

Advance DevOps

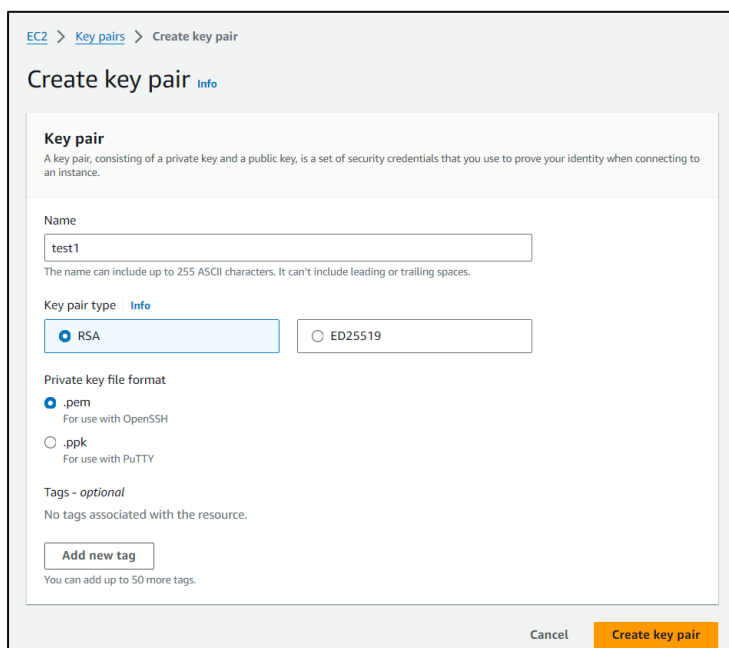
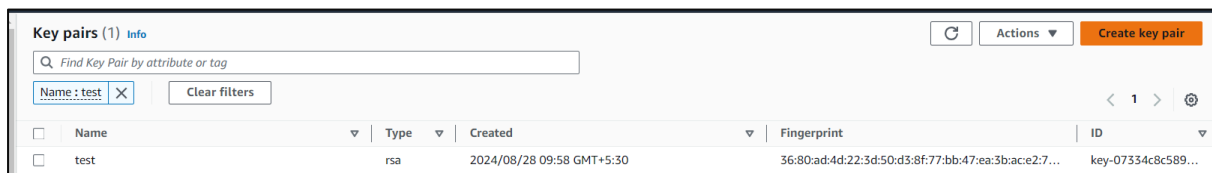
Experiment 4

Aim:

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

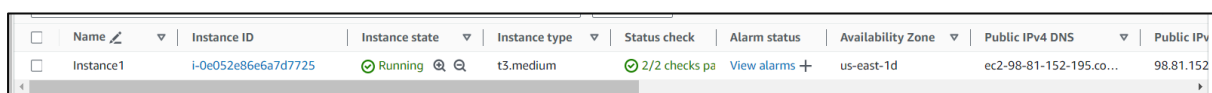
Steps:

1. Create a key pair



The .pem file will be downloaded on your machine and will be required in the further steps.

2. Now we will create an EC2 Ubuntu instance. Select the key pair which you just created while creating this instance.



3. Now edit the inbound rules to allow ssh

Edit inbound rules [Info](#)

Inbound rules control the incoming traffic that's allowed to reach the instance.

Inbound rules [Info](#)

Security group rule ID	Type	Protocol	Port range	Source	Description - optional	
sgr-0f9dae3bbadffb973	All traffic	All	All	Custom	Q	Delete
-	SSH	TCP	22	Anywhere...	Q	Delete

[Add rule](#)

[Cancel](#) [Preview changes](#) [Save rules](#)

4. Open git bash and go to the directory where pem file is located and use chmod to provide permissions.

```

Dell@DESKTOP-0VNTA1M MINGW64 ~/Downloads (master)
$ chmod 400 test1.pem

```

5. Now use this command on the terminal: ssh -i <keyname>.pem ubuntu@<public_ip_address> and replace

- Keyname with the name of your key pair, in our case test1.
- As we are using amazon Linux instead of ubuntu we will have ec2-user
- Replace public ip address with its value. Go to your instance and scroll down you will find the public ip address there.

```

Dell@DESKTOP-0VNTA1M MINGW64 ~/Downloads (master)
$ ssh -i "test1.pem" ec2-user@ec2-44-204-14-37.compute-1.amazonaws.com
The authenticity of host 'ec2-44-204-14-37.compute-1.amazonaws.com (44.204.14.37)' can't be established.
ED25519 key fingerprint is SHA256:CtXhAZnv4MFbUai03z96MQzMKK6JxuN/nWlIerDSazI.
This key is not known by any other names.
Are you sure you want to continue connecting (yes/no/[fingerprint])? yes
Warning: Permanently added 'ec2-44-204-14-37.compute-1.amazonaws.com' (ED25519) to the list of known hosts.

#_
~\_  ####_
~\_  #####\
~\_  \###\
~\_  \#/
~\_  V~' ->
~\_  .-.-
~\_  /_/_/
~\_  /m/' ->

Amazon Linux 2023

https://aws.amazon.com/linux/amazon-linux-2023

[ec2-user@ip-172-31-81-24 ~]$

```

6. Docker installation:

We will be installing docker by using “sudo yum install docker -y”

```
[root@ip-172-31-81-24 ec2-user]# sudo yum install docker -y
Last metadata expiration check: 0:01:25 ago on Sat Sep 14 06:42:34 2024.
Dependencies resolved.
Package Architecture Version Repository Size
Installing:
docker x86_64 25.0.6-1.amzn2023.0.2 amazonlinux 44 M
Installing dependencies:
containerd x86_64 1.7.20-1.amzn2023.0.1 amazonlinux 35 M
iptables-libs x86_64 1.8.8-3.amzn2023.0.2 amazonlinux 401 k
iptables-nft x86_64 1.8.8-3.amzn2023.0.2 amazonlinux 153 k
libcgroup x86_64 3.0-1.amzn2023.0.1 amazonlinux 75 k
libnetfilter_conntrack x86_64 1.0.8-2.amzn2023.0.2 amazonlinux 58 k
libnetfilter_link x86_64 1.0.1-19.amzn2023.0.2 amazonlinux 30 k
libnftnl x86_64 1.2.2-2.amzn2023.0.2 amazonlinux 84 k
pigz x86_64 2.5-1.amzn2023.0.3 amazonlinux 83 k
runc x86_64 1.1.13-1.amzn2023.0.1 amazonlinux 3.2 M
Transaction Summary
Install 10 Packages
Total download size: 84 M
Installed size: 317 M
Downloading Packages:
(1/10): iptables-libs-1.8.8-3.amzn2023.0.2.x86_64.rpm 4.3 MB/s | 401 kB 00:00
(2/10): iptables-nft-1.8.8-3.amzn2023.0.2.x86_64.rpm 3.3 MB/s | 153 kB 00:00
(3/10): libcgroup-3.0-1.amzn2023.0.1.x86_64.rpm 1.6 MB/s | 75 kB 00:00
(4/10): libnetfilter_conntrack-1.0.8-2.amzn2023.0.2.x86_64.rpm 1.6 MB/s | 58 kB 00:00
(5/10): libnetfilter_link-1.0.1-19.amzn2023.0.2.x86_64.rpm 940 kB/s | 30 kB 00:00
(6/10): libnftnl-1.2.2-2.amzn2023.0.2.x86_64.rpm 1.6 MB/s | 84 kB 00:00
(7/10): pigz-2.5-1.amzn2023.0.3.x86_64.rpm 2.1 MB/s | 83 kB 00:00
(8/10): runc-1.1.13-1.amzn2023.0.1.x86_64.rpm 19 MB/s | 3.2 MB 00:00
(9/10): containerd-1.7.20-1.amzn2023.0.1.x86_64.rpm 27 MB/s | 35 MB 00:01
(10/10): docker-25.0.6-1.amzn2023.0.2.x86_64.rpm 27 MB/s | 44 MB 00:01
Total 49 MB/s | 84 MB 00:01
Running transaction check
Transaction check succeeded.
Running transaction test
Transaction test succeeded.
Running transaction
Preparing : runc-1.1.13-1.amzn2023.0.1.x86_64 1/1
Installing : containerd-1.7.20-1.amzn2023.0.1.x86_64 1/10
Installing : containerd-1.7.20-1.amzn2023.0.1.x86_64 2/10
Running scriptlet: containerd-1.7.20-1.amzn2023.0.1.x86_64 7/10
```

7. Then to configure cgroup in a daemon json file we will run

```
cd /etc/docker
```

```
cat <<EOF | sudo tee /etc/docker/daemon.json
```

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

```
EOF
```

```
sudo systemctl enable docker
```

```
sudo systemctl daemon-reload
```

```
sudo systemctl restart docker
```

```
[root@ip-172-31-81-24 ec2-user]# cd /etc/docker
cat <<EOF | sudo tee /etc/docker/daemon.json
{
  "exec-opts": ["native.cgroupdriver=systemd"]
}
EOF
sudo systemctl enable docker
sudo systemctl daemon-reload
sudo systemctl restart docker
{
  "exec-opts": ["native.cgroupdriver=systemd"]
}
Created symlink /etc/systemd/system/multi-user.target.wants/docker.service → /usr/lib/systemd/system/docker.service.
```

8. Kubernetes installation:

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

[Debian-based distributions](#) [Red Hat-based distributions](#)

[Without a package manager](#)

1. Set SELinux to `permissive` mode:

These instructions are for Kubernetes 1.31.

```
# Set SELinux in permissive mode (effectively disabling it)
sudo setenforce 0
sudo sed -i 's/^SELINUX=enforcing$/SELINUX=permissive/' /etc/selinux/config
```

```
# 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-172-31-81-24 docker]# sudo setenforce 0
sudo sed -i 's/SELINUX=enforcing/SELINUX=permissive/' /etc/selinux/config
[root@ip-172-31-81-24 docker]# cat <dev> | 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
[crn]
[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
[root@ip-172-31-81-24 docker]# sudo yum install -y kubelet kubeadm kubectl --disableexcludes=kubernetes
kubernetes
Dependencies resolved.
Package Architecture Version Repository Size
Installing:
kubelet x86_64 1.31.1-150500.1.1 kubernetes 11 M
kubeadm x86_64 1.31.1-150500.1.1 kubernetes 11 M
kubectl x86_64 1.31.1-150500.1.1 kubernetes 15 M
Installing dependencies:
container-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
Transaction Summary
Install 9 Packages
Total download size: 51 M
Installed size: 269 M
Downloading Packages:
(1/9): libnetfilter_cttimeout-1.0.0-19.amzn2023.0.2.x86_64.rpm 490 kB/s | 24 kB 00:00
(2/9): libnetfilter_cthelper-1.0.0-21.amzn2023.0.2.x86_64.rpm 410 kB/s | 24 kB 00:00
(3/9): libnetfilter_queue-1.0.5-2.amzn2023.0.2.x86_64.rpm 1.2 MB/s | 30 kB 00:00
(4/9): container-tools-1.4.6-2.amzn2023.0.2.x86_64.rpm 2.3 MB/s | 208 kB 00:00
(5/9): cri-tools-1.31.1-150500.1.1.x86_64.rpm 25 MB/s | 6.9 MB 00:00
(6/9): kubeadm-1.31.1-150500.1.1.x86_64.rpm 23 MB/s | 11 MB 00:00
(7/9): kubectl-1.31.1-150500.1.1.x86_64.rpm 35 MB/s | 15 MB 00:00
(8/9): kubelet-1.31.1-150500.1.1.x86_64.rpm 25 MB/s | 7.1 MB 00:00
(9/9): kubernetes-cni-1.5.1-150500.1.1.x86_64.rpm 58 MB/s | 51 MB 00:00
Total
kubernetes 25 kB/s | 1.7 kB 00:00
Importing GPG key 0x9A296436:
Userid : "Isiv:kubernetes OBS Project <isiv:kubernetes@build.opensuse.org>"
Fingerprint: 0E15 B164 86C0 3778 9E87 6E1A 2346 54D8 9A29 6436
From : https://pkgs.k8s.io/core:/stable:/v1.31/rpm/repodata/repomd.xml.key
Key imported successfully
Running transaction check
Transaction check succeeded.
Running transaction test
Transaction test succeeded.
Running transaction
Preparing :
Installing : kubernetes-cni-1.5.1-150500.1.1.x86_64
Installing : cri-tools-1.31.1-150500.1.1.x86_64
Installing : libnetfilter_queue-1.0.5-2.amzn2023.0.2.x86_64
Installing : libnetfilter_cttimeout-1.0.0-19.amzn2023.0.2.x86_64
Installing : libnetfilter_cthelper-1.0.0-21.amzn2023.0.2.x86_64
Installing : container-tools-1.4.6-2.amzn2023.0.2.x86_64
Running scriptlet: container-tools-1.4.6-2.amzn2023.0.2.x86_64
Installing : kubelet-1.31.1-150500.1.1.x86_64
Installing : kubeadm-1.31.1-150500.1.1.x86_64
Installing : kubectl-1.31.1-150500.1.1.x86_64
Running scriptlet: kubectl-1.31.1-150500.1.1.x86_64
Verifying : container-tools-1.4.6-2.amzn2023.0.2.x86_64
Verifying : libnetfilter_cthelper-1.0.0-21.amzn2023.0.2.x86_64
Verifying : libnetfilter_cttimeout-1.0.0-19.amzn2023.0.2.x86_64
Verifying : libnetfilter_queue-1.0.5-2.amzn2023.0.2.x86_64
Verifying : cri-tools-1.31.1-150500.1.1.x86_64
Verifying : kubeadm-1.31.1-150500.1.1.x86_64
Verifying : kubectl-1.31.1-150500.1.1.x86_64
Verifying : kubelet-1.31.1-150500.1.1.x86_64
Verifying : kubernetes-cni-1.5.1-150500.1.1.x86_64
Installed:
container-tools-1.4.6-2.amzn2023.0.2.x86_64 cri-tools-1.31.1-150500.1.1.x86_64 kubeadm-1.31.1-150500.1.1.x86_64
kubelet-1.31.1-150500.1.1.x86_64 kubernetes-cni-1.5.1-150500.1.1.x86_64 libnetfilter_cthelper-1.0.0-21.amzn2023.0.2.x86_64
libnetfilter_queue-1.0.5-2.amzn2023.0.2.x86_64
Complete!
[root@ip-172-31-81-24 docker]# sudo systemctl enable --now kubelet
Created symlink /etc/systemd/system/multi-user.target.wants/kubelet.service -> /usr/lib/systemd/system/kubelet.service.
[root@ip-172-31-81-24 docker]#
```

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

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

```
[root@ip-172-31-81-24 docker]# sudo swapoff -a
[root@ip-172-31-81-24 docker]# echo "net.bridge.bridge-nf-call-iptables=1" | sudo tee -a /etc/sysctl.conf
net.bridge.bridge-nf-call-iptables=1
[root@ip-172-31-81-24 docker]# sudo sysctl -p
net.bridge.bridge-nf-call-iptables = 1
[root@ip-172-31-81-24 docker]#
```

10. Initializing kubecuster:

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

```
[root@ip-172-31-81-24 docker]# sudo kubeadm init --pod-network-cidr=10.244.0.0/16
[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
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-172-31-81-24 docker]# sudo kubeadm init --pod-network-cidr=10.244.0.0/16 --ignore-preflight-errors=NumCPU,Mem
[init] Using Kubernetes version: v1.31.0
```

```
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 172.31.81.24:6443 --token 4a91z3.yz6rwmkf9yncyd2 \
--discovery-token-ca-cert-hash sha256:3404bd1bcdd9cf90a003673f622d1672acb4c6ce7c15c4738c80a0a1560fe70d
[root@ip-172-31-81-24 docker]#
```

11. The mkdir command that is generated after initialization has to be copy pasted in the terminal.

```
[root@ip-172-31-81-24 docker]# mkdir -p $HOME/.kube
sudo cp -i /etc/kubernetes/admin.conf $HOME/.kube/config
sudo chown $(id -u):$(id -g) $HOME/.kube/config
[root@ip-172-31-81-24 docker]#
```

12. Then, add a common networking plugin called flannel:

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

```
[root@ip-172-31-81-24 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
[root@ip-172-31-81-24 docker]#
```

13. Now that the cluster is up and running, we can deploy our nginx server on this cluster.

Apply this deployment file using this command to create a deployment

```
kubectl apply -f https://k8s.io/examples/application/deployment.yaml
```

```
[root@ip-172-31-81-24 docker]# kubectl apply -f https://k8s.io/examples/application/deployment.yaml
deployment.apps/nginx-deployment created
[root@ip-172-31-81-24 docker]#
```

14. Use kubectl get pods to check if pod is working correctly

```
[root@ip-172-31-81-24 docker]# kubectl get pods
```

NAME	READY	STATUS	RESTARTS	AGE
nginx-deployment-d556bf558-8jd1f	0/1	Pending	0	18s

15. To change status from pending to running use following command: kubectl describe pod nginx.

```
[root@ip-172-31-16-56 ~]# kubectl describe pod nginx
```

Name: nginx-deployment-d556bf558-gw8v8
 Namespace: default
 Priority: 0
 Service Account: default
 Node: <none>
 Labels: app=nginx
 pod-template-hash=d556bf558
 Annotations: <none>
 Status: Pending
 IP: <none>
 IPs: <none>
 Controlled By: ReplicaSet/nginx-deployment-d556bf558
 Containers:

nginx:
 Image: nginx:1.14.2
 Port: 80/TCP
 Host Port: 0/TCP
 Environment: <none>
 Mounts:

```
Conditions:
```

Type	Status
PodScheduled	False

Volumes:

kube-api-access-f9k9s:
 Type: Projected (a volume that contains injected data from multiple 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 300s
 node.kubernetes.io/unreachable:NoExecute op=Exists for 300s

Events:

Type	Reason	Age	From	Message
Warning	FailedScheduling	114s	default-scheduler	0/1 nodes are available: 1 node(s) had untoleration taint {node-role.kubernetes.io/control-plane: }.
Warning	Preemption	0/1 nodes are available: 1 Preemption is not helpful for scheduling.		
Warning	FailedScheduling	3m18s	default-scheduler	0/1 nodes are available: 1 node(s) had untoleration taint {node-role.kubernetes.io/control-plane: }.
Warning	Preemption	0/1 nodes are available: 1 Preemption is not helpful for scheduling.		

Use the below command to remove taints

```
[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

16. Check the pod status

```
[ec2-user@ip-172-31-26-174 ~]$ kubectl get pods
```

NAME	READY	STATUS	RESTARTS	AGE
nginx	1/1	Running	1 (6s ago)	90s

17. port forward the deployment to your localhost so that you can view it.

```
[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
```

18. 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://127.0.0.1:8080
```

Conclusion: In this experiment we created an ec2 instance, enabled ssh by editing the inbound rules. After that we installed docker and Kubernetes and configured internet options to allow bridging. Once this setup got completed, we added a common networking plugin called flannel. Once the cluster started running we deployed nginx server on this cluster and verified deployment.