Rujuta Medhi **D15A-28**

EXPERIMENT:03

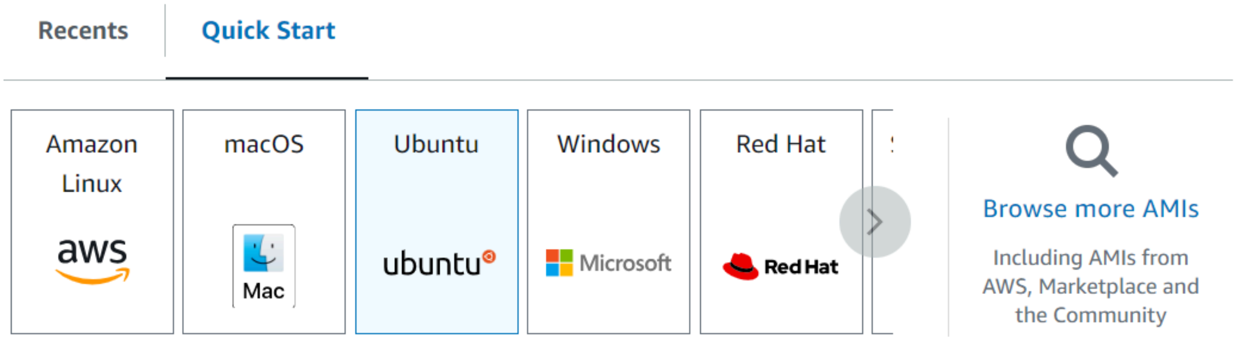
Aim: To understand the Kubernetes Cluster Architecture, install and Spin Up a Kubernetes Cluster on Linux Machines/Cloud Platforms.

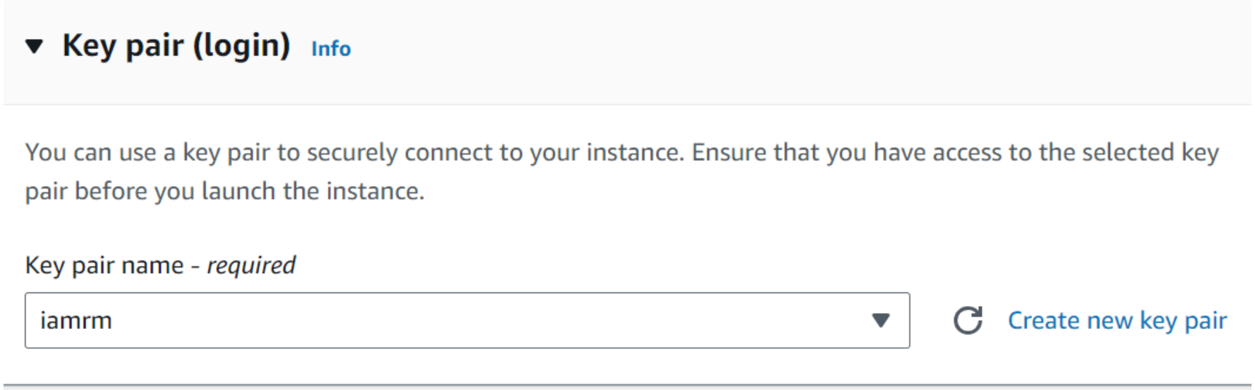
Theory: To understand Kubernetes Cluster Architecture and how to install and spin up a Kubernetes cluster on Linux machines or cloud platforms, it's essential to grasp the fundamental components and design principles of Kubernetes.

Overview of Kubernetes: Kubernetes is an open-source container orchestration platform developed by Google, designed to automate the deployment, scaling, and management of containerized applications. It provides a robust infrastructure that supports microservices architecture, offering features such as self-healing, scaling, and zero-downtime deployments. Kubernetes can run on various environments, including public clouds (like AWS and Azure), private clouds, and bare metal servers.

Implementation:

Creation of 2 EC2 instances

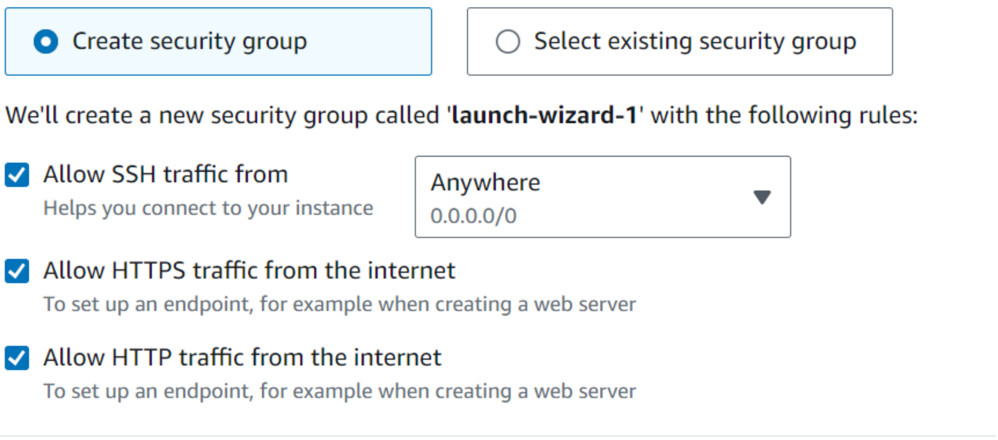




You can use a key pair to securely connect to your instance. Ensure that you have access to the selected key pair before you launch the instance.

Key pair name - *required*

iamrm



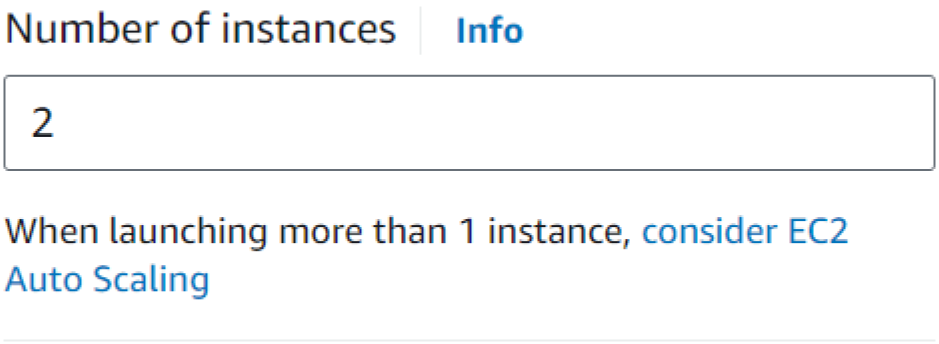
● Create security group　○ Select existing security group

We'll create a new security group called '**launch-wizard-1**' with the following rules:

☑ Allow SSH traffic from — Anywhere 0.0.0.0/0
Helps you connect to your instance

☑ Allow HTTPS traffic from the internet
To set up an endpoint, for example when creating a web server

☑ Allow HTTP traffic from the internet
To set up an endpoint, for example when creating a web server

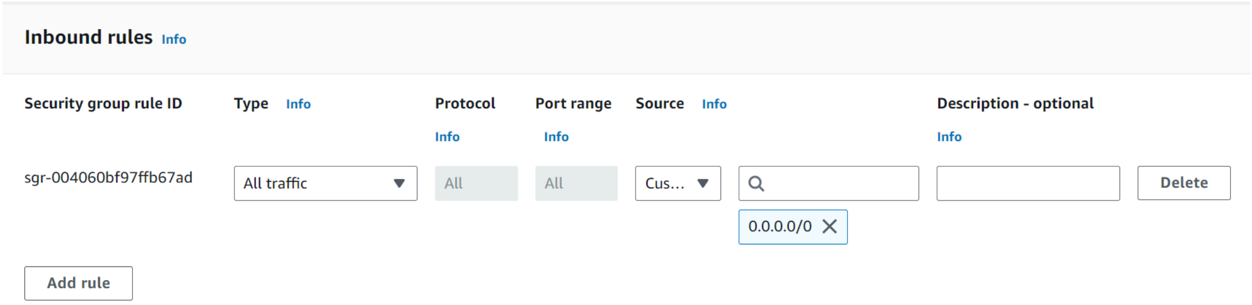


Number of instances

2

When launching more than 1 instance, consider EC2 Auto Scaling

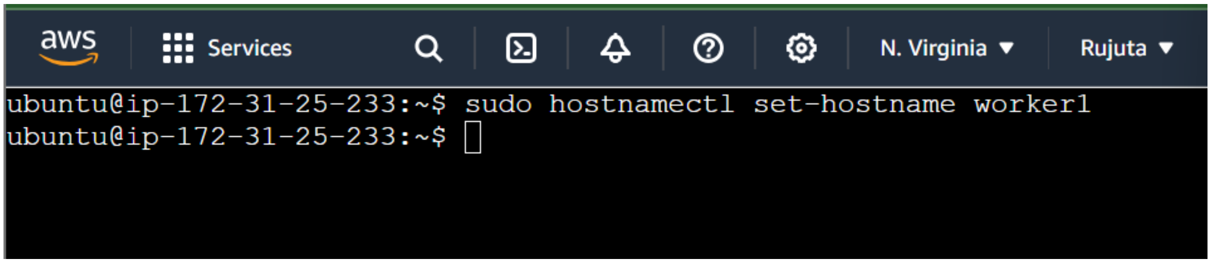
Edit its Inbound Rules set 'All traffic'



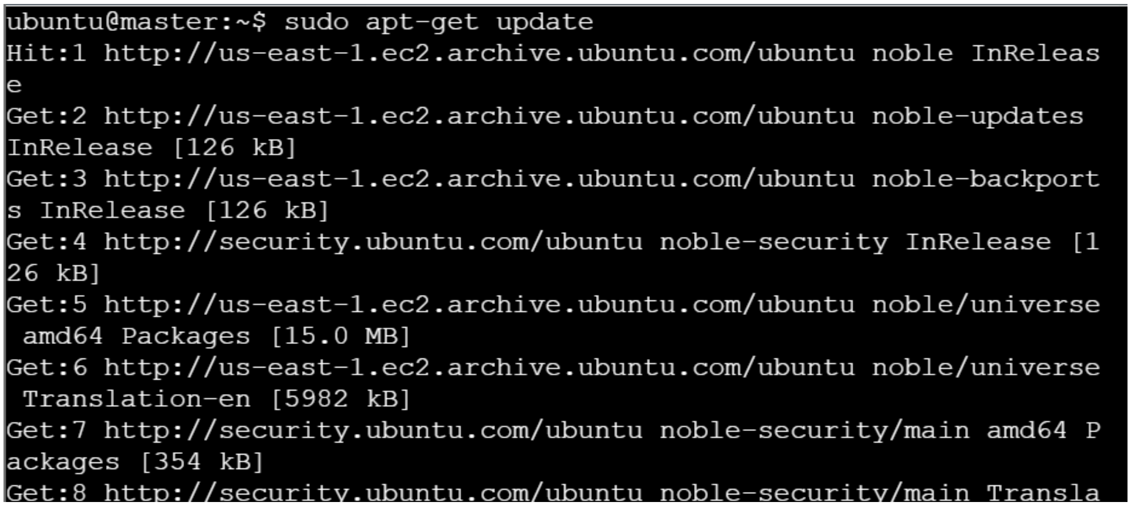
Inbound rules

Security group rule ID	Type	Protocol	Port range	Source		Description - optional	
sgr-004060bf97ffb67ad	All traffic	All	All	Cus...	0.0.0.0/0		Delete

Set master and worker as hostname on respective servers

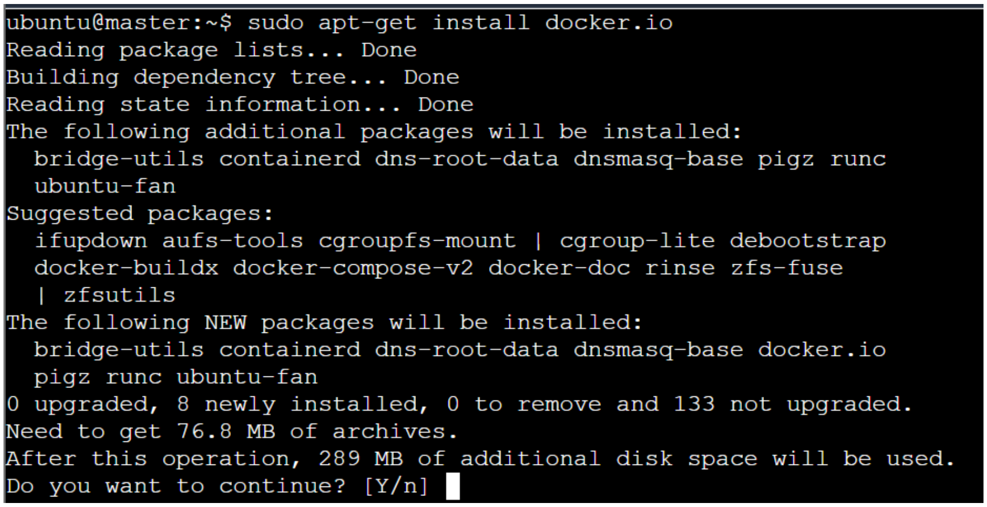


```
ubuntu@ip-172-31-25-233:~$ sudo hostnamectl set-hostname worker1
ubuntu@ip-172-31-25-233:~$ 
```



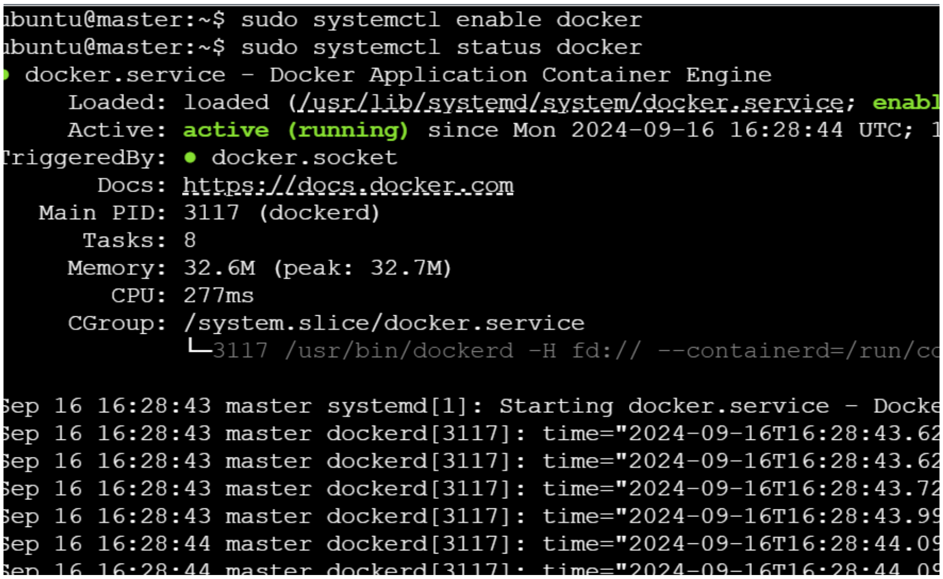
```
ubuntu@master:~$ sudo apt-get update
Hit:1 http://us-east-1.ec2.archive.ubuntu.com/ubuntu noble InReleas
e
Get:2 http://us-east-1.ec2.archive.ubuntu.com/ubuntu noble-updates
InRelease [126 kB]
Get:3 http://us-east-1.ec2.archive.ubuntu.com/ubuntu noble-backport
s InRelease [126 kB]
Get:4 http://security.ubuntu.com/ubuntu noble-security InRelease [1
26 kB]
Get:5 http://us-east-1.ec2.archive.ubuntu.com/ubuntu noble/universe
 amd64 Packages [15.0 MB]
Get:6 http://us-east-1.ec2.archive.ubuntu.com/ubuntu noble/universe
 Translation-en [5982 kB]
Get:7 http://security.ubuntu.com/ubuntu noble-security/main amd64 P
ackages [354 kB]
Get:8 http://security.ubuntu.com/ubuntu noble-security/main Transla
```

Installation of Docker-



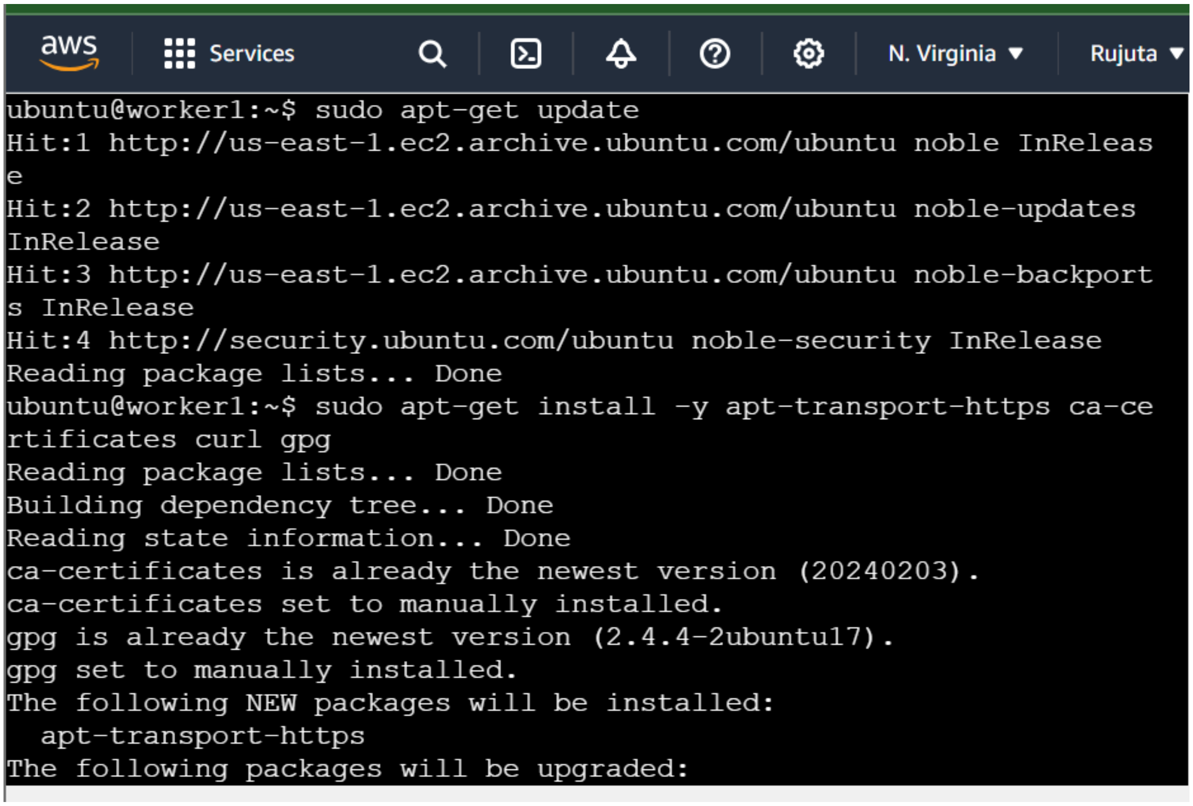
```
ubuntu@master:~$ sudo apt-get install docker.io
Reading package lists... Done
Building dependency tree... Done
Reading state information... Done
The following additional packages will be installed:
  bridge-utils containerd dns-root-data dnsmasq-base pigz runc
  ubuntu-fan
Suggested packages:
  ifupdown aufs-tools cgroupfs-mount | cgroup-lite debootstrap
  docker-buildx docker-compose-v2 docker-doc rinse zfs-fuse
  | zfsutils
The following NEW packages will be installed:
  bridge-utils containerd dns-root-data dnsmasq-base docker.io
  pigz runc ubuntu-fan
0 upgraded, 8 newly installed, 0 to remove and 133 not upgraded.
Need to get 76.8 MB of archives.
After this operation, 289 MB of additional disk space will be used.
Do you want to continue? [Y/n] █
```

Enabling the Docker



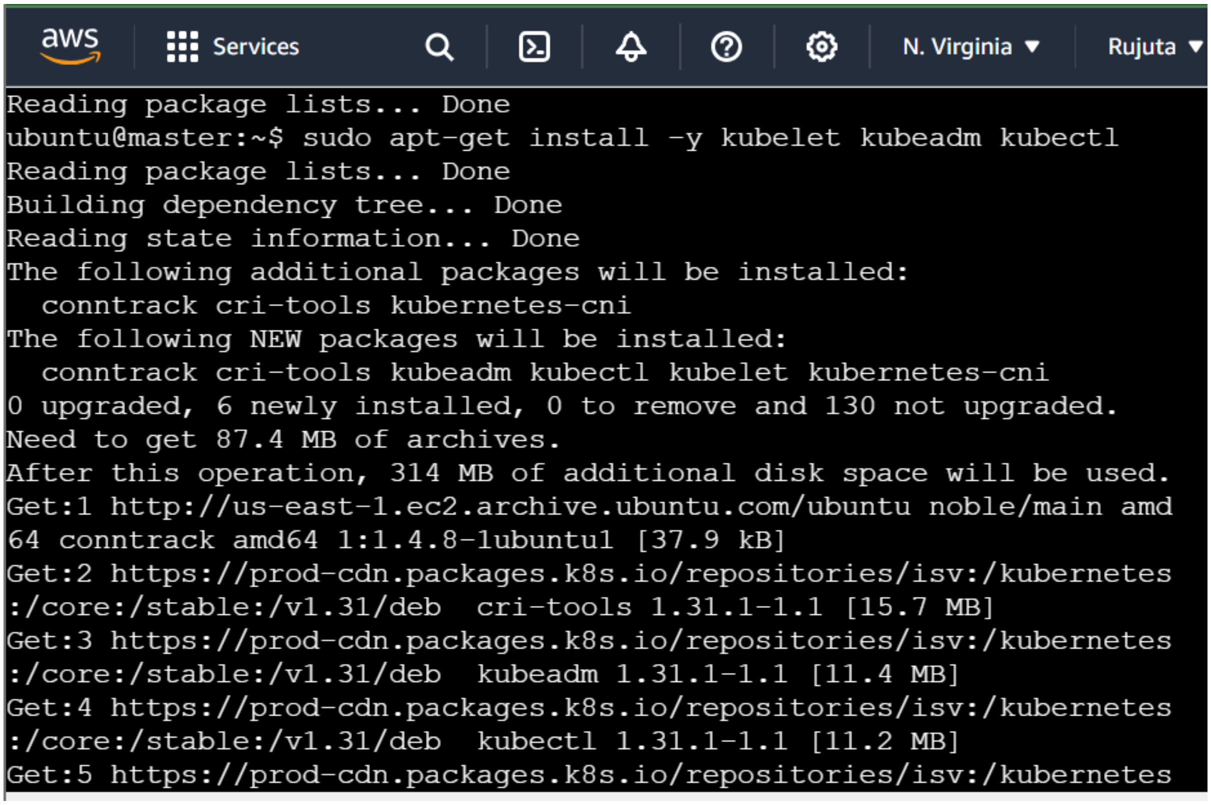
```
ubuntu@master:~$ sudo systemctl enable docker
ubuntu@master:~$ sudo systemctl status docker
● docker.service - Docker Application Container Engine
     Loaded: loaded (/usr/lib/systemd/system/docker.service; enabl
     Active: active (running) since Mon 2024-09-16 16:28:44 UTC; 1
TriggeredBy: ● docker.socket
       Docs: https://docs.docker.com
   Main PID: 3117 (dockerd)
      Tasks: 8
     Memory: 32.6M (peak: 32.7M)
        CPU: 277ms
     CGroup: /system.slice/docker.service
             └─3117 /usr/bin/dockerd -H fd:// --containerd=/run/co

Sep 16 16:28:43 master systemd[1]: Starting docker.service - Docke
Sep 16 16:28:43 master dockerd[3117]: time="2024-09-16T16:28:43.62
Sep 16 16:28:43 master dockerd[3117]: time="2024-09-16T16:28:43.62
Sep 16 16:28:43 master dockerd[3117]: time="2024-09-16T16:28:43.72
Sep 16 16:28:43 master dockerd[3117]: time="2024-09-16T16:28:43.99
Sep 16 16:28:44 master dockerd[3117]: time="2024-09-16T16:28:44.09
Sep 16 16:28:44 master dockerd[3117]: time="2024-09-16T16:28:44.09
```

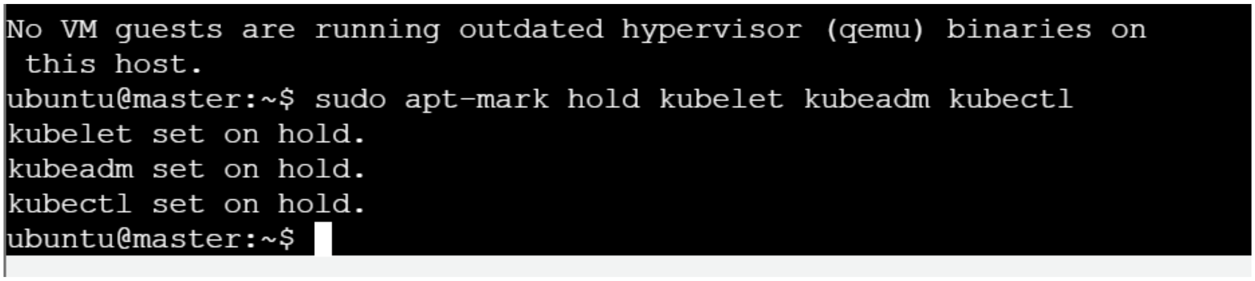


```
ubuntu@worker1:~$ sudo apt-get update
Hit:1 http://us-east-1.ec2.archive.ubuntu.com/ubuntu noble InReleas
e
Hit:2 http://us-east-1.ec2.archive.ubuntu.com/ubuntu noble-updates
InRelease
Hit:3 http://us-east-1.ec2.archive.ubuntu.com/ubuntu noble-backport
s InRelease
Hit:4 http://security.ubuntu.com/ubuntu noble-security InRelease
Reading package lists... Done
ubuntu@worker1:~$ sudo apt-get install -y apt-transport-https ca-ce
rtificates curl gpg
Reading package lists... Done
Building dependency tree... Done
Reading state information... Done
ca-certificates is already the newest version (20240203).
ca-certificates set to manually installed.
gpg is already the newest version (2.4.4-2ubuntu17).
gpg set to manually installed.
The following NEW packages will be installed:
  apt-transport-https
The following packages will be upgraded:
```

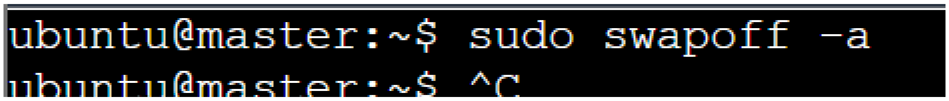
Installation of Kubernetes-



```
Reading package lists... Done
ubuntu@master:~$ sudo apt-get install -y kubelet kubeadm kubectl
Reading package lists... Done
Building dependency tree... Done
Reading state information... Done
The following additional packages will be installed:
  conntrack cri-tools kubernetes-cni
The following NEW packages will be installed:
  conntrack cri-tools kubeadm kubectl kubelet kubernetes-cni
0 upgraded, 6 newly installed, 0 to remove and 130 not upgraded.
Need to get 87.4 MB of archives.
After this operation, 314 MB of additional disk space will be used.
Get:1 http://us-east-1.ec2.archive.ubuntu.com/ubuntu noble/main amd
64 conntrack amd64 1:1.4.8-1ubuntu1 [37.9 kB]
Get:2 https://prod-cdn.packages.k8s.io/repositories/isv:/kubernetes
:/core:/stable:/v1.31/deb  cri-tools 1.31.1-1.1 [15.7 MB]
Get:3 https://prod-cdn.packages.k8s.io/repositories/isv:/kubernetes
:/core:/stable:/v1.31/deb  kubeadm 1.31.1-1.1 [11.4 MB]
Get:4 https://prod-cdn.packages.k8s.io/repositories/isv:/kubernetes
:/core:/stable:/v1.31/deb  kubectl 1.31.1-1.1 [11.2 MB]
Get:5 https://prod-cdn.packages.k8s.io/repositories/isv:/kubernetes
```

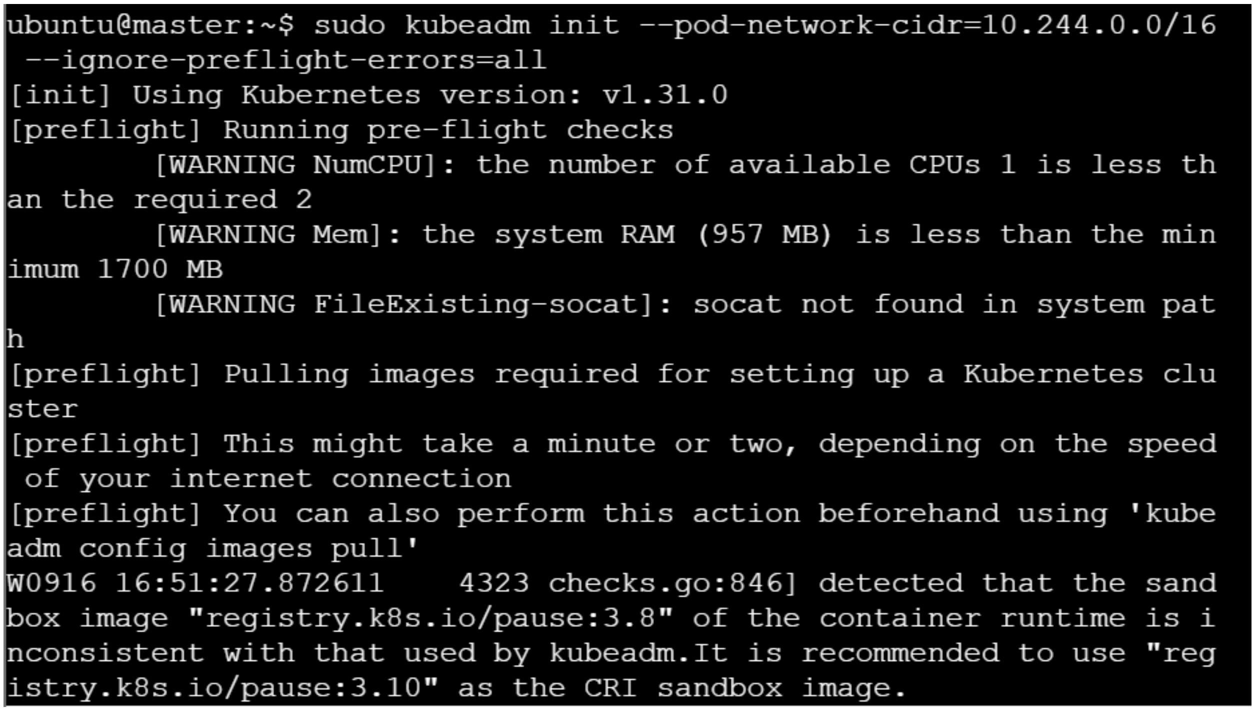


```
No VM guests are running outdated hypervisor (qemu) binaries on
 this host.
ubuntu@master:~$ sudo apt-mark hold kubelet kubeadm kubectl
kubelet set on hold.
kubeadm set on hold.
kubectl set on hold.
ubuntu@master:~$ 
```

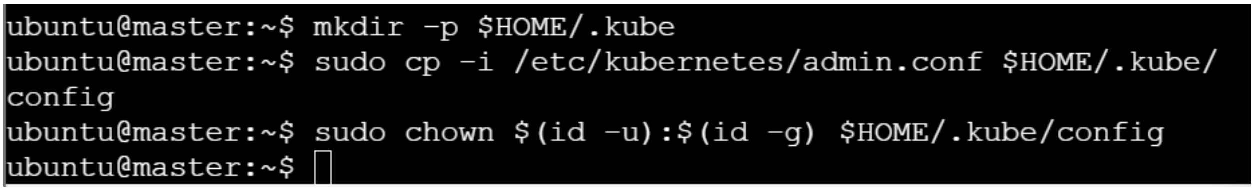


```
ubuntu@master:~$ sudo swapoff -a
ubuntu@master:~$ ^C
```

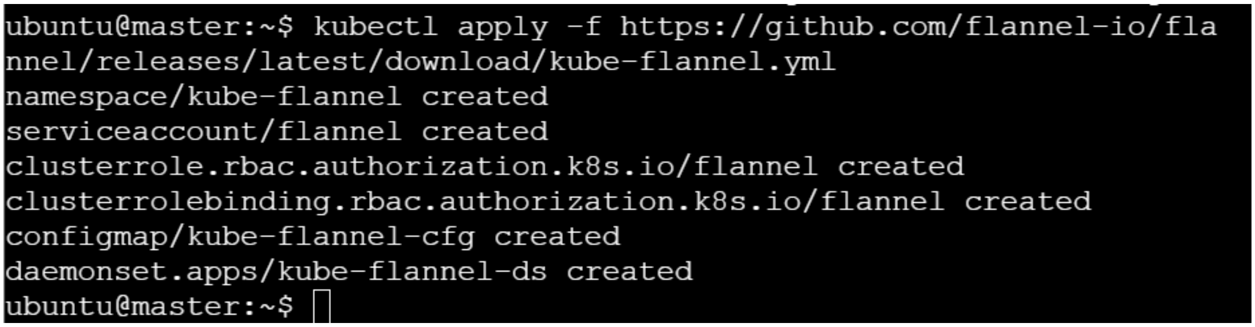
Initialize Kubernetes on master-



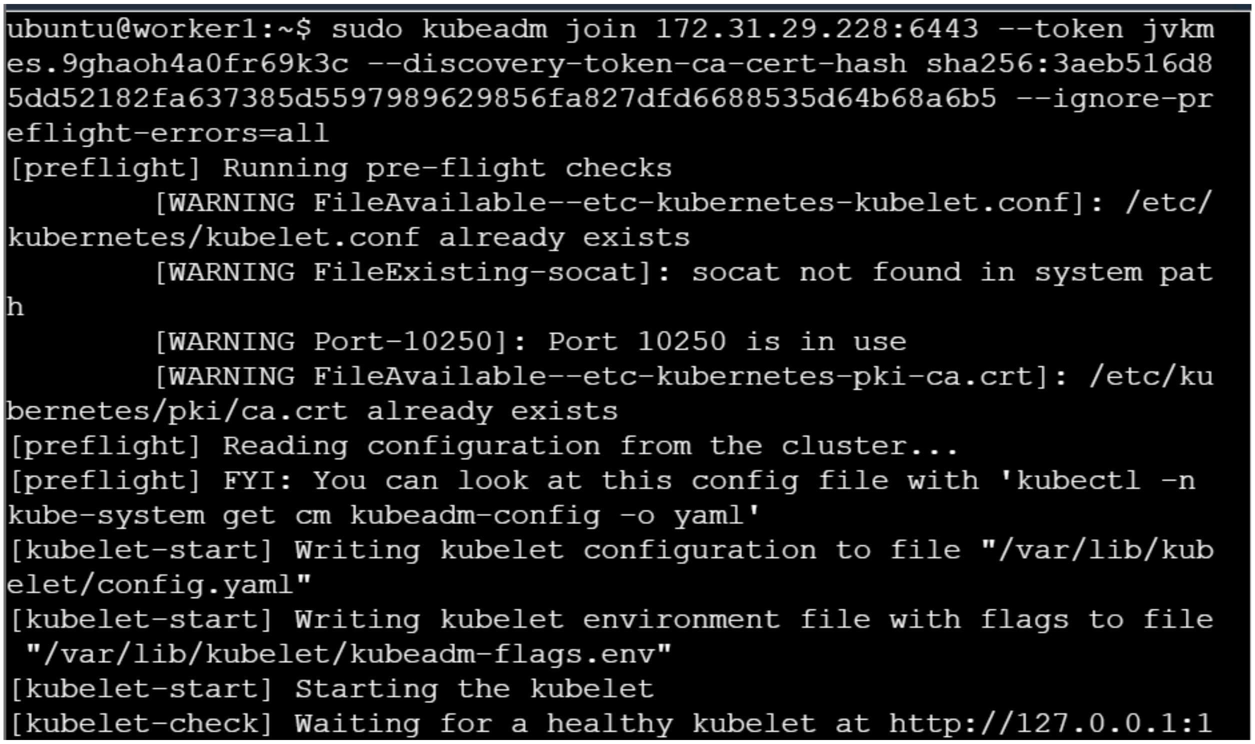
```
ubuntu@master:~$ sudo kubeadm init --pod-network-cidr=10.244.0.0/16
 --ignore-preflight-errors=all
[init] Using Kubernetes version: v1.31.0
[preflight] Running pre-flight checks
        [WARNING NumCPU]: the number of available CPUs 1 is less th
an the required 2
        [WARNING Mem]: the system RAM (957 MB) is less than the min
imum 1700 MB
        [WARNING FileExisting-socat]: socat not found in system pat
h
[preflight] Pulling images required for setting up a Kubernetes clu
ster
[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 'kube
adm config images pull'
W0916 16:51:27.872611    4323 checks.go:846] detected that the sand
box image "registry.k8s.io/pause:3.8" of the container runtime is i
nconsistent with that used by kubeadm.It is recommended to use "reg
istry.k8s.io/pause:3.10" as the CRI sandbox image.
```



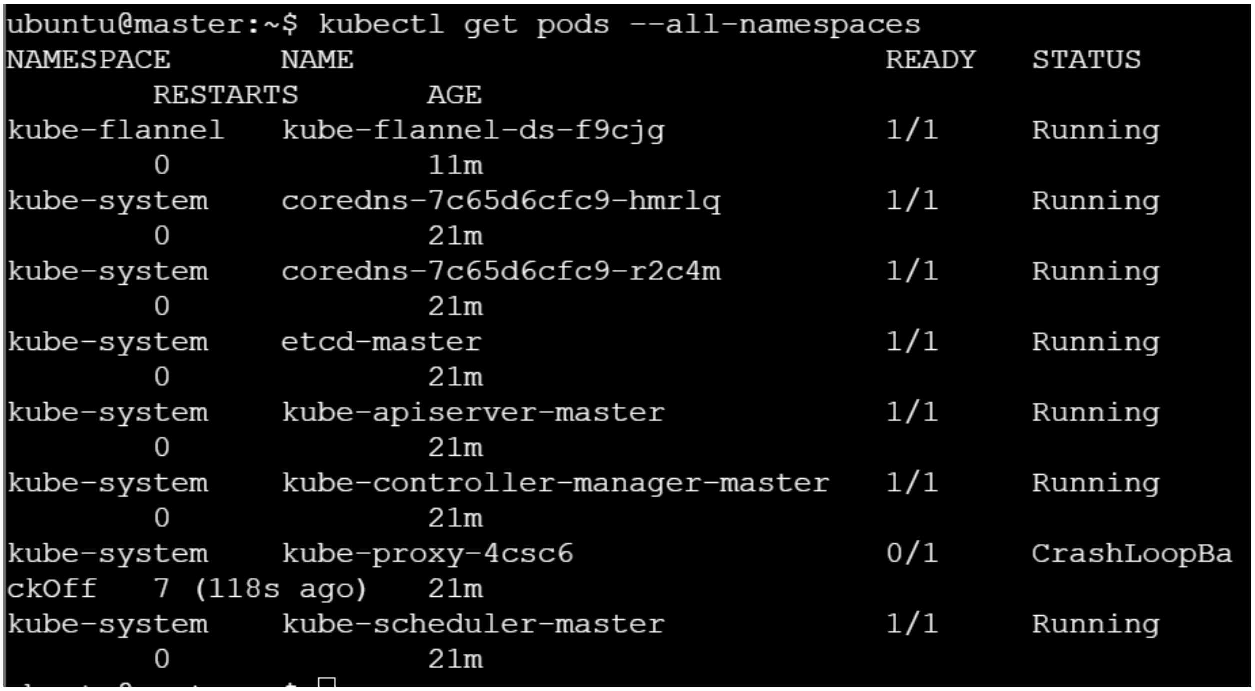
```
ubuntu@master:~$ mkdir -p $HOME/.kube
ubuntu@master:~$ sudo cp -i /etc/kubernetes/admin.conf $HOME/.kube/
config
ubuntu@master:~$ sudo chown $(id -u):$(id -g) $HOME/.kube/config
ubuntu@master:~$ 
```



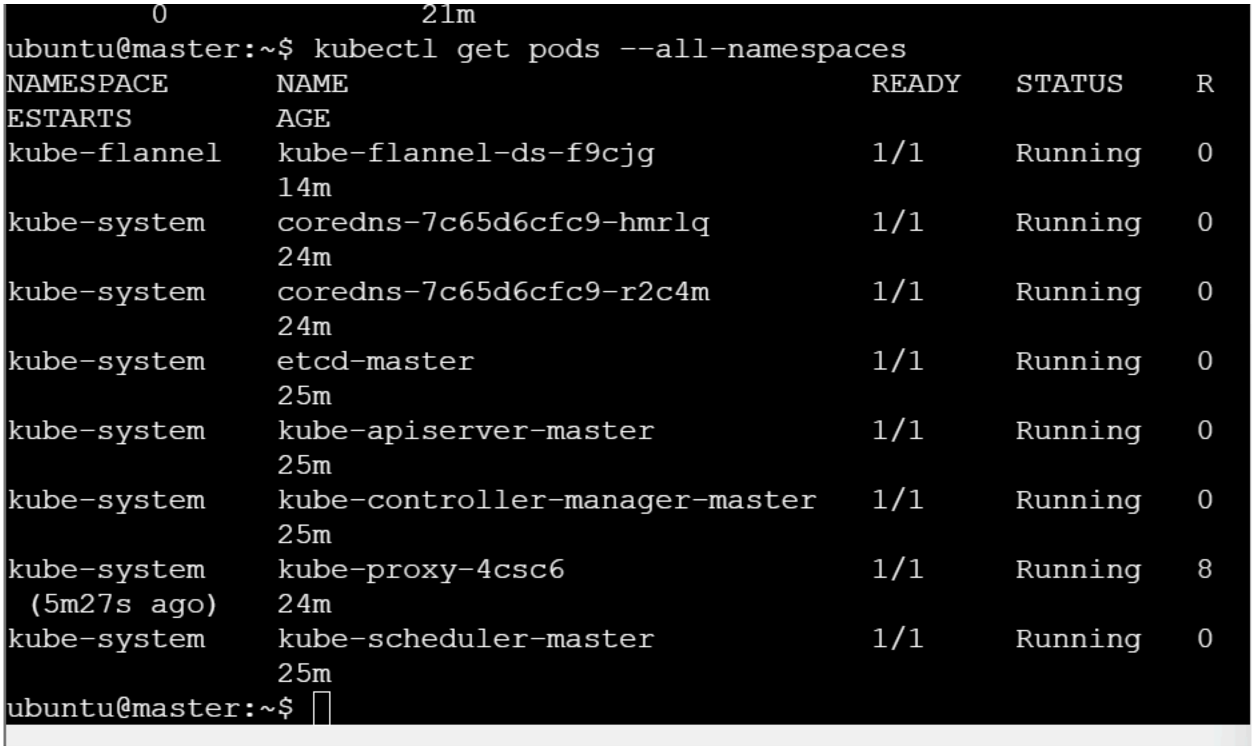
```
ubuntu@master:~$ kubectl apply -f https://github.com/flannel-io/fla
nnel/releases/latest/download/kube-flannel.yml
namespace/kube-flannel created
serviceaccount/flannel created
clusterrole.rbac.authorization.k8s.io/flannel created
clusterrolebinding.rbac.authorization.k8s.io/flannel created
configmap/kube-flannel-cfg created
daemonset.apps/kube-flannel-ds created
ubuntu@master:~$ 
```



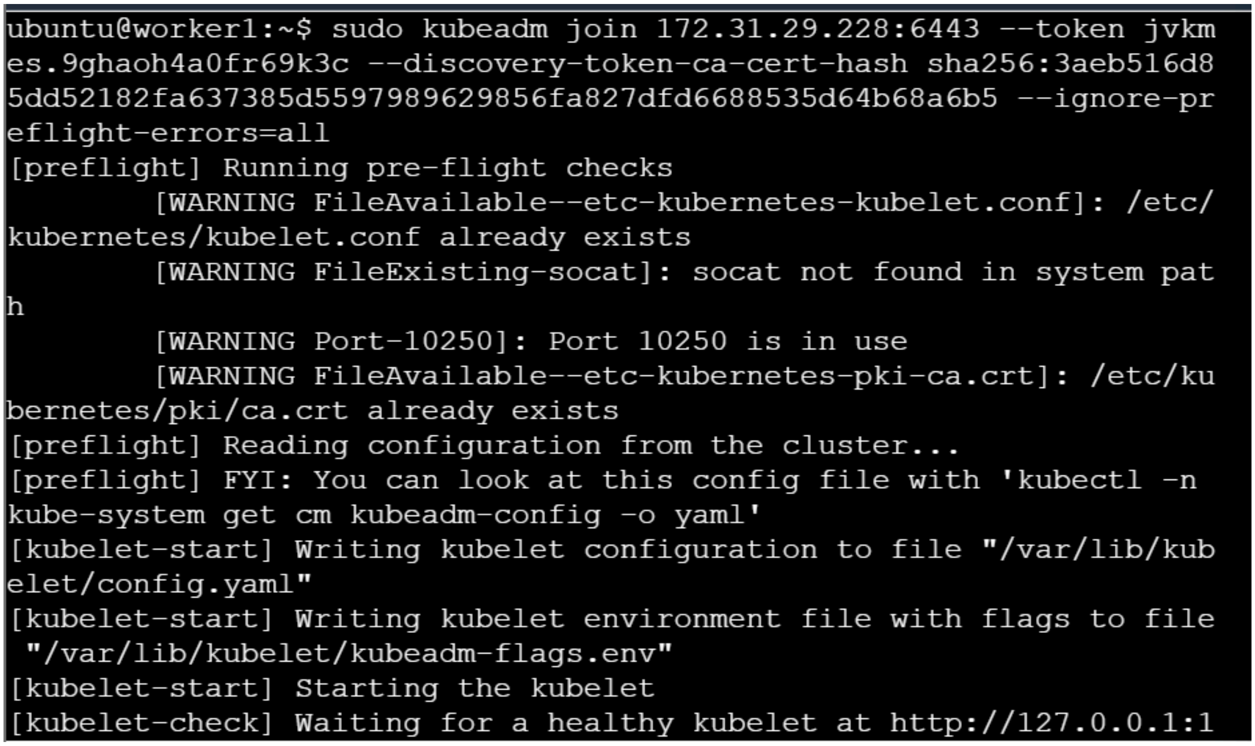
```
ubuntu@worker1:~$ sudo kubeadm join 172.31.29.228:6443 --token jvkm
es.9ghaoh4a0fr69k3c --discovery-token-ca-cert-hash sha256:3aeb516d8
5dd52182fa637385d5597989629856fa827dfd6688535d64b68a6b5 --ignore-pr
eflight-errors=all
[preflight] Running pre-flight checks
        [WARNING FileAvailable--etc-kubernetes-kubelet.conf]: /etc/
kubernetes/kubelet.conf already exists
        [WARNING FileExisting-socat]: socat not found in system pat
h
        [WARNING Port-10250]: Port 10250 is in use
        [WARNING FileAvailable--etc-kubernetes-pki-ca.crt]: /etc/ku
bernetes/pki/ca.crt already exists
[preflight] Reading configuration from the cluster...
[preflight] FYI: You can look at this config file with 'kubectl -n
kube-system get cm kubeadm-config -o yaml'
[kubelet-start] Writing kubelet configuration to file "/var/lib/kub
elet/config.yaml"
[kubelet-start] Writing kubelet environment file with flags to file
 "/var/lib/kubelet/kubeadm-flags.env"
[kubelet-start] Starting the kubelet
[kubelet-check] Waiting for a healthy kubelet at http://127.0.0.1:1
```



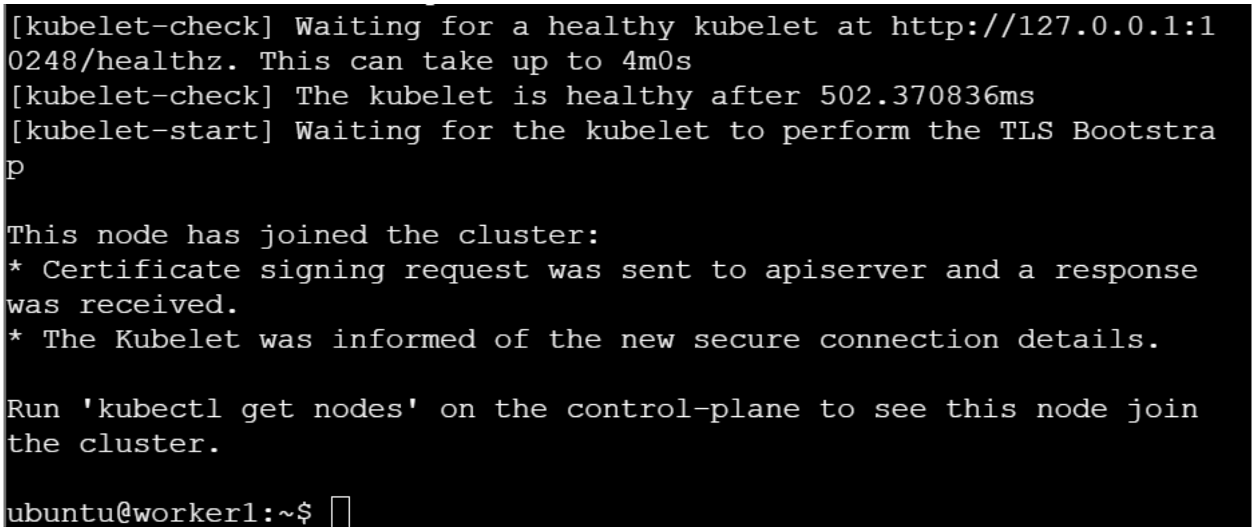
```
ubuntu@master:~$ kubectl get pods --all-namespaces
NAMESPACE      NAME                             READY   STATUS
        RESTARTS       AGE
kube-flannel   kube-flannel-ds-f9cjg            1/1     Running
        0              11m
kube-system    coredns-7c65d6cfc9-hmrlq         1/1     Running
        0              21m
kube-system    coredns-7c65d6cfc9-r2c4m         1/1     Running
        0              21m
kube-system    etcd-master                      1/1     Running
        0              21m
kube-system    kube-apiserver-master            1/1     Running
        0              21m
kube-system    kube-controller-manager-master   1/1     Running
        0              21m
kube-system    kube-proxy-4csc6                 0/1     CrashLoopBa
ckOff   7 (118s ago)   21m
kube-system    kube-scheduler-master            1/1     Running
        0              21m
```



```
        0              21m
ubuntu@master:~$ kubectl get pods --all-namespaces
NAMESPACE      NAME                              READY   STATUS    R
ESTARTS        AGE
kube-flannel   kube-flannel-ds-f9cjg             1/1     Running   0
               14m
kube-system    coredns-7c65d6cfc9-hmrlq          1/1     Running   0
               24m
kube-system    coredns-7c65d6cfc9-r2c4m          1/1     Running   0
               24m
kube-system    etcd-master                       1/1     Running   0
               25m
kube-system    kube-apiserver-master             1/1     Running   0
               25m
kube-system    kube-controller-manager-master    1/1     Running   0
               25m
kube-system    kube-proxy-4csc6                  1/1     Running   8
 (5m27s ago)   24m
kube-system    kube-scheduler-master             1/1     Running   0
               25m
ubuntu@master:~$ 
```



```
ubuntu@worker1:~$ sudo kubeadm join 172.31.29.228:6443 --token jvkm
es.9ghaoh4a0fr69k3c --discovery-token-ca-cert-hash sha256:3aeb516d8
5dd52182fa637385d5597989629856fa827dfd6688535d64b68a6b5 --ignore-pr
eflight-errors=all
[preflight] Running pre-flight checks
        [WARNING FileAvailable--etc-kubernetes-kubelet.conf]: /etc/
kubernetes/kubelet.conf already exists
        [WARNING FileExisting-socat]: socat not found in system pat
h
        [WARNING Port-10250]: Port 10250 is in use
        [WARNING FileAvailable--etc-kubernetes-pki-ca.crt]: /etc/ku
bernetes/pki/ca.crt already exists
[preflight] Reading configuration from the cluster...
[preflight] FYI: You can look at this config file with 'kubectl -n
kube-system get cm kubeadm-config -o yaml'
[kubelet-start] Writing kubelet configuration to file "/var/lib/kub
elet/config.yaml"
[kubelet-start] Writing kubelet environment file with flags to file
 "/var/lib/kubelet/kubeadm-flags.env"
[kubelet-start] Starting the kubelet
[kubelet-check] Waiting for a healthy kubelet at http://127.0.0.1:1
```

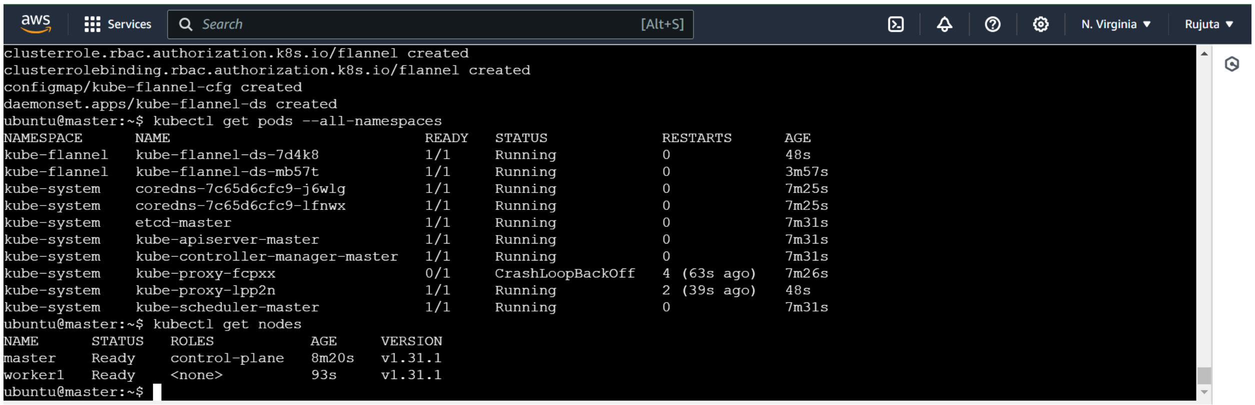


```
[kubelet-check] Waiting for a healthy kubelet at http://127.0.0.1:1
0248/healthz. This can take up to 4m0s
[kubelet-check] The kubelet is healthy after 502.370836ms
[kubelet-start] Waiting for the kubelet to perform the TLS Bootstra
p

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.

ubuntu@worker1:~$
```



```
clusterrole.rbac.authorization.k8s.io/flannel created
clusterrolebinding.rbac.authorization.k8s.io/flannel created
configmap/kube-flannel-cfg created
daemonset.apps/kube-flannel-ds created
ubuntu@master:~$ kubectl get pods --all-namespaces
NAMESPACE      NAME                               READY   STATUS             RESTARTS      AGE
kube-flannel   kube-flannel-ds-7d4k8              1/1     Running            0             48s
kube-flannel   kube-flannel-ds-mb57t              1/1     Running            0             3m57s
kube-system    coredns-7c65d6cfc9-j6wlg           1/1     Running            0             7m25s
kube-system    coredns-7c65d6cfc9-lfnwx           1/1     Running            0             7m25s
kube-system    etcd-master                        1/1     Running            0             7m31s
kube-system    kube-apiserver-master              1/1     Running            0             7m31s
kube-system    kube-controller-manager-master     1/1     Running            0             7m31s
kube-system    kube-proxy-fcpxx                   0/1     CrashLoopBackOff   4 (63s ago)   7m26s
kube-system    kube-proxy-lpp2n                   1/1     Running            2 (39s ago)   48s
kube-system    kube-scheduler-master              1/1     Running            0             7m31s
ubuntu@master:~$ kubectl get nodes
NAME      STATUS   ROLES           AGE     VERSION
master    Ready    control-plane   8m20s   v1.31.1
worker1   Ready    <none>          93s     v1.31.1
ubuntu@master:~$
```