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One node Kubernetes Cluster on Ubuntu 22.04 with helm and calico installation and configuration (Step-by-Step Guide)

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Install Kubernetes on Ubuntu 22.04 with Helm, Calico, a master node, to automate deployment, scaling, and management of containerized applications.

Kubernetes Nodes:

In a Kubernetes cluster two categories of nodes:

Master nodes manage control API calls for the Kubernetes cluster, overseeing pods, controllers, services, and nodes.

Worker nodes provide runtime environments for containers, allowing container pods to span multiple nodes for optimal resource allocation and management.

Prerequisites:

Before diving into the installation, ensure that your environment meets the following prerequisites:

- An Ubuntu 22.04 system.
- Privileged access to the system (root or sudo user).
- Active internet connection.
- Minimum 2GB RAM or more.
- Minimum 2 CPU cores (or 2 vCPUs).
- 20 GB of free disk space on /var (or more).

Step 1: Create One Ubuntu Instance 22.04 (in my case, AWS EC2 t3.large type)

After creating the Ubuntu Server, log in using any tool and open the terminal.

Step 2: Update and Upgrade Ubuntu (all nodes, my case one node)

Open a terminal and execute the following commands:

```
sudo apt-get update  
sudo apt-get upgrade
```

Step 3: Disable Swap (all nodes, my case one node)

Disable swap and set essential kernel parameters on all nodes for better Kubernetes performance by running these commands

```
sudo swapoff -a
sudo sed -i 's/^(\..*\)$/#\1/g' /etc/fstab
```

Step 4: Add Kernel Parameters (all nodes)

Load the required kernel modules on all nodes:

```
sudo tee /etc/modules-load.d/containerd.conf <<EOF
overlay br_netfilter EOF
sudo modprobe overlay
sudo modprobe br_netfilter
```

```
sudo tee /etc/sysctl.d/kubernetes.conf <<EOF
net.bridge.bridge-nf-call-ip6tables = 1
net.bridge.bridge-nf-call-iptables = 1
net.ipv4.ip_forward = 1 EOF
```

```
sudo sysctl -system
```

Step 5: Install Containerd Runtime (all nodes)

```
sudo apt install -y curl gnupg2 software-properties-
common apt-transport-https ca-certificates
```

```
sudo curl -fsSL
https://download.docker.com/linux/ubuntu/gpg | sudo
gpg --dearmor -o /etc/apt/trusted.gpg.d/docker.gpg
```

```
sudo add-apt-repository "deb [arch=amd64]
https://download.docker.com/linux/ubuntu
$(lsb_release -cs) stable"
```

```
sudo apt update
```

```
sudo apt install -y containerd.io
```

```
containerd config default | sudo tee  
/etc/containerd/config.toml >/dev/null 2>&1
```

```
sudo sed -i 's/SystemdCgroup \= false/SystemdCgroup  
\= true/g' /etc/containerd/config.toml
```

```
sudo systemctl restart containerd
```

```
sudo systemctl enable containerd
```

```
sudo apt-get update
```

Step 6: Add Apt Repository for Kubernetes and Install Kubectl, Kubeadm, and Kubelet (all nodes)

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

```
curl -fsSL  
https://pkgs.k8s.io/core:/stable:/v1.29/deb/Release.  
key | sudo gpg --dearmor -o  
/etc/apt/keyrings/kubernetes-apt-keyring.gpg
```

```
echo 'deb [signed-by=/etc/apt/keyrings/kubernetes-  
apt-keyring.gpg]  
https://pkgs.k8s.io/core:/stable:/v1.29/deb/ /' |  
sudo tee /etc/apt/sources.list.d/kubernetes.lis
```

```
sudo apt-get update
```

```
sudo apt-get install -y kubelet kubeadm kubectl
```

```
sudo apt-mark hold kubelet kubeadm kubectl
```

Step 7: Initialize Kubernetes Cluster with Kubeadm (master node)

```
sudo kubeadm init
```

```
mkdir -p $HOME/.kube
```

```
sudo cp -i /etc/kubernetes/admin.conf  
$HOME/.kube/config
```

```
sudo chown $(id -u):$(id -g) $HOME/.kube/config
```

use kubectl commands to check the cluster and node status:

```
kubectl get nodes
```

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Step 8: Install Kubernetes Network Plugin (master node)

```
kubectl apply -f  
https://raw.githubusercontent.com/projectcalico/calico/v3.25.0/manifests/calico.yaml
```

verify whether our cluster is successfully created:

```
kubectl get pods -n kube-system kubectl get nodes
```

```
kubectl describe node node-name
```

Identify the taint label and execute the following command to enable a single-node Kubernetes cluster to function as both master and worker:

```
kubect1 taint node ip-172-31-24-243 node-  
role.kubernetes.io/control-plane:NoSchedule-
```

Step 9: Install helm

In my case using script for installation execute below command:

```
curl -fsSL -o get_helm.sh  
https://raw.githubusercontent.com/helm/helm/main/scripts/get-helm-3
```

```
chmod 700 get_helm.sh
```

```
./get_helm.sh
```

Helm installed or not check uses this command:

```
helm version
```

Step 10 : deploy application using helm chart

Check have any helm repo or not use this command:

```
helm repo list
```

If no helm repo found, add any repo based one your require:

```
helm repo add bitnami  
https://charts.bitnami.com/bitnami
```

Again execute helm repo list command your will see bitnami repository already added in your list

Install helm chart in your kubernetes cluster:

```
helm install my-nginx bitnami/nginx
```

Check pod deployed or not :

```
kubectl get pods
```

How to uninstall helm chart:

```
helm uninstall my-nginx bitnami/nginx
```

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