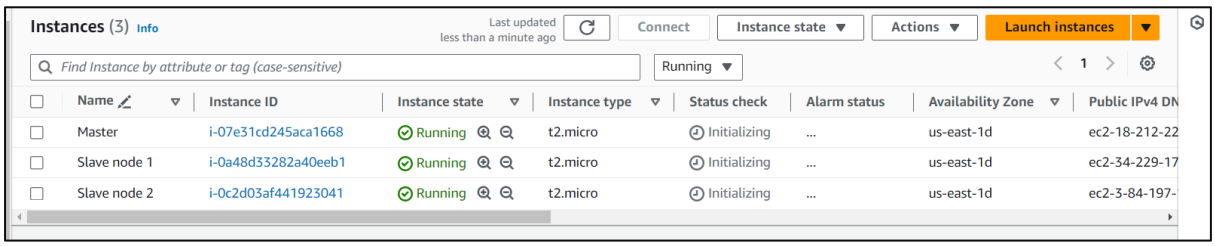
Advance DevOps

Experiment 3

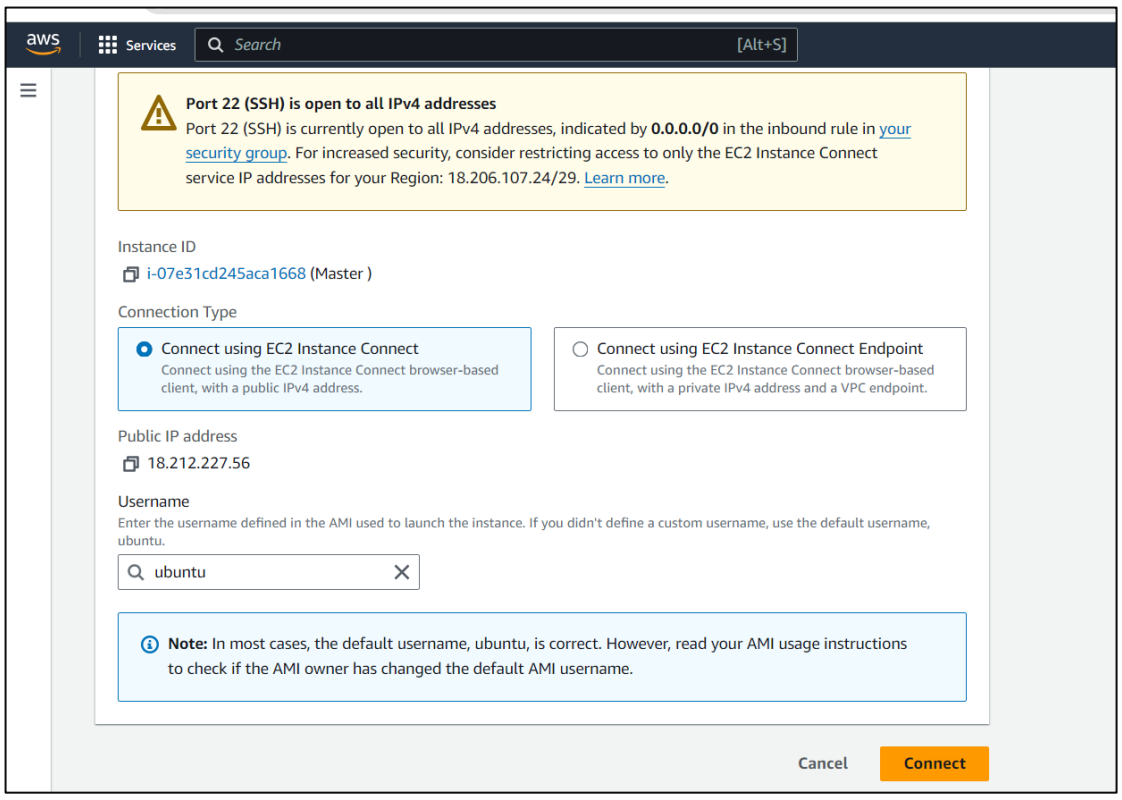
Aim: To understand the Kubernetes Cluster Architecture, install and Spin Up a Kubernetes Cluster on Linux Machines/Cloud Platforms.

Steps:

1. We will create 3 EC2 instances. One will be the master node and the other 2 will be slave/worker nodes.

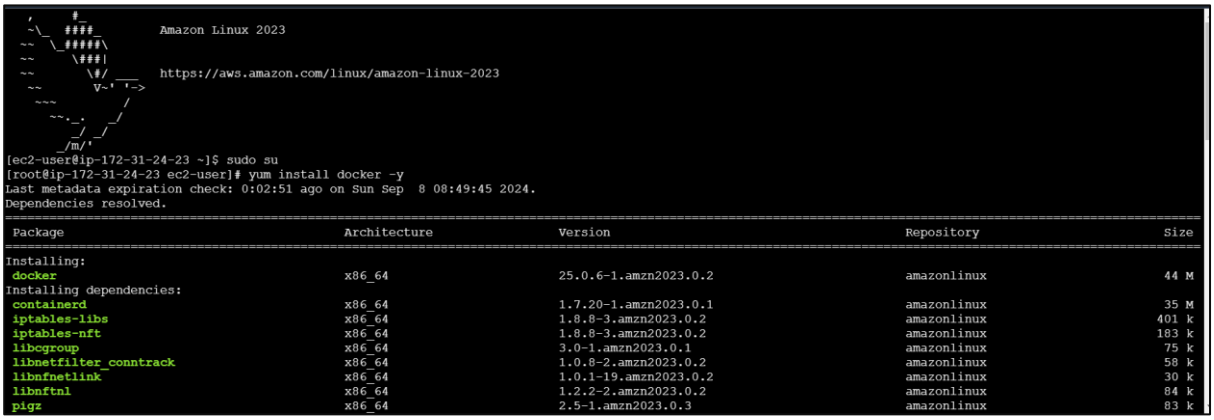


2. After the instances have been created, we will connect them one by one.

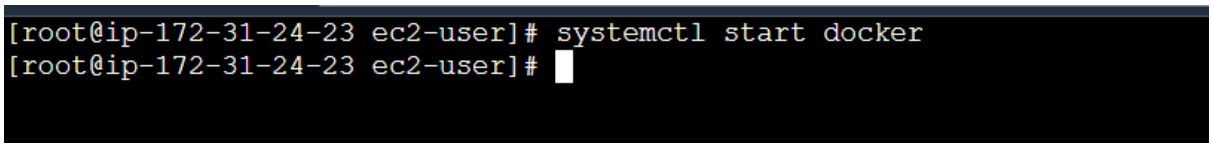


3. Docker installation:

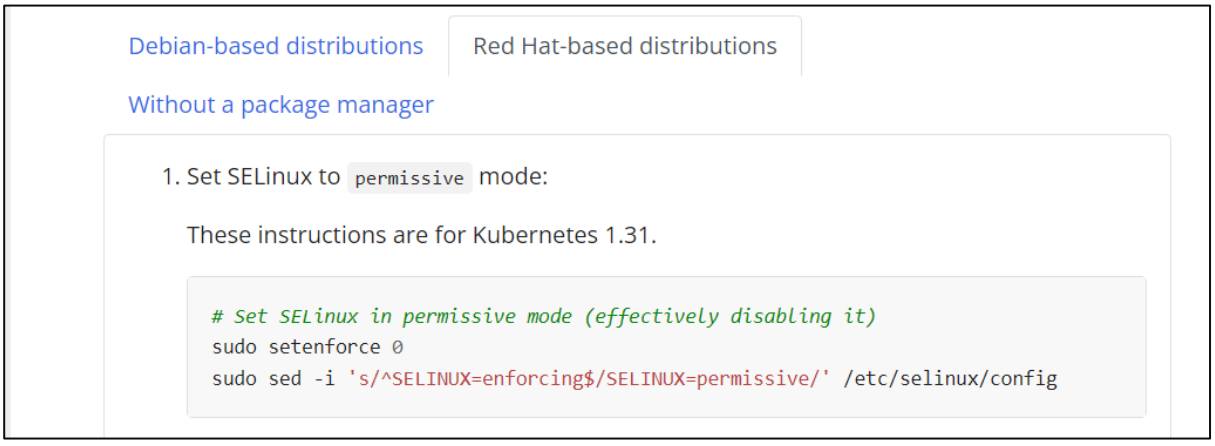
   This step has to be performed on all the 3 instances.
   The following command has to be run:
   yum install docker -y



4. After successfully docker has been installed it has to be started on all machines by using the command “systemctl start docker”



5. Kubernetes installation:
   Search kubeadm installation on your browser and scroll down and select red hat-based distributions.



```
# This overwrites any existing configuration in /etc/yum.repos.d/kubernetes.repo
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
```

3. Install kubelet, kubeadm and kubectl:

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

4. (Optional) Enable the kubelet service before running kubeadm:

```
sudo systemctl enable --now kubelet
```

Copy the above given steps and paste in the terminal. This will create a Kubernetes repository, install kubelet, kubeadm and kubectl and also enable the services.

```
[root@ip-172-31-24-23 ec2-user]# sudo yum install -y kubelet kubeadm kubectl --disableexcludes=kubernetes
Kubernetes                                                                          52 kB/s | 7.3 kB     00:00
Dependencies resolved.
================================================================================================================
 Package                      Architecture        Version                          Repository             Size
================================================================================================================
Installing:
 kubeadm                      x86_64              1.31.0-150500.1.1                kubernetes             11 M
 kubectl                      x86_64              1.31.0-150500.1.1                kubernetes             11 M
 kubelet                      x86_64              1.31.0-150500.1.1                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
 socat                        x86_64              1.7.4.2-1.amzn2023.0.2           amazonlinux           303 k

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

Total download size: 51 M
Installed size: 270 M
Downloading Packages:
(1/10): libnetfilter_cthelper-1.0.0-21.amzn2023.0.2.x86_64.rpm                     459 kB/s |  24 kB     00:00
(2/10): libnetfilter_queue-1.0.5-2.amzn2023.0.2.x86_64.rpm                         1.4 MB/s |  30 kB     00:00
```

```
  Installing       : conntrack-tools-1.4.6-2.amzn2023.0.2.x86_64                                            7/10
  Running scriptlet: conntrack-tools-1.4.6-2.amzn2023.0.2.x86_64                                            7/10
  Installing       : kubelet-1.31.0-150500.1.1.x86_64                                                       8/10
  Running scriptlet: kubelet-1.31.0-150500.1.1.x86_64                                                       8/10
  Installing       : kubeadm-1.31.0-150500.1.1.x86_64                                                       9/10
  Installing       : kubectl-1.31.0-150500.1.1.x86_64                                                      10/10
  Running scriptlet: kubectl-1.31.0-150500.1.1.x86_64                                                      10/10
  Verifying        : conntrack-tools-1.4.6-2.amzn2023.0.2.x86_64                                            1/10
  Verifying        : libnetfilter_cthelper-1.0.0-21.amzn2023.0.2.x86_64                                     2/10
  Verifying        : libnetfilter_cttimeout-1.0.0-19.amzn2023.0.2.x86_64                                    3/10
  Verifying        : libnetfilter_queue-1.0.5-2.amzn2023.0.2.x86_64                                         4/10
  Verifying        : socat-1.7.4.2-1.amzn2023.0.2.x86_64                                                    5/10
  Verifying        : cri-tools-1.31.1-150500.1.1.x86_64                                                     6/10
  Verifying        : kubeadm-1.31.0-150500.1.1.x86_64                                                       7/10
  Verifying        : kubectl-1.31.0-150500.1.1.x86_64                                                       8/10
  Verifying        : kubelet-1.31.0-150500.1.1.x86_64                                                       9/10
  Verifying        : kubernetes-cni-1.5.1-150500.1.1.x86_64                                                10/10

Installed:
  conntrack-tools-1.4.6-2.amzn2023.0.2.x86_64         cri-tools-1.31.1-150500.1.1.x86_64                  kubeadm-1.31.0-150500.1.1.x86_64
  kubectl-1.31.0-150500.1.1.x86_64                    kubelet-1.31.0-150500.1.1.x86_64                    kubernetes-cni-1.5.1-150500.1.1.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
  socat-1.7.4.2-1.amzn2023.0.2.x86_64

Complete!
[root@ip-172-31-24-23 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-172-31-24-23 ec2-user]#
```

6. We can check if repository has been created by using yum repolist command

```
[root@ip-172-31-24-23 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-172-31-24-23 ec2-user]#
```

7. Now we will be initializing the kubeadm. For that “kubeadm init” command has to be used. It may show errors but those can be ignored by using --ignore-preflight-errors=all

```
[root@ip-172-31-24-23 ec2-user]# kubeadm init
[init] Using Kubernetes version: v1.31.0
[preflight] Running pre-flight checks
        [WARNING FileExisting-tc]: tc not found in system path
error execution phase preflight: [preflight] Some fatal errors occurred:
        [ERROR NumCPU]: the number of available CPUs 1 is less than the required 2
        [ERROR Mem]: the system RAM (949 MB) is less than the minimum 1700 MB
[preflight] If you know what you are doing, you can make a check non-fatal with `--ignore-preflight-errors=...`
To see the stack trace of this error execute with --v=5 or higher
[root@ip-172-31-24-23 ec2-user]# ^C
[root@ip-172-31-24-23 ec2-user]# kubeadm init --ignore-preflight-errors=NumCPU --ignore-preflight-errors=Mem
[init] Using Kubernetes version: v1.31.0
[preflight] Running pre-flight checks
        [WARNING NumCPU]: the number of available CPUs 1 is less than the required 2
        [WARNING Mem]: the system RAM (949 MB) is less than the minimum 1700 MB
        [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'
W0908 09:11:46.376173   28683 checks.go:846] detected that the sandbox image "registry.k8s.io/pause:3.8" of the container runtime is inconsistent with that used b
y 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-172-31-24-23.ec2.internal kubernetes kubernetes.default kubernetes.default.svc kubernetes.default.svc.c
luster.local] and IPs [10.96.0.1 172.31.24.23]
[certs] Generating "apiserver-kubelet-client" certificate and key
[certs] Generating "front-proxy-ca" certificate and key
```

```
[root@ip-172-31-82-191 ec2-user]# kubeadm init --ignore-preflight-errors=NumCPU --ignore-preflight-errors=Mem
[init] Using Kubernetes version: v1.31.0
[preflight] Running pre-flight checks
W0913 15:43:09.666583    2255 checks.go:1080] [preflight] WARNING: Couldn't create the interface used for talking to the container runtime: failed to create new C
RI runtime service: validate service connection: validate CRI v1 runtime API for endpoint "unix:///var/run/containerd/containerd.sock": rpc error: code = Unavaila
ble desc = connection error: desc = "transport: Error while dialing: dial unix /var/run/containerd/containerd.sock: connect: no such file or directory"
        [WARNING FileExisting-socat]: socat not found in system path
        [WARNING FileExisting-tc]: tc not found in system path
error execution phase preflight: [preflight] Some fatal errors occurred:
        [ERROR FileContent--proc-sys-net-ipv4-ip_forward]: /proc/sys/net/ipv4/ip_forward contents are not set to 1
[preflight] If you know what you are doing, you can make a check non-fatal with `--ignore-preflight-errors=...`
To see the stack trace of this error execute with --v=5 or higher
[root@ip-172-31-82-191 ec2-user]# ^C
[root@ip-172-31-82-191 ec2-user]# systemctl start docker
[root@ip-172-31-82-191 ec2-user]# kubeadm init --ignore-preflight-errors=NumCPU --ignore-preflight-errors=Mem
[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 15:44:18.815161    2565 checks.go:846] detected that the sandbox image "registry.k8s.io/pause:3.8" of the container runtime is inconsistent with that used b
y 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-172-31-82-191.ec2.internal kubernetes kubernetes.default kubernetes.default.svc kubernetes.default.svc.
```

8. On successful initialization we need to copy and paste the following commands on the master machine itself:

```
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
```

9. Next copy and paste 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
```

10. 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
```

11. 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:

This experiment enabled the creation of a Kubernetes cluster and the successful joining of all 3 nodes using various commands. Errors during initialization can be handled in two ways: 1. By ignoring the errors, or 2. By changing the instance type to t3.medium or t3.large if the issue is related to insufficient memory space or CPU resources.