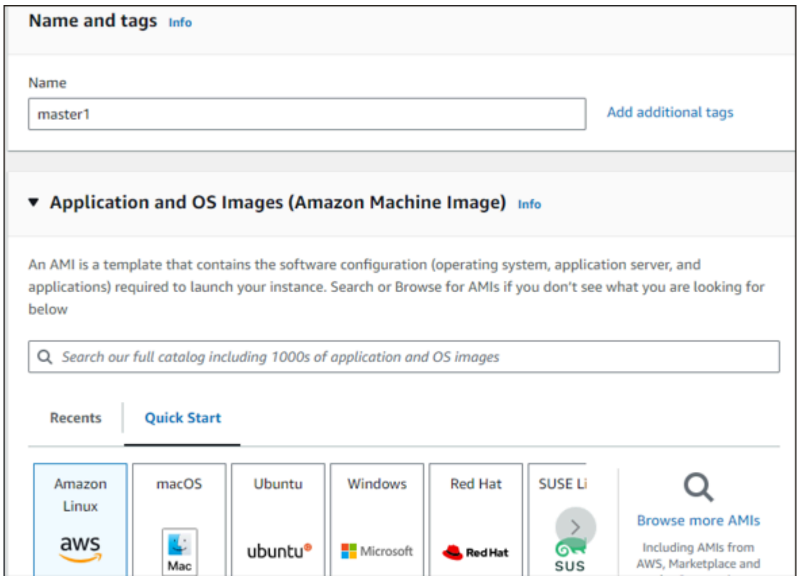
AIM:To understand the Kubernetes Cluster Architecture, install and Spin Up a Kubernetes Cluster on Linux Machines/Cloud Platforms.

Create 3 EC2 Ubuntu Instances on AWS.

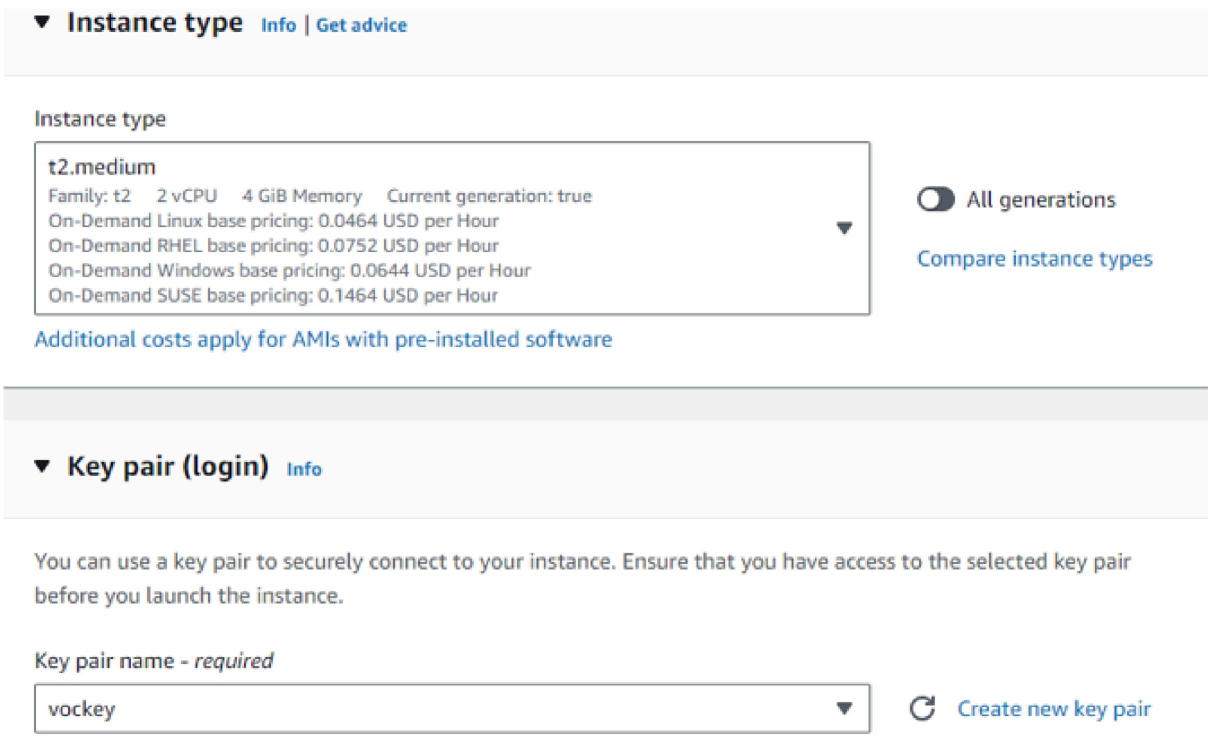
Login to your AWS console.Go to services and in that search for EC2 and create 3 EC2 Ubuntu Instances as master 1 ,node1 and node 2.While making an instance make sure to select Amazon Linux and in linux type instead of default t2 .micro select t2.medium.


Name and tags Info

Name: master1

An AMI is a template that contains the software configuration (operating system, application server, and applications) required to launch your instance. Search or Browse for AMIs if you don't see what you are looking for below

Search our full catalog including 1000s of application and OS images


Instance type Info | Get advice

Instance type

```
t2.medium
Family: t2    2 vCPU    4 GiB Memory    Current generation: true
On-Demand Linux base pricing: 0.0464 USD per Hour
On-Demand RHEL base pricing: 0.0752 USD per Hour
On-Demand Windows base pricing: 0.0644 USD per Hour
On-Demand SUSE base pricing: 0.1464 USD per Hour
```

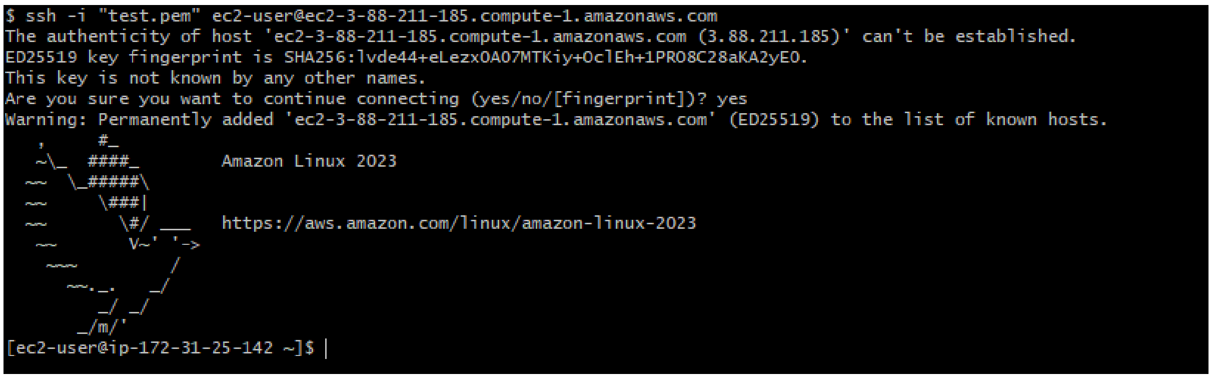
Additional costs apply for AMIs with pre-installed software

Key pair (login) Info

You can use a key pair to securely connect to your instance. Ensure that you have access to the selected key pair before you launch the instance.

Key pair name - *required*: vockey

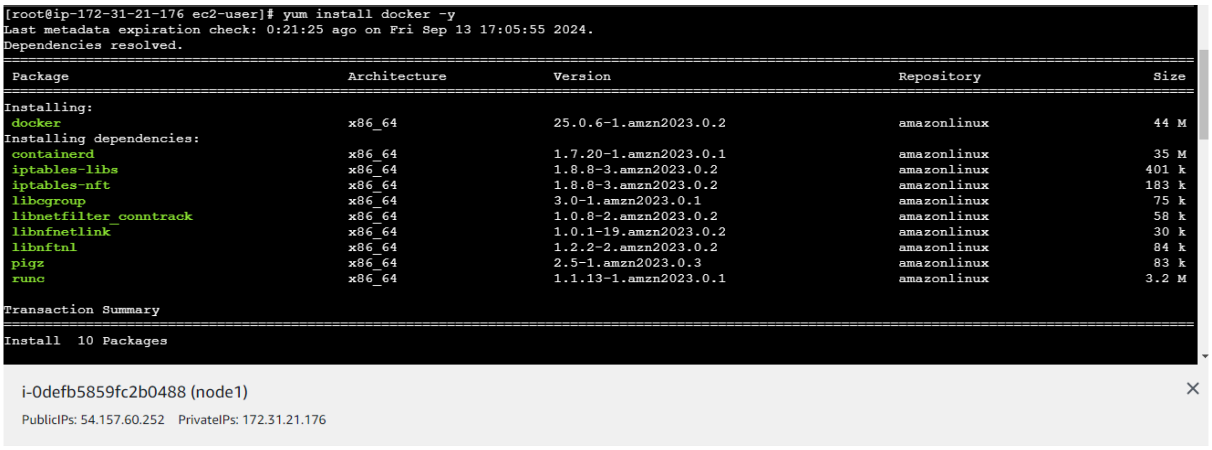
Setting SSH for establishing connections



```
$ ssh -i "test.pem" ec2-user@ec2-3-88-211-185.compute-1.amazonaws.com
The authenticity of host 'ec2-3-88-211-185.compute-1.amazonaws.com (3.88.211.185)' can't be established.
ED25519 key fingerprint is SHA256:lvde44+eLezxOA07MTKiy+OclEh+1PRO8C28aKA2yEO.
This key is not known by any other names.
Are you sure you want to continue connecting (yes/no/[fingerprint])? yes
Warning: Permanently added 'ec2-3-88-211-185.compute-1.amazonaws.com' (ED25519) to the list of known hosts.
   ,     #_
   ~\_  ####_        Amazon Linux 2023
  ~~  \_#####\
  ~~     \###|
  ~~       \#/ ___   https://aws.amazon.com/linux/amazon-linux-2023
   ~~       V~' '->
    ~~~         /
      ~~._.   _/
         _/ _/
       _/m/'
[ec2-user@ip-172-31-25-142 ~]$ |
```

INSTALLATION OF DOCKER

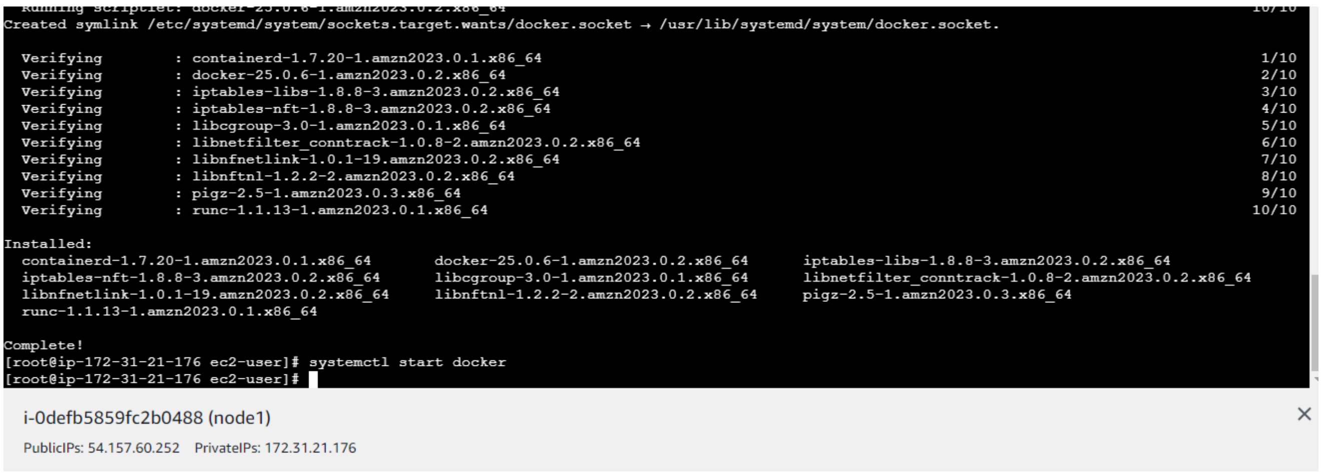
For installing docker we use the following steps:
STEP 1: In node 1 EC2 instance install docker and repeat the same step for master and node2 .
Syntax:yum install docker -y



```
[root@ip-172-31-21-176 ec2-user]# yum install docker -y
Last metadata expiration check: 0:21:25 ago on Fri Sep 13 17:05:55 2024.
Dependencies resolved.
==========================================================================================================================
 Package                           Architecture             Version                                Repository         Size
==========================================================================================================================
Installing:
 docker                            x86_64                   25.0.6-1.amzn2023.0.2                  amazonlinux        44 M
Installing dependencies:
 containerd                        x86_64                   1.7.20-1.amzn2023.0.1                  amazonlinux        35 M
 iptables-libs                     x86_64                   1.8.8-3.amzn2023.0.2                   amazonlinux       401 k
 iptables-nft                      x86_64                   1.8.8-3.amzn2023.0.2                   amazonlinux       183 k
 libcgroup                         x86_64                   3.0-1.amzn2023.0.1                     amazonlinux        75 k
 libnetfilter_conntrack            x86_64                   1.0.8-2.amzn2023.0.2                   amazonlinux        58 k
 libnfnetlink                      x86_64                   1.0.1-19.amzn2023.0.2                  amazonlinux        30 k
 libnftnl                          x86_64                   1.2.2-2.amzn2023.0.2                   amazonlinux        84 k
 pigz                              x86_64                   2.5-1.amzn2023.0.3                     amazonlinux        83 k
 runc                              x86_64                   1.1.13-1.amzn2023.0.1                  amazonlinux       3.2 M

Transaction Summary
==========================================================================================================================
Install  10 Packages
```

i-0defb5859fc2b0488 (node1)
PublicIPs: 54.157.60.252   PrivateIPs: 172.31.21.176

STEP 2: After the installation of docker is successfully completed in all the three instances start the docker by the syntax given below:
Syntax :systemctl start docker.
Start the docker in master and node2 too .



```
Created symlink /etc/systemd/system/sockets.target.wants/docker.socket → /usr/lib/systemd/system/docker.socket.

  Verifying        : containerd-1.7.20-1.amzn2023.0.1.x86_64                                                    1/10
  Verifying        : docker-25.0.6-1.amzn2023.0.2.x86_64                                                        2/10
  Verifying        : iptables-libs-1.8.8-3.amzn2023.0.2.x86_64                                                  3/10
  Verifying        : iptables-nft-1.8.8-3.amzn2023.0.2.x86_64                                                   4/10
  Verifying        : libcgroup-3.0-1.amzn2023.0.1.x86_64                                                        5/10
  Verifying        : libnetfilter_conntrack-1.0.8-2.amzn2023.0.2.x86_64                                         6/10
  Verifying        : libnfnetlink-1.0.1-19.amzn2023.0.2.x86_64                                                  7/10
  Verifying        : libnftnl-1.2.2-2.amzn2023.0.2.x86_64                                                       8/10
  Verifying        : pigz-2.5-1.amzn2023.0.3.x86_64                                                             9/10
  Verifying        : runc-1.1.13-1.amzn2023.0.1.x86_64                                                         10/10

Installed:
  containerd-1.7.20-1.amzn2023.0.1.x86_64       docker-25.0.6-1.amzn2023.0.2.x86_64      iptables-libs-1.8.8-3.amzn2023.0.2.x86_64
  iptables-nft-1.8.8-3.amzn2023.0.2.x86_64      libcgroup-3.0-1.amzn2023.0.1.x86_64      libnetfilter_conntrack-1.0.8-2.amzn2023.0.2.x86_64
  libnfnetlink-1.0.1-19.amzn2023.0.2.x86_64     libnftnl-1.2.2-2.amzn2023.0.2.x86_64     pigz-2.5-1.amzn2023.0.3.x86_64
  runc-1.1.13-1.amzn2023.0.1.x86_64

Complete!
[root@ip-172-31-21-176 ec2-user]# systemctl start docker
[root@ip-172-31-21-176 ec2-user]#
```

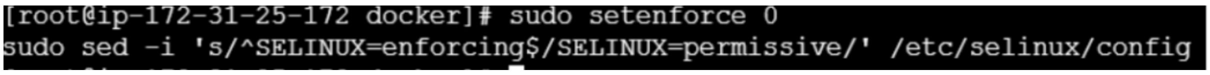
i-0defb5859fc2b0488 (node1)
PublicIPs: 54.157.60.252 PrivateIPs: 172.31.21.176

INSTALLATION OF KUBERNETES

After installing and starting the docker in all the three instances ,now lets install kubernetes for the installation we use the following steps:

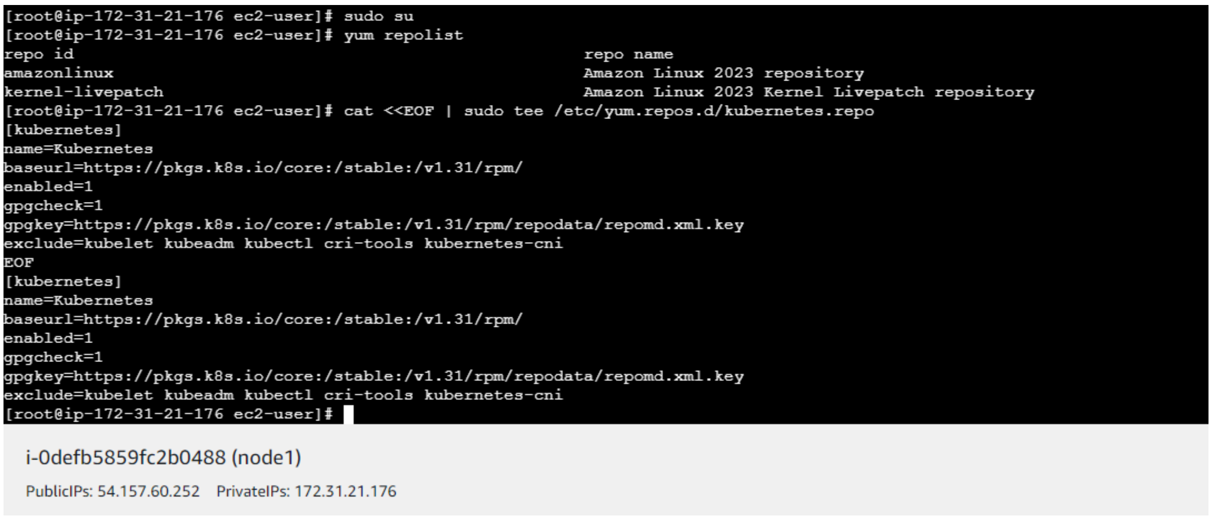
STEP 1: Set SELinux to permissive mode:
Syntax:`sudo setenforce 0`

```
sudo sed -i 's/^SELINUX=enforcing$/SELINUX=permissive/'
/etc/selinux/config
```



```
[root@ip-172-31-25-172 docker]# sudo setenforce 0
sudo sed -i 's/^SELINUX=enforcing$/SELINUX=permissive/' /etc/selinux/config
```

STEP 2: Add the Kubernetes yum repository. The exclude parameter in the repository definition ensures that the packages related to Kubernetes are not upgraded upon running yum update as there's a special procedure that must be followed for upgrading Kubernetes



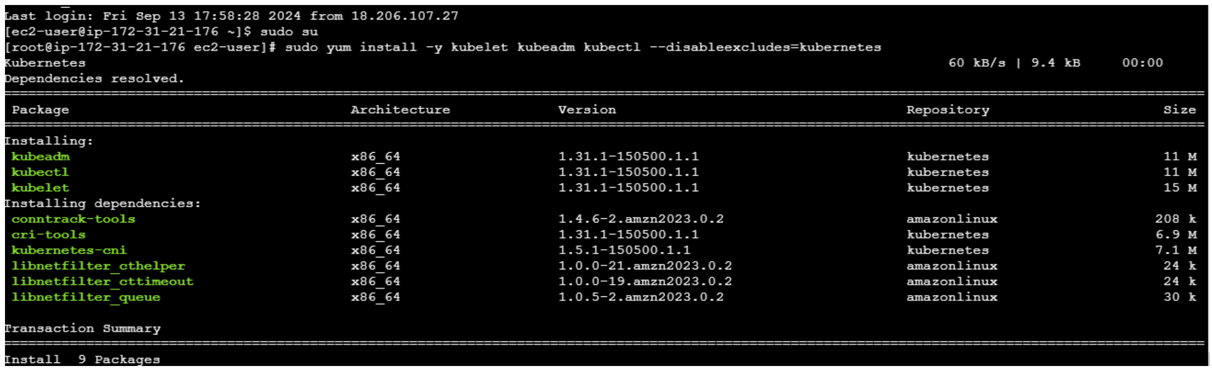
```
[root@ip-172-31-21-176 ec2-user]# sudo su
[root@ip-172-31-21-176 ec2-user]# yum repolist
repo id                                                    repo name
amazonlinux                                                Amazon Linux 2023 repository
kernel-livepatch                                           Amazon Linux 2023 Kernel Livepatch repository
[root@ip-172-31-21-176 ec2-user]# cat <<EOF | sudo tee /etc/yum.repos.d/kubernetes.repo
[kubernetes]
name=Kubernetes
baseurl=https://pkgs.k8s.io/core:/stable:/v1.31/rpm/
enabled=1
gpgcheck=1
gpgkey=https://pkgs.k8s.io/core:/stable:/v1.31/rpm/repodata/repomd.xml.key
exclude=kubelet kubeadm kubectl cri-tools kubernetes-cni
EOF
[kubernetes]
name=Kubernetes
baseurl=https://pkgs.k8s.io/core:/stable:/v1.31/rpm/
enabled=1
gpgcheck=1
gpgkey=https://pkgs.k8s.io/core:/stable:/v1.31/rpm/repodata/repomd.xml.key
exclude=kubelet kubeadm kubectl cri-tools kubernetes-cni
[root@ip-172-31-21-176 ec2-user]#
```

i-0defb5859fc2b0488 (node1)

PublicIPs: 54.157.60.252 PrivateIPs: 172.31.21.176

STEP 3: Install kubelet, kubeadm and kubectl:

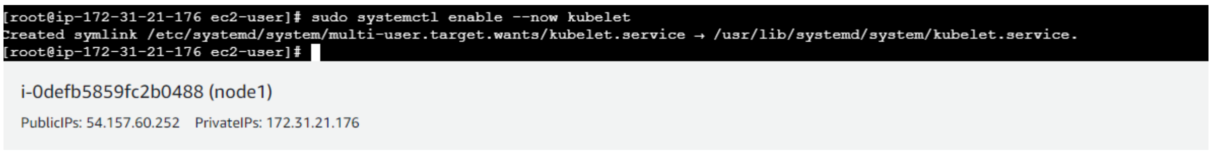
Syntax:`sudo yum install -y kubelet kubeadm kubectl --disableexcludes=kubernetes`



```
Last login: Fri Sep 13 17:58:28 2024 from 18.206.107.27
[ec2-user@ip-172-31-21-176 ~]$ sudo su
[root@ip-172-31-21-176 ec2-user]# sudo yum install -y kubelet kubeadm kubectl --disableexcludes=kubernetes
Kubernetes                                                                                60 kB/s | 9.4 kB     00:00
Dependencies resolved.
========================================================================================================================
 Package                         Architecture          Version                            Repository              Size
========================================================================================================================
Installing:
 kubeadm                         x86_64                1.31.1-150500.1.1                  kubernetes              11 M
 kubectl                         x86_64                1.31.1-150500.1.1                  kubernetes              11 M
 kubelet                         x86_64                1.31.1-150500.1.1                  kubernetes              15 M
Installing dependencies:
 conntrack-tools                 x86_64                1.4.6-2.amzn2023.0.2               amazonlinux            208 k
 cri-tools                       x86_64                1.31.1-150500.1.1                  kubernetes             6.9 M
 kubernetes-cni                  x86_64                1.5.1-150500.1.1                   kubernetes             7.1 M
 libnetfilter_cthelper           x86_64                1.0.0-21.amzn2023.0.2              amazonlinux             24 k
 libnetfilter_cttimeout          x86_64                1.0.0-19.amzn2023.0.2              amazonlinux             24 k
 libnetfilter_queue              x86_64                1.0.5-2.amzn2023.0.2               amazonlinux             30 k

Transaction Summary
========================================================================================================================
Install  9 Packages
```

STEP 4: Enable the kubelet service before running kubeadm:

Syntax:`sudo systemctl enable --now kubelet`

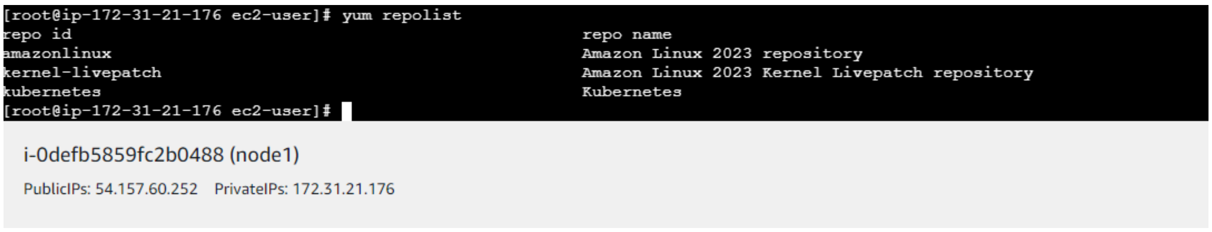


```
[root@ip-172-31-21-176 ec2-user]# sudo systemctl enable --now kubelet
Created symlink /etc/systemd/system/multi-user.target.wants/kubelet.service → /usr/lib/systemd/system/kubelet.service.
[root@ip-172-31-21-176 ec2-user]#
```

i-0defb5859fc2b0488 (node1)

PublicIPs: 54.157.60.252 PrivateIPs: 172.31.21.176

STEP 5: It can be seen from the repolist command which lists all the repository we can see that kubernetes in installed repeat all these steps on master1 and node2.



```
[root@ip-172-31-21-176 ec2-user]# yum repolist
repo id                                                    repo name
amazonlinux                                                Amazon Linux 2023 repository
kernel-livepatch                                           Amazon Linux 2023 Kernel Livepatch repository
kubernetes                                                 Kubernetes
[root@ip-172-31-21-176 ec2-user]#
```

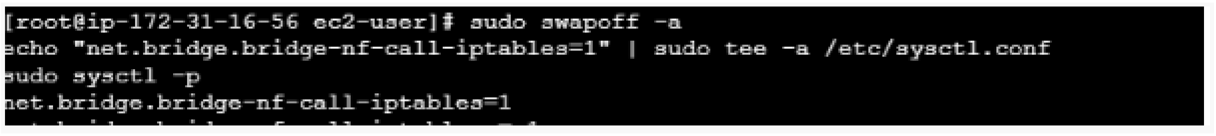
i-0defb5859fc2b0488 (node1)

PublicIPs: 54.157.60.252 PrivateIPs: 172.31.21.176

STEP 6 : This command disable swap space and configure the system to use iptables for bridged network traffic, then apply these settings.

Syntax:`sudo swapoff -a`

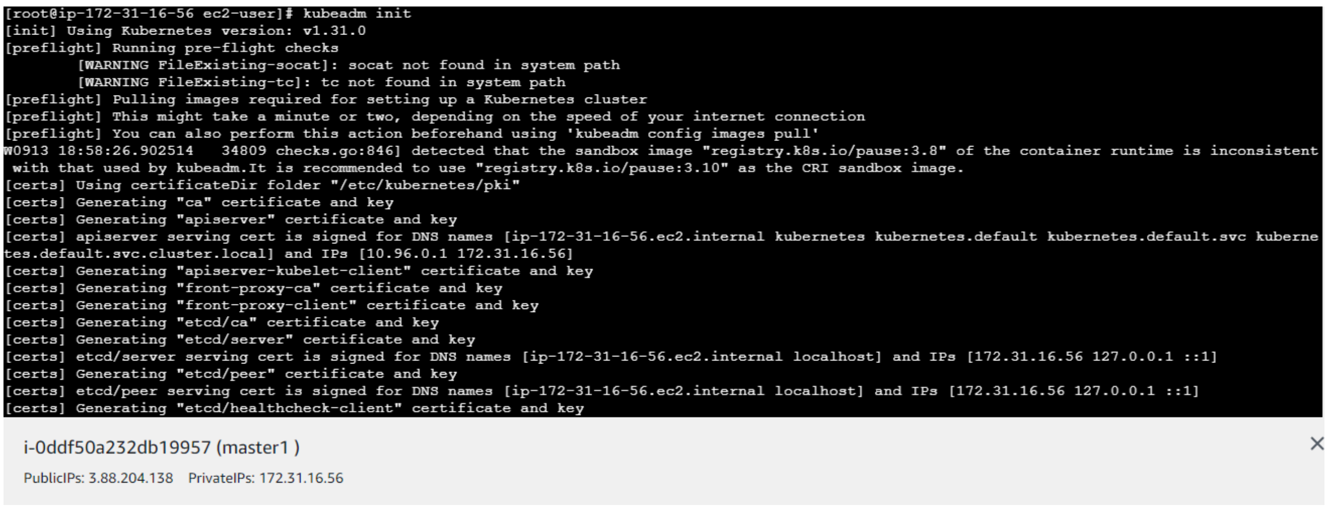
```
echo "net.bridge.bridge-nf-call-iptables=1" | sudo tee -a
/etc/sysctl.conf
sudo sysctl -p
```



```
[root@ip-172-31-16-56 ec2-user]# sudo swapoff -a
echo "net.bridge.bridge-nf-call-iptables=1" | sudo tee -a /etc/sysctl.conf
sudo sysctl -p
net.bridge.bridge-nf-call-iptables=1
```

STEP 7: Initialize Kubernetes in master instance .

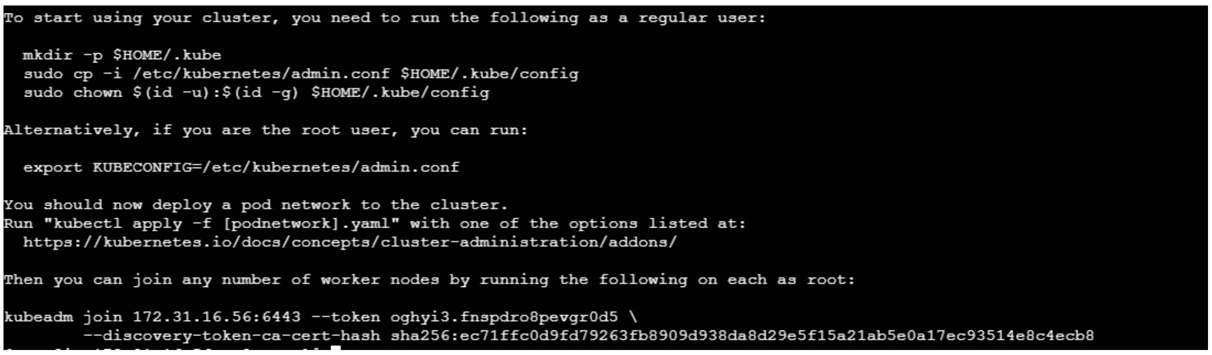
```
Syntax: kubeadm init
```



```
[root@ip-172-31-16-56 ec2-user]# kubeadm init
[init] Using Kubernetes version: v1.31.0
[preflight] Running pre-flight checks
        [WARNING FileExisting-socat]: socat not found in system path
        [WARNING FileExisting-tc]: tc not found in system path
[preflight] Pulling images required for setting up a Kubernetes cluster
[preflight] This might take a minute or two, depending on the speed of your internet connection
[preflight] You can also perform this action beforehand using 'kubeadm config images pull'
W0913 18:58:26.902514   34809 checks.go:846] detected that the sandbox image "registry.k8s.io/pause:3.8" of the container runtime is inconsistent
 with that used by kubeadm.It is recommended to use "registry.k8s.io/pause:3.10" as the CRI sandbox image.
[certs] Using certificateDir folder "/etc/kubernetes/pki"
[certs] Generating "ca" certificate and key
[certs] Generating "apiserver" certificate and key
[certs] apiserver serving cert is signed for DNS names [ip-172-31-16-56.ec2.internal kubernetes kubernetes.default kubernetes.default.svc kuberne
tes.default.svc.cluster.local] and IPs [10.96.0.1 172.31.16.56]
[certs] Generating "apiserver-kubelet-client" certificate and key
[certs] Generating "front-proxy-ca" certificate and key
[certs] Generating "front-proxy-client" certificate and key
[certs] Generating "etcd/ca" certificate and key
[certs] Generating "etcd/server" certificate and key
[certs] etcd/server serving cert is signed for DNS names [ip-172-31-16-56.ec2.internal localhost] and IPs [172.31.16.56 127.0.0.1 ::1]
[certs] Generating "etcd/peer" certificate and key
[certs] etcd/peer serving cert is signed for DNS names [ip-172-31-16-56.ec2.internal localhost] and IPs [172.31.16.56 127.0.0.1 ::1]
[certs] Generating "etcd/healthcheck-client" certificate and key
```

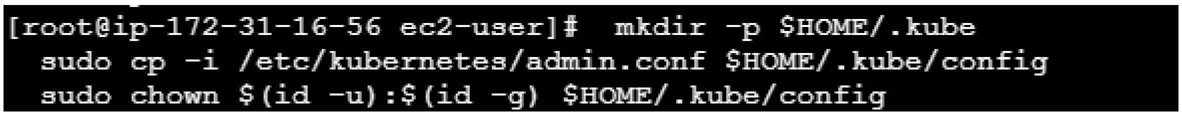
i-0ddf50a232db19957 (master1)

PublicIPs: 3.88.204.138 PrivateIPs: 172.31.16.56



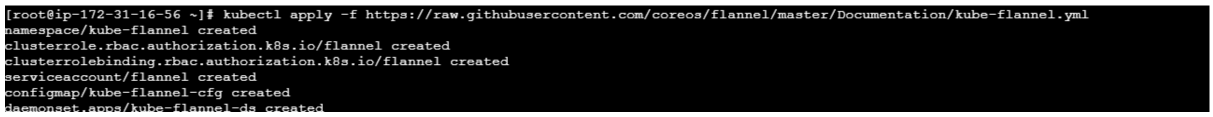
```
To start using your cluster, you need to run the following as a regular user:

  mkdir -p $HOME/.kube
  sudo cp -i /etc/kubernetes/admin.conf $HOME/.kube/config
  sudo chown $(id -u):$(id -g) $HOME/.kube/config

Alternatively, if you are the root user, you can run:

  export KUBECONFIG=/etc/kubernetes/admin.conf

You should now deploy a pod network to the cluster.
Run "kubectl apply -f [podnetwork].yaml" with one of the options listed at:
  https://kubernetes.io/docs/concepts/cluster-administration/addons/

Then you can join any number of worker nodes by running the following on each as root:

kubeadm join 172.31.16.56:6443 --token oghyi3.fnspdro8pevgr0d5 \
        --discovery-token-ca-cert-hash sha256:ec71ffc0d9fd79263fb8909d938da8d29e5f15a21ab5e0a17ec93514e8c4ecb8
```

STEP 8:`Use the mkdir and chown commands shown above`



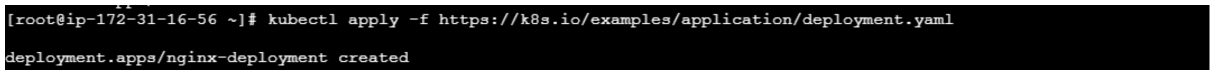
```
[root@ip-172-31-16-56 ec2-user]#  mkdir -p $HOME/.kube
  sudo cp -i /etc/kubernetes/admin.conf $HOME/.kube/config
  sudo chown $(id -u):$(id -g) $HOME/.kube/config
```

STEP 9: Add a common networking plugin called flannel
Syntax:`kubectl apply -f https://raw.githubusercontent.com/coreos/flannel/master/Documentation/kube-flannel.yml`



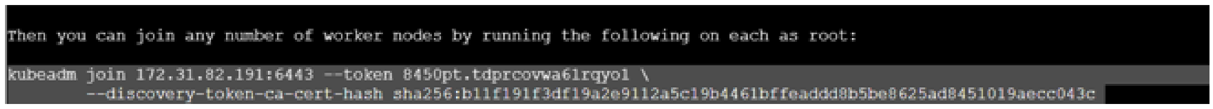
```
[root@ip-172-31-16-56 ~]# kubectl apply -f https://raw.githubusercontent.com/coreos/flannel/master/Documentation/kube-flannel.yml
namespace/kube-flannel created
clusterrole.rbac.authorization.k8s.io/flannel created
clusterrolebinding.rbac.authorization.k8s.io/flannel created
serviceaccount/flannel created
configmap/kube-flannel-cfg created
daemonset.apps/kube-flannel-ds created
```

STEP 10: Apply deployment of nginx server using the following command.
Syntax:
`kubectl apply -f https://k8s.io/examples/application/deployment.yaml`



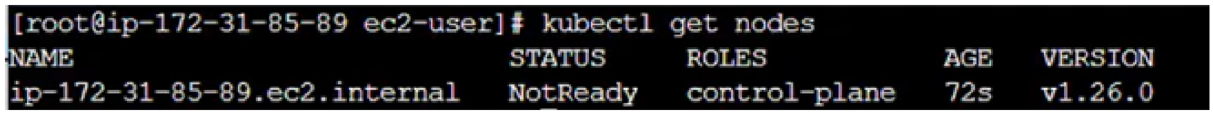
```
[root@ip-172-31-16-56 ~]# kubectl apply -f https://k8s.io/examples/application/deployment.yaml

deployment.apps/nginx-deployment created
```

STEP 11: Next copy and past the join link in the worker nodes so that the worker nodes can join the cluster.



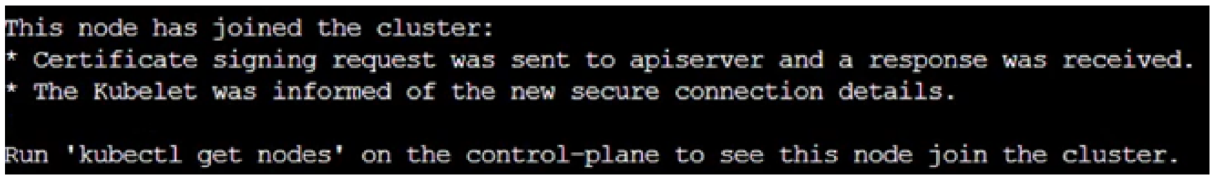
```
Then you can join any number of worker nodes by running the following on each as root:

kubeadm join 172.31.82.191:6443 --token 8450pt.tdprcovwa61rqyo1 \
        --discovery-token-ca-cert-hash sha256:b11f191f3df19a2e9112a5c19b4461bffeaddd8b5be8625ad8451019aecc043c
```

STEP 12: We can check the nodes that have joined the cluster using kubectl get nodes. Right now there is only one node which is the master node.



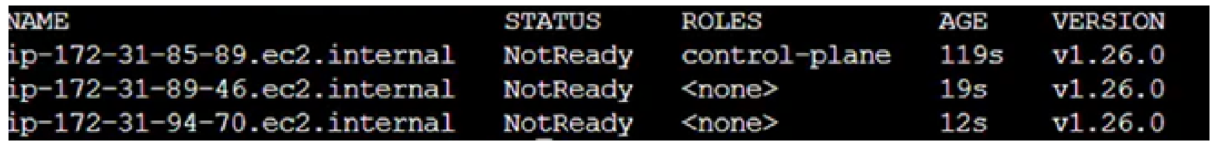
```
[root@ip-172-31-85-89 ec2-user]# kubectl get nodes
NAME                           STATUS     ROLES           AGE   VERSION
ip-172-31-85-89.ec2.internal   NotReady   control-plane   72s   v1.26.0
```

STEP 13: After performing join commands on the worker nodes we will get following output:



```
This node has joined the cluster:
* Certificate signing request was sent to apiserver and a response was received.
* The Kubelet was informed of the new secure connection details.

Run 'kubectl get nodes' on the control-plane to see this node join the cluster.
```

Once again when you run kubectl get nodes you will now see all 3 nodes have joined the cluster:



```
NAME                           STATUS     ROLES           AGE    VERSION
ip-172-31-85-89.ec2.internal   NotReady   control-plane   119s   v1.26.0
ip-172-31-89-46.ec2.internal   NotReady   <none>          19s    v1.26.0
ip-172-31-94-70.ec2.internal   NotReady   <none>          12s    v1.26.0
```

Conclusion: In this experiment we have created 3 EC2 instances, while making instance make sure to click on AmazonLinux and change the instance type to t3.medium or large if it says the memory space or number of CPU's is not enough. Setting SSH for establishing connections in that we have installed and started docker and kubernetes ,initialising kubernetes and by performing various steps we have learned how to link both of the nodes that is node1 and node2 to the main node that is master1 .