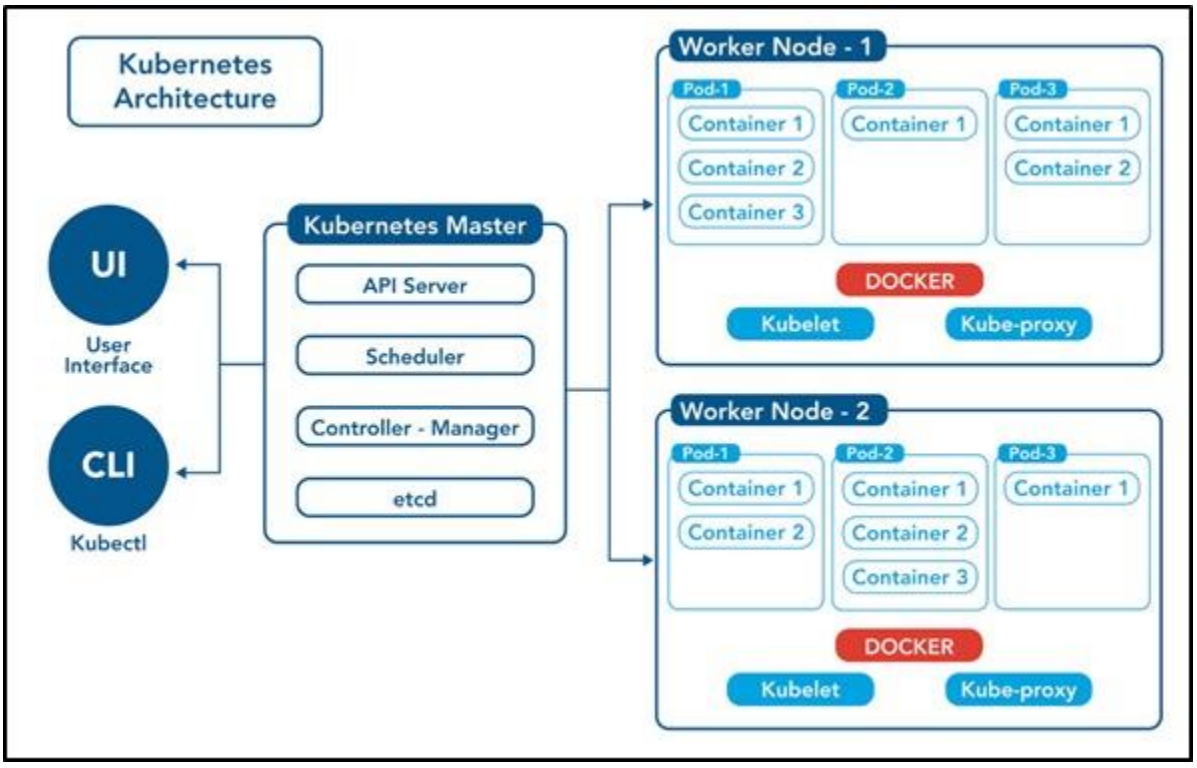
Kubernetes (K8s)

Kubernetes is an open-source container orchestration engine for automating deployment, scaling, and management of containerized applications. The open-source project is hosted by the Cloud Native Computing Foundation (CNCF).
It provides a scalable and resilient framework for automating the deployment, scaling, and management of applications across clusters of servers.



A SMALL HISTORY OF K8S:

- In the early 2000s, Google started developing a system called Borg to manage their internal containerized applications.
- Borg enabled Google to run applications at scale, providing features such as automatic scaling, service discovery, and fault tolerance.
- In 2014, Google open-sourced a version of Borg called Kubernetes.
- Kubernetes was donated to the Cloud Native Computing Foundation (CNCF), a neutral home for open-source cloud-native projects, in July 2015.
- Kubernetes 1.8 added significant enhancements for storage, security, and networking. Key features included the stable release of the stateful sets API, expanded support for volume plugins, and improvements in security policies.

- Check URL: https://kubernetes.io/releases/ for more release details.

Control Plane /Master Node

The control plane's components make global decisions about the cluster (for example, scheduling), as well as detecting and responding to cluster events (for example, starting up a new pod when a deployment's replicas field is unsatisfied).

Control plane components can be run on any machine in the cluster. Do not run user containers on this machine.

Node Components / Worker Nodes

Node components run on every node, maintaining running pods and providing the Kubernetes runtime environment.

1. Master Node: The master node is responsible for managing the cluster and coordinating the overall state of the system. It includes the following components:

a. API Server: The API server is the central control point for all interactions with the cluster. It exposes the Kubernetes API and handles requests from users and other components.

b. Scheduler: The scheduler is responsible for assigning workloads (pods) to individual worker nodes based on resource requirements, constraints, and other policies.

c. Controller Manager: The controller manager runs various controllers that monitor the cluster state and drive it towards the desired state. Examples include the replication controller, node controller, and service controller.

d. etcd: etcd is a distributed key-value store used by Kubernetes to store cluster state and configuration data.

1. **Pod**: The basic building block of Kubernetes. A pod represents a single instance of a running process within the cluster. It can encapsulate one or more containers that share the same network and storage resources.

1. **Create a pod using run command**

$ kubectl run <pod-name> --image=<image-name> --port=<container-port>

$ kubectl run my-pod --image=nginx --port=80

2. **View all the pods**

(In default namespace)

$ kubectl get pods

(In All namespace)

$ kubectl get pods -A

# For a specific namespace
$ kubectl get pods -n kube-system

# For a specific type
$ kubectl get pods <pod-name>
$ kubectl get pods <pod-name> -o wide
$ kubectl get pods <pod-name> -o yaml
$ kubectl get pods <pod-name> -o json

3. **Describe a pod (View Pod details**)
$ kubectl describe pod <pod-name>
$ kubectl describe pod my-pod
4. View Logs of a pod
$ kubectl logs <pod-name>
$ kubectl logs my-pod

5. Execute any command inside Pod (Inside Pod OS)
$ kubectl exec <pod-name> -- <command>

```
apiVersion: v1
kind: Pod
metadata:
  name: my-pod
  labels:
      app: my-web-app
    type: backend
spec:
  containers:
    - name: nginx-container
      image: nginx
      ports:
        - containerPort: 80
```

```
apiVersion: v1
kind: Pod
metadata:
  name: my-app
spec:
  containers:
    - name: my-app-container
      image: <images>      ports:
        - containerPort: 9090
```

```
kind: ReplicaSet
metadata:
  name: my-rs
  labels:
    name: my-rs
spec:
  replicas: 4
  selector:
    matchLabels:
      apptype: web-backend
  template:
    metadata:
      labels:
        apptype: web-backend
    spec:
      containers:
      - name: my-app
        image:
        ports:
          - containerPort: 8080

apiVersion: apps/v1
kind: Deployment
metadata:
  name: my-deploy
  labels:
    name: my-deploy
spec:
  replicas: 4
  selector:
    matchLabels:
      apptype: web-backend
  strategy:
    type: RollingUpdate
  template:
    metadata:
      labels:
        apptype: web-backend
    spec:
      containers:
      - name: my-app
        image:
```

```
    ports:
      - containerPort: 7070
```

kubectl create deployment webnginx2 --image=nginx:latest --replicas=1

kubectl scale deploy <deployment-name> --replicas=<desired-replica-count>

Services (short name = svc):
Service is an abstraction that defines a logical set of pods and a policy to access them. Services enable network connectivity and load balancing to the pods that are part of the service, allowing other components within or outside the cluster to interact with the application.
Service Types: Kubernetes supports different types of services:
1. **NodePort:** Exposes the service on a static port on each selected node's IP. This type makes the service accessible from outside the cluster by the <NodeIP>:<NodePort> combination.

2. **Cluster IP**: Exposes the service on a cluster-internal IP. This type makes the service only reachable within the cluster.

3. **LoadBalancer**: Creates an external load balancer in cloud environments, which routes traffic to the service.

2. Create Deployment by executing above YAML file
$ kubectl create -f web-deploy.yml
# Do necessary modifications if exist, else create new
$ kubectl create -f web-deploy.yml
# Completely Modify Pod Template
$ kubectl replace –f web-deploy.yml

3. View Deployments
$ kubectl get deployments
$ kubectl get deploy
$ kubectl get deploy -o wide
$ kubectl get deploy <deployment-name> -o json
$ kubectl get deploy <deployment-name> -o yaml
4. View Deployment Description
$ kubectl describe deploy <deployment-name>
5. We can modify generated/updated YAML file
$ kubectl edit deploy <deployment-name>
change replicas: count to any other value then (ESC):wq

# We can modify our YAML file and then execute apply command
$ kubectl apply -f web-deploy.yml

We can Even scale using command also
$ kubectl scale deploy <deployment-name> --replicas=<desired-replica-count>

6. Delete Deployment
$ kubectl delete deploy <deployment-name>
$ kubectl delete -f web-deploy.yml

2. Create ReplicaSet by executing above YAML file
$ kubectl create -f rs-test.yml
# Do necessary modifications if exist, else create new
$ kubectl apply -f rs-test.yml
# Completely Modify Pod Template
$ kubectl replace –f rs-test.yml

3. View ReplicaSets
$ kubectl get replicasets
$ kubectl get rs
$ kubectl get rs –o wide
$ kubectl get rs <replica-set-name> –o json
$ kubectl get rs <replica-set-name> –o yaml

4. **View ReplicaSet Description**
$ kubectl describe rs <replica-set-name>
5. We can modify generated/updated YAML file
$ kubectl edit rs <replica-set-name>
change replicas: count to any other value then (ESC):wq

# We can modify our YAML file and then execute apply command
$ kubectl apply -f rs-test.yml

We can Even scale using command also
$ kubectl scale replicaset <replicaset-name> --replicas=<desired-replica-count>

6. Delete ReplicaSet
$ kubectl delete rs <replica-set-name>
$ kubectl delete -f rs-test.yml

```
apiVersion: apps/v1
kind: Deployment
metadata:
  name: my-deploy
  labels:
    name: my-deploy
spec:
  replicas: 1
  selector:
    matchLabels:
      apptype: web-backend
  strategy:
    type: RollingUpdate
  template:
    metadata:
      labels:
        apptype: web-backend
    spec:
      containers:
      - name: my-app
        image:
        ports:
        - containerPort: 7070
---

apiVersion: v1
kind: Service
metadata:
  name: my-service
  labels:
    app: my-service
    type: backend-app
spec:
  type: NodePort
  ports:
   - targetPort: 7070
     port: 7070
     nodePort: 30002
  selector:
    apptype: web-backend
```

```
apiVersion: apps/v1
kind: Deployment
metadata:
  name: my-deploy
  labels:
    name: my-deploy
spec:
  replicas: 1
  selector:
    matchLabels:
      apptype: web-backend
  strategy:
    type: RollingUpdate
  template:
    metadata:
      labels:
        apptype: web-backend
    spec:
      containers:
      - name: my-app
        image:
        ports:
        - containerPort: 9000

---

apiVersion: v1
kind: Service
metadata:
  name: my-service
  labels:
    app: my-service
spec:
  type: NodePort
  ports:
    - port: 9000
      targetPort: 8080
      nodePort: 30002
  selector:
    apptype: web-backend
```

Namespace (short name = ns):
namespace is a virtual cluster or logical partition within a cluster that provides a way to organize and isolate resources. It allows multiple teams or projects to share the same physical cluster while maintaining resource separation and access control.

# To create a namespace:
$ kubectl create namespace <namespace-name>
$ kubectl create ns my-bank
# To switch to a specific namespace: (make this as default type)
$ kubectl config set-context --current --namespace=<namespace-name>
# To list all namespaces:
$ kubectl get namespaces
# To get resources within a specific namespace:
$ kubectl get <resource-type> -n <namespace-name>
$ kubectl get deploy -n my-bank
$ kubectl get deploy --namespace my-bank
$ kubectl get all --namespace my-bank
# To delete a namespace and all associated resources:
$ kubectl delete namespace <namespace-name>
$ kubectl delete ns my-bank

kubectl create ns mydeploy
kubectl apply -f deploy.yml -n mydeploy

```
apiVersion: v1
kind: Namespace
metadata:
  name: my-demo-ns
```

```
apiVersion: v1
kind: Pod
metadata:
  name: my-pod
  namespace: my-demo-ns
spec:
  containers:
  - name: my-container
    image: nginx:latest
```