

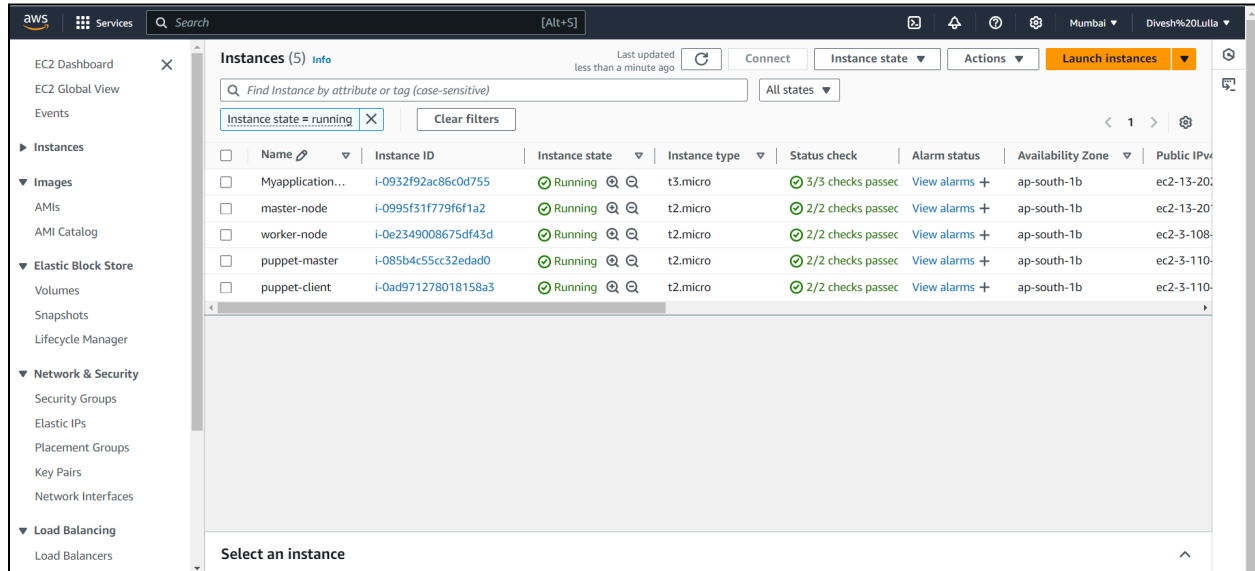
## Experiment 3

### Aim:

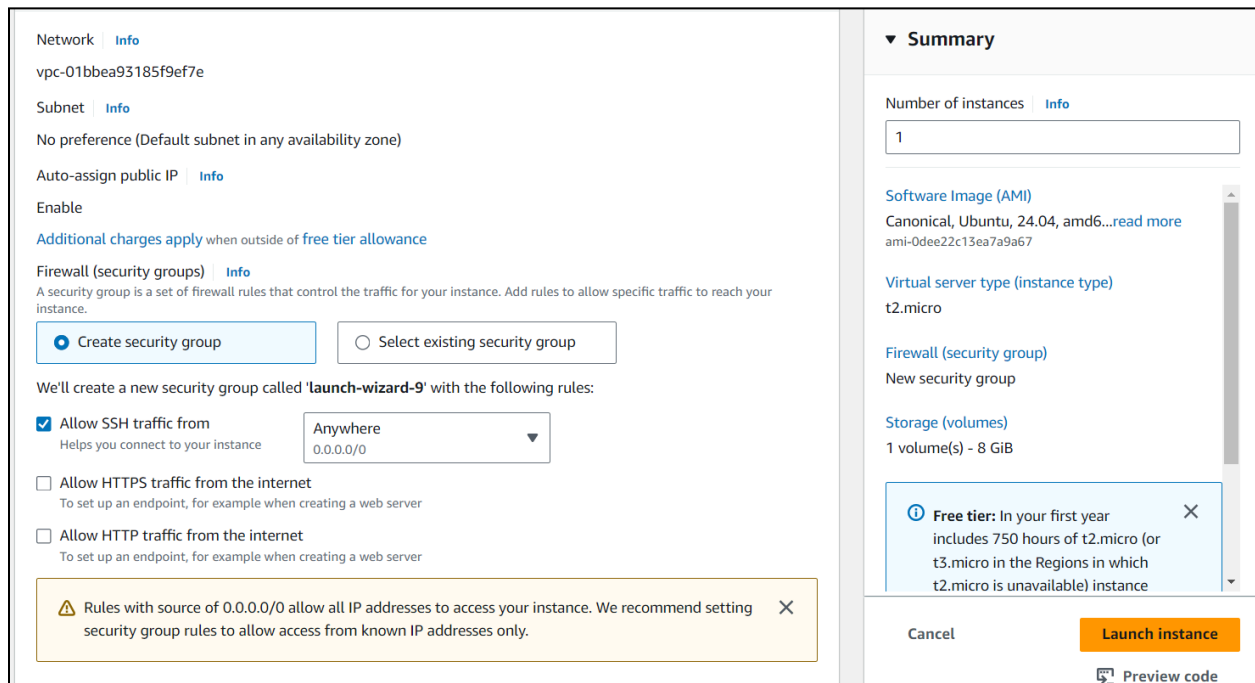
To understand the Kubernetes Cluster Architecture, install and Spin Up a KubernetesCluster on Linux Machines/Cloud Platforms.

### Implementation:

#### 1) Create EC2 Ubuntu Instances on AWS. (Master and Worker)



#### 2) Edit the Security Group Inbound Rules to allow SSH



### 3) AWS CLI for master and worker instances.

```
Welcome to Ubuntu 24.04.1 LTS (GNU/Linux 6.8.0-1016-aws x86_64)

* Documentation:  https://help.ubuntu.com
* Management:    https://landscape.canonical.com
* Support:        https://ubuntu.com/pro

System information as of Mon Oct 14 08:47:34 UTC 2024

System load:  0.14           Processes:           105
Usage of /:   22.9% of 6.71GB Users logged in:          0
Memory usage: 21%           IPv4 address for enx0: 172.31.15.196
Swap usage:   0%

Expanded Security Maintenance for Applications is not enabled.

0 updates can be applied immediately.

Enable ESM Apps to receive additional future security updates.
See https://ubuntu.com/esm or run: sudo pro status

The list of available updates is more than a week old.
To check for new updates run: sudo apt update

The programs included with the Ubuntu system are free software;
the exact distribution terms for each program are described in the
individual files in /usr/share/doc/*/copyright.

i-Oe2349008675df43d (worker-node)
PublicIPs: 3.108.237.154  PrivateIPs: 172.31.15.196
```

### 4) Assign Unique Hostname for Each Server Node

```
$ sudo hostnamectl set-hostname master-node
$ sudo hostnamectl set-hostname worker-1
```

```
Last login: Mon Oct 14 09:15:11 2024 from 13.233.177.3
ubuntu@master-node:~$
```

## Set up Docker (both master and worker)

### 5) Install Docker

```
Last login: Mon Oct 14 09:15:17 2024 from 13.233.177.4
ubuntu@worker-1:~$ sudo apt-get update
Hit:1 http://ap-south-1.ec2.archive.ubuntu.com/ubuntu noble InRelease
Get:2 http://ap-south-1.ec2.archive.ubuntu.com/ubuntu noble-updates InRelease [126 kB]
Get:3 http://ap-south-1.ec2.archive.ubuntu.com/ubuntu noble-backports InRelease [126 kB]
Get:4 http://ap-south-1.ec2.archive.ubuntu.com/ubuntu noble/universe amd64 Packages [15.0 MB]
Get:5 http://security.ubuntu.com/ubuntu noble-security InRelease [126 kB]
Get:6 http://ap-south-1.ec2.archive.ubuntu.com/ubuntu noble/universe Translation-en [5982 kB]
Get:7 http://ap-south-1.ec2.archive.ubuntu.com/ubuntu noble/universe amd64 Components [3871 kB]
Get:8 http://ap-south-1.ec2.archive.ubuntu.com/ubuntu noble/universe amd64 c-n-f Metadata [301 kB]
Get:9 http://ap-south-1.ec2.archive.ubuntu.com/ubuntu noble/multiverse amd64 Packages [269 kB]
Get:10 http://ap-south-1.ec2.archive.ubuntu.com/ubuntu noble/multiverse Translation-en [118 kB]
Get:11 http://ap-south-1.ec2.archive.ubuntu.com/ubuntu noble/multiverse amd64 Components [35.0 kB]
Get:12 http://ap-south-1.ec2.archive.ubuntu.com/ubuntu noble/multiverse amd64 c-n-f Metadata [8328 B]
Get:13 http://ap-south-1.ec2.archive.ubuntu.com/ubuntu noble-updates/main amd64 Packages [542 kB]
Get:14 http://ap-south-1.ec2.archive.ubuntu.com/ubuntu noble-updates/main Translation-en [133 kB]
Get:15 http://ap-south-1.ec2.archive.ubuntu.com/ubuntu noble-updates/main amd64 c-n-f Metadata [9048 B]
Get:16 http://ap-south-1.ec2.archive.ubuntu.com/ubuntu noble-updates/universe amd64 Packages [386 kB]
Get:17 http://ap-south-1.ec2.archive.ubuntu.com/ubuntu noble-updates/universe Translation-en [160 kB]
Get:18 http://ap-south-1.ec2.archive.ubuntu.com/ubuntu noble-updates/universe amd64 Components [45.0 kB]
Get:19 http://ap-south-1.ec2.archive.ubuntu.com/ubuntu noble-updates/universe amd64 c-n-f Metadata [15.0 kB]
```

### 6) \$ sudo apt-get install docker.io

```
Reading package lists... Done
ubuntu@worker-1:~$ 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 12 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] y
Get:1 http://ap-south-1.ec2.archive.ubuntu.com/ubuntu noble/universe amd64 pigz amd64 2.8-1 [65.6 kB]
Get:2 http://ap-south-1.ec2.archive.ubuntu.com/ubuntu noble/main amd64 bridge-utils amd64 1.7.1-1ubuntu2 [33.9 kB]
Get:3 http://ap-south-1.ec2.archive.ubuntu.com/ubuntu noble-updates/main amd64 runc amd64 1.1.12-0ubuntu3.1 [8599 kB]
Get:4 http://ap-south-1.ec2.archive.ubuntu.com/ubuntu noble-updates/main amd64 containerd amd64 1.7.12-0ubuntu4.1 [38.6 MB]
Get:5 http://ap-south-1.ec2.archive.ubuntu.com/ubuntu noble/main amd64 dns-root-data all 2023112702-willsync1 [4450 B]
Get:6 http://ap-south-1.ec2.archive.ubuntu.com/ubuntu noble/main amd64 dnsmasq-base amd64 2.90-2build2 [375 kB]
Get:7 http://ap-south-1.ec2.archive.ubuntu.com/ubuntu noble-updates/universe amd64 docker.io amd64 24.0.7-0ubuntu4.1 [29.1 MB]
Get:8 http://ap-south-1.ec2.archive.ubuntu.com/ubuntu noble/universe amd64 ubuntu-fan all 0.12.16 [35.2 kB]
Fetched 76.8 MB in 1s (65.0 MB/s)
Preconfiguring packages ...
Selecting previously unselected package pigz.
(Reading database ... 67836 files and directories currently installed.)
Preparing to unpack .../0-pigz_2.8-1_amd64.deb ...

i-0e2349008675df43d (worker-node)
PublicIPs: 3.108.237.154 PrivateIPs: 172.31.15.196
```

### 7) \$ docker --version

```
No VM guests are running outdated hypervisor (qemu) binaries on this host.
ubuntu@master-node:~$ docker --version
Docker version 24.0.7, build 24.0.7-0ubuntu4.1
ubuntu@master-node:~$
```

i-0995f31f779f6f1a2 (master-node)

PublicIPs: 13.201.134.120 PrivateIPs: 172.31.0.46

## 8) Start and Enable Docker

```
$ sudo systemctl enable docker
```

```
$ sudo systemctl status docker
```

```
$ sudo systemctl start docker
```

```
Docker version 24.0.7, build 24.0.7-0ubuntu4.1
ubuntu@worker-1:~$ sudo systemctl enable docker
ubuntu@worker-1:~$ sudo systemctl status docker
● docker.service - Docker Application Container Engine
   Loaded: loaded (/usr/lib/systemd/system/docker.service; enabled; preset: enabled)
   Active: active (running) since Mon 2024-10-14 09:28:17 UTC; 3min 0s ago
 TriggeredBy: ● docker.socket
   Docs: https://docs.docker.com
  Main PID: 3180 (dockerd)
    Tasks: 9
   Memory: 23.3M (peak: 25.6M)
      CPU: 291ms
   CGroup: /system.slice/docker.service
           └─3180 /usr/bin/dockerd -H fd:// --containerd=/run/containerd/containerd.sock

Oct 14 09:28:16 worker-1 systemd[1]: Starting docker.service - Docker Application Container Engine...
Oct 14 09:28:16 worker-1 dockerd[3180]: time="2024-10-14T09:28:16.580030562Z" level=info msg="Starting up"
Oct 14 09:28:16 worker-1 dockerd[3180]: time="2024-10-14T09:28:16.582310409Z" level=info msg="detected 127.0.0.53 nameserver, assuming systemd-resolved, s
Oct 14 09:28:16 worker-1 dockerd[3180]: time="2024-10-14T09:28:16.691703290Z" level=info msg="Loading containers: start."
Oct 14 09:28:16 worker-1 dockerd[3180]: time="2024-10-14T09:28:16.990582033Z" level=info msg="Loading containers: done."
Oct 14 09:28:17 worker-1 dockerd[3180]: time="2024-10-14T09:28:17.016100058Z" level=info msg="Docker daemon" commit=24.0.7-0ubuntu4.1 graphdriver=overlay2
Oct 14 09:28:17 worker-1 dockerd[3180]: time="2024-10-14T09:28:17.016523367Z" level=info msg="Daemon has completed initialization"
Oct 14 09:28:17 worker-1 dockerd[3180]: time="2024-10-14T09:28:17.073794104Z" level=info msg="API listen on /run/docker.sock"
Oct 14 09:28:17 worker-1 systemd[1]: Started docker.service - Docker Application Container Engine.
lines 1-21/21 (END)
```

i-Oe2349008675df43d (worker-node)

PublicIPs: 3.108.237.154 PrivateIPs: 172.31.15.196

## 9) Install Kubernetes( both master and worker node)

```
$ sudo apt-get update
```

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

```
aws Services Q Search [Alt+S]
ubuntu@worker-1:~$ sudo apt-get update
Hit:1 http://ap-south-1.ec2.archive.ubuntu.com/ubuntu noble InRelease
Hit:2 http://ap-south-1.ec2.archive.ubuntu.com/ubuntu noble-updates InRelease
Hit:3 http://ap-south-1.ec2.archive.ubuntu.com/ubuntu noble-backports InRelease
Hit:4 http://security.ubuntu.com/ubuntu noble-security InRelease
Reading package lists... Done
ubuntu@worker-1:~$ sudo apt-get install -y apt-transport-https ca-certificates curl
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.
curl is already the newest version (8.5.0-2ubuntu10.4).
curl set to manually installed.
The following NEW packages will be installed:
  apt-transport-https
0 upgraded, 1 newly installed, 0 to remove and 12 not upgraded.
Need to get 3974 B of archives.
After this operation, 35.8 kB of additional disk space will be used.
Get:1 http://ap-south-1.ec2.archive.ubuntu.com/ubuntu noble/universe amd64 apt-transport-https all 2.7.14build2 [3974 B]
Fetched 3974 B in 0s (288 kB/s)
Selecting previously unselected package apt-transport-https.
(Reading database ... 68203 files and directories currently installed.)
Preparing to unpack .../apt-transport-https_2.7.14build2_all.deb ...
Unpacking apt-transport-https (2.7.14build2) ...
Setting up apt-transport-https (2.7.14build2) ...
Scanning processes...
```

i-Oe2349008675df43d (worker-node)

PublicIPs: 3.108.237.154 PrivateIPs: 172.31.15.196

```
$ sudo curl -fsSLo /usr/share/keyrings/kubernetes-archive-keyring.gpg
https://packages.cloud.google.com/apt/doc/apt-key.gpg (download the google cloud public
signing key) (curl -fsSL https://pkgs.k8s.io/core:/stable:/v1.31/deb/Release.key | sudo gpg
--dearmor -o /etc/apt/keyrings/kubernetes-apt-keyring.gpg)
```

```
$ echo "deb [signed-by=/usr/share/keyrings/kubernetes-archive-keyring.gpg]
https://apt.kubernetes.io/ kubernetes-xenial main" | sudo tee
/etc/apt/sources.list.d/kubernetes.list (add the Kubernetes apt repository:) (echo "deb
[signed-by=/etc/apt/keyrings/kubernetes-apt-keyring.gpg]
https://pkgs.k8s.io/core:/stable:/v1.31/deb/ /" | sudo tee /etc/apt/sources.list.d/kubernetes.list
```

```
deb [signed-by=/etc/apt/keyrings/kubernetes-apt-keyring.gpg] https://pkgs.k8s.io/core:/stable:/v1.31/deb/ /
ubuntu@master-node:~$ sudo apt-get update
Hit:1 http://ap-south-1.ec2.archive.ubuntu.com/ubuntu noble InRelease
Hit:2 http://ap-south-1.ec2.archive.ubuntu.com/ubuntu noble-updates InRelease
Hit:3 http://ap-south-1.ec2.archive.ubuntu.com/ubuntu noble-backports InRelease
Hit:4 http://security.ubuntu.com/ubuntu noble-security InRelease
Get:5 https://prod-cdn.packages.k8s.io/repositories/iscv/kubernetes:/core:/stable:/v1.31/deb InRelease [1186 B]
Get:6 https://prod-cdn.packages.k8s.io/repositories/iscv/kubernetes:/core:/stable:/v1.31/deb Packages [4865 B]
Fetched 6051 B in 1s (10.6 kB/s)
Reading package lists... Done
ubuntu@master-node:~$ 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 12 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://ap-south-1.ec2.archive.ubuntu.com/ubuntu noble/main amd64 conntrack amd64 1:1.4.8-1ubuntu1 [37.9 kB]
Get:2 https://prod-cdn.packages.k8s.io/repositories/iscv/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/iscv/kubernetes:/core:/stable:/v1.31/deb kubeadm 1.31.1-1.1 [11.4 MB]
Get:4 https://prod-cdn.packages.k8s.io/repositories/iscv/kubernetes:/core:/stable:/v1.31/deb kubectl 1.31.1-1.1 [11.2 MB]
Get:5 https://prod-cdn.packages.k8s.io/repositories/iscv/kubernetes:/core:/stable:/v1.31/deb kubernetes-cni 1.5.1-1.1 [33.9 MB]
Get:6 https://prod-cdn.packages.k8s.io/repositories/iscv/kubernetes:/core:/stable:/v1.31/deb kubelet 1.31.1-1.1 [15.2 MB]
Fetched 87.4 MB in 2s (56.7 MB/s)
```

```
i-0995f31f779f6f1a2 (master-node)
PublicIPs: 13.201.134.120 PrivateIPs: 172.31.0.46
```

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

i-0e2349008675df43d (worker-node)  
PublicIPs: 3.108.237.154 PrivateIPs: 172.31.15.196

i-0995f31f779f6f1a2 (master-node)  
PublicIPs: 13.201.134.120 PrivateIPs: 172.31.0.46

## 12) \$ kubectl get pods --all-namespaces

```
clusterrolebinding.rbac.authorization.k8s.io/flannel created
configmap/kube-flannel-cfg created
daemonset.apps/kube-flannel-ds created
ubuntu@master-node:~$ kubectl get pods --all-namespaces
NAMESPACE      NAME                                     READY   STATUS    RESTARTS   AGE
kube-flannel    kube-flannel-ds-f77qk                  1/1     Running   0           43s
kube-system     coredns-7c65d6cfc9-qxyp2              1/1     Running   0           7m36s
kube-system     coredns-7c65d6cfc9-wxhn2              1/1     Running   0           7m36s
kube-system     etcd-master-node                       1/1     Running   0           7m41s
kube-system     kube-apiserver-master-node             1/1     Running   0           7m41s
kube-system     kube-controller-manager-master-node    1/1     Running   0           7m41s
kube-system     kube-proxy-4ls8p                       0/1     CrashLoopBackOff 4 (52s ago) 7m37s
kube-system     kube-scheduler-master-node             1/1     Running   0           7m41s
ubuntu@master-node:~$
```

i-0995f31f779f6f1a2 (master-node)

PublicIPs: 13.201.134.120 PrivateIPs: 172.31.0.46

## Join Worker Node to Cluster (on worker node)

13) sudo kubeadm join 172.31.40.240:6443 --token i0zoaj.tblkx57b8mg41aq3 --discovery-token-ca-cert-hash sha256:b66cf6a507714d87b3012ab879b7af89f0d484df29bd6bccc7808e713a1c52fa --ignore-preflight-errors=all

```
user sessions are running outdated binaries.

VM guests are running outdated hypervisor (qemu) binaries on this host.
ubuntu@worker-1:~$ sudo kubeadm join 172.31.0.46:6443 --token m9nz62.2n5myt10eyamax1 \
--discovery-token-ca-cert-hash sha256:08459ead16alc35030f987b04013dce59dc38c9716489dbeac7c16416076da15 \
--ignore-preflight-errors=all
reflight] Running pre-flight checks
[WARNING FileExisting-socat]: socat not found in system path
reflight] Reading configuration from the cluster...
reflight] FYI: You can look at this config file with 'kubectl -n kube-system get cm kubeadm-config -o yaml'
ubelet-start] Writing kubelet configuration to file "/var/lib/kubelet/config.yaml"
ubelet-start] Writing kubelet environment file with flags to file "/var/lib/kubelet/kubeadm-flags.env"
ubelet-start] Starting the kubelet
ubelet-check] Waiting for a healthy kubelet at http://127.0.0.1:10248/healthz. This can take up to 4m0s
ubelet-check] The kubelet is healthy after 1.502221294s
ubelet-start] Waiting for the kubelet to perform the TLS Bootstrap

is 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.

n 'kubectl get nodes' on the control-plane to see this node join the cluster.
ubuntu@worker-1:~$
```

i-0e2349008675df43d (worker-node)

PublicIPs: 3.108.237.154 PrivateIPs: 172.31.15.196

#### 14) \$ kubectl get nodes (on master node )

```
kubeadm join 172.31.0.46:6443 --token m9nz62.2n5mbyt10eyamax1 \
--discovery-token-ca-cert-hash sha256:08459ead16a1c35030f987b04013dce59dc38c9716489dbeac7c16416076da15
ubuntu@master-node:~$ mkdir -p $HOME/.kube
ubuntu@master-node:~$ sudo cp -i /etc/kubernetes/admin.conf $HOME/.kube/config
ubuntu@master-node:~$ sudo chown $(id -u):$(id -g) $HOME/.kube/config
ubuntu@master-node:~$ kubectl apply -f https://github.com/flannel-io/flannel/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-node:~$ kubectl get pods --all-namespaces
NAMESPACE      NAME                                     READY   STATUS    RESTARTS   AGE
kube-flannel    kube-flannel-ds-f77qk                  1/1     Running   0           43s
kube-system     coredns-7c65d6cfc9-qxyp2              1/1     Running   0           7m36s
kube-system     coredns-7c65d6cfc9-wxhn2              1/1     Running   0           7m36s
kube-system     etcd-master-node                       1/1     Running   0           7m41s
kube-system     kube-apiserver-master-node             1/1     Running   0           7m41s
kube-system     kube-controller-manager-master-node    1/1     Running   0           7m41s
kube-system     kube-proxy-4ls8p                       0/1     CrashLoopBackOff   4 (52s ago)   7m37s
kube-system     kube-scheduler-master-node             1/1     Running   0           7m41s
ubuntu@master-node:~$ ^C
ubuntu@master-node:~$ kubectl get nodes
NAME        STATUS    ROLES    AGE   VERSION
master-node Ready     control-plane   11m   v1.31.1
worker-1    Ready     <none>         40s   v1.31.1
ubuntu@master-node:~$
```

i-0995f31f779f6f1a2 (master-node)

PublicIPs: 13.201.134.120 PrivateIPs: 172.31.0.46

we now have a Kubernetes cluster running across AWS EC2 Instances. This cluster can be used to further deploy applications and their loads being distributed across these machines.

#### Conclusion:

Successfully understood the Kubernetes cluster architecture and deployed a Kubernetes cluster on Linux machines/cloud platforms, demonstrating seamless setup and orchestration.