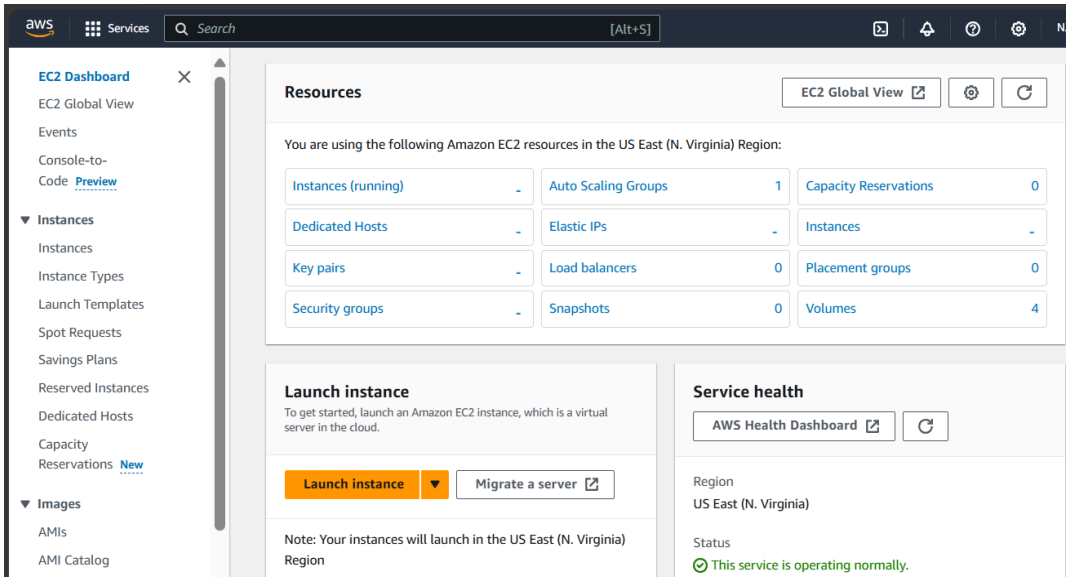
Experiment 4

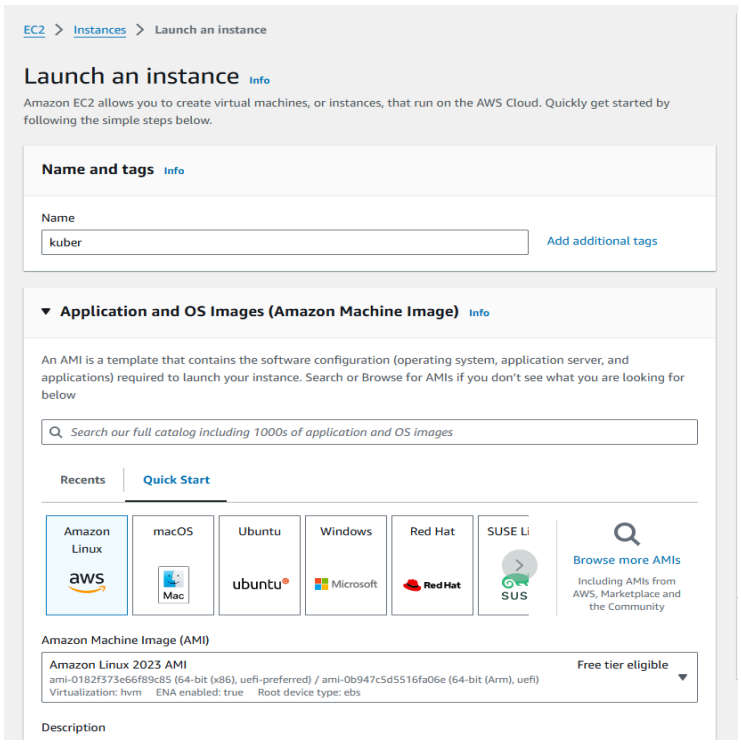
Aim: To install Kubectl and execute Kubectl commands to manage the Kubernetes cluster and deploy Your First Kubernetes Application.

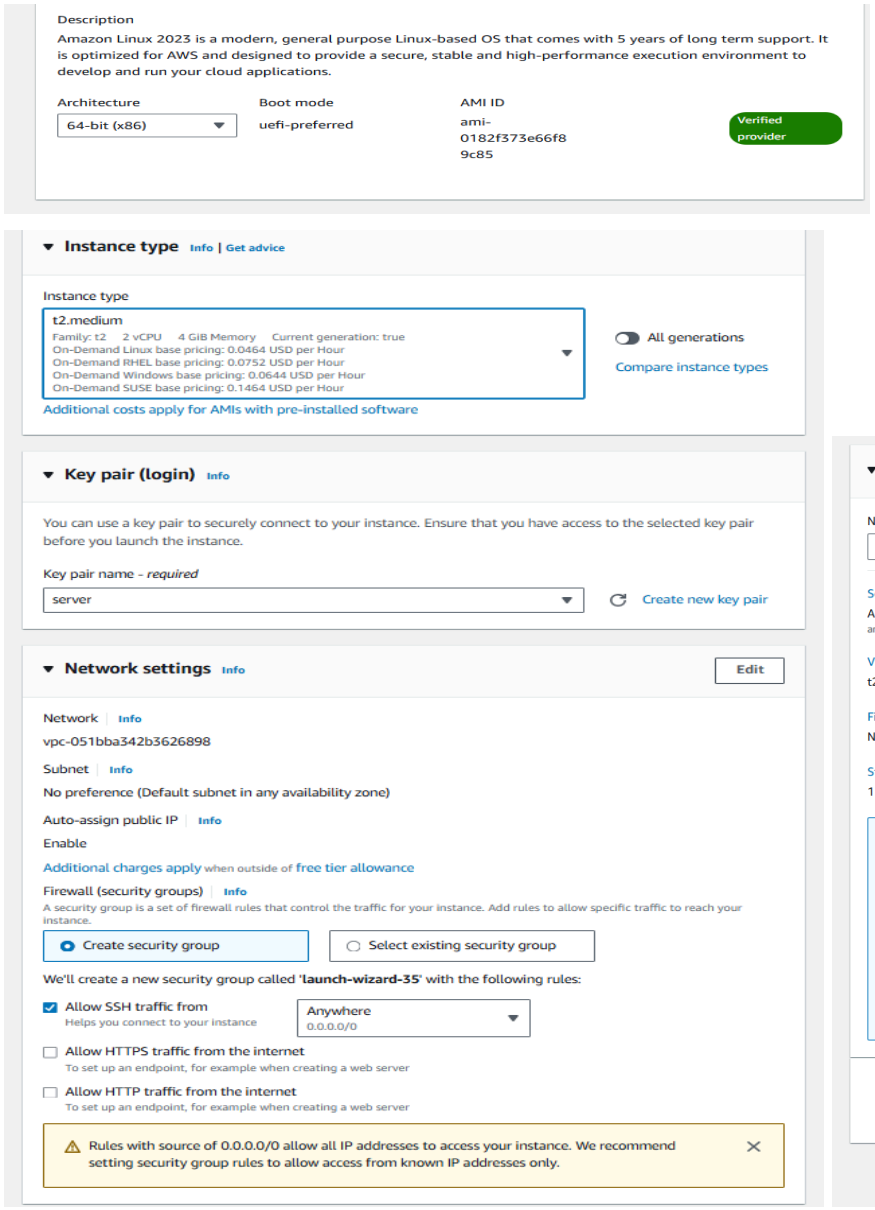
Procedure:

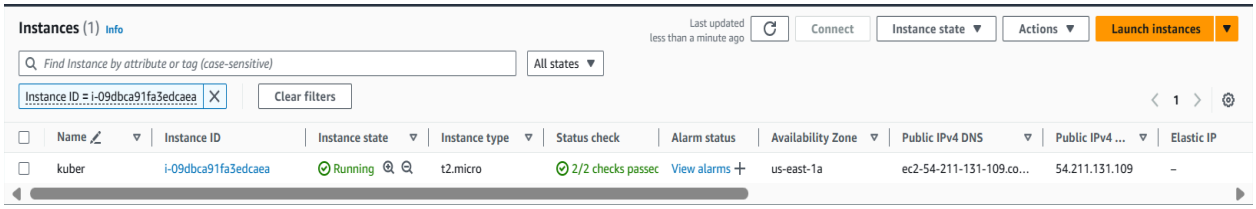
1. **Creation Of EC-2 instance**

- Create an EC2 AWS Linux instance on AWS .also edit the Security Group Inbound Rules to allow SSH. then select the t2.micro instance type

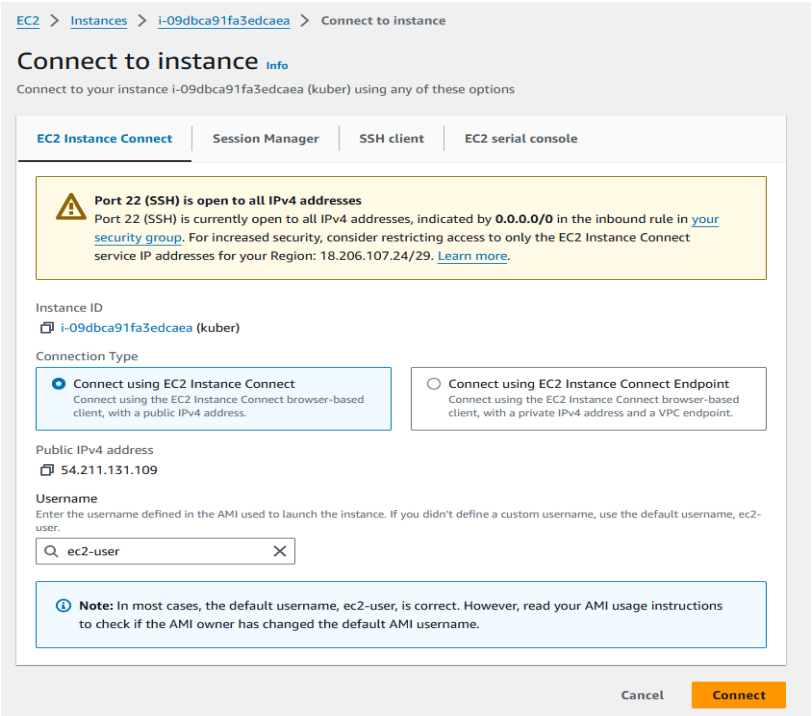








- Thus Kuber named -instance gets created.Then click on Id of that instance then click on connect button you will se this:



- Then go into SSH client where you will get this command
  Chmod 400 “keyname.pem”
  ssh -i <keyname>.pem ubuntu@<public_ip_address> copy it and then connect it and run the following command for establishing connection.(I have entered this command on git bash where i entered in downloads where server.pem is stored then as the key is not accessible hence we need to change its mode using chmod 400 “key name.pem”. Then use the given command for making connections).

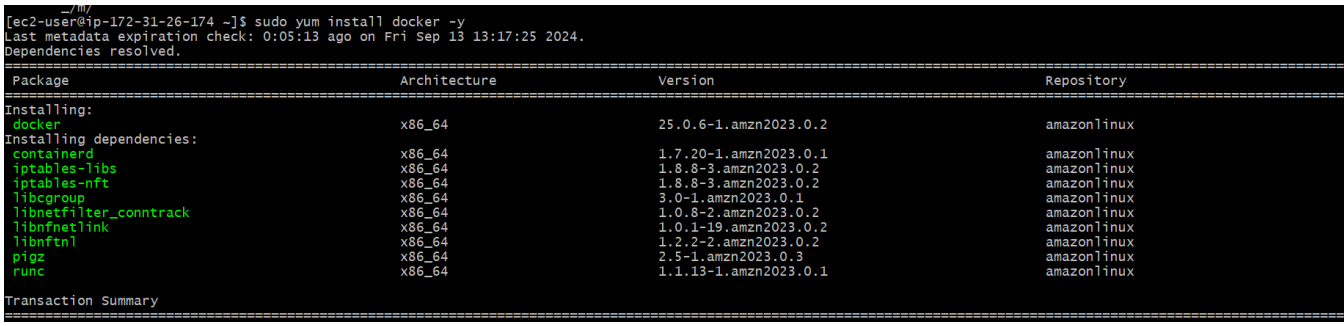
```
Sadneya@DESKTOP-IEPNL3D MINGW64 ~ (master)
$ cd downloads

Sadneya@DESKTOP-IEPNL3D MINGW64 ~/downloads (master)
$ chmod 400 "server.pem"

Sadneya@DESKTOP-IEPNL3D MINGW64 ~/downloads (master)
$ ssh -i "server.pem" ec2-user@ec2-54-196-176-21.compute-1.amazonaws.com
The authenticity of host 'ec2-54-196-176-21.compute-1.amazonaws.com (54.196.176.
21)' can't be established.
ED25519 key fingerprint is SHA256:lE4CbWC3AOKdn1J+99jTmUzur4joKQmThQyRcwIJzUU.
This key is not known by any other names.
Are you sure you want to continue connecting (yes/no/[fingerprint])? yes
Warning: Permanently added 'ec2-54-196-176-21.compute-1.amazonaws.com' (ED25519)
 to the list of known hosts.
   ,     #_
   ~\_  ####_        Amazon Linux 2023
  ~~  \_#####\
  ~~     \###|
  ~~       \#/ ___   https://aws.amazon.com/linux/amazon-linux-2023
   ~~       V~' '->
    ~~~         /
      ~~._.   _/
         _/ _/
       _/m/'
```

2. Installation of Docker

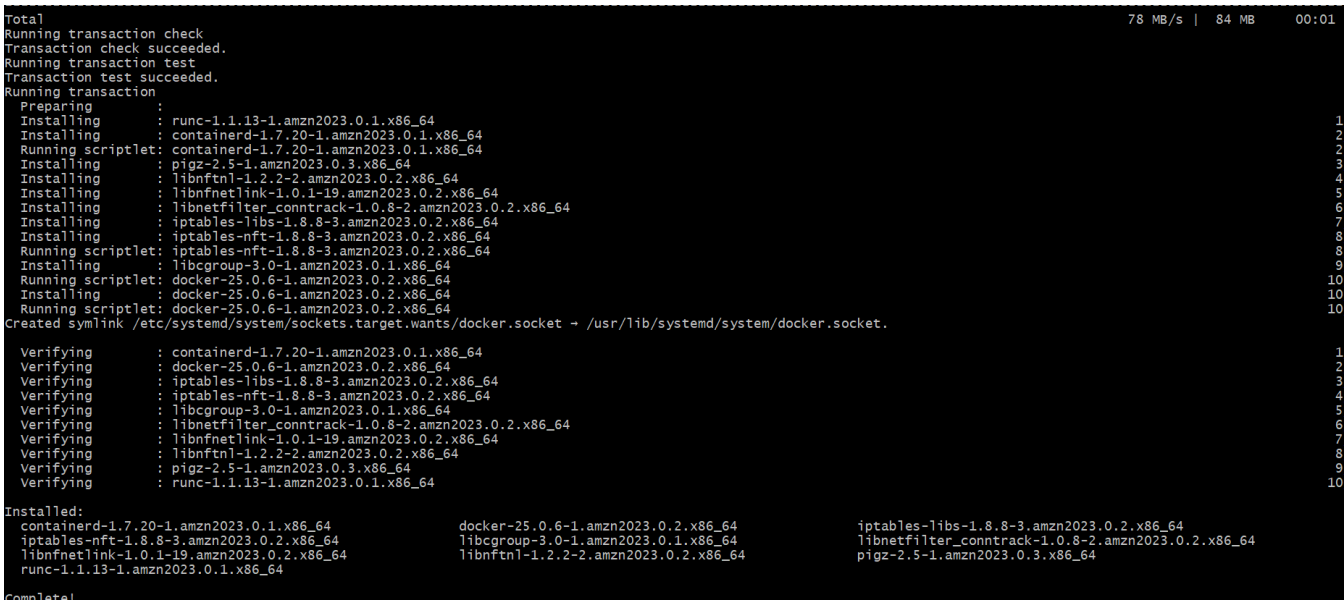
1. . For installation of Docker into the machines run the following command:
   sudo yum install docker -y



```
[ec2-user@ip-172-31-26-174 ~]$ sudo yum install docker -y
Last metadata expiration check: 0:05:13 ago on Fri Sep 13 13:17:25 2024.
Dependencies resolved.
```

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

```
Transaction Summary
```



```
Total                                                                                                78 MB/s |  84 MB     00:01
Running transaction check
Transaction check succeeded.
Running transaction test
Transaction test succeeded.
Running transaction
  Preparing        :                                                                                                          1
  Installing       : runc-1.1.13-1.amzn2023.0.1.x86_64                                                                        1
  Installing       : containerd-1.7.20-1.amzn2023.0.1.x86_64                                                                  2
  Running scriptlet: containerd-1.7.20-1.amzn2023.0.1.x86_64                                                                  2
  Installing       : pigz-2.5-1.amzn2023.0.3.x86_64                                                                           3
  Installing       : libnftnl-1.2.2-2.amzn2023.0.2.x86_64                                                                     4
  Installing       : libnfnetlink-1.0.1-19.amzn2023.0.2.x86_64                                                                5
  Installing       : libnetfilter_conntrack-1.0.8-2.amzn2023.0.2.x86_64                                                       6
  Installing       : iptables-libs-1.8.8-3.amzn2023.0.2.x86_64                                                                7
  Installing       : iptables-nft-1.8.8-3.amzn2023.0.2.x86_64                                                                 8
  Running scriptlet: iptables-nft-1.8.8-3.amzn2023.0.2.x86_64                                                                 8
  Installing       : libcgroup-3.0-1.amzn2023.0.1.x86_64                                                                      9
  Running scriptlet: docker-25.0.6-1.amzn2023.0.2.x86_64                                                                      10
  Installing       : docker-25.0.6-1.amzn2023.0.2.x86_64                                                                      10
  Running scriptlet: docker-25.0.6-1.amzn2023.0.2.x86_64                                                                      10
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
  Verifying        : docker-25.0.6-1.amzn2023.0.2.x86_64                                                                      2
  Verifying        : iptables-libs-1.8.8-3.amzn2023.0.2.x86_64                                                                3
  Verifying        : iptables-nft-1.8.8-3.amzn2023.0.2.x86_64                                                                 4
  Verifying        : libcgroup-3.0-1.amzn2023.0.1.x86_64                                                                      5
  Verifying        : libnetfilter_conntrack-1.0.8-2.amzn2023.0.2.x86_64                                                       6
  Verifying        : libnfnetlink-1.0.1-19.amzn2023.0.2.x86_64                                                                7
  Verifying        : libnftnl-1.2.2-2.amzn2023.0.2.x86_64                                                                     8
  Verifying        : pigz-2.5-1.amzn2023.0.3.x86_64                                                                           9
  Verifying        : runc-1.1.13-1.amzn2023.0.1.x86_64                                                                        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!
```

- Then, configure cgroup in a daemon.json file by using following commands
  cd /etc/docker
  cat <<EOF | sudo tee /etc/docker/daemon.json
  {
  "exec-opts": ["native.cgroupdriver=systemd"],
  "log-driver": "json-file",
  "log-opts": {
  "max-size": "100m"
  },
  "storage-driver": "overlay2"
  }
  EOF

```
[ec2-user@ip-172-31-26-174 ~]$ cd /etc/docker
[ec2-user@ip-172-31-26-174 docker]$ cat <<EOF | sudo tee /etc/docker/daemon.json
{
"exec-opts": ["native.cgroupdriver=systemd"],
"log-driver": "json-file",
"log-opts": {
"max-size": "100m"
},
"storage-driver": "overlay2"
}
EOF
{
"exec-opts": ["native.cgroupdriver=systemd"],
"log-driver": "json-file",
"log-opts": {
"max-size": "100m"
},
"storage-driver": "overlay2"
}
```

- Then after this run the following command to enable and start docker and also to load the daemon.json file.
  sudo systemctl enable docker
  sudo systemctl daemon-reload
  sudo systemctl restart docker

```
[ec2-user@ip-172-31-26-174 docker]$ sudo systemctl enable docker
Created symlink /etc/systemd/system/multi-user.target.wants/docker.service → /usr/lib/syste
[ec2-user@ip-172-31-26-174 docker]$ sudo systemctl daemon-reload
[ec2-user@ip-172-31-26-174 docker]$ sudo systemctl restart docker
[ec2-user@ip-172-31-26-174 docker]$ docker -v
Docker version 25.0.5, build 5dc9bcc
```

- docker -v

```
[ec2-user@ip-172-31-80-126 docker]$ docker -v
Docker version 25.0.5, build 5dc9bcc
```

3. Then Install Kubernetes with the following command.

- SELinux needs to be disable before configuring kubelet thus run the following command
  sudo setenforce 0
  sudo sed -i 's/^SELINUX=enforcing$/SELINUX=permissive/' /etc/selinux/config

```
[ec2-user@ip-172-31-26-174 docker]$ sudo setenforce 0
sudo sed -i 's/^SELINUX=enforcing$/SELINUX=permissive/' /etc/selinux/config
```

- Here We are adding kubernetes using the repository whose command is given below.
  cat <<EOF | sudo tee /etc/yum.repos.d/kubernetes.repo
  [kubernetes]
  name=Kubernetes
  baseurl=https://pkgs.k8s.io/core:/stable:/v1.30/rpm/
  enabled=1
  gpgcheck=1
  gpgkey=https://pkgs.k8s.io/core:/stable:/v1.30/rpm/repodata/repomd.xml.key
  exclude=kubelet kubeadm kubectl cri-tools kubernetes-cni
  EOF

```
[ec2-user@ip-172-31-26-174 docker]$ sudo setenforce 0
sudo sed -i 's/^SELINUX=enforcing$/SELINUX=permissive/' /etc/selinux/config
[ec2-user@ip-172-31-26-174 docker]$ cat <<EOF | sudo tee /etc/yum.repos.d/kubernetes.repo
[kubernetes]
name=Kubernetes
baseurl=https://pkgs.k8s.io/core:/stable:/v1.30/rpm/
enabled=1
gpgcheck=1
gpgkey=https://pkgs.k8s.io/core:/stable:/v1.30/rpm/repodata/repomd.xml.key
exclude=kubelet kubeadm kubectl cri-tools kubernetes-cni
EOF
[kubernetes]
name=Kubernetes
baseurl=https://pkgs.k8s.io/core:/stable:/v1.30/rpm/
enabled=1
gpgcheck=1
gpgkey=https://pkgs.k8s.io/core:/stable:/v1.30/rpm/repodata/repomd.xml.key
exclude=kubelet kubeadm kubectl cri-tools kubernetes-cni
```

- After that Run following command to make the updation and also to install kubelet ,kubeadm, kubectl:
  sudo yum update

```
[ec2-user@ip-172-31-80-126 docker]$ sudo yum update
Kubernetes                                                          100 kB/s |  17 kB     00:00
Dependencies resolved.
Nothing to do.
Complete!
```

sudo yum install -y kubelet kubeadm kubectl --disableexcludes=kubernetes

```
[ec2-user@ip-172-31-80-126 docker]$ sudo yum install -y kubelet kubeadm kubectl --disableexcludes=kubernetes
Last metadata expiration check: 0:00:10 ago on Fri Sep 13 10:31:17 2024.
Dependencies resolved.
================================================================================================
 Package                   Architecture     Version                     Repository         Size
================================================================================================
Installing:
 kubeadm                   x86_64           1.30.5-150500.1.1           kubernetes         10 M
 kubectl                   x86_64           1.30.5-150500.1.1           kubernetes         10 M
 kubelet                   x86_64           1.30.5-150500.1.1           kubernetes         17 M
Installing dependencies:
 conntrack-tools           x86_64           1.4.6-2.amzn2023.0.2        amazonlinux       208 k
 cri-tools                 x86_64           1.30.1-150500.1.1           kubernetes        8.6 M
 kubernetes-cni            x86_64           1.4.0-150500.1.1            kubernetes        6.7 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
```

```
Total                                                   64 MB/s |  53 MB     00:00
Kubernetes                                              20 kB/s | 1.7 kB     00:00
Importing GPG key 0x9A296436:
 Userid     : "isv:kubernetes OBS Project <isv:kubernetes@build.opensuse.org>"
 Fingerprint: DE15 B144 86CD 377B 9E87 6E1A 2346 54DA 9A29 6436
 From       : https://pkgs.k8s.io/core:/stable:/v1.30/rpm/repodata/repomd.xml.key
Key imported successfully
Running transaction check
Transaction check succeeded.
Running transaction test
Transaction test succeeded.
Running transaction
  Preparing        :                                                              1/1
  Installing       : kubernetes-cni-1.4.0-150500.1.1.x86_64                       1/9
  Installing       : cri-tools-1.30.1-150500.1.1.x86_64                           2/9
  Installing       : libnetfilter_queue-1.0.5-2.amzn2023.0.2.x86_64               3/9
  Installing       : libnetfilter_cttimeout-1.0.0-19.amzn2023.0.2.x86_64          4/9
  Installing       : libnetfilter_cthelper-1.0.0-21.amzn2023.0.2.x86_64           5/9
  Installing       : conntrack-tools-1.4.6-2.amzn2023.0.2.x86_64                  6/9
  Running scriptlet: conntrack-tools-1.4.6-2.amzn2023.0.2.x86_64                  6/9
  Installing       : kubelet-1.30.5-150500.1.1.x86_64                             7/9
  Running scriptlet: kubelet-1.30.5-150500.1.1.x86_64                             7/9
  Installing       : kubeadm-1.30.5-150500.1.1.x86_64                             8/9
  Installing       : kubectl-1.30.5-150500.1.1.x86_64                             9/9
  Running scriptlet: kubectl-1.30.5-150500.1.1.x86_64                             9/9
  Verifying        : conntrack-tools-1.4.6-2.amzn2023.0.2.x86_64                  1/9
  Verifying        : libnetfilter_cthelper-1.0.0-21.amzn2023.0.2.x86_64           2/9
  Verifying        : libnetfilter_cttimeout-1.0.0-19.amzn2023.0.2.x86_64          3/9
  Verifying        : libnetfilter_queue-1.0.5-2.amzn2023.0.2.x86_64               4/9
  Verifying        : cri-tools-1.30.1-150500.1.1.x86_64                           5/9
  Verifying        : kubeadm-1.30.5-150500.1.1.x86_64                             6/9
  Verifying        : kubectl-1.30.5-150500.1.1.x86_64                             7/9
  Verifying        : kubelet-1.30.5-150500.1.1.x86_64                             8/9
  Verifying        : kubernetes-cni-1.4.0-150500.1.1.x86_64                       9/9

Installed:
  conntrack-tools-1.4.6-2.amzn2023.0.2.x86_64         cri-tools-1.30.1-150500.1.1.x86_64                   kubeadm-1.30.5-150500.1.1.x86_64
  kubectl-1.30.5-150500.1.1.x86_64                    kubelet-1.30.5-150500.1.1.x86_64                     kubernetes-cni-1.4.0-150500.1.1.x86_64
  libnetfilter_cthelper-1.0.0-21.amzn2023.0.2.x86_64  libnetfilter_cttimeout-1.0.0-19.amzn2023.0.2.x86_64  libnetfilter_queue-1.0.5-2.amzn2023.0.2.x86_64

Complete!
```

- After installing Kubernetes, we need to configure internet options to allow bridging.

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

```
[ec2-user@ip-172-31-26-174 docker]$ 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
net.bridge.bridge-nf-call-iptables = 1
```

4. Initialize the Kubecluster

sudo kubeadm init --pod-network-cidr=10.244.0.0/16

```
[ec2-user@ip-172-31-80-126 docker]$ sudo kubeadm init --pod-network-cidr=10.244.0.0/16
I0913 10:32:44.629146   26680 version.go:256] remote version is much newer: v1.31.0; falling back to: stable-1.30
[init] Using Kubernetes version: v1.30.4
[preflight] Running pre-flight checks
```

```
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 172.31.26.174:6443 --token pv0yyi.xhllqhclfjr50pt8 \
        --discovery-token-ca-cert-hash sha256:8293b2f6d29de466bd859007f5adbcdb3a
ecb0c446ba09033d32a5846b3d434f
```

- copy the token and save for future use .
  kubeadm join 172.31.26.174:6443 --token pv0yyi.xhllqhclfjr50pt8
  \--discovery-token-ca-cert-hash
  sha256:8293b2f6d29de466bd859007f5adbcdb3aecb0c446ba09033d32a5846b3d434f
- Copy the mkdir and chown commands from the top and execute them
  mkdir -p $HOME/.kube
  sudo cp -i /etc/kubernetes/admin.conf $HOME/.kube/config
  sudo chown $(id -u):$(id -g) $HOME/.kube/config

```
[ec2-user@ip-172-31-80-126 docker]$  mkdir -p $HOME/.kube
  sudo cp -i /etc/kubernetes/admin.conf $HOME/.kube/config
  sudo chown $(id -u):$(id -g) $HOME/.kube/config
```

- Then, add a common networking plugin called flannel as mentioned in the code.

kubectl apply -f
https://raw.githubusercontent.com/coreos/flannel/master/Documentation/kube-flannel.yml

```
[ec2-user@ip-172-31-26-174 docker]$ 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
```

5. Now that the cluster is up and running,we can deploy our nginx server on this cluster. Apply deployment using this following command:

kubectl apply -f https://k8s.io/examples/pods/simple-pod.yaml

```
[ec2-user@ip-172-31-26-174 docker]$ kubectl apply -f https://k8s.io/examples/pods/s
imple-pod.yaml
pod/nginx created
```

Then use **kubectl get pods** to check whether the pod gets created or not.

```
[ec2-user@ip-172-31-26-174 docker]$ kubectl get pods
NAME    READY   STATUS    RESTARTS   AGE
nginx   0/1     Pending   0          12s
```

To convert state from pending to running use following command:

kubectl describe pod nginx This command will help to describe the pods it gives reason for failure as it shows the untolerated taints which need to be untainted.

- kubectl describe pod nginx

```
[ec2-user@ip-172-31-26-174 docker]$ kubectl describe pod nginx
Name:             nginx
Namespace:        default
Priority:         0
Service Account:  default
Node:             <none>
Labels:           <none>
Annotations:      <none>
Status:           Pending
IP:
IPs:              <none>
Containers:
  nginx:
    Image:        nginx:1.14.2
    Port:         80/TCP
    Host Port:    0/TCP
    Environment:  <none>
    Mounts:
      /var/run/secrets/kubernetes.io/serviceaccount from kube-api-access-k4lj6 (ro)
```

```
Conditions:
  Type           Status
  PodScheduled   False
Volumes:
  kube-api-access-k4lj6:
    Type:                    Projected (a volume that contains injected data from m
ultiple sources)
    TokenExpirationSeconds:  3607
    ConfigMapName:           kube-root-ca.crt
    ConfigMapOptional:       <nil>
    DownwardAPI:             true
QoS Class:                   BestEffort
Node-Selectors:              <none>
Tolerations:                 node.kubernetes.io/not-ready:NoExecute op=Exists for 3
00s
                             node.kubernetes.io/unreachable:NoExecute op=Exists for
 300s
Events:
  Type     Reason            Age   From               Message
  ----     ------            ----  ----               -------
  Warning  FailedScheduling  7s    default-scheduler  0/1 nodes are available: 1 no
de(s) had untolerated taint {node-role.kubernetes.io/control-plane: }. preemption:
0/1 nodes are available: 1 Preemption is not helpful for scheduling.
```

- kubectl taint nodes --all node-role.kubernetes.io/control-plane-

```
[ec2-user@ip-172-31-26-174 ~]$ kubectl taint nodes --all node-role.kubernetes.io
/control-plane-
node/ip-172-31-26-174.ec2.internal untainted
```

6. Now check pod status is is running perform **kubectl get pods** this command.

```
[ec2-user@ip-172-31-28-70 docker]$  kubectl get pods
NAME    READY   STATUS              RESTARTS   AGE
nginx   0/1     ContainerCreating   0          39s
[ec2-user@ip-172-31-28-70 docker]$  kubectl get pods
NAME    READY   STATUS    RESTARTS      AGE
nginx   1/1     Running   1 (45s ago)   70s
```

7.Lastly, mention the port you want to host. Here i have used localhost 8081 then check it.

kubectl port-forward nginx 8081:80

```
[ec2-user@ip-172-31-26-174 ~]$ kubectl port-forward nginx 8081:80
Forwarding from 127.0.0.1:8081 -> 80
Forwarding from [::1]:8081 -> 80
```

8. Verify your deployment

Open up a new terminal and ssh to your EC2 instance.

Then, use this curl command to check if the Nginx server is running.

curl --head http://127.0.0.1:8081

HTTP/1.1 200 OK

If the response is 200 OK and you can see the Nginx server name, your deployment was successful. We have successfully deployed our Nginx server on our EC2 instance.

Conclusion: Firstly I created an EC2 AWS Linux instance successfully.then installed docker and kubernetes successfully.then initialized kubernetes which given me token and chown and mkdir command. Then I execute mkdir and chown the command successfully. Then I installed a networking plugin called flannel successfully. Then I tried to deploy nginx which initially gave an error. Then I deployed (simple-pod.yml) nginx successfully and also checked by using the get pods command.then hosted it on localhost 8081 ie http://localhost:8081 successfully.