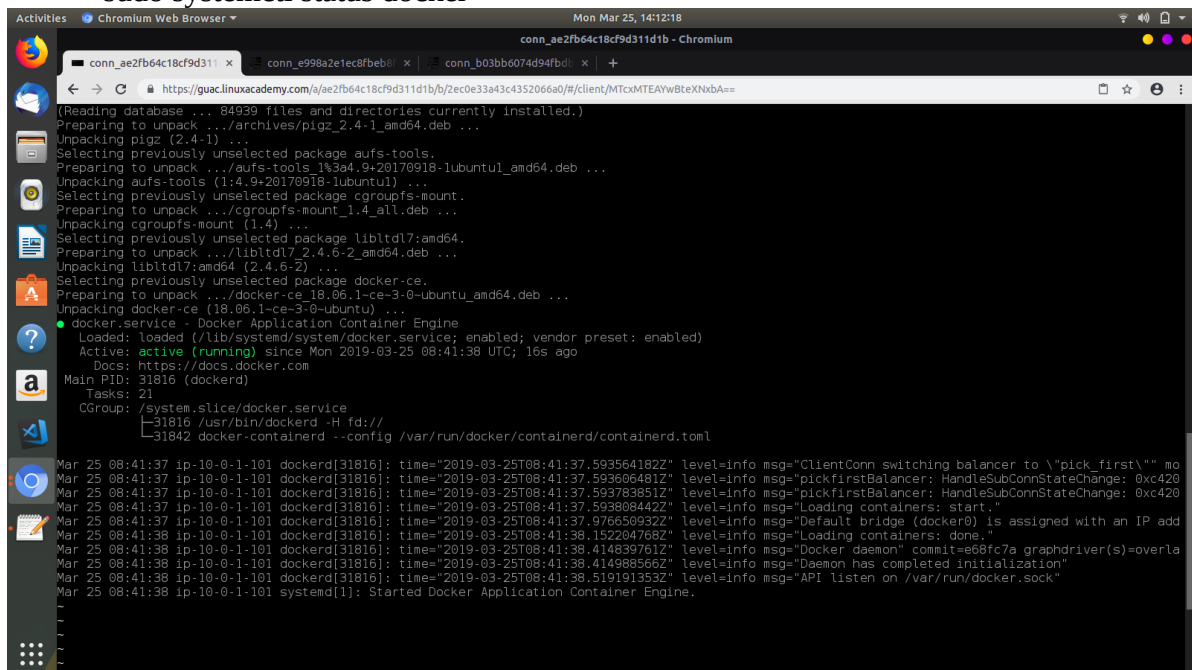


Kubernetes – Building A Three Node Cluster

- This cluster is made on cloud servers provided by linux academy.
- The cluster contains three nodes – one master, two worker.
- Cluster will be using docker as container runtime.
- Cluster is built using kubeadm, which helps in automating the cluster building process.
- Kubelet acts as a middle-man between kubernetes api and container runtime.

Documentation

1. Install Docker on all three server nodes.
 - Adding gpg key for docker repository
`curl -fsSL https://download.docker.com/linux/ubuntu/gpg | sudo apt-key add -`
 - Adding the docker repository
`sudo add-apt-repository \`
`"deb [arch=amd64] https://download.docker.com/linux/ubuntu \`
`$(lsb_release -cs) \`
`stable"`
 - Updating the package listing
`sudo apt-get update`
 - Installing the docker community edition
`sudo apt-get install -y docker-ce=18.06.1~ce~3-0~ubuntu`
 - Preventing docker auto update
`sudo apt-mark hold docker-ce`
 - Checking status of docker
`sudo systemctl status docker`



```
(Reading database ... 84939 files and directories currently installed.)
Preparing to unpack .../archives/pigz_2.4-1_amd64.deb ...
Unpacking pigz (2.4-1) ...
Selecting previously unselected package aufs-tools.
Preparing to unpack .../aufs-tools_1%3a4.0+20170918-1ubuntu1_amd64.deb ...
Unpacking aufs-tools (1:4.0+20170918-1ubuntu1) ...
Selecting previously unselected package cgroupfs-mount.
Preparing to unpack .../cgroupfs-mount_1.4_all.deb ...
Unpacking cgroupfs-mount (1.4) ...
Selecting previously unselected package libltdl7:amd64.
Preparing to unpack .../libltdl7_2.4.6-2_amd64.deb ...
Unpacking libltdl7:amd64 (2.4.6-2) ...
Selecting previously unselected package docker-ce.
Preparing to unpack .../docker-ce_18.06.1~ce~3-0~ubuntu_amd64.deb ...
Unpacking docker-ce (18.06.1~ce~3-0~ubuntu) ...
Setting up docker.service - Docker Application Container Engine
Loaded: loaded (/lib/systemd/system/docker.service; enabled; vendor preset: enabled)
Active: active (running) since Mon 2019-03-25 08:41:38 UTC; 16s ago
Docs: https://docs.docker.com
Main PID: 31816 (dockerd)
Tasks: 21
CGroup: /system.slice/docker.service
└─31816 /usr/bin/dockerd -H fd://
   └─31842 docker-containerd --config /var/run/docker/containerd/containerd.toml

Mar 25 08:41:37 ip-10-0-1-101 dockerd[31816]: time="2019-03-25T08:41:37.593564182Z" level=info msg="ClientConn switching balancer to \"pick_first\"" mo
Mar 25 08:41:37 ip-10-0-1-101 dockerd[31816]: time="2019-03-25T08:41:37.593605481Z" level=info msg="pickfirstBalancer: HandleSubConnStateChange: 0xc420
Mar 25 08:41:37 ip-10-0-1-101 dockerd[31816]: time="2019-03-25T08:41:37.593789891Z" level=info msg="pickfirstBalancer: HandleSubConnStateChange: 0xc420
Mar 25 08:41:37 ip-10-0-1-101 dockerd[31816]: time="2019-03-25T08:41:37.593808442Z" level=info msg="Loading containers: start."
Mar 25 08:41:37 ip-10-0-1-101 dockerd[31816]: time="2019-03-25T08:41:37.976550932Z" level=info msg="Default bridge (docker0) is assigned with an IP add
Mar 25 08:41:38 ip-10-0-1-101 dockerd[31816]: time="2019-03-25T08:41:38.152204768Z" level=info msg="Loading containers: done."
Mar 25 08:41:38 ip-10-0-1-101 dockerd[31816]: time="2019-03-25T08:41:38.414839761Z" level=info msg="Docker daemon" commit=e68fc7a graphdriver(s)=overla
Mar 25 08:41:38 ip-10-0-1-101 dockerd[31816]: time="2019-03-25T08:41:38.414988566Z" level=info msg="Daemon has completed initialization"
Mar 25 08:41:38 ip-10-0-1-101 dockerd[31816]: time="2019-03-25T08:41:38.519191353Z" level=info msg="API listen on /var/run/docker.sock"
Mar 25 08:41:38 ip-10-0-1-101 systemd[1]: Started Docker Application Container Engine.
```

```
docker.service - Docker Application Container Engine
Loaded: loaded (/lib/systemd/system/docker.service; enabled; vendor preset: enabled)
Active: active (running) since Mon 2019-03-25 08:41:41 UTC; 16s ago
Docs: https://docs.docker.com
Main PID: 31793 (dockerd)
Tasks: 22
CGroup: /system.slice/docker.service
        └─31793 /usr/bin/dockerd -H fd://
           └─31821 docker-containerd --config /var/run/docker/containerd/containerd.toml

Mar 25 08:41:41 ip-10-0-1-102 dockerd[31793]: time="2019-03-25T08:41:41.093606921Z" level=info msg="ClientConn switching balancer to \"pick_first\"" mo
Mar 25 08:41:41 ip-10-0-1-102 dockerd[31793]: time="2019-03-25T08:41:41.093718230Z" level=info msg="pickfirstBalancer: HandleSubConnStateChange: 0xc420
Mar 25 08:41:41 ip-10-0-1-102 dockerd[31793]: time="2019-03-25T08:41:41.093982601Z" level=info msg="pickfirstBalancer: HandleSubConnStateChange: 0xc420
Mar 25 08:41:41 ip-10-0-1-102 dockerd[31793]: time="2019-03-25T08:41:41.094091734Z" level=info msg="Loading containers: start."
Mar 25 08:41:41 ip-10-0-1-102 dockerd[31793]: time="2019-03-25T08:41:41.293681022Z" level=info msg="Default bridge (docker0) is assigned with an IP add
Mar 25 08:41:41 ip-10-0-1-102 dockerd[31793]: time="2019-03-25T08:41:41.456498100Z" level=info msg="Loading containers: done."
Mar 25 08:41:41 ip-10-0-1-102 dockerd[31793]: time="2019-03-25T08:41:41.893149387Z" level=info msg="Docker daemon" commit=e68fc7a graphdriver(s)=overla
Mar 25 08:41:41 ip-10-0-1-102 dockerd[31793]: time="2019-03-25T08:41:41.893258086Z" level=info msg="Daemon has completed initialization"
Mar 25 08:41:41 ip-10-0-1-102 systemd[1]: Started Docker Application Container Engine.
Mar 25 08:41:41 ip-10-0-1-102 dockerd[31793]: time="2019-03-25T08:41:41.915613462Z" level=info msg="API listen on /var/run/docker.sock"
```

```
docker.service - Docker Application Container Engine
Loaded: loaded (/lib/systemd/system/docker.service; enabled; vendor preset: enabled)
Active: active (running) since Mon 2019-03-25 08:41:43 UTC; 16s ago
Docs: https://docs.docker.com
Main PID: 31723 (dockerd)
Tasks: 21
CGroup: /system.slice/docker.service
        └─31723 /usr/bin/dockerd -H fd://
           └─31750 docker-containerd --config /var/run/docker/containerd/containerd.toml

Mar 25 08:41:43 ip-10-0-1-103 dockerd[31723]: time="2019-03-25T08:41:43.237605274Z" level=info msg="ClientConn switching balancer to \"pick_first\"" mo
Mar 25 08:41:43 ip-10-0-1-103 dockerd[31723]: time="2019-03-25T08:41:43.237640731Z" level=info msg="pickfirstBalancer: HandleSubConnStateChange: 0xc420
Mar 25 08:41:43 ip-10-0-1-103 dockerd[31723]: time="2019-03-25T08:41:43.237986596Z" level=info msg="pickfirstBalancer: HandleSubConnStateChange: 0xc420
Mar 25 08:41:43 ip-10-0-1-103 dockerd[31723]: time="2019-03-25T08:41:43.238001440Z" level=info msg="Loading containers: start."
Mar 25 08:41:43 ip-10-0-1-103 dockerd[31723]: time="2019-03-25T08:41:43.452489819Z" level=info msg="Default bridge (docker0) is assigned with an IP add
Mar 25 08:41:43 ip-10-0-1-103 dockerd[31723]: time="2019-03-25T08:41:43.616631178Z" level=info msg="Loading containers: done."
Mar 25 08:41:43 ip-10-0-1-103 dockerd[31723]: time="2019-03-25T08:41:43.905381148Z" level=info msg="Docker daemon" commit=e68fc7a graphdriver(s)=overla
Mar 25 08:41:43 ip-10-0-1-103 dockerd[31723]: time="2019-03-25T08:41:43.905507868Z" level=info msg="Daemon has completed initialization"
Mar 25 08:41:43 ip-10-0-1-103 dockerd[31723]: time="2019-03-25T08:41:43.929063161Z" level=info msg="API listen on /var/run/docker.sock"
Mar 25 08:41:43 ip-10-0-1-103 systemd[1]: Started Docker Application Container Engine.
```

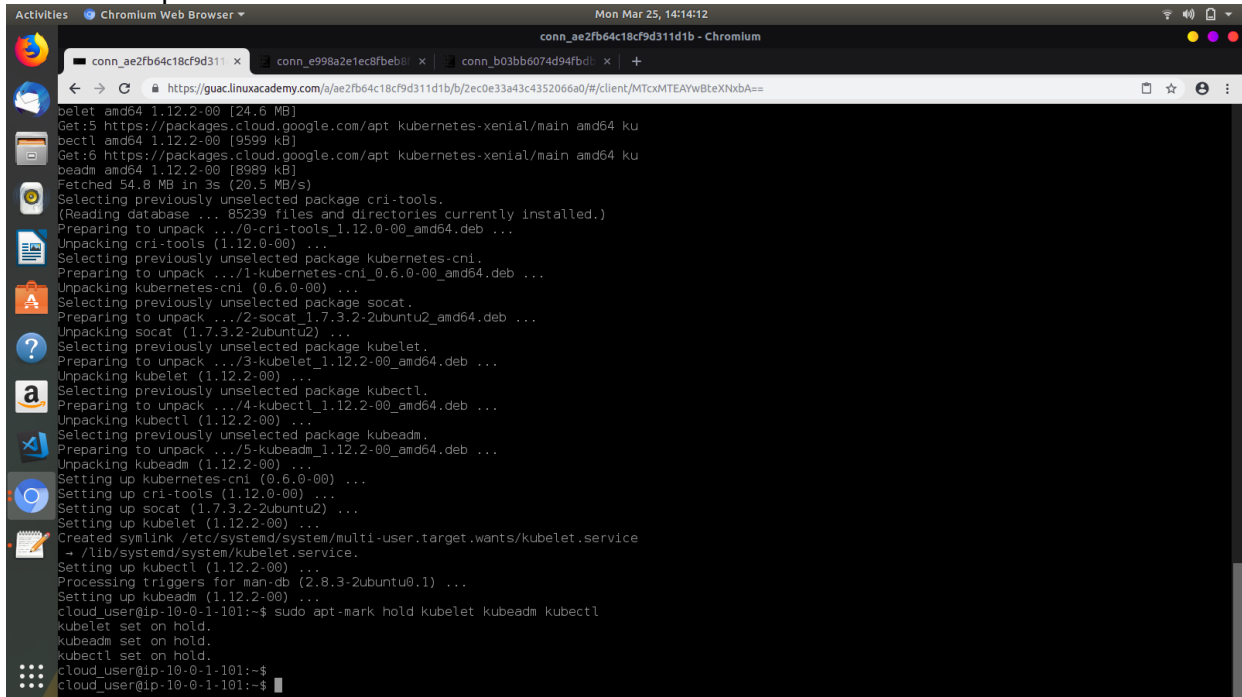
2. Installing kubeadm, kubelet, kubectl on all nodes.

- Adding gpg key for kubernetes repository
curl -s https://packages.cloud.google.com/apt/doc/apt-key.gpg | sudo apt-key add -
- Adding kubernetes repository
cat << EOF | sudo tee /etc/apt/sources.list.d/kubernetes.list
deb https://apt.kubernetes.io/ kubernetes-xenial main
EOF
- Updating package listing
sudo apt-get update
- Installing kubelet, kubeadm, kubectl

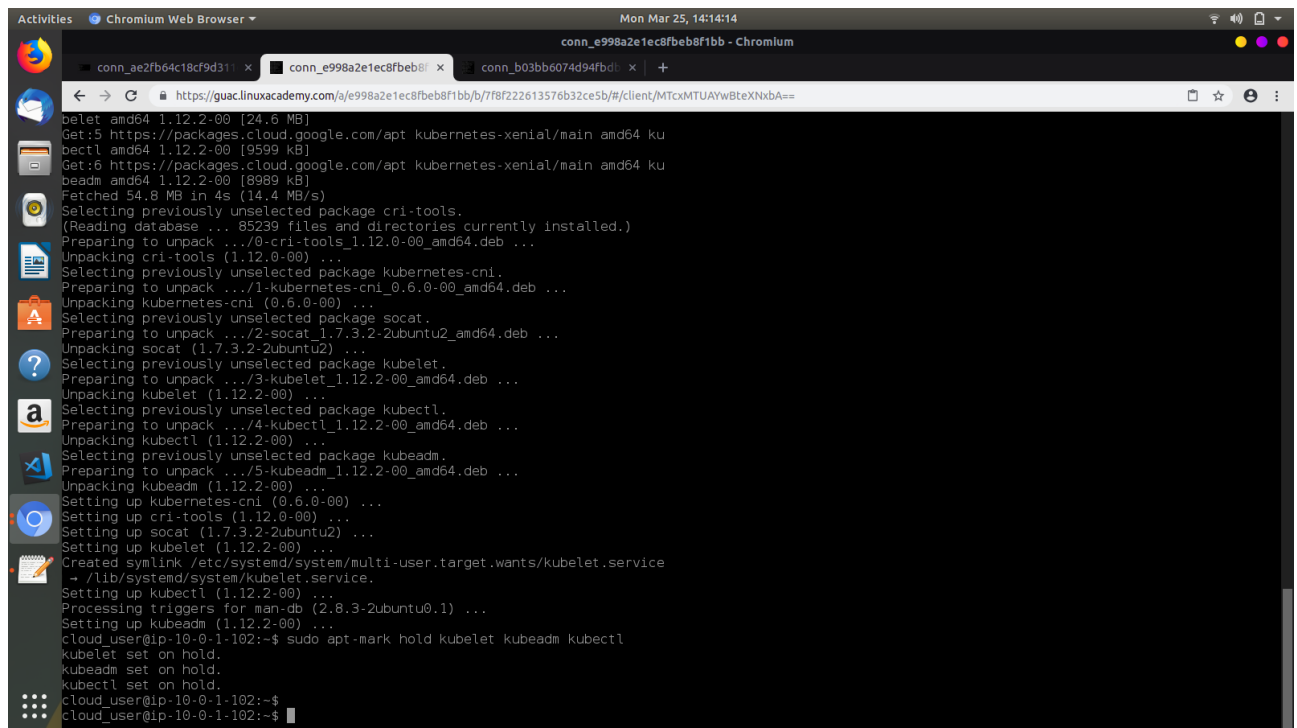
`sudo apt-get install -y kubelet=1.12.2-00 kubeadm=1.12.2-00 kubectl=1.12.2-00`

- Preventing auto updates

`sudo apt-mark hold kubelet kubeadm kubectl`



```
cloud_user@ip-10-0-1-101:~$ sudo apt-get install -y kubelet=1.12.2-00 kubeadm=1.12.2-00 kubectl=1.12.2-00
Get:1 https://packages.cloud.google.com/apt/kubernetes-xenial/main amd64 kubelet 1.12.2-00 [9599 kB]
Get:2 https://packages.cloud.google.com/apt/kubernetes-xenial/main amd64 kubeadm 1.12.2-00 [8989 kB]
Get:3 https://packages.cloud.google.com/apt/kubernetes-xenial/main amd64 kubectl 1.12.2-00 [24.6 MB]
Fetched 54.8 MB in 3s (20.5 MB/s)
Selecting previously unselected package cri-tools.
(Reading database ... 85239 files and directories currently installed.)
Preparing to unpack .../0-cri-tools_1.12.0-00_amd64.deb ...
Unpacking cri-tools (1.12.0-00) ...
Selecting previously unselected package kubernetecni.
Preparing to unpack .../1-kubernetecni_0.6.0-00_amd64.deb ...
Unpacking kubernetecni (0.6.0-00) ...
Selecting previously unselected package socat.
Preparing to unpack .../2-socat_1.7.3.2-2ubuntu2_amd64.deb ...
Unpacking socat (1.7.3.2-2ubuntu2) ...
Selecting previously unselected package kubelet.
Preparing to unpack .../3-kubelet_1.12.2-00_amd64.deb ...
Unpacking kubelet (1.12.2-00) ...
Selecting previously unselected package kubectl.
Preparing to unpack .../4-kubectl_1.12.2-00_amd64.deb ...
Unpacking kubectl (1.12.2-00) ...
Selecting previously unselected package kubeadm.
Preparing to unpack .../5-kubeadm_1.12.2-00_amd64.deb ...
Unpacking kubeadm (1.12.2-00) ...
Setting up kubernetecni (0.6.0-00) ...
Setting up cri-tools (1.12.0-00) ...
Setting up socat (1.7.3.2-2ubuntu2) ...
Setting up kubelet (1.12.2-00) ...
Created symlink /etc/systemd/system/multi-user.target.wants/kubelet.service
Setting up kubectl (1.12.2-00) ...
Processing triggers for man-db (2.8.3-2ubuntu0.1) ...
Setting up kubeadm (1.12.2-00) ...
cloud_user@ip-10-0-1-101:~$ sudo apt-mark hold kubelet kubeadm kubectl
kubelet set on hold.
kubeadm set on hold.
kubectl set on hold.
cloud_user@ip-10-0-1-101:~$
```



```
cloud_user@ip-10-0-1-102:~$ sudo apt-get install -y kubelet=1.12.2-00 kubeadm=1.12.2-00 kubectl=1.12.2-00
Get:1 https://packages.cloud.google.com/apt/kubernetes-xenial/main amd64 kubelet 1.12.2-00 [9599 kB]
Get:2 https://packages.cloud.google.com/apt/kubernetes-xenial/main amd64 kubeadm 1.12.2-00 [8989 kB]
Get:3 https://packages.cloud.google.com/apt/kubernetes-xenial/main amd64 kubectl 1.12.2-00 [24.6 MB]
Fetched 54.8 MB in 4s (14.4 MB/s)
Selecting previously unselected package cri-tools.
(Reading database ... 85239 files and directories currently installed.)
Preparing to unpack .../0-cri-tools_1.12.0-00_amd64.deb ...
Unpacking cri-tools (1.12.0-00) ...
Selecting previously unselected package kubernetecni.
Preparing to unpack .../1-kubernetecni_0.6.0-00_amd64.deb ...
Unpacking kubernetecni (0.6.0-00) ...
Selecting previously unselected package socat.
Preparing to unpack .../2-socat_1.7.3.2-2ubuntu2_amd64.deb ...
Unpacking socat (1.7.3.2-2ubuntu2) ...
Selecting previously unselected package kubelet.
Preparing to unpack .../3-kubelet_1.12.2-00_amd64.deb ...
Unpacking kubelet (1.12.2-00) ...
Selecting previously unselected package kubectl.
Preparing to unpack .../4-kubectl_1.12.2-00_amd64.deb ...
Unpacking kubectl (1.12.2-00) ...
Selecting previously unselected package kubeadm.
Preparing to unpack .../5-kubeadm_1.12.2-00_amd64.deb ...
Unpacking kubeadm (1.12.2-00) ...
Setting up kubernetecni (0.6.0-00) ...
Setting up cri-tools (1.12.0-00) ...
Setting up socat (1.7.3.2-2ubuntu2) ...
Setting up kubelet (1.12.2-00) ...
Created symlink /etc/systemd/system/multi-user.target.wants/kubelet.service
Setting up kubectl (1.12.2-00) ...
Processing triggers for man-db (2.8.3-2ubuntu0.1) ...
Setting up kubeadm (1.12.2-00) ...
cloud_user@ip-10-0-1-102:~$ sudo apt-mark hold kubelet kubeadm kubectl
kubelet set on hold.
kubeadm set on hold.
kubectl set on hold.
cloud_user@ip-10-0-1-102:~$
```

```
Get:5 https://packages.cloud.google.com/apt/kubernetes-xenial/main amd64 ku
bectl amd64 1.12.2-00 [9599 kB]
Get:6 https://packages.cloud.google.com/apt/kubernetes-xenial/main amd64 ku
beadm amd64 1.12.2-00 [8989 kB]
Fetched 54.8 MB in 2s (33.4 MB/s)
Selecting previously unselected package cri-tools.
(Reading database ... 85239 files and directories currently installed.)
Preparing to unpack .../0-cri-tools_1.12.0-00_amd64.deb ...
Unpacking cri-tools (1.12.0-00) ...
Selecting previously unselected package kubectctl.
Preparing to unpack .../1-kubectctl_0.6.0-00_amd64.deb ...
Unpacking kubectctl (0.6.0-00) ...
Selecting previously unselected package socat.
Preparing to unpack .../2-socat_1.7.3.2-2ubuntu2_amd64.deb ...
Unpacking socat (1.7.3.2-2ubuntu2) ...
Selecting previously unselected package kubelet.
Preparing to unpack .../3-kubelet_1.12.2-00_amd64.deb ...
Unpacking kubelet (1.12.2-00) ...
Selecting previously unselected package kubectl.
Preparing to unpack .../4-kubectl_1.12.2-00_amd64.deb ...
Unpacking kubectl (1.12.2-00) ...
Selecting previously unselected package kubeadm.
Preparing to unpack .../5-kubeadm_1.12.2-00_amd64.deb ...
Unpacking kubeadm (1.12.2-00) ...
Setting up cri-tools (1.12.0-00) ...
Setting up socat (1.7.3.2-2ubuntu2) ...
Setting up kubelet (1.12.2-00) ...
Created symlink /etc/systemd/system/multi-user.target.wants/kubelet.service
→ /lib/systemd/system/kubelet.service.
Setting up kubectl (1.12.2-00) ...
Processing triggers for man-db (2.8.3-2ubuntu0.1) ...
Setting up kubeadm (1.12.2-00) ...
sudo apt-mark hold kubelet kubeadm kubectl
cloud_user@ip-10-0-1-103:~$ sudo apt-mark hold kubelet kubeadm kubectl
kubelet set on hold.
kubeadm set on hold.
kubectl set on hold.
cloud_user@ip-10-0-1-103:~$
cloud_user@ip-10-0-1-103:~$
```

3. Building cluster with kubeadm

- For setting for flannel network plugin
sudo kubeadm init --pod-network-cidr=10.244.0.0/16
- Setting up kubeconfig that local user can use kubectl on master
mkdir -p \$HOME/.kube
sudo cp -i /etc/kubernetes/admin.conf \$HOME/.kube/config
sudo chown \$(id -u):\$(id -g) \$HOME/.kube/config
- Checking kubectl
kubectl version

```
[markmaster] Marking the node ip-10-0-1-101 as master by adding the label "
node-role.kubernetes.io/master="
[markmaster] Marking the node ip-10-0-1-101 as master by adding the taints
[node-role.kubernetes.io/master:NoSchedule]
[patchnode] Uploading the CRI Socket information "/var/run/docker.sock"
to the Node API object "ip-10-0-1-101" as an annotation
[bootstraptoken] using token: 2mk0yg.k9w63xzyjgdlslw2
[bootstraptoken] configured RBAC rules to allow Node Bootstrap tokens to po
st CSRs in order for nodes to get long term certificate credentials
[bootstraptoken] configured RBAC rules to allow the csrapprover controller
automatically approve CSRs from a Node Bootstrap Token
[bootstraptoken] configured RBAC rules to allow certificate rotation for al
l node client certificates in the cluster
[bootstraptoken] creating the "cluster-info" ConfigMap in the "kube-public"
namespace
[addons] Applied essential addon: CoreDNS
[addons] Applied essential addon: kube-proxy

Your Kubernetes master has initialized successfully!

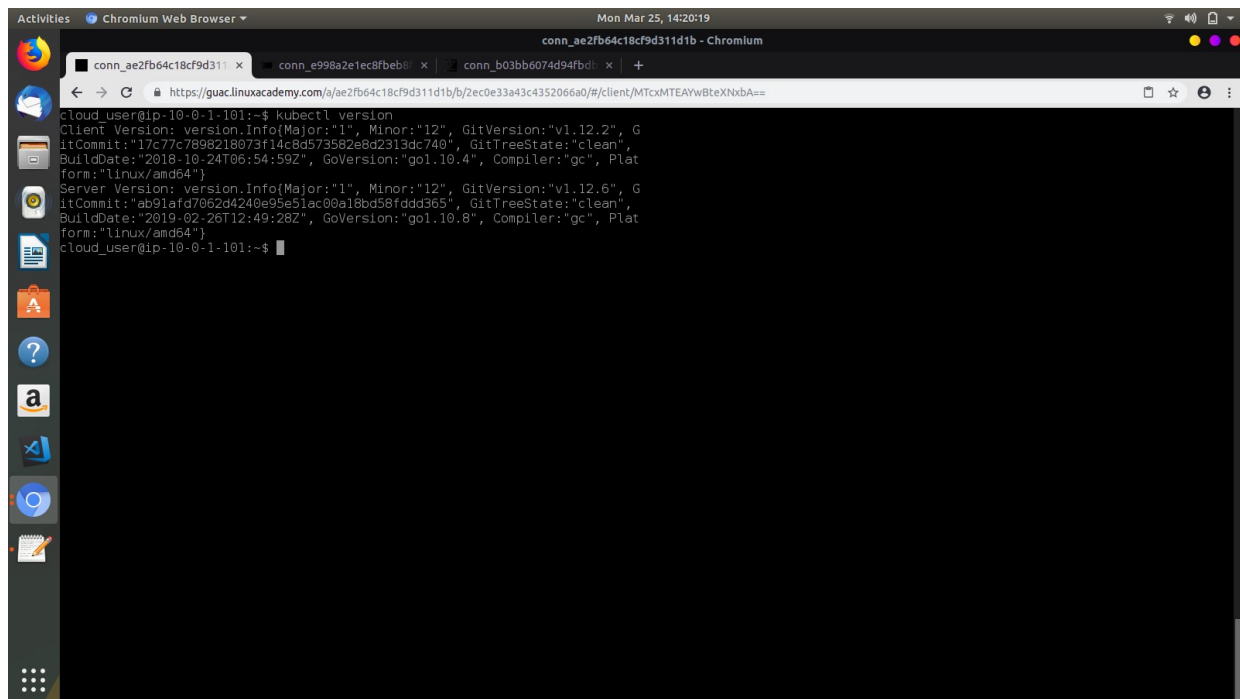
To start using your cluster, you need to run the following as a regular use
r:

mkdir -p $HOME/.kube
sudo cp -i /etc/kubernetes/admin.conf $HOME/.kube/config
sudo chown $(id -u):$(id -g) $HOME/.kube/config

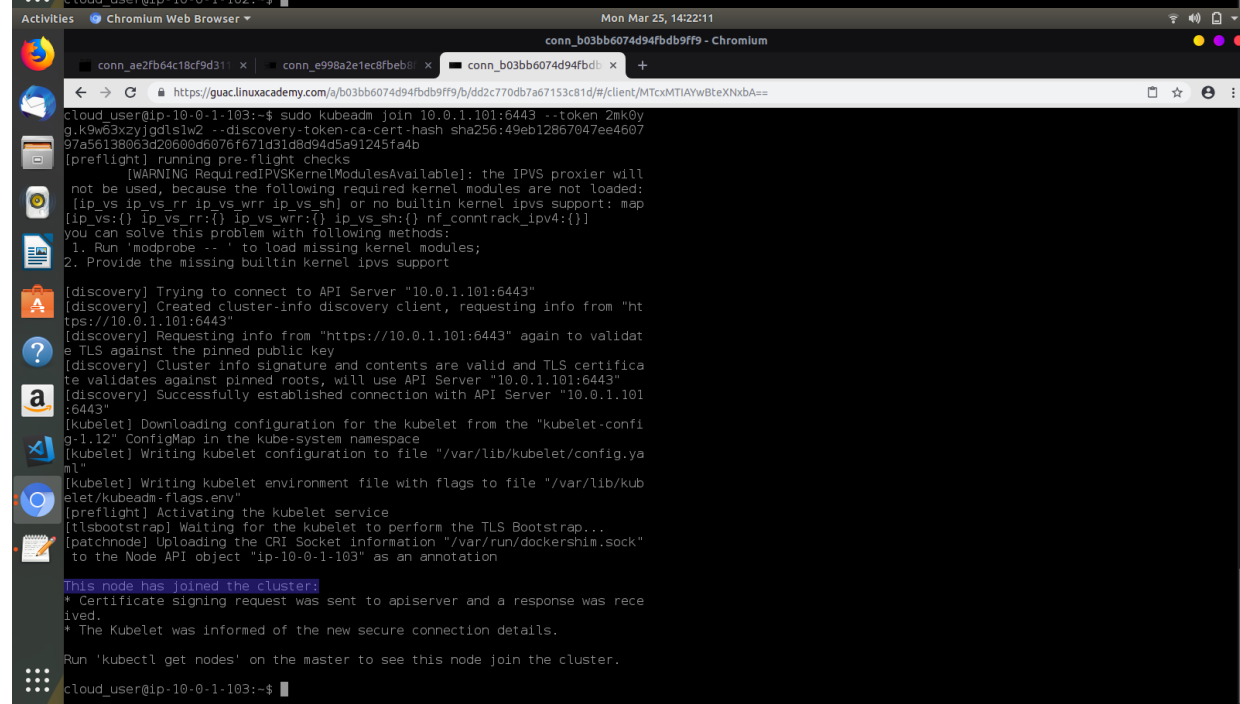
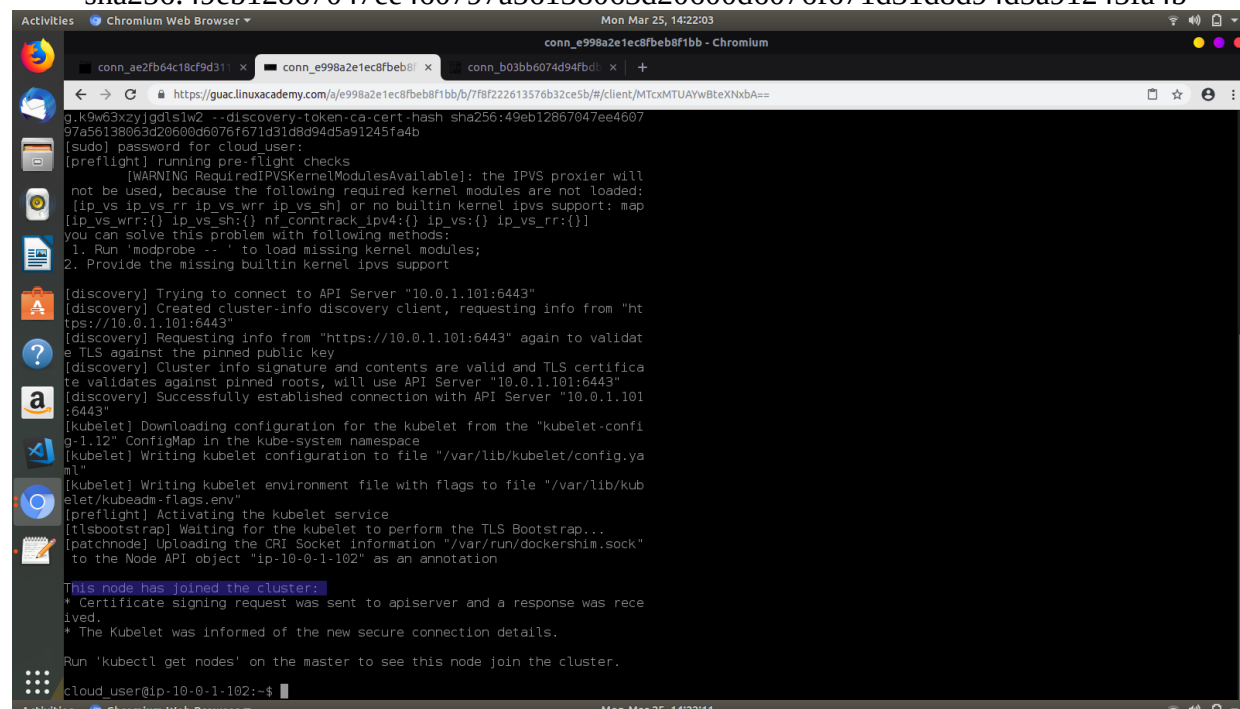
You should now deploy a pod network to the cluster.
Run "kubectl apply -f [podnetwork].yaml" with one of the options listed at:
https://kubernetes.io/docs/concepts/cluster-administration/addons/

You can now join any number of machines by running the following on each no
de as root:

kubeadm join 10.0.1.101:6443 --token 2mk0yg.k9w63xzyjgdlslw2 --discovery-
token-ca-cert-hash sha256:49eb12867047ee460797a56138063d20600d6076f71d31d8
d94d5a91245fa4b
cloud_user@ip-10-0-1-101:~$
```



- Joining two worker nodes to the master node in cluster
`sudo kubeadm join 10.0.1.101:6443 --token 2mk0yg.k9w63xyjgdl5w2 --discovery-token-ca-cert-hash sha256:49eb12867047ee460797a56138063d20600d6076f671d31d8d94d5a91245fa4b`



- `kubectl get nodes`
Nodes status not ready yet, we need a virtual network plugin.

```
cloud_user@ip-10-0-1-101:~$ kubectl version
Client Version: version.Info{Major:"1", Minor:"12", GitVersion:"v1.12.2", GitCommit:"17c77c7898218073f14c8d573582e8d2313dc740", GitTreeState:"clean", BuildDate:"2018-10-24T06:54:59Z", GoVersion:"go1.10.4", Compiler:"gc", Platform:"linux/amd64"}
Server Version: version.Info{Major:"1", Minor:"12", GitVersion:"v1.12.6", GitCommit:"ab91af7062d4240e95e51ac00a18bd58fddd365", GitTreeState:"clean", BuildDate:"2019-02-26T12:49:28Z", GoVersion:"go1.10.8", Compiler:"gc", Platform:"linux/amd64"}

cloud_user@ip-10-0-1-101:~$ sudo kubectl get nodes
NAME          STATUS    ROLES    AGE   VERSION
ip-10-0-1-101 NotReady  master   6m18s v1.12.2
ip-10-0-1-102 NotReady  <none>    32s   v1.12.2
ip-10-0-1-103 NotReady  <none>    46s   v1.12.2
cloud_user@ip-10-0-1-101:~$
```

- Turning on ip-tables on all 3 nodes.
`echo "net.bridge.bridge-nf-call-iptables=1" | sudo tee -a /etc/sysctl.conf`
`sudo sysctl -p`
- Install flannel on master using YAML
`kubectl apply -f`
<https://raw.githubusercontent.com/coreos/flannel/bc79dd1505b0c8681ece4de4c0d86c5cd2643275/Documentation/kube-flannel.yml>
- Now all 3 nodes in cluster are ready
`kubectl get nodes`

```
cloud_user@ip-10-0-1-101:~$ kubectl version
Client Version: version.Info{Major:"1", Minor:"12", GitVersion:"v1.12.2", GitCommit:"17c77c7898218073f14c8d573582e8d2313dc740", GitTreeState:"clean", BuildDate:"2018-10-24T06:54:59Z", GoVersion:"go1.10.4", Compiler:"gc", Platform:"linux/amd64"}
Server Version: version.Info{Major:"1", Minor:"12", GitVersion:"v1.12.6", GitCommit:"ab91af7062d4240e95e51ac00a18bd58fddd365", GitTreeState:"clean", BuildDate:"2019-02-26T12:49:28Z", GoVersion:"go1.10.8", Compiler:"gc", Platform:"linux/amd64"}

cloud_user@ip-10-0-1-101:~$ sudo kubectl get nodes
NAME          STATUS    ROLES    AGE   VERSION
ip-10-0-1-101 NotReady  master   6m18s v1.12.2
ip-10-0-1-102 NotReady  <none>    32s   v1.12.2
ip-10-0-1-103 NotReady  <none>    46s   v1.12.2

cloud_user@ip-10-0-1-101:~$ echo "net.bridge.bridge-nf-call-iptables=1" | sudo tee -a /etc/sysctl.conf
net.bridge.bridge-nf-call-iptables=1
cloud_user@ip-10-0-1-101:~$ sudo sysctl -p
net.bridge.bridge-nf-call-iptables = 1
cloud_user@ip-10-0-1-101:~$
cloud_user@ip-10-0-1-101:~$ kubectl apply -f https://raw.githubusercontent.com/coreos/flannel/bc79dd1505b0c8681ece4de4c0d86c5cd2643275/Documentation/kube-flannel.yml
clusterrole.rbac.authorization.k8s.io/flannel created
clusterrolebinding.rbac.authorization.k8s.io/flannel created
serviceaccount/flannel created
configmap/kube-flannel-cfg created
daemonset.extensions/kube-flannel-ds-amd64 created
daemonset.extensions/kube-flannel-ds-arm64 created
daemonset.extensions/kube-flannel-ds-arm created
daemonset.extensions/kube-flannel-ds-ppc64le created
daemonset.extensions/kube-flannel-ds-s390x created
cloud_user@ip-10-0-1-101:~$ kubectl get nodes
NAME          STATUS    ROLES    AGE   VERSION
ip-10-0-1-101 Ready      master   7m26s v1.12.2
ip-10-0-1-102 Ready      <none>    100s  v1.12.2
ip-10-0-1-103 Ready      <none>    114s  v1.12.2
cloud_user@ip-10-0-1-101:~$
```