Advanced DevOps Lab

Experiment 4

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

Theory:

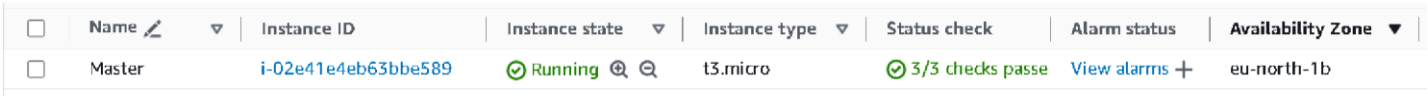
Originally developed by Google, Kubernetes is an open-source container orchestration platform designed to automate the deployment, scaling, and management of containerized applications. In fact, Kubernetes has established itself as the de facto standard for container orchestration and is the flagship project of the Cloud Native Computing Foundation (CNCF), backed by key players like Google, AWS, Microsoft, IBM, Intel, Cisco, and Red Hat.

Kubernetes Deployment

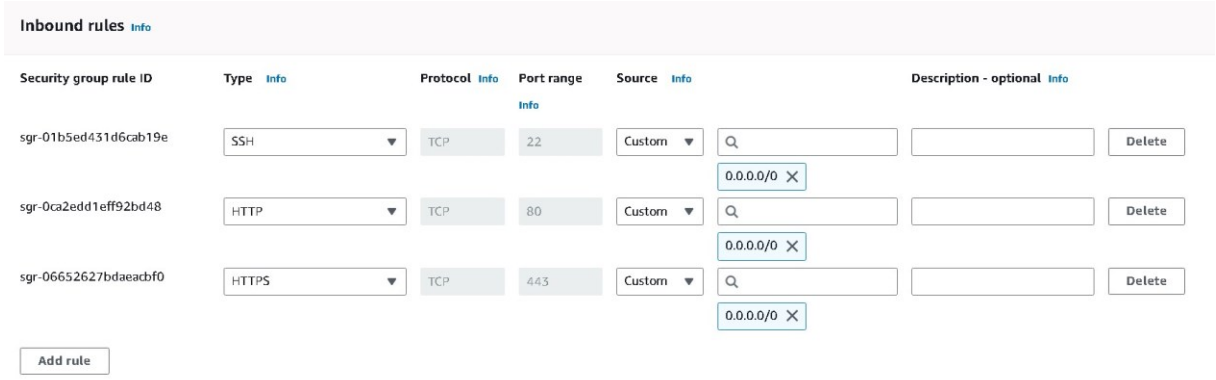
A Kubernetes Deployment is used to tell Kubernetes how to create or modify instances of the pods that hold a containerized application. Deployments can scale the number of replica pods, enable the rollout of updated code in a controlled manner, or roll back to an earlier deployment version if necessary.

Steps:

1. Create an EC2 Ubuntu Instance on AWS.



2. Edit the Security Group Inbound Rules to allow SSH



3. SSH into the machine **ssh -i <keyname>.pem ubuntu@<public_ip_address>**

```
kagoran@LAPTOP-7NM7ITJ2:~$ chmod 400 onekeypair.pem
kagoran@LAPTOP-7NM7ITJ2:~$ ls -l onekeypair.pem
-r-------- 1 kagoran kagoran 1678 Sep 14 10:27 onekeypair.pem
```

```
kagoran@LAPTOP-7NM7ITJ2:~$ ssh -i onekeypair.pem ubuntu@13.60.197.8
Welcome to Ubuntu 24.04 LTS (GNU/Linux 6.8.0-1012-aws x86_64)

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

 System information as of Sat Sep 14 04:58:19 UTC 2024

  System load:  0.0               Temperature:           -273.1 C
  Usage of /:   22.9% of 6.71GB   Processes:             108
  Memory usage: 21%               Users logged in:       0
  Swap usage:   0%                IPv4 address for ens5: 172.31.45.229


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

Last login: Sat Sep 14 04:46:00 2024 from 13.48.4.203
To run a command as administrator (user "root"), use "sudo <command>".
See "man sudo_root" for details.

ubuntu@ip-172-31-45-229:~$
```

4. Install Docker

```
curl -fsSL https://download.docker.com/linux/ubuntu/gpg | sudo apt-key
add sudo add-apt-repository "deb [arch=amd64]
https://download.docker.com/linux/ubuntu $(lsb_release -cs) stable"
sudo apt-get update sudo apt-get install -y docker-ce
```

Then, configure cgroup in a daemon.json file.

```
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
```

5. Install Kubernetes

```
sudo apt-get update
# apt-transport-https may be a dummy package; if so, you can skip that
package sudo apt-get install -y apt-transport-https ca-certificates curl gpg
# If the directory `/etc/apt/keyrings` does not exist, it should be created
before the curl command, read the note below. # sudo mkdir -p -m 755
/etc/apt/keyrings curl -fsSL
https://pkgs.k8s.io/core:/stable:/v1.31/deb/Release.key | sudo gpg
--dearmor -o /etc/apt/keyrings/kubernetes-apt-keyring.gpg
# This overwrites any existing configuration in
/etc/apt/sources.list.d/kubernetes.list 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 sudo
apt-get update sudo apt-get install -y kubelet
kubeadm kubectl sudo apt-mark hold kubelet
kubeadm kubectl sudo systemctl enable --now
kubelet
```

```
ubuntu@ip-172-31-40-255:~$ # Add Kubernetes GPG key
curl -s https://packages.cloud.google.com/apt/doc/apt-key.gpg | sudo apt-key add -

# Add Kubernetes repository
sudo tee /etc/apt/sources.list.d/kubernetes.list <<EOF
deb https://apt.kubernetes.io/ kubernetes-xenial main
EOF

# Update package list
sudo apt-get update

# Install kubelet, kubeadm, and kubectl
sudo apt-get install -y kubelet kubeadm kubectl

# Hold the versions of Kubernetes components
sudo apt-mark hold kubelet kubeadm kubectl
Warning: apt-key is deprecated. Manage keyring files in trusted.gpg.d instead (see apt-key(8)).
OK
deb https://apt.kubernetes.io/ kubernetes-xenial main
Hit:1 http://eu-north-1.ec2.archive.ubuntu.com/ubuntu noble InRelease
Hit:2 http://eu-north-1.ec2.archive.ubuntu.com/ubuntu noble-updates InRelease
Hit:3 http://eu-north-1.ec2.archive.ubuntu.com/ubuntu noble-backports InRelease
Hit:4 https://download.docker.com/linux/ubuntu noble InRelease
Hit:5 http://security.ubuntu.com/ubuntu noble-security InRelease
Ign:6 https://packages.cloud.google.com/apt kubernetes-xenial InRelease
Err:7 https://packages.cloud.google.com/apt kubernetes-xenial Release
```

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
```

```
ubuntu@ip-172-31-45-229:~$ # Disable swap
sudo swapoff -a

# Allow bridging for iptables
echo "net.bridge.bridge-nf-call-iptables=1" | sudo tee -a /etc/sysctl.conf

# Apply sysctl changes
sudo sysctl -p
net.bridge.bridge-nf-call-iptables=1
net.bridge.bridge-nf-call-iptables = 1
ubuntu@ip-172-31-45-229:~$
```

6. Initialize the Kubecluster

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

```
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 172.31.45.229:6443 --token s9zq75.bsi7js5f62ridulc \
        --discovery-token-ca-cert-hash sha256:91eae090fdd49337bf70d5bf7478e60bc85820d0996651871129a082db6fa8f1
ubuntu@ip-172-31-45-229:~$
```

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
```

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

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

```
ubuntu@ip-172-31-45-229:~$ 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
```

7. 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
```

```
ubuntu@ip-172-31-45-229:~$ kubectl apply -f https://k8s.io/examples/application/deployment.yaml
deployment.apps/nginx-deployment created
ubuntu@ip-172-31-45-229:~$
```

Use ‘kubectl get pods’ to verify if the deployment was properly created and the pod is working correctly.

```
ubuntu@ip-172-31-45-229:~$ kubectl get pods
NAME                                READY   STATUS    RESTARTS   AGE
nginx-deployment-d556bf558-krhbv    0/1     Pending   0          2m29s
nginx-deployment-d556bf558-mhlm2    0/1     Pending   0          2m29s
ubuntu@ip-172-31-45-229:~$
```

Next up, create a name alias for this pod.

```
POD_NAME=$(kubectl get pods -l app=nginx -o
jsonpath="{.items[0].metadata.name}")
```

8. Lastly, port forward the deployment to your localhost so that you can view it.

```
kubectl port-forward $POD_NAME 8080:80
```

9. 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
```

```
ubuntu@ip-172-31-45-229:~$ curl --head http://127.0.0.1:8080
HTTP/1.1 200 OK
Server: nginx/1.18.0
Date: Sat, 14 Sep 2024 7:20:53 GMT
Content-Type: text/html
Content-Length: 612
Connection: keep-alive
ETag: "5c0692e1-265"
Accept-Ranges: bytes
```

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:

In this experiment, we successfully installed Kubernetes and Docker on an AWS EC2 Ubuntu instance, configured essential settings, and initialized a Kubernetes cluster. We deployed an Nginx server using a Kubernetes Deployment and applied a Flannel networking plugin for pod communication. By verifying the pod status and forwarding ports, we accessed the Nginx server

locally. The successful `200 OK` response from the curl command confirmed that the deployment was operational. This setup demonstrated fundamental Kubernetes operations, including cluster management, application deployment, and verification, showcasing Kubernetes' power in orchestrating containerized applications efficiently.