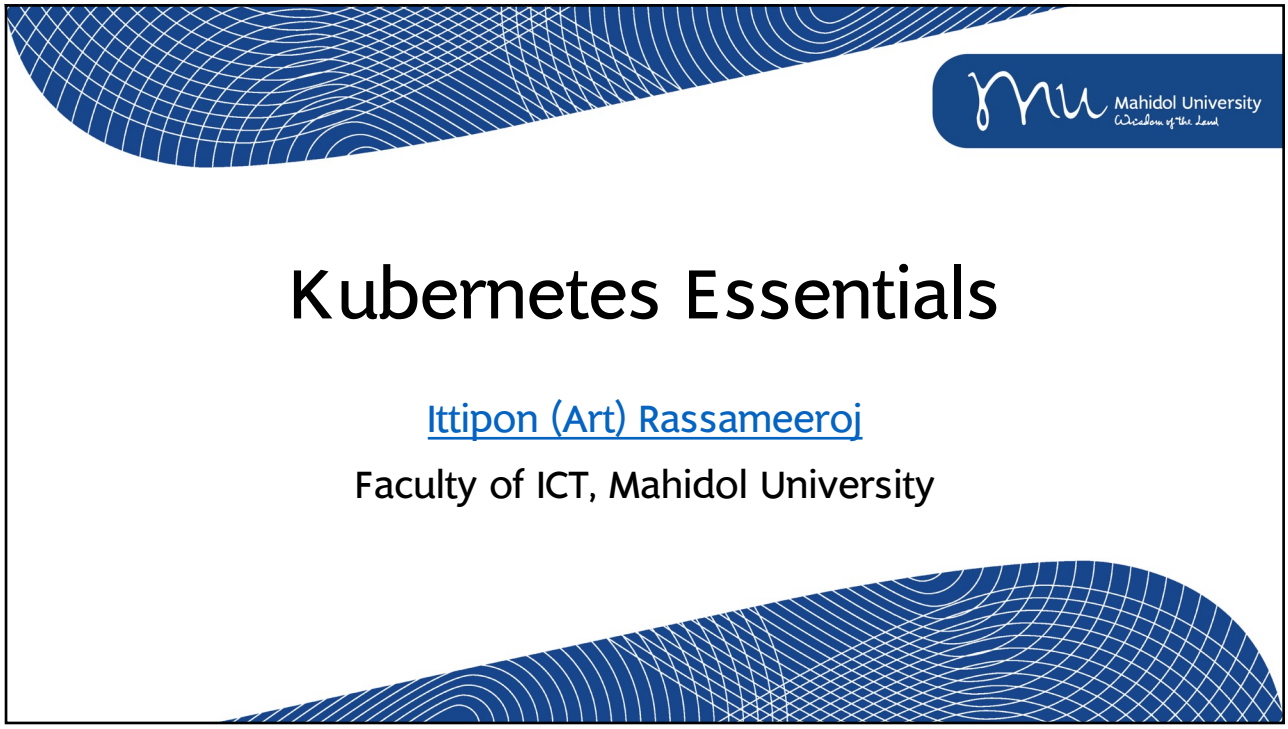
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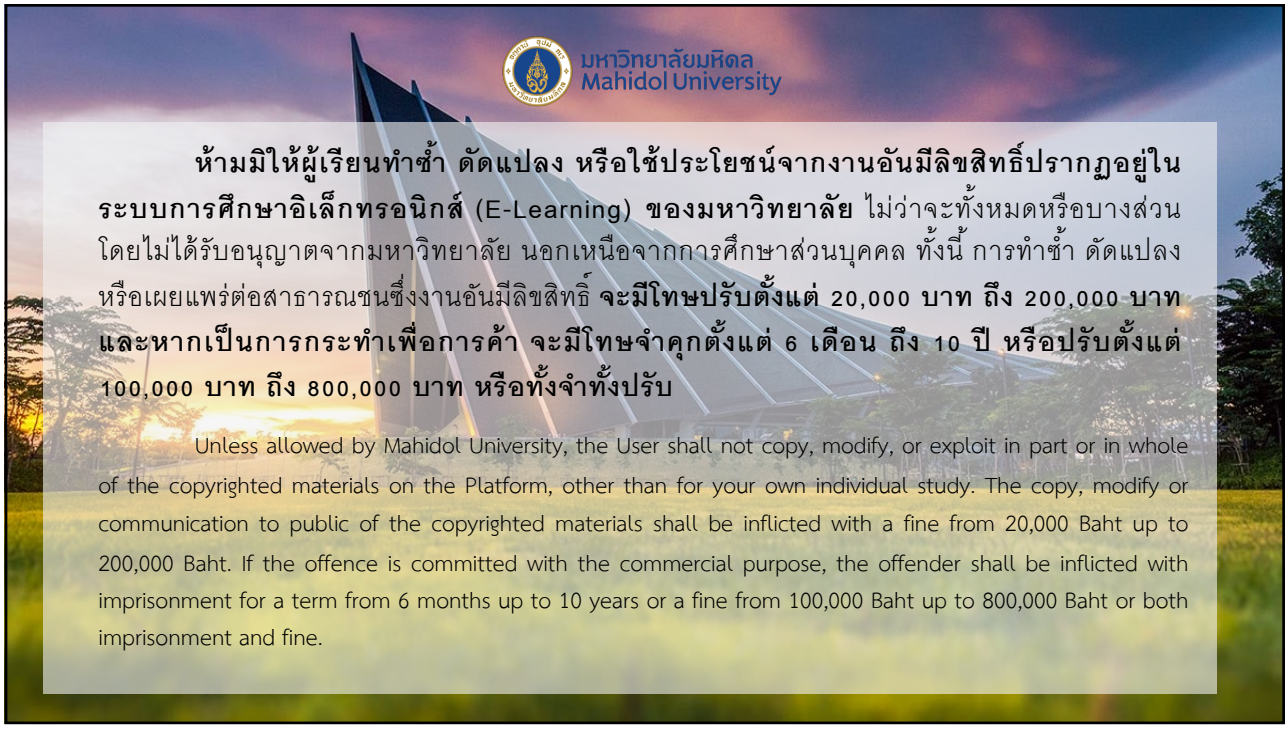
Kubernetes Essentials
Ittipon (Art) Rassameeroj
Faculty of ICT, Mahidol University

1


มหาวิทยาลัยมหิดล
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Agenda

- Why do we need Kubernetes?
- What's Kubernetes?
- Kubernetes architecture
- Kubernetes key features
- Kubernetes basic concepts
- Kubernetes security

3

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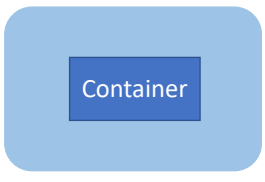
Docker on a Server



Node

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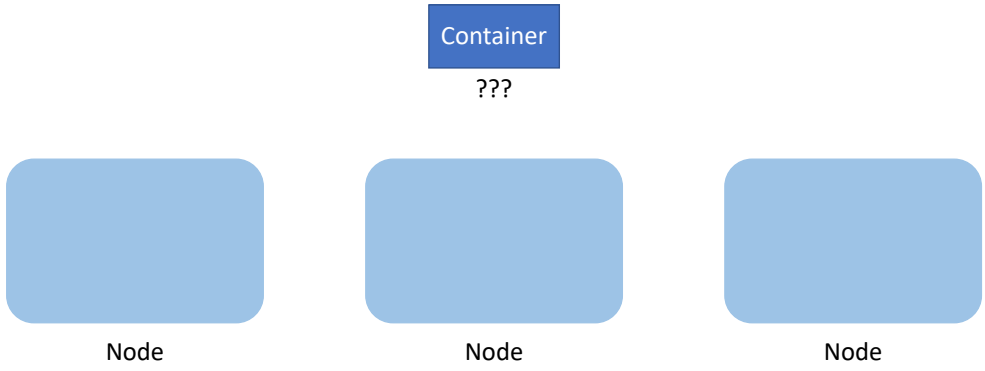
Docker on Multiple Servers



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What is Kubernetes (K8S)?

- Kubernetes, in Greek, means the Helmsman, or pilot of the ship.
- It is pilot of a ship of containers.
- Kubernetes is a software written in Go for automating deployment, scaling, and management of containerized applications.
- Focus on manage applications, not machines.
- Open source, open API container orchestrator
- Supports multiple cloud and bare-metal environments.

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What is Kubernetes (K8S)?

- Inspired and informed by 15 years of Google's experiences and internal systems.
- Kubernetes 1.0 was launched in OSCON 2015
- Kubernetes was based on Google Borg and Omega
- Other systems like Kubernetes are Apache Mesos, Docker Swarm, etc.

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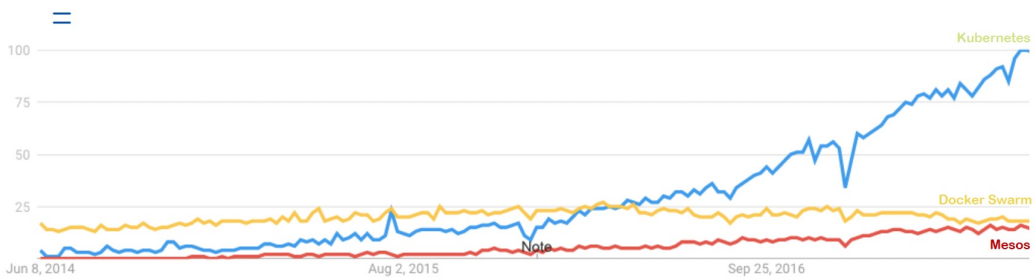
Kubernetes is a Leader



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CLOUD NATIVE COMPUTING FOUNDATION

- https://www.cncf.io
- Controls and manages projects under CNCF.
- Develops and supports related ecosystems.
- Organize events, seminar, training, certification
- In every 3 months approximately, there is a new release of Kubernetes.

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Kubernetes Key Features

- Automatic bin packing
- Self-healing
- Horizontal manual/auto-scaling
- Service discovery & load balancing
- Automated rollouts and rollbacks
- Secret and configuration management
- Storage orchestration
- Batch execution

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Kubernetes Platform

Certified Kubernetes - Distribution

Source: https://landscape.cncf.io

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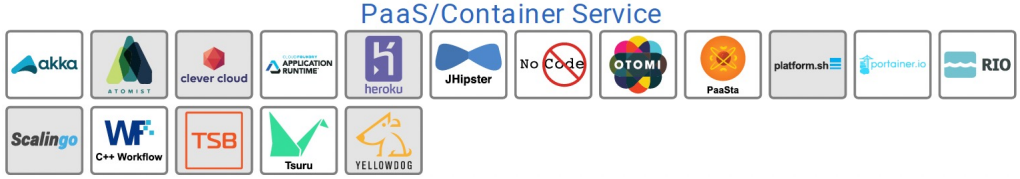
Kubernetes Platform

Certified Kubernetes - Installer

PaaS/Container Service



Source: https://landscape.cncf.io

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Kubernetes Platform

Certified Kubernetes - Hosted

Source: https://landscape.cncf.io

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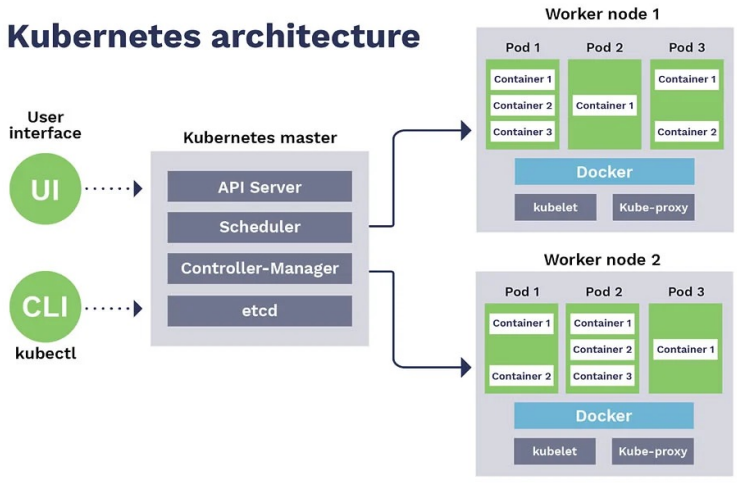
Kubernetes architecture



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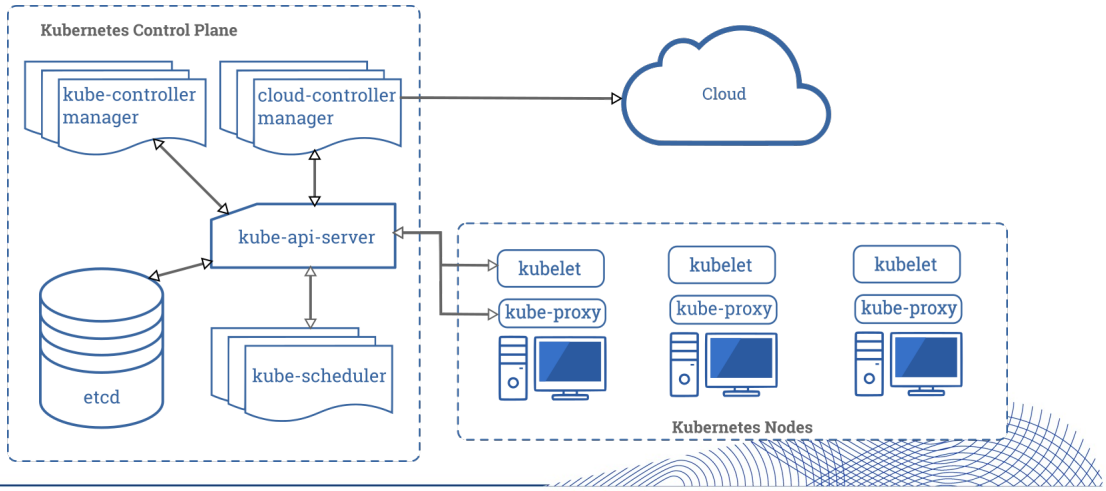
Architecture



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Control Plane

- Kube-api-server
  - Pod, deployments, and the horizontal pod auto-scaler have API endpoints.
  - Kubernetes API has a REST interface.
  - kubectl and kubeadm are CLI tools to communicate with the Kubernetes API via HTTP request.
    - `$ kubectl api-resources`
    - `$ kubectl get pods -n kube-system`
- etcd stores metadata and the cluster status

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Control Plane

- Kubelet
  - An agent that runs on every worker node
  - Makes sure that containers in a pod are running and healthy.
  - Communicates directly with the api-server in the control plane.
- Container runtime
  - A kublet assigned to new pod starts a container using Container Runtime Interface (CRI).
  - CRI enables that kublet to create containers with the engines: Containerd, CRI-O, Kata Containers, AWS Firecracker.

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Control Plane

- Kube-proxy
  - Makes sure pods and services can communicate
  - Each kube-proxy communicates directly with the kube-api-server.
- Kube-scheduler
  - Pods scheduler in worker nodes based on resources availability, requests limit, etc.

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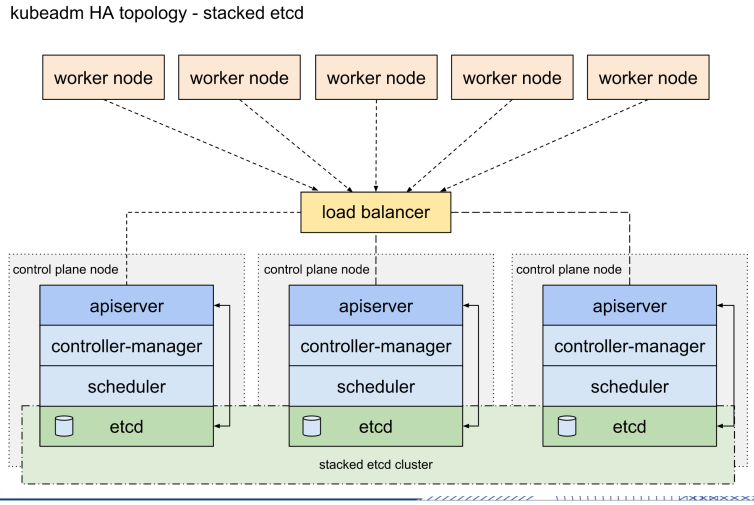
HA Topology – Stacked etcd



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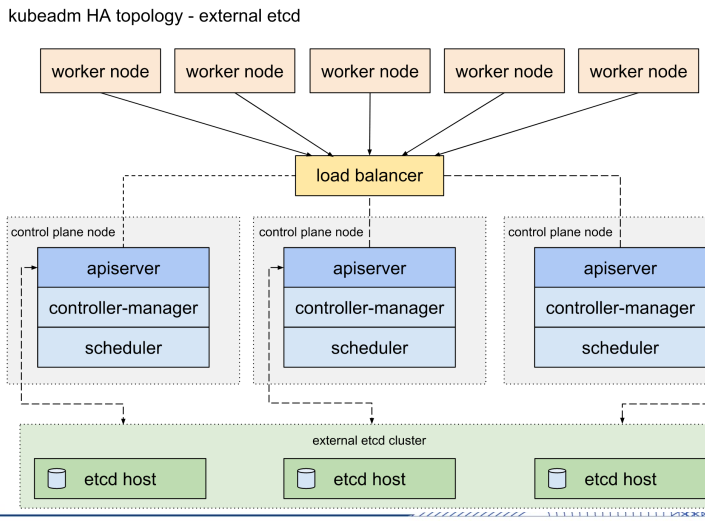
HA Topology – External etcd



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Kubernetes Basic Concept


Manifest File

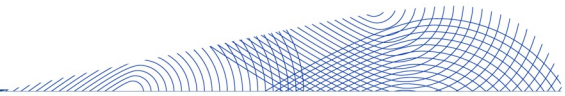

Pod


Deployment


Service


Namespace


Rolling Update



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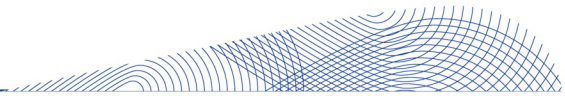
Creating K8S Clusters

- Docker Desktop
  - single-node Kubernetes cluster
- Minikube
  - The official local Kubernetes release.
  - Single node only
- K3d
  - It is much faster than Minikube.
  - It is used for Kubernetes conformance tests.
- KinD
  - It is lightning fast, supports multiple clusters.
  - Supports multiple worker nodes per cluster.



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Lab1: Installation Options

- Docker Desktop: https://www.docker.com/products/docker-desktop/
- Install kubectl: https://kubernetes.io/docs/tasks/tools/
- Install minikube: https://minikube.sigs.k8s.io/docs/start/

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Kubernetes Sandbox

- https://labs.play-with-k8s.com
- It's free!
- Clean up every 4 hours

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YAML

- YAML Ain't Markup Language
- It's often used for configuration files.
- Like a suitcase, YAML lets you package and pick up your data and take it to another location and unload it without requiring anything extra from the developer.

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YAML

XML	JSON	YAML

<Servers>
<Server>
<name>Server1</name>
<owner>John</owner>
<created>05232023</created>
<status>active</status>
</Server>
</Servers>
	{
	Servers: [
	{
	name: Server1,
	owner: John,
	created: 05232023,
	status: active,
	}
	]
	}
		Servers:
		- name: Server1
		owner: John
		created: 05232023
		status: active

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YAML

Key Value Pair	Array/Lists	Dictionary/Map
Fruit: Apple Vegetable: Carrot Liquid: Water Meat: Chicken	Fruits: - Orange - Apple - Banana Vegetables: - Carrot - Cauliflower - Tomato	Banana: Calories: 105 Fat: 0.4 g Carbs: 27 g Grapes: Calories: 62 Fat: 0.3 g Carbs: 16 g

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YAML

Key value + dictionary + lists

```
Fruits:
    - Banana:
        Calories: 105
        Fat: 0.4 g
        Carbs: 27 g
    - Grape:
        Calories: 105
        Fat: 0.3 g
        Carbs: 16 g
```

Notes:

- Ordering
  - Dictionary = unordered
  - List = ordered
- Comment = #

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Kubernetes Manifest File

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

Infrastructure as code (IaC)

Kind	Version
Pod	v1
Service	v1
ReplicaSet	apps/v1
Deployment	apps/v1

Syntax Checker:

https://yamlchecker.com/

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Basic Commands

- `kubectl get all`
- `kubectl get pods`
- `kubectl get services`
- `kubectl apply -f myfile.yml`
- `kubectl get services`
- `kubectl logs mypod`
- `kubectl delete pod mypod`
- `kubectl delete replicaset myapp_replicaset`
- `kubectl delete service myservice`
- `kubectl delete pod --all`
- `kubectl delete service -all`
- `kubectl delete all --all`

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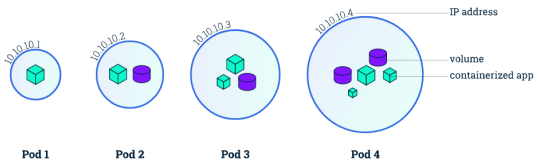
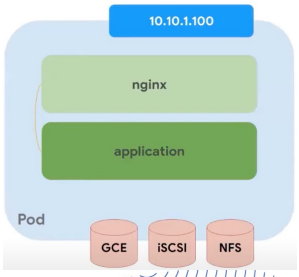
Pod

- A pod is a smallest unit.
- Logical application
  - One or more containers and volumes
  - Shared namespaces
  - One IP per pod
- Resources are shared among containers in a pod.
- Each pod has unique ID (UID)





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Pod

- We normally create a pod by Deployment, Job, or StatefulSet.
- Sidecar: a container provides a service, and other container is responsible for updating data in the first container
- We can do horizontal scaling by increasing a number of pods
- When a node fail, scheduler will create a pod for that.

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Lab 2: Creating a Pod

- Create a pod containing Nginx container using command

```
kubectl run nginx --image=nginx
kubectl get pods
kubectl get pods -o wide
```

- Delete the pod that we just created

```
kubectl delete pod podname
```

- Create a pod contained Nginx container using nginx.yaml file

```
kubectl create -f nginx.yaml
```

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

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Pod

```
> 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:           172.17.0.24
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
```

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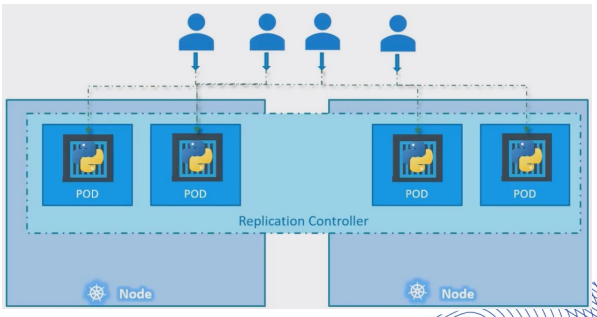
Replica Controller & Replica Set

- Replication Controller (the old one) is replaced by Replica Set
- High availability, load balancing, and scalability



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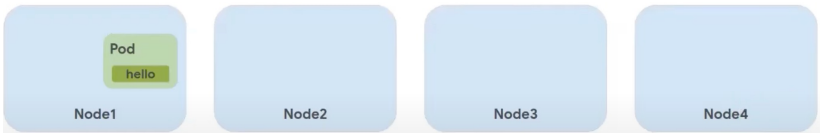
Deployment

```
app: hello
replicas: 1
```



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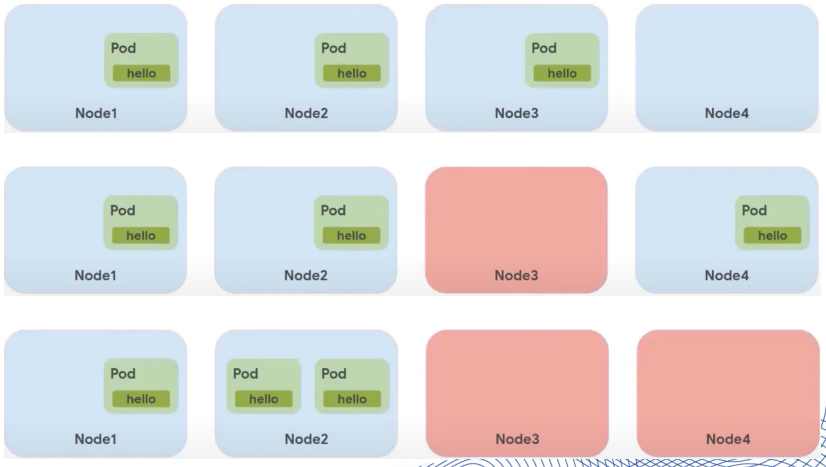
Deployment

```
app: hello
replicas: 3
```



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ReplicaSets

replicaset-definition.yml

```yaml
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
```

```
> kubectl create -f replicaset-definition.yml
replicaset "myapp-replicaset" deleted

> kubectl get replicaset
NAME            DESIRED   CURRENT   READY     AGE
myapp-replicaset   3         3         3         19s

> kubectl get pods
NAME                   READY     STATUS    RESTARTS   AGE
myapp-replicaset-9dd19   1/1       Running   0          45s
myapp-replicaset-9jtpx   1/1       Running   0          45s
myapp-replicaset-hq84m   1/1       Running   0          45s
```

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Scaling

replicaset-definition.yml

```yaml
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
```

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

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

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

TYPE NAME

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Lab 3: Replica Sets

- Create a replica set as 3 using a yaml file (replica-definition.ymal) based Nginx container in Lab 2 as a template
- Try to delete one pod and check what happen
- Create a new pod with nginx.yaml file (in Lab 2) and with the same existing label of replicaset
- Change replicaset to 4 then check a number of pods you have by:

  `kubectl edit replicaset myapp-replicaset`
- Change replicaset to 2 then check a number of pods you have

  `kubectl scale replicaset myapp-replicaset --replicas=2`

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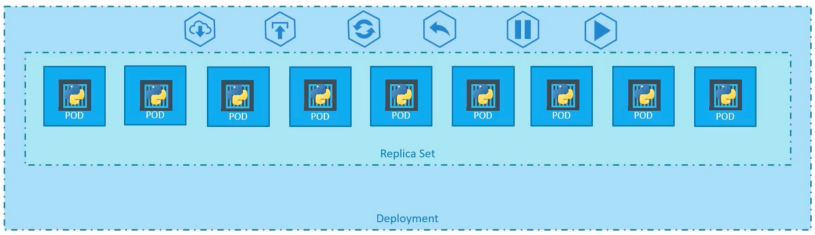
Deployment

- Deployment is used to define how many duplicated pods we want in our application, how upgrading/updating, how rolling back
- Services enables other applications from outside to connect to our application.



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Deployment Definition

deployment-definition.yml

```yaml
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
```

```
> 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-6795844b58-5rbjl   1/1     Running   0          2m
myapp-deployment-6795844b58-h4w55   1/1     Running   0          2m
myapp-deployment-6795844b58-1fjhv   1/1     Running   0          2m
```

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Deployments, Replica Sets, and Pods

```
> 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-lfjhv      1/1     Running   0          9h
```

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Lab 4: Creating a Deployment

- Create deployment.yaml file
- `kubectl create -f deployment.yaml`
- `kubectl get delployments`
- `kubectl get pods`
- `kubectl describe deployment myapp-deployment`
- `kubectl get all`

```yaml
apiVersion: apps/v1
kind: Deployment
metadata:
  name: myapp-delopment
  labels:
    tier: frontend
    app: nginx
spec:
  selector:
    matchLabels:
      app: myapp
  replicas: 3
  template:
    metadata:
      name: nginx-2
      labels:
        app: myapp
    spec:
      containers:
        - name: nginx
          image: nginx
```

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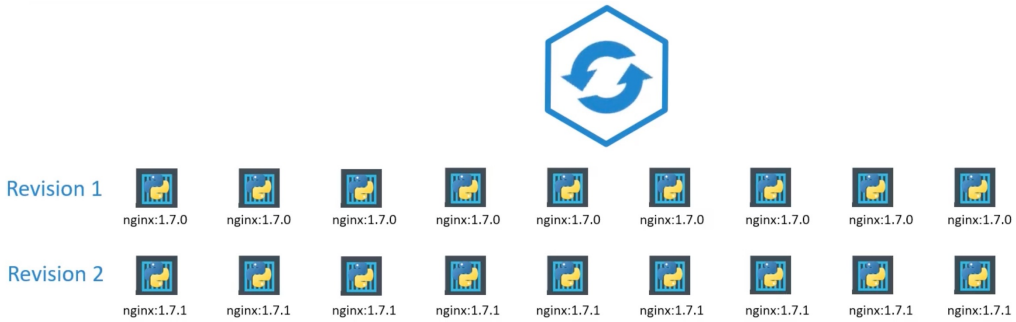
Rollout and Update



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Rollout Commands

```
> 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
```

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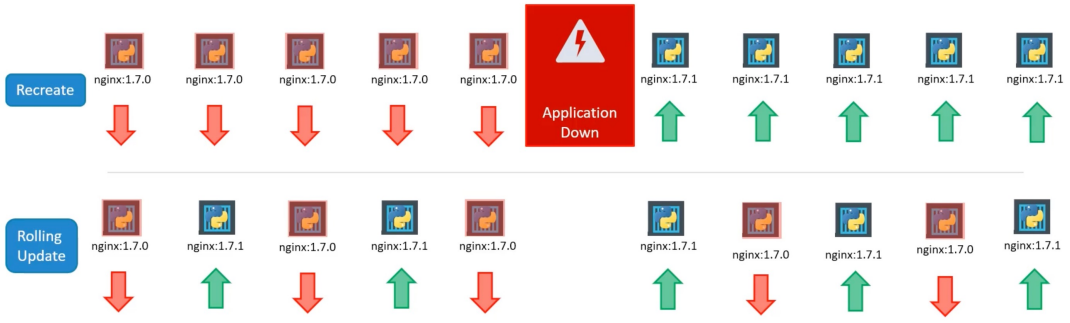
Deployment Strategies



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Deployment Approaches

deployment-definition.yml

```yaml
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
```

```
> 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
```


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```
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","m
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","metadat
Files\\Google...
                        kubernetes.io/change-cause=kubectl apply --filename=d:\Mumshad Files\Google Drive\Udemy\Kubernetes\De
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

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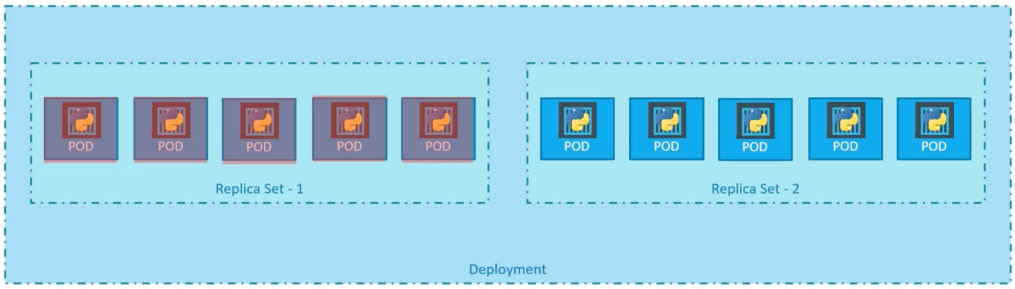
Upgrading




```
> kubectl get replicasets
NAME                          DESIRED   CURRENT   READY   AGE
myapp-deployment-67c749c58c   0         0         0       22m
myapp-deployment-7d57dbdb8d   5         5         5       20m
```

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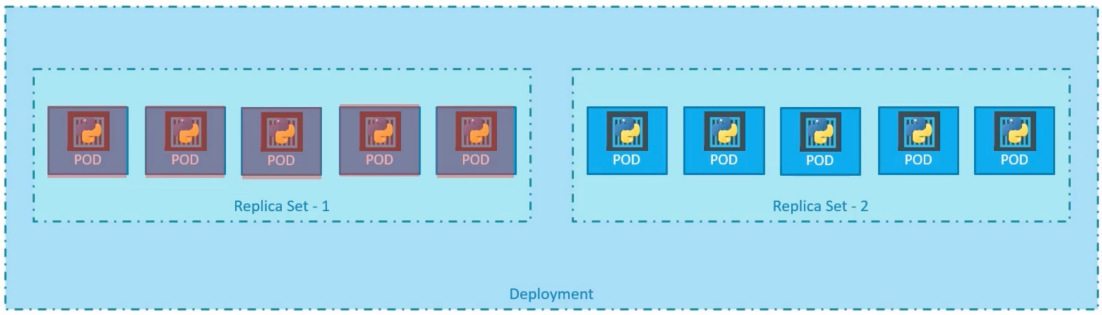
Rollback




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

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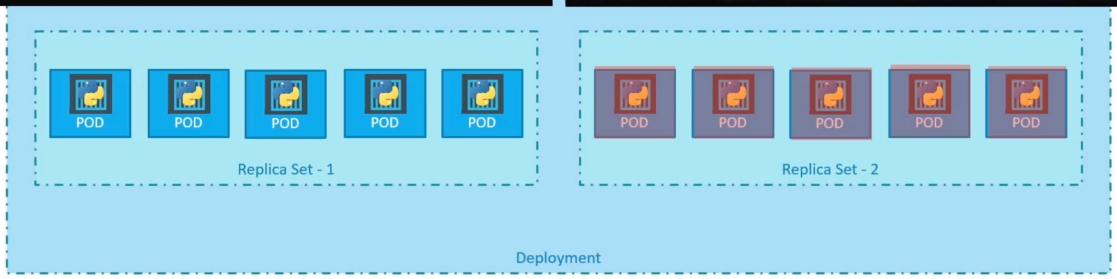
Rollback

```
> kubectl get replicasets
NAME                          DESIRED   CURRENT   READY   AGE
myapp-deployment-67c749c58c   0         0         0       22m
myapp-deployment-7d57dbdb8d   5         5         5       20m
```

```
> kubectl get replicasets
NAME                          DESIRED   CURRENT   READY   AGE
myapp-deployment-67c749c58c   5         5         5       22m
myapp-deployment-7d57dbdb8d   0         0         0       20m
```




```
> kubectl rollout undo deployment/myapp-deployment
deployment "myapp-deployment" rolled back
```

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Command Summary

- `kubectl run nginx --image=nginx`
- `kubectl create -f deployment-definition.yml`
- `kubectl get deployments`
- `kubectl apply -f deployment-definition.yml`
- `kubectl set image deployment/myapp-deployment nginx=nginx:1.9.1`
- `kubectl rollout status deployment/myapp-deployment`
- `kubectl rollout history deployment/myall-deployment`
- `kubectl rollout undo deployment/myapp-deploy`

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Lab 5: Update & Rollback

- Create rollout deployment from deployment.yaml (in Lab 4) and check rollout status.
- Downgrade Nginx image to a lower version (e.g., 1.18)
- Downgrade Nginx image to a lower version (e.g., 1.18-perl) by using different approach from the previous
- Undo Nginx to the previous version (e.g., 1.18)
- Try to change Nginx image to any not existing name and see what happen

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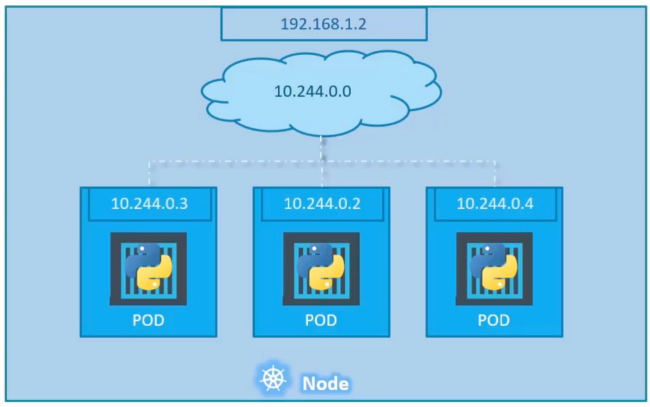
Networking



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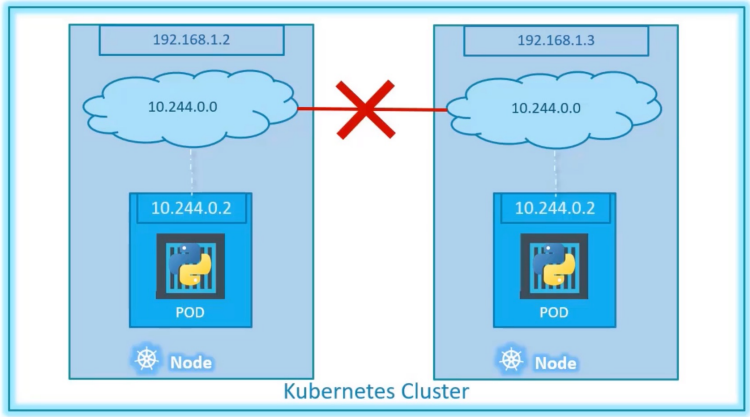
Cluster Networking



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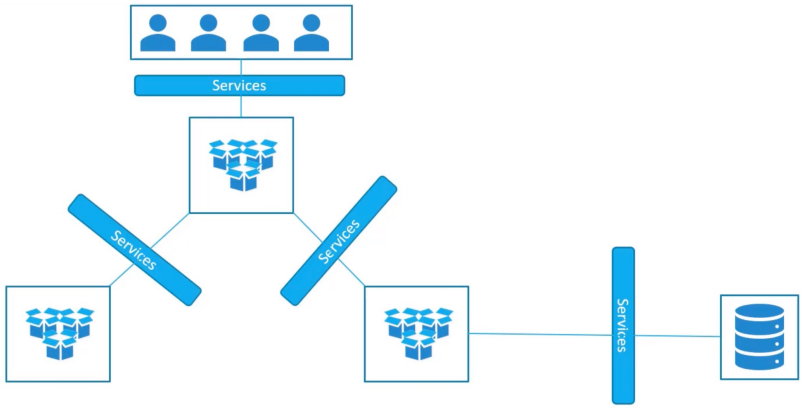
Service



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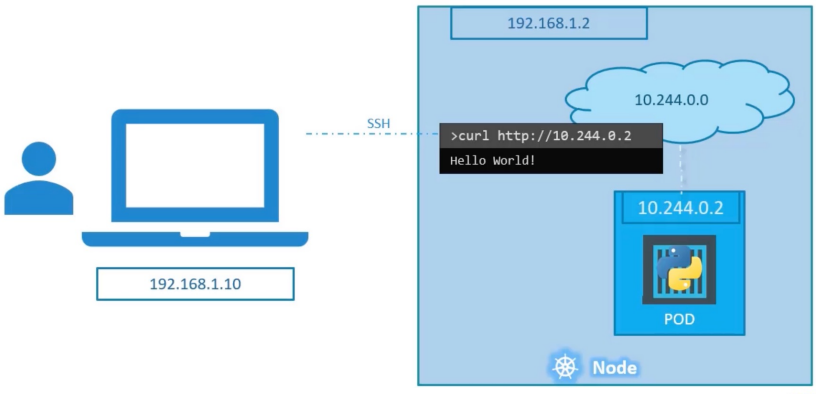
Service Use Case



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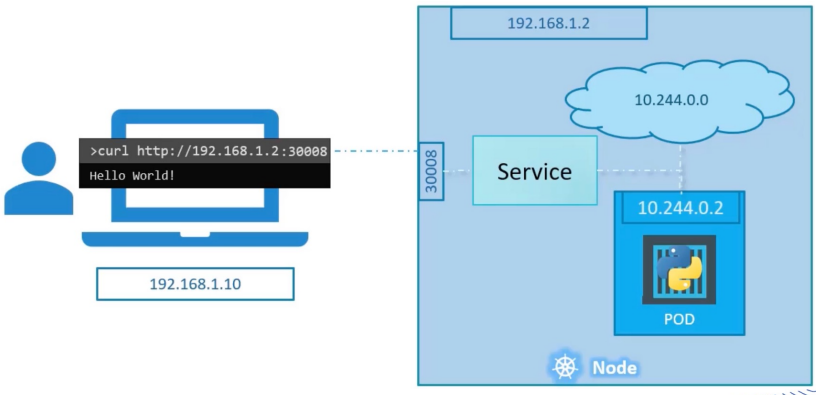
Service Use Case



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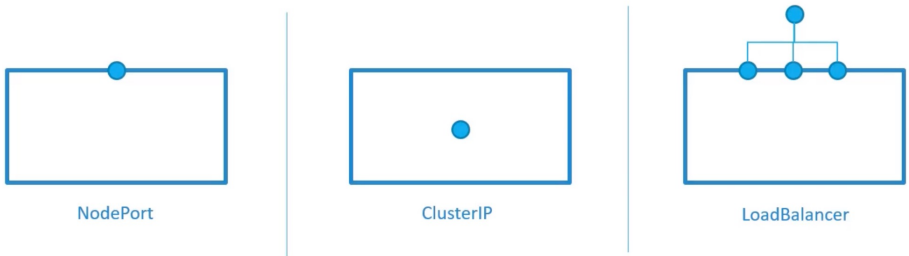
Service Types



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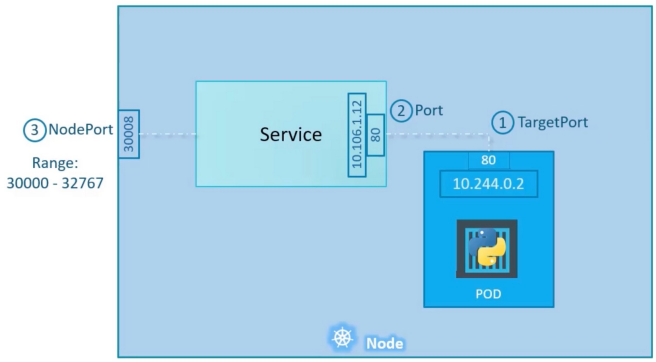
NodePort



service-definition.yml

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

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

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NodePort

service-definition.yml

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

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

pod-definition.yml

```yaml
apiVersion: v1
kind: Pod

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

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NodePort

service-definition.yml

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

spec:
    type: NodePort
    ports:
     - targetPort: 80
       port: 80
       nodePort: 30008
    selector:
       app: myapp
       type: front-end
```

pod-definition.yml

```yaml
apiVersion: v1
kind: Pod

metadata:
 name: myapp-pod
 labels:


spec:
  containers:
  - name: nginx-container
    image: nginx
```

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NodePort

```
> 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
```

```
> 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>
```

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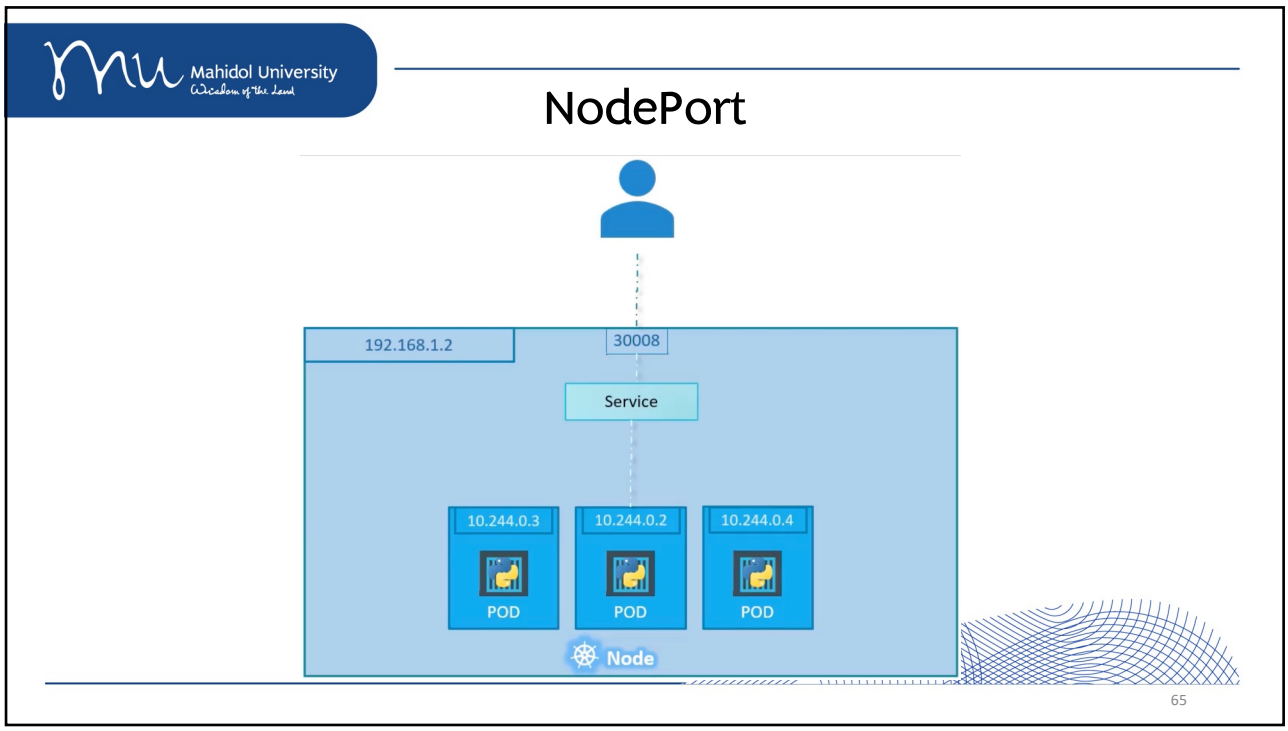
Mahidol University
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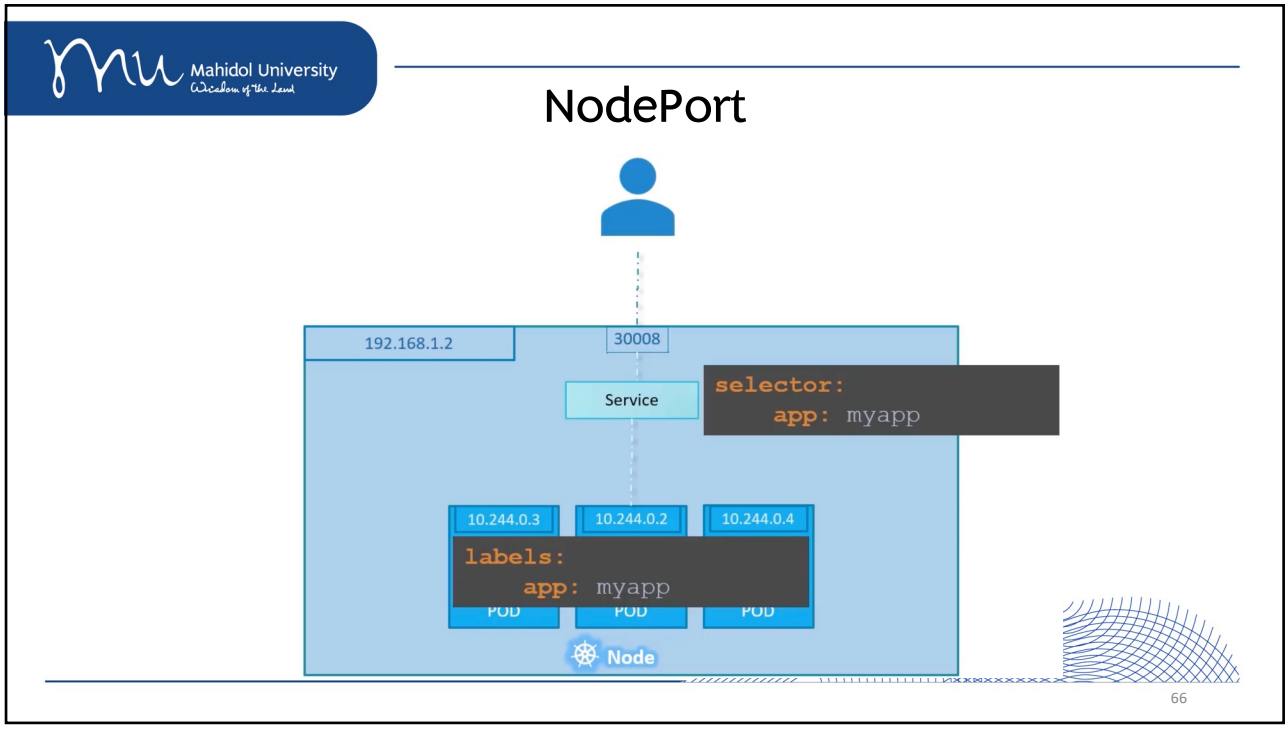
NodePort
192.168.1.2
30008
Service
10.244.0.3
10.244.0.2
10.244.0.4
POD
POD
POD
Node
65

65


Mahidol University
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NodePort
192.168.1.2
30008
Service
selector:
app: myapp
10.244.0.3
10.244.0.2
10.244.0.4
labels:
app: myapp
POD
POD
POD
Node
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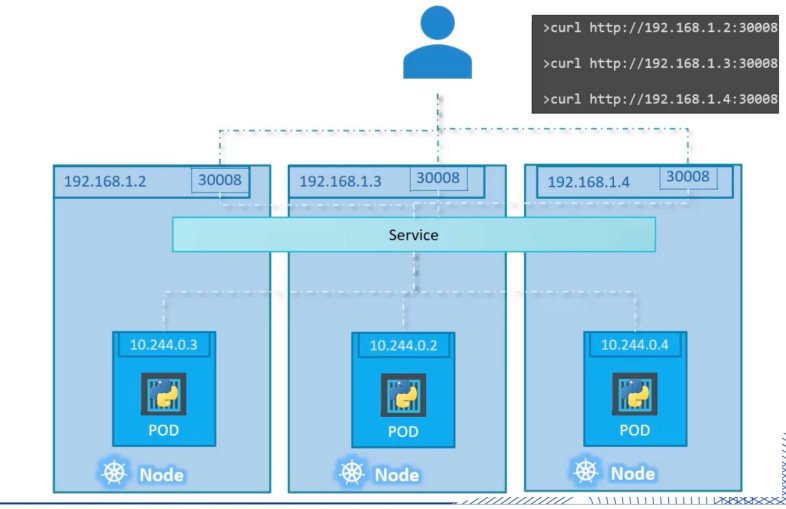
NodePort



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Lab 6: Services (Optional)

Create service-definition.yaml

- `kubectl create -f service-definition.yaml`
- `kubectl get svc`
- `minikube service myapp-service --url`

```yaml
apiVersion: v1
kind: Service
metadata:
  name: myapp-service
spec:
  type: NodePort
  ports:
    - port: 80
      targetPort: 80
      nodePort: 30004
  selector:
    app: myapp
```

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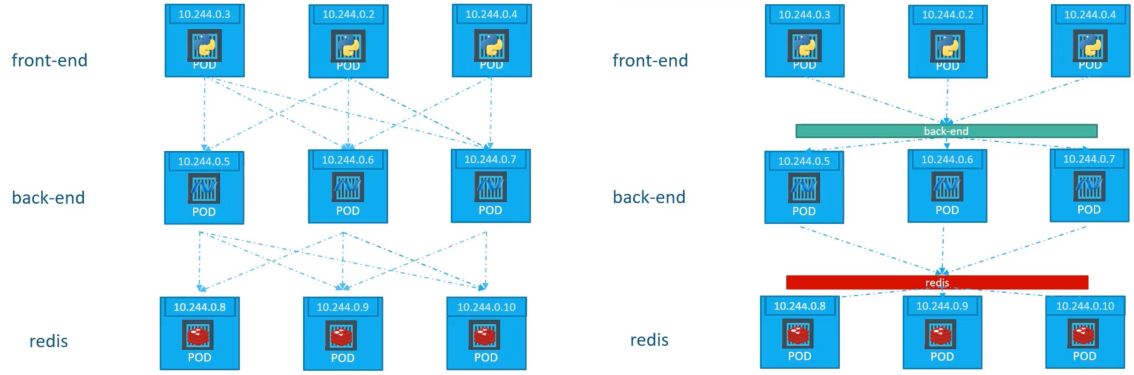
ClusterIP



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ClusterIP

service-definition.yml

```yaml
apiVersion: v1
kind: Service
metadata:
    name: back-end

spec:
    type: ClusterIP
    ports:
     - targetPort: 80
       port: 80

    selector:
```

pod-definition.yml

```yaml
apiVersion: v1
kind: Pod

metadata:
 name: myapp-pod
 labels:
    app: myapp
    type: back-end
spec:
  containers:
  - name: nginx-container
    image: nginx
```

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ClusterIP

service-definition.yml

```yaml
apiVersion: v1
kind: Service
metadata:
    name: back-end

spec:
    type: ClusterIP
    ports:
     - targetPort: 80
       port: 80

    selector:
       app: myapp
       type: back-end
```

pod-definition.yml

```yaml
apiVersion: v1
kind: Pod

metadata:
 name: myapp-pod
 labels:


spec:
  containers:
  - name: nginx-container
    image: nginx
```

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ClusterIP

```
> 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
```

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Load Balancer

Example voting app

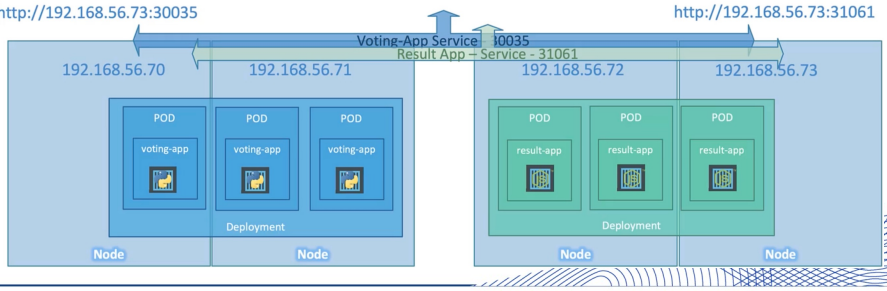
http://example-vote.com
http://example-result.com

http://192.168.56.70:30035
http://192.168.56.71:30035
http://192.168.56.72:30035
http://192.168.56.73:30035

http://192.168.56.70:31061
http://192.168.56.71:31061
http://192.168.56.72:31061
http://192.168.56.73:31061

service-definition.yml

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



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Namespace

- Namespaces partition a Kubernetes cluster and are designed as an easy way to apply quotas and policies to groups of objects.
- They're not designed for strong workload isolation.
- Namespaces are a good way of sharing a single cluster among different departments and environments, such as Dev, Test, QA.
- We can create different namespaces to organize or isolate your applications and microservices.

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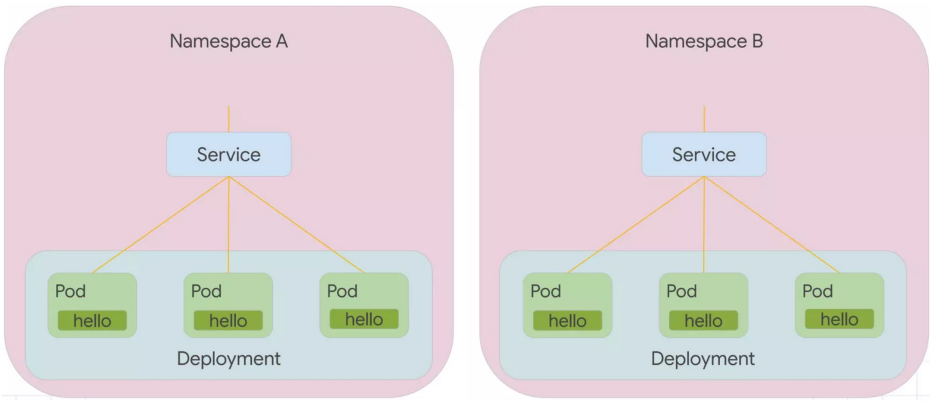
Namespace



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Namespace

- `kubectl api-resources`
- `kubectl get namespaces`
- `kubectl apply -f file.yml`
- `kubectl delete -f file.yml`
- `kubectl create ns mynamespace`
- `kubectl delete ns mynamespace`

```yaml
---
apiVersion: v1
kind: Namespace
metadata:
  name: development
---
apiVersion: v1
kind: Namespace
metadata:
  name: production
```

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Deploying Namespace

```
apiVersion: v1
kind: ServiceAccount
metadata:
  namespace: shield     <<==== Namespace
  name: default
---
apiVersion: v1
kind: Service
metadata:
  namespace: shield     <<==== Namespace
  name: the-bus
spec:
  ports:
  - nodePort: 31112
    port: 8080
    targetPort: 8080
  selector:
    env: marvel
---
apiVersion: v1
kind: Pod
metadata:
  namespace: shield     <<==== Namespace
  name: triskelion
<Snip>
```

```
$ kubectl apply -f shield-app.yml
serviceaccount/default configured
service/the-bus configured
pod/triskelion created
```

```
$ kubectl get pods -n shield
NAME         READY   STATUS    RESTARTS   AGE
triskelion   1/1     Running   0          48s

$ kubectl get svc -n shield
NAME      TYPE       CLUSTER-IP     EXTERNAL-IP   PORT(S)          AGE
the-bus   NodePort   10.43.30.174   <none>        8080:31112/TCP   52s
```

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Logs

```
$ kubectl get pod -n namespace
$ kubectl logs pod_name -n namespace
```

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Resource Management

```yaml
---
apiVersion: v1
kind: Pod
metadata:
  name: frontend
spec:
  containers:
  - name: app
    image: images.my-company.example/app:v4
    resources:
      requests:
        memory: "64Mi"
        cpu: "250m"
      limits:
        memory: "128Mi"
        cpu: "500m"
  - name: log-aggregator
    image: images.my-company.example/log-aggregator:v6
    resources:
      requests:
        memory: "64Mi"
        cpu: "250m"
      limits:
        memory: "128Mi"
        cpu: "500m"
```

https://kubernetes.io/docs/concepts/configuration/manage-resources-containers/

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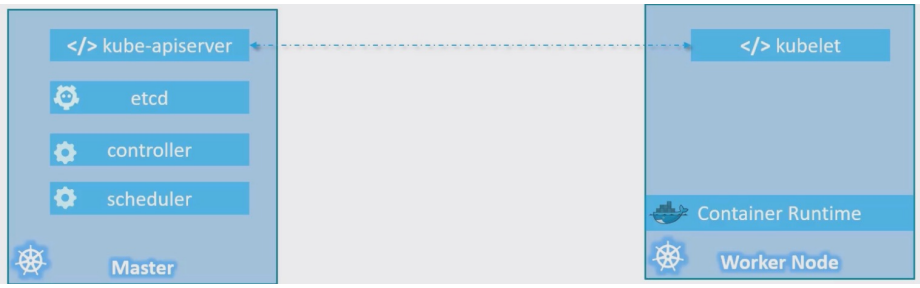
Multi-node Cluster



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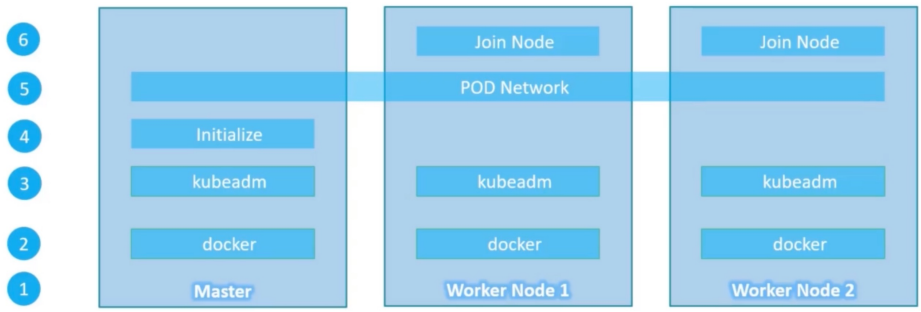
Multi-node Cluster Using kubeadm



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Kubernetes Security

- Any internet server is susceptible to attack.
- Threats are always changing.
- There are best practices you can apply right away.
- Steal data, cryptocurrency mining, DDoS attacks
- https://docs.snyk.io/scan-cloud-deployment/snyk-infrastructure-as-code/snyk-cli-for-infrastructure-as-code/test-your-kubernetes-files-with-our-cli-tool

  `$ snyk iac test file.yml`
- A hardening guide: https://media.defense.gov/2022/Aug/29/2003066362/-1/-1/0/CTR_KUBERNETES_HARDENING_GUIDANCE_1.2_20220829.PDF

```
18      spec:
19        containers:
20        - name: pod-info-container
21          image: kimschles/pod-info-app:latest
22          resources:
23            requests:
24              memory: "64Mi"
25              cpu: "250m"
26            limits:
27              memory: "128Mi"
28              cpu: "500m"
29          securityContext:
30            allowPrivilegeEscalation: false
31            runAsNonRoot: true
32            capabilities:
33              drop:
34                - ALL
35            readOnlyRootFilesystem: true
36          ports:
37          - containerPort: 3000
```

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Wisdom of the Land

References

- KodeKloud.com
- Opsta
- Nigel Poulton, ”The Kubernetes Book”, 2023.

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