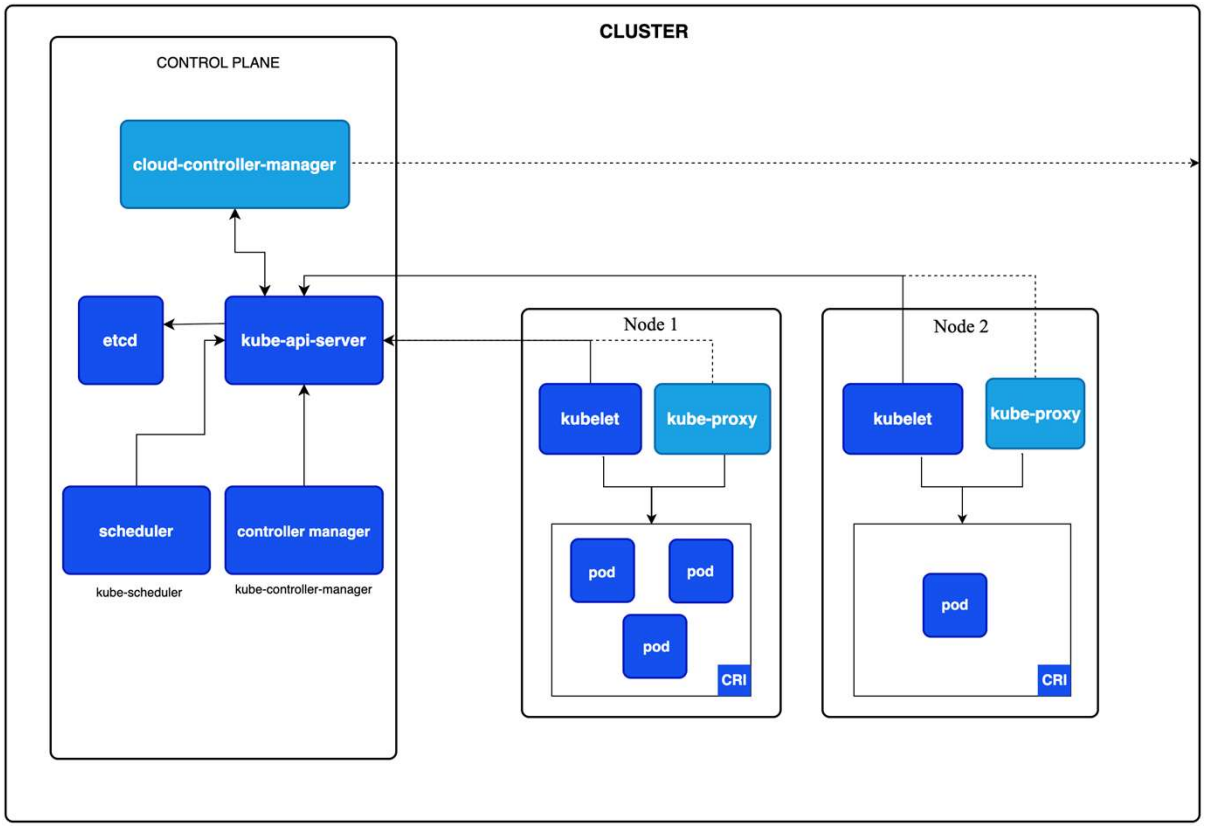
Cluster Architecture

K8s part 1

Cluster Architecture

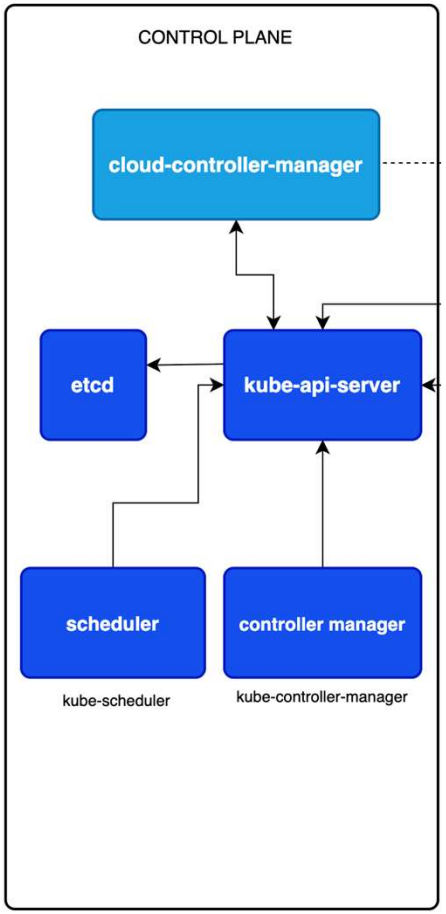
1. Control plane -> ทำหน้าที่เหมือน vCenter ควบคุม resources ต่างๆใน cluster สามารถทำ HA ได้

2. Node -> ทำหน้าที่เหมือน ESX host มีหน้าที่รัน workload ตามที่ Control plane สั่ง



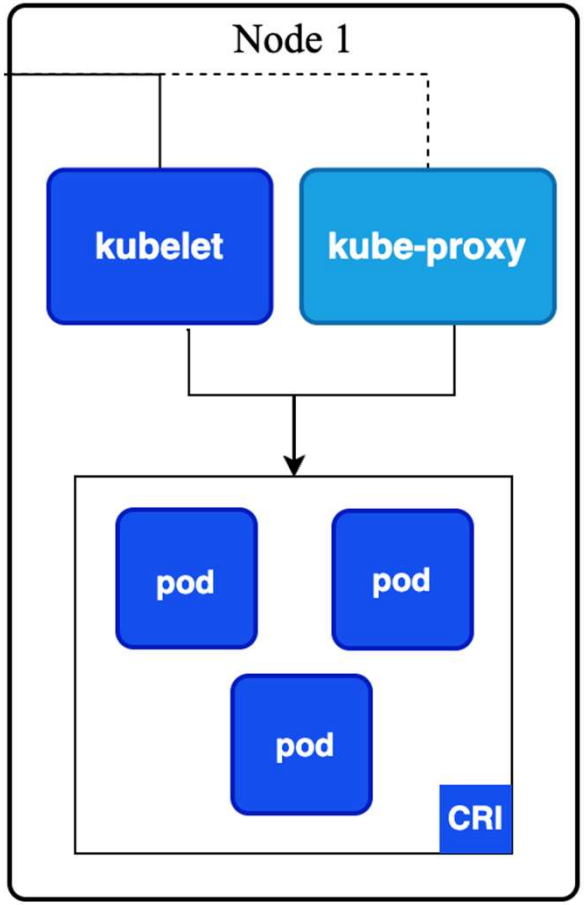
Control plane components

- kube-control-manager -> ทำหน้าที่ควบคุมทรัพยากรต่างๆใน cluster
- kube-schedule -> ทำหน้าที่จัดสรรทรัพยากรต่างๆใน cluster
- kube-api-server -> ทำหน้าที่ตัวกลางติดต่อสื่อทั้งหมดใน cluster
- etdc -> เป็นฐานข้อมูลทำหน้าที่เก็บข้อมูลต่างๆใน cluster



Node components

- kubelet -> เป็น agent สื่อสารกับ control plan
- kube-proxy -> เป็นตัวเชื่อม traffic ที่คุยกันใน cluster
- CRI -> เป็นตัวกลางระหว่าง kubelet สั่งงาน container runtime



CMD

kubectl cluster-info

```
controlplane:~$ kubectl cluster-info
Kubernetes control plane is running at https://172.30.1.2:6443
CoreDNS is running at https://172.30.1.2:6443/api/v1/namespaces/kube-system/services/kube-dns:dns/proxy
```

kubectl get nodes

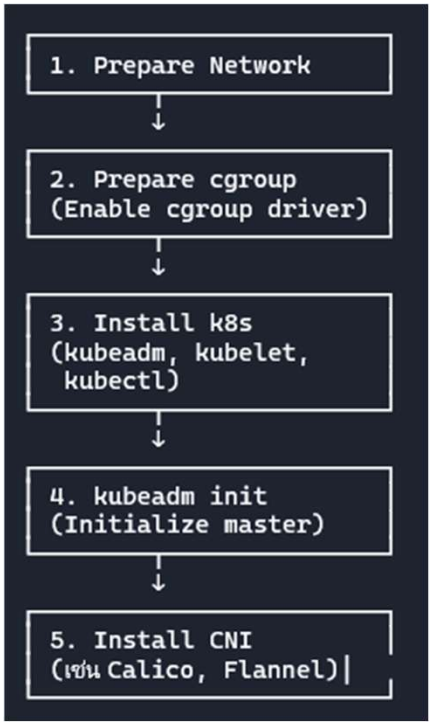
```
controlplane:~$ kubectl get node
NAME           STATUS   ROLES           AGE     VERSION
controlplane   Ready    control-plane   3d21h   v1.33.2
node01         Ready    <none>          3d20h   v1.33.2
```

CMD

kubectl get pods –A –o wide

```
controlplane:~$ k get po -n kube-system -o wide
NAME                                       READY   STATUS    RESTARTS      AGE    IP              NODE           NOMINATED NODE   READINESS GATES
calico-kube-controllers-fdf5f5495-vxpw5    1/1     Running   2 (36m ago)   5d12h  192.168.0.3     controlplane   <none>           <none>
canal-4xxhw                                2/2     Running   2 (37m ago)   5d11h  172.30.2.2      node01         <none>           <none>
canal-wlt99                                2/2     Running   2 (36m ago)   5d11h  172.30.1.2      controlplane   <none>           <none>
coredns-6ff97d97f9-4wljj                   1/1     Running   1 (37m ago)   5d11h  192.168.1.2     node01         <none>           <none>
coredns-6ff97d97f9-wmpcb                   1/1     Running   1 (37m ago)   5d11h  192.168.1.3     node01         <none>           <none>
etcd-controlplane                          1/1     Running   3 (36m ago)   5d12h  172.30.1.2      controlplane   <none>           <none>
kube-apiserver-controlplane                1/1     Running   3 (36m ago)   5d12h  172.30.1.2      controlplane   <none>           <none>
kube-controller-manager-controlplane       1/1     Running   2 (36m ago)   5d12h  172.30.1.2      controlplane   <none>           <none>
kube-proxy-d8lhg                           1/1     Running   1 (37m ago)   5d11h  172.30.2.2      node01         <none>           <none>
kube-proxy-txl4k                           1/1     Running   2 (36m ago)   5d12h  172.30.1.2      controlplane   <none>           <none>
kube-scheduler-controlplane                1/1     Running   2 (36m ago)   5d12h  172.30.1.2      controlplane   <none>           <none>
```

Control plane install



Prepare network

cat <<EOF | sudo tee /etc/sysctl.d/k8s.conf

net.ipv4.ip_forward = 1

EOF

sudo sysctl --system

sysctl net.ipv4.ip_forward

** output =1 ***

```
controlplane:~$ cat <<EOF | sudo tee /etc/sysctl.d/k8s.conf
net.ipv4.ip_forward = 1
EOF
net.ipv4.ip_forward = 1
```

Prepare cgroup

vi /etc/containerd/config.toml

systemdCgroup = true

sudo systemctl restart containerd

```
[plugins."io.containerd.grpc.v1.cri".containerd.runtimes.runc.options]
  BinaryName = ""
  CriuImagePath = ""
  CriuPath = ""
  CriuWorkPath = ""
  IoGid = 0
  IoUid = 0
  NoNewKeyring = false
  NoPivotRoot = false
  Root = ""
  ShimCgroup = ""
  SystemdCgroup = true
```

Install K8s

```
sudo apt-get update
sudo apt-get install -y apt-transport-https ca-certificates curl gpg

curl -fsSL https://pkgs.k8s.io/core:/stable:/v1.33/deb/Release.key | sudo gpg --dearmor -o /etc/apt/keyrings/kubernetes-apt-keyring.gpg

echo 'deb [signed-by=/etc/apt/keyrings/kubernetes-apt-keyring.gpg] https://pkgs.k8s.io/core:/stable:/v1.33/deb/ /' | sudo tee /etc/apt/sources.list.d/kubernetes.list

sudo apt-get update
sudo apt-cache madison kubeadm
sudo apt-get install -y kubelet kubeadm kubectl
sudo apt-mark hold kubelet kubeadm kubectl
```

kubeadm init

kubeadm init --apiserver-advertise-address=
--kubernetes-version= --pod-network-cidr=

*** พยายามใช้ kubeadm init –h ***

```
Usage:
  kubeadm init [flags]
  kubeadm init [command]

Available Commands:
  phase       Use this command to invoke single phase of the "init" workflow

Flags:
      --apiserver-advertise-address string   The IP address the API Server will advertise it's listening on. If
      --apiserver-bind-port int32            Port for the API Server to bind to. (default 6443)
      --apiserver-cert-extra-sans strings    Optional extra Subject Alternative Names (SANs) to use for the API
      --cert-dir string                      The path where to save and store the certificates. (default "/etc/
      --certificate-key string               Key used to encrypt the control-plane certificates in the kubeadm-
      --config string                        Path to a kubeadm configuration file.
      --control-plane-endpoint string        Specify a stable IP address or DNS name for the control plane.
      --cri-socket string                    Path to the CRI socket to connect. If empty kubeadm will try to au
rd CRI socket.
      --dry-run                              Don't apply any changes; just output what would be done.
      --feature-gates string                 A set of key=value pairs that describe feature gates for various f
                                             ControlPlaneKubeletLocalMode=true|false (BETA - default=true)
                                             NodeLocalCRISocket=true|false (ALPHA - default=false)
                                             PublicKeysECDSA=true|false (DEPRECATED - default=false)
                                             RootlessControlPlane=true|false (ALPHA - default=false)
                                             WaitForAllControlPlaneComponents=true|false (BETA - default=true)
```

Install CNI

https://kubernetes.io/docs/concepts/cluster-administration/addons/

*** Deamonset CNI status Running

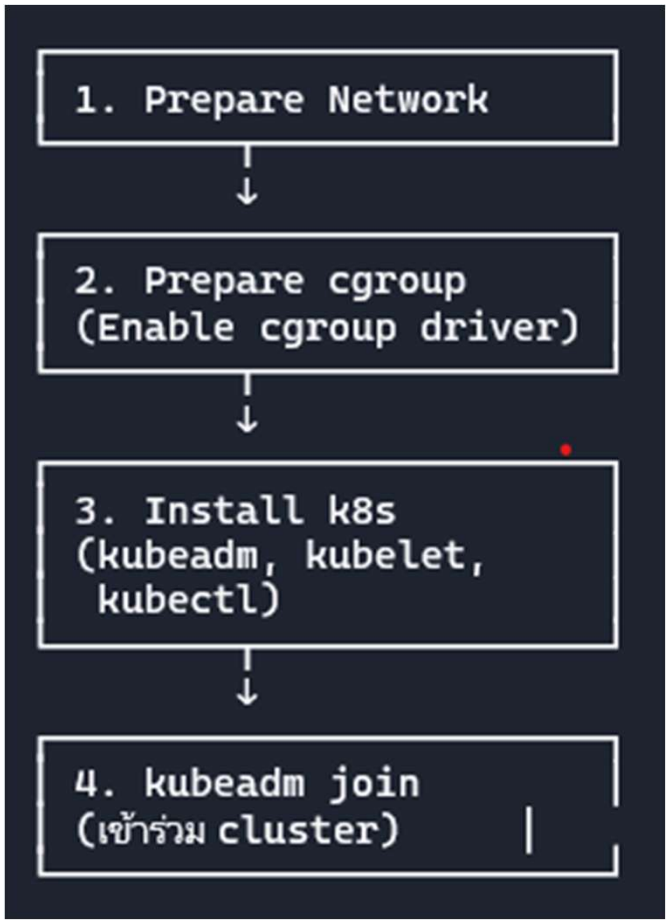
```
controlplane:~$ k get nodes
NAME           STATUS   ROLES           AGE     VERSION
controlplane   Ready    control-plane   5d12h   v1.33.2
node01         Ready    <none>          5d12h   v1.33.2
controlplane:~$ k get pods -n kube-system
NAME                                       READY   STATUS    RESTARTS      AGE
calico-kube-controllers-fdf5f5495-vxpw5    1/1     Running   2 (10m ago)   5d12h
canal-4xxhw                                2/2     Running   2 (10m ago)   5d12h
canal-wlt99                                2/2     Running   2 (10m ago)   5d12h
```

Node install

kubeadm join ip-master:6443 --token 8tsrg6.8hlcdombbk1qwmv2 --discovery-token-ca-cert-hash sha256:134d379eb4613d3154a0ab5de356979b40b05d8cbc2134e088f84965f860d551

Note print token

kubeadm token create --print-join-command



Check running component

Control node

kubectl get pods –A –o wide

```
controlplane:~$ k get po -n kube-system -o wide
NAME                                   READY   STATUS    RESTARTS      AGE    IP              NODE           NOMINATED NODE   READINESS GATES
calico-kube-controllers-fdf5f5495-vxpw5   1/1     Running   2 (36m ago)   5d12h   192.168.0.3     controlplane   <none>           <none>
canal-4xxhw                            2/2     Running   2 (37m ago)   5d11h   172.30.2.2      node01         <none>           <none>
canal-wlt99                            2/2     Running   2 (36m ago)   5d11h   172.30.1.2      controlplane   <none>           <none>
coredns-6ff97d97f9-4wljj               1/1     Running   1 (37m ago)   5d11h   192.168.1.2     node01         <none>           <none>
coredns-6ff97d97f9-wmpcb               1/1     Running   1 (37m ago)   5d11h   192.168.1.3     node01         <none>           <none>
etcd-controlplane                      1/1     Running   3 (36m ago)   5d12h   172.30.1.2      controlplane   <none>           <none>
kube-apiserver-controlplane            1/1     Running   3 (36m ago)   5d12h   172.30.1.2      controlplane   <none>           <none>
kube-controller-manager-controlplane   1/1     Running   2 (36m ago)   5d12h   172.30.1.2      controlplane   <none>           <none>
kube-proxy-d8lhg                       1/1     Running   1 (37m ago)   5d11h   172.30.2.2      node01         <none>           <none>
kube-proxy-txl4k                       1/1     Running   2 (36m ago)   5d12h   172.30.1.2      controlplane   <none>           <none>
kube-scheduler-controlplane            1/1     Running   2 (36m ago)   5d12h   172.30.1.2      controlplane   <none>           <none>
```

Kube-Api config

Path

/etc/kubernetes/manifests/kube-apiserver.yaml

สามารถแก้ service-cluster-cidr

```
controlplane:~$ cat /etc/kubernetes/manifests/kube-apiserver.yaml
apiVersion: v1
kind: Pod
metadata:
  annotations:
    kubeadm.kubernetes.io/kube-apiserver.advertise-address.endpoint: 172.30.1.2:6443
  creationTimestamp: null
  labels:
    component: kube-apiserver
    tier: control-plane
  name: kube-apiserver
  namespace: kube-system
spec:
  containers:
  - command:
    - kube-apiserver
    - --advertise-address=172.30.1.2
    - --allow-privileged=true
    - --authorization-mode=Node,RBAC
    - --client-ca-file=/etc/kubernetes/pki/ca.crt
    - --enable-admission-plugins=NodeRestriction
    - --enable-bootstrap-token-auth=true
    - --etcd-cafile=/etc/kubernetes/pki/etcd/ca.crt
    - --etcd-certfile=/etc/kubernetes/pki/apiserver-etcd-client.crt
    - --etcd-keyfile=/etc/kubernetes/pki/apiserver-etcd-client.key
    - --etcd-servers=https://127.0.0.1:2379
    - --kubelet-client-certificate=/etc/kubernetes/pki/apiserver-kubelet-client.crt
    - --kubelet-client-key=/etc/kubernetes/pki/apiserver-kubelet-client.key
    - --kubelet-preferred-address-types=InternalIP,ExternalIP,Hostname
    - --proxy-client-cert-file=/etc/kubernetes/pki/front-proxy-client.crt
    - --proxy-client-key-file=/etc/kubernetes/pki/front-proxy-client.key
    - --requestheader-allowed-names=front-proxy-client
    - --requestheader-client-ca-file=/etc/kubernetes/pki/front-proxy-ca.crt
    - --requestheader-extra-headers-prefix=X-Remote-Extra-
    - --requestheader-group-headers=X-Remote-Group
    - --requestheader-username-headers=X-Remote-User
    - --secure-port=6443
    - --service-account-issuer=https://kubernetes.default.svc.cluster.local
    - --service-account-key-file=/etc/kubernetes/pki/sa.pub
    - --service-account-signing-key-file=/etc/kubernetes/pki/sa.key
    - --service-cluster-ip-range=10.96.0.0/12
    - --tls-cert-file=/etc/kubernetes/pki/apiserver.crt
    - --tls-private-key-file=/etc/kubernetes/pki/apiserver.key
    image: registry.k8s.io/kube-apiserver:v1.33.2
```

Controller config

Path

/etc/kubernetes/manifests/kube-apiserver.yaml

สามารถแก้ pod-network-cidr

```
controlplane:~$ cat /etc/kubernetes/manifests/kube-controller-manager.yaml
apiVersion: v1
kind: Pod
metadata:
  creationTimestamp: null
  labels:
    component: kube-controller-manager
    tier: control-plane
  name: kube-controller-manager
  namespace: kube-system
spec:
  containers:
  - command:
    - kube-controller-manager
    - --allocate-node-cidrs=true
    - --authentication-kubeconfig=/etc/kubernetes/controller-manager.conf
    - --authorization-kubeconfig=/etc/kubernetes/controller-manager.conf
    - --bind-address=127.0.0.1
    - --client-ca-file=/etc/kubernetes/pki/ca.crt
    - --cluster-cidr=192.168.0.0/16
    - --cluster-name=kubernetes
    - --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
    - --requestheader-client-ca-file=/etc/kubernetes/pki/front-proxy-ca.crt
    - --root-ca-file=/etc/kubernetes/pki/ca.crt
    - --service-account-private-key-file=/etc/kubernetes/pki/sa.key
    - --service-cluster-ip-range=10.96.0.0/12
    - --use-service-account-credentials=true
    image: registry.k8s.io/kube-controller-manager:v1.33.2
```

Scheduler config

Path

/etc/kubernetes/manifests/kube-apiserver.yaml

```
controlplane:~$ cat /etc/kubernetes/manifests/kube-scheduler.yaml
apiVersion: v1
kind: Pod
metadata:
  creationTimestamp: null
  labels:
    component: kube-scheduler
    tier: control-plane
  name: kube-scheduler
  namespace: kube-system
spec:
  containers:
  - command:
    - kube-scheduler
    - --authentication-kubeconfig=/etc/kubernetes/scheduler.conf
    - --authorization-kubeconfig=/etc/kubernetes/scheduler.conf
    - --bind-address=127.0.0.1
    - --kubeconfig=/etc/kubernetes/scheduler.conf
    - --leader-elect=true
    image: registry.k8s.io/kube-scheduler:v1.33.2
```

Etcd config

Path

/etc/kubernetes/manifests/etcd.yaml

```
controlplane:~$ ls /etc/kubernetes/manifests/
etcd.yaml  kube-apiserver.yaml  kube-controller-manager.yaml  kube-scheduler.yaml
controlplane:~$ cat /etc/kubernetes/manifests/etcd.yaml
apiVersion: v1
kind: Pod
metadata:
  annotations:
    kubeadm.kubernetes.io/etcd.advertise-client-urls: https://172.30.1.2:2379
  creationTimestamp: null
  labels:
    component: etcd
    tier: control-plane
  name: etcd
  namespace: kube-system
spec:
  containers:
  - command:
    - etcd
    - --advertise-client-urls=https://172.30.1.2:2379
    - --cert-file=/etc/kubernetes/pki/etcd/server.crt
    - --client-cert-auth=true
    - --data-dir=/var/lib/etcd
    - --experimental-initial-corrupt-check=true
    - --experimental-watch-progress-notify-interval=5s
    - --initial-advertise-peer-urls=https://172.30.1.2:2380
    - --initial-cluster=controlplane=https://172.30.1.2:2380
    - --key-file=/etc/kubernetes/pki/etcd/server.key
    - --listen-client-urls=https://127.0.0.1:2379,https://172.30.1.2:2379
    - --listen-metrics-urls=http://127.0.0.1:2381
    - --listen-peer-urls=https://172.30.1.2:2380
    - --name=controlplane
    - --peer-cert-file=/etc/kubernetes/pki/etcd/peer.crt
    - --peer-client-cert-auth=true
    - --peer-key-file=/etc/kubernetes/pki/etcd/peer.key
    - --peer-trusted-ca-file=/etc/kubernetes/pki/etcd/ca.crt
    - --snapshot-count=10000
    - --trusted-ca-file=/etc/kubernetes/pki/etcd/ca.crt
    image: registry.k8s.io/etcd:3.5.21-0
```

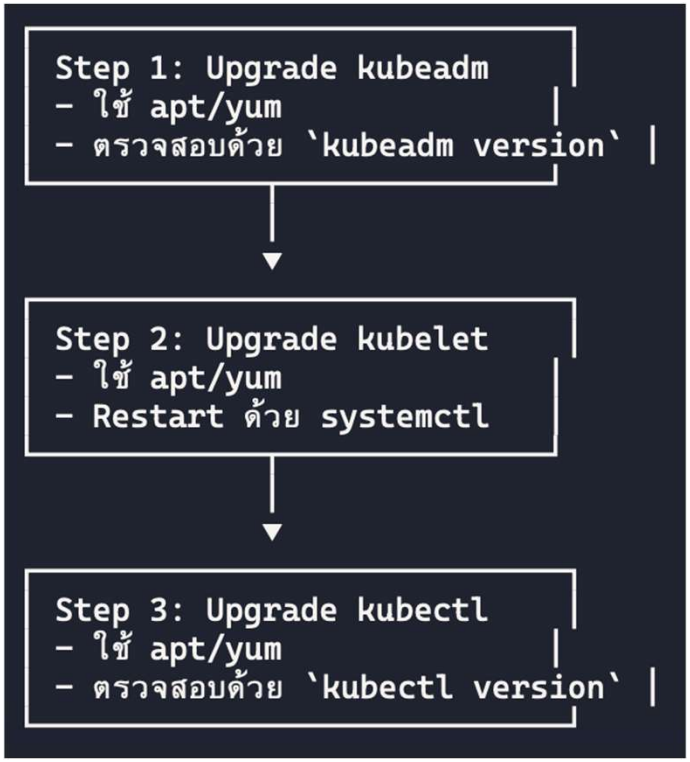
Scheduler config

- Path

/etc/kubernetes/manifests/kube-apiserver.yaml

```
controlplane:~$ cat /etc/kubernetes/manifests/kube-scheduler.yaml
apiVersion: v1
kind: Pod
metadata:
  creationTimestamp: null
  labels:
    component: kube-scheduler
    tier: control-plane
  name: kube-scheduler
  namespace: kube-system
spec:
  containers:
  - command:
    - kube-scheduler
    - --authentication-kubeconfig=/etc/kubernetes/scheduler.conf
    - --authorization-kubeconfig=/etc/kubernetes/scheduler.conf
    - --bind-address=127.0.0.1
    - --kubeconfig=/etc/kubernetes/scheduler.conf
    - --leader-elect=true
    image: registry.k8s.io/kube-scheduler:v1.33.2
```

Upgrade



Control plan

kubectl drain control

kubeadm version

sudo apt-mark unhold kubelet kubeadm kubectl

apt update

apt-cache madison kubeadm

apt-get install kubeadm=1.33.0-1.1

kubeadm upgrade plan 1.33.0-1.1

kubeadm upgrade apply 1.33.0-1.1

apt-get install kubelet=1.33.0-1.1 kubelet=1.33.0-1.1

systemctl daemon-reload

systemctl restart kubelet

ข้าม version -> vi /etc/apt/sources.list.d/kubernetes.list

```
controlplane:~$ kubeadm upgrade plan
[preflight] Running pre-flight checks.
[upgrade/config] Reading configuration from the "kubeadm-config" ConfigMap in namespace "kube-system"...
[upgrade/config] Use 'kubeadm init phase upload-config --config your-config-file' to re-upload it.
[upgrade] Running cluster health checks
[upgrade] Fetching available versions to upgrade to
[upgrade/versions] Cluster version: 1.33.2
[upgrade/versions] kubeadm version: v1.33.2
I0925 15:53:06.464038   14490 version.go:261] remote version is much newer: v1.34.1; falling back to: stable-1.33
[upgrade/versions] Target version: v1.33.5
[upgrade/versions] Latest version in the v1.33 series: v1.33.5

Components that must be upgraded manually after you have upgraded the control plane with 'kubeadm upgrade apply':
COMPONENT   NODE           CURRENT   TARGET
kubelet     controlplane   v1.33.2   v1.33.5
kubelet     node01         v1.33.2   v1.33.5

Upgrade to the latest version in the v1.33 series:

COMPONENT                 NODE           CURRENT    TARGET
kube-apiserver            controlplane   v1.33.2    v1.33.5
kube-controller-manager   controlplane   v1.33.2    v1.33.5
kube-scheduler            controlplane   v1.33.2    v1.33.5
kube-proxy                               1.33.2     v1.33.5
CoreDNS                                  v1.12.0    v1.12.0
etcd                      controlplane   3.5.21-0   3.5.21-0

You can now apply the upgrade by executing the following command:

        kubeadm upgrade apply v1.33.5

Note: Before you can perform this upgrade, you have to update kubeadm to v1.33.5.

_____________________________________________________________________


The table below shows the current state of component configs as understood by this version of kubeadm.
Configs that have a "yes" mark in the "MANUAL UPGRADE REQUIRED" column require manual config upgrade or
resetting to kubeadm defaults before a successful upgrade can be performed. The version to manually
upgrade to is denoted in the "PREFERRED VERSION" column.

API GROUP                 CURRENT VERSION   PREFERRED VERSION   MANUAL UPGRADE REQUIRED
kubeproxy.config.k8s.io   v1alpha1          v1alpha1            no
kubelet.config.k8s.io     v1beta1           v1beta1             no
_____________________________________________________________________
```

Node

kubectl drain node01

kubeadm version

apt update

apt-mark unhold kubelet kubeadm kubectl

apt-cache madison kubeadm

apt-get upgrade –y kubeadm=1.33.0-1.1

kubeadm upgrade node

apt-get install kubelet=1.33.0-1.1 kubelet=1.33.0-1.1

systemctl daemon-reload

systemctl restart kubelet

apt-mark hold kubelet kubeadm kubectl

ข้าม version -> vi /etc/apt/sources.list.d/kubernetes.list

🔧 เปรียบเทียบคำสั่ง Drain, Cordon, Uncordon

คำสั่ง	จุดประสงค์หลัก	ผลกระทบต่อ Pod บน Node	Node รับ Pod ใหม่หรือไม่	ใช้เมื่อ...
`kubectl`	ป้องกันไม่ให้มีการ schedule Pod ใหม่	ไม่มีผลต่อ Pod ที่รันอยู่	❌ ไม่รับ Pod ใหม่	เตรียม node สำหรับ maintenance
`kubectl`	เปิดให้ node รับ Pod ใหม่อีกครั้ง	ไม่มีผลต่อ Pod ที่รันอยู่	✅ รับ Pod ใหม่ได้	หลังจาก maintenance เสร็จ
`kubectl`	ย้าย Pod ออกจาก node เพื่อ maintenance	✅ ลบ Pod ที่สามารถ reschedule ได้	❌ ไม่รับ Pod ใหม่	ต้องการเคลียร์ node เพื่อปิดหรืออัปเดต

Troubershooting

Control plan

1.kubectl get … อะไรไม่ได้แสดงว่า kube-api มีปัญหา

2. Pod ไม่ถูก deploy (status pending) ไปที่ node แสดงว่า kube-schedule มีปัญหา

3. Deployment มีปัญหาแสดงว่า control plan มีปัญหา

4. ในกรณีที่ kubectl ใช้ไม่ได้ อาจจะต้องใช้ crictl ช่วย debug

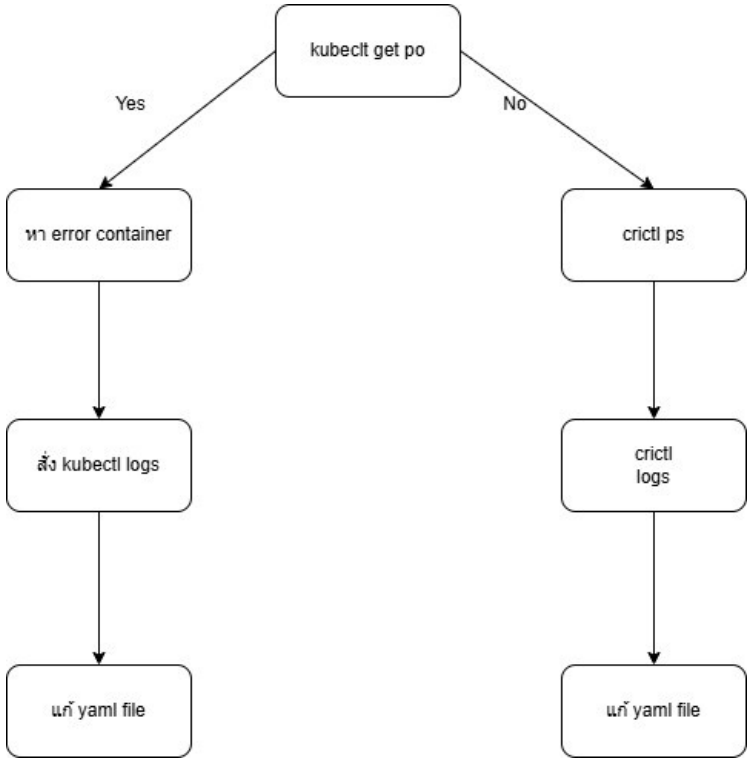
อย่าลืมว่า K8s เป็น Automate แต่ container รันผ่านพวก container run time

Logs path

/var/log/syslog

/var/log/containers

/var/log/pods



Node

1. ให้ check -> service kubelet status

2. ดู log error -> /var/log/syslog

3. ดู config kubelet -> /var/lib/kubelet/kubeadm-flags.env

สามารถใช้คำสั่ง journalctl –u xxx

Debug Cert

kubeadm certs check-expiration

Kubeadm certs renew