Kubernetes

6. Kubernetes

What is Kubernetes?

Kubernetes is an open-source container orchestration system for automating software deployment, scaling, and management. Google originally designed Kubernetes, but the Cloud Native Computing Foundation now maintains the project.

Cloud based K8S Services-

- GKE- Google kubernetes services
- AKS- Azure kubernetes services
- Amazon EKS(Elastic kubernetes services)

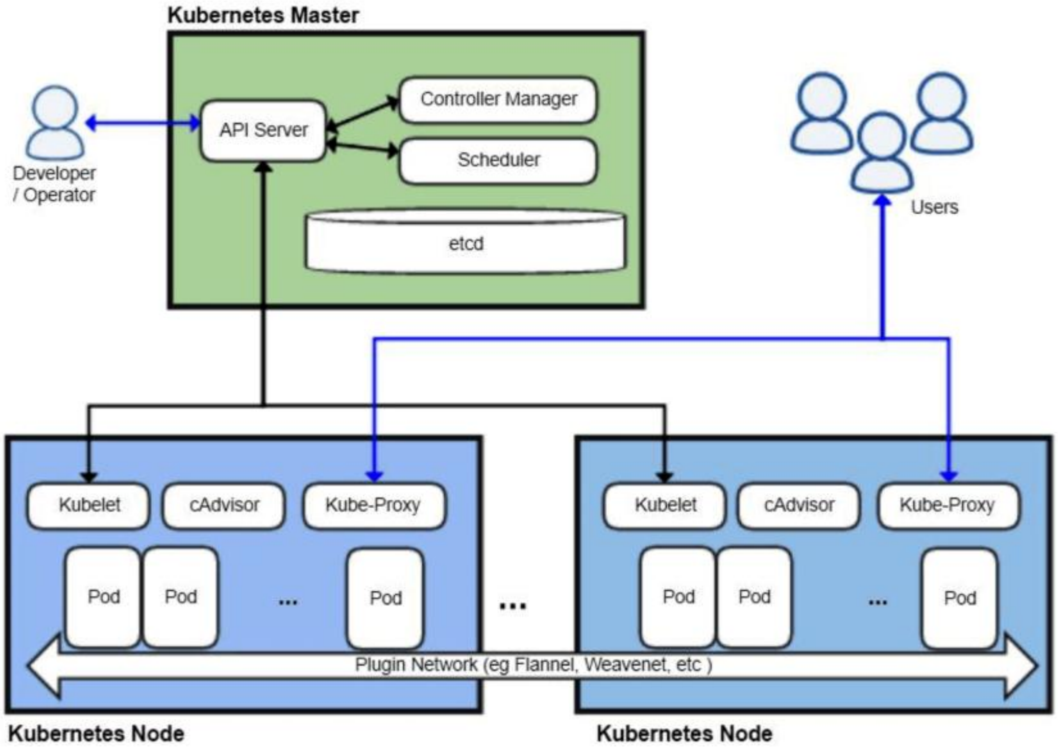
Kubernets Vs Docker Swarm

FEATURES	KUBERNETES	DOCKER SWARM
Installation and cluster configuration	Complicated & time Consuming	Fast & Easy
Support	K8s Can work with almost all container types like Rocket, Docker, ContainerD	Work with Docker only
GUI	GUI Available	GUI not available
Data Volumes	Only shared with containers in same pod	Can be shared with any other Container
Update & Rollback	Process Scheduling to maintain services while updating	Progressive updates of services health monitoring throughout the update
Autoscaling	Support vertical & Horizontal Autoscalling	Not support Autoscalling

Logging & Monitoring	Inbuilt tool present for monitoring	Used 3rd party tools like Splunk

Architecture:

- Components of Kubernetes (k8s) cluster



- **Control Plane Components**
- The control plane components make decisions about the cluster
- Control plane can be run on any machine in the cluster
- We can create a highly available cluster by using multiple machines for control plane components
- **The components are:**
- kube-apiserver
- etcd
- kube-scheduler
- kube-controller-manager
- kube-cloud-controller-manager

- **Node Components:**

- They run on every node, maintaining running pods and providing k8s runtime environment.
- Our applications will be running on nodes
- The Node Components are

- kubelet
- kube-proxy
- Container runtime

- **Kube-Apiserver:**
- The API server is a component of k8s control plane that exposes k8s API (Front-end of k8s)
- All the communication between control plane and nodes is also handled by api server
- To make k8s HA (highly Available), we can horizontal scale api-server
- As a user of k8s cluster we can interact with kube-api server using API with json or a tool called a kubectl which is a command line tool

- **etcd:**

Is a strongly consistent, distributed key-value store that provides a reliable way to store data that needs to be accessed by a distributed system or cluster of machines. It gracefully handles leader elections during network partitions and can tolerate machine failure, even in the leader node.

- This is distribute key-value store.
- k8s uses etc to store all the cluster data

- **kube-scheduler:**
- Control plane component that creates Pods on the nodes by selecting them

- **kube-controller-manager:**
- Control plane component runs controller processes. Each controller is a separate process, but to reduce complexity they run in single process
- **Some major types of controller are**
- Node Controller: Responsible for noticing and responding when node goes down
- Job Controller
- Endpoints controller

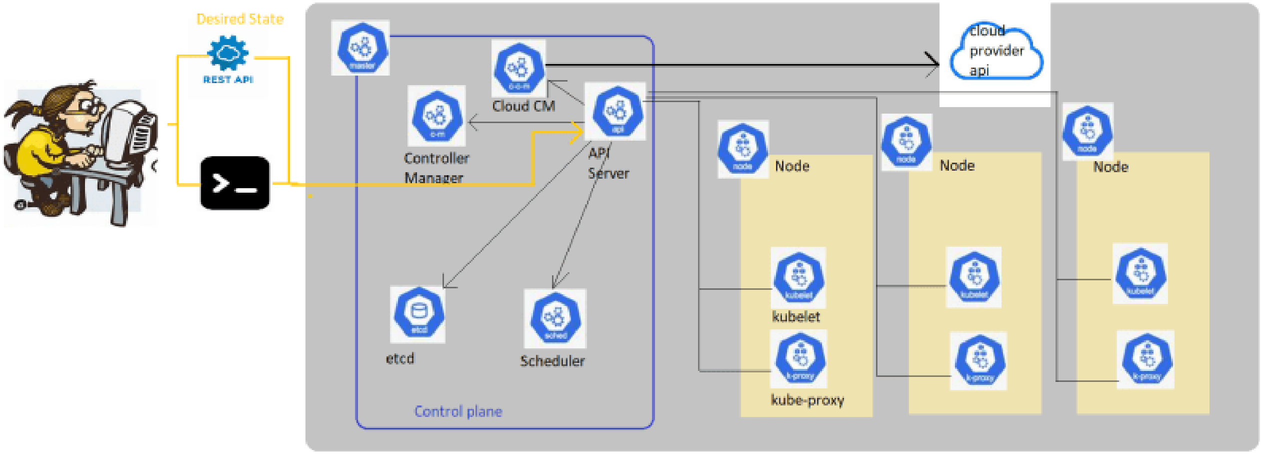
- **Cloud-controller-manager:**
- This component embeds cloud-specific logic

- **Kubelet:**
- This is an agent that runs on each node in the cluster.
- Kubelet receives requests/orders to create new Pods

- **kube-proxy:**
- This is a network proxy that runs on each node in k8s
- This maintains network rules on the nodes
- Kube proxy is responsible for routing network traffic in the k8s cluster. To do this job, the proxy should be present on all the nodes in the cluster

- **Container runtime:**
- Kubernetes supports container run times such as contained, CRI-O and any implementation of Kubernetes CRI (Container Runtime instance)

- **Basic Workflow**

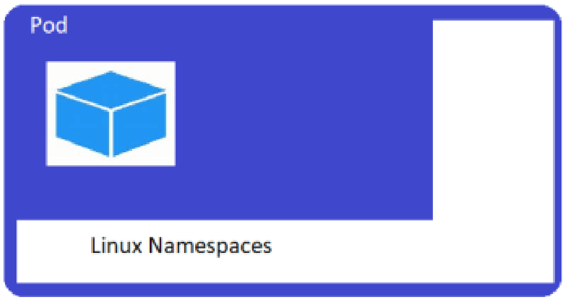


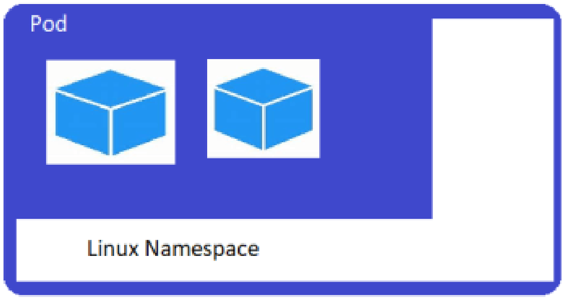
To interact with k8s cluster we have two major options

- programmatically by using REST API with json payloads
- kubectl command line by using YAML manifests
- When we interact with kubectl we create yaml manifest which has minimum details required where we express what we want rather than how it is done.
- when we work with clusters especially container clusters we embrace cattle mindset (pet vs cattle)

Pods in k8s

- A Pod is smallest unit of creation in k8s.
- Container will exist inside Pod.
- A Pod is collection of application containers and volumes running inside the same execution environment
- Each container in a pod runs with in its own cgroup, but they share a number of Linux namespaces
- Each Pod gets a unique IP address in k8s cluster. The containers running inside the Pod share the same IP Address and port space, have the same host name





- A Pod can have any number of containers, but ideally its not a good idea to run multiple containers in a Pod.
- A Pod should represent a microservice/application so running one container is considered as best idea.

Kubectl cheatsheet

- Refer Here

kubectl has two primary commands to obtain information

- get
- describe

Pod:

- Smallest unit in kubernetes.
- Pod contains a container
- Pods can contain more than one container and the extra containers are referred as side-car containers
- Scaling the application in k8s is scaling pods not containers
- To create pods (anything) in k8s we have two approaches
- **Imperative**: we create objects using command line
- **Declarative**: We create manifests i.e. yaml files where we express what we want
- Imperative way of creating pods

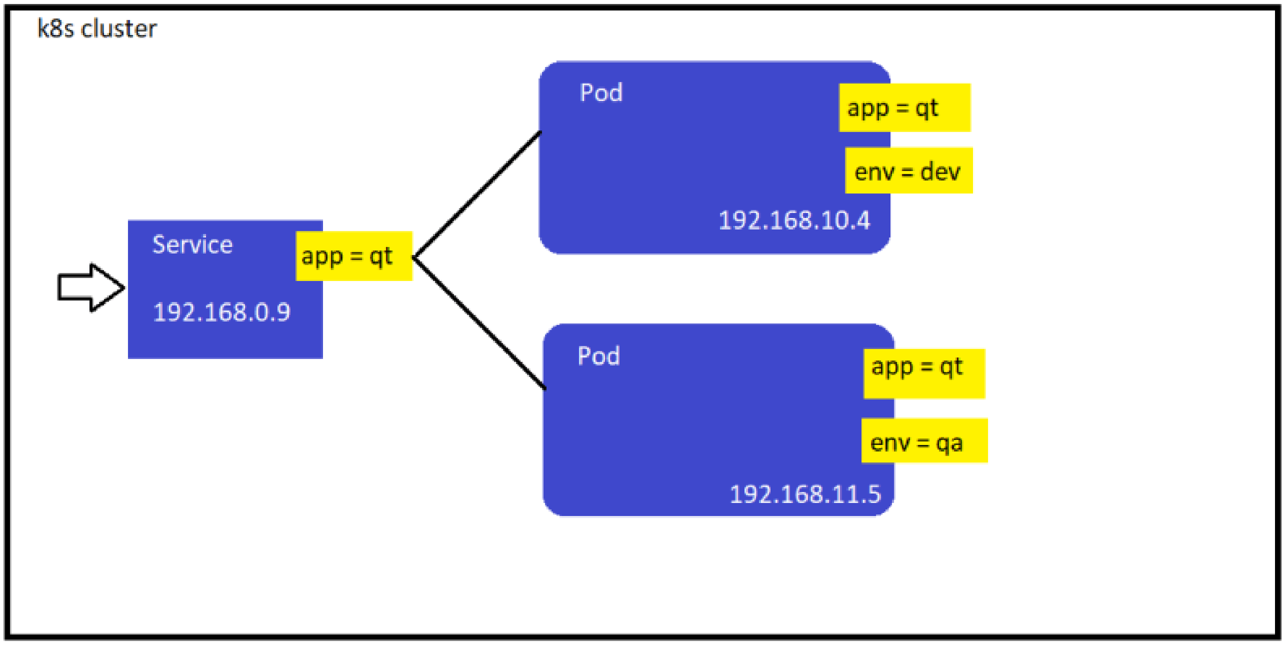
```
#kubectl run –help
```

```
#kubectl run hello-pod –image jenkins/jenkins:lts-jdk11
```

```
#kubectl delete pods hello-pod
```

K8s Service

- K8s service when created gets a cluster ip which is virtual in nature, when any other resource tries to access the service using cluster ip it forwards to request to one of the pod matching labels



- An easier way to create the service is by using kubectl expose
- K8s service uses a label selectors which will find all the pods with matching labels and will load-balance across all the pods
- since the cluster ip is virtual, its stable and it is appropriate to give it a DNS address.
- K8s provides a DNS service exposed to Pods running in cluster.
- Lets create a K8s service Refer Here for the changes.
- Service should not forward the request to faulty pods, as this might impact application access, so lets see what can be done over here.

- **Readiness Checks/Probes:**
- This is to check whether the application in container running in Pod is ready to serve requests or not
- If this check fails the k8s removes the Ip address of Pods from all endpoints in Services

- **Liveness Checks/Probes:**
- This is to check whether or not application in container is running or not.
- K8s restarts containers if this check fails based on restart policy

- Refer Here for writing checks or probes
- Refer Here for the sample probes

- Accessing the service from outside cluster: For this in k8s service we have 3 options
- **Node Port:** Where you expose service on some port of the node
- **Load Balancer Integration:** Generally in all the managed clusters like AKS, EKS, GKE cluster is configured to integrate with external load balancers, so this can be used to expose the service
- **External Name**: Will be a DNS record which you can add to existing DNS servers

Kubernetes Deployment

- We know that Replica set manage pods.
- Deployment manages replica set.
- K8s is a self-healing system. The top level deployment object manages replica set, when you adjust number of replicas it will not match desired state so it will scale up or down
- Deployment allows us to deploy the newer versions of the applications by ensuring it supports all the necessary options to minimize/make zero down time deployments and rollout to a new version or roll back to the older version.
- Refer Here for the changeset & Refer Here for the fix for wrong indentation.

K8s Storage Solutions

- **Volumes**: k8s Volume has a lifecycle equal to Pod. Once the Pod is deleted, the data will be lost
- **Persistent Volumes:** These volumes have lifecylce independent of Pod, So data will not be lost
- To create Persistent Volumes, We have two options
- Manual Provisioning: In this case we need to manually create the storage to be used by the k8s cluster
- Dynamic Provisioning: In this K8s will try to automatically create the storage based on the details provided. We prefer this approach on clouds
- K8s has the following types of persistent volumes Refer Here

- In K8s Storage Class provides a way for administrators to describe the classes of storage.
- If you are using managed k8s, it will already have some storage classes defined
- aks
- eks
- In K8s, we need to understand the relation between storage classes, Persistent Volumes and Persistent Volume Claims

What is Persistent Volume Claim (PVC)

- PVC is request for platform to create a persitent volume (PV) and attach it to your pods.
- Storage classes define the details (hardware details(ssd/hdd/block/file))

Pod -> PVC -> PV -> Target Machine (Type of this is defined by SC)

- When we are using the volume to mounted on multiple pods Refer Here
- Refer Here for the changeset containing changes to create a PVC which create a PV of size 1 GB of type managed-premium

- **Stateful Sets:** For storage solutions, where each instance of the application in Pod requires its own private volume then, we go for stateful sets. Stateful sets use PVC to claim PV.

Helm

- Helm is a package-manager for k8s.
- When we want to create a package for our application, we create helm-chart.