

Experiment No 3

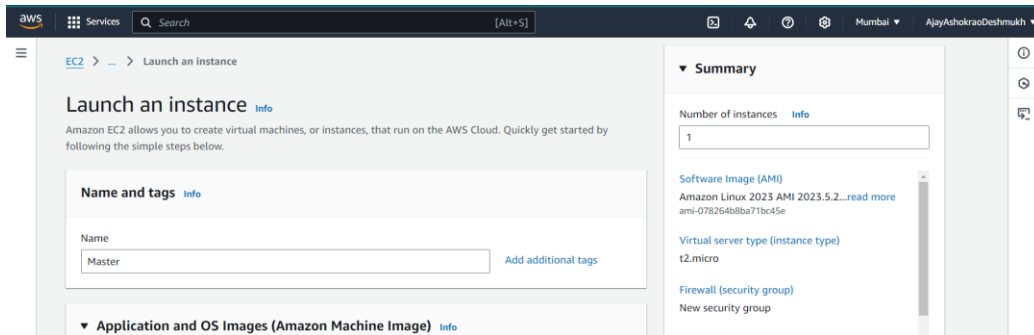
Name: Ajay Deshmukh

Roll No: 12

Div: D15B

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

1) Launch 2 EC2 instance and select Ubuntu in AMI



2) Create new key pair

×

Create key pair

Key pair name

Key pairs allow you to connect to your instance securely.

ajay_private_key2

The name can include up to 255 ASCII characters. It can't include leading or trailing spaces.

Key pair type

☒ RSA
RSA encrypted private and public key pair

☐ ED25519
ED25519 encrypted private and public key pair

Private key file format

☒ .pem
For use with OpenSSH

☐ .ppk
For use with PuTTY

⚠ When prompted, store the private key in a secure and accessible location on your computer. You will need it later to connect to your instance. [Learn more](#)

Cancel

Create key pair

3) In Security group select all checkbox and launch instance

4) Go to security group and edit inbound rules of both instance

5) Delete all the rules and add new rule with All traffic and Anywhere-IPv4

Inbound rules (1/1)							Manage tags	Edit inbound rules
Filter security group rules							< 1 >	⚙
<input checked="" type="checkbox"/>	Name	Security group rule...	IP version	Type	Protocol	Port range		
<input checked="" type="checkbox"/>	-	sgr-07c7275a5903c511f	IPv4	All traffic	All	All		

6) Now in running instances click on master instance and click on connect

EC2 Instance Connect
Session Manager
SSH client
EC2 serial console

Instance ID

i-0d7f35ca2039c23b1 (Master)

Connection Type

☒ **Connect using EC2 Instance Connect**
Connect using the EC2 Instance Connect browser-based client, with a public IPv4 address.

☐ **Connect using EC2 Instance Connect Endpoint**
Connect using the EC2 Instance Connect browser-based client, with a private IPv4 address and a VPC endpoint.

Public IP address

3.110.175.160

User name

Enter the user name defined in the AMI used to launch the instance. If you didn't define a custom user name, use the default user name, ubuntu.

Note: In most cases, the default user name, ubuntu, is correct. However, read your AMI usage instructions to check if the AMI owner has changed the default AMI user name.

Cancel
Connect

8) Similarly connect the worker

9) Set hostname to master and worker respectively

```
ubuntu@ip-172-31-12-130:~$ sudo hostnamectl set-hostname master
ubuntu@ip-172-31-12-130:~$
```

```
ubuntu@master:~$
```

```
ubuntu@worker:~$
```

10) Use command `sudo apt-get update` on both master and worker CLI

`sudo apt-get update` on both

```

Get:24 http://ap-south-1.ec2.archive.ubuntu.com/ubuntu jammy-backports/main Translation-en [10.5 kB]
Get:25 http://ap-south-1.ec2.archive.ubuntu.com/ubuntu jammy-backports/main amd64 c-n-f Metadata [388 B]
Get:26 http://ap-south-1.ec2.archive.ubuntu.com/ubuntu jammy-backports/restricted amd64 c-n-f Metadata [1.1 kB]
Get:27 http://ap-south-1.ec2.archive.ubuntu.com/ubuntu jammy-backports/universe amd64 Packages [24.3 kB]
Get:28 http://ap-south-1.ec2.archive.ubuntu.com/ubuntu jammy-backports/universe Translation-en [16.4 kB]
Get:29 http://ap-south-1.ec2.archive.ubuntu.com/ubuntu jammy-backports/universe amd64 c-n-f Metadata [644 B]
Get:30 http://ap-south-1.ec2.archive.ubuntu.com/ubuntu jammy-backports/multiverse amd64 c-n-f Metadata [1.1 kB]
Get:31 http://security.ubuntu.com/ubuntu jammy-security/main amd64 Packages [765 kB]
Get:32 http://security.ubuntu.com/ubuntu jammy-security/main Translation-en [165 kB]
Get:33 http://security.ubuntu.com/ubuntu jammy-security/main amd64 c-n-f Metadata [11.3 kB]
Get:34 http://security.ubuntu.com/ubuntu jammy-security/restricted amd64 Packages [826 kB]
Get:35 http://security.ubuntu.com/ubuntu jammy-security/restricted Translation-en [133 kB]
Get:36 http://security.ubuntu.com/ubuntu jammy-security/restricted amd64 c-n-f Metadata [536 B]
Get:37 http://security.ubuntu.com/ubuntu jammy-security/universe amd64 Packages [781 kB]
Get:38 http://security.ubuntu.com/ubuntu jammy-security/universe Translation-en [143 kB]
Get:39 http://security.ubuntu.com/ubuntu jammy-security/universe amd64 c-n-f Metadata [16.7 kB]
Get:40 http://security.ubuntu.com/ubuntu jammy-security/multiverse amd64 Packages [36.5 kB]
Get:41 http://security.ubuntu.com/ubuntu jammy-security/multiverse Translation-en [7060 B]
Get:42 http://security.ubuntu.com/ubuntu jammy-security/multiverse amd64 c-n-f Metadata [260 B]
Fetched 27.1 MB in 5s (5664 kB/s)
Reading package lists... Done
ubuntu@master:~$

```

11) Installing Docker on both CLI

sudo apt-get install docker.io on both

```

Done.
Created symlink /etc/systemd/system/multi-user.target.wants/docker.service → /lib/systemd/system/docker.service.
Created symlink /etc/systemd/system/sockets.target.wants/docker.socket → /lib/systemd/system/docker.socket.
Processing triggers for dbus (1.12.20-2ubuntu4.1) ...
Processing triggers for man-db (2.10.2-1) ...
Scanning processes...
Scanning linux images...

Running kernel seems to be up-to-date.

No services need to be restarted.

No containers need to be restarted.

No user sessions are running outdated binaries.

No VM guests are running outdated hypervisor (qemu) binaries on this host.
ubuntu@master:~$

```

12) Enable Docker on both CLI and check its status

sudo systemctl enable docker

sudo systemctl status docker on both

```

No VM guests are running outdated hypervisor (qemu) binaries on this host.
ubuntu@master:~$ sudo systemctl enable docker
ubuntu@master:~$ sudo systemctl status docker
● docker.service - Docker Application Container Engine
   Loaded: loaded (/lib/systemd/system/docker.service; enabled; vendor preset: enabled)
   Active: active (running) since Sun 2023-09-17 17:23:49 UTC; 3min 30s ago
 TriggeredBy: ● docker.socket
     Docs: https://docs.docker.com
    Main PID: 3050 (dockerd)
      Tasks: 7
     Memory: 33.2M
        CPU: 291ms
    CGroup: /system.slice/docker.service
            └─3050 /usr/bin/dockerd -H fd:// --containerd=/run/containerd/containerd.sock

```

DOCKER INSTALLED SUCCESSFULLY

13) Now for Installing Kubernetes (On both CLI)

sudo apt-get update

```
ubuntu@master:~$ sudo apt-get update
Hit:1 http://ap-south-1.ec2.archive.ubuntu.com/ubuntu jammy InRelease
Hit:2 http://ap-south-1.ec2.archive.ubuntu.com/ubuntu jammy-updates InRelease
Hit:3 http://ap-south-1.ec2.archive.ubuntu.com/ubuntu jammy-backports InRelease
Hit:4 http://security.ubuntu.com/ubuntu jammy-security InRelease
Reading package lists... Done
ubuntu@master:~$
```

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

```
Updating certificates in /etc/ssl/certs...
rehash: warning: skipping ca-certificates.crt, it does not contain exactly one certificate or CRL
19 added, 6 removed; done.
Setting up libcurl4:amd64 (7.81.0-1ubuntu1.13) ...
Setting up curl (7.81.0-1ubuntu1.13) ...
Processing triggers for man-db (2.10.2-1) ...
Processing triggers for libc-bin (2.35-0ubuntu3.1) ...
Processing triggers for ca-certificates (20230311ubuntu0.22.04.1) ...
Updating certificates in /etc/ssl/certs...
0 added, 0 removed; done.
Running hooks in /etc/ca-certificates/update.d...
done.
Scanning processes...
Scanning linux images...

Running kernel seems to be up-to-date.

No services need to be restarted.

No containers need to be restarted.

No user sessions are running outdated binaries.

No VM guests are running outdated hypervisor (qemu) binaries on this host.
ubuntu@master:~$
```

14) Download Google cloud public signing key

sudo curl -fsSL /usr/share/keyrings/kubernetes-archive-keyring.gpg <https://dl.k8s.io/apt/doc/apt-key.gpg>

```
No VM guests are running outdated hypervisor (qemu) binaries on this host.
ubuntu@master:~$ sudo curl -fsSL /usr/share/keyrings/kubernetes-archive-keyring.gpg https://dl.k8s.io/apt/doc/apt-key.gpg
ubuntu@master:~$
```

15) Adding kubernetes apt repository

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

```
ubuntu@master:~$ 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
deb [signed-by=/usr/share/keyrings/kubernetes-archive-keyring.gpg] https://apt.kubernetes.io/ kubernetes-xenial main
ubuntu@master:~$
```

16) Run this 3 commands

sudo apt-get update

```
ubuntu@master:~$ sudo apt-get update
Hit:1 http://ap-south-1.ec2.archive.ubuntu.com/ubuntu jammy InRelease
Hit:2 http://ap-south-1.ec2.archive.ubuntu.com/ubuntu jammy-updates InRelease
Hit:3 http://ap-south-1.ec2.archive.ubuntu.com/ubuntu jammy-backports InRelease
Hit:4 http://security.ubuntu.com/ubuntu jammy-security InRelease
Get:5 https://packages.cloud.google.com/apt kubernetes-xenial InRelease [8993 B]
Get:6 https://packages.cloud.google.com/apt kubernetes-xenial/main amd64 Packages [69.9 kB]
Fetched 78.9 kB in 1s (53.8 kB/s)
Reading package lists... Done
ubuntu@master:~$
```

sudo apt-get install -y kubelet kubeadm kubectl

```

Setting up conntrack (1:1.4.6-2build2) ...
Setting up kubect1 (1.28.2-00) ...
Setting up ebtables (2.0.11-4build2) ...
Setting up socat (1.7.4.1-3ubuntu4) ...
Setting up cri-tools (1.26.0-00) ...
Setting up kubernetes-cni (1.2.0-00) ...
Setting up kubelet (1.28.2-00) ...
Created symlink /etc/systemd/system/multi-user.target.wants/kubelet.service → /lib/systemd/system/kubelet.service.
Setting up kubeadm (1.28.2-00) ...
Processing triggers for man-db (2.10.2-1) ...
Scanning processes...
Scanning linux images...

Running kernel seems to be up-to-date.

No services need to be restarted.

No containers need to be restarted.

No user sessions are running outdated binaries.

No VM guests are running outdated hypervisor (qemu) binaries on this host.
ubuntu@master:~$ █

```

sudo apt-mark hold kubelet kubeadm kubect1

```

ubuntu@master:~$ sudo apt-mark hold kubelet kubeadm kubect1
kubelet set on hold.
kubeadm set on hold.
kubect1 set on hold.
ubuntu@master:~$ █

```

KUBERNETES INSTALLED SUCCESSFULLY

17) Kubernetes Deployment

sudo swapoff -a

```

ubuntu@master:~$ sudo swapoff -a
ubuntu@master:~$ █

```

18) Initialize kubernetes on Master

sudo touch "/etc/docker/daemon.json"

sudo nano "/etc/docker/daemon.json" Run this command and copy paste this

```

{
"exec-opts": ["native.cgroupdriver=systemd"]
}

```

Then press ctrl + O and enter then ctrl + X

sudo cat "/etc/docker/daemon.json"

sudo systemctl daemon-reload

sudo systemctl restart docker

sudo systemctl restart kubelet

sudo kubeadm reset

```

ubuntu@master:~$ sudo touch "/etc/docker/daemon.json"
ubuntu@master:~$ sudo nano "/etc/docker/daemon.json" █

```



```
ubuntu@master:~$ sudo cat "/etc/docker/daemon.json"
{
    "exec-opts": ["native.cgroupdriver=systemd"],
    "log-driver": "json-file",
    "log-opts": {
        "max-size": "100m"
    },
    "storage-driver": "overlay2"
}
ubuntu@master:~$
```

```
ubuntu@master:~$ sudo systemctl daemon-reload
ubuntu@master:~$ sudo systemctl restart docker
ubuntu@master:~$ sudo systemctl restart kubelet
ubuntu@master:~$ sudo kubeadm reset
W0917 18:15:57.371540 10839 preflight.go:56] [reset] WARNING:
[reset] Are you sure you want to proceed? [y/N]: y
[preflight] Running pre-flight checks
W0917 18:16:01.329044 10839 removeetcdmember.go:106] [reset] No
[reset] Deleted contents of the etcd data directory: /var/lib/etcd
[reset] Stopping the kubelet service
[reset] Unmounting mounted directories in "/var/lib/kubelet"
```

\$ sudo kubeadm init --pod-network-cidr=10.244.0.0/16 --ignore-preflight-errors=all

```
ubuntu@master:~$ sudo kubeadm init --pod-network-cidr=10.244.0.0/16 --ignore-preflight-errors=all
[init] Using Kubernetes version: v1.28.2
[preflight] Running pre-flight checks
    [WARNING NumCPU]: the number of available CPUs 1 is less than the required 2
    [WARNING Mem]: the system RAM (965 MB) is less than the minimum 1700 MB
[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 in beforehand using 'kubeadm config images pull'
W0917 18:17:31.346348 10860 checks.go:835] detected that the sandbox image "registry.k8s.io/pause:3.9"
It is recommended that using "registry.k8s.io/pause:3.9" 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 [kubernetes kubernetes.default kubernetes.default.svc 172.31.12.130]
[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 [localhost master] and IPs [172.31.12.130]
[certs] Generating "etcd/peer" certificate and key
[certs] etcd/peer serving cert is signed for DNS names [localhost master] and IPs [172.31.12.130]
[certs] Generating "etcd/healthcheck-client" certificate and key
[certs] Generating "apiserver-etcd-client" certificate and key
[certs] Generating "sa" key and public key
```

```
kubeadm join 172.31.12.130:6443 --token 67nba2.98zekjx1ogwtrr29 --discovery-token-ca-cert-hash
sha256:5d3403f5221016f77cbcd1757a266467af45dc41b765ebe535f15ee058baf883
```

Your Kubernetes control-plane has initialized successfully!

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 172.31.12.130:6443 --token 67nba2.98zekjxlogwtrr29 \
--discovery-token-ca-cert-hash sha256:5d3403f5221016f77cbcd1757a266467af45dc41b765ebe535f15ee058baf883
ubuntu@master:~$
```

```
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/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:~$
```

```
[kubelet-start] Writing kubelet configuration to file "/var/lib/kubelet/config.yaml"
[kubelet-start] Writing kubelet environment file with flags to file "/var/lib/kubelet/kubeadm-flags.env"
[kubelet-start] Starting the kubelet
[kubelet-start] Waiting for the kubelet to perform the TLS Bootstrap...
I0917 18:31:31.967826 11348 kubelet.go:220] [kubelet-start] preserving the crisocket information for th
I0917 18:31:31.968119 11348 patchnode.go:31] [patchnode] Uploading the CRI Socket information "unix:///
as an annotation
I0917 18:31:31.968407 11348 cert_rotation.go:137] Starting client certificate rotation controller
```

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@worker:~$
```

```
ubuntu@master:~$ kubectl get pods --all-namespaces
The connection to the server 172.31.12.130:6443 was refused - did you specify the right host or port?
ubuntu@master:~$
```

```
ubuntu@master:~$ kubectl get nodes
NAME          STATUS    ROLES          AGE   VERSION
master        Ready     control-plane   24m   v1.28.2
worker        Ready     <none>          11m   v1.28.2
ubuntu@master:~$
```

```
aws Services Search [Alt+S]
Expanded Security Maintenance for Applications is not enabled.

128 updates can be applied immediately.
68 of these updates are standard security updates.
To see these additional updates run: apt list --upgradable

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

Last login: Sun Sep 17 18:56:17 2023 from 13.233.177.5
ubuntu@master:~$ kubectl get pods --all-namespaces
NAMESPACE   NAME                                     READY   STATUS    RESTARTS   AGE
kube-flannel kube-flannel-ds-f4469                 1/1     Running   12 (80s ago) 36m
kube-flannel kube-flannel-ds-nt47t                 1/1     Running   13 (81s ago) 28m
kube-system  coredns-5dd5756b68-5kqv4             1/1     Running   8 (80s ago)  40m
kube-system  coredns-5dd5756b68-stpx6             1/1     Running   8 (80s ago)  40m
kube-system  etcd-master                           1/1     Running   12 (3m6s ago) 41m
kube-system  kube-apiserver-master                 1/1     Running   16 (80s ago)  41m
kube-system  kube-controller-manager-master        1/1     Running   15 (3m6s ago) 41m
kube-system  kube-proxy-97gzj                     1/1     Running   18 (29s ago)  40m
kube-system  kube-proxy-mm6xl                     1/1     Running   13 (81s ago)  28m
kube-system  kube-scheduler-master                 1/1     Running   16 (2m49s ago) 41m
ubuntu@master:~$ kubectl get nodes
NAME     STATUS   ROLES    AGE   VERSION
master   Ready    control-plane 43m   v1.28.2
worker   Ready    <none>      30m   v1.28.2
ubuntu@master:~$
```

Conclusion:

Thus we have understood the Kubernetes Cluster Architecture, installed and spun a Kubernetes Cluster on AWS Cloud Platform.