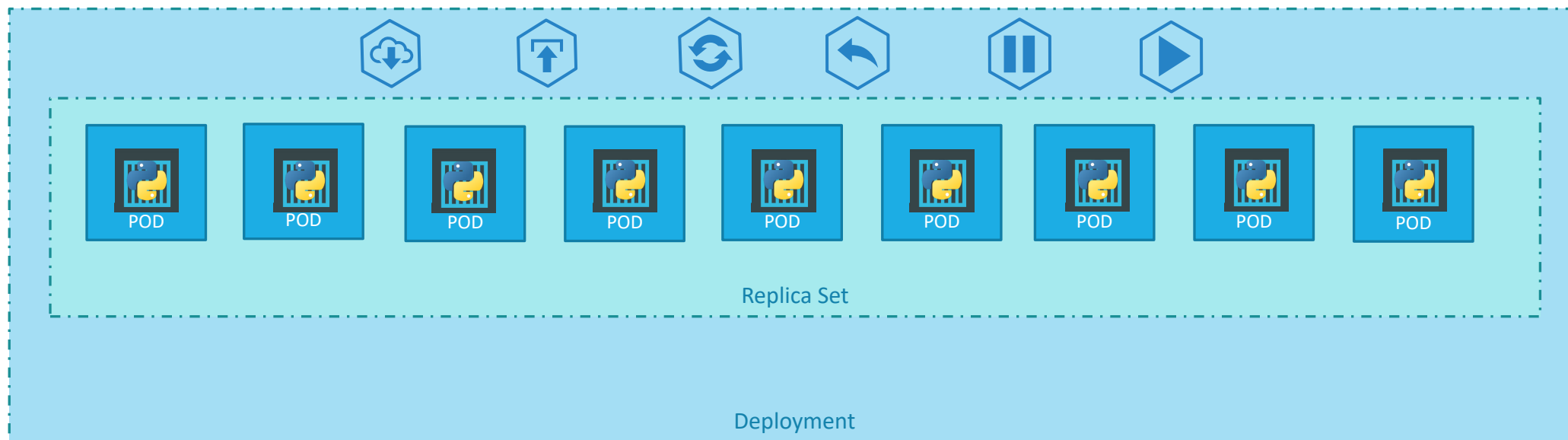
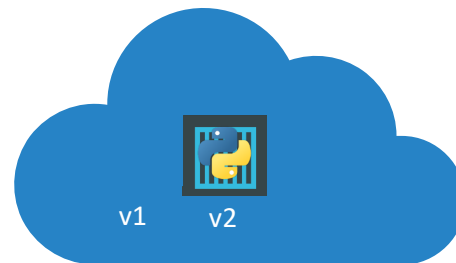
ReplicaSet

ReplicaSet as an Horizontal Pod Autoscaler Target

<https://kubernetes.io/docs/concepts/workloads/controllers/replicaset/#replicaset-as-an-horizontal-pod-autoscaler-target>

Deployment

Deployment



Definition

```
> kubectl create -f deployment-definition.yml
```

```
deployment "myapp-deployment" created
```

```
> kubectl get deployments
```

| NAME | DESIRED | CURRENT | UP-TO-DATE | AVAILABLE | AGE |
|------------------|---------|---------|------------|-----------|-----|
| myapp-deployment | 3 | 3 | 3 | 3 | 21s |

```
> kubectl get replicaset
```

| NAME | DESIRED | CURRENT | READY | AGE |
|-----------------------------|---------|---------|-------|-----|
| myapp-deployment-6795844b58 | 3 | 3 | 3 | 2m |

```
> kubectl get pods
```

| NAME | READY | STATUS | RESTARTS | AGE |
|-----------------------------------|-------|---------|----------|-----|
| myapp-deployment-6795844b58-5rbj1 | 1/1 | Running | 0 | 2m |
| myapp-deployment-6795844b58-h4w55 | 1/1 | Running | 0 | 2m |
| myapp-deployment-6795844b58-lfjvh | 1/1 | Running | 0 | 2m |

```
deployment-definition.yml
```

```
apiVersion: apps/v1
```

```
kind: Deployment
```

```
metadata:
```

```
  name: myapp-deployment
```

```
  labels:
```

```
    app: myapp
```

```
    type: front-end
```

```
spec:
```

```
  template:
```

```
    metadata:
```

```
      name: myapp-pod
```

```
      labels:
```

```
        app: myapp
```

```
        type: front-end
```

```
    spec:
```

```
      containers:
```

```
        - name: nginx-container
```

```
          image: nginx
```

```
replicas: 3
```

```
selector:
```

```
  matchLabels:
```

```
    type: front-end
```

commands

```
> kubectl get all
```

| NAME | DESIRED | CURRENT | UP-TO-DATE | AVAILABLE | AGE |
|-------------------------|---------|---------|------------|-----------|-----|
| deploy/myapp-deployment | 3 | 3 | 3 | 3 | 9h |

| NAME | DESIRED | CURRENT | READY | AGE |
|--------------------------------|---------|---------|-------|-----|
| rs/myapp-deployment-6795844b58 | 3 | 3 | 3 | 9h |

| NAME | READY | STATUS | RESTARTS | AGE |
|---------------------------------------|-------|---------|----------|-----|
| po/myapp-deployment-6795844b58-5rbjl | 1/1 | Running | 0 | 9h |
| po/myapp-deployment-6795844b58-h4w55 | 1/1 | Running | 0 | 9h |
| po/myapp-deployment-6795844b58-lfj hv | 1/1 | Running | 0 | 9h |

Demo

Deployment

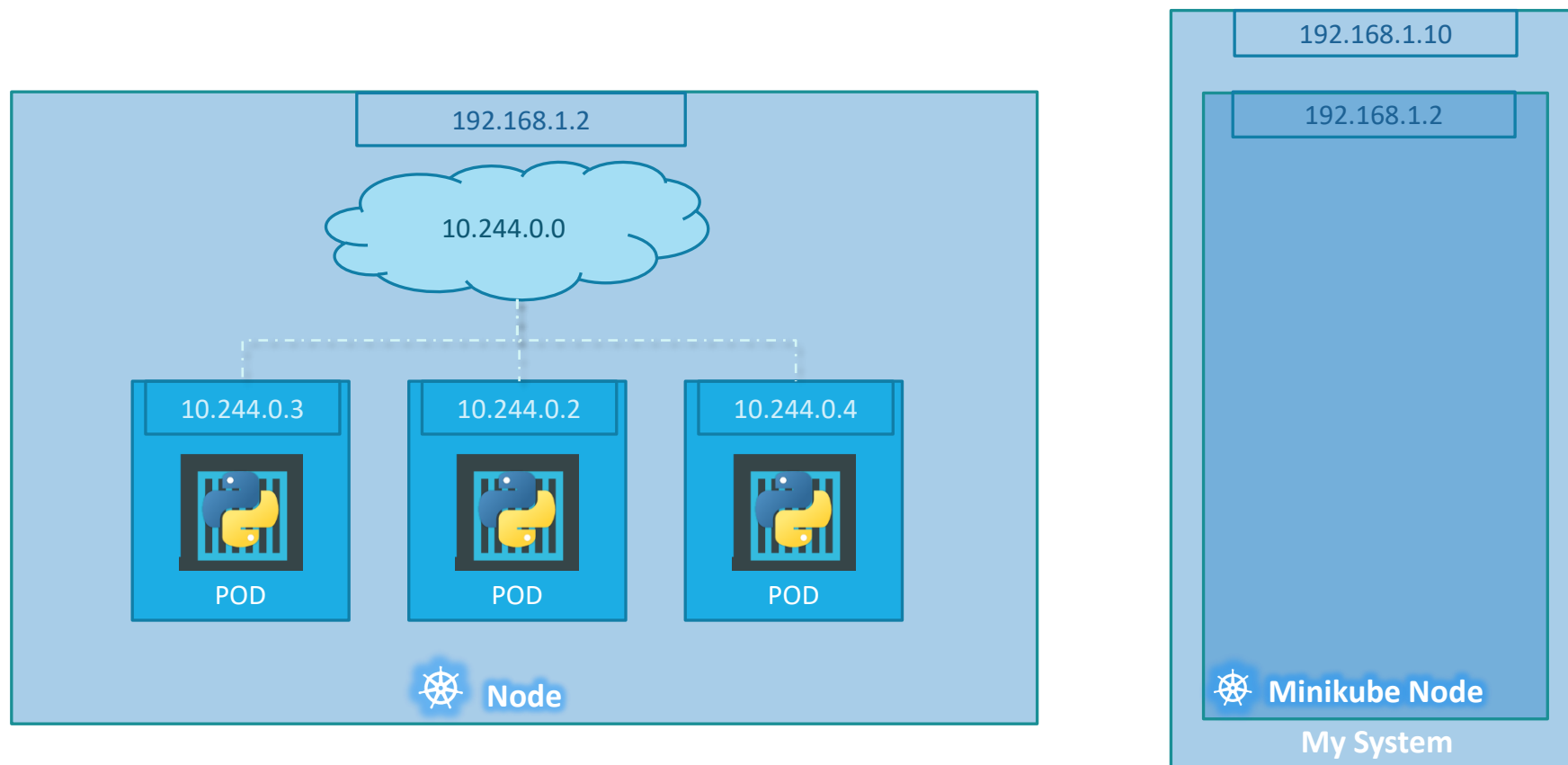
Demo

Deployment

Networking 101

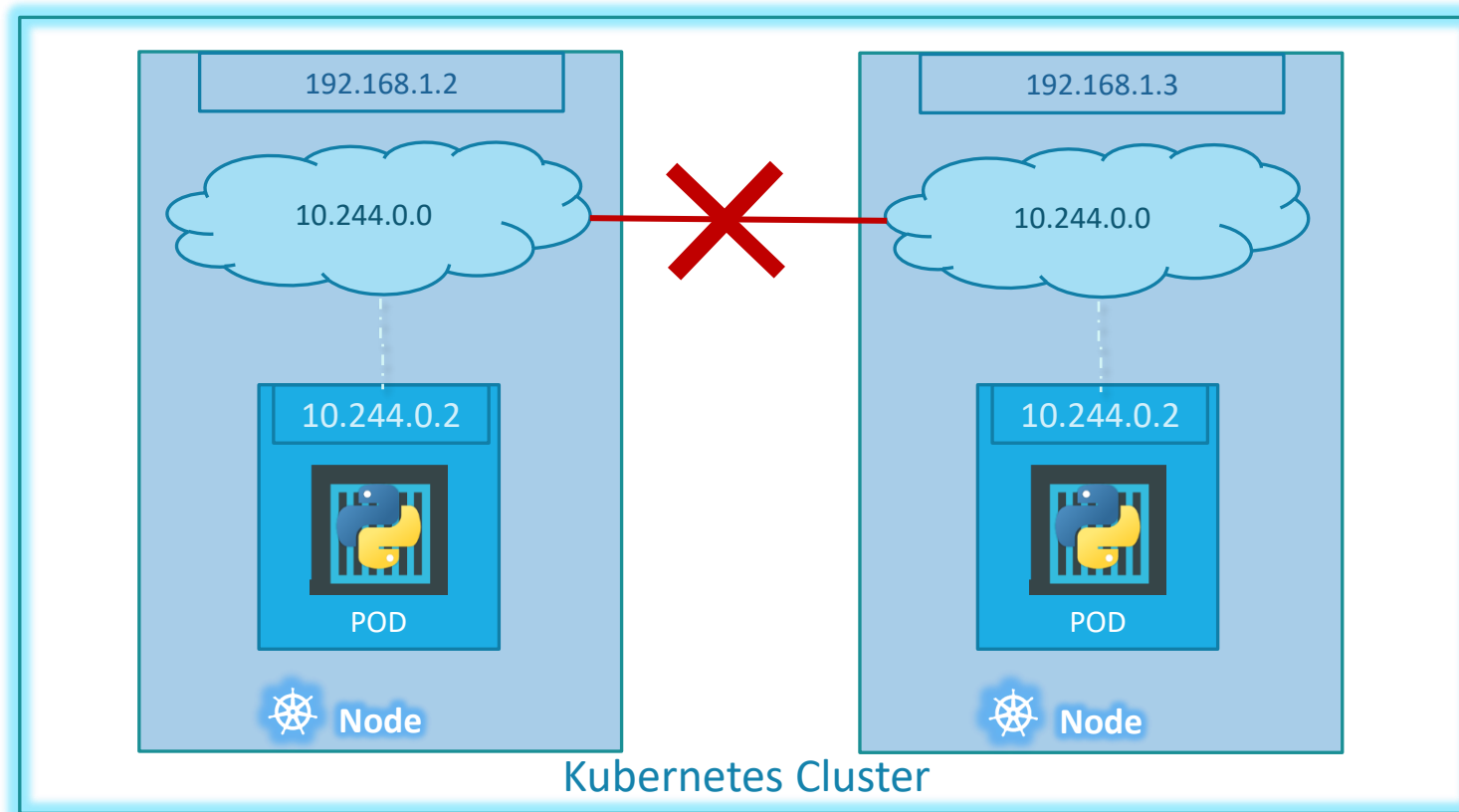
Kubernetes Networking - 101

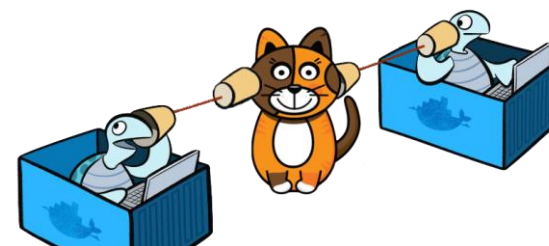
- IP Address is assigned to a POD



Cluster Networking

- All containers/PODs can communicate to one another without NAT
- All nodes can communicate with all containers and vice-versa without NAT





Cluster Networking Setup

(3/4) Installing a pod network

You **MUST** install a pod network add-on so that your pods can communicate with each other.

The network must be deployed before any applications. Also, kube-dns, an internal helper service, will not start up before a network is installed. kubeadm only supports Container Network Interface (CNI) based networks (and does not support kubenet).

Several projects provide Kubernetes pod networks using CNI, some of which also support Network Policy. See the [add-ons page](#) for a complete list of available network add-ons. IPv6 support was added in CNI v0.6.0. CNI bridge and local-ipam are the only supported IPv6 network plugins in 1.9.

Note: kubeadm sets up a more secure cluster by default and enforces use of RBAC. Please make sure that the network manifest of choice supports RBAC.

You can install a pod network add-on with the following command:

```
kubectl apply -f <add-on.yaml>
```

NOTE: You can install **only one** pod network per cluster.

Choose one...

Calico

Canal

Flannel

Kube-router

Romana

Weave Net

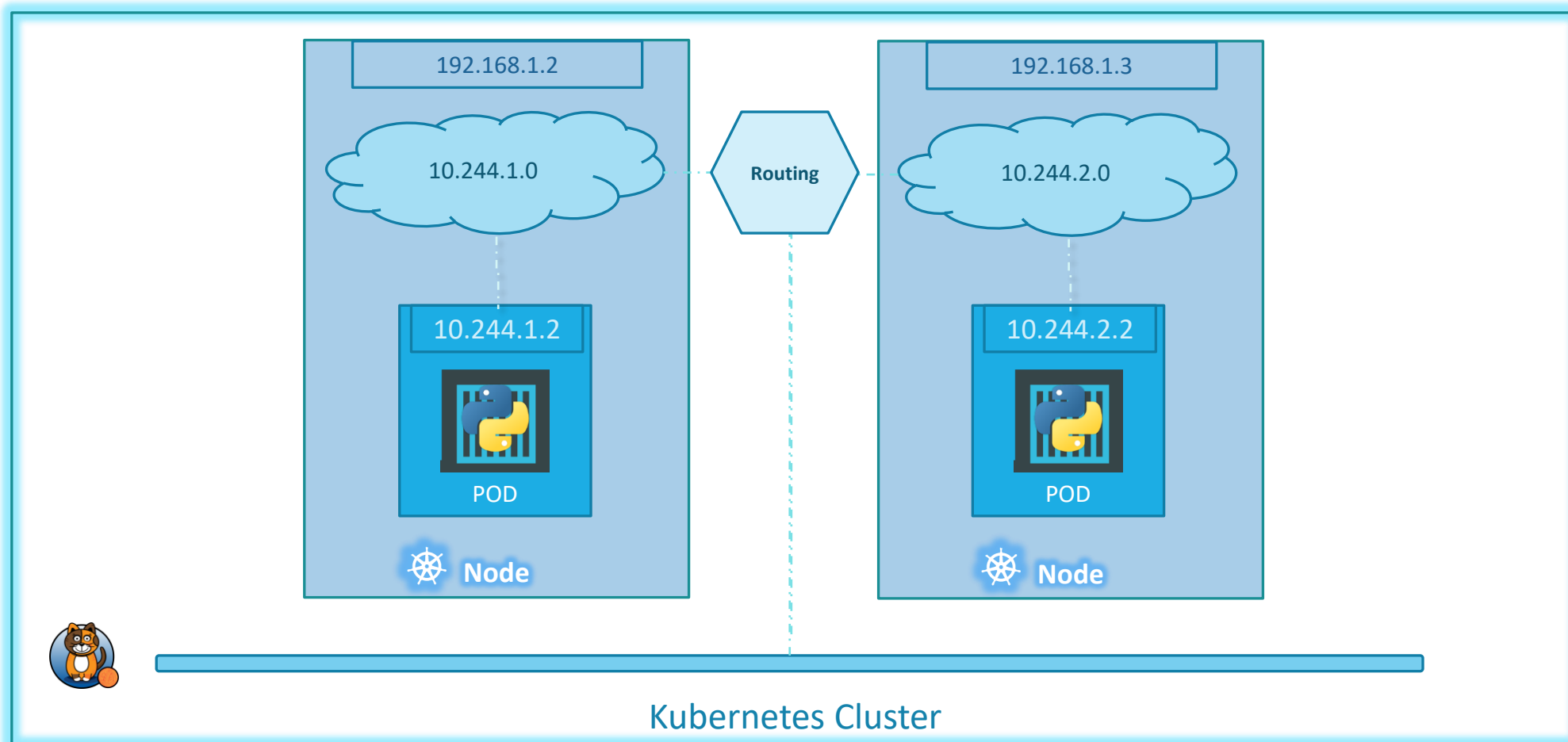
Refer to the Calico documentation for a [kubeadm quickstart](#), a [kubeadm installation guide](#), and other resources.

Note:

- In order for Network Policy to work correctly, you need to pass `--pod-network-cidr=192.168.0.0/16` to `kubeadm init`.
- Calico works on `amd64` only.

```
kubectl apply -f https://docs.projectcalico.org/v3.0/getting-started/kubernetes/installation/hosted/kubeadm/1.7/calico.yaml
```

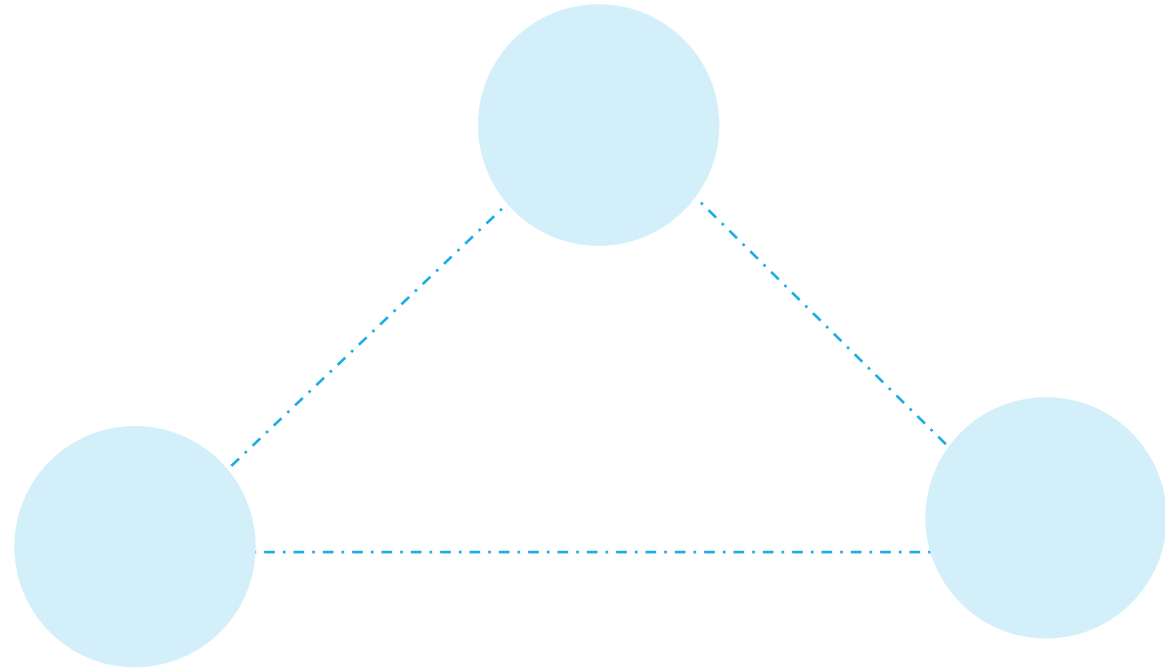
Cluster Networking



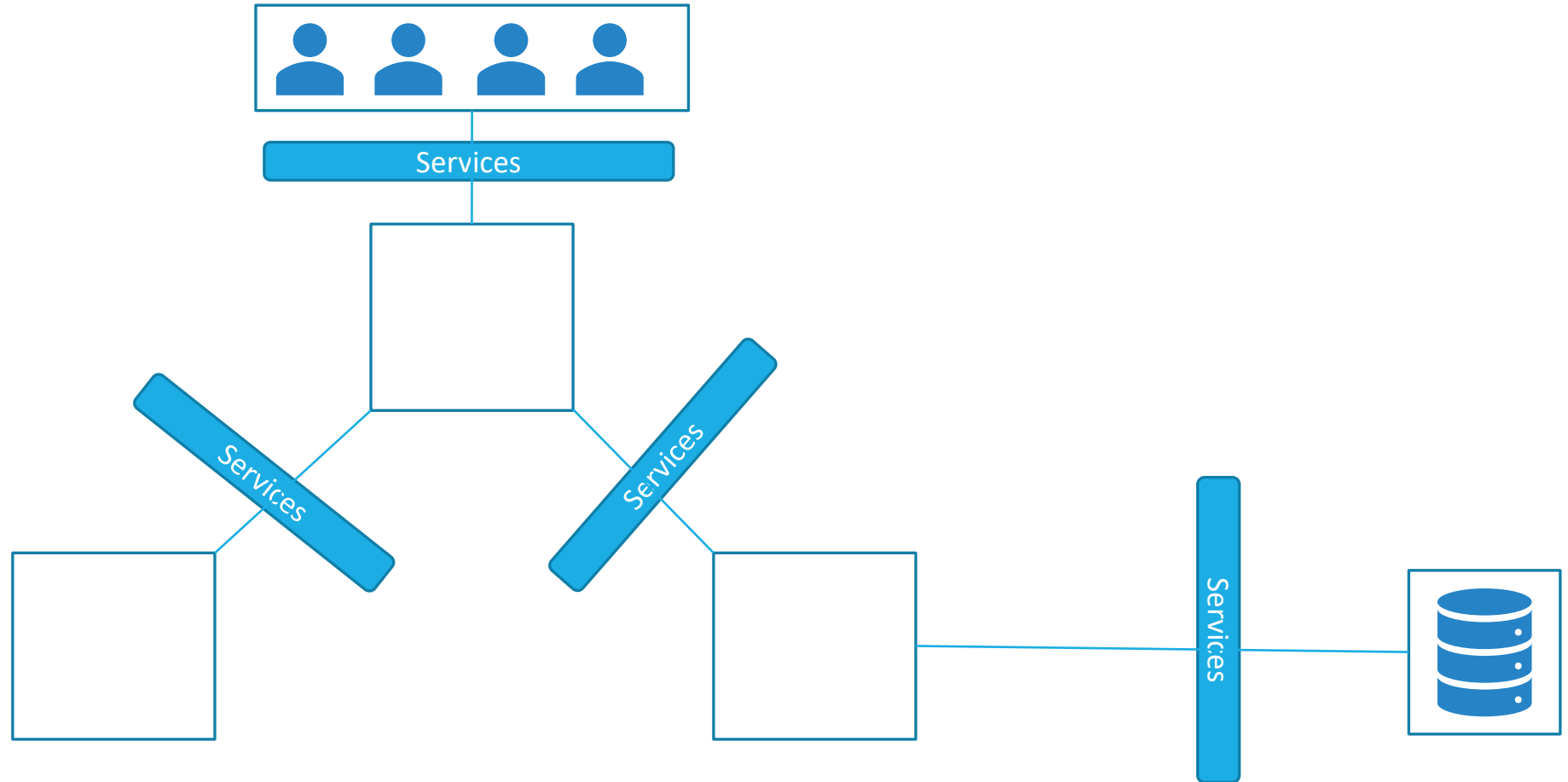
Demo

Networking

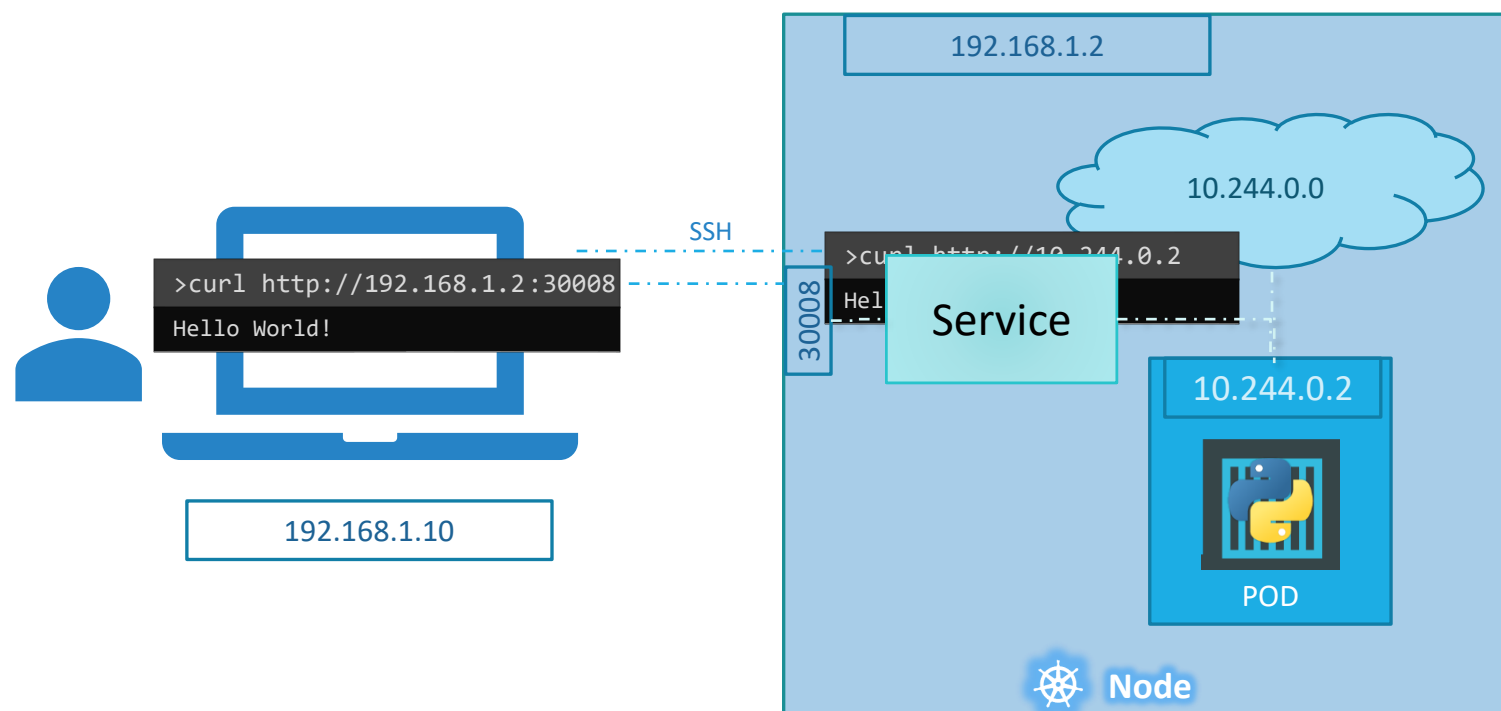
Services



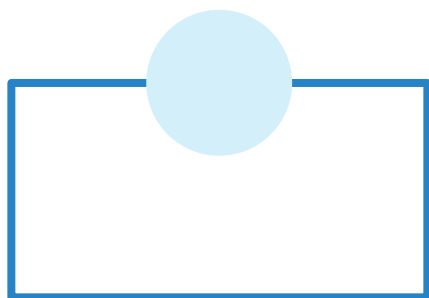
Services



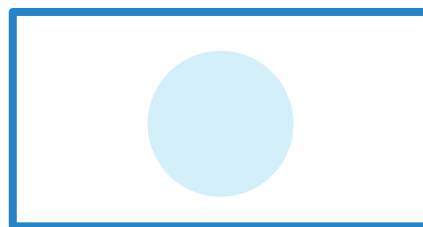
Service



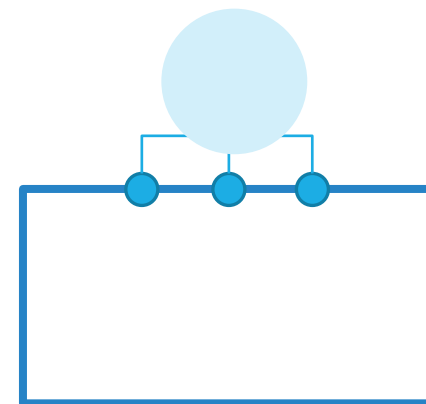
Services Types



NodePort

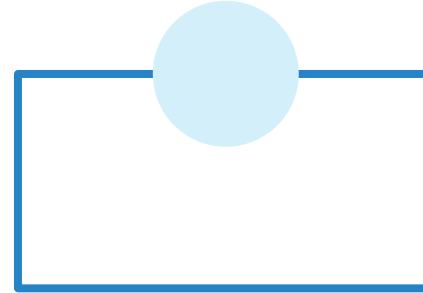


ClusterIP

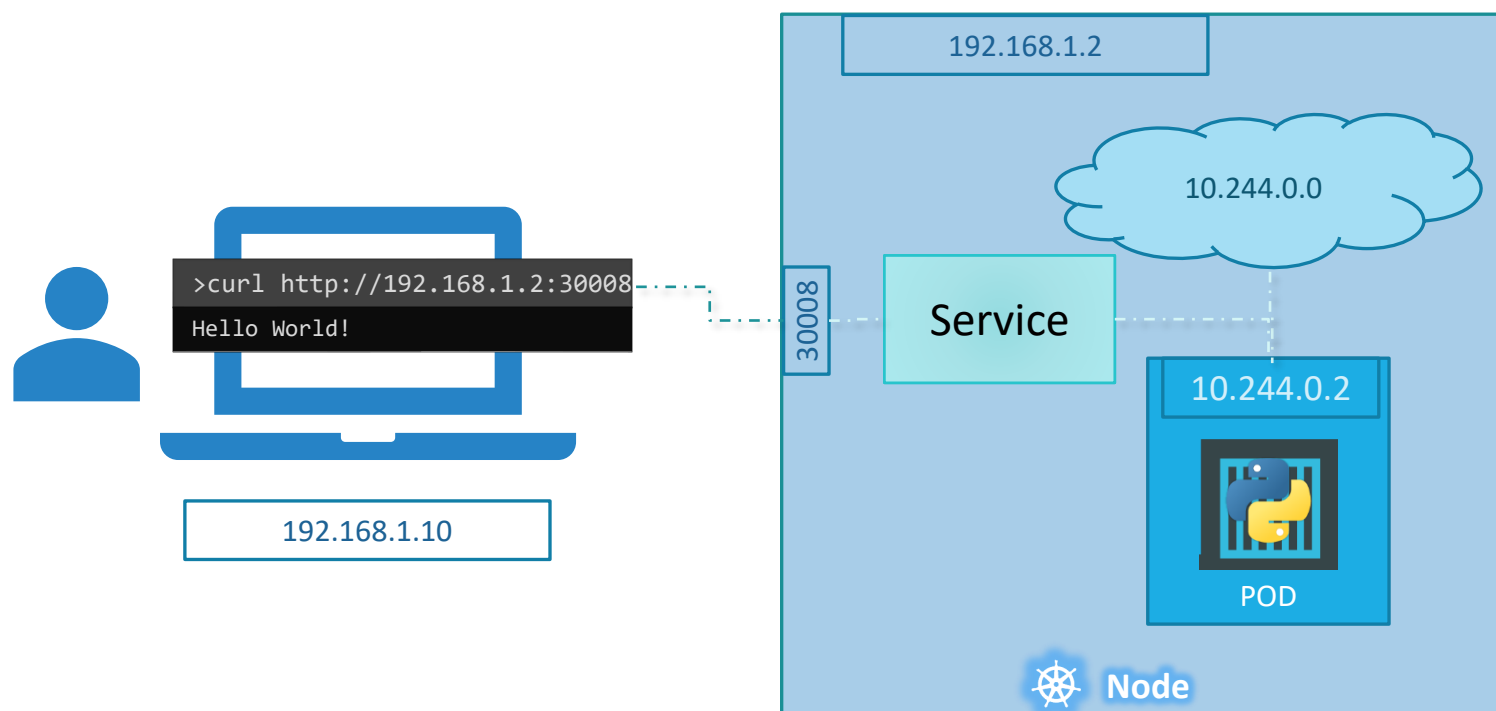


LoadBalancer

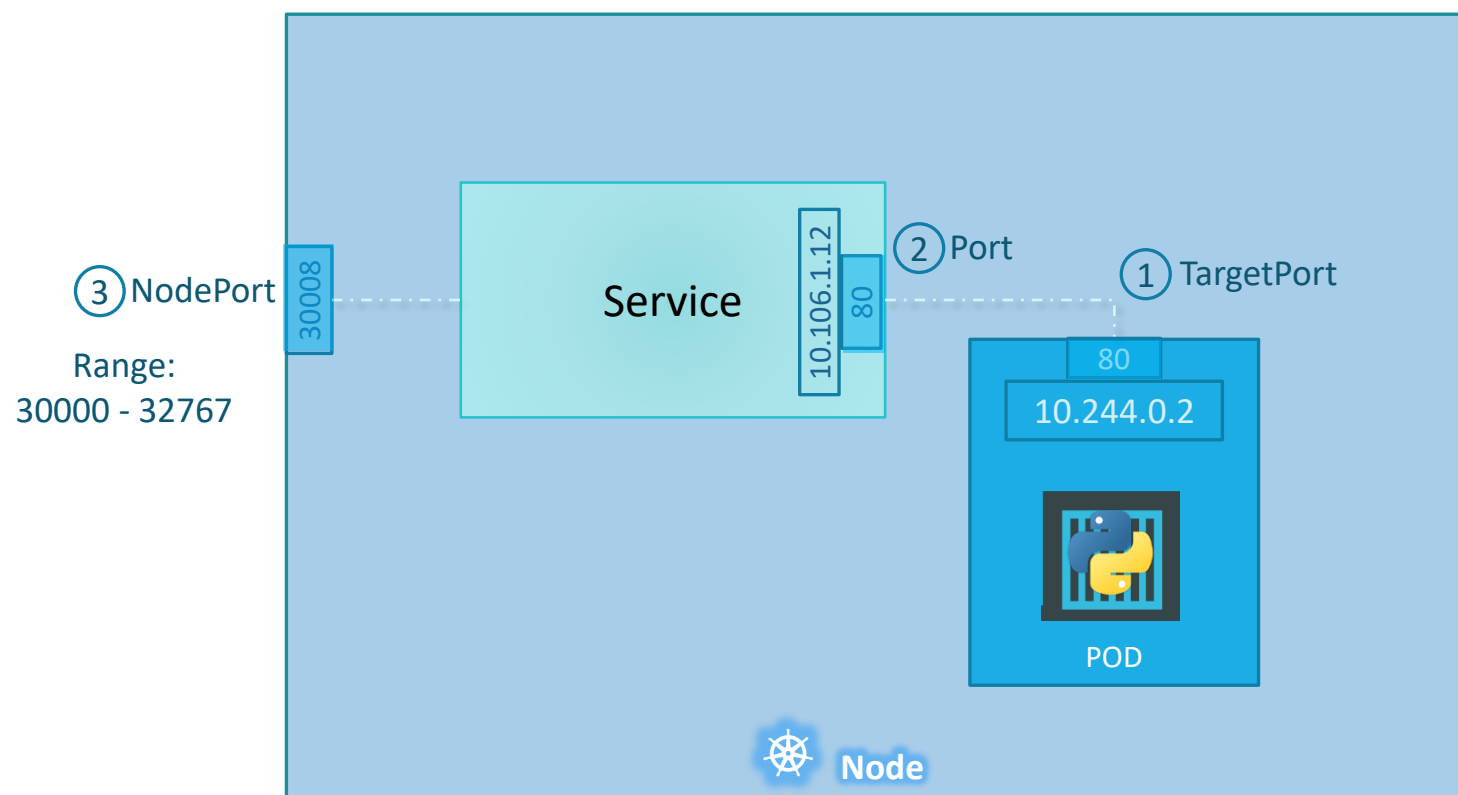
NodePort



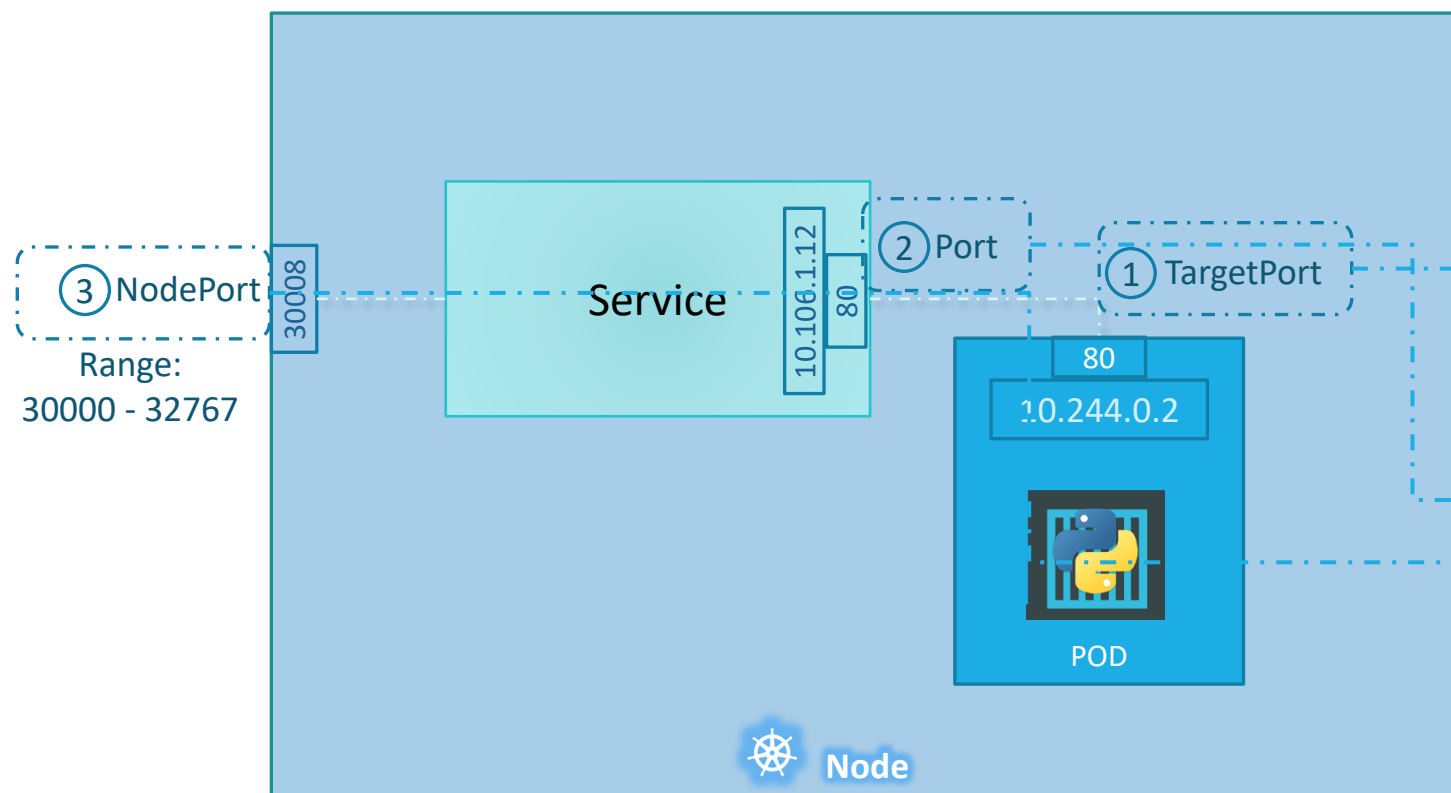
Service - NodePort



Service - NodePort



Service - NodePort



```
service-definition.yml

apiVersion: v1
kind: Service
metadata:
  name: myapp-service

spec:
  type: NodePort
  ports:
    - targetPort: 80
      *port: 80
      nodePort: 30008
```

Service - NodePort

service-definition.yml

```
apiVersion: v1
kind: Service
metadata:
  name: myapp-service
spec:
  type: NodePort
  ports:
    - targetPort: 80
      port: 80
      nodePort: 30008
  selector:
```

pod-definition.yml

```
> kubectl create -f service-definition.yml
```

```
service "myapp-service" created
```

```
> kubectl get services
```

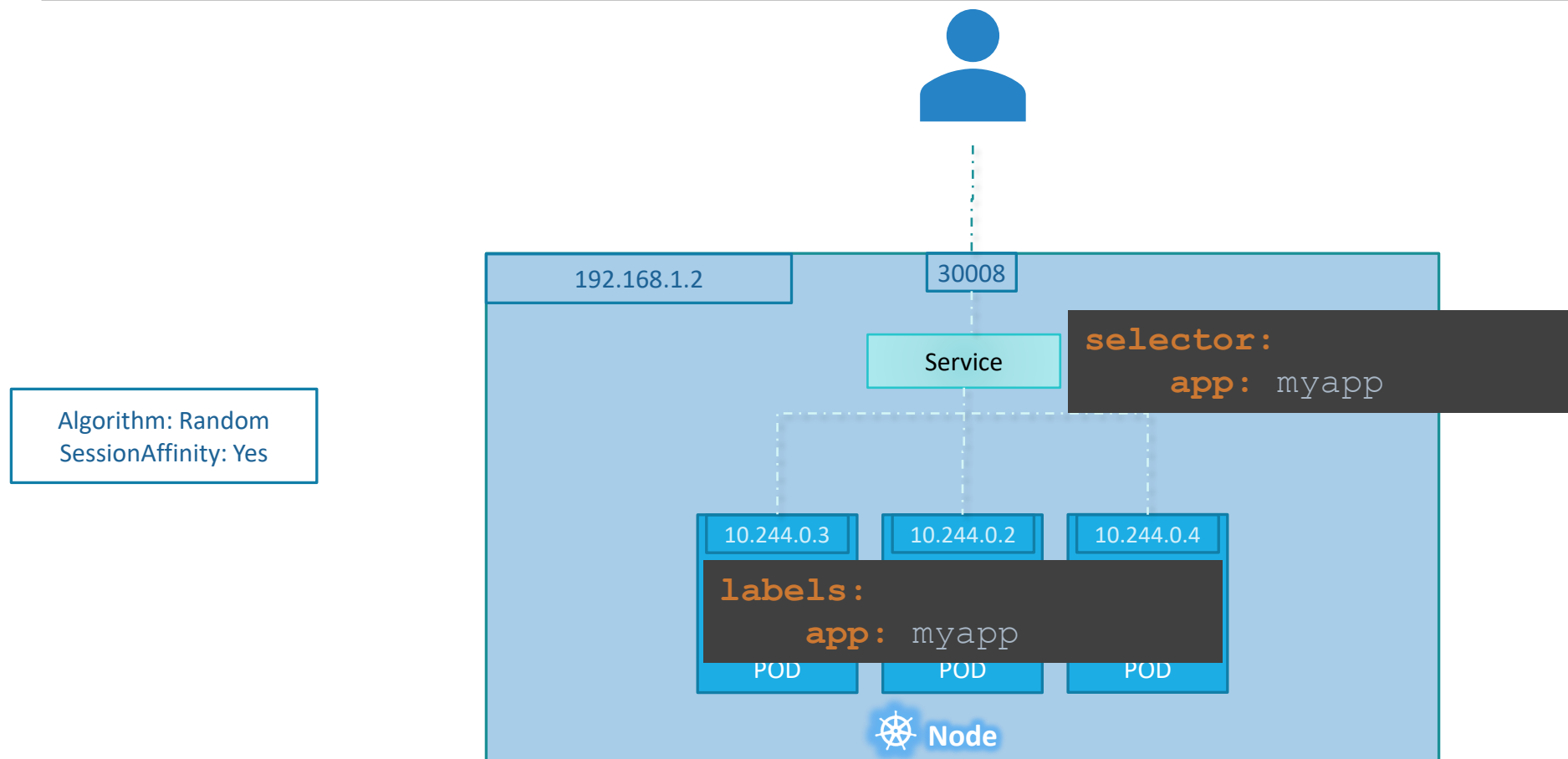
| NAME | TYPE | CLUSTER-IP | EXTERNAL-IP | PORT(S) | AGE |
|---------------|-----------|----------------|-------------|--------------|-----|
| kubernetes | ClusterIP | 10.96.0.1 | <none> | 443/TCP | 16d |
| myapp-service | NodePort | 10.106.127.123 | <none> | 80:30008/TCP | 5m |

```
app: myapp
```

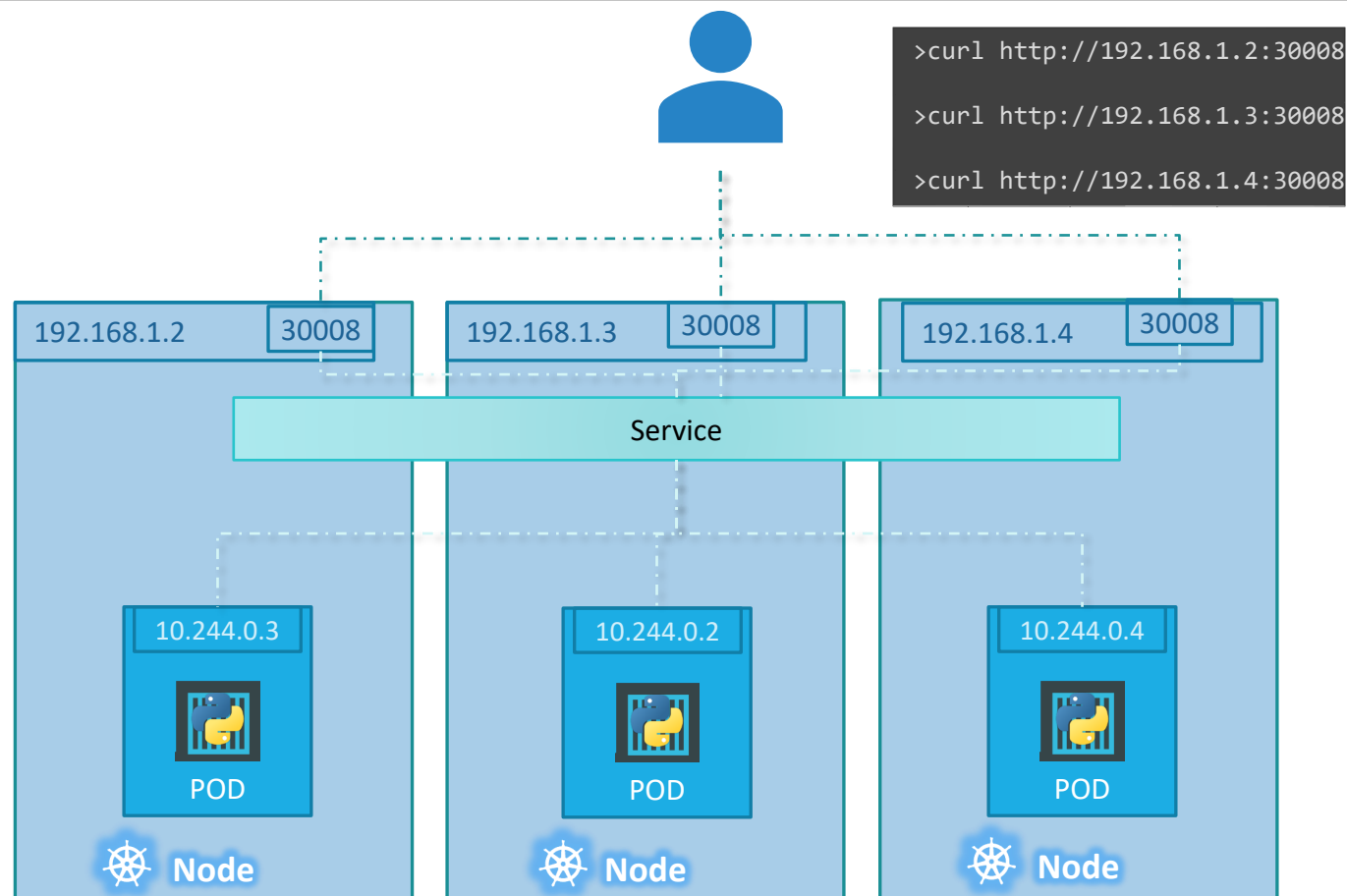
```
> curl http://192.168.1.2:30008
```

```
<html>
<head>
<title>Welcome to nginx!</title>
<style>
  body {
    width: 35em;
    margin: 0 auto;
    font-family: Tahoma, Verdana, Arial, sans-serif;
  }
</style>
</head>
<body>
```

Service - NodePort



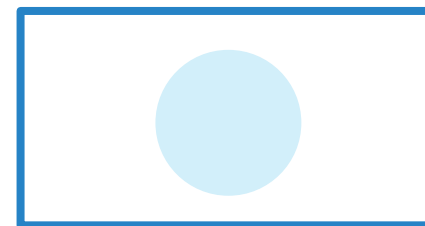
Service - NodePort



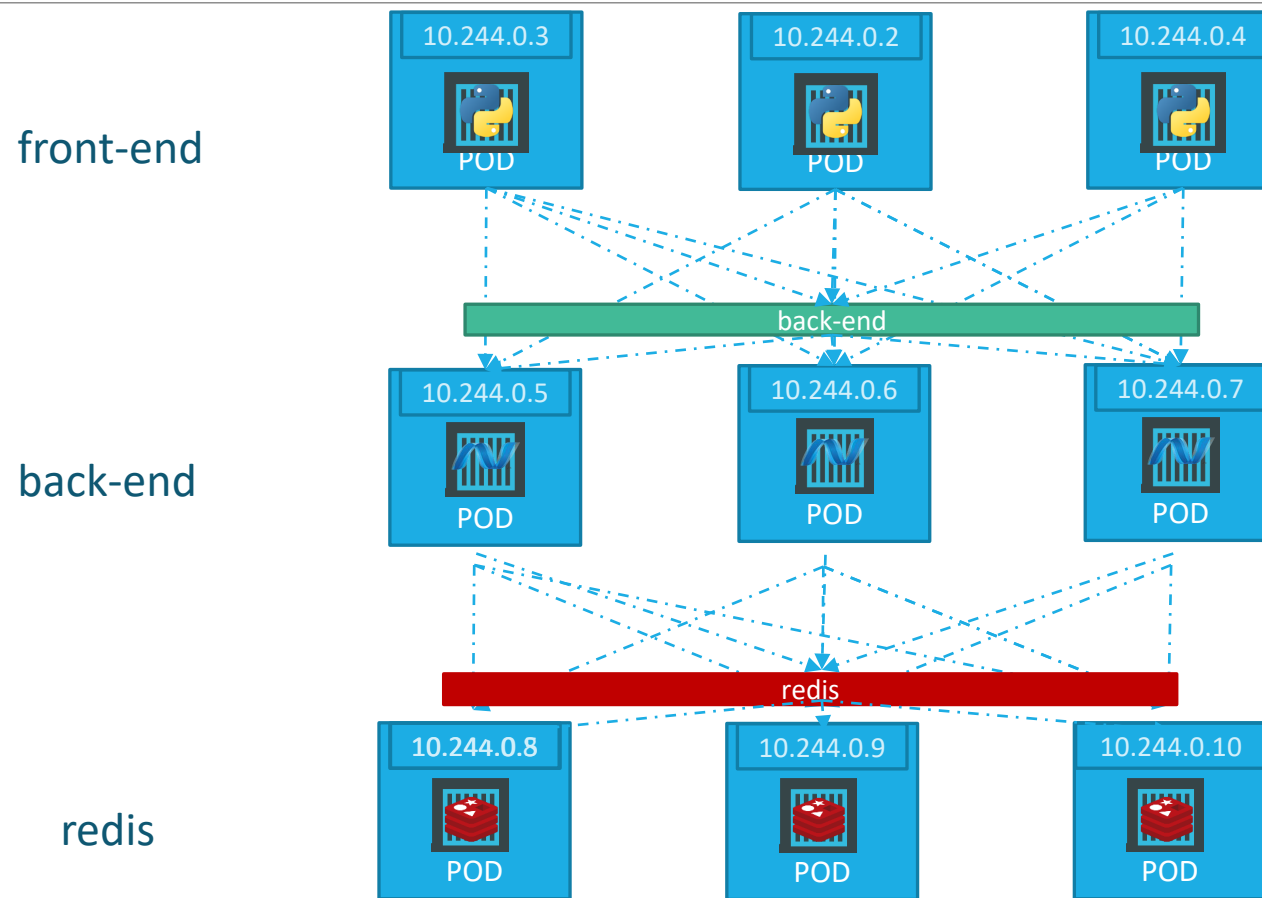
Demo

Service - NodePort

ClusterIP



ClusterIP



service-definition.yml

```
apiVersion: v1
kind: Service
metadata:
  name: back-end
spec:
  type: ClusterIP
  ports:
    - targetPort: 80
      port: 80
  selector:
```

pod-definition.yml

```
> kubectl create -f service-definition.yml
```

```
service "back-end" created
```

```
> kubectl get services
```

| NAME | TYPE | CLUSTER-IP | EXTERNAL-IP | PORT(S) | AGE |
|------------|-----------|----------------|-------------|---------|-----|
| kubernetes | ClusterIP | 10.96.0.1 | <none> | 443/TCP | 16d |
| back-end | ClusterIP | 10.106.127.123 | <none> | 80/TCP | 2m |

```
  app: myapp
```

```
  type: back-end
```

```
spec:
```

```
  containers:
```

```
    - name: nginx-container
```

```
      image: nginx
```

Demo

Service - NodePort

References

<https://kubernetes.io/docs/concepts/services-networking/dns-pod-service/>

Deployment

Updates and Rollback

Rollout and Versioning



Revision 1



nginx:1.7.0



nginx:1.7.0



nginx:1.7.0



nginx:1.7.0



nginx:1.7.0



nginx:1.7.0



nginx:1.7.0



nginx:1.7.0



nginx:1.7.0

Revision 2



nginx:1.7.1



nginx:1.7.1



nginx:1.7.1



nginx:1.7.1



nginx:1.7.1



nginx:1.7.1



nginx:1.7.1



nginx:1.7.1



nginx:1.7.1

Rollout Command

```
> kubectl rollout status deployment/myapp-deployment
```

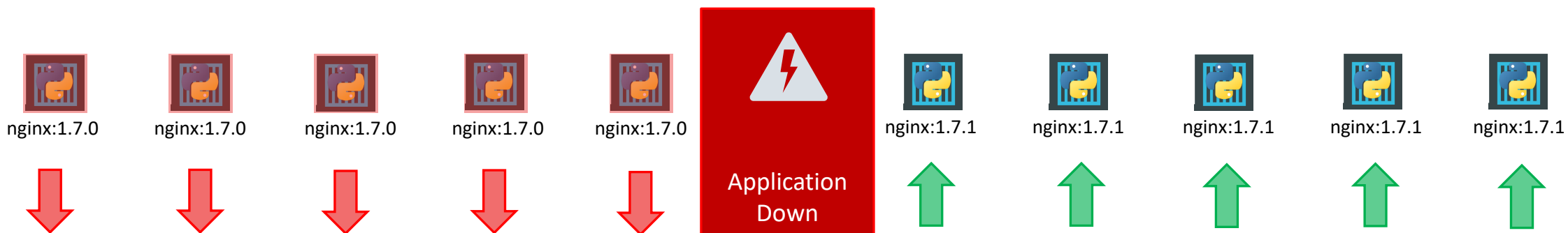
```
Waiting for rollout to finish: 0 of 10 updated replicas are available...  
Waiting for rollout to finish: 1 of 10 updated replicas are available...  
Waiting for rollout to finish: 2 of 10 updated replicas are available...  
Waiting for rollout to finish: 3 of 10 updated replicas are available...  
Waiting for rollout to finish: 4 of 10 updated replicas are available...  
Waiting for rollout to finish: 5 of 10 updated replicas are available...  
Waiting for rollout to finish: 6 of 10 updated replicas are available...  
Waiting for rollout to finish: 7 of 10 updated replicas are available...  
Waiting for rollout to finish: 8 of 10 updated replicas are available...  
Waiting for rollout to finish: 9 of 10 updated replicas are available...  
deployment "myapp-deployment" successfully rolled out
```

```
> kubectl rollout history deployment/myapp-deployment
```

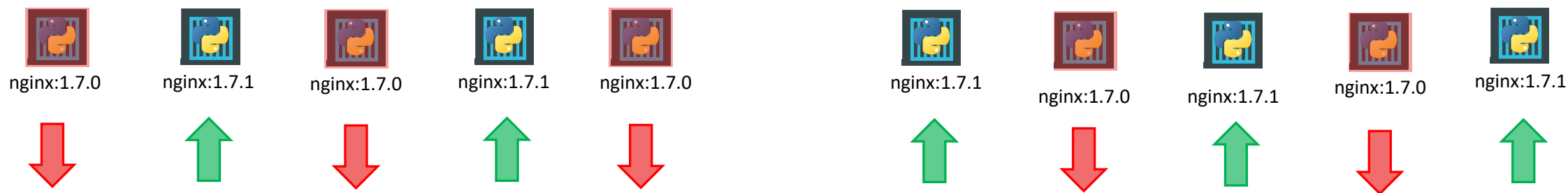
```
deployments "myapp-deployment"  
REVISION  CHANGE-CAUSE  
1          <none>  
2          kubectl apply --filename=deployment-definition.yml --record=true
```


Deployment Strategy

Recreate



Rolling Update



Kubectl apply

```
> kubectl apply -f deployment-definition.yml  
deployment "myapp-deployment" configured
```

```
> kubectl set image deployment/myapp-deployment \  
    nginx=nginx:1.9.1  
deployment "myapp-deployment" image is updated
```

deployment-definition.yml

```
apiVersion: apps/v1  
kind: Deployment  
metadata:  
  name: myapp-deployment  
  labels:  
    app: myapp  
    type: front-end  
spec:  
  template:  
    metadata:  
      name: myapp-pod  
      labels:  
        app: myapp  
        type: front-end  
    spec:  
      containers:  
        - name: nginx-container  
          image: nginx:1.7.1  
  replicas: 3  
  selector:  
    matchLabels:  
      type: front-end
```

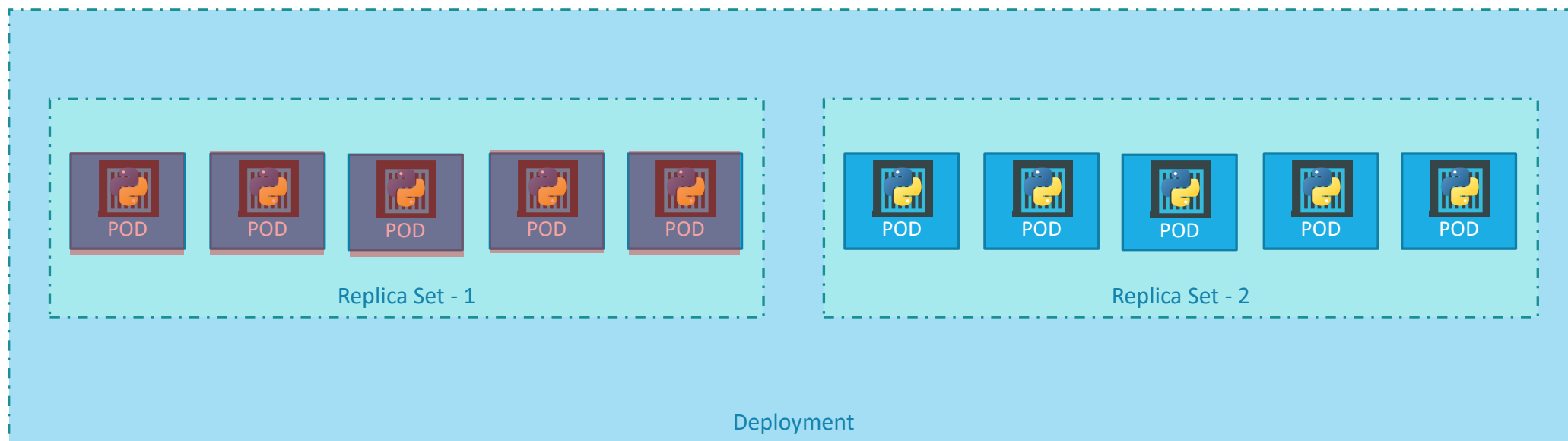
```
C:\Kubernetes>kubectl describe deployment myapp-deployment
Name:          myapp-deployment
Namespace:     default
CreationTimestamp: Sat, 03 Mar 2018 17:01:55 +0800
Labels:        app=myapp
               type=front-end
Annotations:   deployment.kubernetes.io/revision=2
               kubectl.kubernetes.io/last-applied-configuration={"apiVersion":"apps/v1","kind":"Deployment","me
s\\Google...
               kubernetes.io/change-cause=kubectl apply --filename=d:\\Mumshad Files\\Google Drive\\Udemy\\Kubernet
Selector:      type=front-end
Replicas:      5 desired | 5 updated | 5 total | 5 available | 0 unavailable
StrategyType:  Recreate
MinReadySeconds: 0
Pod Template:
  Labels:  app=myapp
           type=front-end
  Containers:
    nginx-container:
      Image:        nginx:1.7.1
      Port:         <none>
      Environment:  <none>
      Mounts:       <none>
      Volumes:      <none>
  Conditions:
    Type           Status    Reason
    ----           -
    Available      True     MinimumReplicasAvailable
    Progressing    True     NewReplicaSetAvailable
    OldReplicaSets: <none>
    NewReplicaSet:  myapp-deployment-54c7d6ccc (5/5 replicas created)
  Events:
    Type      Reason          Age    From          Message
    ----      -
    Normal    ScalingReplicaSet  11m    deployment-controller  Scaled up replica set myapp-deployment-6795844b58 to 5
    Normal    ScalingReplicaSet  1m     deployment-controller  Scaled down replica set myapp-deployment-6795844b58 to 0
    Normal    ScalingReplicaSet  56s    deployment-controller  Scaled up replica set myapp-deployment-54c7d6ccc to 5
```

Recreate

```
C:\Kubernetes>kubectl describe deployment myapp-deployment
Name:          myapp-deployment
Namespace:     default
CreationTimestamp: Sat, 03 Mar 2018 17:16:53 +0800
Labels:        app=myapp
               type=front-end
Annotations:   deployment.kubernetes.io/revision=2
               kubectl.kubernetes.io/last-applied-configuration={"apiVersion":"apps/v1","kind":"Deployment","metadate
Files\\Google...
               kubernetes.io/change-cause=kubectl apply --filename=d:\\Mumshad Files\\Google Drive\\Udemy\\Kubernet
Selector:      type=front-end
Replicas:      5 desired | 5 updated | 6 total | 4 available | 2 unavailable
StrategyType:  RollingUpdate
MinReadySeconds: 0
RollingUpdateStrategy: 25% max unavailable, 25% max surge
Pod Template:
  Labels:  app=myapp
           type=front-end
  Containers:
    nginx-container:
      Image:        nginx
      Port:         <none>
      Environment:  <none>
      Mounts:       <none>
      Volumes:      <none>
  Conditions:
    Type           Status    Reason
    ----           -
    Available      True     MinimumReplicasAvailable
    Progressing    True     ReplicaSetUpdated
    OldReplicaSets: myapp-deployment-67c749c58c (1/1 replicas created)
    NewReplicaSet:  myapp-deployment-7d57dbdb8d (5/5 replicas created)
  Events:
    Type      Reason          Age    From          Message
    ----      -
    Normal    ScalingReplicaSet  1m     deployment-controller  Scaled up replica set myapp-deployment-67c749c58c to 5
    Normal    ScalingReplicaSet  1s     deployment-controller  Scaled up replica set myapp-deployment-7d57dbdb8d to 2
    Normal    ScalingReplicaSet  1s     deployment-controller  Scaled down replica set myapp-deployment-67c749c58c to 4
    Normal    ScalingReplicaSet  1s     deployment-controller  Scaled up replica set myapp-deployment-7d57dbdb8d to 3
    Normal    ScalingReplicaSet  0s     deployment-controller  Scaled down replica set myapp-deployment-67c749c58c to 3
    Normal    ScalingReplicaSet  0s     deployment-controller  Scaled up replica set myapp-deployment-7d57dbdb8d to 4
    Normal    ScalingReplicaSet  0s     deployment-controller  Scaled down replica set myapp-deployment-67c749c58c to 2
    Normal    ScalingReplicaSet  0s     deployment-controller  Scaled up replica set myapp-deployment-7d57dbdb8d to 5
    Normal    ScalingReplicaSet  0s     deployment-controller  Scaled down replica set myapp-deployment-67c749c58c to 1
```

RollingUpdate

Upgrades



```
> kubectl get replicaset
```

| NAME | DESIRED | CURRENT | READY | AGE |
|-----------------------------|---------|---------|-------|-----|
| myapp-deployment-67c749c58c | 0 | 0 | 0 | 22m |
| myapp-deployment-7d57dbdb8d | 5 | 5 | 5 | 20m |

Rollback

```
> kubectl get replicaset
```

| NAME | DESIRED | CURRENT | READY | AGE |
|-----------------------------|---------|---------|-------|-----|
| myapp-deployment-67c749c58c | 0 | 0 | 0 | 22m |
| myapp-deployment-7d57dbdb8d | 5 | 5 | 5 | 20m |

```
> kubectl get replicaset
```

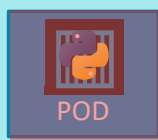
| NAME | DESIRED | CURRENT | READY | AGE |
|-----------------------------|---------|---------|-------|-----|
| myapp-deployment-67c749c58c | 5 | 5 | 5 | 22m |
| myapp-deployment-7d57dbdb8d | 0 | 0 | 0 | 20m |



POD



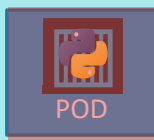
POD



POD



POD



POD

Replica Set - 1



POD



POD



POD



POD



POD

Replica Set - 2

Deployment

```
> kubectl rollout undo deployment/myapp-deployment
```

```
deployment "myapp-deployment" rolled back
```

kubectl run

```
> kubectl run nginx --image=nginx  
deployment "nginx" created
```

Summarize Commands

Create

```
> kubectl create -f deployment-definition.yml --record=true
```

Get

```
> kubectl get deployments
```

Update

```
> kubectl apply -f deployment-definition.yml
```

```
> kubectl set image deployment/myapp-deployment nginx=nginx:1.9.1
```

Status

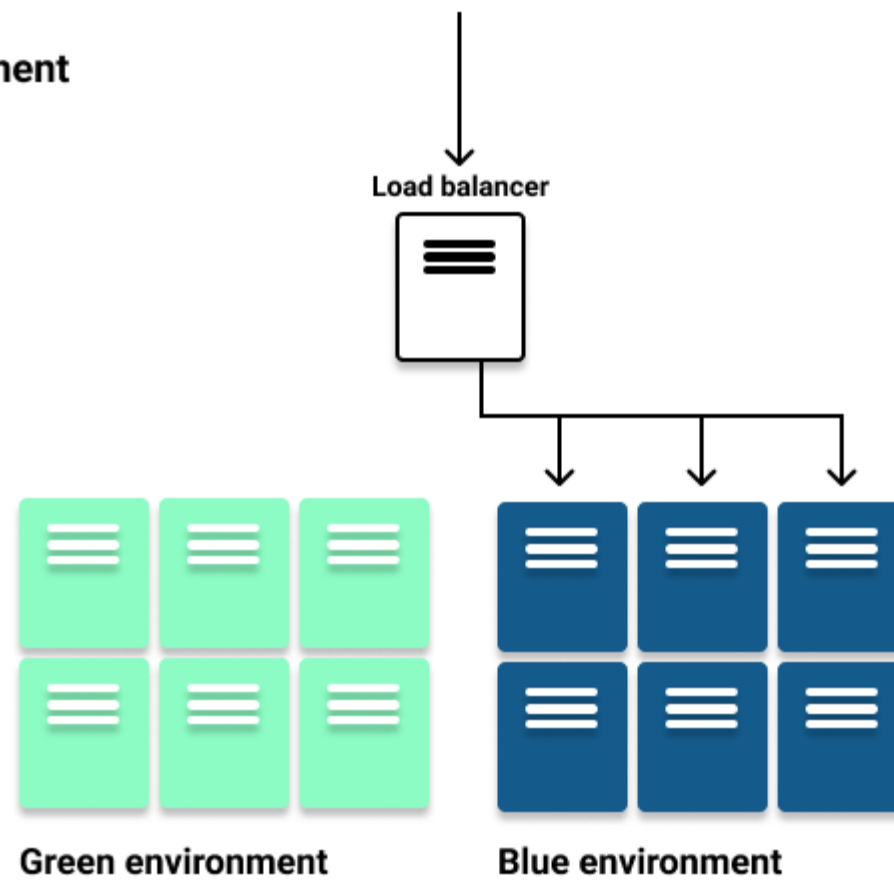
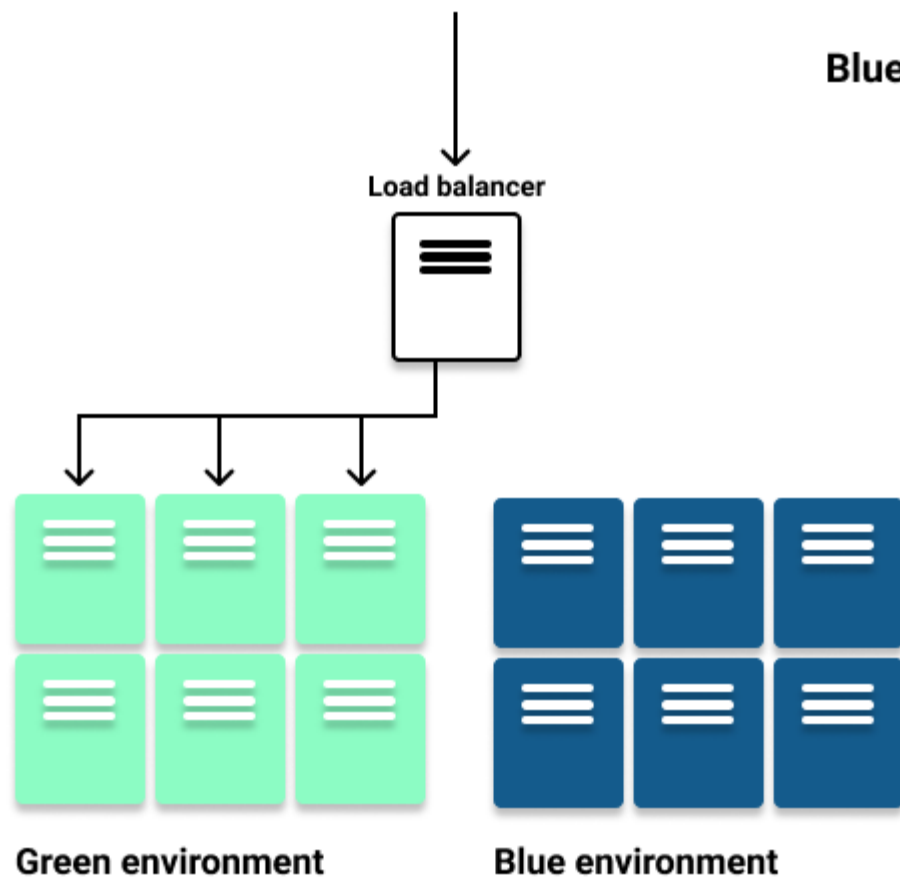
```
> kubectl rollout status deployment/myapp-deployment
```

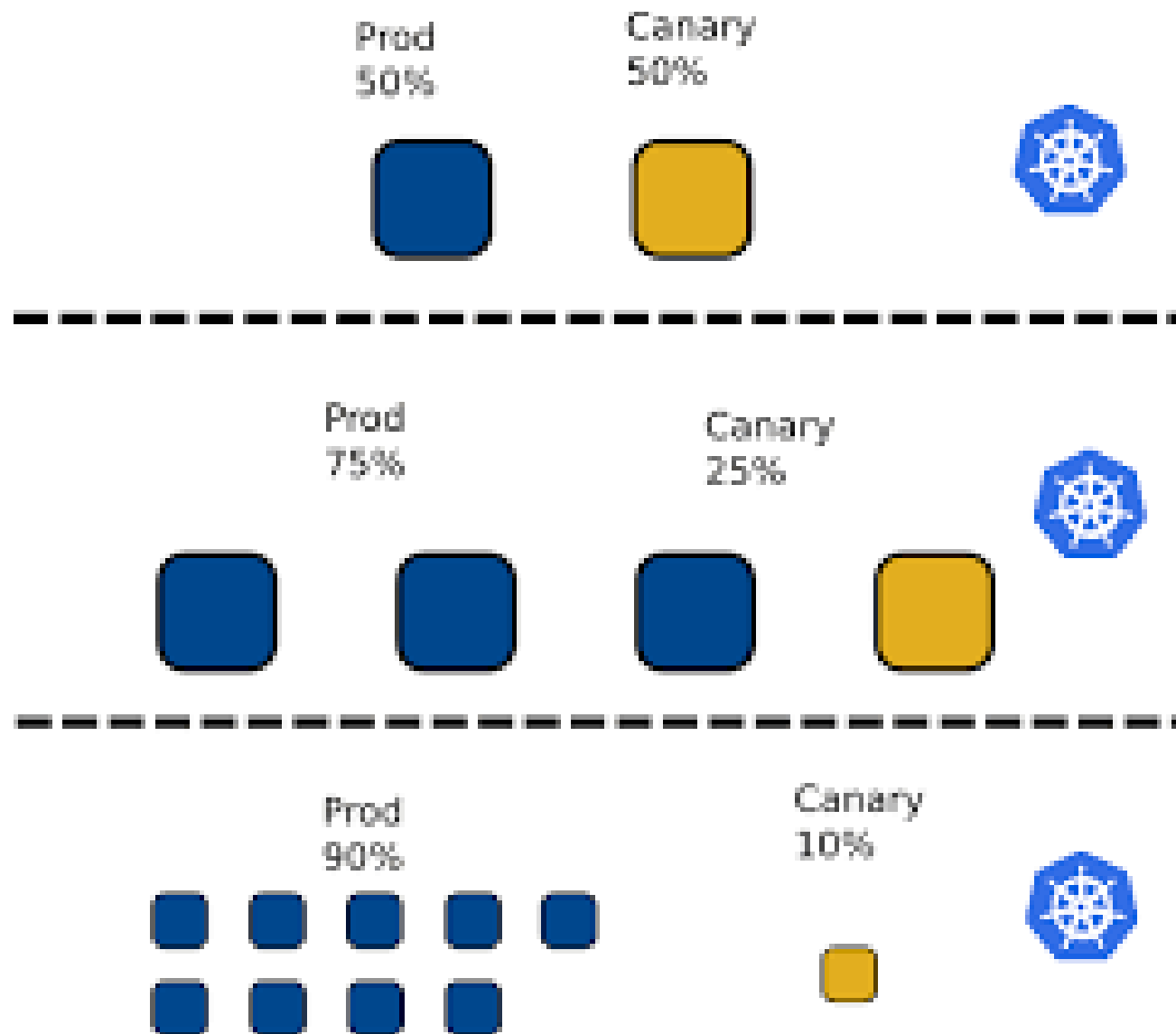
```
> kubectl rollout history deployment/myapp-deployment
```

Rollback

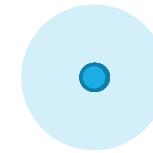
```
> kubectl rollout undo deployment/myapp-deployment
```

Blue green deployment

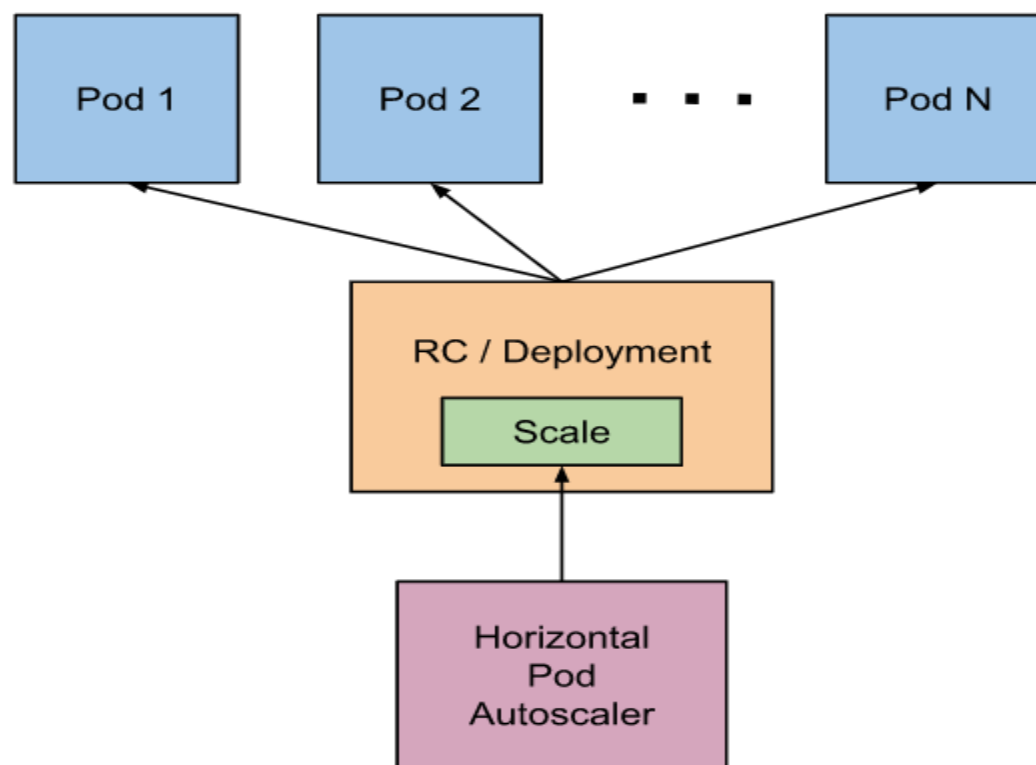




Autoscaling



Autoscaling



Autoscaling

```
kubectl autoscale deployment myapp-deployment --cpu-percent=50 --min=1 --max=10
```

```
kubectl get hpa
```

#but you need to set a metric deployment first otherwise it won't be able to collect the metric

```
kubectl delete hpa myapp-deployment
```

Kubernetes Cluster



Pod



Container



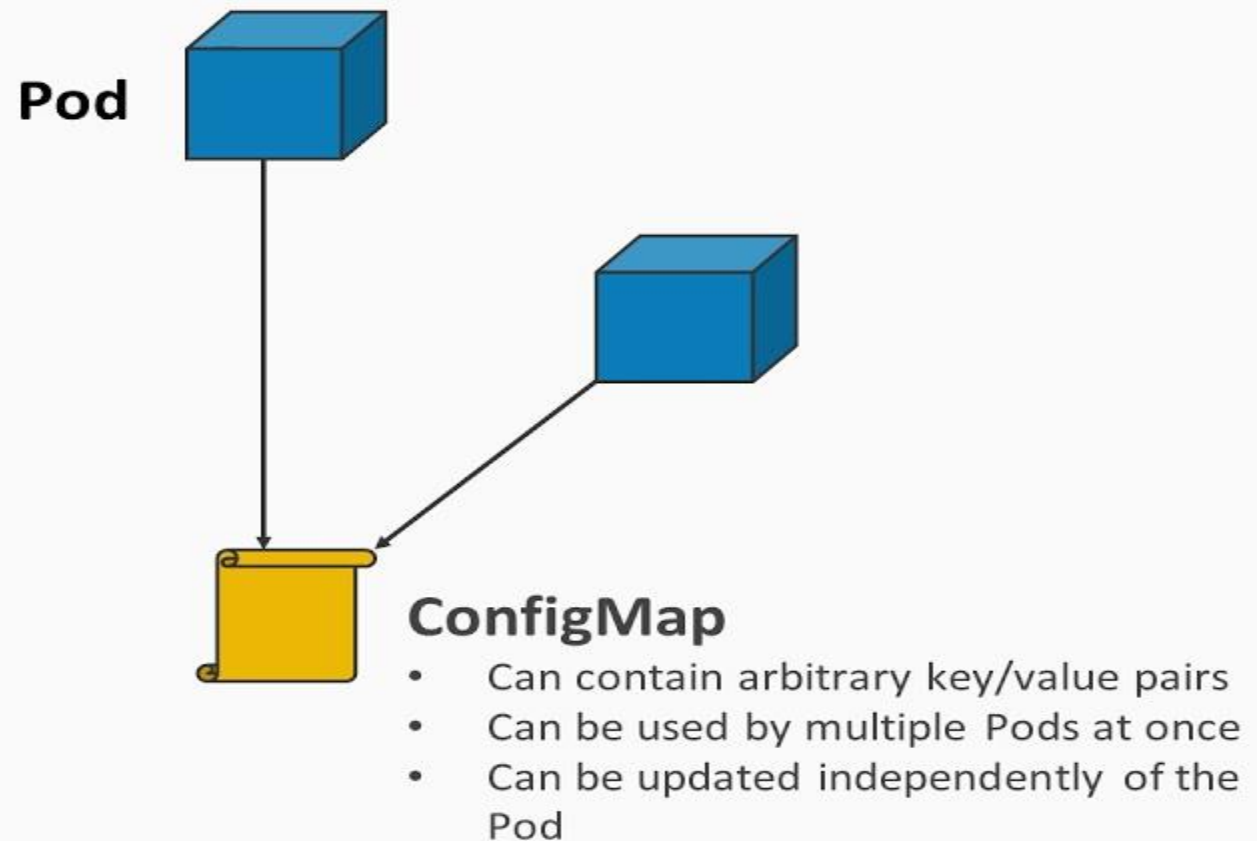
Secret Volume

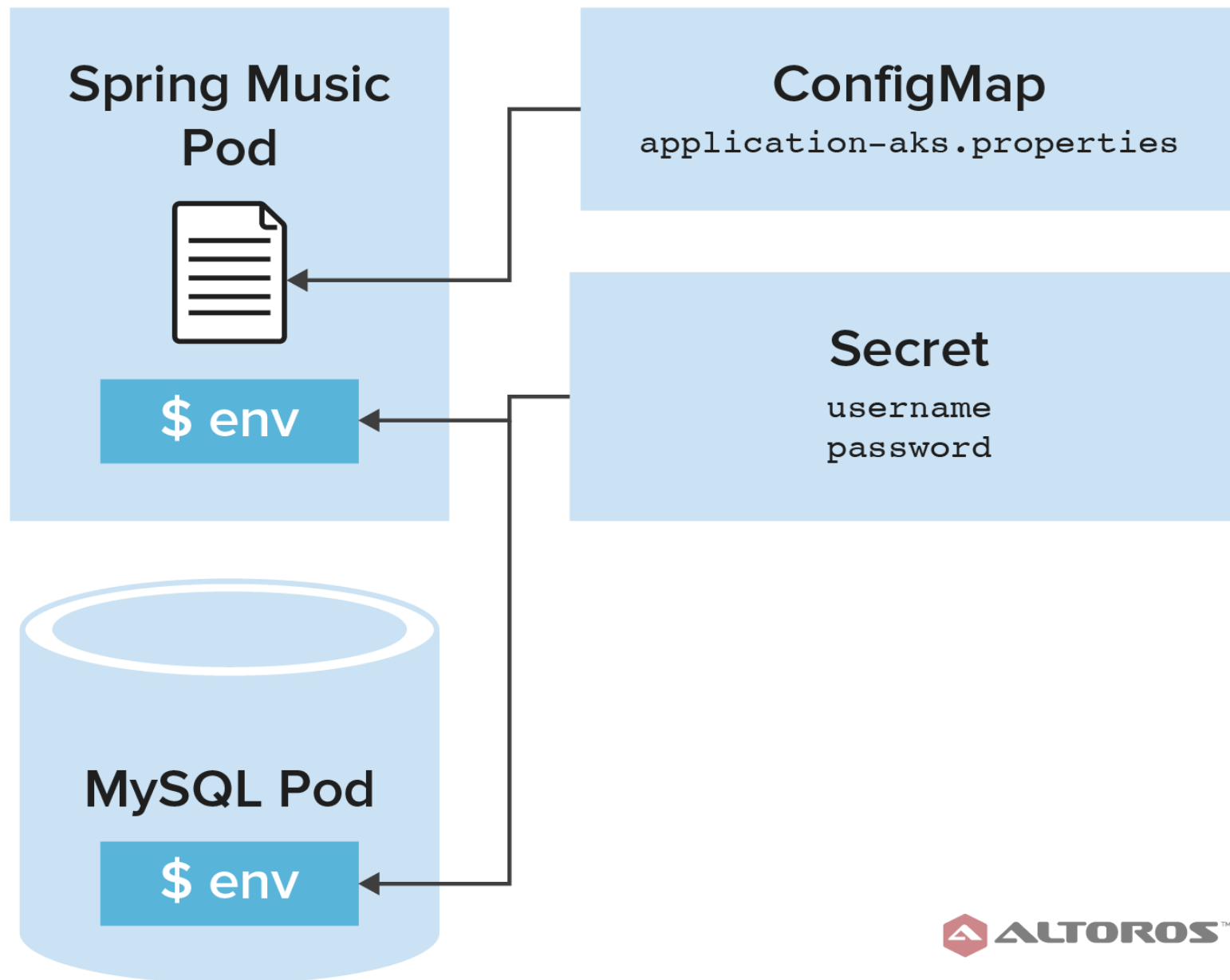
Secret

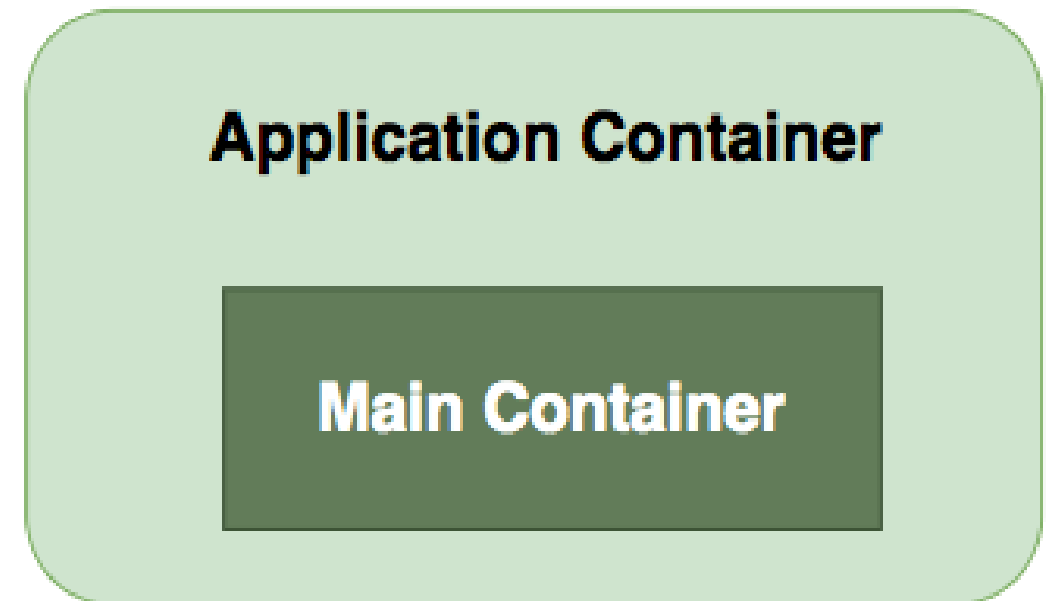
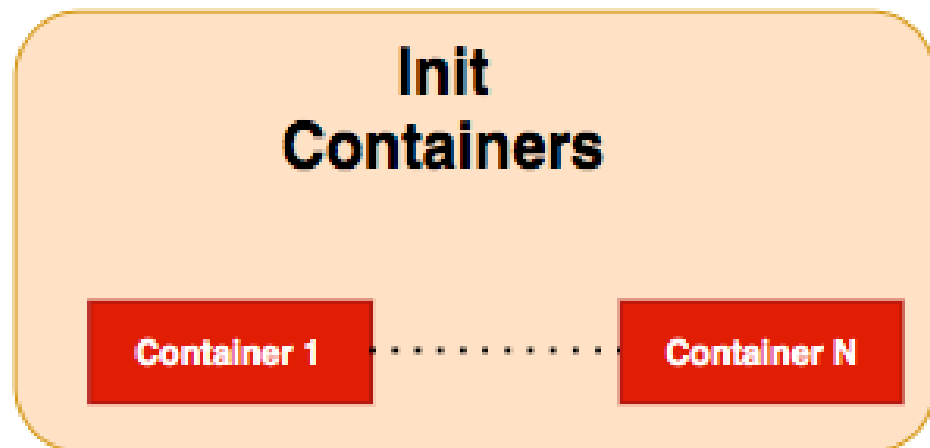


Sensitive Data

Pod Configuration







Main container starts only after Init Container finishes

Pod

PV and PVC

Persistent Storage in Kubernetes

Persistent Storage

A Persistent Volume (PV) is a piece of storage in the cluster that has been provisioned by an administrator or dynamically provisioned using Storage Classes. It is a resource in the cluster just like a node is a cluster resource. PVs are volume plugins like Volumes but have a lifecycle independent of any individual Pod that uses the PV.

A PersistentVolumeClaim (PVC) is a request for storage by a user. It is similar to a Pod. Pods consume node resources and PVCs consume PV resources. Pods can request specific levels of resources (CPU and Memory). Claims can request specific size and access modes (e.g., they can be mounted ReadWriteOnce, ReadOnlyMany or ReadWriteMany)

Access Types and Methods

| Volume Plugin | ReadWriteOnce | ReadOnlyMany | ReadWriteMany |
|----------------------|-----------------------|-----------------------|-----------------------|
| AWSElasticBlockStore | ✓ | - | - |
| AzureFile | ✓ | ✓ | ✓ |
| AzureDisk | ✓ | - | - |
| CephFS | ✓ | ✓ | ✓ |
| Cinder | ✓ | - | - |
| CSI | depends on the driver | depends on the driver | depends on the driver |
| FC | ✓ | ✓ | - |
| FlexVolume | ✓ | ✓ | depends on the driver |
| Flocker | ✓ | - | - |
| GCEPersistentDisk | ✓ | ✓ | - |

Persistent Volume

```
apiVersion: v1
kind: PersistentVolume
metadata:
  name: task-pv-volume
  labels:
    type: local
spec:
  storageClassName: manual
  capacity:
    storage: 10Gi
  accessModes:
    - ReadWriteOnce
  hostPath:
    path: "/mnt/data"
```

Persistent Volume Claim

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



NODE 1

POD

PVC

PV

DISK

PV

DISK

NODE 2

PV

DISK

PV

DISK

NODE 3

POD

PVC

PV

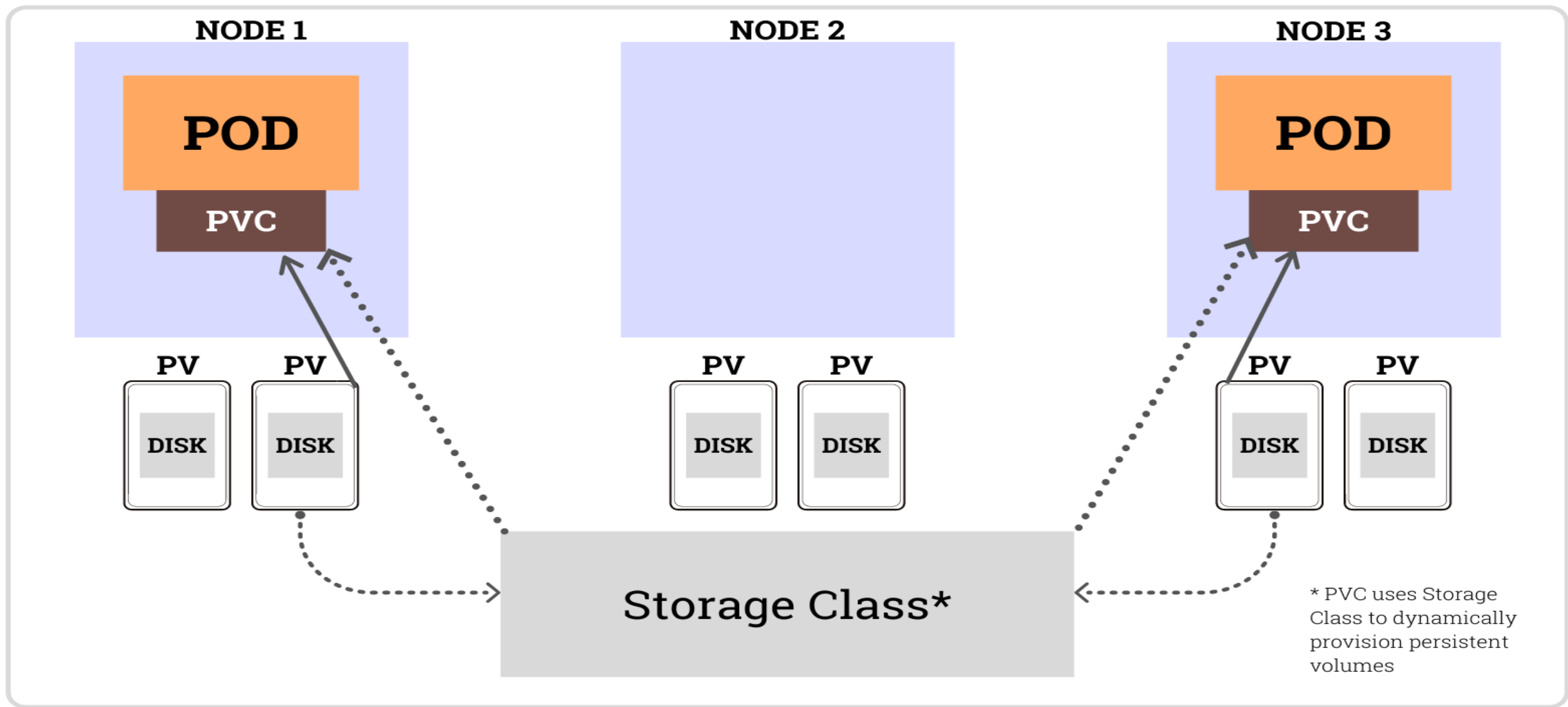
DISK

PV

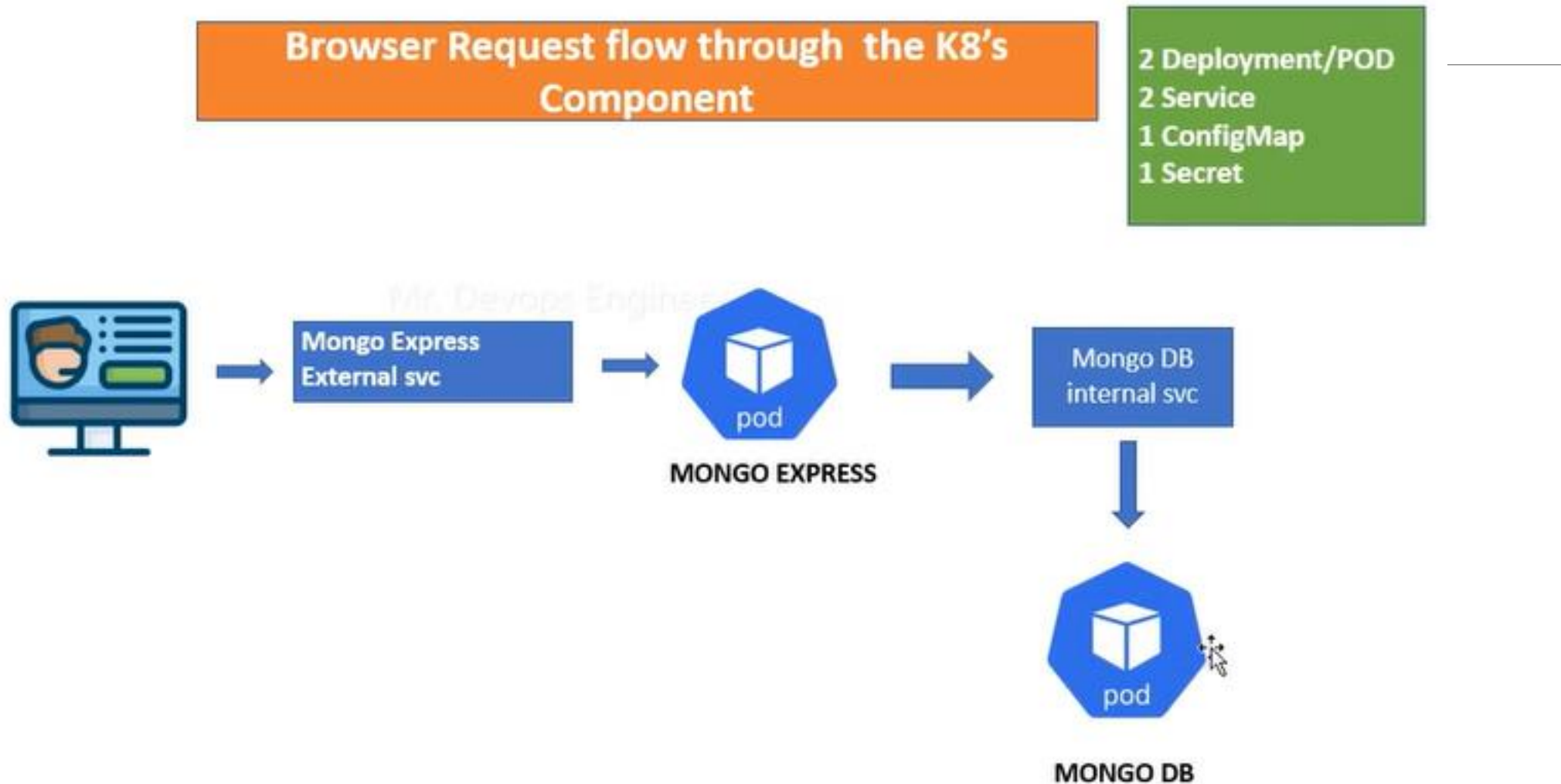
DISK

Storage Class*

* PVC uses Storage Class to dynamically provision persistent volumes

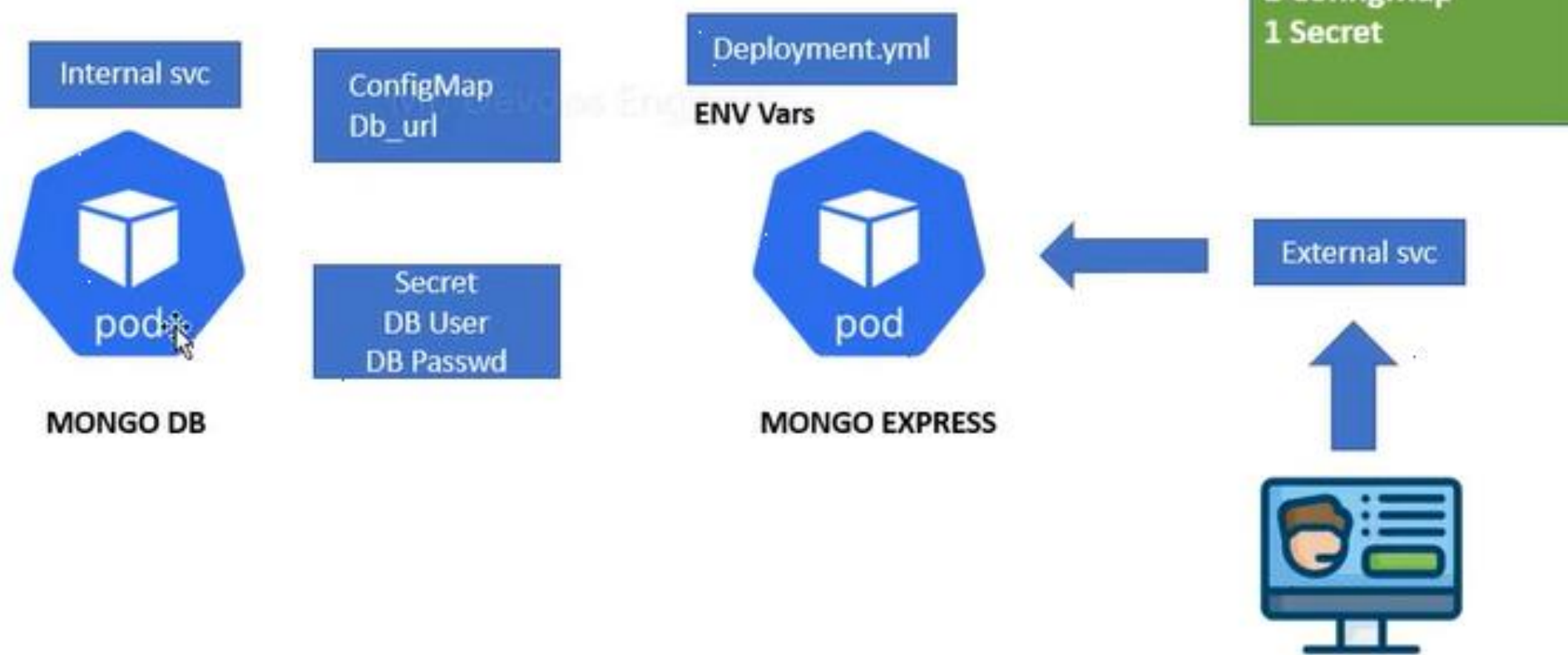


kubernetes_end2end_front-backend

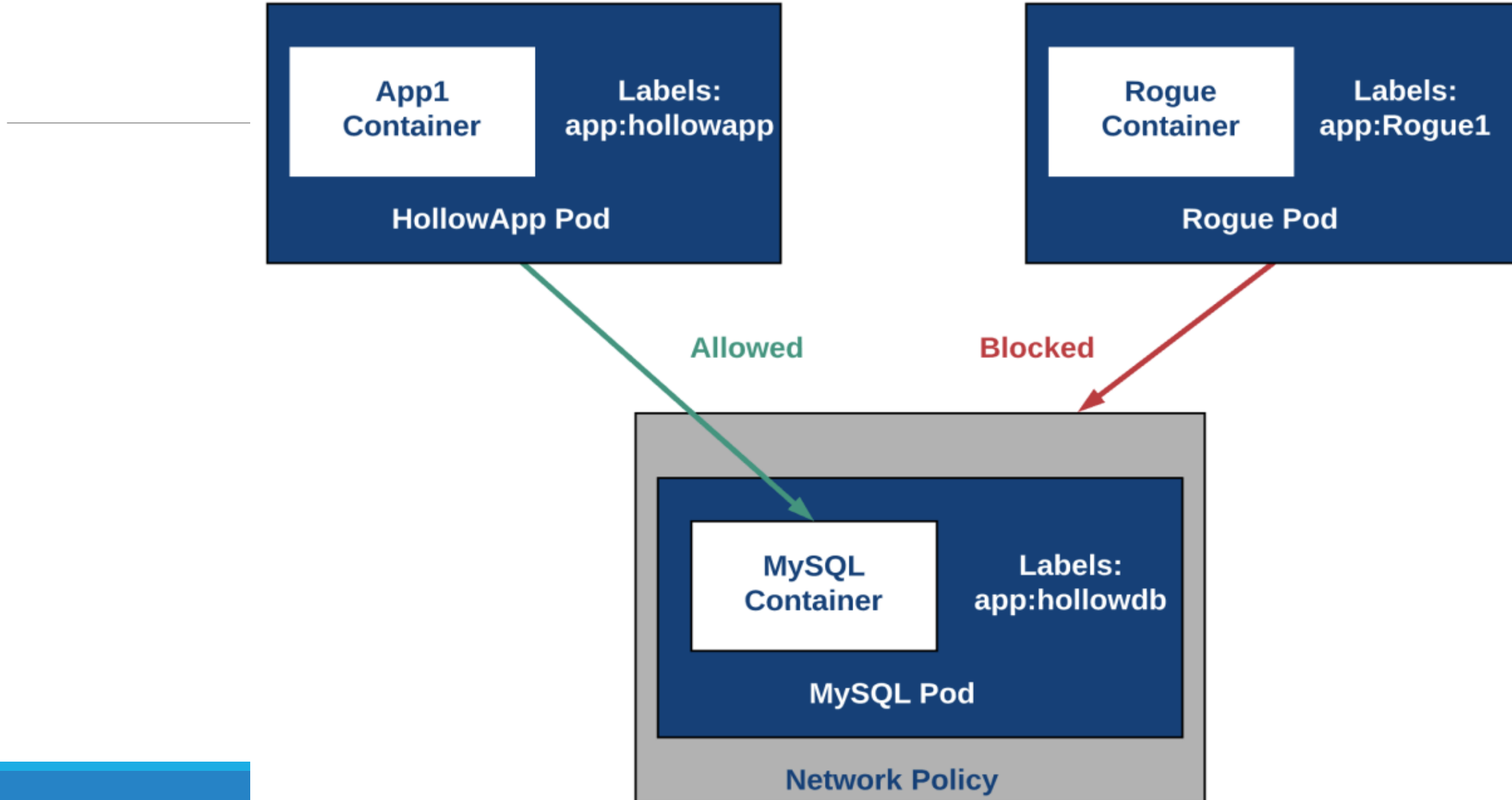




Overview Of K8's Component



Network policy



Kubernetes security best practices

- Follow the Principle of Least Privilege:
- Use RBAC (Role-Based Access Control)
- Avoid giving excessive permissions to pods and containers.
- Keep Kubernetes Up to Date
- Use trusted sources for container images.
- Scan container images for vulnerabilities.
- Regularly update and patch your base images.
- Implement network policies to restrict pod-to-pod communication.
- Use firewall rules and network security groups to control external access to your cluster.
- Expose the API server securely, using TLS.
- Use authentication mechanisms like client certificates or JWT tokens.
- Disable anonymous access.
- Encrypt data at rest in etcd, which is used as Kubernetes' key-value store.
- Implement access controls and authentication for etcd.
- Enforce security policies on pods using PodSecurityPolicies or the newer PodSecurity admission controller.
- Use Kubernetes Secrets for sensitive information.
- Enable audit logging for the Kubernetes API server. Store and monitor these logs for security incidents.

- Implement monitoring and intrusion detection systems like Prometheus, Grafana, and Falco to monitor and alert on cluster activities.
- Avoid running containers as privileged.
- Isolate the worker nodes in your cluster to prevent unauthorized access.
- Implement strong access controls to the host machines.
- Regularly scan your cluster for vulnerabilities and perform security audits.
- Consider using third-party security tools and services designed for Kubernetes security. Eg : kube-bench.
- Refer to the Center for Internet Security (CIS) Kubernetes benchmarks for a comprehensive security guide.

Health-checks

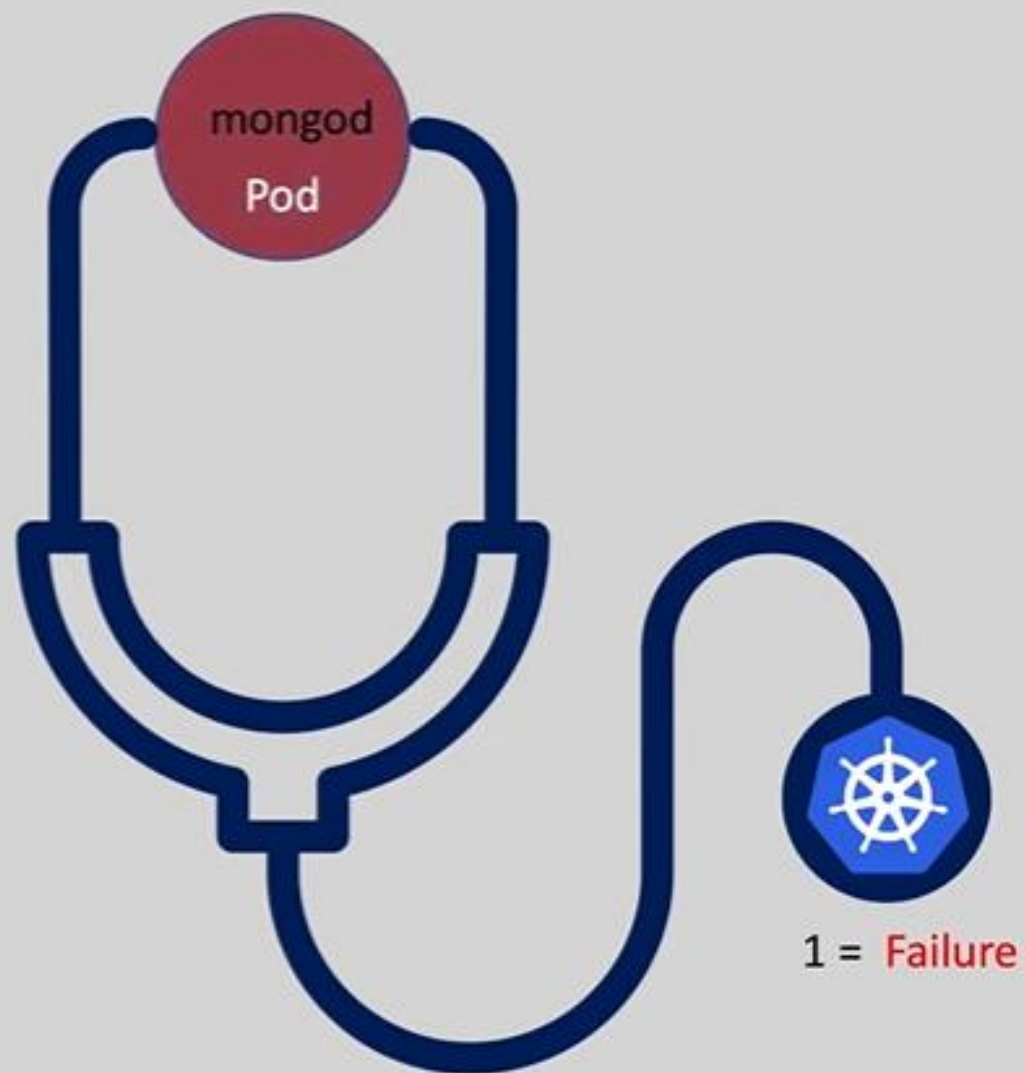
- ✓ **Bugs**
- ✓ **Timeouts while communicating with external service**
- ✓ **DB Connection failure**
- ✓ **OutOfMemory Issues**
- ✓ **Etc..**



- Pods get restarted everytime after **liveliness probe** fails.
- Pods are removed from svc endpoint after **readiness probe** fails.
- If **startup probe** fails , container is killed and follows restart policy which is by default = Always

Liveness Probe:

```
livenessProbe:  
  exec:  
    command:  
      - mongo  
      - --eval  
      - "db.adminCommand('ping')"
```



Probing Mechanisms:

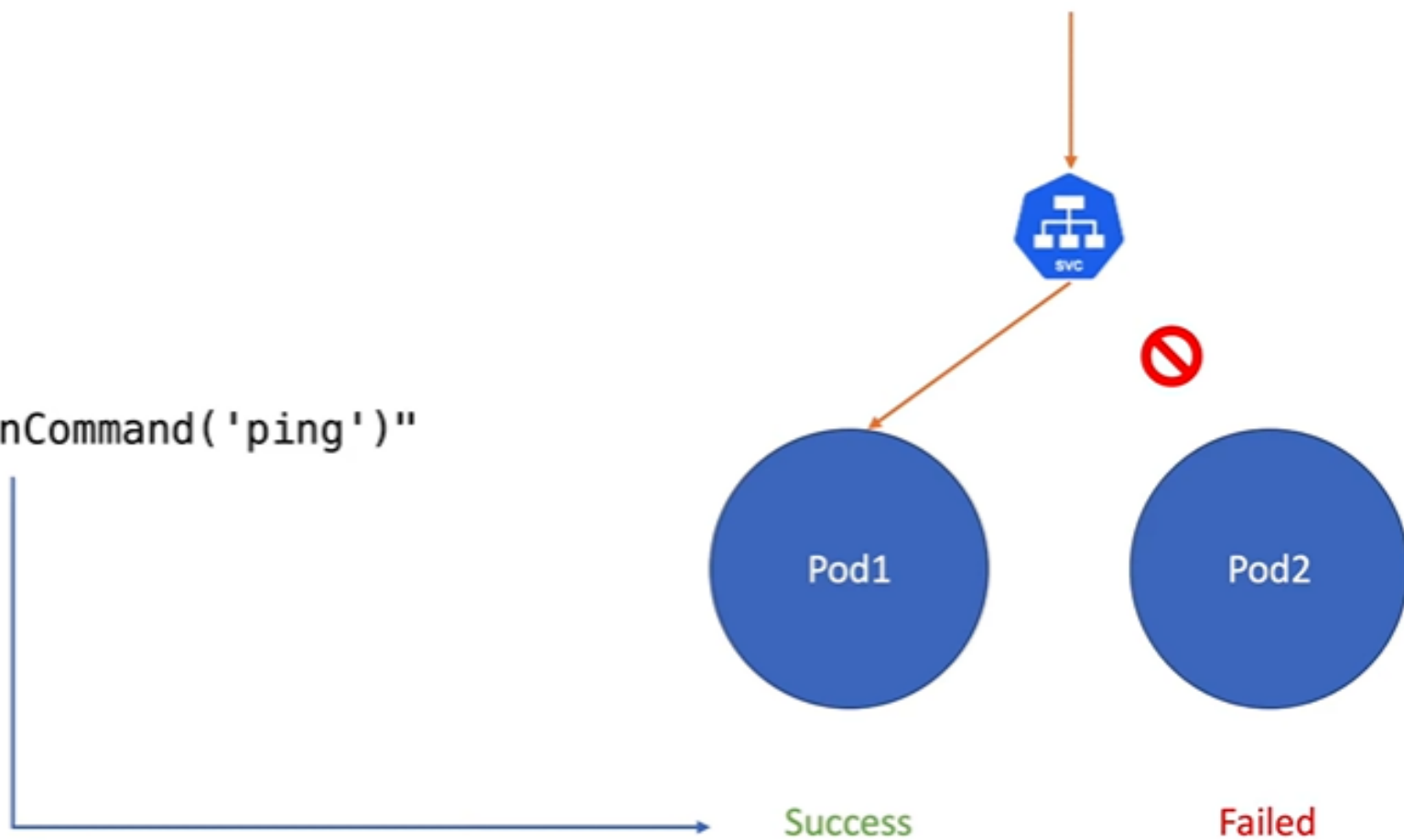
| | Exec | HTTP | TCP |
|---------|--|--|------------------------------------|
| Probe | <pre>exec: command: - mongo - --eval - "db.adminCommand('ping')"</pre> | <pre>httpGet: path: /health port: 8080</pre> | <pre>tcpSocket: port: 8080</pre> |
| Success | 0 | 200-399 | If port accepts traffic |
| Failure | 1 | Other than 200-399 | If port can't accept traffic |

Probing Customization:

| | Purpose | Default Value |
|---------------------------------------|---|---------------|
| <code>initialDelaySeconds</code> | Delay to run the probe initially | 0 seconds |
| <code>periodSeconds</code> | How frequently probe should execute after initial delay | 10 seconds |
| <code>timeoutSeconds</code> | Timeout period to mark as failure | 1 second |
| <code>failure/successThreshold</code> | How many times to retry in case of failure | 3 times |

Readiness Probe:

```
readinessProbe:  
  exec:  
    command:  
      - mongo  
      - --eval  
      - "db.adminCommand('ping')"
```



Startup Probe:

```
startupProbe:  
  exec:  
    command:  
      - mongo  
      - --eval  
      - "db.adminCommand('ping')"
```

