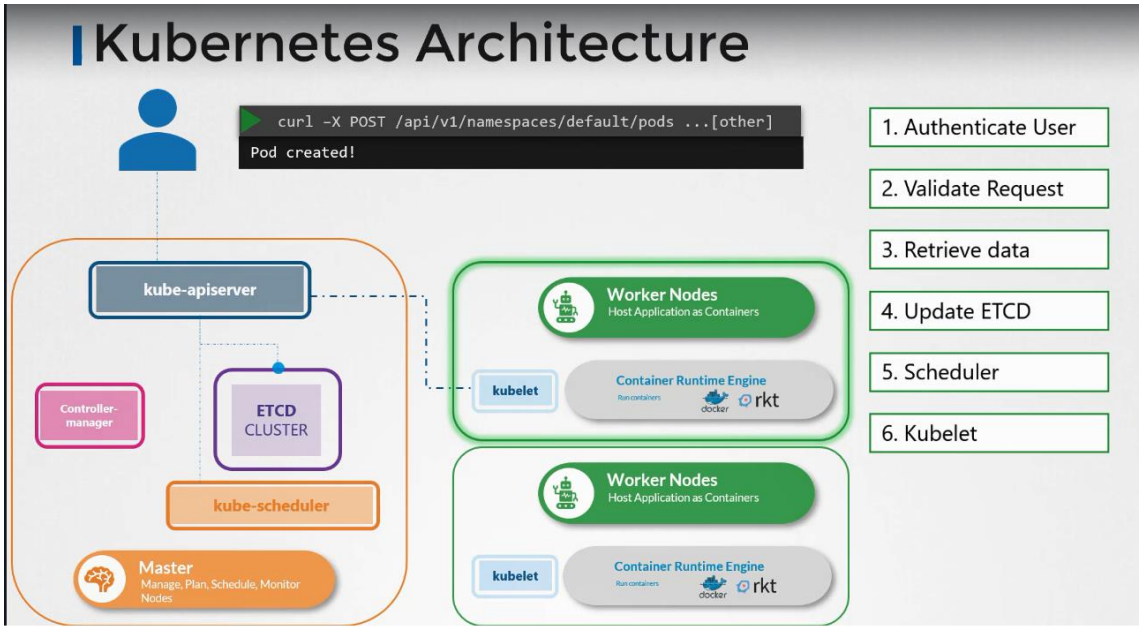
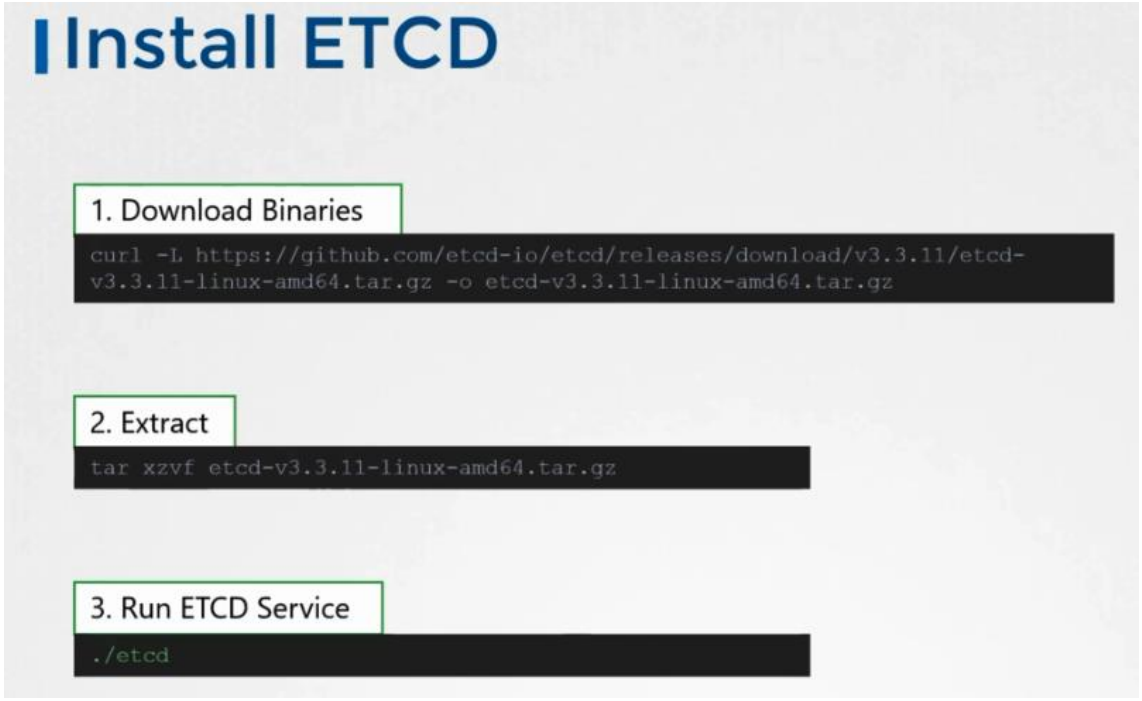
CKA

Cluster Architecture



Host your aplication as container with automated fashion – k8s

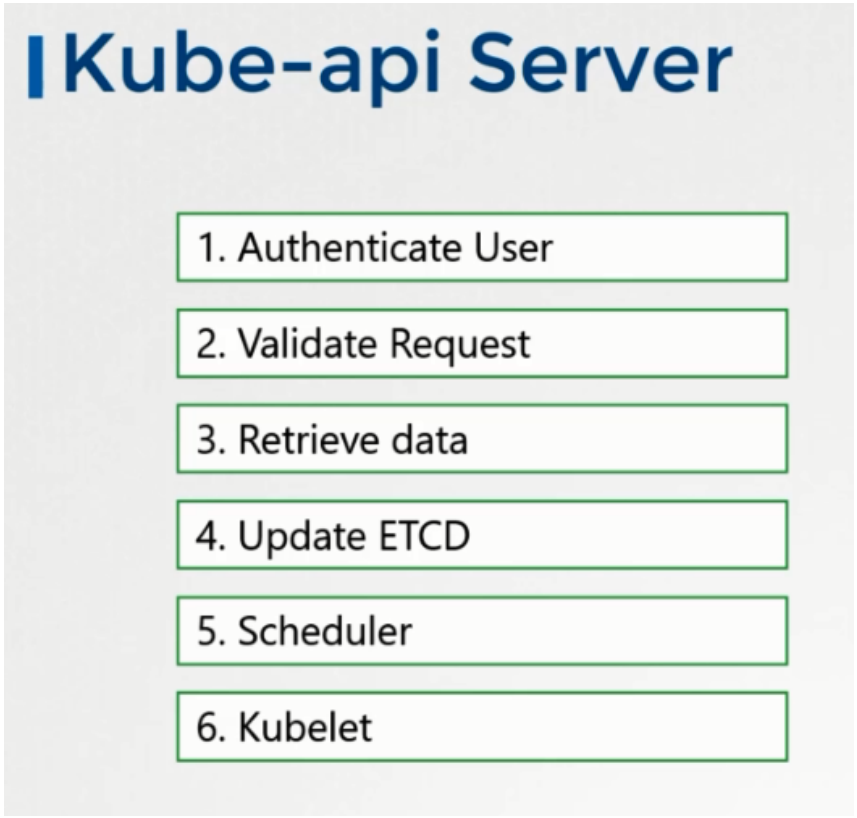
ETCD : it’s a DB that stores information in a key value pair



Every information you see from the kubectl is FROM the ETCD server

Kubectl get node,pod,secret,configs,roles etc

Kube api server only component to interact with ETCD db



Kube schedular only decides which pod has to deploy on which node , It doesnot actually place the pod in Node.Kubelet

deploys the pod in node

Compute-quota.yaml

```yaml
apiVersion: v1
kind: ResourceQuota
metadata:
    name: compute-quota
    namespace: dev
spec:
  hard:
    pods: "10"
    requests.cpu: "4"
    requests.memory: 5Gi
    limits.cpu: "10"
    limits.memory: 10Gi
```

```
> kubectl create -f compute-quota.yaml
```

Schedular 5%

1. Manual schedule : Directly give node name

pod-definition.yaml

```yaml
apiVersion: v1
kind: Pod
metadata:
  name: nginx
  labels:
    name: nginx
spec:
  containers:
  - name: nginx
    image: nginx
    ports:
      - containerPort: 8080

  nodeName: node02
```

2. If pod is already deployed on the node but you want to put it in different node.

Then you have to give BIND POST request

Pod-bind-definition.yaml

```yaml
apiVersion: v1
kind: Binding
metadata:
  name: nginx
target:
  apiVersion: v1
  kind: Node
  name: node02
```

```
curl --header "Content-Type:application/json" --request POST --data '{"apiVersion":"v1", "kind": "Binding" …. }
http://$SERVER/api/v1/namespaces/default/pods/$PODNAME/binding/
```

Lables and selectors and annotations

K get pod –selector app=ov,wf=ov,hus=karthik

kubectl taint nodes master node-role.kubernetes.io/master:NoSchedule-

Resources and requirements and Limits

kubectl run nginx --image=nginx --restart=Never

--requests=cpu=100m,memory=256Mi --limits=cpu=200m,memory=512Mi --dry-run -o yaml

```yaml
spec:
  containers:
  - name: simple-webapp-color
    image: simple-webapp-color
    ports:
      - containerPort: 8080
    resources:
      requests:
        memory: "1Gi"
        cpu: 1
      limits:
        memory: "2Gi"
        cpu: 2
```

Container cannot use the more CPU than its limit. But memory can use than its limits.

Daemon Sets:

Daemon sets are like replicasets, It helps to run multiple instances of pods

But it run one copy of your pod in each node/cluster

It ensures one copy of pod is always runs in each node.

Best for monitoring and log views

Ex: kube-proxy pod in each node, wavenet in each node(Networking)

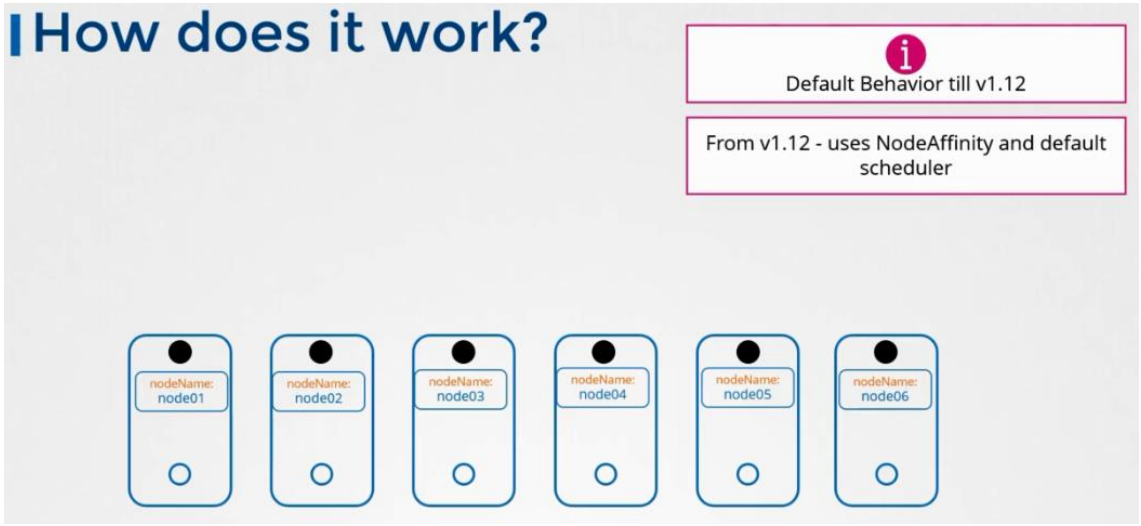
daemon-set-definition.yaml

```yaml
apiVersion: apps/v1
kind: DaemonSet
metadata:
  name: monitoring-daemon
spec:
  selector:
    matchLabels:
      app: monitoring-agent
  template:
    metadata:
      labels:
        app: monitoring-agent
    spec:
      containers:
      - name: monitoring-agent
        image: monitoring-agent
```

replicaset-definition.yaml

```yaml
apiVersion: apps/v1
kind: ReplicaSet
metadata:
  name: monitoring-daemon
spec:
  selector:
    matchLabels:
      app: monitoring-agent
  template:
    metadata:
      labels:
        app: monitoring-agent
    spec:
      containers:
      - name: monitoring-agent
        image: monitoring-agent
```

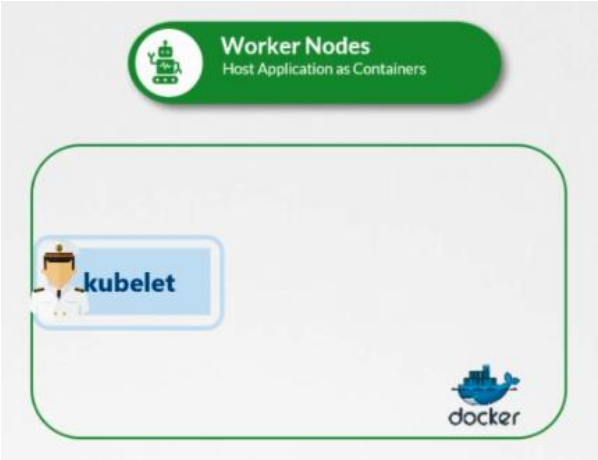
Set node name in the pod and deploy it in all node



Static pods:

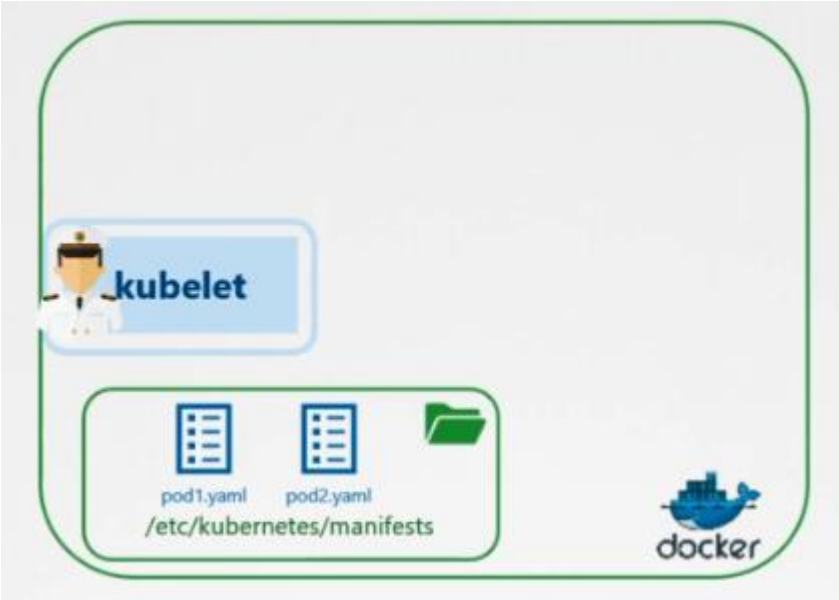
No master, no other nodes.

Only one node



Kubelet can manage to run th containers in the node without master.

Kubelet knows to create the pod. So it requires pod definition files. So place it in the specified directory

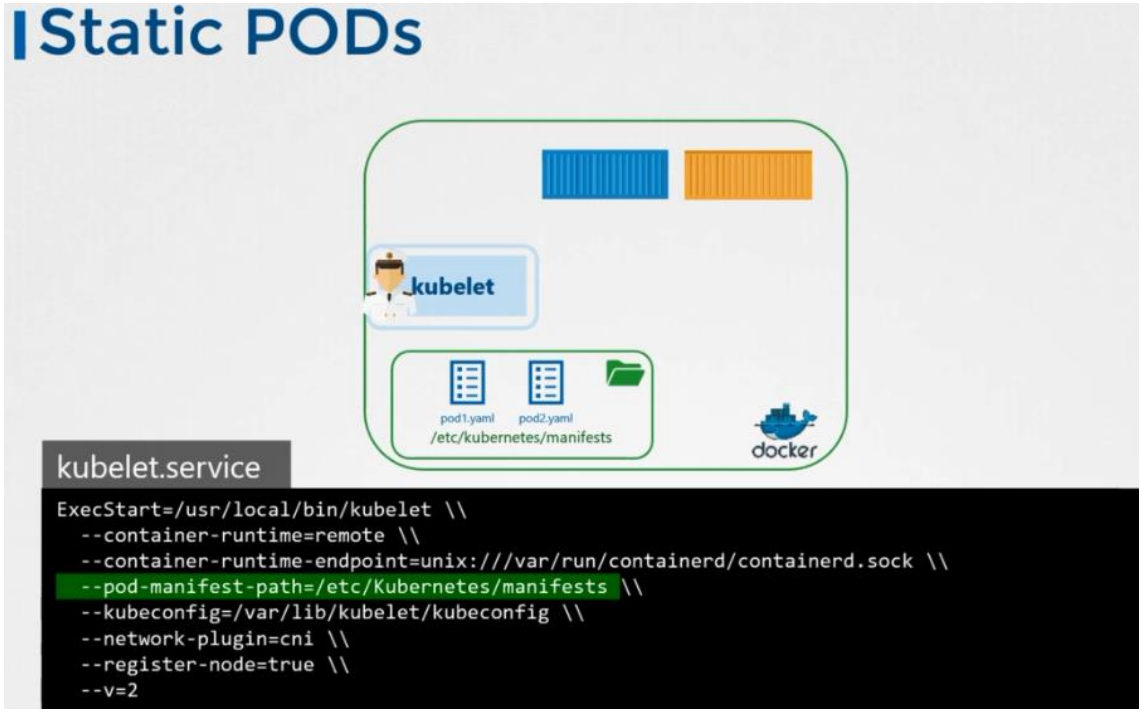


If any changes in the file, new file added/removed kubelet make sure the changes. It also ensure to rerun the pod if it fails.

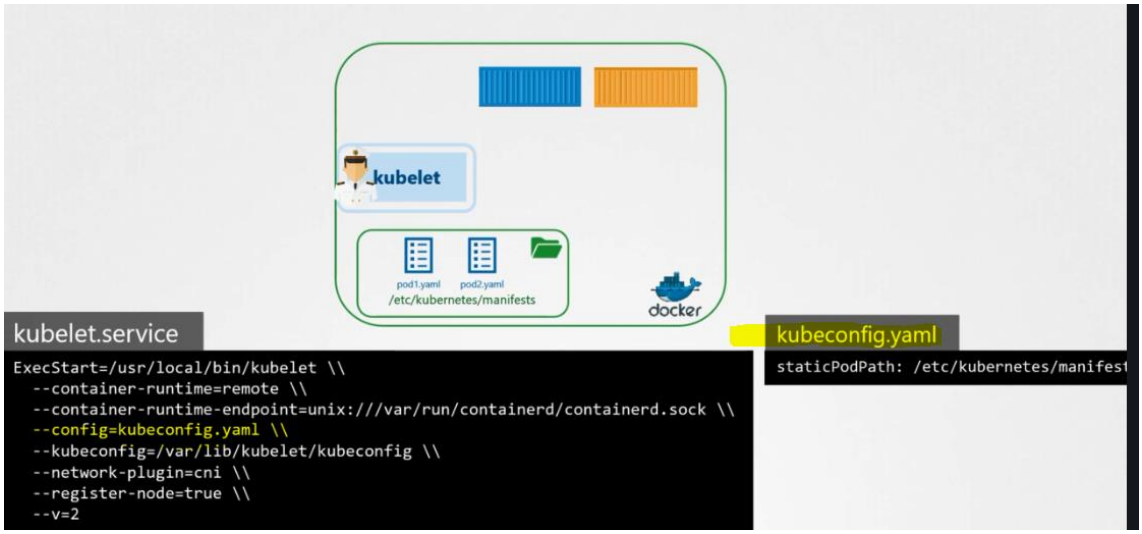
We can only create the pod , not Deploy/replicaSet

Kubelet can work only in the pod level

Directly you can specify the directory path like below or



Specify common file and give the directory path in that file

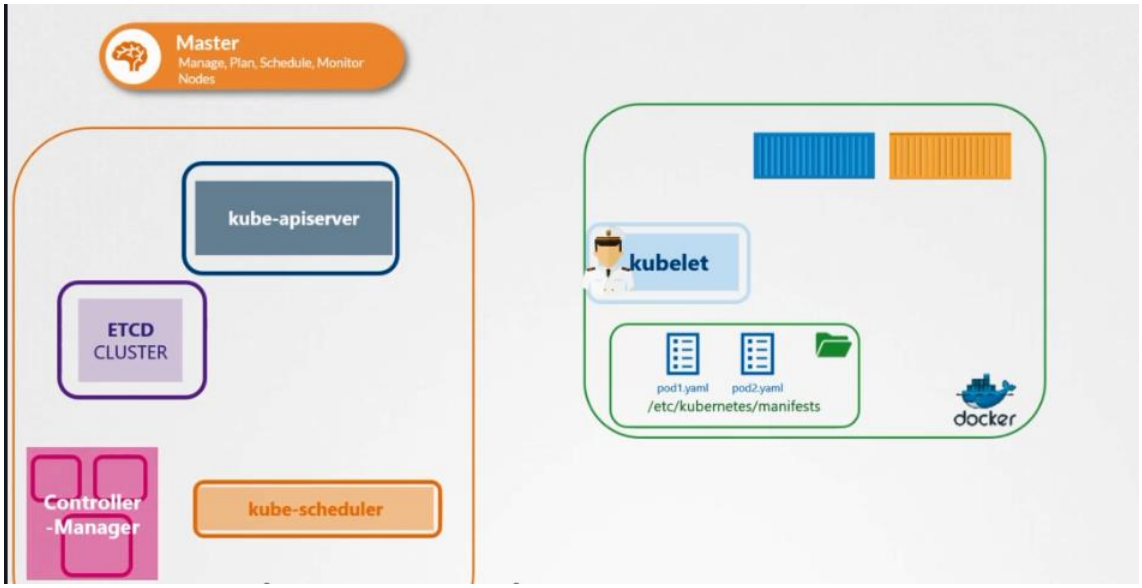


ps -aux | grep kubelet

--config=/var/lib/kubelet/config.yaml

Kubectl works with kube-apiServer only. So with only kubelet we need to use docker ps.

It can also created pod from apiserver and local manifest file acting as static pod.

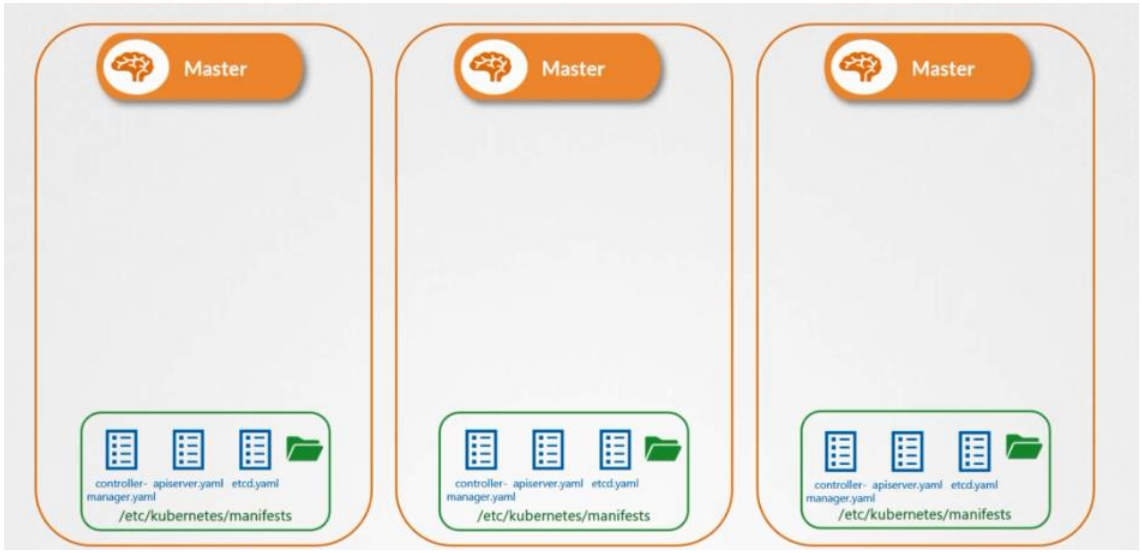


This time static pod also listed by kubectl

```
kubectl get pods
NAME                READY     STATUS              RESTARTS   AGE
static-web-node01   0/1       ContainerCreating   0          29s
```

We can only read/view the pod. We cannot edit it from kube-api-server.

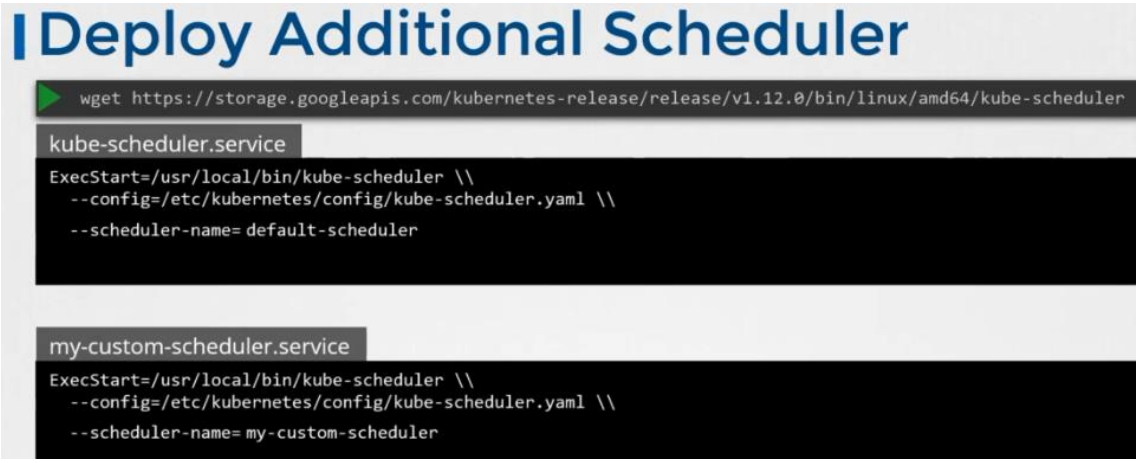
Static pod use case is making a node as master node.

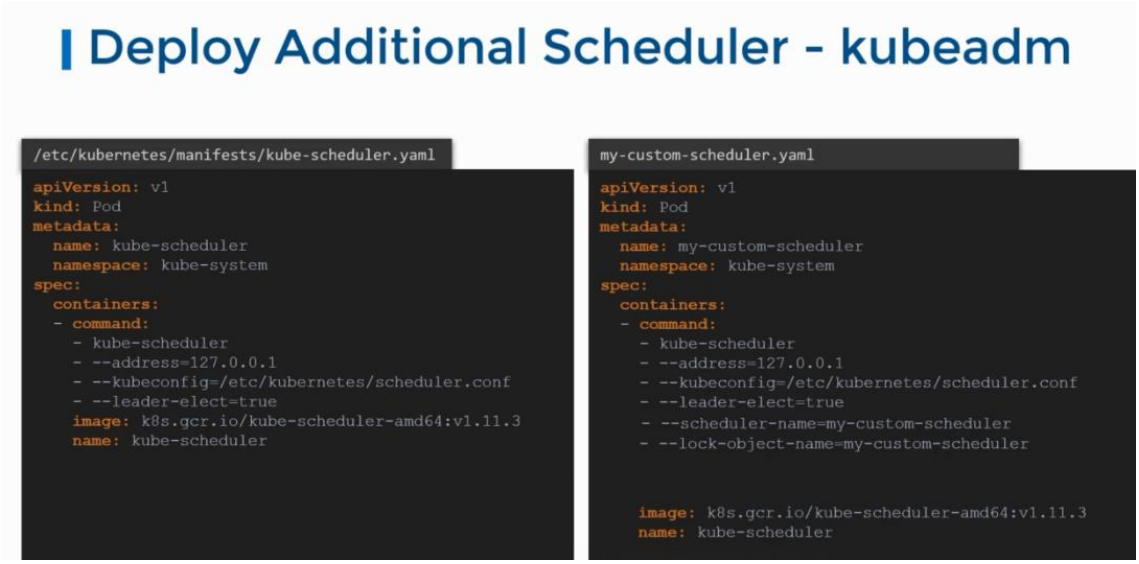


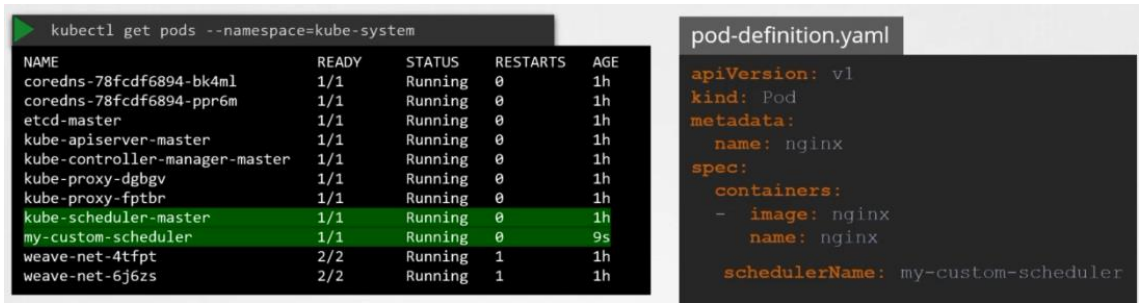
Static PODs	DaemonSets
Created by the Kubelet	Created by Kube-API server (DaemonSet Controller)
Deploy Control Plane components as Static Pods	Deploy Monitoring Agents, Logging Agents on nodes
Ignored by the Kube-Scheduler	

Multiple Schedulers:

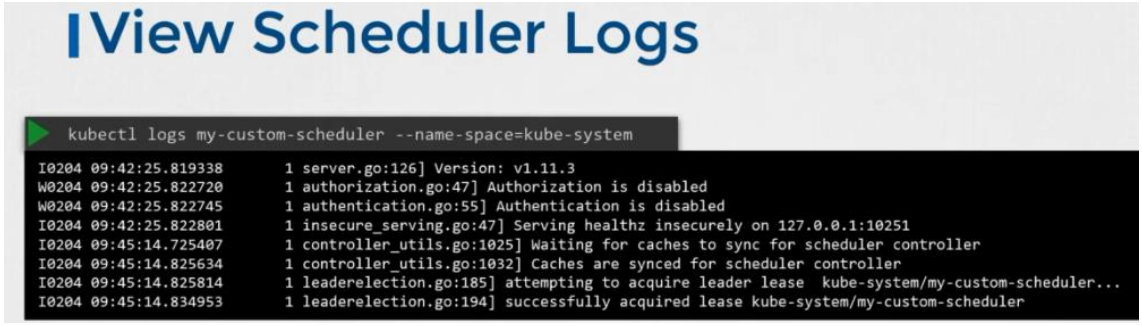
We can create your custom schedular







Kubectl get events command to list all the events in the current namespace



Logging and Monitoring

Monitors:

Node level :

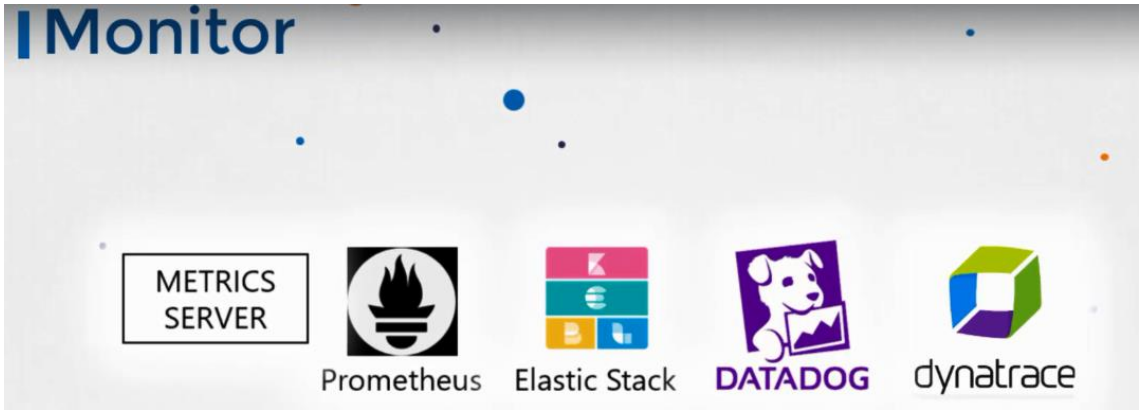
No of nodes, healthy, performance, cpu , mem, disk utilization

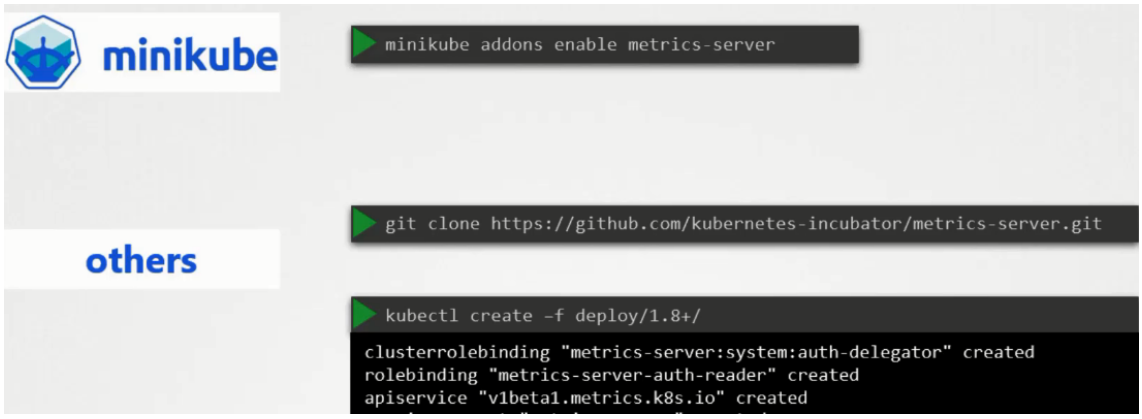
pod level metrics :

no of pods, cpu, mem consumptions

no build in monitor in k8s

other property solutions





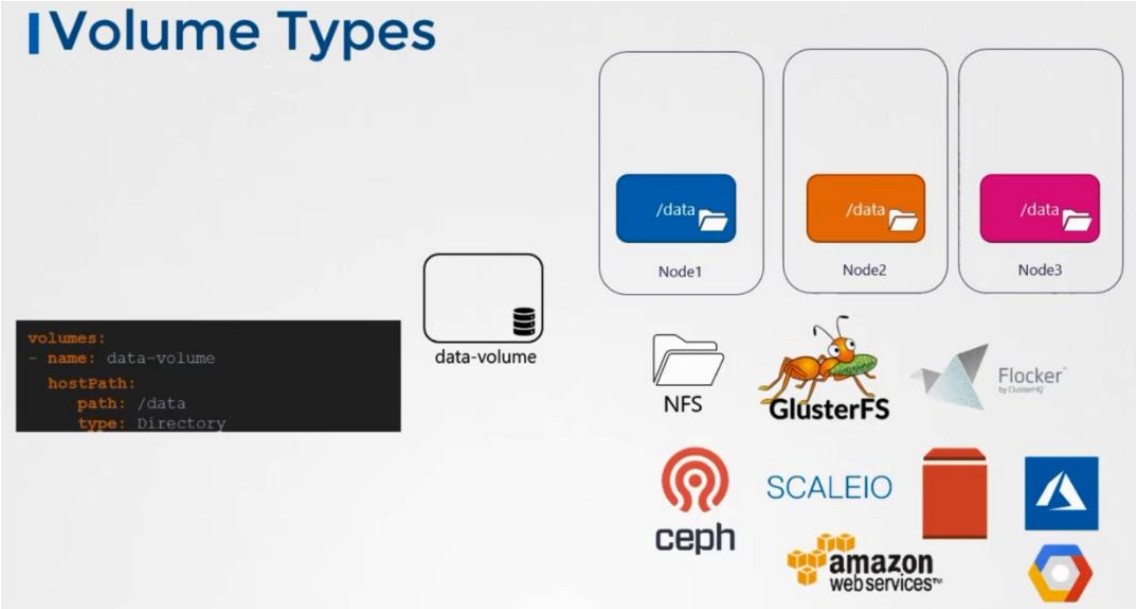
え

```
kubectl top node
NAME          CPU(cores)   CPU%      MEMORY(bytes)   MEMORY%
kubemaster    166m         8%        1337Mi          70%
kubenode1     36m          1%        1046Mi          55%
kubenode2     39m          1%        1048Mi          55%
```

```
kubectl top pod
NAME          CPU(cores)   CPU%      MEMORY(bytes)   MEMORY%
nginx         166m         8%        1337Mi          70%
redis         36m          1%        1046Mi          55%
```

Kubectl logs –f pod-name container-name

Kubectl logs podname



Application topic

Know deployments, rollingupdate,recreate,rollout

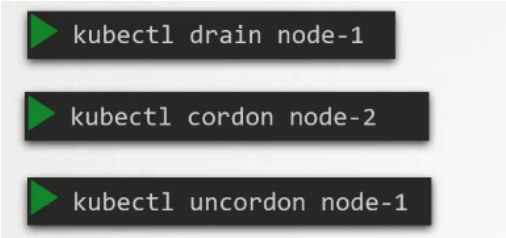
Must study config topic of CKAD

Command line args:

k run --image=kodekloud/webapp-color webapp-green --restart=Never -- --color green

ENV,config map, secrets, multi container, init container, self healing -> replicas

Cluster maintanence



kubeadm - upgrade


```
kubeadm upgrade plan
```

```
[preflight] Running pre-flight checks.
[upgrade] Making sure the cluster is healthy:
[upgrade/config] Making sure the configuration is correct:
[upgrade] Fetching available versions to upgrade to
[upgrade/versions] Cluster version: v1.11.8
[upgrade/versions] kubeadm version: v1.11.3
[upgrade/versions] Latest stable version: v1.13.4
[upgrade/versions] Latest version in the v1.11 series: v1.11.8

Components that must be upgraded manually after you have
upgraded the control plane with 'kubeadm upgrade apply':
COMPONENT   CURRENT       AVAILABLE
Kubelet     3 x v1.11.3   v1.13.4

Upgrade to the latest stable version:

COMPONENT            CURRENT   AVAILABLE
API Server           v1.11.8   v1.13.4
Controller Manager   v1.11.8   v1.13.4
Scheduler            v1.11.8   v1.13.4
Kube Proxy           v1.11.8   v1.13.4
CoreDNS              1.1.3     1.1.3
Etcd                 3.2.18    N/A
```

kubeadm - upgrade

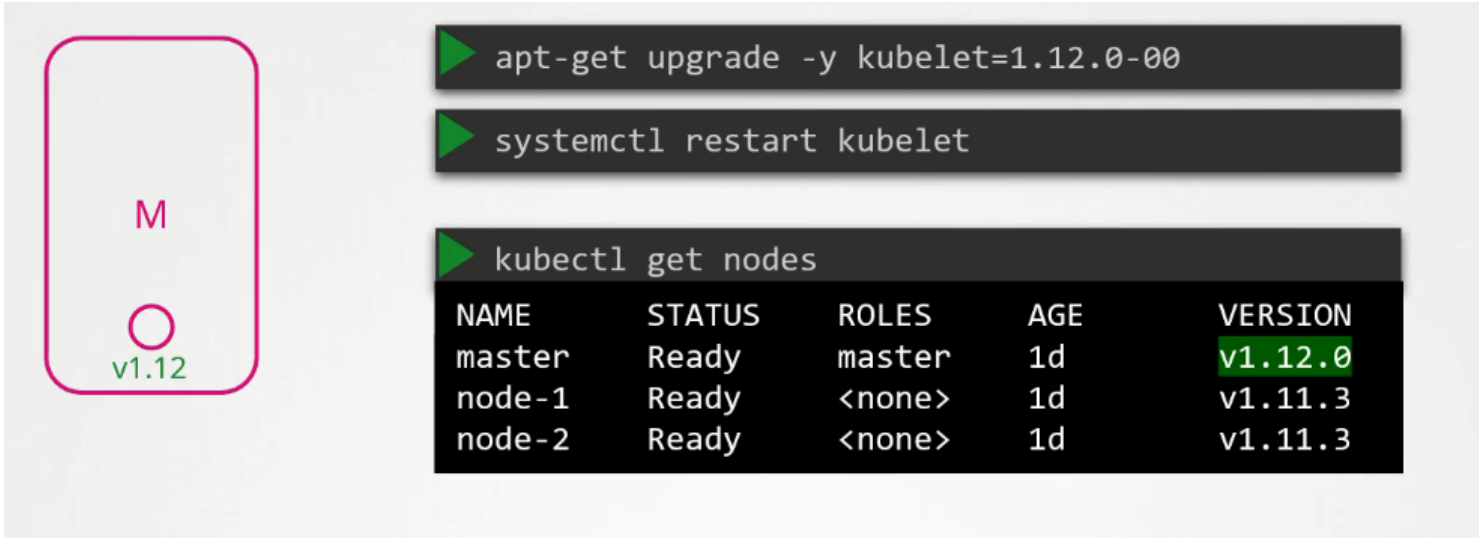

```
apt-get upgrade -y kubeadm=1.12.0-00
```

```
kubeadm upgrade apply v1.12.0
```

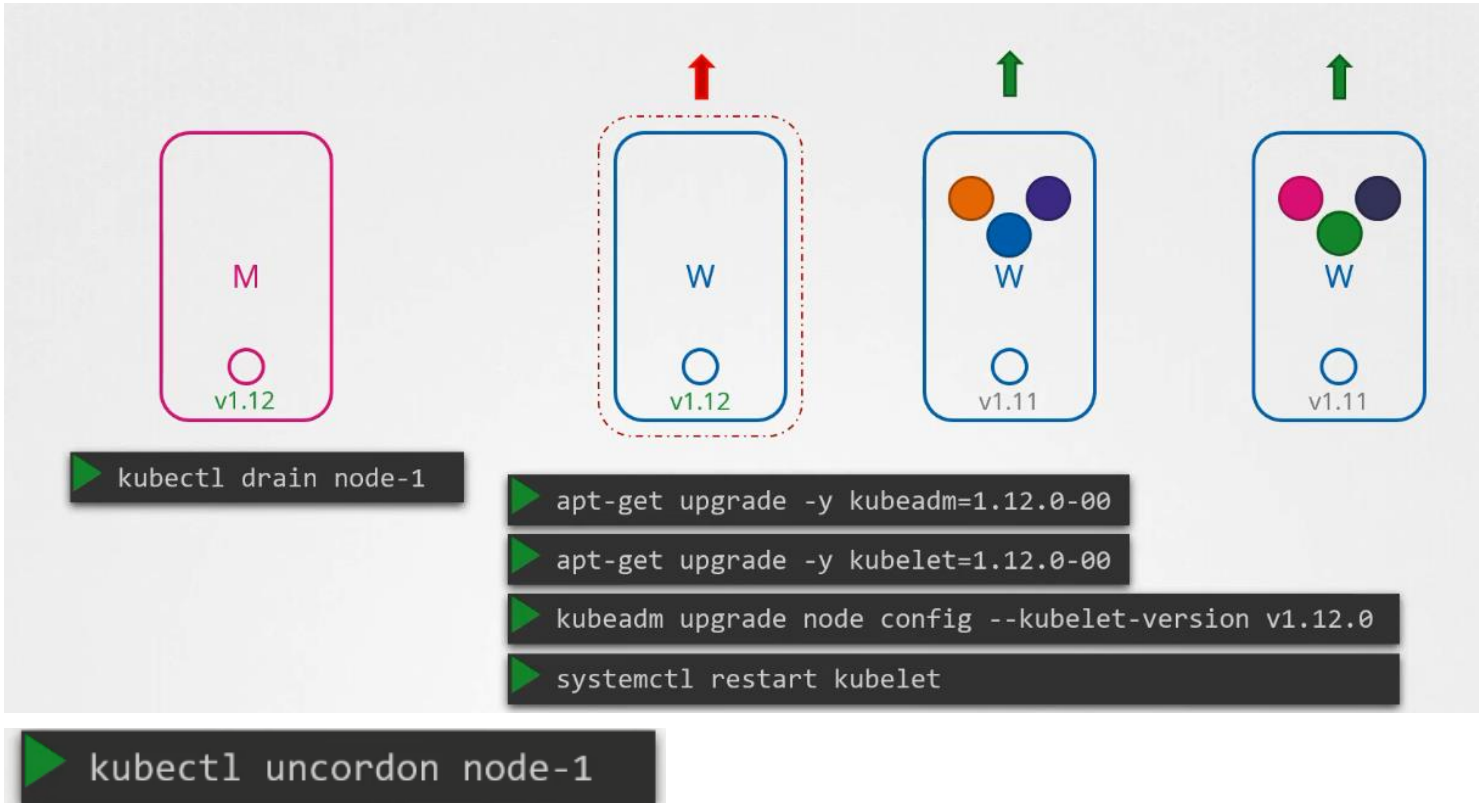
```
…

[upgrade/successful] SUCCESS! Your cluster was upgraded to "v1.12.0". Enjoy!

[upgrade/kubelet] Now that your control plane is upgraded, please proceed with
upgrading your kubelets if you haven't already done so.
```

```
kubectl get nodes
```

```
NAME      STATUS    ROLES     AGE       VERSION
master    Ready     master    1d        v1.11.3
node-1    Ready     <none>    1d        v1.11.3
node-2    Ready     <none>    1d        v1.11.3
```



Master node completed. Worker node upgrade



After upgrading,We have to uncordon node to schedule a new pod in this node

Backup – Resource Configs

kube-apiserver

Resource Configuration

```
kubectl get all --all-namespaces -o yaml > all-deploy-services.yaml
```

VELERO

Formerly called ARK by HeptIO

Backup - ETCD

ETCD Cluster

ETCD M ETCD M ETCD M

```
ETCDCTL_API=3 etcdctl \
    snapshot save snapshot.db
```

```
ls
snapshot.db
```

```
ETCDCTL_API=3 etcdctl \
    snapshot status snapshot.db
```

```
+----------+----------+------------+------------+
|   HASH   | REVISION | TOTAL KEYS | TOTAL SIZE |
+----------+----------+------------+------------+
| e63b3fc5 |   473353 |        875 |     4.1 MB |
+----------+----------+------------+------------+
```

Restore - ETCD

ETCD Cluster

```
ETCDCTL_API=3 etcdctl \
   snapshot restore snapshot.db \
   --data-dir /var/lib/etcd-from-backup \
   --initial-cluster master-
1=https://192.168.5.11:2380,master-
2=https://192.168.5.12:2380 \
   --initial-cluster-token etcd-cluster-1 \
   --initial-advertise-peer-urls
https://${INTERNAL_IP}:2380
```

```
I | mvcc: restore compact to 475629
I | etcdserver/membership: added member 5e89ccdfe3
[https://192.168.5.12:2380] to cluster 894c7131f5165a78
I | etcdserver/membership: added member c8246cee7c
[https://192.168.5.11:2380] to cluster 894c7131f5165a78
```

```
systemctl daemon-reload
```

```
service etcd restart
```

```
ETCDCTL_API=3 etcdctl \
     snapshot save snapshot.db
```

```
ls
snapshot.db
```

```
service kube-apiserver stop
Service kube-apiserver stopped
```

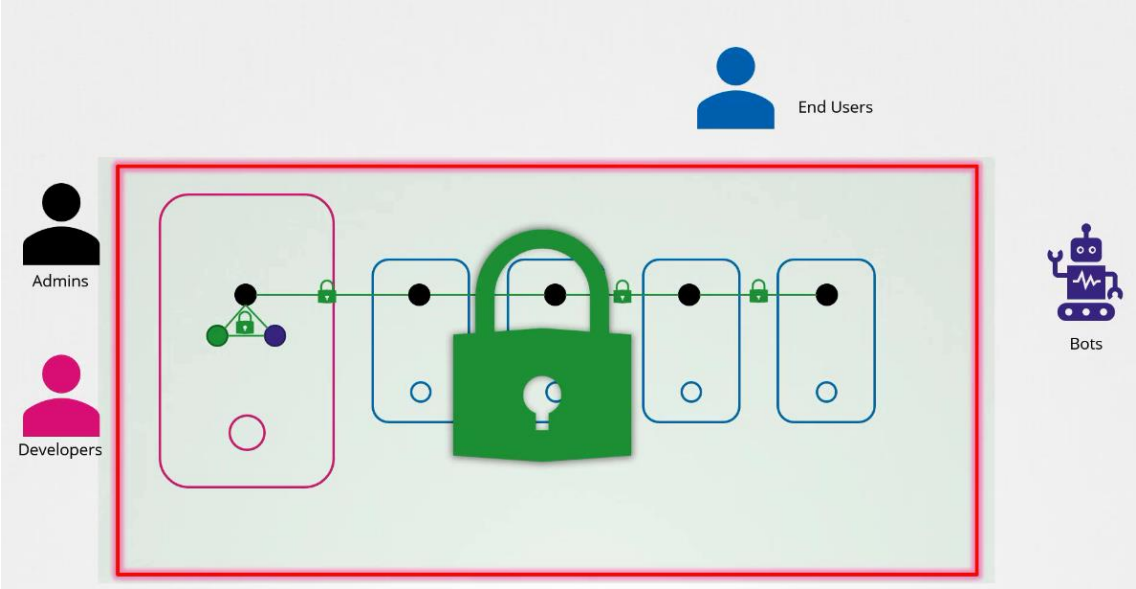
etcd.service

```
ExecStart=/usr/local/bin/etcd \\
  --name ${ETCD_NAME} \\
  --cert-file=/etc/etcd/kubernetes.pem \\
  --key-file=/etc/etcd/kubernetes-key.pem \\
  --peer-cert-file=/etc/etcd/kubernetes.pem \\
  --peer-key-file=/etc/etcd/kubernetes-key.pem \\
  --trusted-ca-file=/etc/etcd/ca.pem \\
  --peer-trusted-ca-file=/etc/etcd/ca.pem \\
  --peer-client-cert-auth \\
  --client-cert-auth \\
  --initial-advertise-peer-urls https://${INTERNAL_
  --listen-peer-urls https://${INTERNAL_IP}:2380 \\
  --listen-client-urls https://${INTERNAL_IP}:2379,
  --advertise-client-urls https://${INTERNAL_IP}:23
  --initial-cluster-token etcd-cluster-1    \
  --initial-cluster controller-0=https://${CONTROLL
  --initial-cluster-state new \\
  --data-dir=/var/lib/etcd-from-backup
```

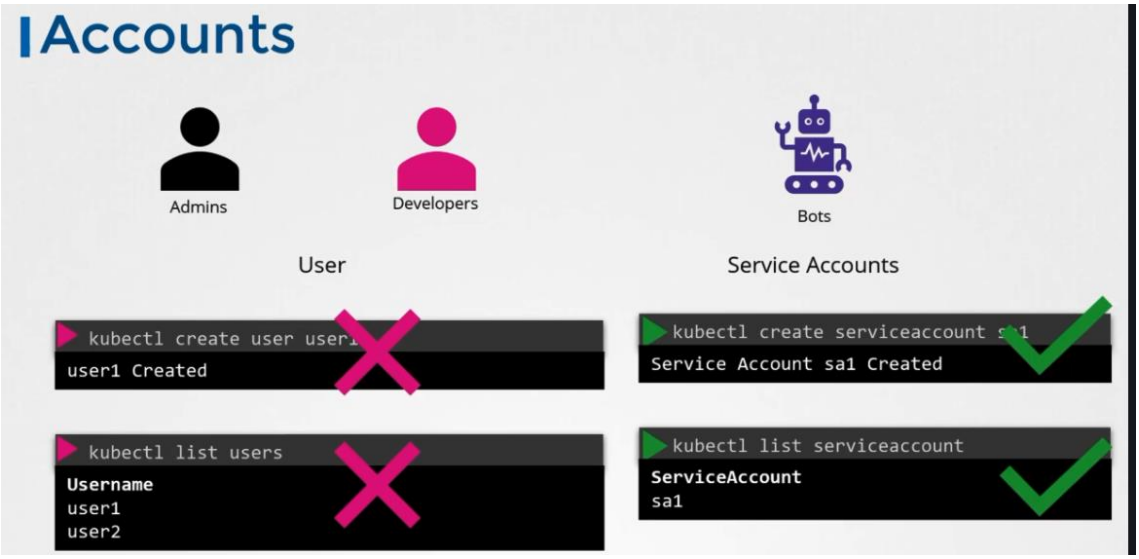
```
service kube-apiserver start
Service kube-apiserver started
```

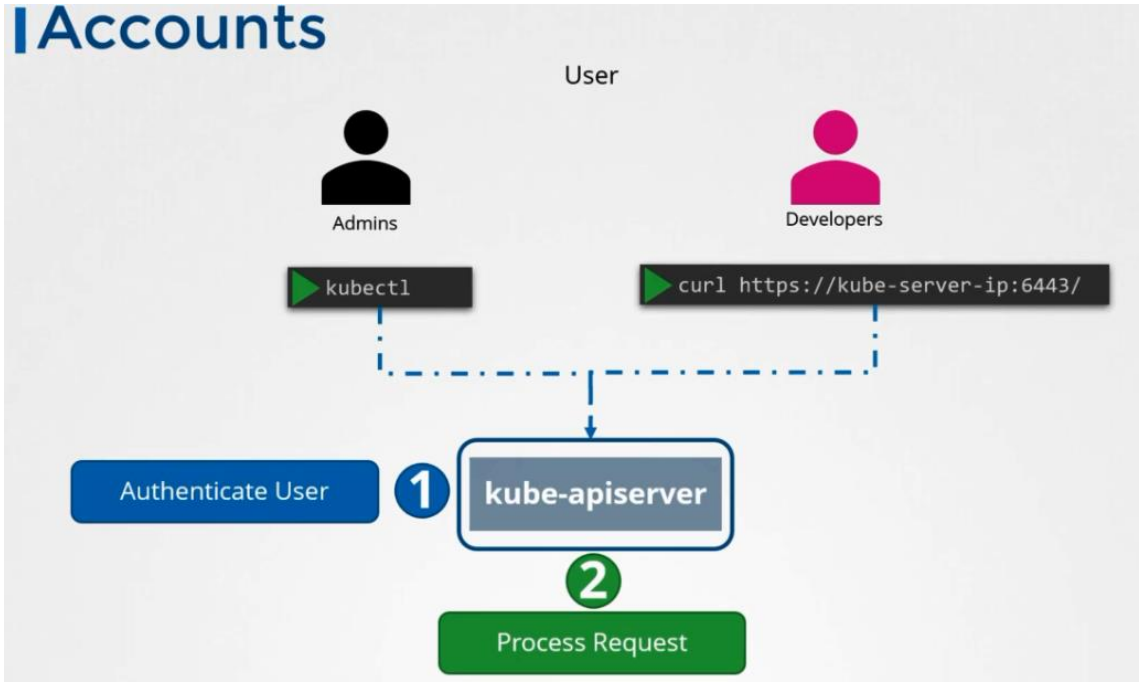
```
ETCDCTL_API=3 etcdctl \
     snapshot save snapshot.db \

     --endpoints=https://127.0.0.1:2379 \
     --cacert=/etc/etcd/ca.crt \
     --cert=/etc/etcd/etcd-server.crt \
     --key=/etc/etcd/etcd-server.key
```

Security



K8s does not manage account natively . it depends on 3rd party like ldap.





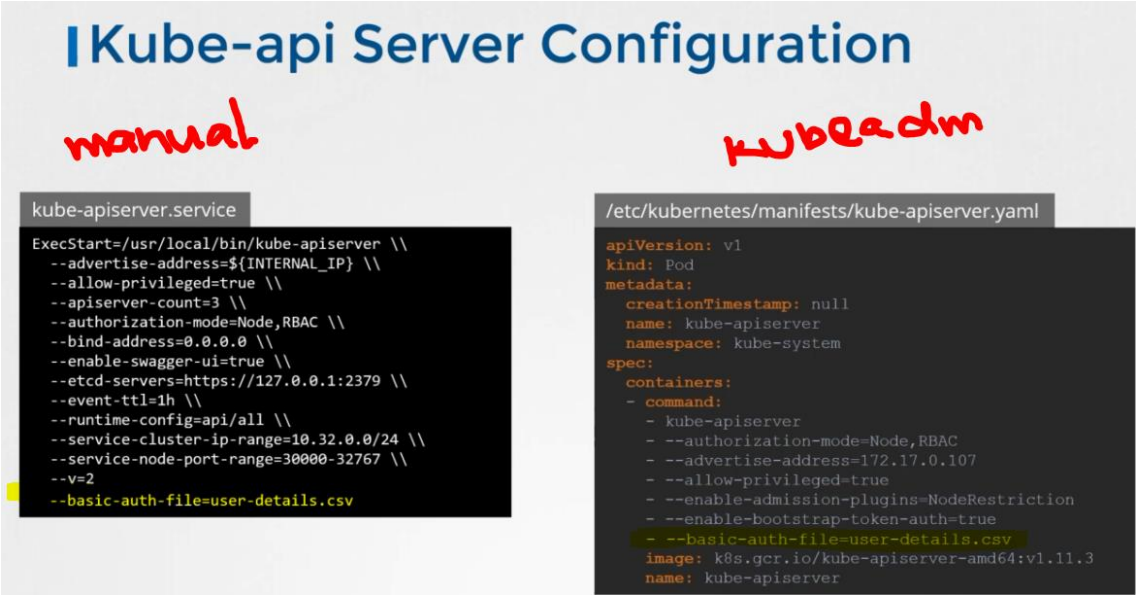
How does kube-api server authenticate ?

Static passwprd File

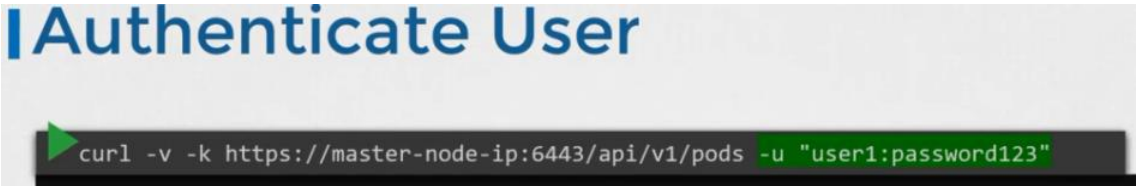
user-details.csv

```
password123,user1,u0001
password123,user2,u0002
password123,user3,u0003
password123,user4,u0004
password123,user5,u0005
```

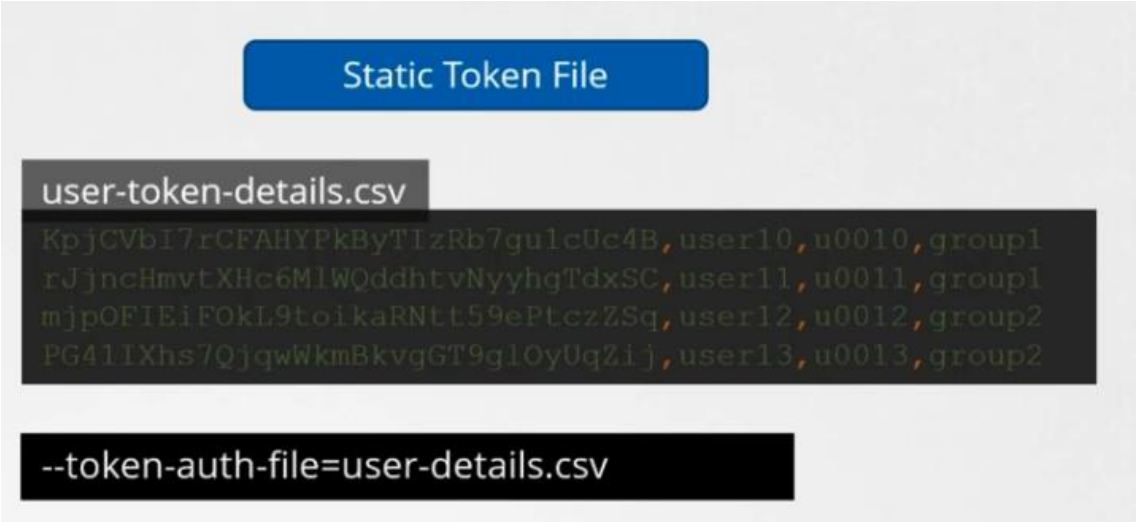
Pass the file name to the kubeapi servera and restart it. For kubeadm -> automaticaly restarts the server



Now you can access kube-api server with the provided athentication



Similarly Token file also passed to kube api server,restart it. Athendicate the user



Setup basic authentication on kubernetes

Note: This is not recommended in a production environment. This is only for learning purposes.
Follow the below instructions to configure basic authentication in a kubeadm setup.

Create a file with user details locally at `/tmp/users/user-details.csv`

```
# User File Contents
password123,user1,u0001
password123,user2,u0002
password123,user3,u0003
password123,user4,u0004
password123,user5,u0005
```

Edit the kube-apiserver static pod configured by kubeadm to pass in the user details.

The file is located at `/etc/kubernetes/manifests/kube-apiserver.yaml`

```
apiVersion: v1
kind: Pod
metadata:
  name: kube-apiserver
  namespace: kube-system
spec:
  containers:
  - command:
    - kube-apiserver
      <content-hidden>
    image: k8s.gcr.io/kube-apiserver-amd64:v1.11.3
    name: kube-apiserver
    volumeMounts:
    - mountPath: /tmp/users
      name: usr-details
      readOnly: true
  volumes:
  - hostPath:
      path: /tmp/users
      type: DirectoryOrCreate
    name: usr-details
```

Modify the kube-apiserver startup options to include the basic-auth file

```
apiVersion: v1
kind: Pod
metadata:
  creationTimestamp: null
  name: kube-apiserver
  namespace: kube-system
spec:
  containers:
  - command:
    - kube-apiserver
    - --authorization-mode=Node,RBAC
      <content-hidden>
    - --basic-auth-file=/tmp/users/user-details.csv
```

Create the necessary roles and role bindings for these users:

```
---
kind: Role
apiVersion: rbac.authorization.k8s.io/v1
metadata:
  namespace: default
  name: pod-reader
rules:
- apiGroups: [""] # "" indicates the core API group
  resources: ["pods"]
  verbs: ["get", "watch", "list"]

---
# This role binding allows "jane" to read pods in the "default" namespace
kind: RoleBinding
apiVersion: rbac.authorization.k8s.io/v1
metadata:
  name: read-pods
  namespace: default
subjects:
- kind: User
  name: user1 # Name is case sensitive
  apiGroup: rbac.authorization.k8s.io
roleRef:
  kind: Role #this must be Role or ClusterRole
  name: pod-reader # this must match the name of the Role or ClusterRole
  apiGroup: rbac.authorization.k8s.io
```

Once created, you may authenticate into the kube-api server using the users credentials

```
curl -v -k https://localhost:6443/api/v1/pods -u "user1:password123"
```

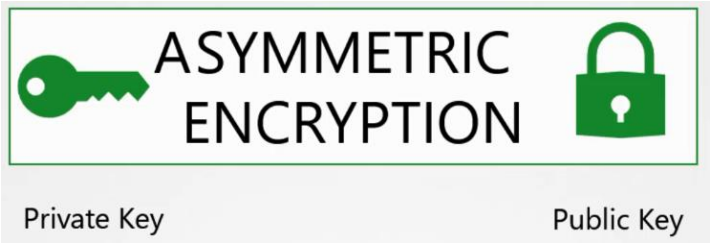
Encryption:

Symmetric encryption:

Same key used to encrypt and decrypt the data. So hackers easily get the key when you send to the server.

Asymteric:

It uses pair of keys . Private key and public key

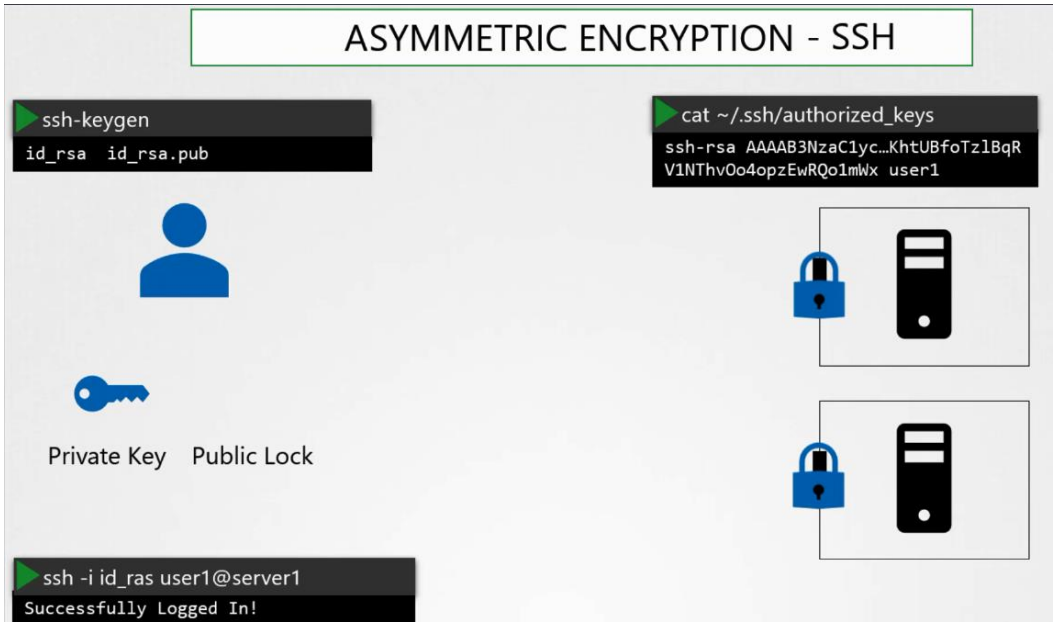


For now we will think Public key as **public lock**

Privatekey only with the users

If you encrypt the data with public lock , you can only open it with associated private key

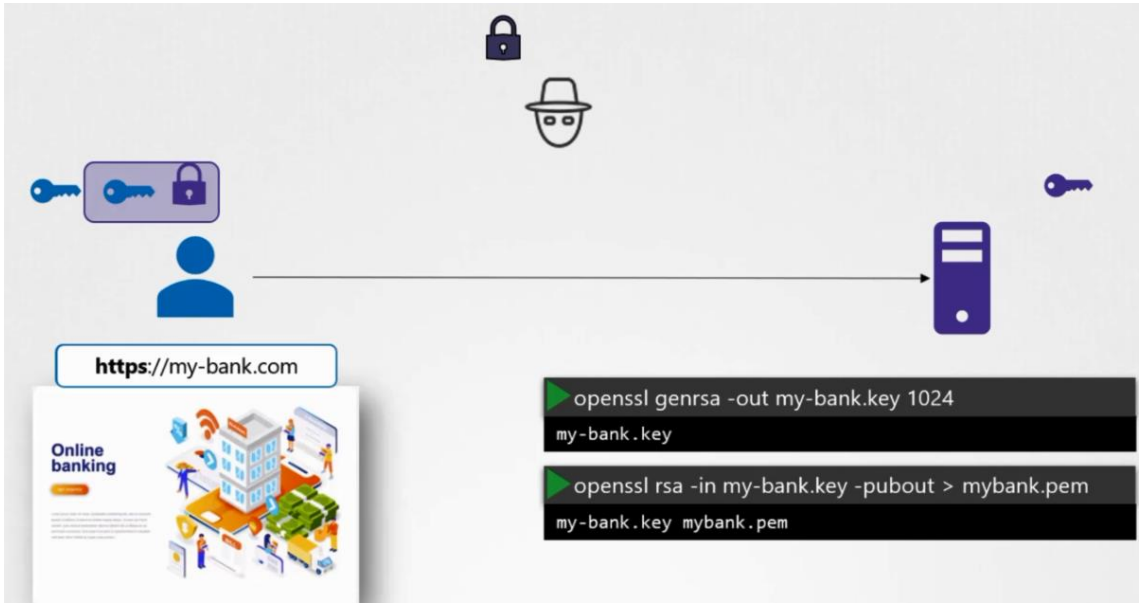
Create a private and public lock , send the public lock to the server.



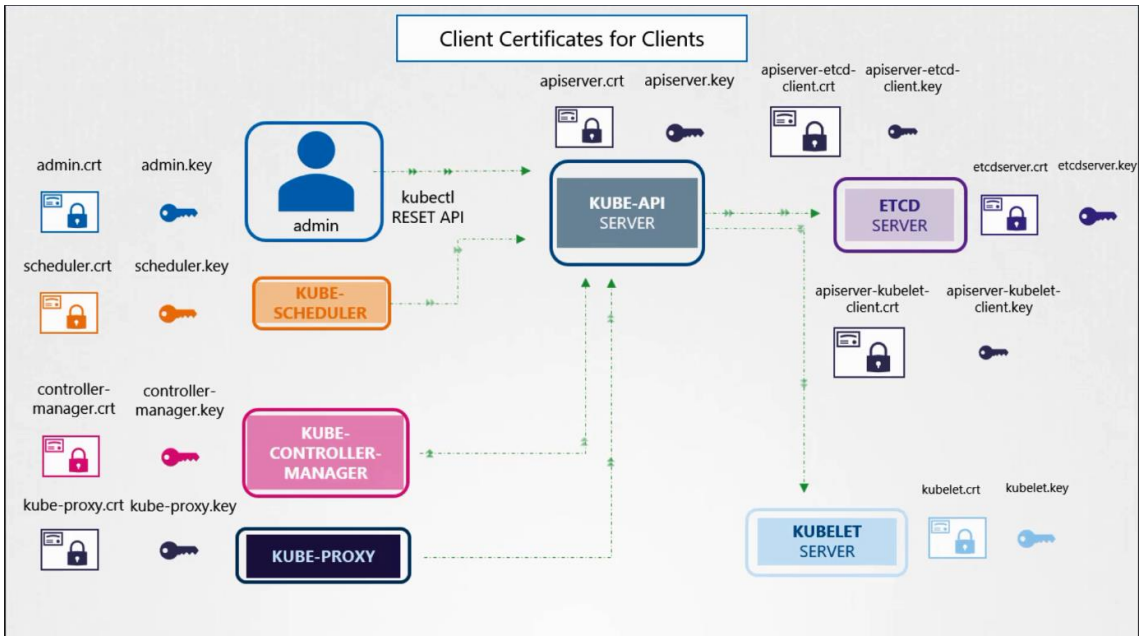
Generate private and public key at server. Send the public key to user.

Encrypt symmetric private key + public key & send to the server.

Now server can decrypt using its private key and get the users encrypted symmetric key. This works good . but we don't know that the server is valid are not. To ensure that its valid, we use CA certificate.

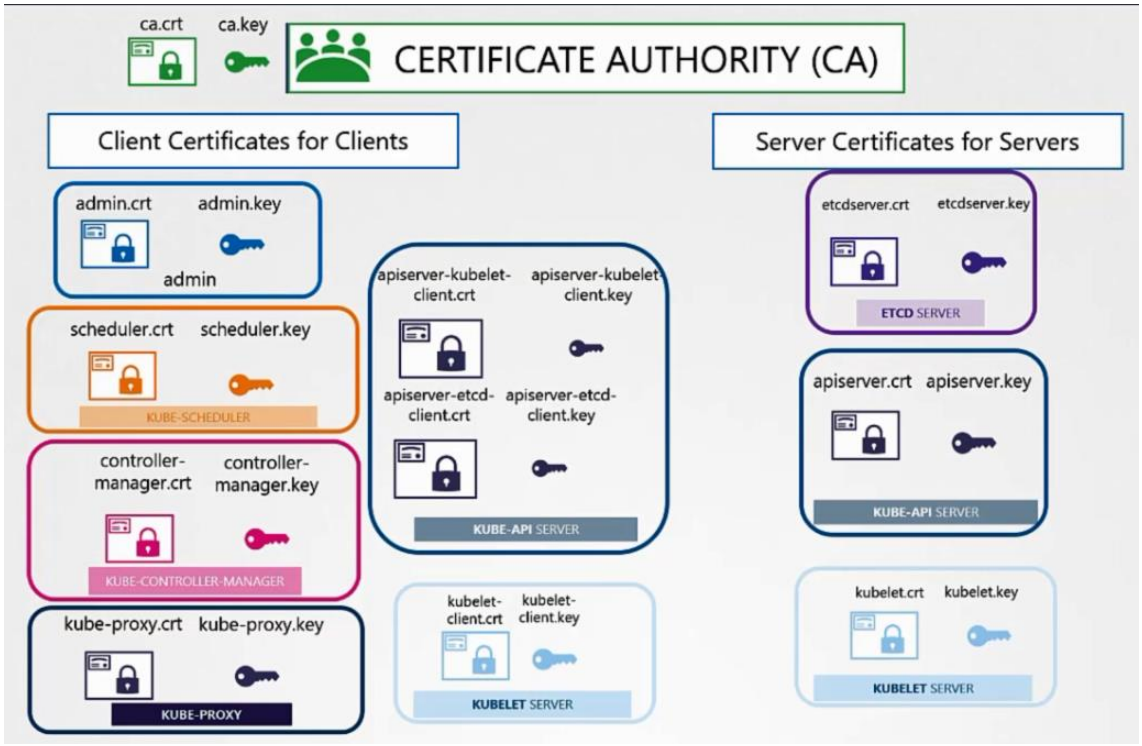


All the participants in the cluster must have unique identity (certificate and private key) to ensure and validate that they are valid users/systems

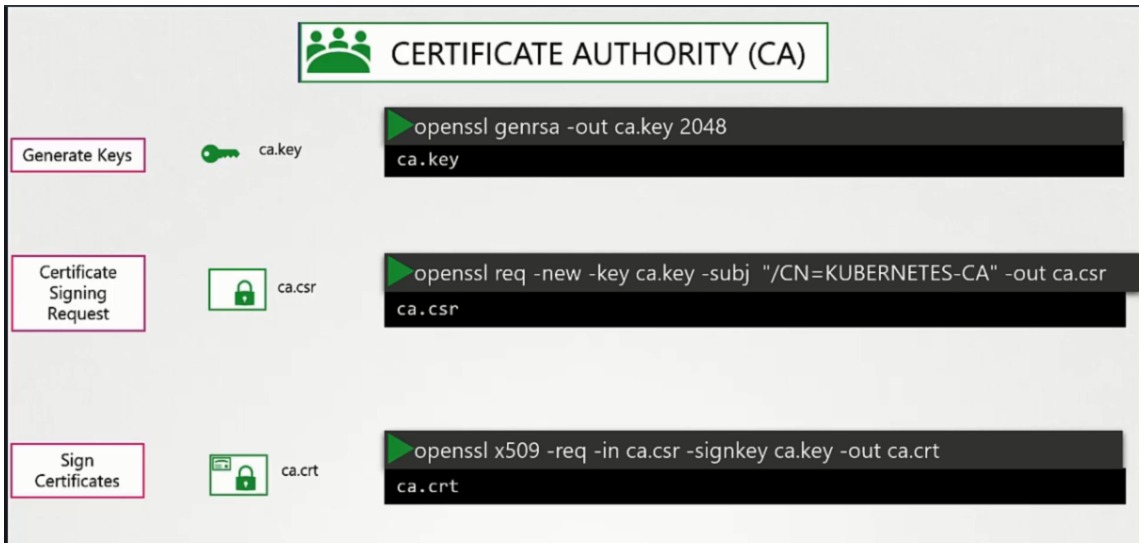


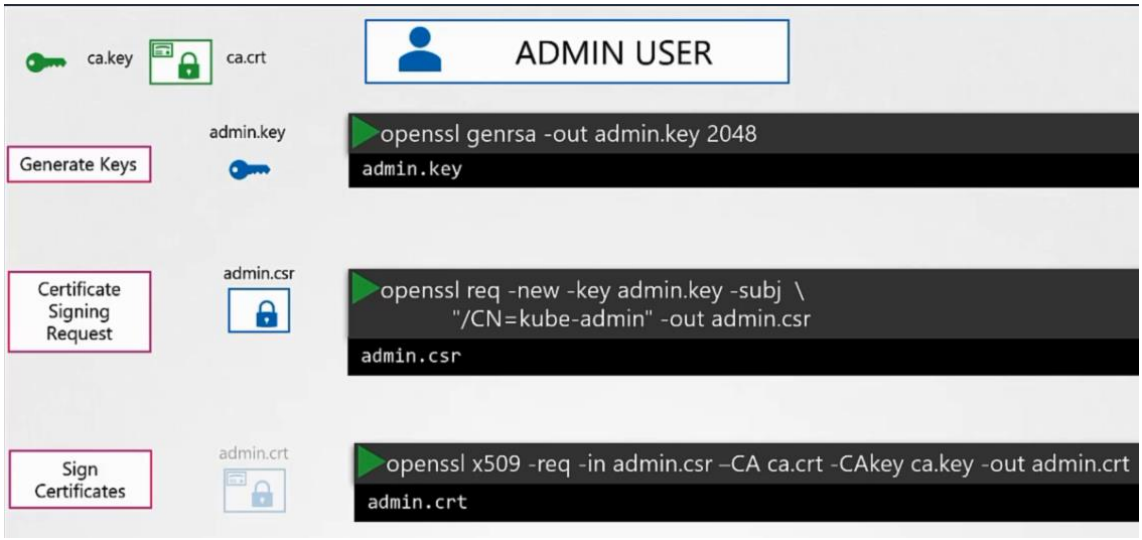
Creating certification : we can use the below toold to create certificate

Here we use openssl to generate certificate



Generating cert & key for CA





Admin users and other users are differnciated by the Groups . ex, admin is in system.masters group

It l be explained later

In the same way we create certificate for all the components.

What to do with the certificates?

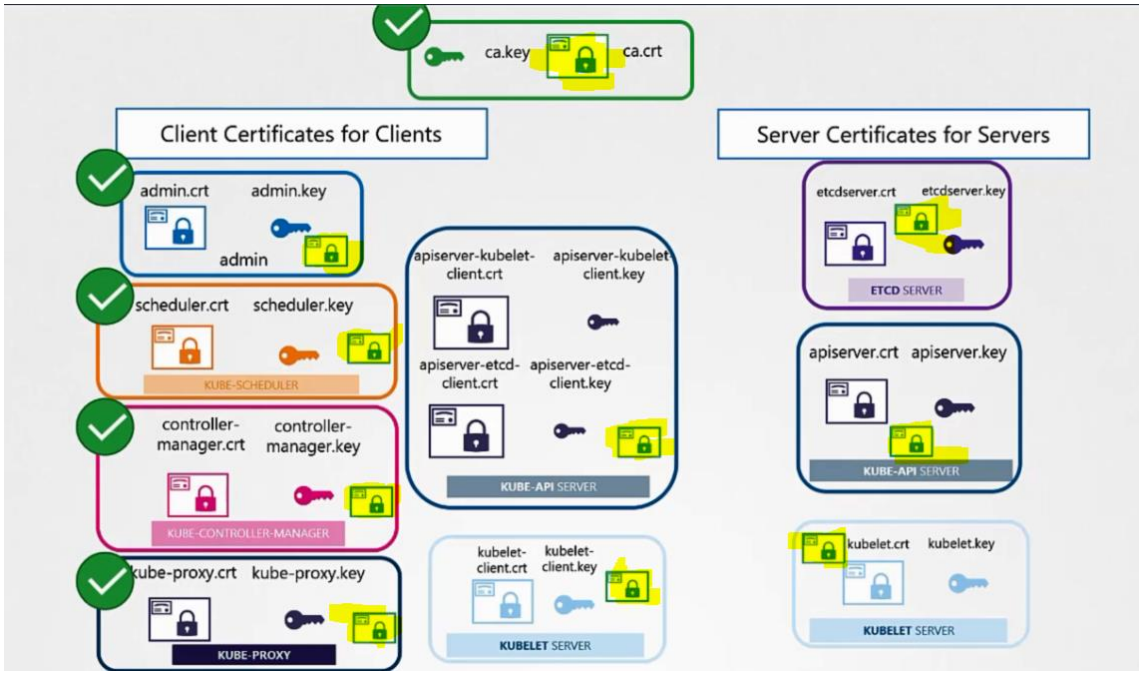
For ex admin related tasks, send curl req with certificate.

```
curl https://kube-apiserver:6443/api/v1/pods \
  --key admin.key --cert admin.crt
  --cacert ca.crt
```

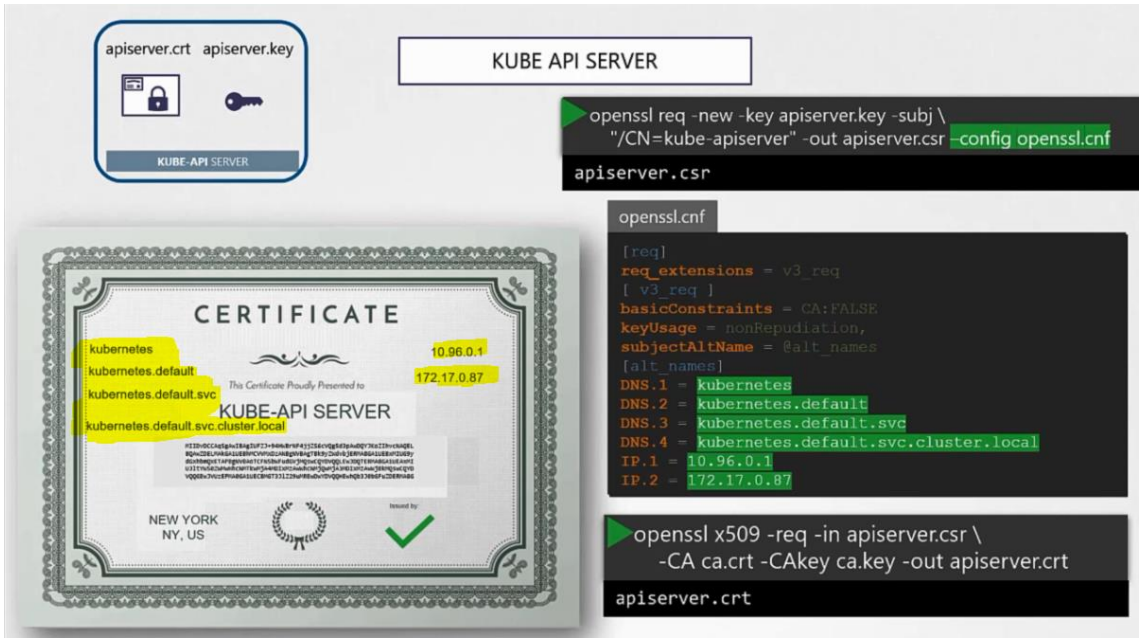
```
{
  "kind": "PodList",
  "apiVersion": "v1",
  "metadata": {
    "selfLink": "/api/v1/pods",
  },
  "items": []
}
```

Every time we cannot type the certificate details in the command. So we l mention it in kube-config file.

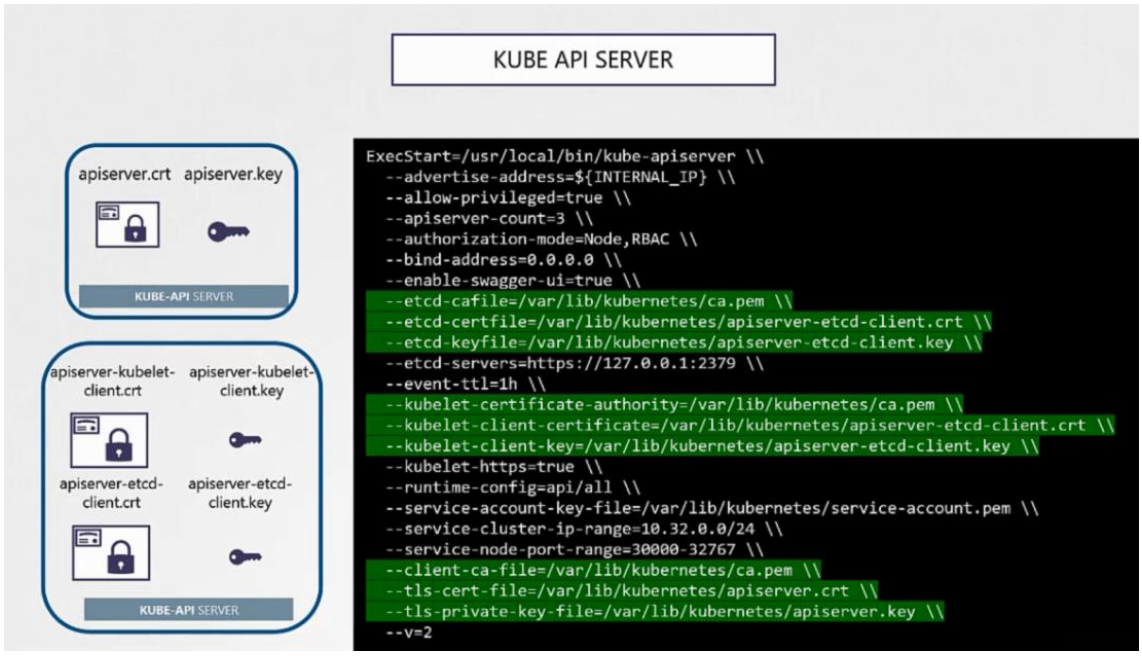
Whenever configure client or server in the cluster, we need to configure the CA certificate in all the components.



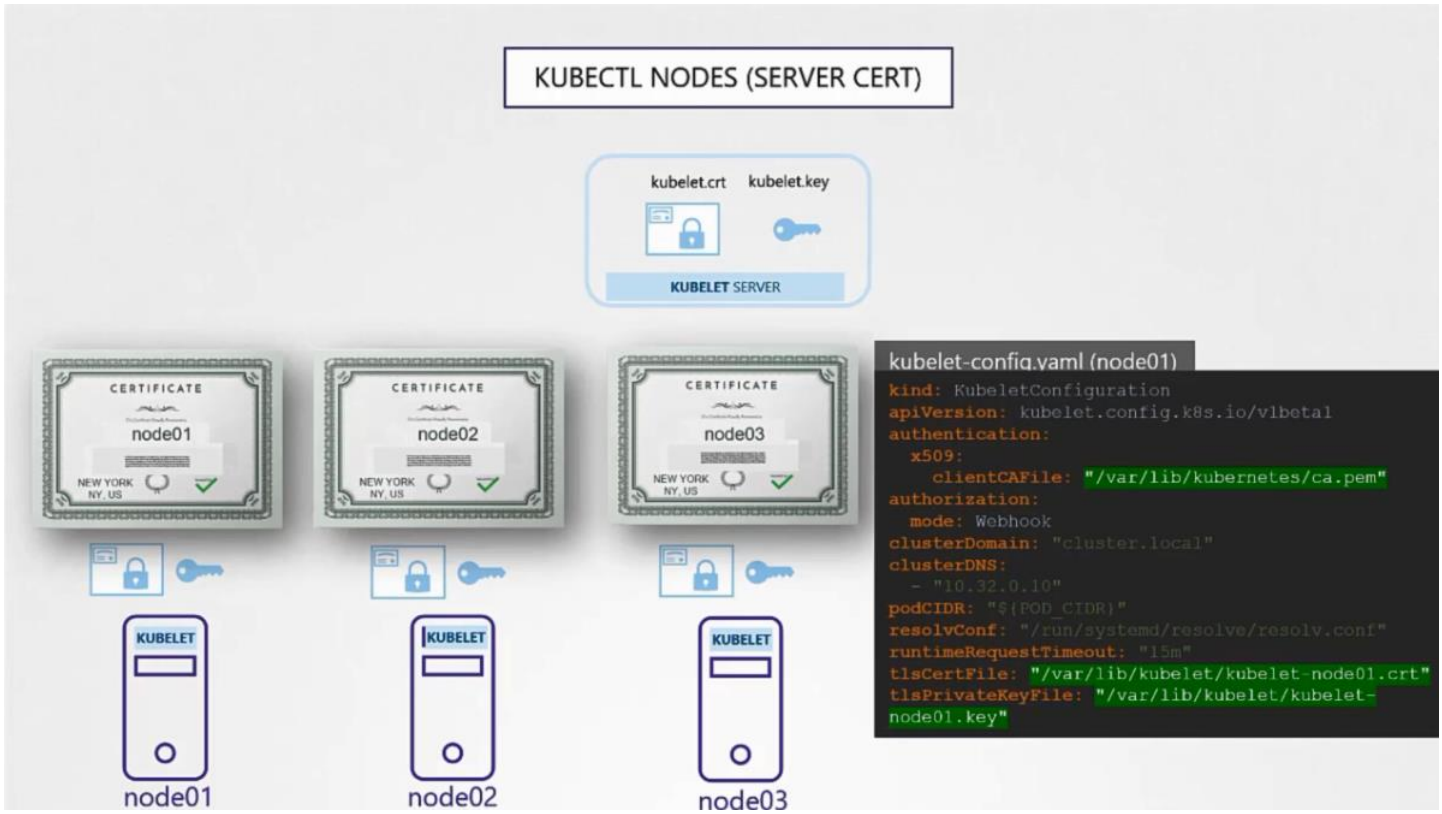
Kubeapi server is used most by all the components. It has many name, dns name, so multiple dns/ip can be configured as below.



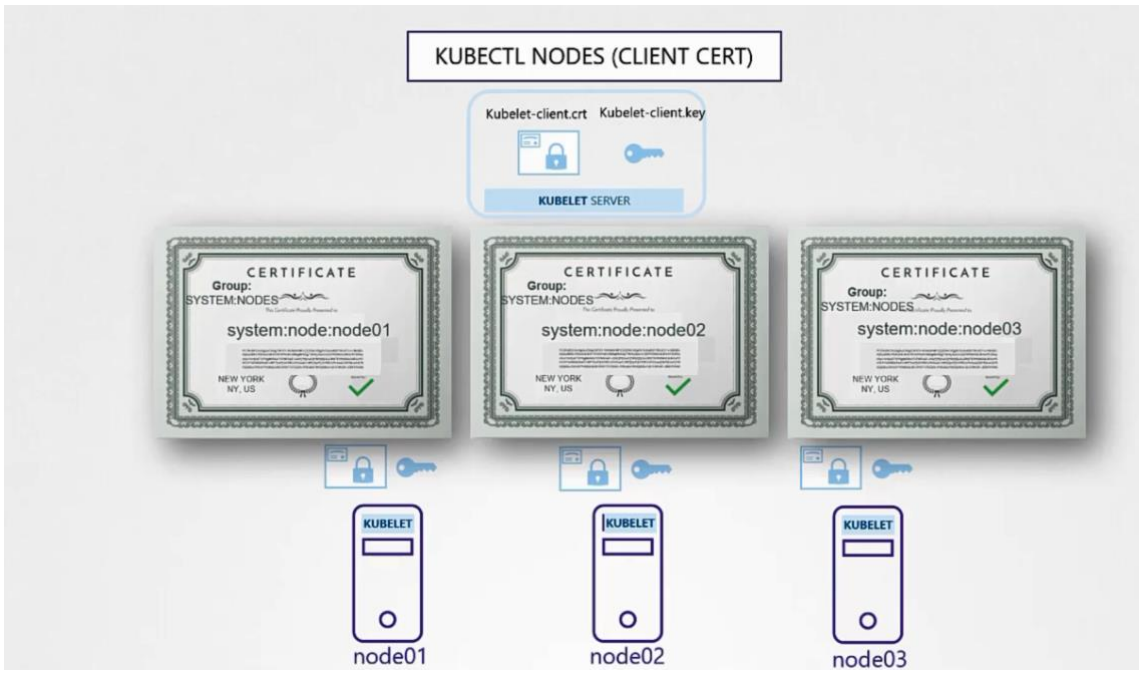
Kube-api server also act as client to etcd and kubelet . all the key should be mentioned as below



Kubelet running on each node. So certificates are issued to the nodename. These are server certificates.



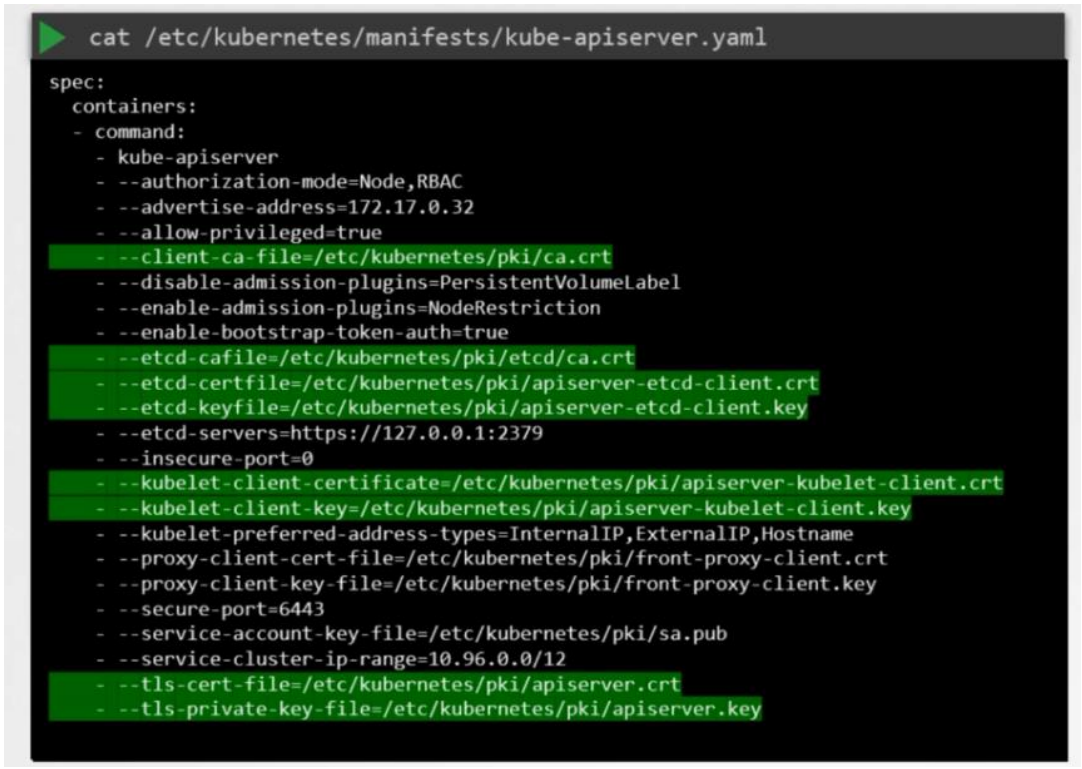
Kubelet also have certificate on client side,



View certificates

1st know how k8s is installed

In kubeadm :



/etc/kubernetes/pki/apiserver.crt

```
openssl x509 -in /etc/kubernetes/pki/apiserver.crt -text -noout
Certificate:
    Data:
        Version: 3 (0x2)
        Serial Number: 3147495682089747350 (0x2bae26a58f090396)
    Signature Algorithm: sha256WithRSAEncryption
        Issuer: CN=kubernetes
        Validity
            Not Before: Feb 11 05:39:19 2019 GMT
            Not After : Feb 11 05:39:20 2020 GMT
        Subject: CN=kube-apiserver
        Subject Public Key Info:
            Public Key Algorithm: rsaEncryption
                Public-Key: (2048 bit)
                Modulus:
                    00:d9:69:38:80:68:3b:b7:2e:9e:25:00:e8:fd:01:

                Exponent: 65537 (0x10001)
        X509v3 extensions:
            X509v3 Key Usage: critical
                Digital Signature, Key Encipherment
            X509v3 Extended Key Usage:
                TLS Web Server Authentication
            X509v3 Subject Alternative Name:
                DNS:master, DNS:kubernetes, DNS:kubernetes.default,
DNS:kubernetes.default.svc, DNS:kubernetes.default.svc.cluster.local, IP
Address:10.96.0.1, IP Address:172.17.0.27
```

Sign a new certificate for the apiserver-etcd-client

openssl x509 -req -in /etc/kubernetes/pki/apiserver-etcd-client.csr -CA /etc/kubernetes/pki/etcd/ca.crt -CAkey /etc/kubernetes/pki/etcd/ca.key -CAcreateserial -out /etc/kubernetes/pki/apiserver-etcd-client.crt

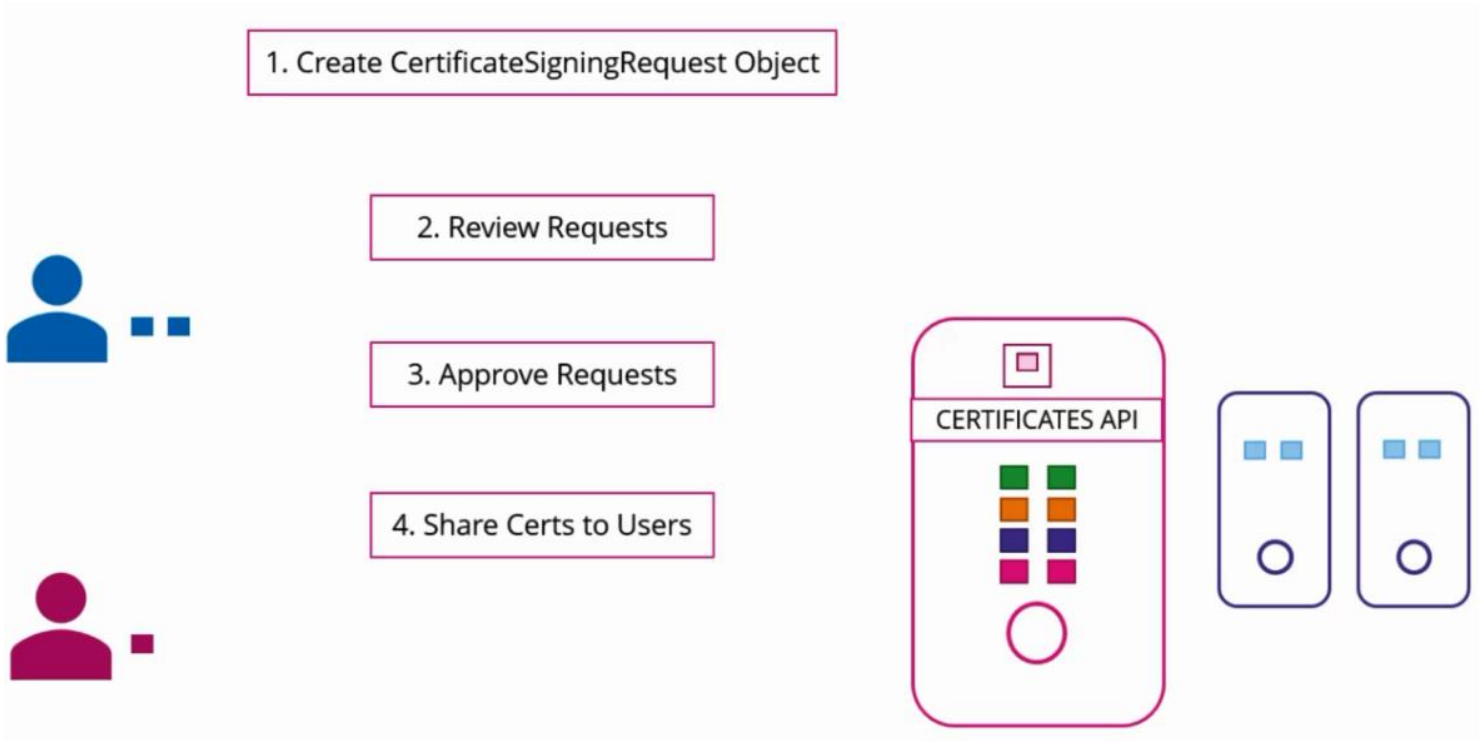
Certificate API:

CA server:

Master node is act as CA server.

When new admin asking for certificate, Admin has to login CA server,and issue certificate. After some time certificate ll be expired and it has to renew,

Instead of login Ca server everytime, admin can use the API call to issue certificate



Flow

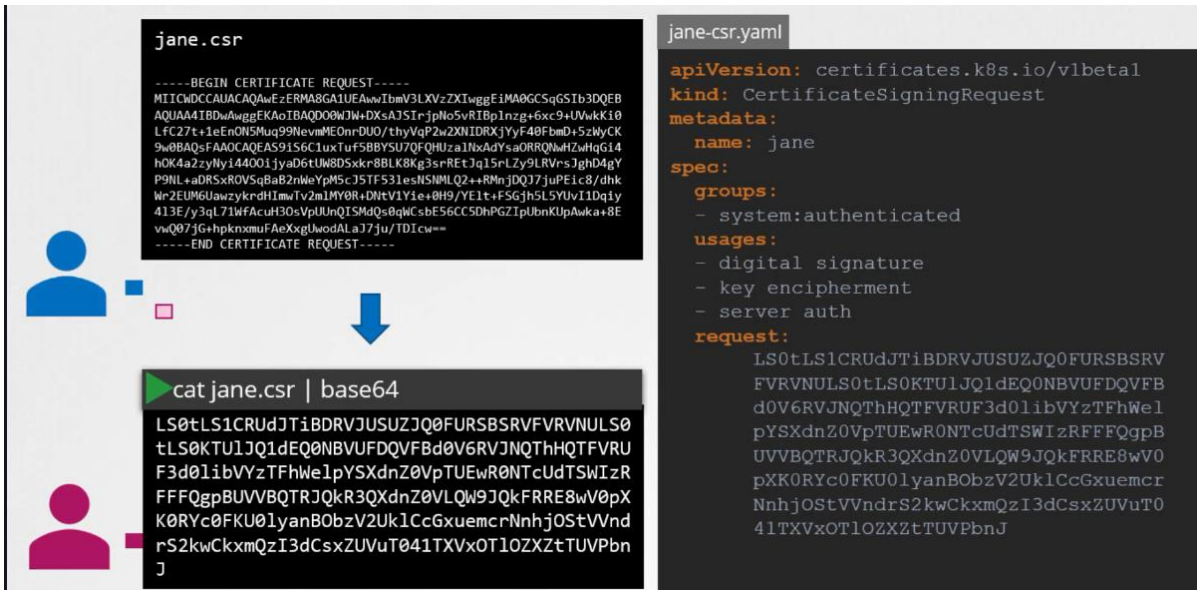
1. User first create the key

```
openssl genrsa -out jane.key 2048
jane.key
```

2. Then generate the certificate signing request to admin

```
openssl req -new -key jane.key -subj  "/CN=jane" -out jane.csr
jane.csr

-----BEGIN CERTIFICATE REQUEST-----
MIICWDCCAUACAQAwEzERMA8GA1UEAwwIbmV3LXVzZXIwggEiMA0GCSqGSIb3DQEB
AQUAA4IBDwAwggEKAoIBAQDO0WJW+DXsAJSIrjpNo5vRIBplnzg+6xc9+UVwkKi0
LfC27t+1eEnON5Muq99NevmMEOnrDUO/thyVqP2w2XNIDRXjYyF40FbmD+5zWyCK
9w0BAQsFAAOCAQEAS9iS6C1uxTuf5BBYSU7QFQHUzalNxAdYsaORRQNwHZwHqGi4
hOK4a2zyNyi44OOijyaD6tUW8D5xkr8BLK8Kg3srREtJql5rLZy9LRVrsJghD4gY
P9NL+aDRSxROVSqBaB2nWeYpM5cJ5TF53lesNSNMLQ2++RMnjDQJ7juPEic8/dhk
Wr2EUM6UawzykrdHImwTv2mlMY0R+DNtV1Yie+0H9/YE1t+FSGjh5L5YUvI1Dqiy
4l3E/y3qL71WfAcuH3OsVpUUnQISMdQs0qWCsbE56CC5DhPGZIpUbnKUpAwka+8E
vwQ07jG+hpknxmuFAeXxgUwodALaJ7ju/TDIcw==
-----END CERTIFICATE REQUEST-----
```

3. Admin takes the key, and create the certificate signing request object

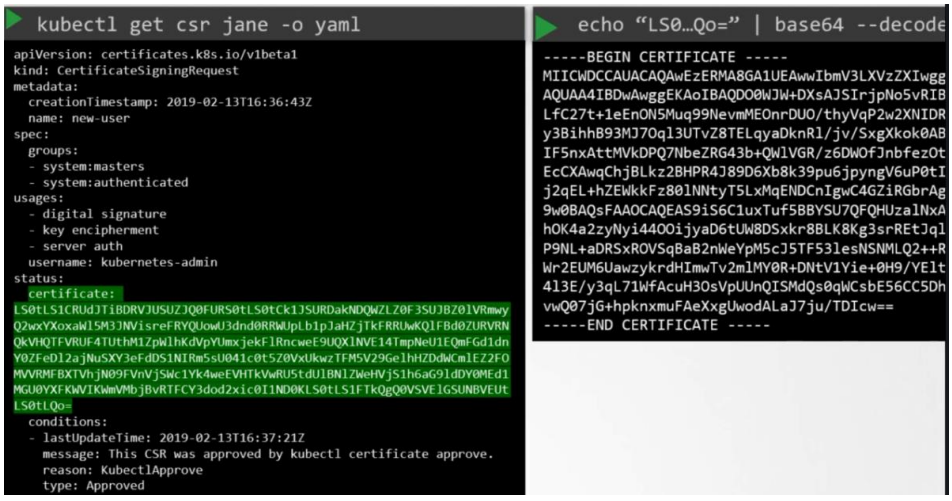


jane-csr.yaml

```yaml
apiVersion: certificates.k8s.io/v1beta1
kind: CertificateSigningRequest
metadata:
  name: jane
spec:
  groups:
  - system:authenticated
  usages:
  - digital signature
  - key encipherment
  - server auth
  request:
      LS0tLS1CRUdJTiBDRVJUSUZJQ0FURSBSRV
      FVRVNULS0tLS0KTUlJQ1dEQ0NBVUFDQVFB
      d0V6RVJNQThHQTFVRUF3d0libVYzTFhWel
      pYSXdnZ0VpTUEwR0NTcUdTSWIzRFFFQgpB
      UVVBQTRJQkR3QXdnZ0VLQW9JQkFRRE8wV0
      pXK0RYc0FKU0lyanBObzV2UklCcGxuemcr
      NnhjOStVVndrS2kwCkxmQzI3dCsxZUVuT0
      41TXVxOTlOZXZtTUVPbnJ
```

4. Once certification siginging request is submitted, admin can use the command to check it and approve it

5. K8s sign the certificate using the CA key pair, and generate the certificate for the user. This certificate and then extracted and shared to the user

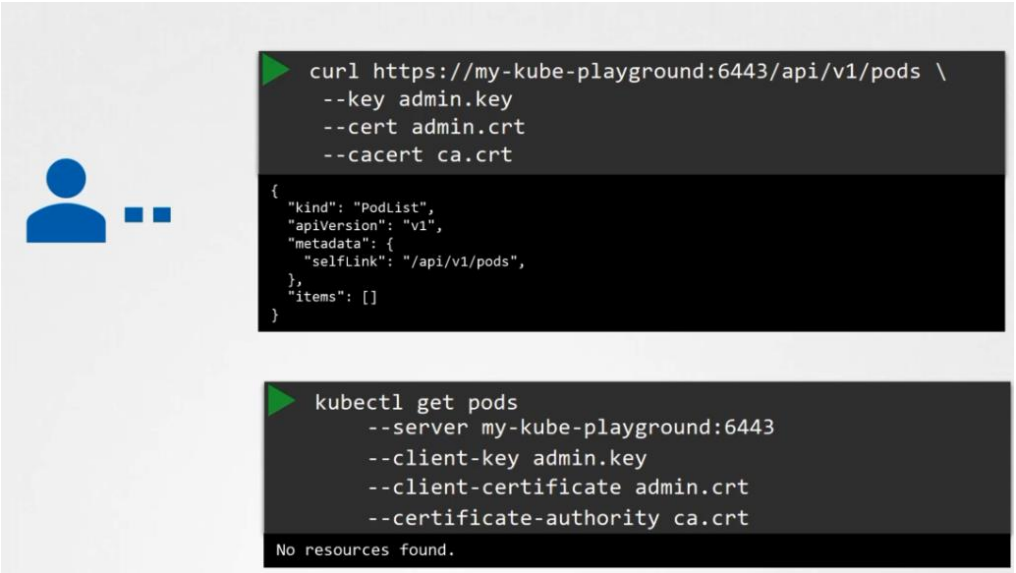


6. Control manager is responsible for CA related tasks

If anyone is sigining the certificate,they should need ROOT certificate. Controller manager has it

```
cat /etc/kubernetes/manifests/kube-controller-manager.yaml
spec:
  containers:
  - command:
    - kube-controller-manager
    - --address=127.0.0.1
    - --cluster-signing-cert-file=/etc/kubernetes/pki/ca.crt
    - --cluster-signing-key-file=/etc/kubernetes/pki/ca.key
    - --controllers=*,bootstrapsigner,tokencleaner
    - --kubeconfig=/etc/kubernetes/controller-manager.conf
    - --leader-elect=true
    - --root-ca-file=/etc/kubernetes/pki/ca.crt
    - --service-account-private-key-file=/etc/kubernetes/pki/sa.key
    - --use-service-account-credentials=true
```

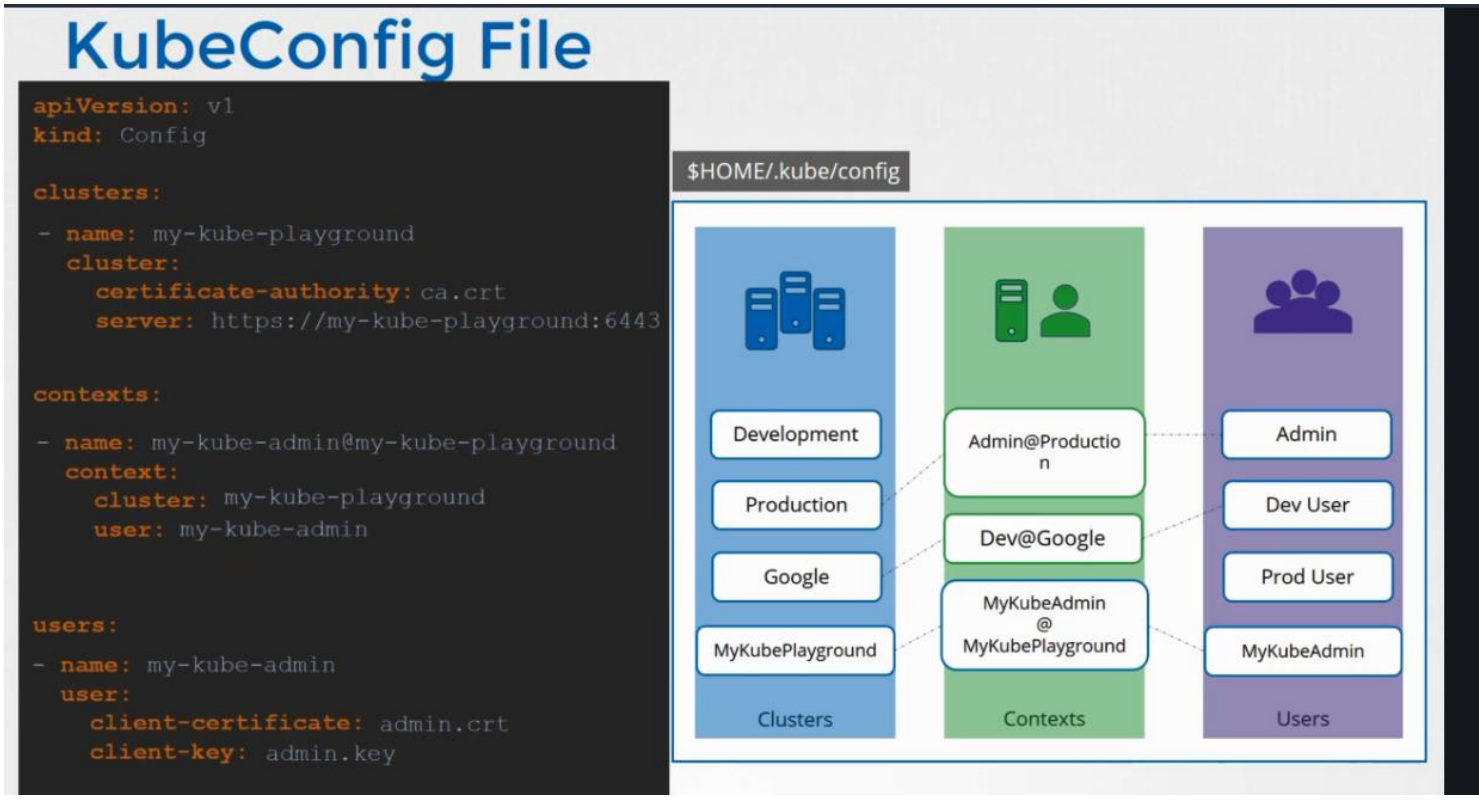
KubeConfigs



Typing those certificates every time is tedious tasks. So we kept it in kube config file.

Config file has 3 sections. 1. Cluster 2. Contexts 3.Users

Context is bridge the cluster and Users. Providing access to which user has to use which cluster



You can also mention the current context

Kubectl config

`kubectl config view`

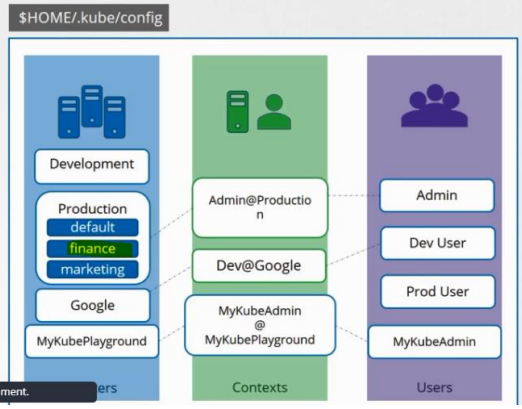
```
apiVersion: v1

kind: Config
current-context: my-kube-admin@my-kube-playground


clusters:
- name: my-kube-playground
- name: development
- name: production


contexts:
- name: my-kube-admin@my-kube-playground
- Name: prod-user@production


users:
- name: my-kube-admin
- name: prod-user
```

`kubectl config use-context prod-user@production`

```
apiVersion: v1

kind: Config
current-context: prod-user@production


clusters:
- name: my-kube-playground
- name: development
- name: production


contexts:
- name: my-kube-admin@my-kube-playground
- Name: prod-user@production


users:
- name: my-kube-admin
- name: prod-user
```

Namespaces

```
apiVersion: v1
kind: Config

clusters:
- name: production
  cluster:
    certificate-authority: ca.crt
    server: https://172.17.0.51:6443

contexts:
- name: admin@production
  context:
    cluster: production
    user: admin
    namespace: finance

users:
- name: admin
  user:
```



13 people bookmarked this moment.

Certificates in KubeConfig

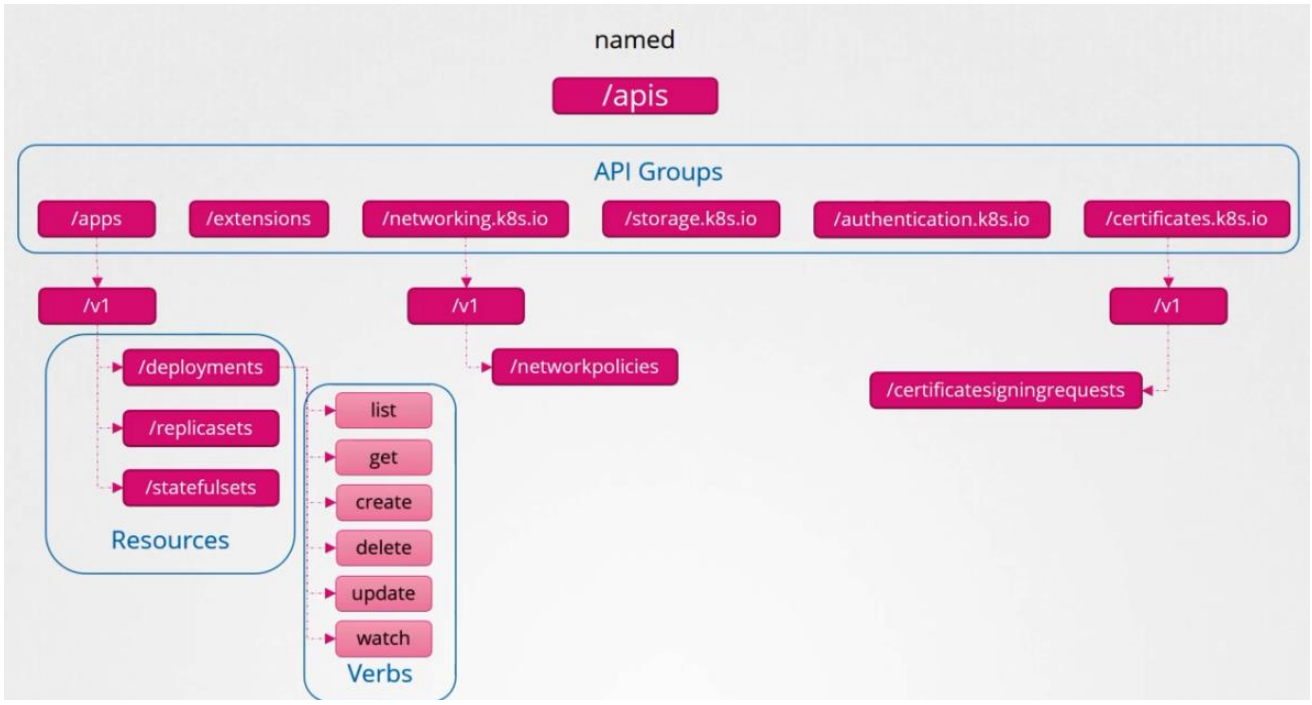
```
apiVersion: v1
kind: Config

clusters:
- name: production
  cluster:
    certificate-authority: /etc/kubernetes/pki/ca.crt
    server: https://172.17.0.51:6443

contexts:
- name: admin@production
  context:
    cluster: production
    user: admin
    namespace: finance

users:
- name: admin
  user:
    client-certificate: /etc/kubernetes/pki/users/admin.crt
    client-key: /etc/kubernetes/pki/users/admin.key
```

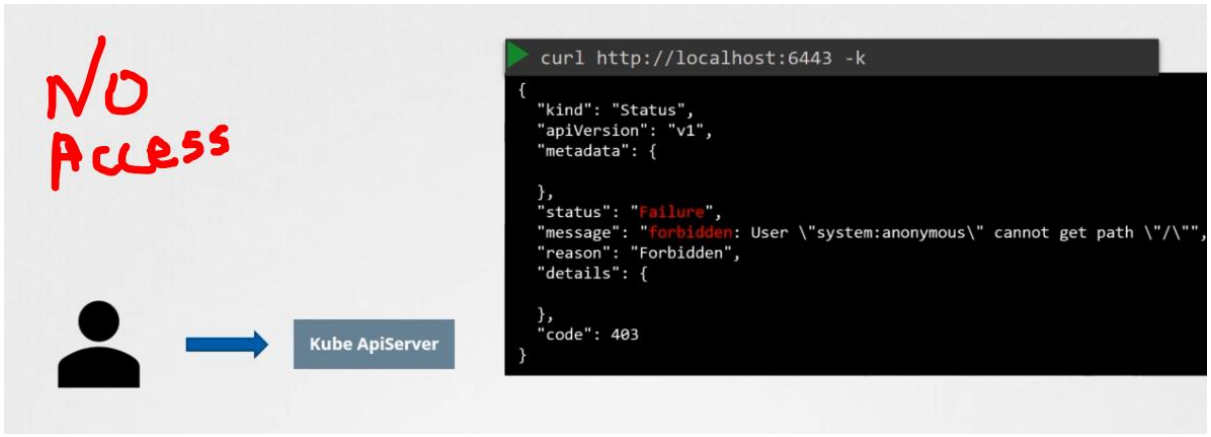
Use full path of the certification or u can paste the certificae

directly

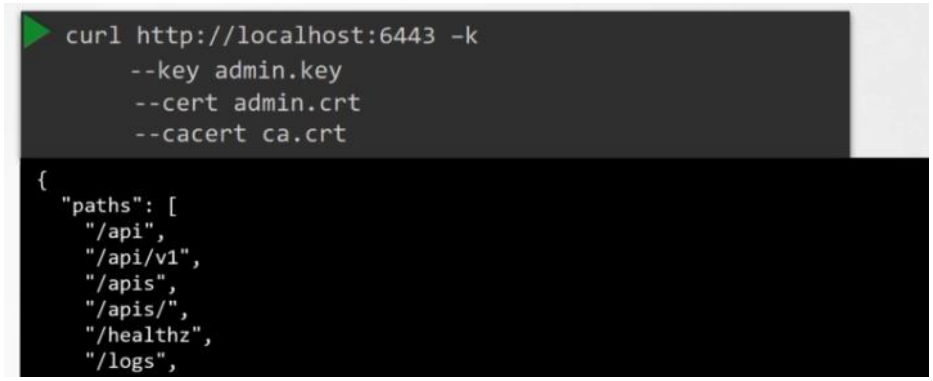

```
kubectl config --kubeconfig=/root/my-kube-config use-context research
```

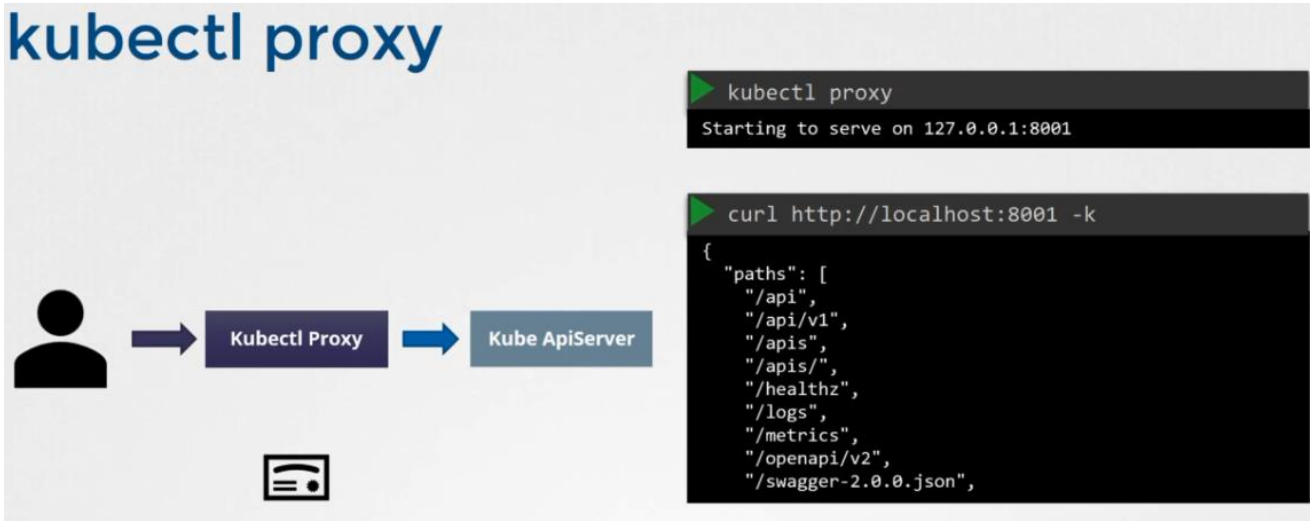
Api Groups:





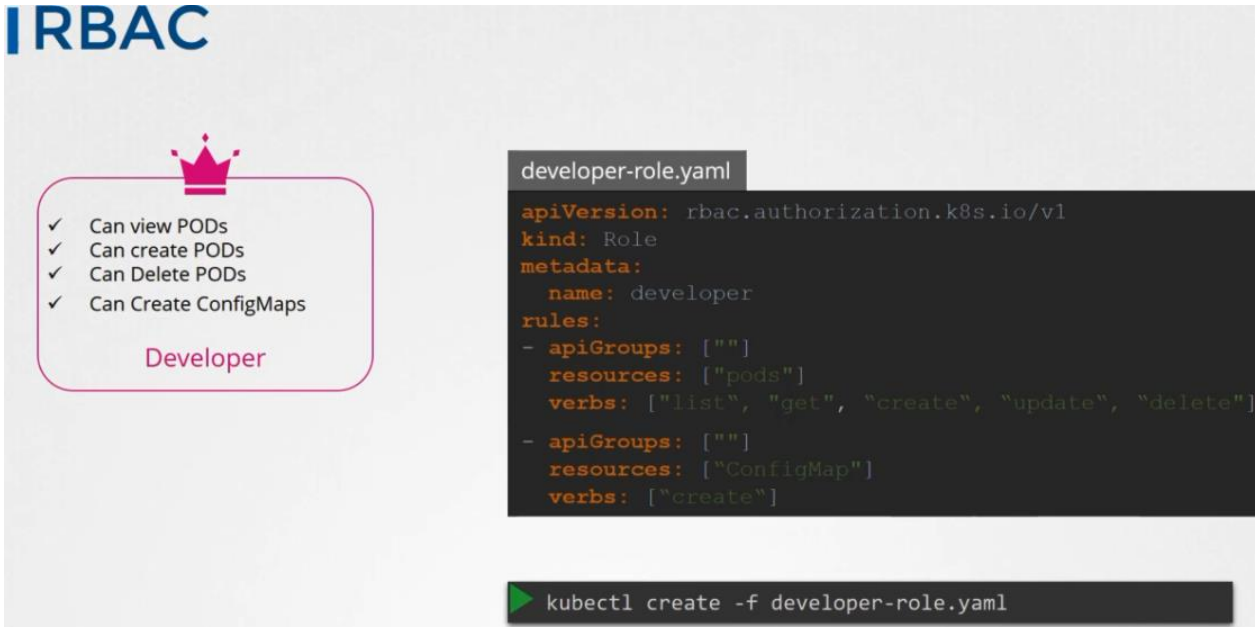
Because certificates required

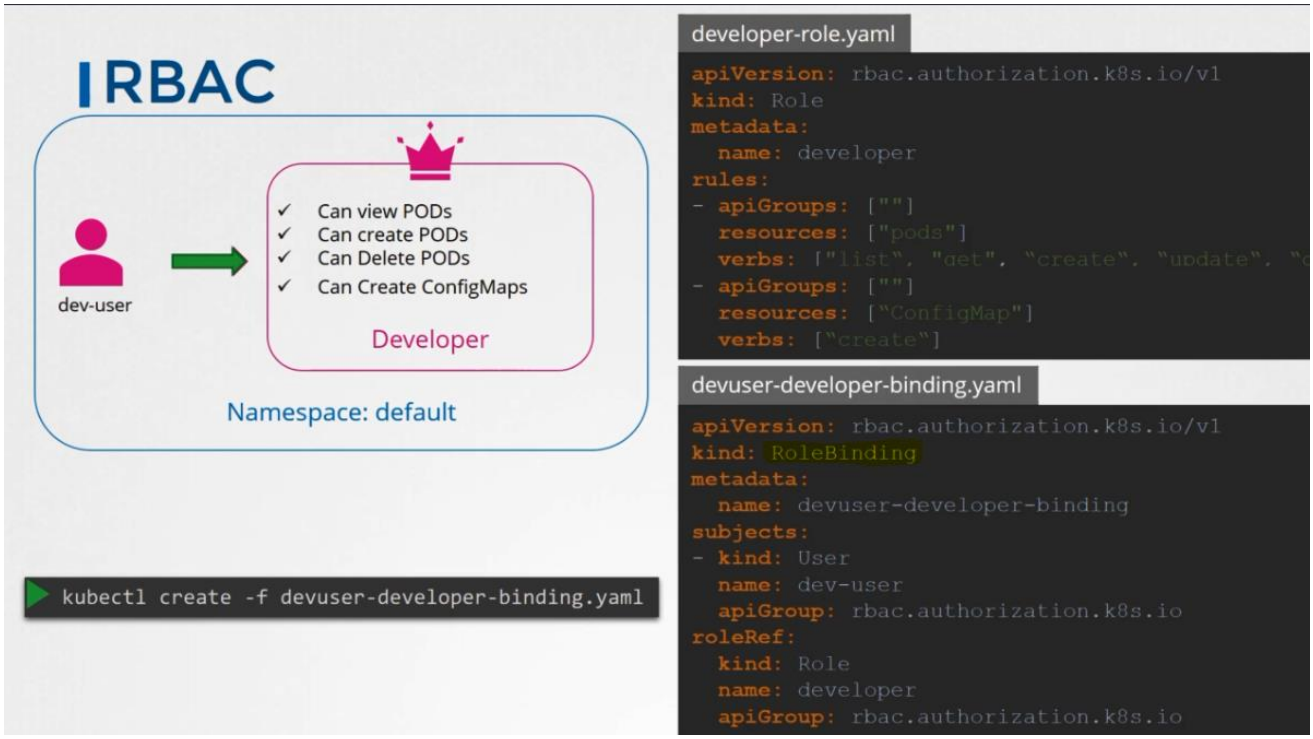




Kubectl – http proxy to access the kube api server; kube proxy – responsible to connect all the pods/services

Role Based Access Control





View RBAC

```
kubectl get roles
```

```
NAME        AGE
developer   4s
```

```
kubectl get rolebindings
```

```
NAME                        AGE
devuser-developer-binding   24s
```

```
kubectl describe role developer
```

```
Name:         developer
Labels:       <none>
Annotations:  <none>
PolicyRule:
  Resources  Non-Resource URLs  Resource Names  Verbs
  ---------  -----------------  --------------  -----
  ConfigMap  []                 []              [create]
  pods       []                 []              [get watch list create delete]
```

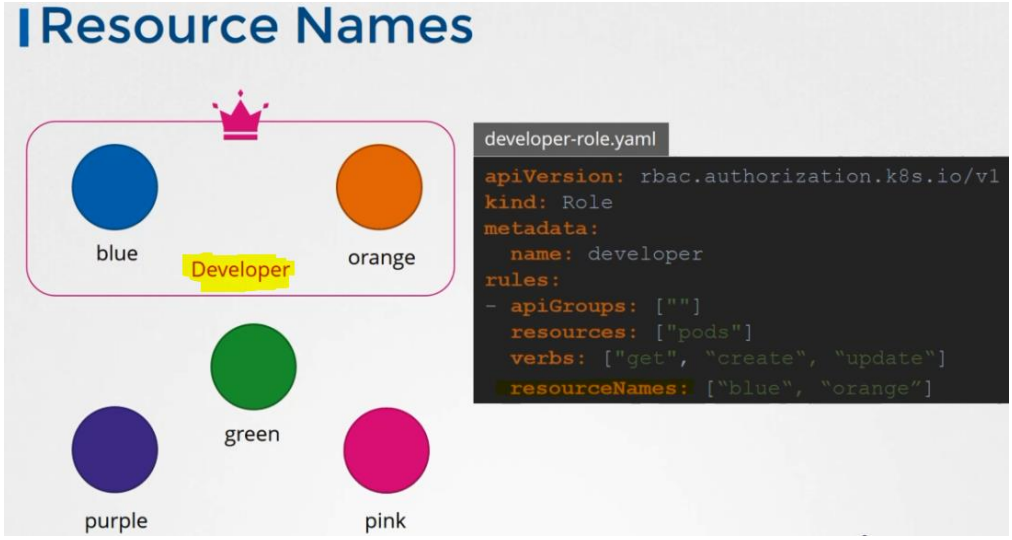
```
kubectl describe rolebinding devuser-developer-binding
```

```
Name:         devuser-developer-binding
Labels:       <none>
Annotations:  <none>
Role:
  Kind:  Role
  Name:  developer
Subjects:
  Kind  Name      Namespace
  ----  ----      ---------
  User  dev-user
```

Check Access

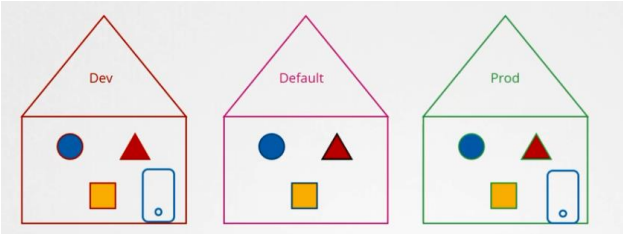
```
kubectl auth can-i create deployments
yes

kubectl auth can-i delete nodes
no

kubectl auth can-i create deployments --as dev-user
no

kubectl auth can-i create pods --as dev-user
yes

kubectl auth can-i create pods --as dev-user --namespace test
no
```

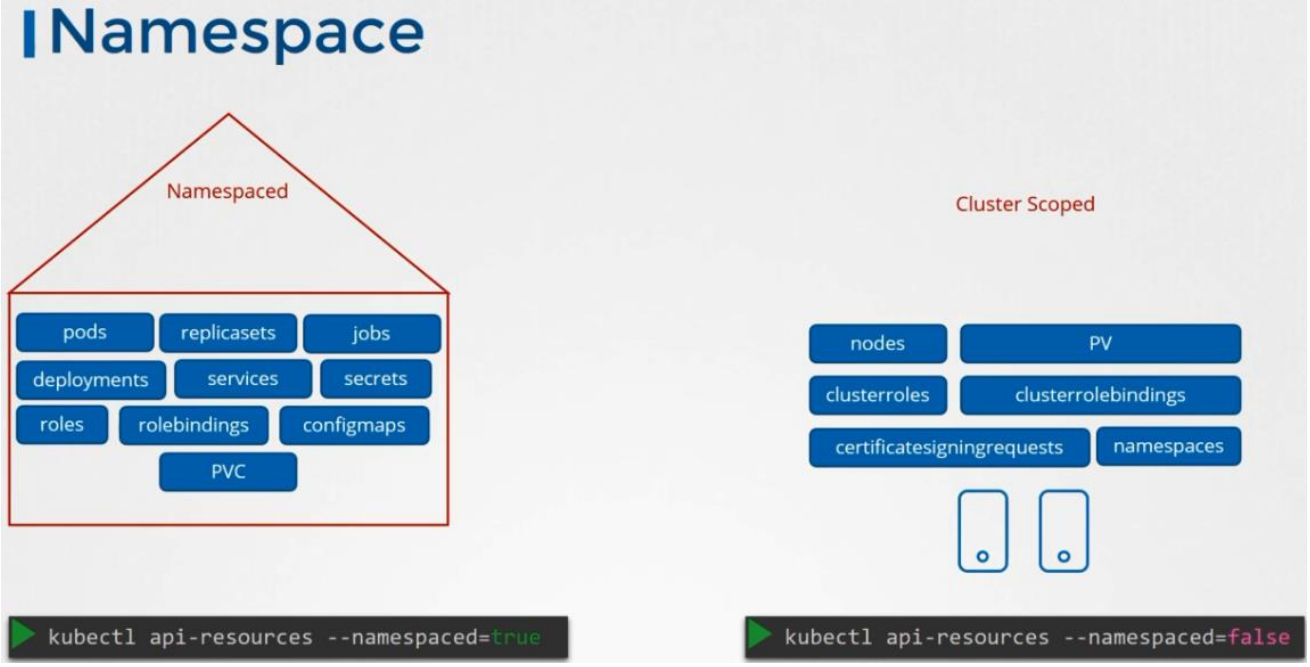
Pod level restrictions to the developer user

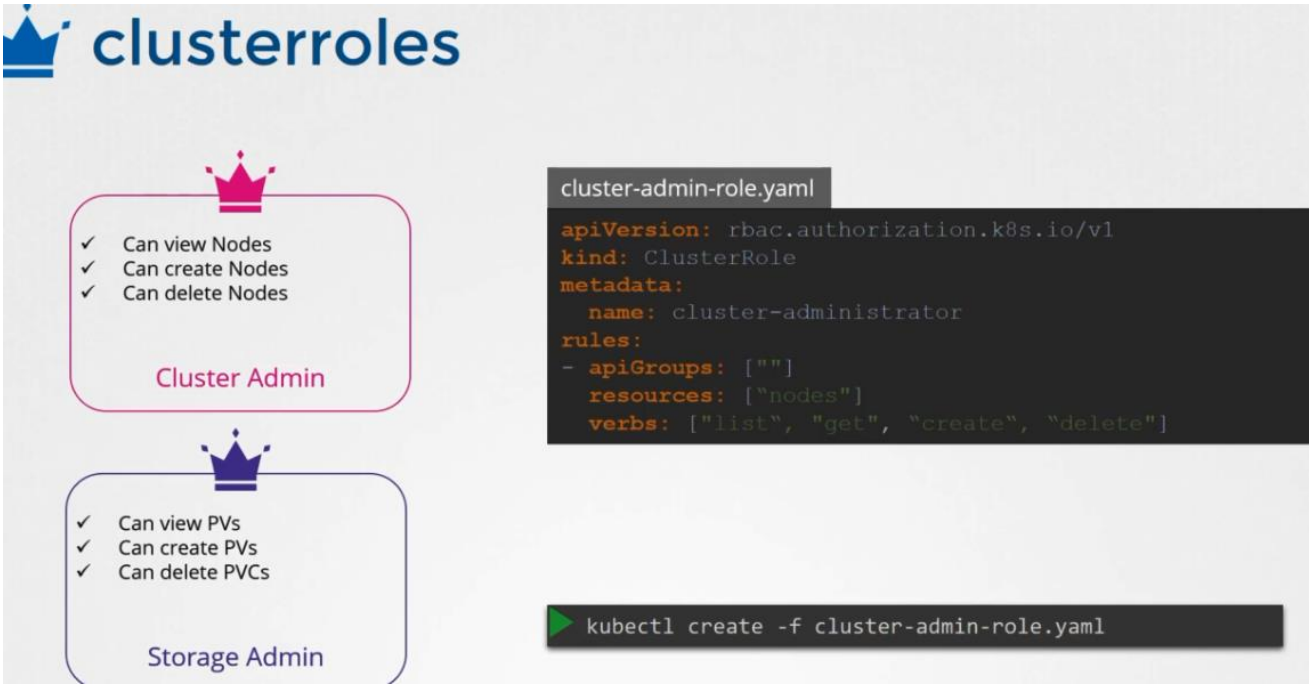


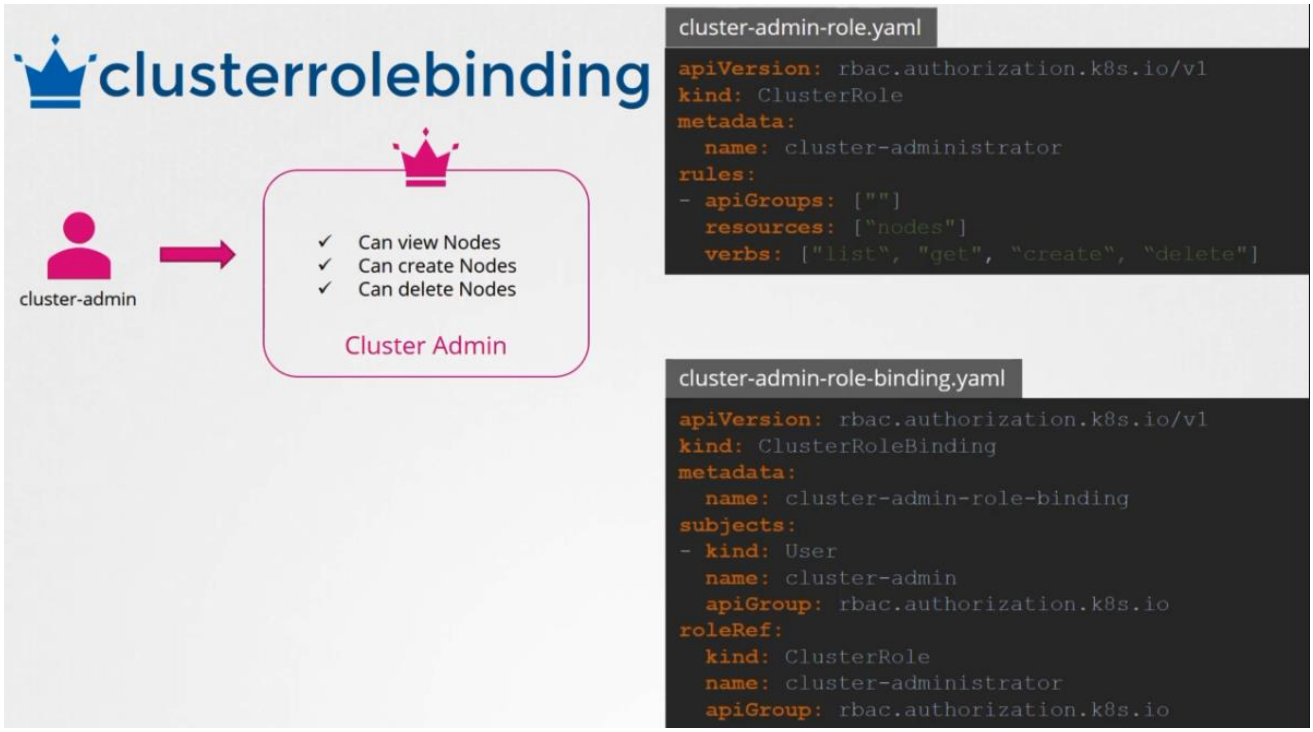
Cluster roles and role bindings:

Nodes are cluster scope , it cannot be bind with namespaces



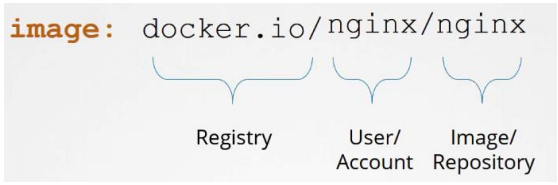


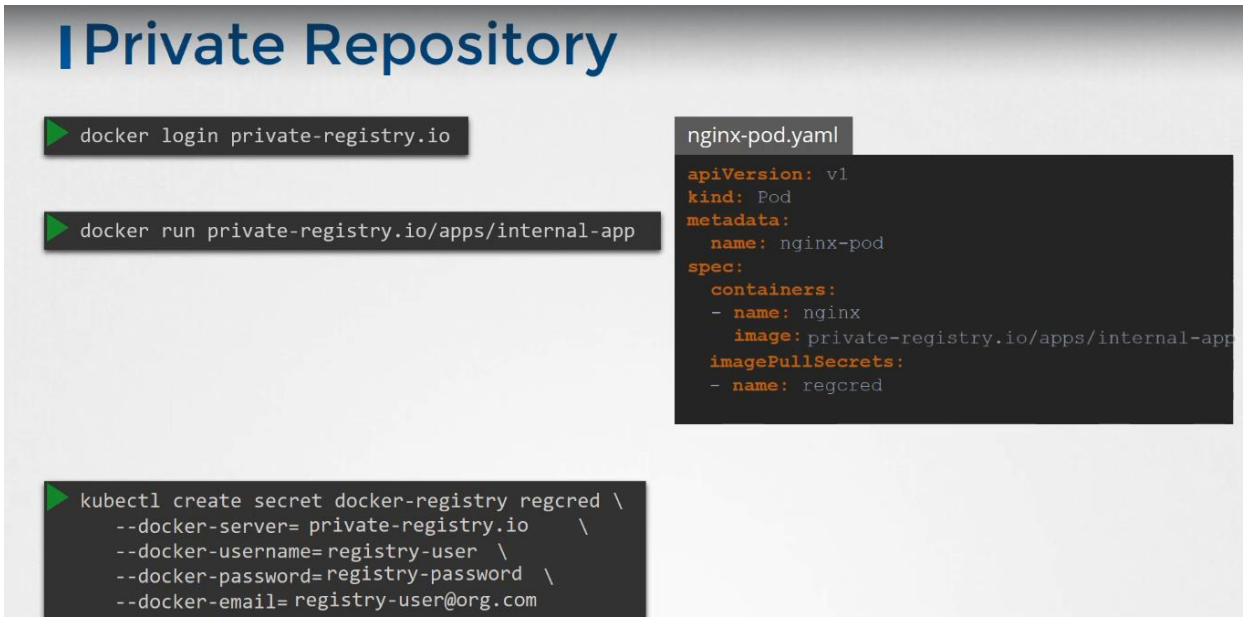




Cluster roles can be applied to all name spaced resources.

Secure images : private repo





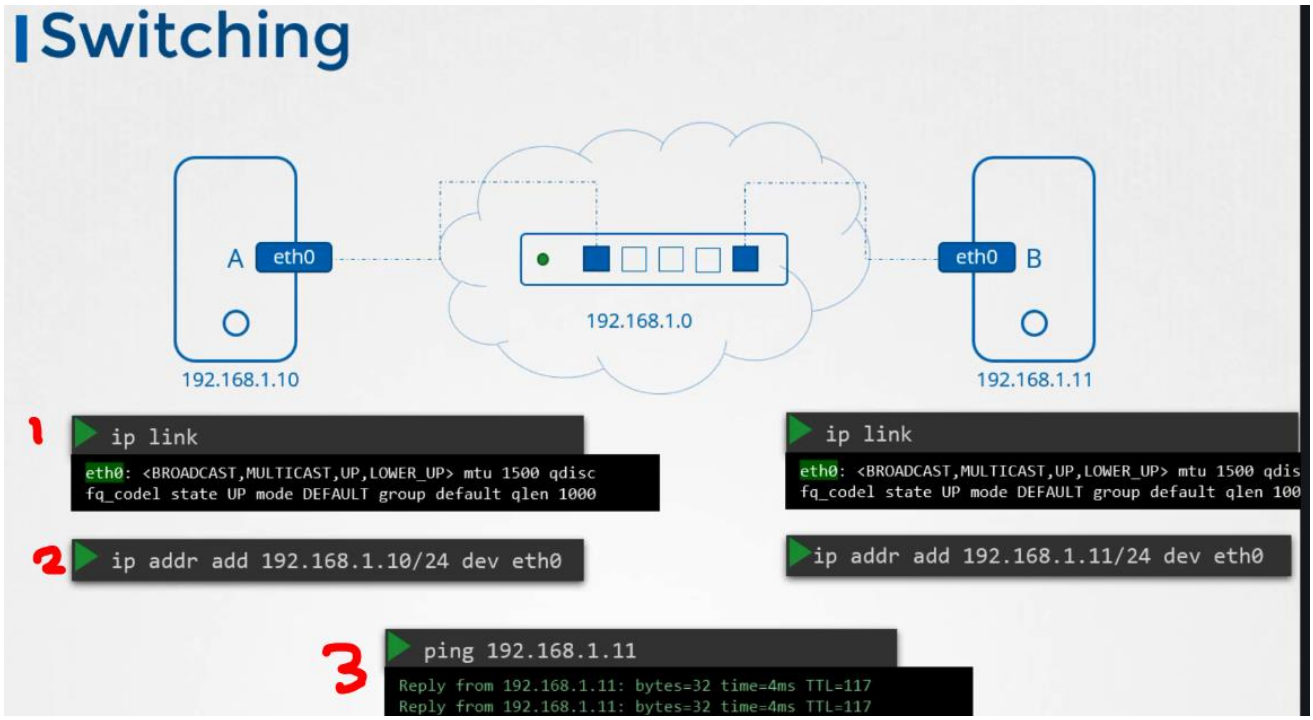
Security contexts, Network policy – from ckad

Networking

Networking Pre-Requisites

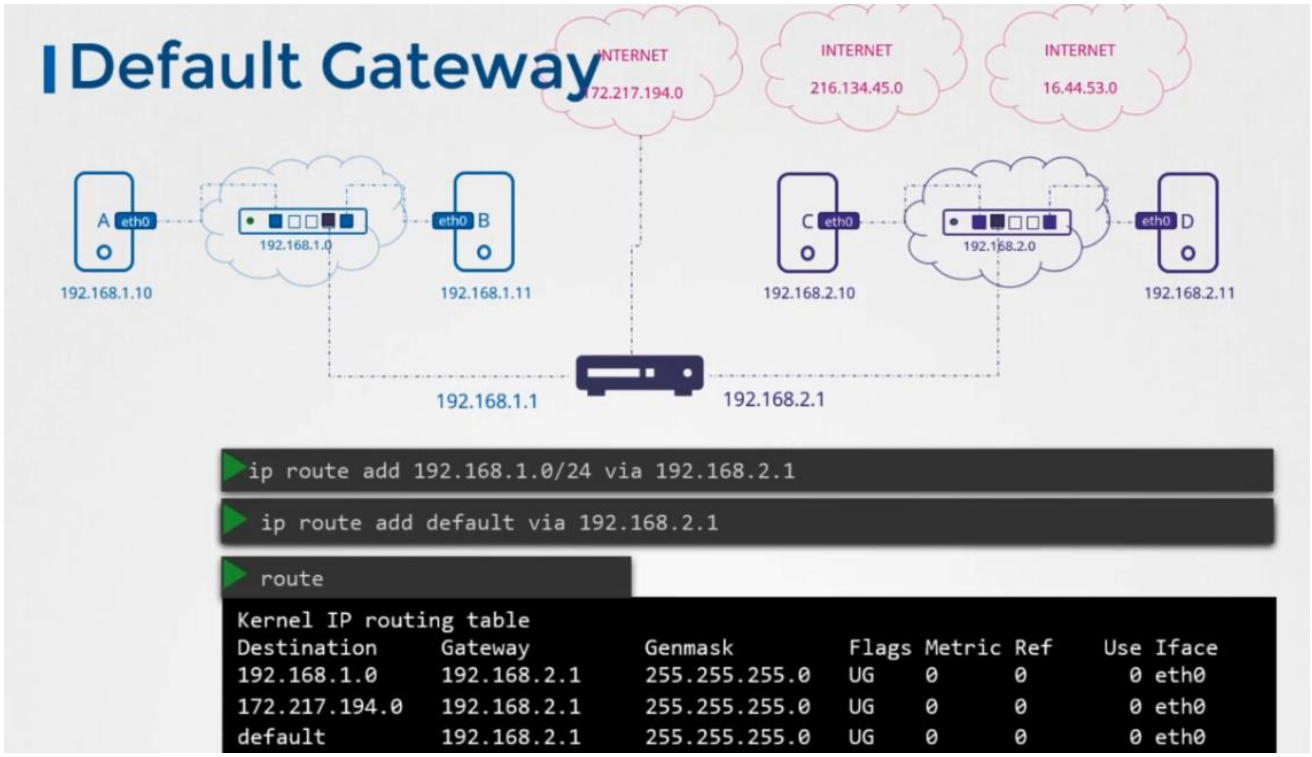
- Switching and Routing
  - Switching
  - Routing
  - Default Gateway
- DNS
  - DNS Configurations on Linux
  - CoreDNS Introduction
- Network Namespaces
- Docker Networking

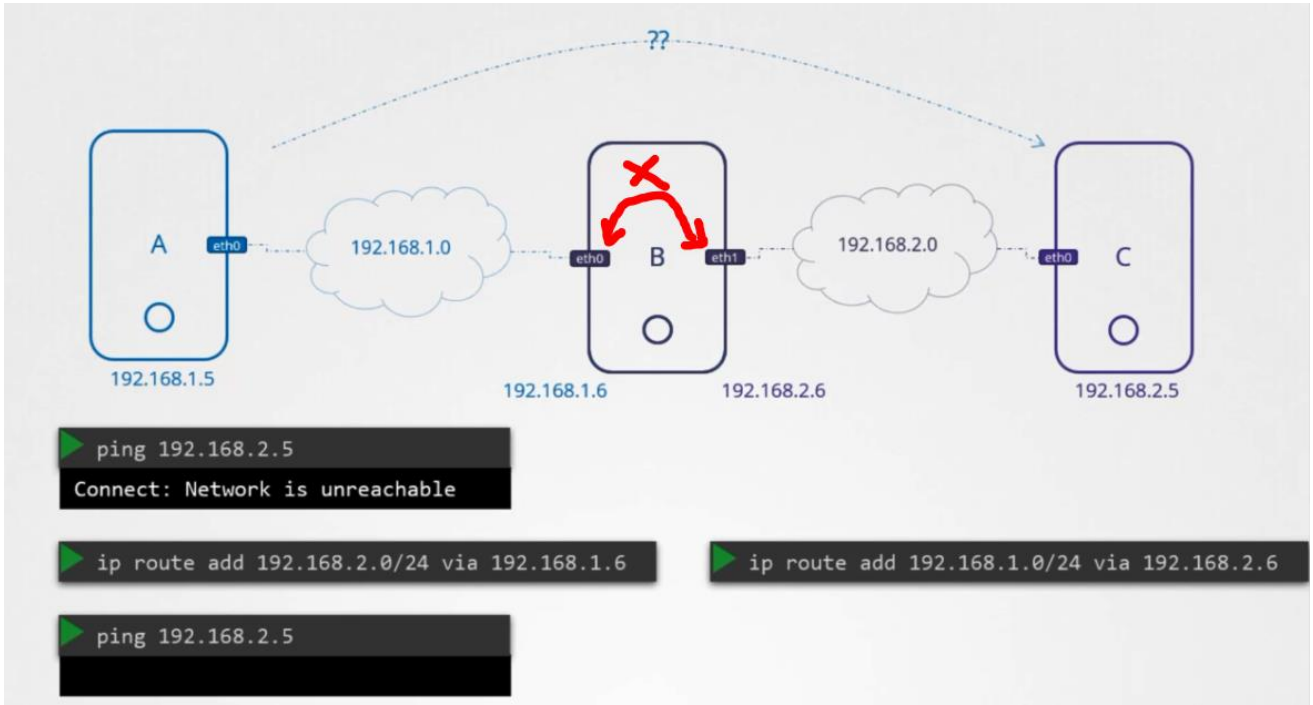
Switching helps to connect internal computers



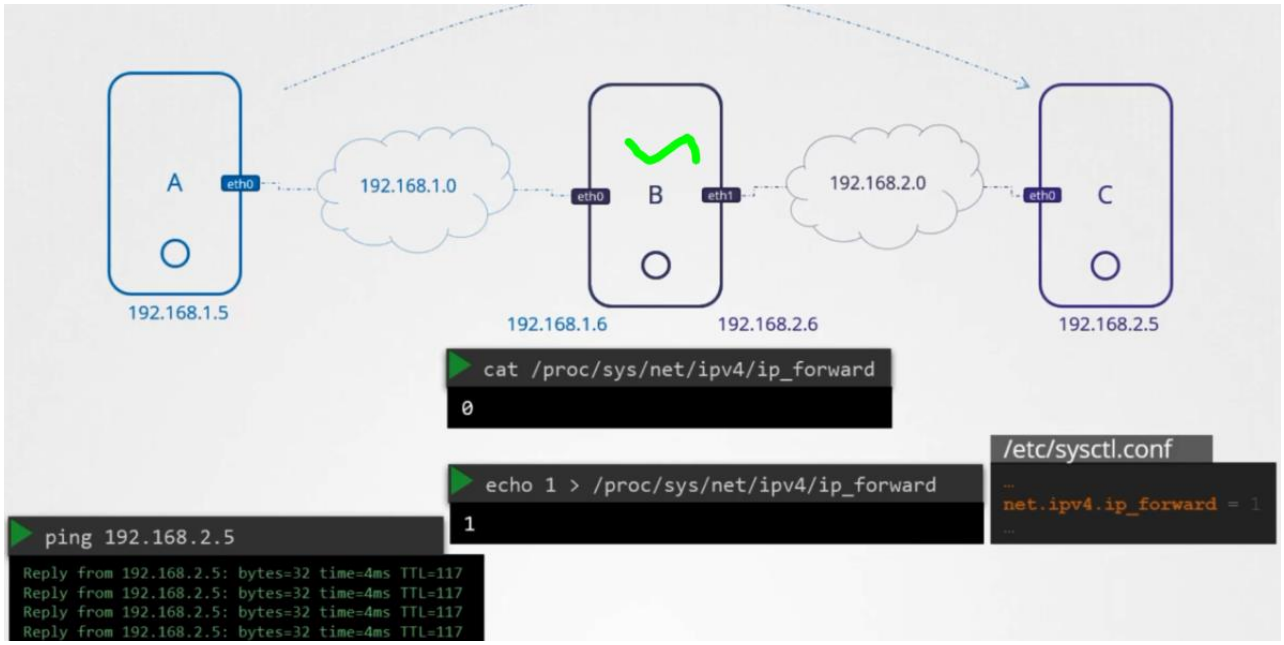
Routers helps to connect two/many networks

Gateway – route to reach the destination





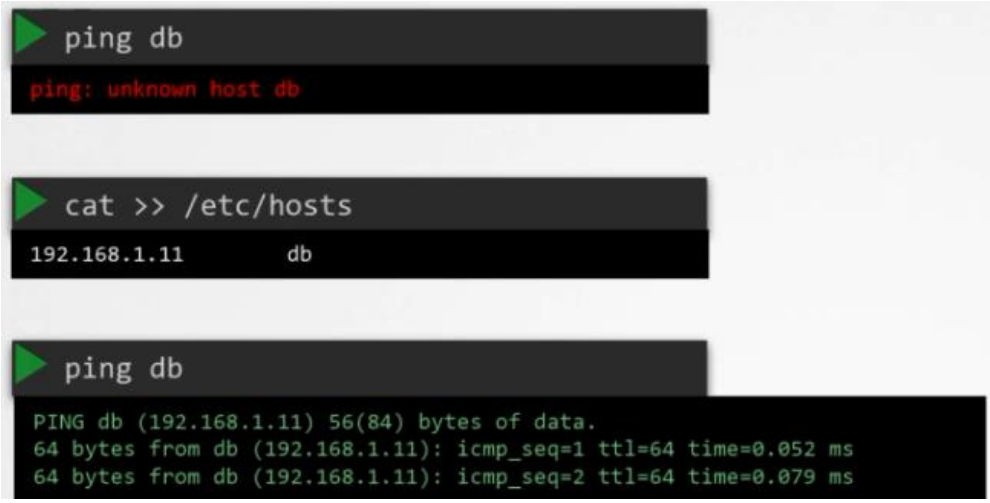
We need to forward B node eth0 to eth1.


A
eth0
192.168.1.0
eth0
B
eth1
192.168.2.0
eth0
C
192.168.1.5
192.168.1.6
192.168.2.6
192.168.2.5
cat /proc/sys/net/ipv4/ip_forward
0
/etc/sysctl.conf
net.ipv4.ip_forward = 1
echo 1 > /proc/sys/net/ipv4/ip_forward
1
ping 192.168.2.5
Reply from 192.168.2.5: bytes=32 time=4ms TTL=117
Reply from 192.168.2.5: bytes=32 time=4ms TTL=117
Reply from 192.168.2.5: bytes=32 time=4ms TTL=117
Reply from 192.168.2.5: bytes=32 time=4ms TTL=117

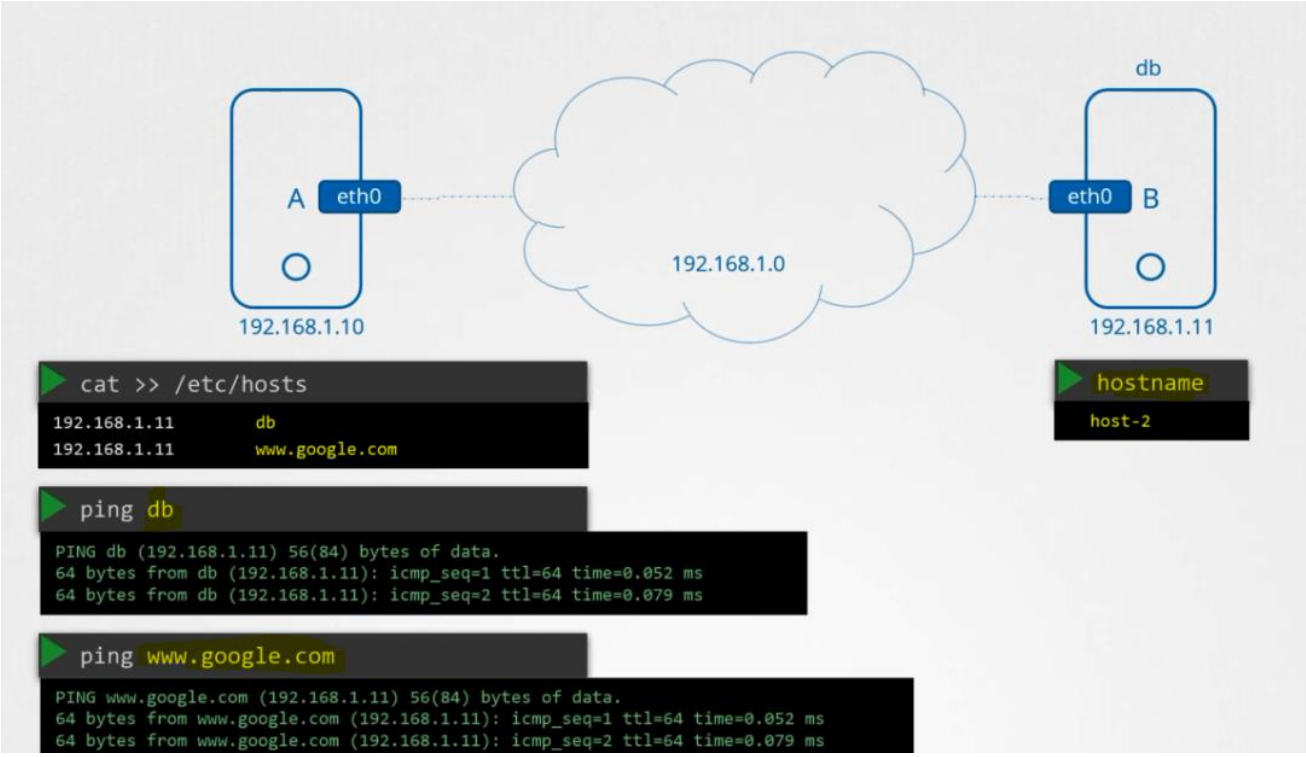
Commands


ip link
ip addr
ip addr add 192.168.1.10/24 dev eth0
ip route
ip route add 192.168.1.0/24 via 192.168.2.1
cat /proc/sys/net/ipv4/ip_forward
1

DNS



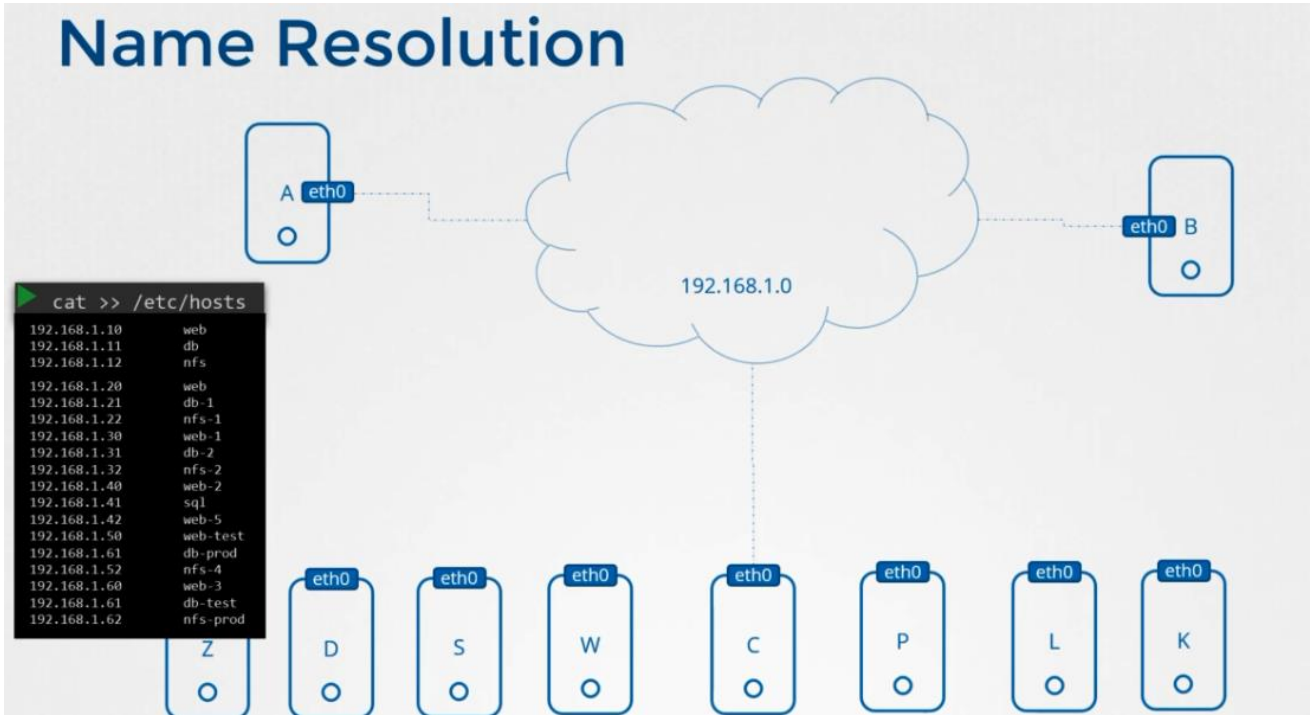
Host A always use its /etc/hosts file



By checking file -> getting ip is called Name resolutions

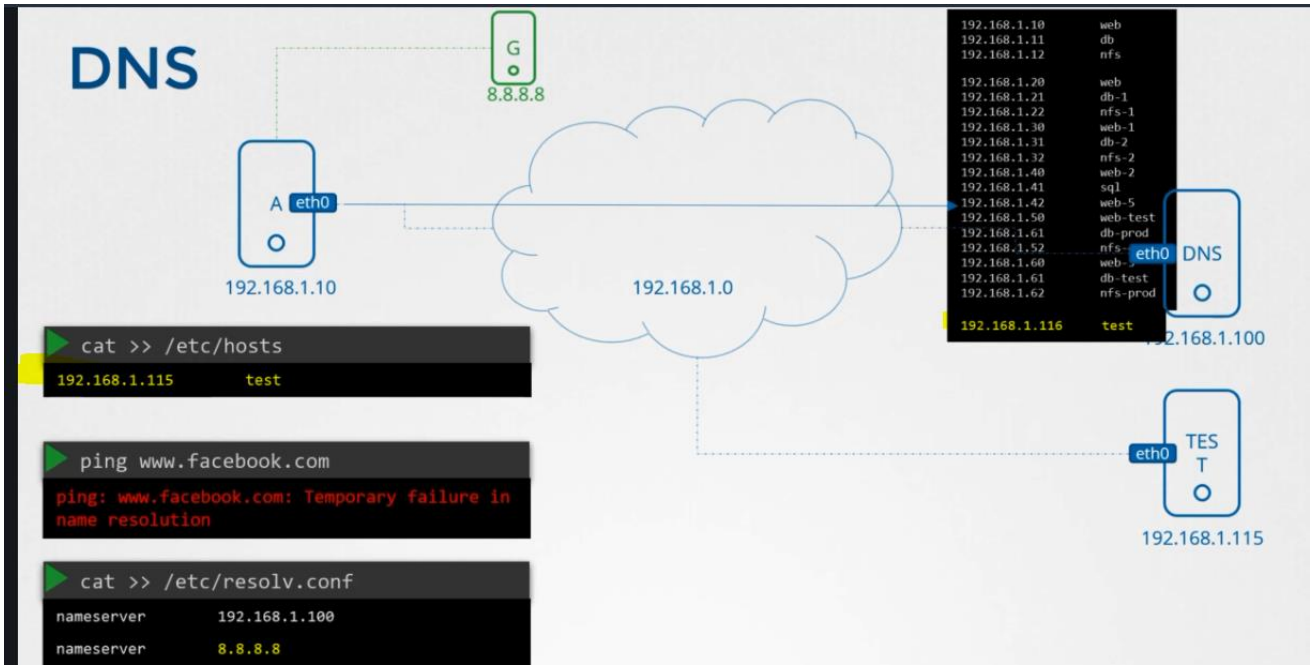
```
cat >> /etc/hosts
192.168.1.11        db
192.168.1.11        www.google.com

ping db

ssh db

curl http://www.google.com
```

Keeping all the node names in /hosts file is very complex and everytime need to change if Ip is changing

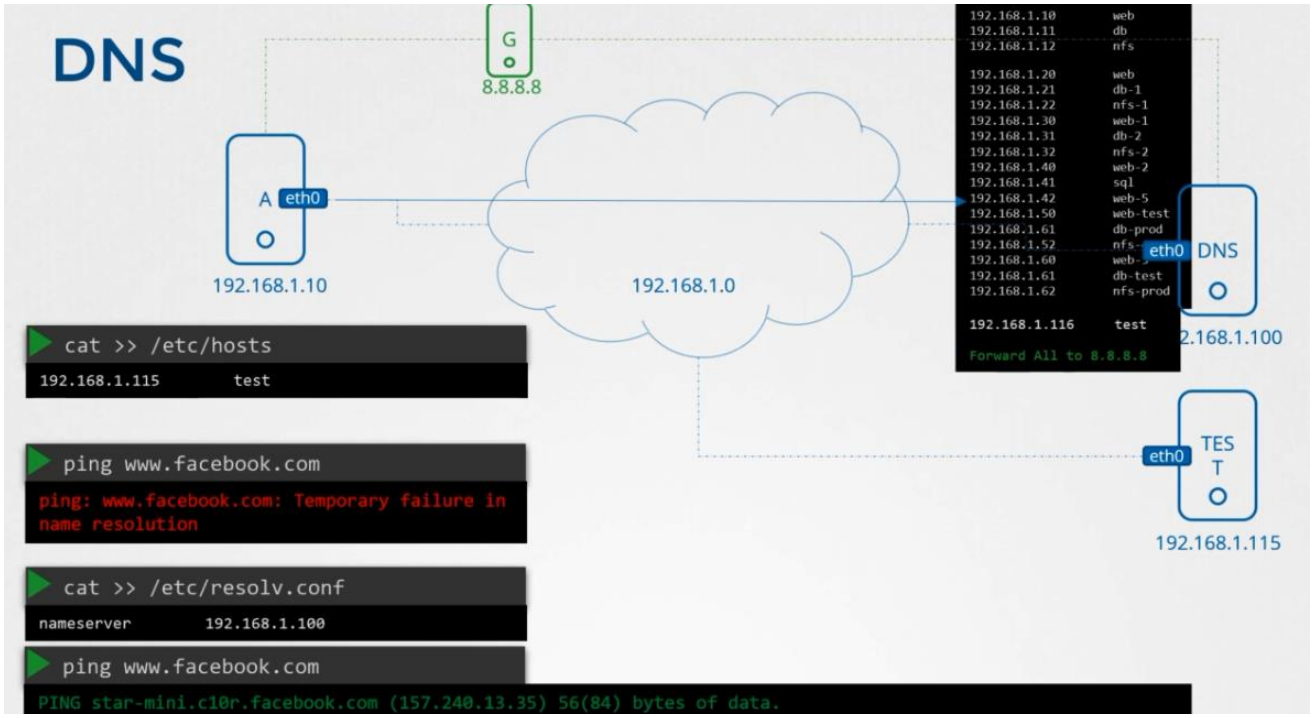


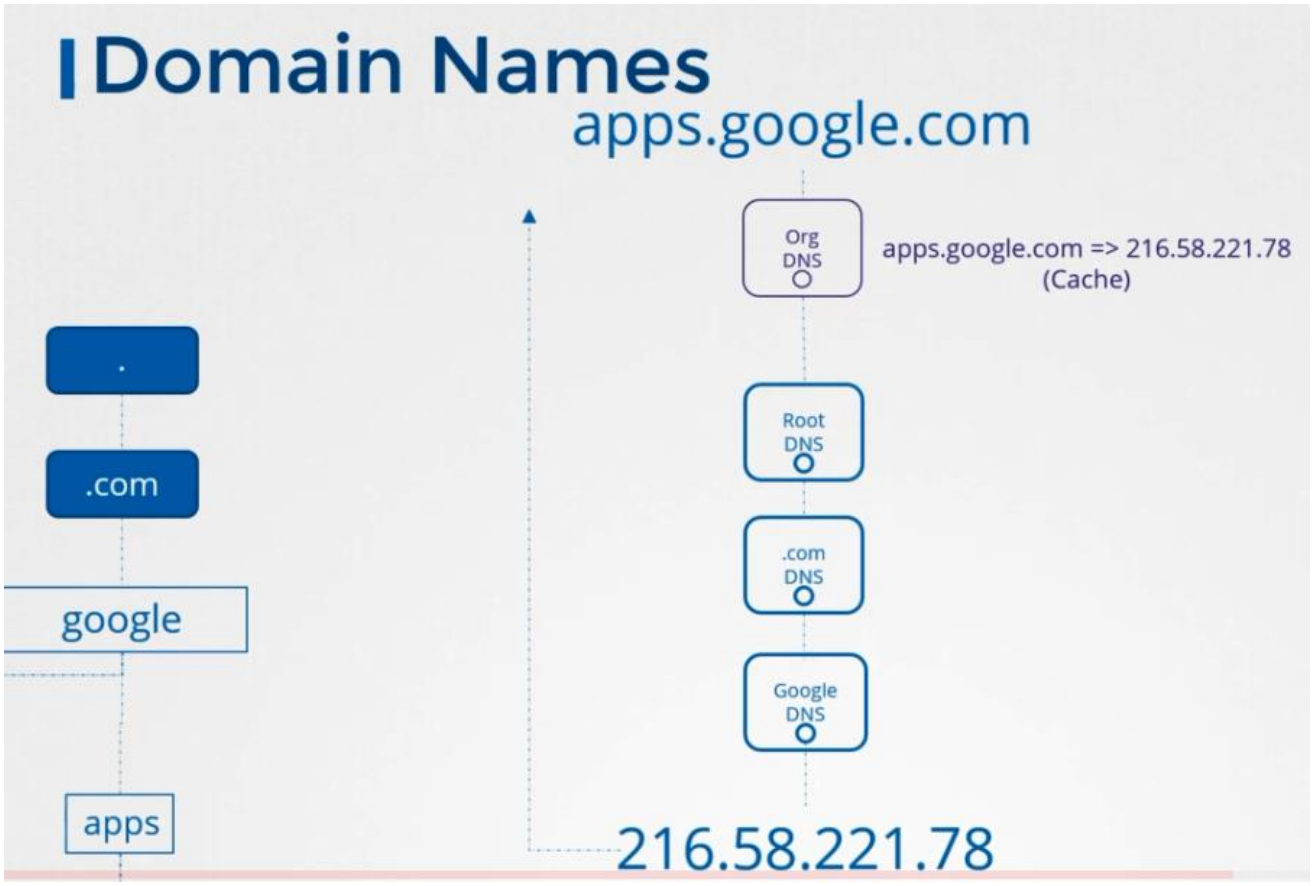
That's why we moved all the /hosts file to single server that's what called DNS server.all the hosts will point to the DNS server instead of its own /etc/hosts files.

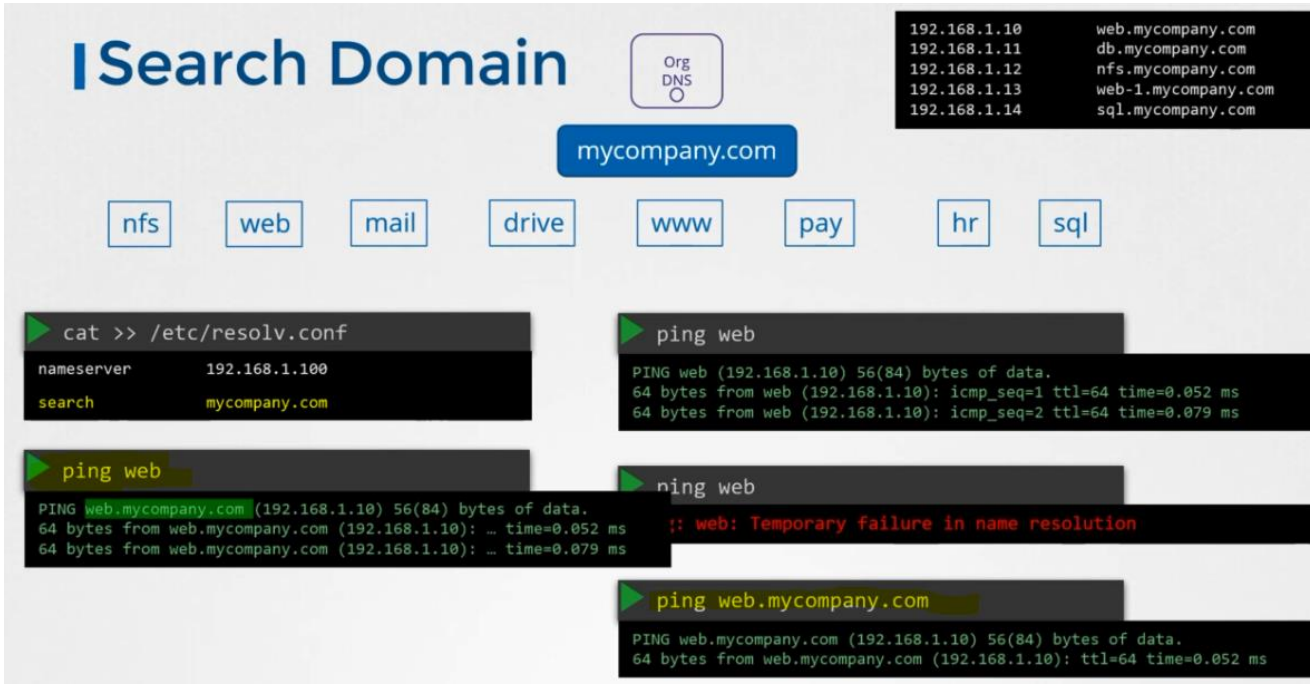
1st it looks for the local host file and then DNS server. Anyway this priority can be changed by editing the (xyz)file.



8.8.8.8 public name server from google



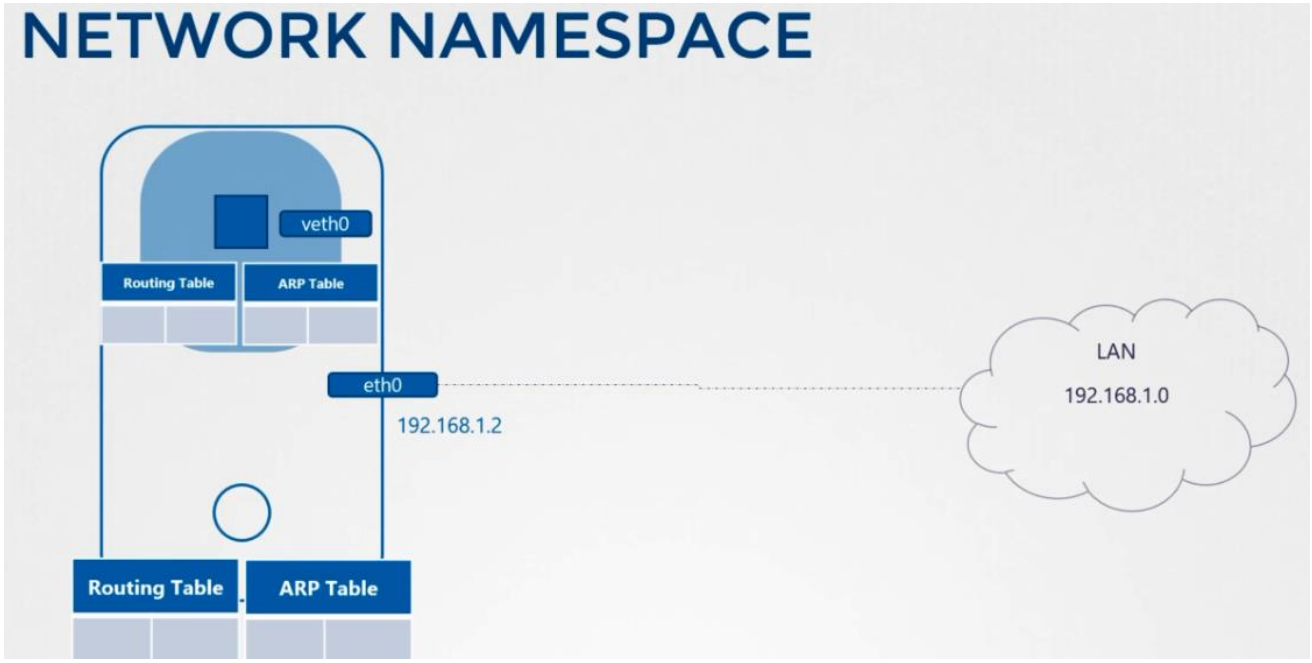


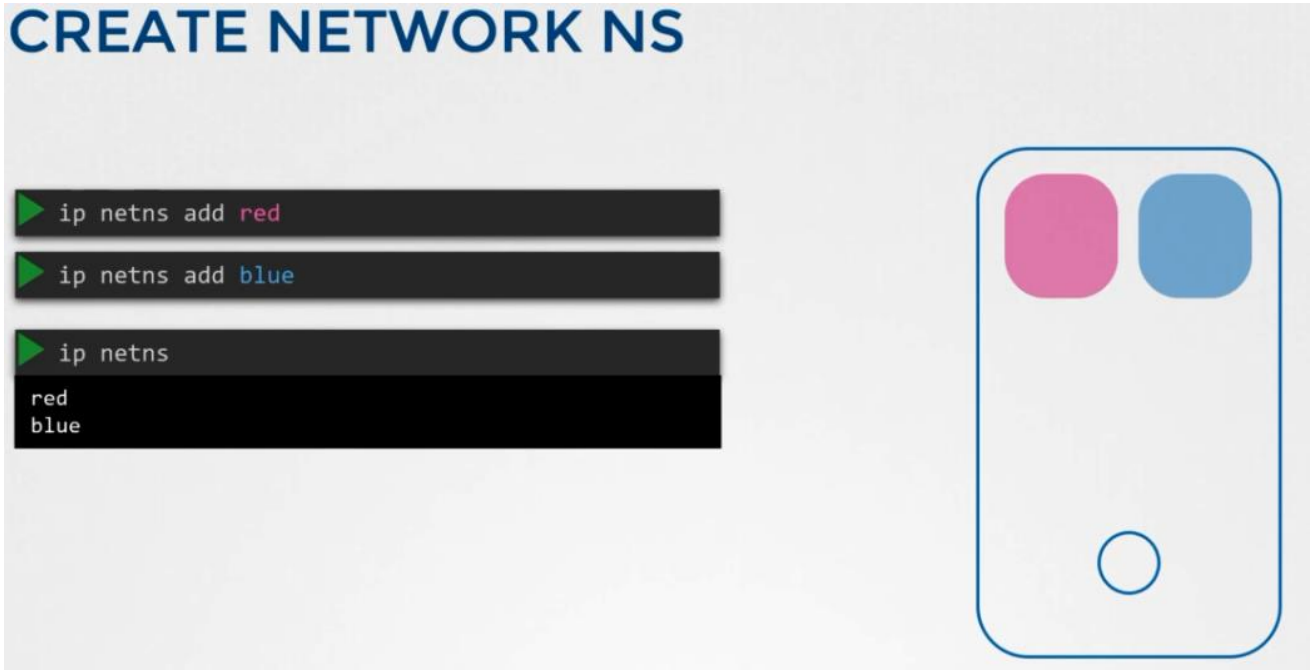


Nslookup only check with DNS server

```
nslookup www.google.com
Server:         8.8.8.8
Address:        8.8.8.8#53

Non-authoritative answer:
Name:   www.google.com
Address: 172.217.0.132
```

Network Namespaces are used by containers to create network isolation



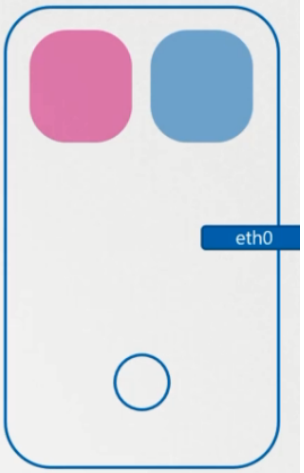


EXEC IN NETWORK NS

```
ip link
1: lo: <LOOPBACK,UP,LOWER_UP> mtu 65536 qdisc state UNKNOWN mode DEFAULT group default qlen 1000
    link/loopback 00:00:00:00:00:00 brd 00:00:00:00:00:00
2: eth0: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc state UP mode DEFAULT qlen 1000
    link/ether 02:42:ac:11:00:08 brd ff:ff:ff:ff:ff:ff
```

```
ip netns exec red   ip link
1: lo: <LOOPBACK,UP,LOWER_UP> mtu 65536 qdisc state UNKNOWN mode DEFAULT group default qlen 1000
    link/loopback 00:00:00:00:00:00 brd 00:00:00:00:00:00
```

```
ip -n red   link
1: lo: <LOOPBACK,UP,LOWER_UP> mtu 65536 qdisc state UNKNOWN mode DEFAULT group default qlen 1000
    link/loopback 00:00:00:00:00:00 brd 00:00:00:00:00:00
```




```
ip netns exec red ip link
          =
ip    -n red        link
```

```
arp
Address                  HWtype  HWaddress           Flags Mask            Iface
172.17.0.21              ether   02:42:ac:11:00:15   C                     eth0
172.16.0.8               ether   06:fe:d3:b5:59:65   C                     eth0
_gateway                 ether   02:42:d5:7a:84:8e   C                     eth0
host01                   ether   02:42:ac:11:00:1c   C                     eth0
```

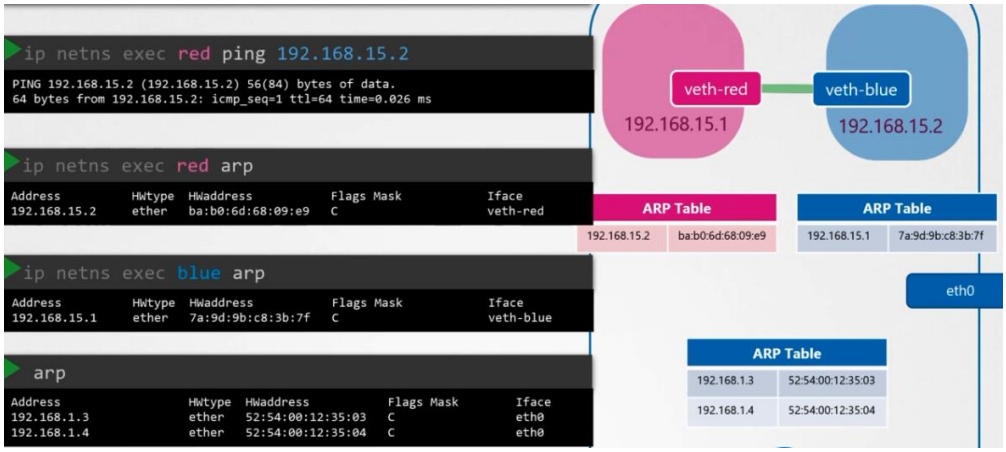
```
ip netns exec red arp
Address                  HWtype  HWaddress           Flags Mask            Iface
```

```
route
Kernel IP routing table
Destination     Gateway         Genmask         Flags Metric Ref    Use Iface
default         _gateway        0.0.0.0         UG    202    0        0 eth0
172.17.0.0      0.0.0.0         255.255.0.0     U     202    0        0 eth0
172.17.0.0      0.0.0.0         255.255.255.0   U     0      0        0 docker0
```

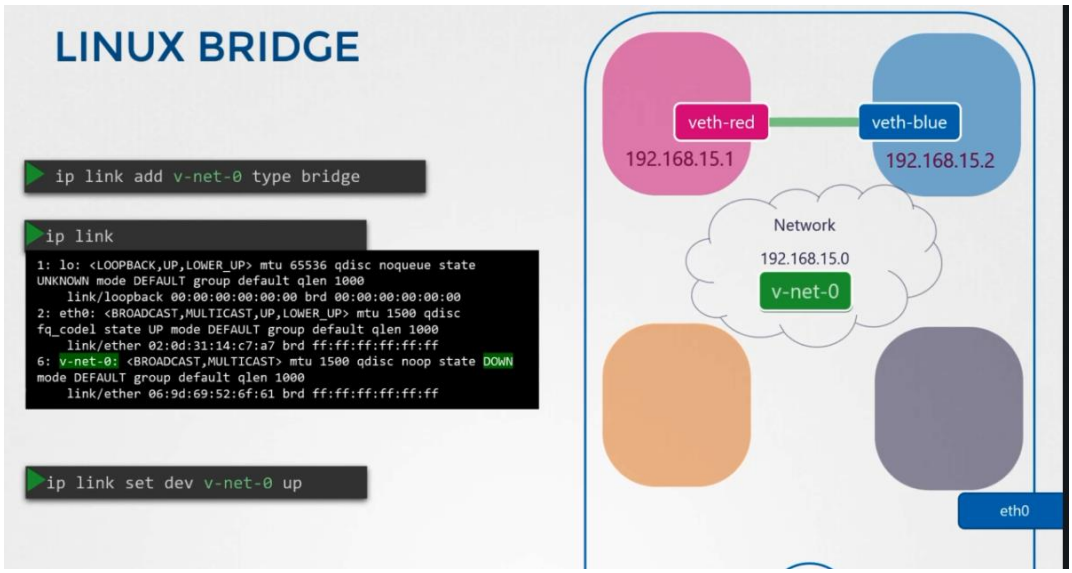
```
ip netns exec red route
Kernel IP routing table
Destination     Gateway         Genmask         Flags Metric Ref    Use Iface
```

Establish connection between namespaces

Separating namespace network from the host network

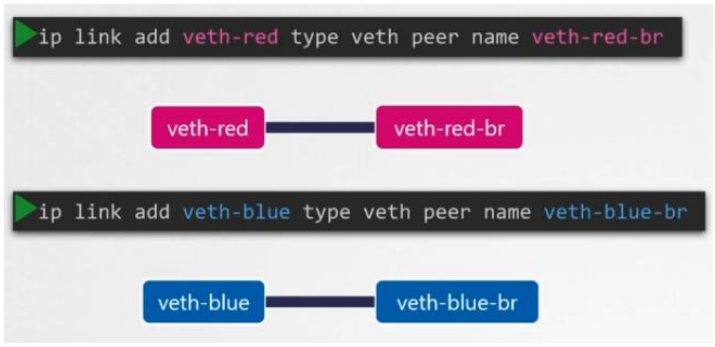


When multiple namespaces are there, we have to create virual switch/bridge and connect them

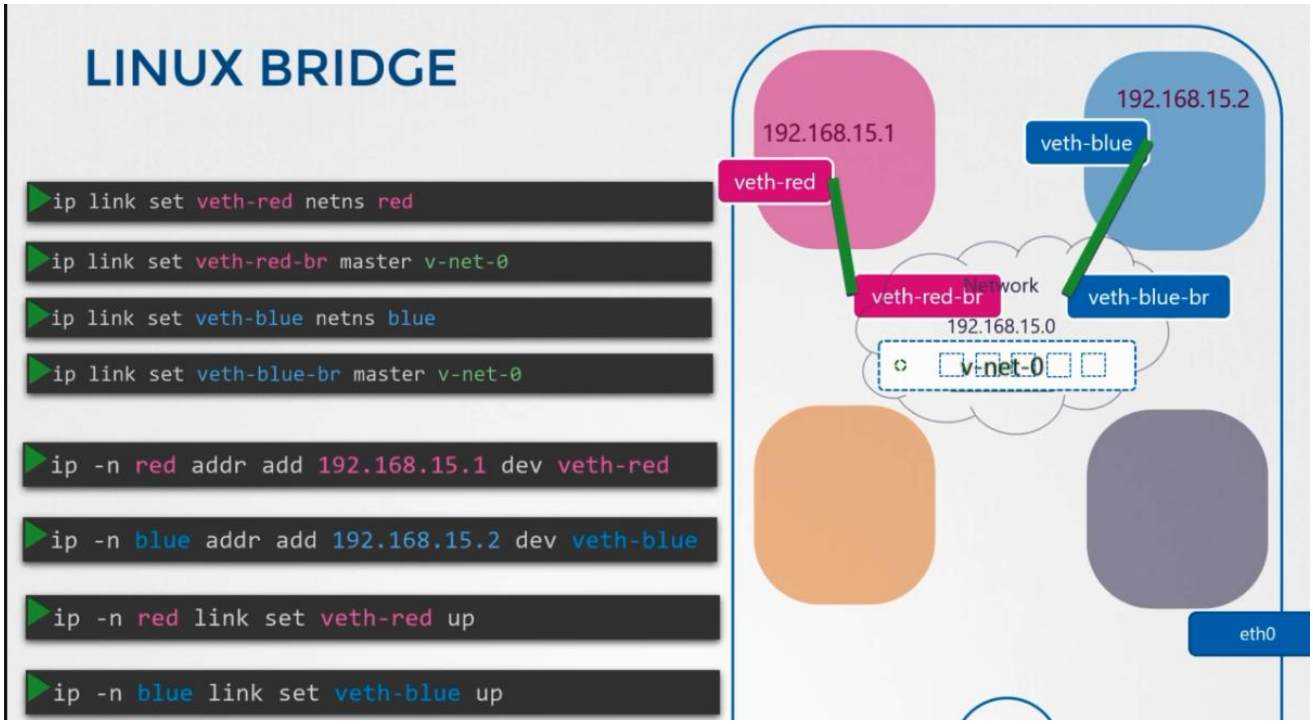


Now we ll delete the previous link. `ip -n red link del veth-red`

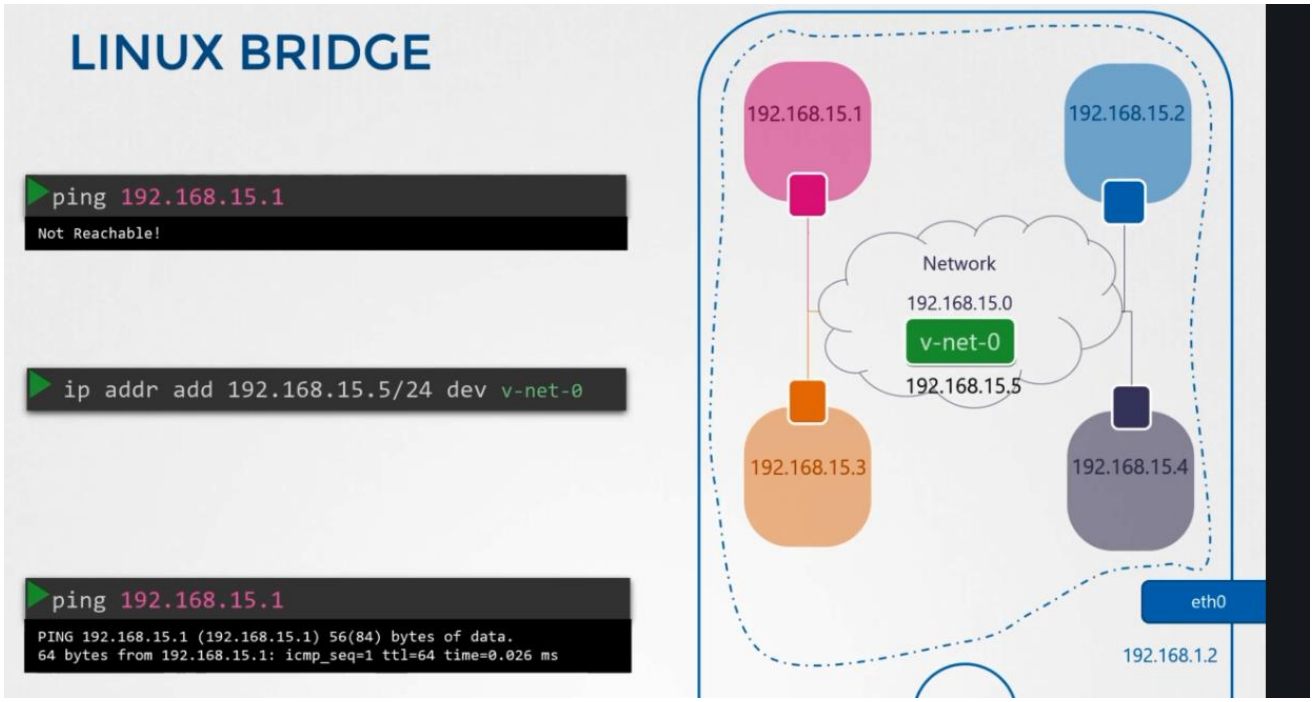
1. create the virtual cables

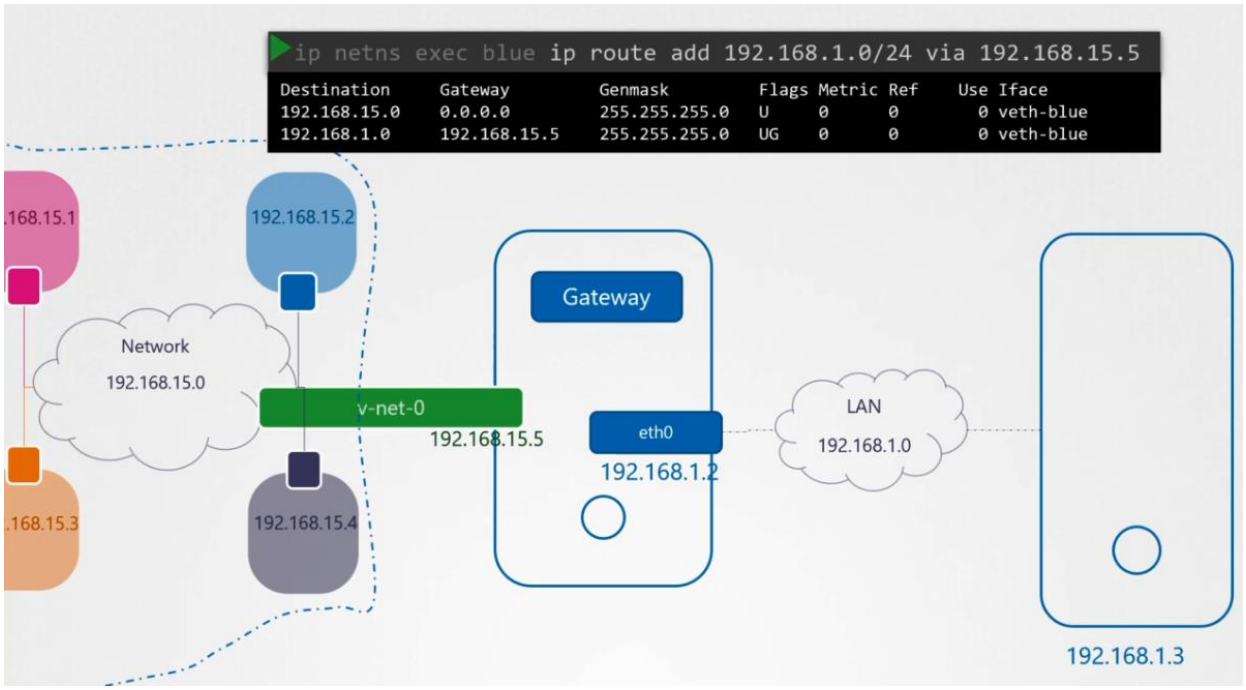


2. Now attach the created cable to the vSwitch by following command and assign IP address. So that it can ping each other through vNetwork



Private vNetwork



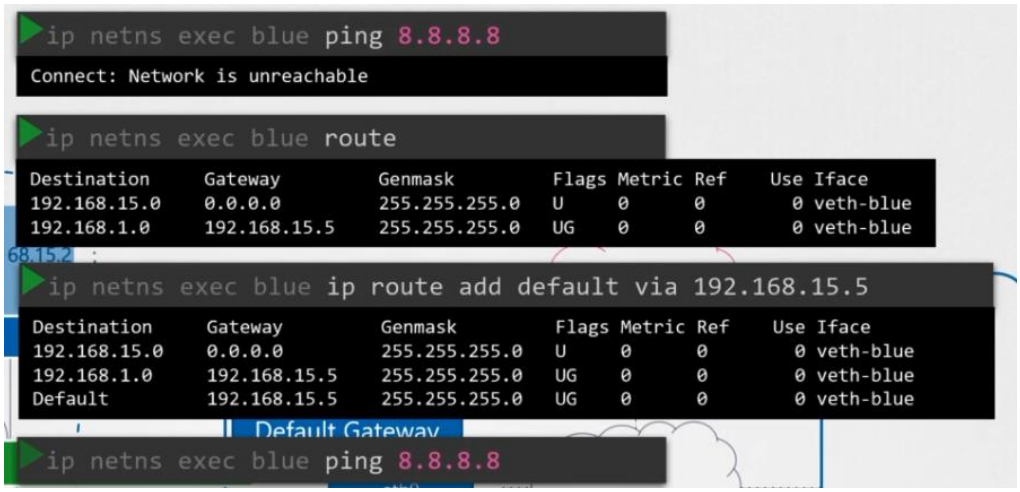


Add NAT to forward the request. Now able to ping from vNetwork to outsde localNetwork

```
iptables -t nat -A POSTROUTING -s 192.168.15.0/24 -j MASQUERADE
```

```
ip netns exec blue ping 192.168.1.3
64 bytes from 192.168.1.3: icmp_seq=1 ttl=63 time=0.587 ms
64 bytes from 192.168.1.3: icmp_seq=2 ttl=63 time=0.466 ms
```

vNetwork to outside world Internet



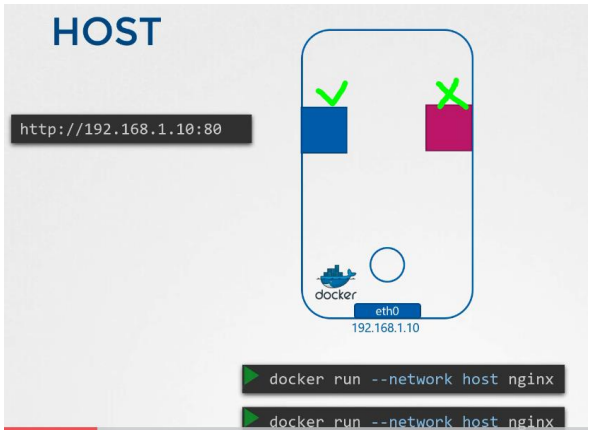
Outside world to vNetwork not able to connect. We need to enable port forwarding rule

Docker Network

1. Docker with no network
2. Docker with host network
3. Docker with Bridge network

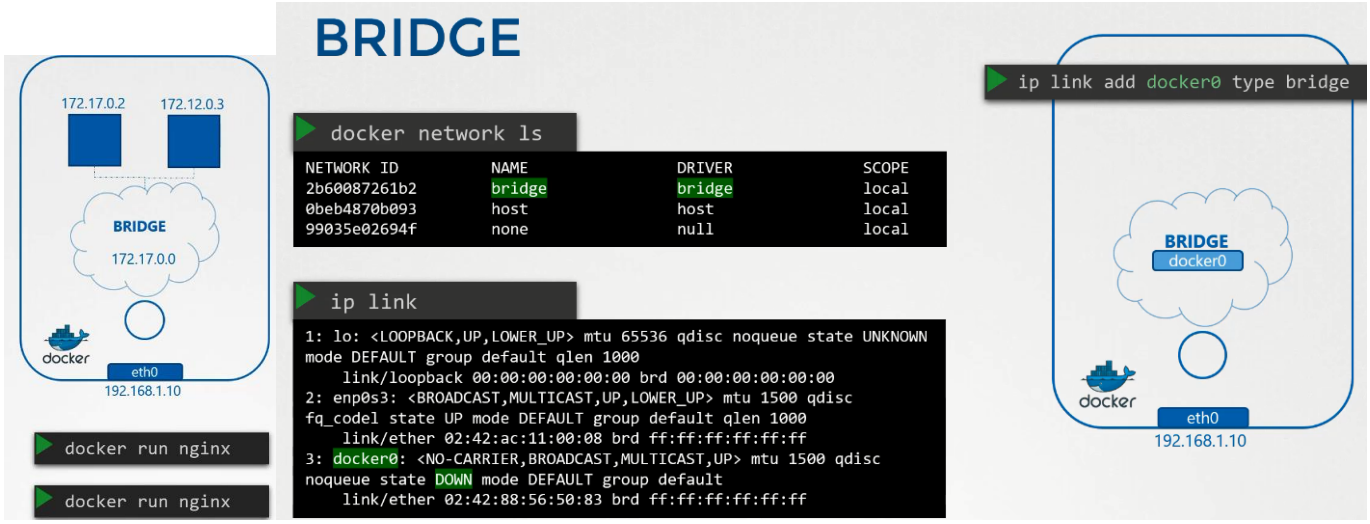
➢ Docker with no network

➢ Docker with Host



Only one container can use host port. Two process cannot listen on the same port

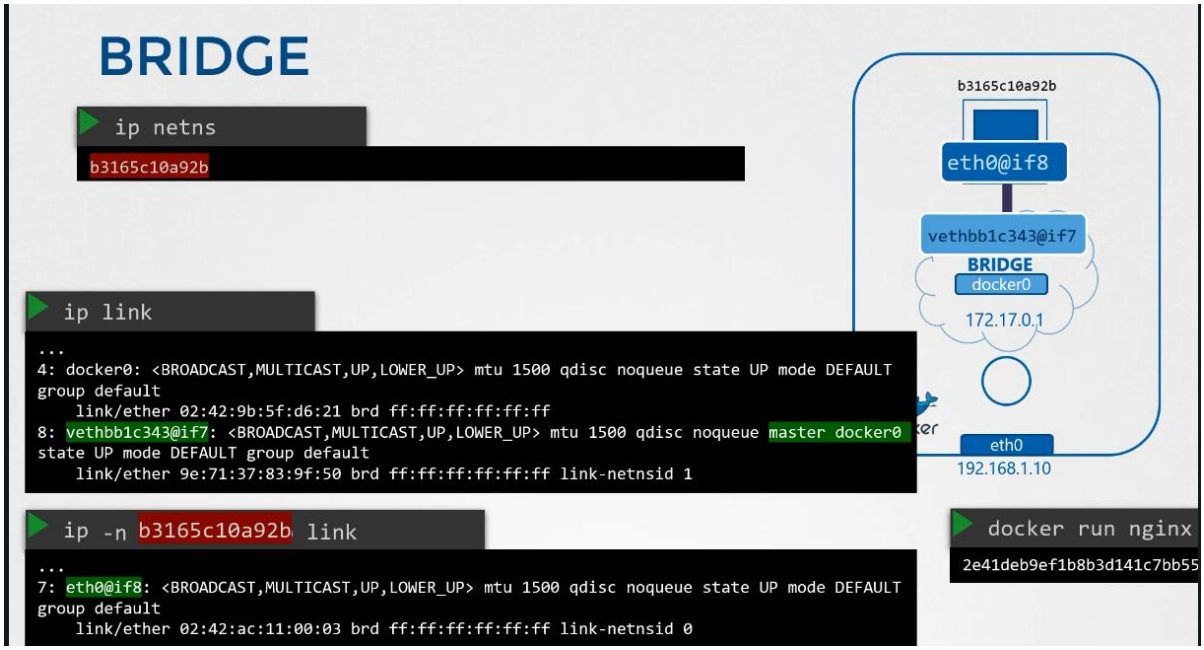
➢ Docker with Bridge



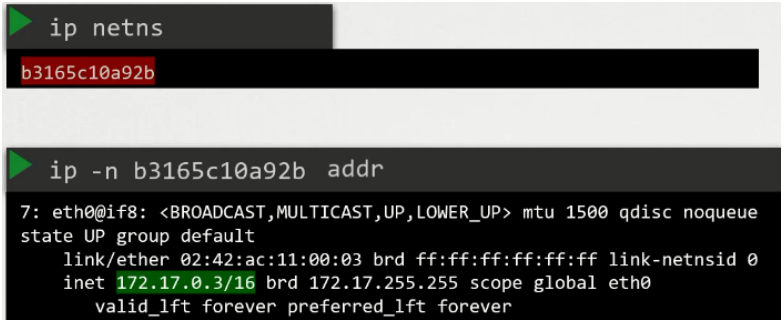
Docker creates network namspace when we run the docker run command.

Container == network namespace.

Docker also follow the same strategy like Network namespace-Linux bridge.

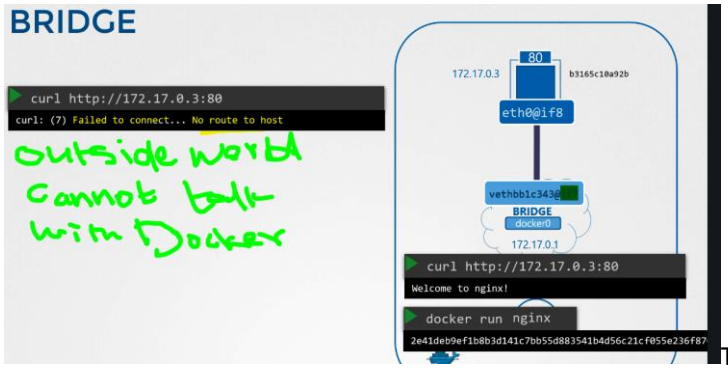


Created vLink and attched to the bridge and container. Container also gets Ip addres



Procedure afor all docker containers

1. Docker creates the namespace
2. Create pair of interfaces (links)
3. Attach one end to the container
4. And another end to the bridge network



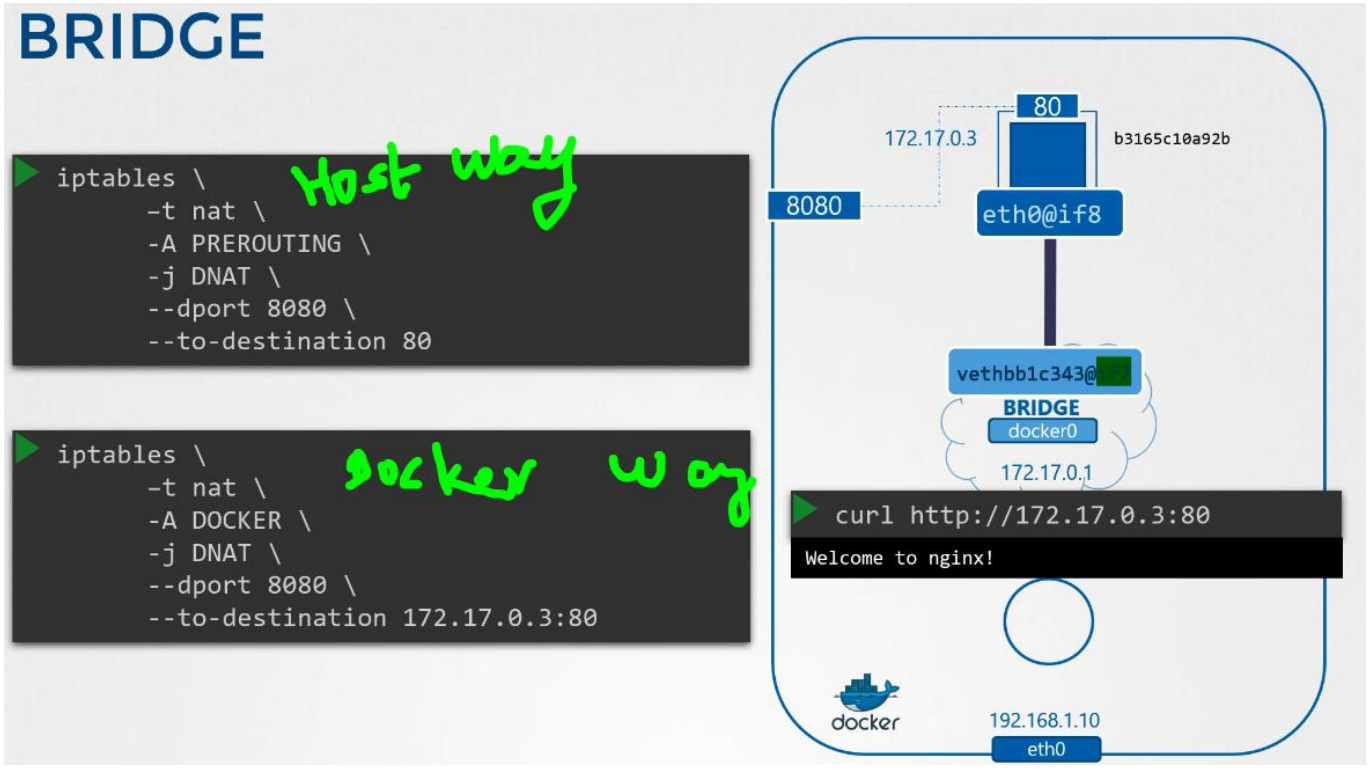
To access from outside to docker , it provides Port Mapping

or Forwarding option.

```
docker run -p 8080:80 nginx
```

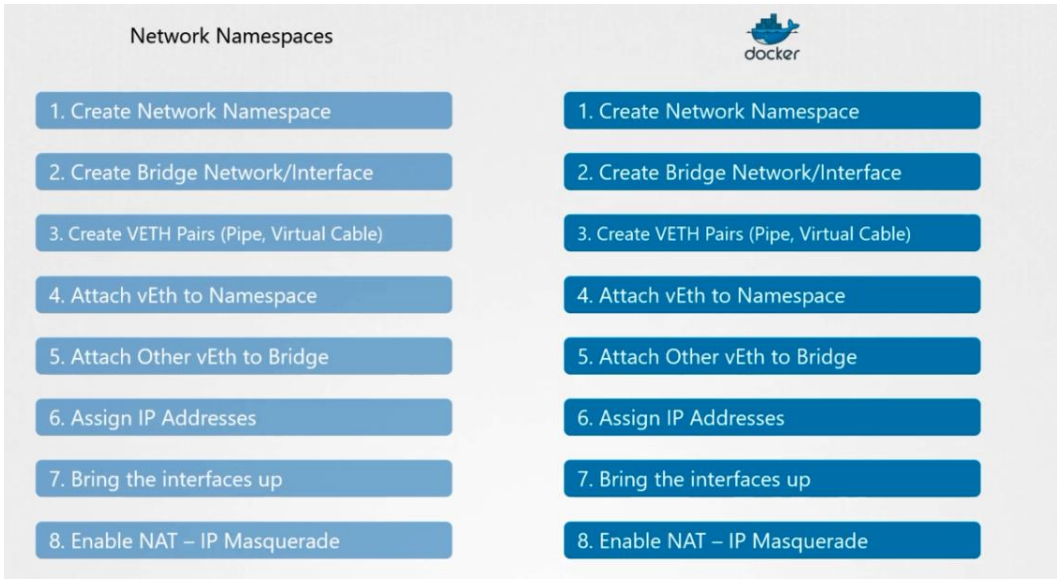
```
curl http://192.168.1.10:8080
Welcome to nginx!
```

How Docker is doing port forwarding ?



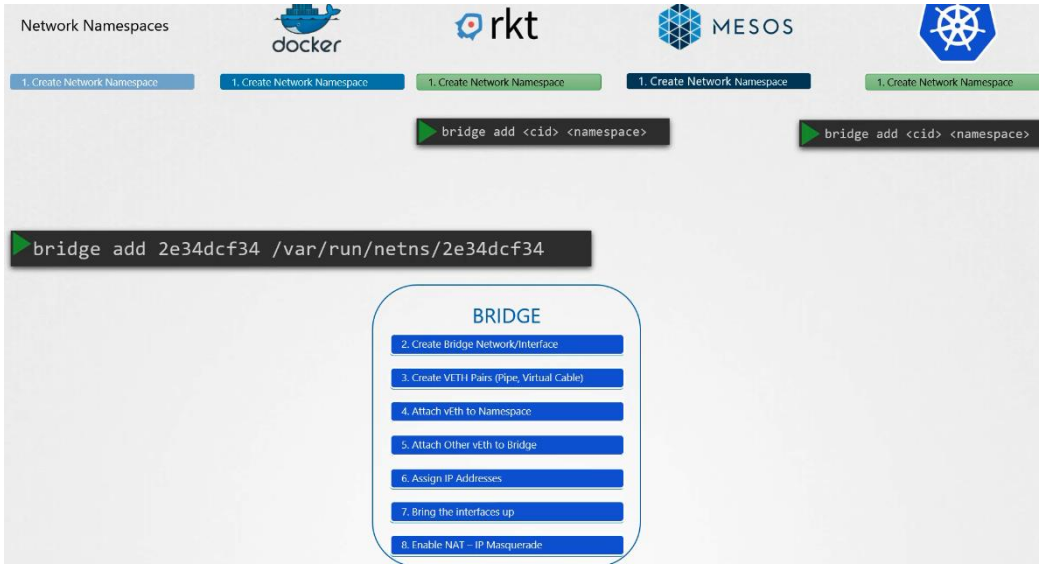
Check the rules

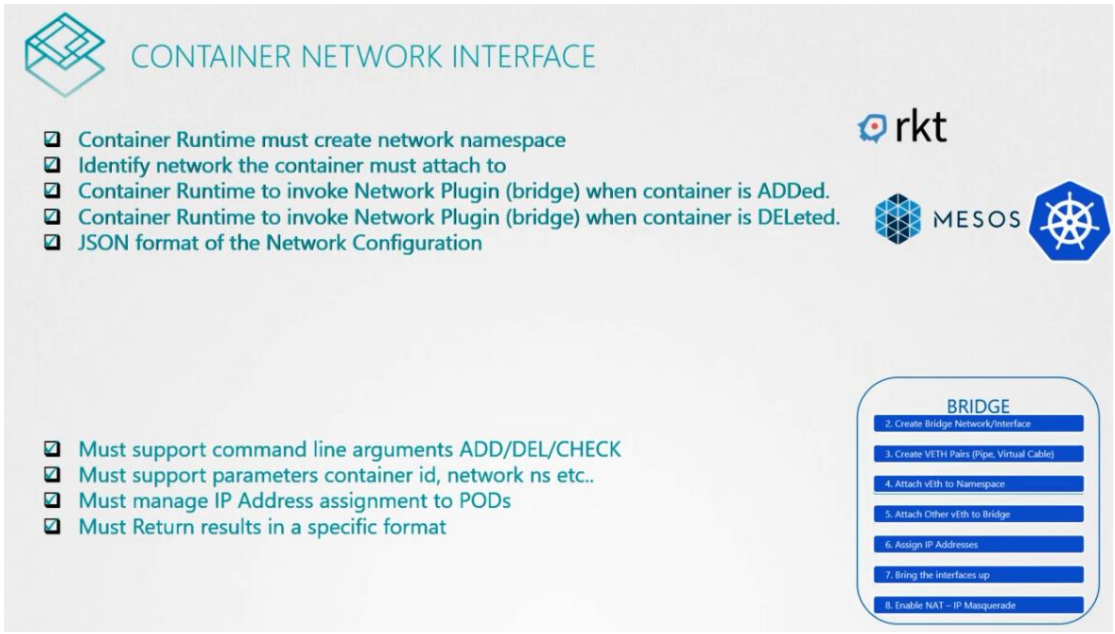
```
iptables -nvL -t nat
Chain DOCKER (2 references)
target     prot opt source               destination
RETURN     all  --  anywhere             anywhere
DNAT       tcp  --  anywhere             anywhere             tcp dpt:8080 to:172.17.0.2:80
```



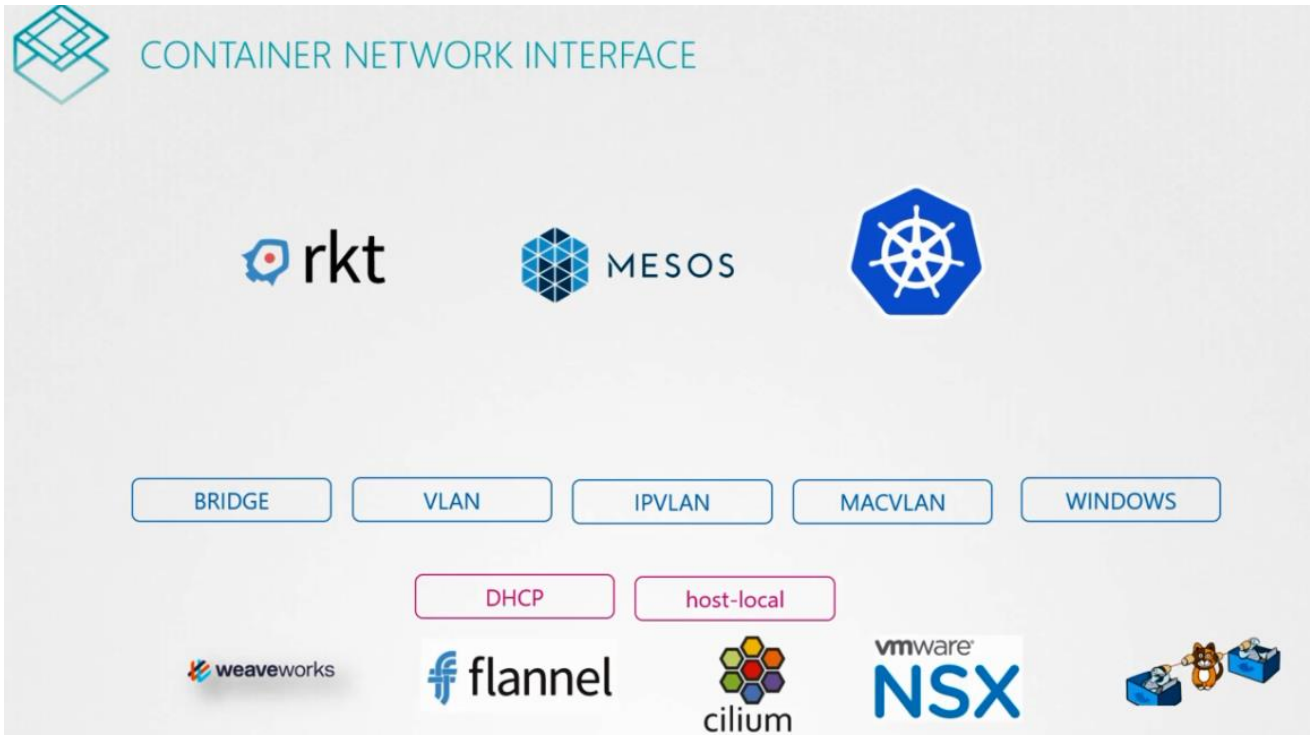
Same approach in all , so why repeated steps ?. better make it as a single standard,use it everywhere

Create Bridge (script), so any one can reuse it.





The below all are implements the CNI standard, except Docker

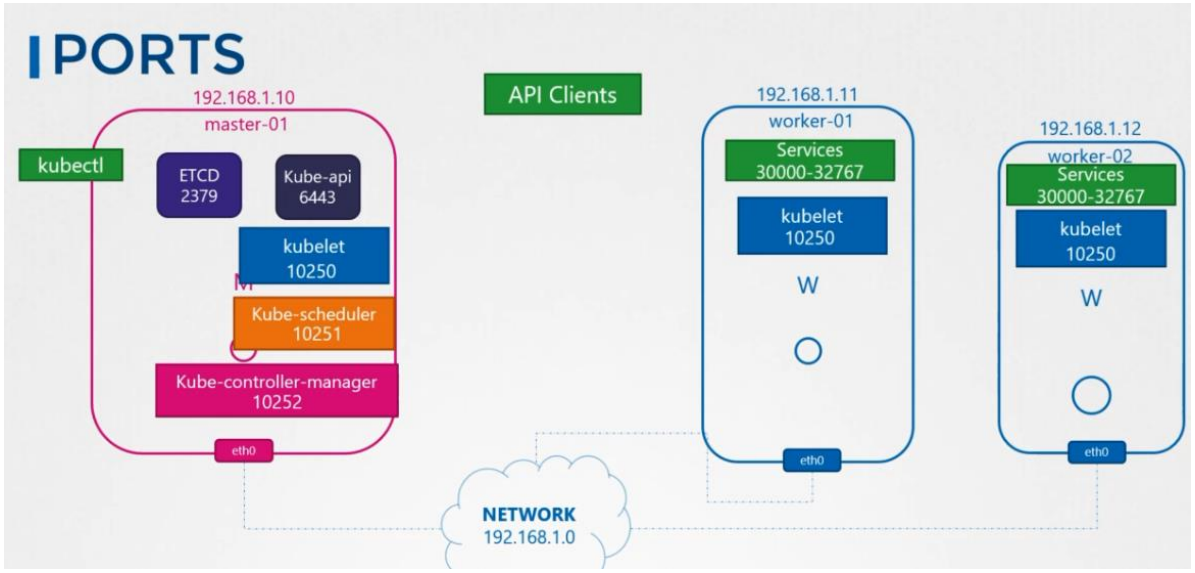


Docker has its own standard called CNM

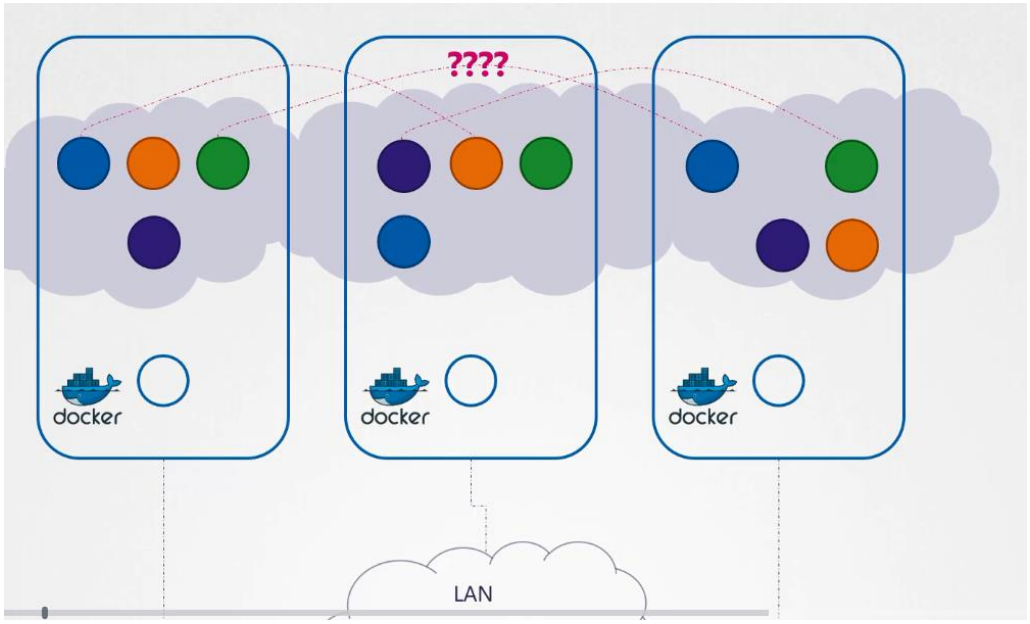

```
docker run --network=none nginx
```

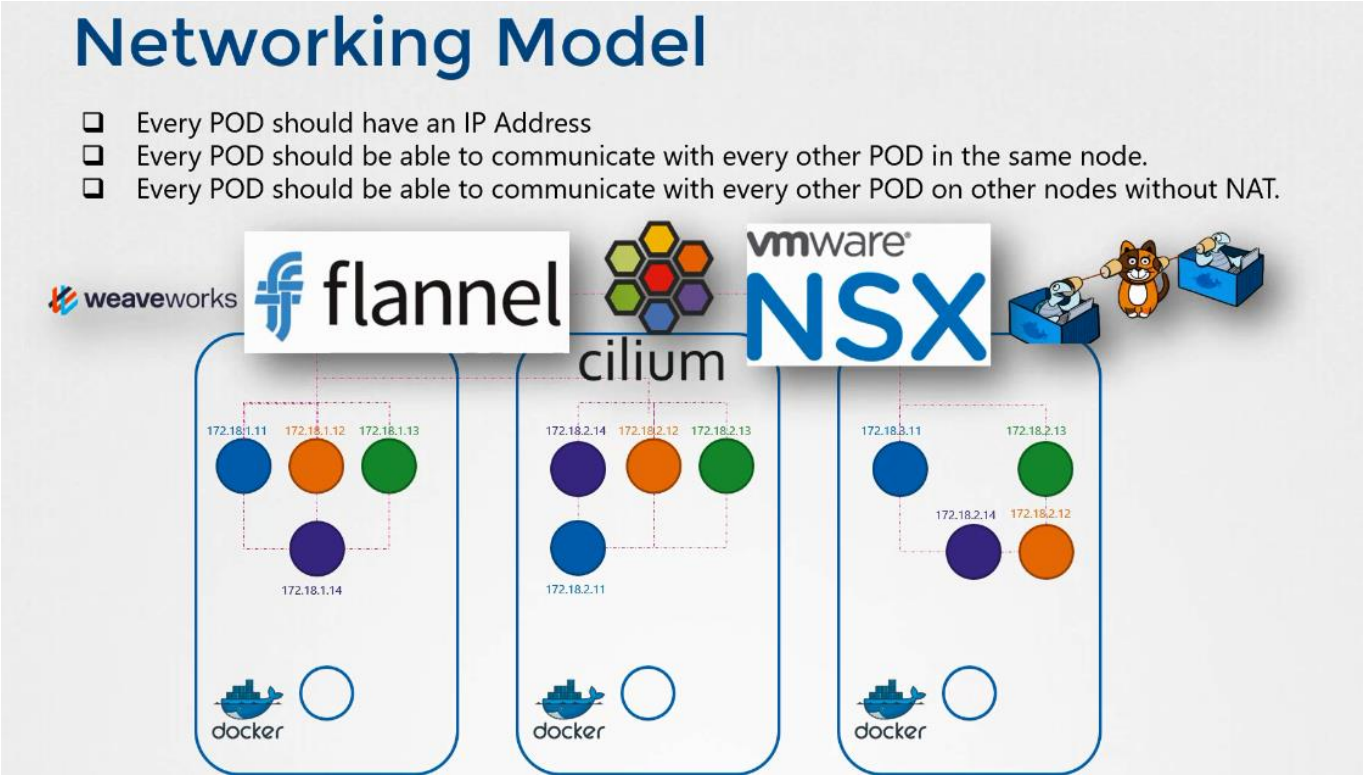
```
bridge add 2e34dcf34 /var/run/netns/2e34dcf34
```

Create docker network with none and manually add the CNI standard N/w



Pod networking : k8s doesnot come with readymade solution for this





Maualy solve N/w solution

1. We have 3 nodes, all assigned IP
2. When containers are created, k8s create namespace for them
3. To enable communicate between them we attach these namespaces to the network. Like in Linux – Bridge Network
4. Create Bridge network in each node and bring them up
5. Assign Ip to the Bridge Network . we decide each bridge n/w has its own subnet
6. Assign IP addres for the Bridge Interface

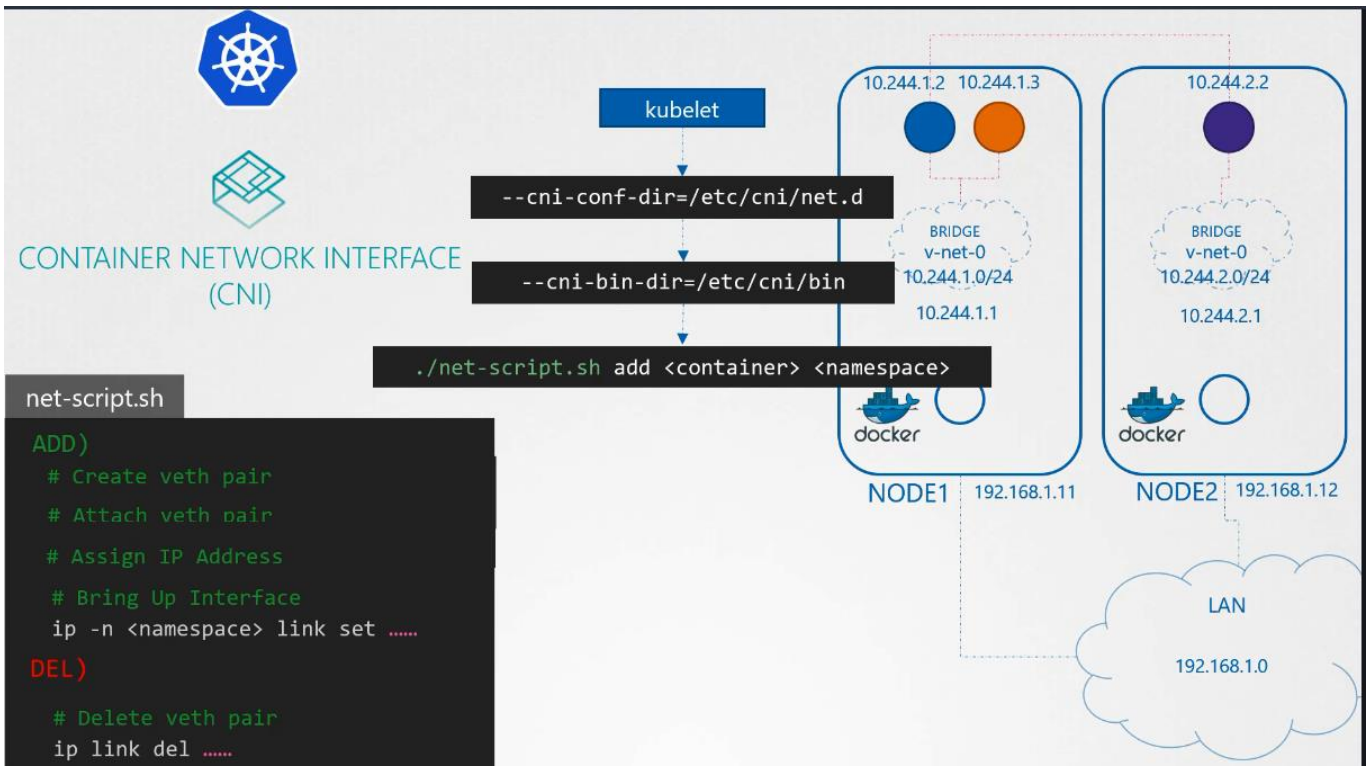
Bridge script

7. Create a wire/link
8. Attach the wire one end at the container another end at the bridge
9. Assign the IP and add the default route – gateway
10. Bring up the interface

Enable communication between one pod to another pod that is in another Node

11. Add IP route -> via node 2 . then pod from node1 can be communicate with pod in node2
12. Add IP route in all the node.

When kubelet creates the container , it looks for the script and runs the script



CNI is set to the kubelet services

Configuring CNI

kubelet.service

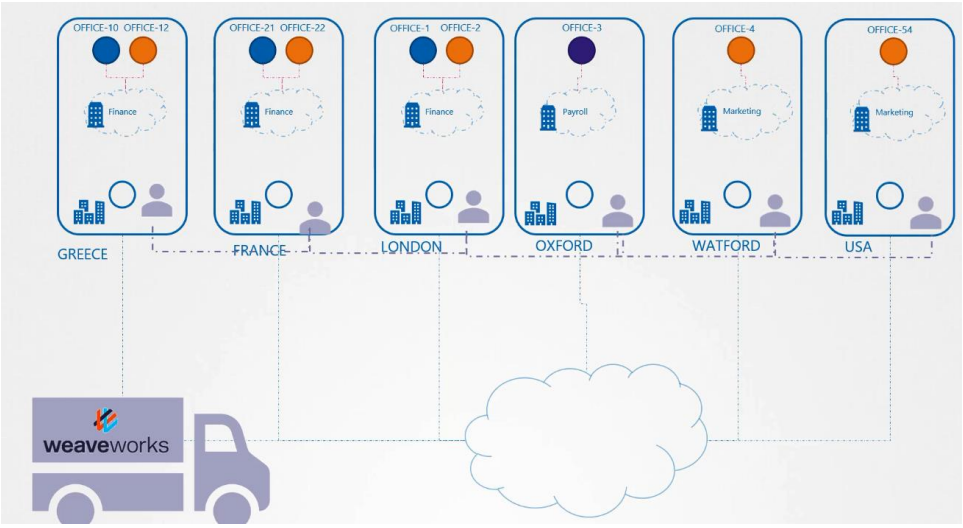
```
ExecStart=/usr/local/bin/kubelet \\
  --config=/var/lib/kubelet/kubelet-config.yaml \\
  --container-runtime=remote \\
  --container-runtime-endpoint=unix:///var/run/containerd/containerd.sock \\
  --image-pull-progress-deadline=2m \\
  --kubeconfig=/var/lib/kubelet/kubeconfig \\
  --network-plugin=cni \\
  --cni-bin-dir=/opt/cni/bin \\
  --cni-conf-dir=/etc/cni/net.d \\
  --register-node=true \\
  --v=2
```

```
ps -aux | grep kubelet
root      2095  1.8  2.4 960676 98788 ?        Ssl  02:32   0:36 /usr/bin/kubelet --bootstrap-kubeconfig=/etc/kubernetes/bootstrap-kubelet.conf --kubeconfig=/etc/kubernetes/kubelet.conf --config=/var/lib/kubelet/config.yaml --cgroup-driver=cgroupfs --cni-bin-dir=/opt/cni/bin --cni-conf-dir=/etc/cni/net.d --network-plugin=cni
```

View kubelet options

```
ls /etc/cni/net.d
10-bridge.conf
cat /etc/cni/net.d/10-bridge.conf
{
    "cniVersion": "0.2.0",
    "name": "mynet",
    "type": "bridge",
    "bridge": "cni0",
    "isGateway": true,
    "ipMasq": true,
    "ipam": {
        "type": "host-local",
        "subnet": "10.22.0.0/16",
        "routes": [
            { "dst": "0.0.0.0/0" }
        ]
    }
}
```

Weave plugin



IPAM – Ip management

kube-proxy

iptables

IP : Port	Forward To:
10.99.13.178:80	10.244.1.2

```
kubelet get pods -o wide
```

```
NAME        READY     STATUS    RESTARTS   AGE       IP           NODE
db          1/1       Running   0          14h       10.244.1.2   node-1
```

```
kubelet get service
```

```
NAME             TYPE        CLUSTER-IP       PORT(S)          AGE
db-service       ClusterIP   10.103.132.104   3306/TCP         12h
```

```
iptables -L -t net | grep db-service
```

```
KUBE-SVC-XA5OGUC7YRHOS3PU  tcp  --  anywhere   10.103.132.104   /* defau
DNAT                       tcp  --  anywhere   anywhere         /* defau
KUBE-SEP-JBWCWHHQM57V2WN7  all  --  anywhere   anywhere         /* defau
```