Setting Up a Kubernetes Cluster with Kubeadm on Azure Virtual Machines

Kubernetes has become the go-to platform for running and scaling containerized applications in the cloud. In this guide, we'll walk through setting up a **production-ready Kubernetes cluster on Azure** using **kubeadm**.

We'll build out one master node and two worker nodes, all provisioned through the **Azure Portal**. To connect and configure the VMs, we'll use **PuTTY (on Windows)** or **SSH (on Mac/Linux)**.

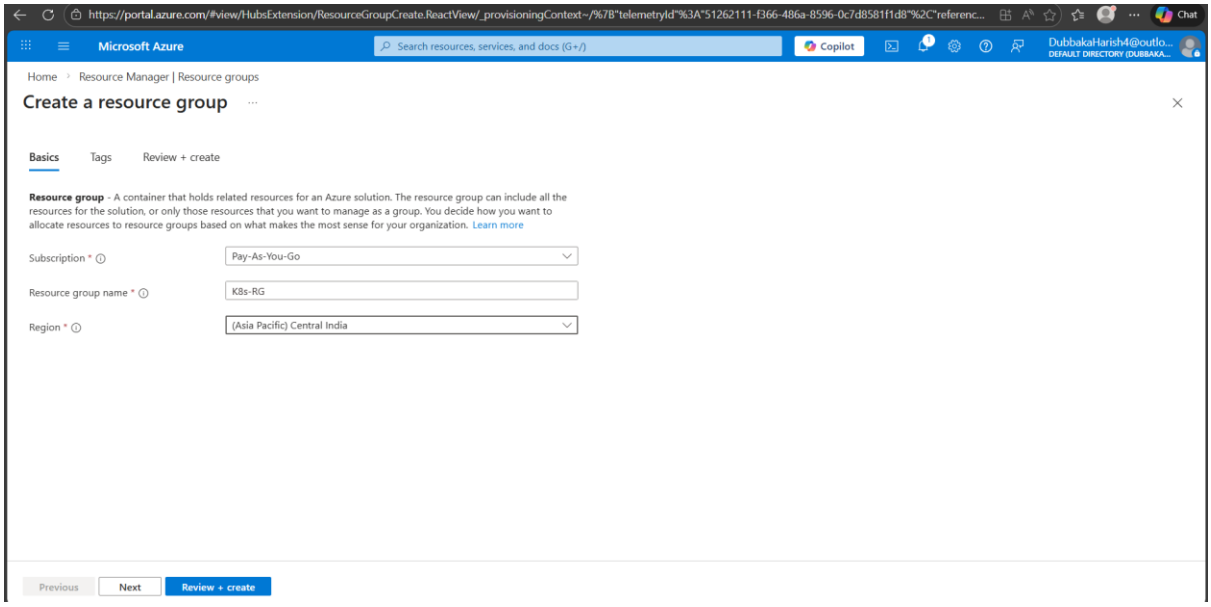
Part 1: Creating Virtual Machines in Azure

Step 1: Log into Azure Portal

👉 Head to portal.azure.com and sign in with your Azure account.

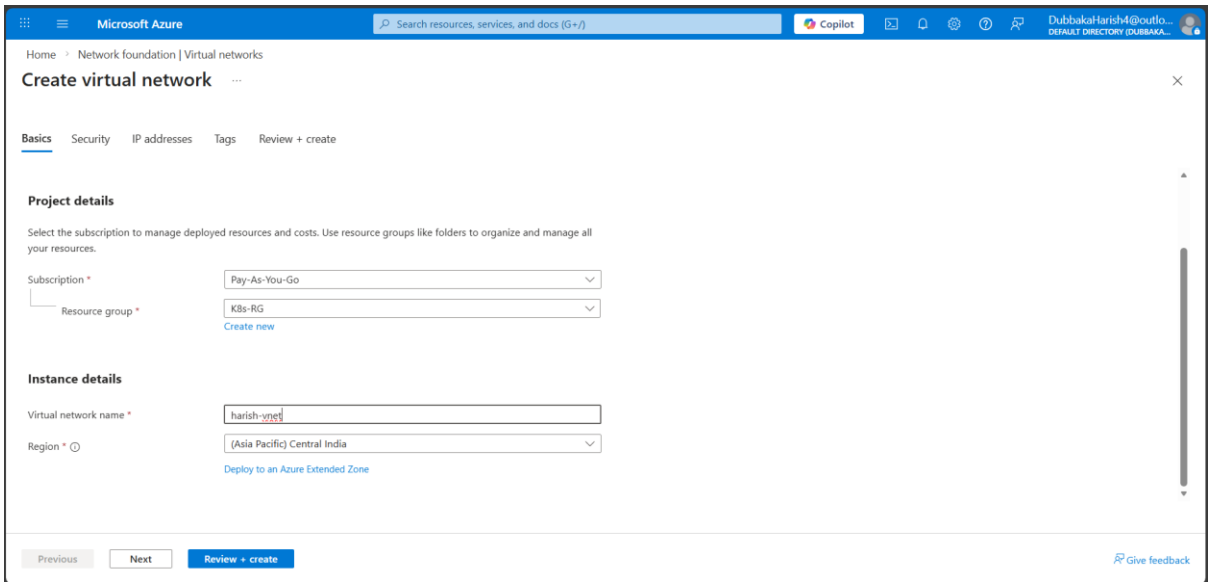
Step 2: Create a Resource Group

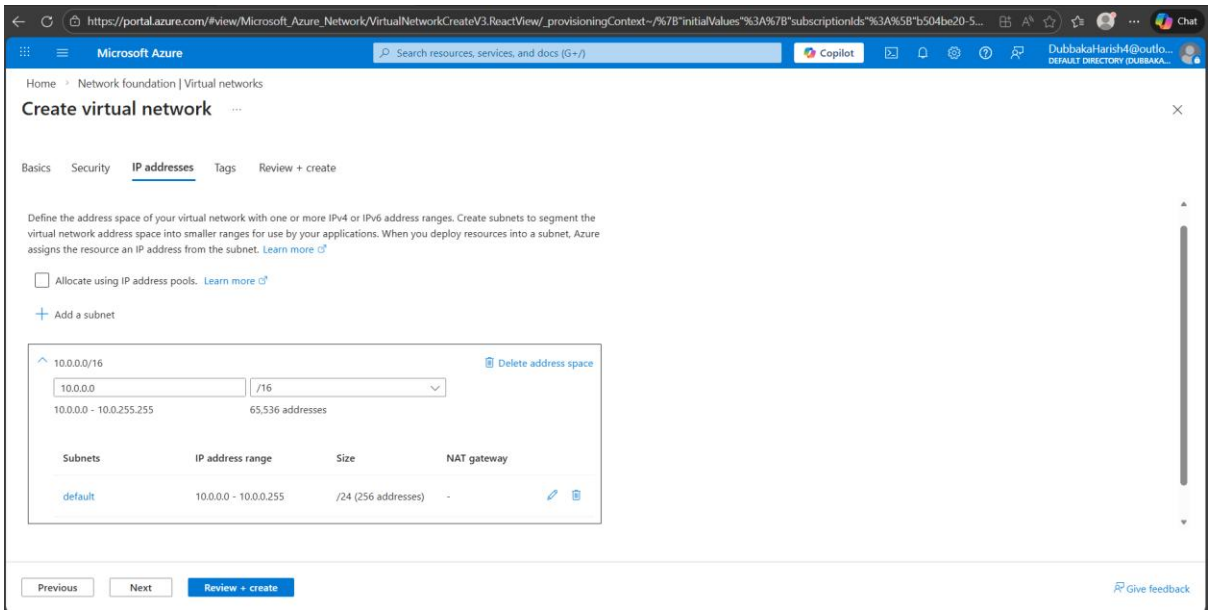
1. In the left menu, click **Resource groups**
2. Hit **+ Create**
3. Fill in the details:
    - **Subscription**: pick yours
    - **Resource group name**: choose something neat (e.g., **K8s-RG**)
    - **Region**: select one near you (e.g., Centra India)
4. Click **Review + create** → **Create**



Step 3: Create a Virtual Network (VNet)

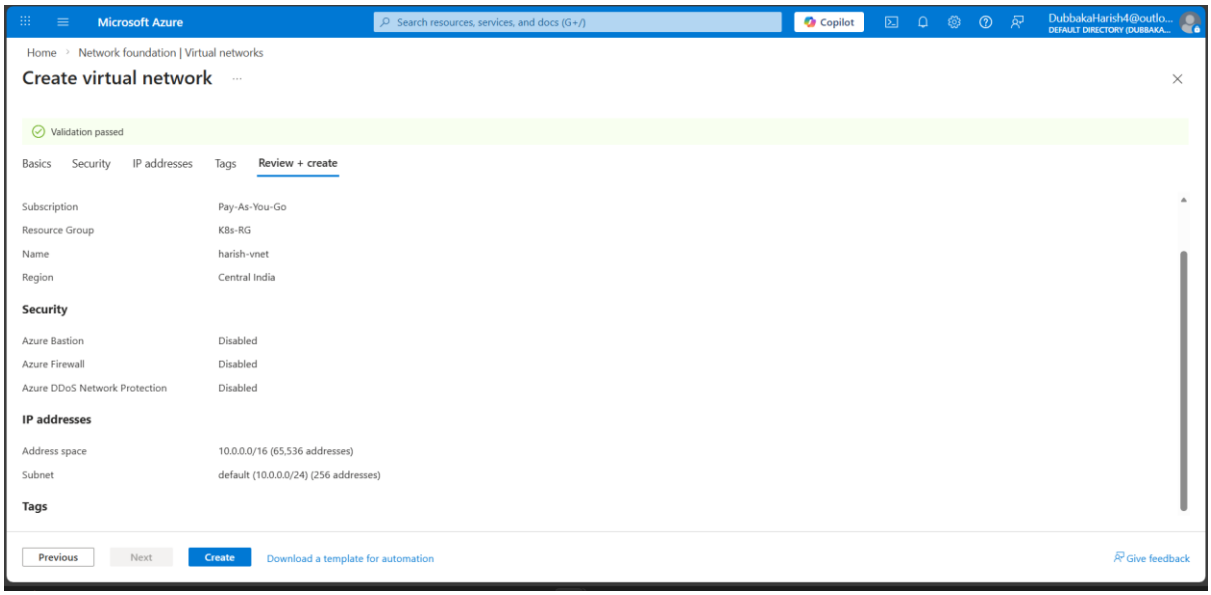
1. Search for **Virtual networks** in the portal
2. Click **+ Create**
3. Configure basics:





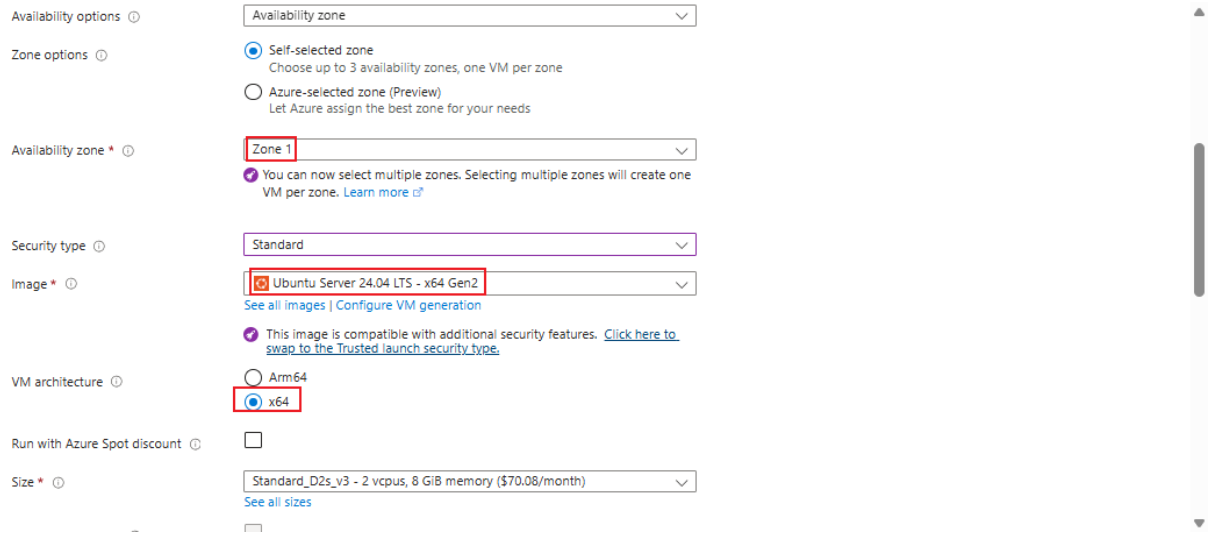
- Name: e.g., **harish-vnet**
- Address space: **10.0.0.0/16**

- Add subnet: **default → 10.0.0.0/24**

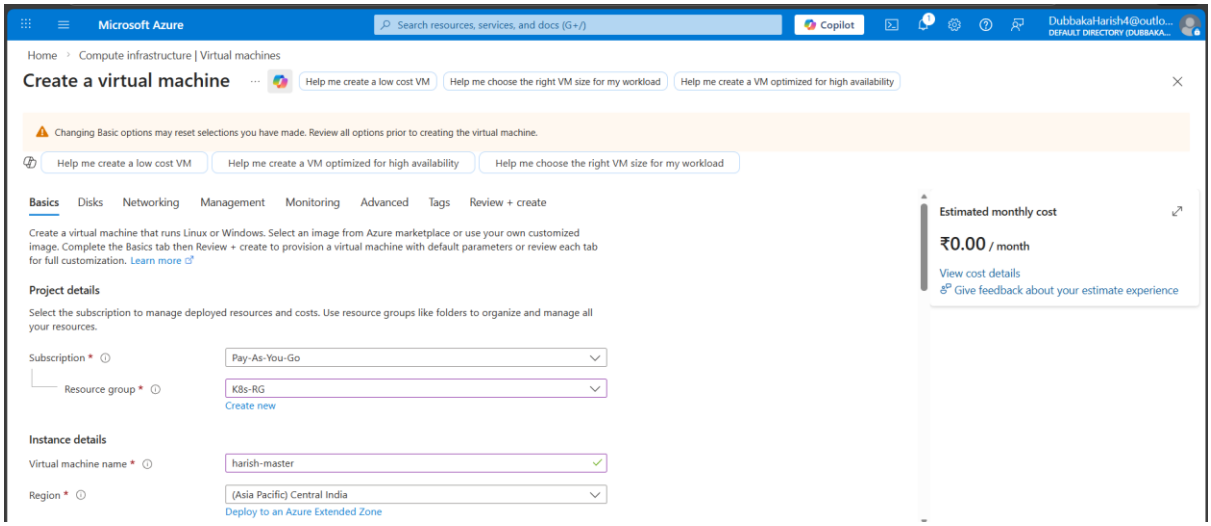


Step 4: Create the Master Node VM

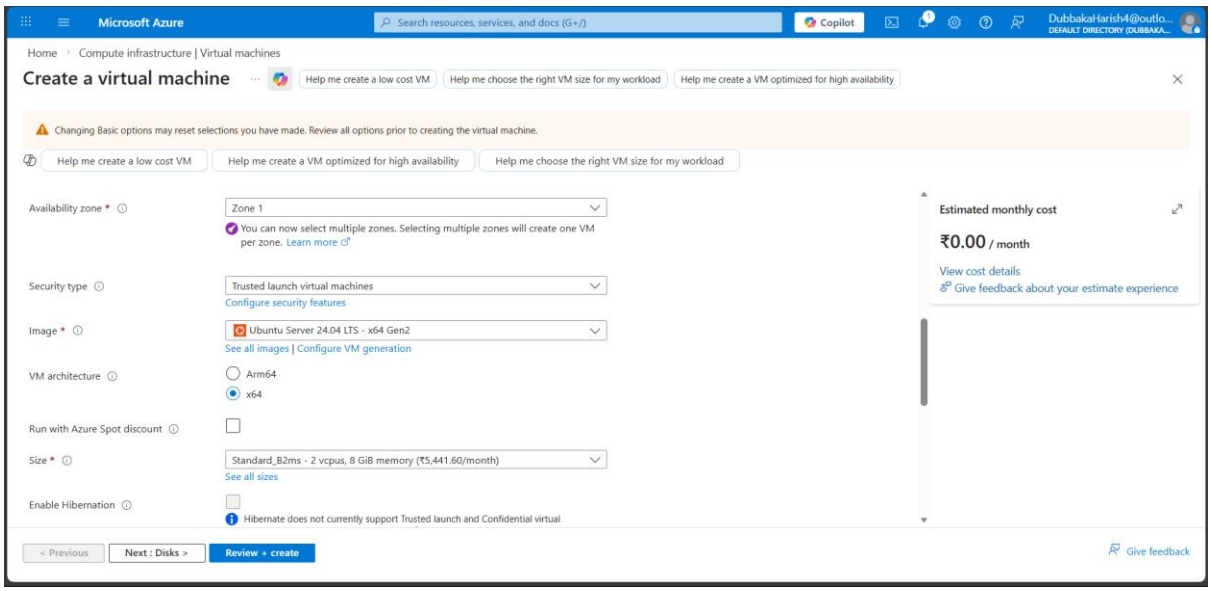
1. From the homepage, click **+ Create a resource** → search for **Ubuntu Server 22.04 LTS**



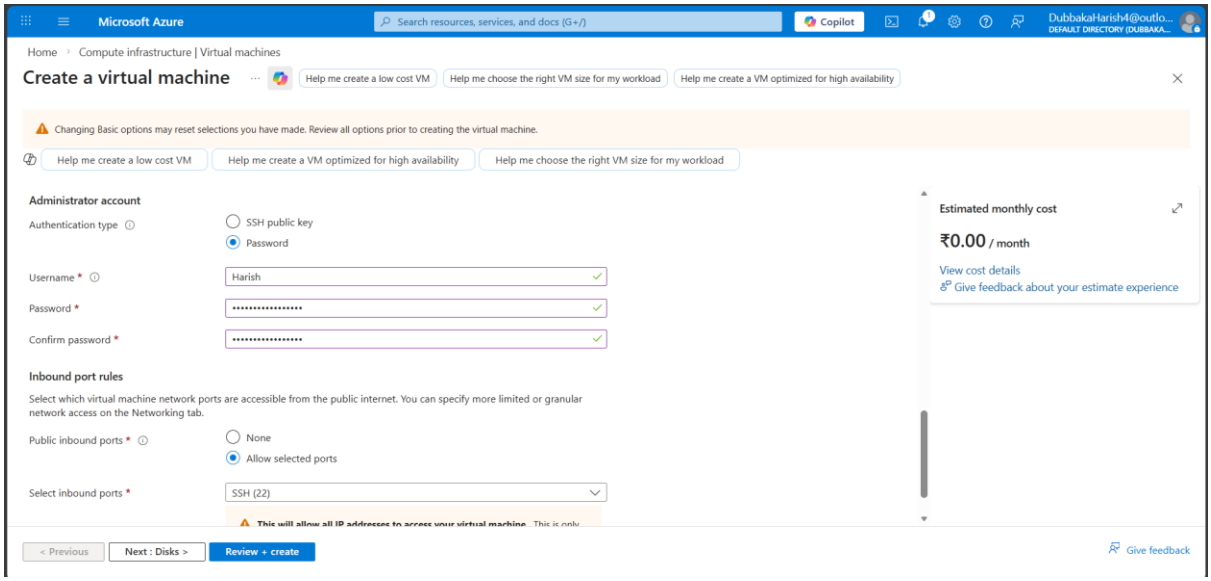
2. Configure:
    - VM name: **harish-master**



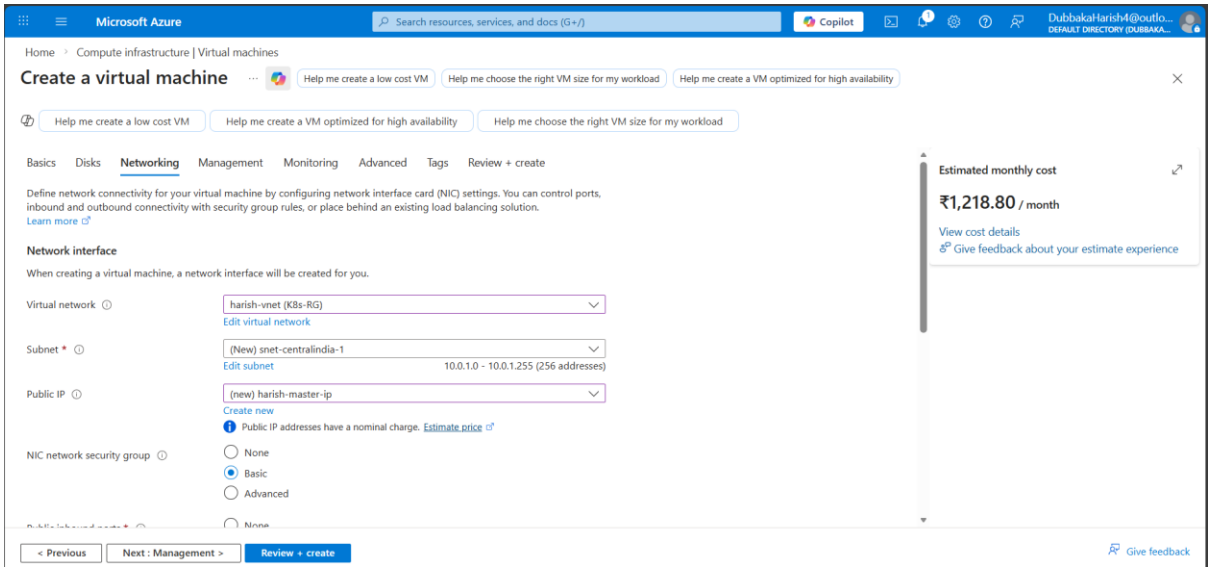
Size: **Standard_D2s_v3** (2 vcpus, 8 GiB RAM)



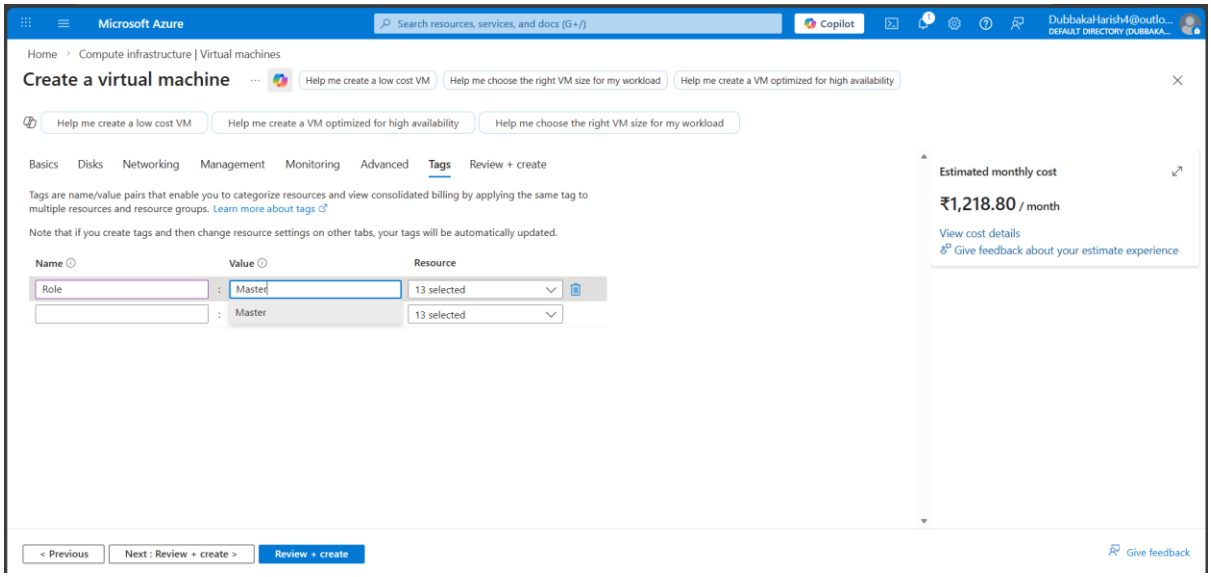
Auth: Password → Harish



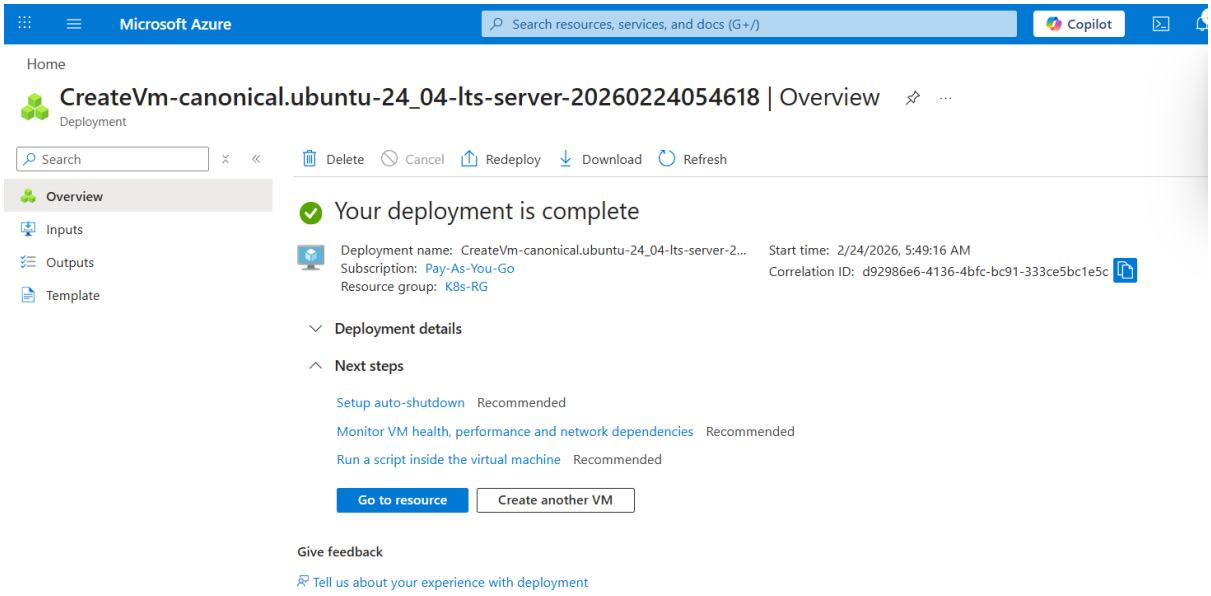
Networking: Attach to your VNet, allow **SSH (22)**



Tag: **Role=master**



3. Hit **Review + create → Create**

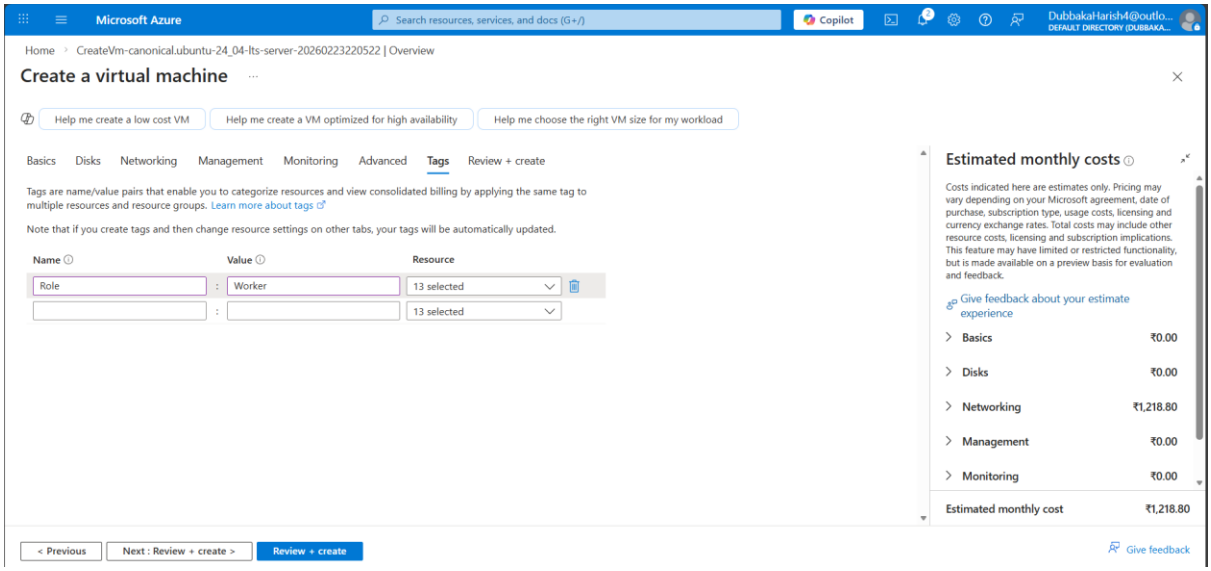


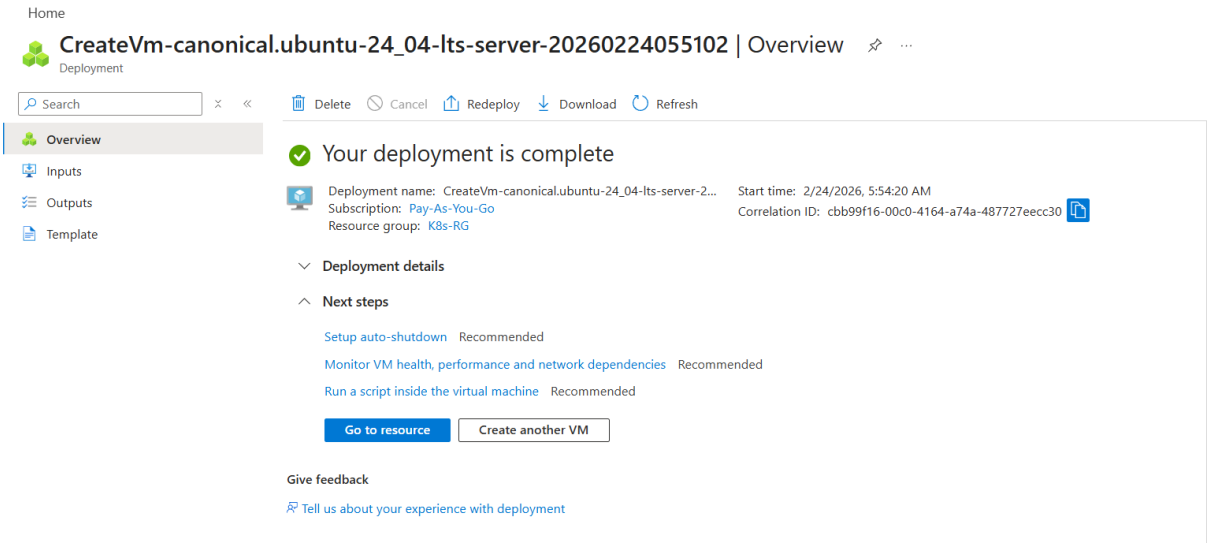
Step 5: Create Worker Node VMs

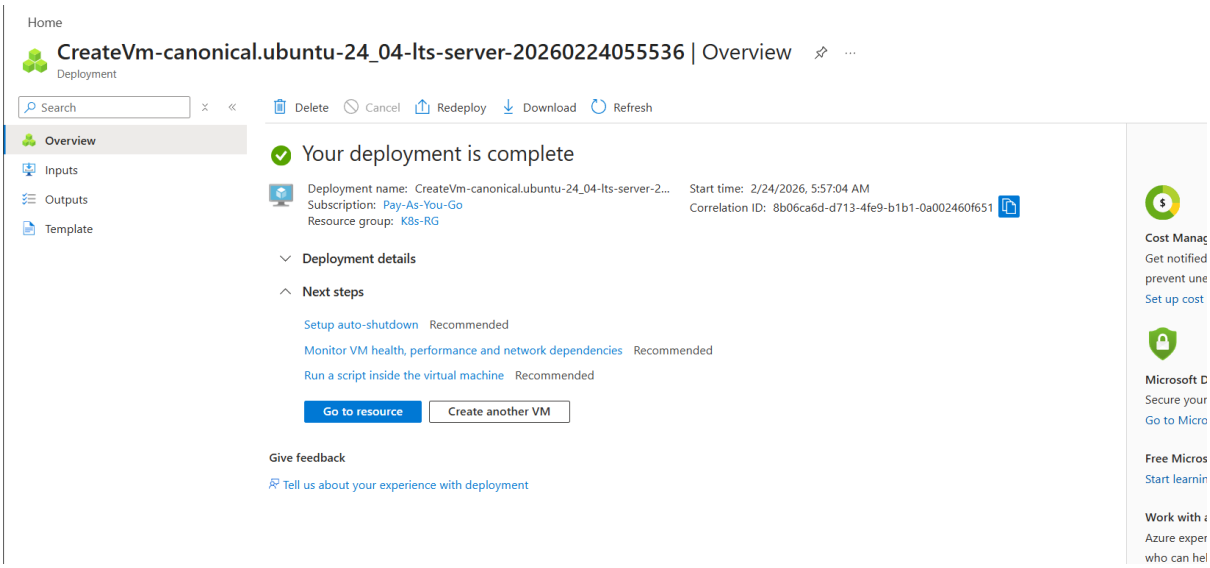
Repeat Step 4 for two more VMs:

- Names: **bantu-worker1** and **chintu-worker2**
- Use **Password** Auth

Tag: **Role=worker**




Home
CreateVm-canonical.ubuntu-24_04-lts-server-20260224055102 | Overview
Deployment
Search
Overview
Inputs
Outputs
Template
Delete
Cancel
Redeploy
Download
Refresh
Your deployment is complete
Deployment name: CreateVm-canonical.ubuntu-24_04-lts-server-2...
Subscription: Pay-As-You-Go
Resource group: K8s-RG
Start time: 2/24/2026, 5:54:20 AM
Correlation ID: cbb99f16-00c0-4164-a74a-487727eecc30
Deployment details
Next steps
Setup auto-shutdown Recommended
Monitor VM health, performance and network dependencies Recommended
Run a script inside the virtual machine Recommended
Go to resource
Create another VM
Give feedback
Tell us about your experience with deployment


Home
CreateVm-canonical.ubuntu-24_04-lts-server-20260224055536 | Overview
Deployment
Search
Overview
Inputs
Outputs
Template
Delete
Cancel
Redeploy
Download
Refresh
Your deployment is complete
Deployment name: CreateVm-canonical.ubuntu-24_04-lts-server-2...
Subscription: Pay-As-You-Go
Resource group: K8s-RG
Start time: 2/24/2026, 5:57:04 AM
Correlation ID: 8b06ca6d-d713-4fe9-b1b1-0a002460f651
Deployment details
Next steps
Setup auto-shutdown Recommended
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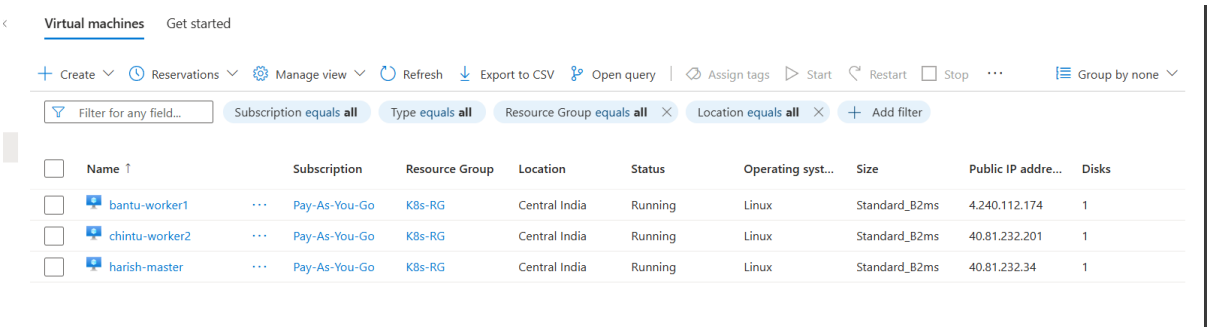
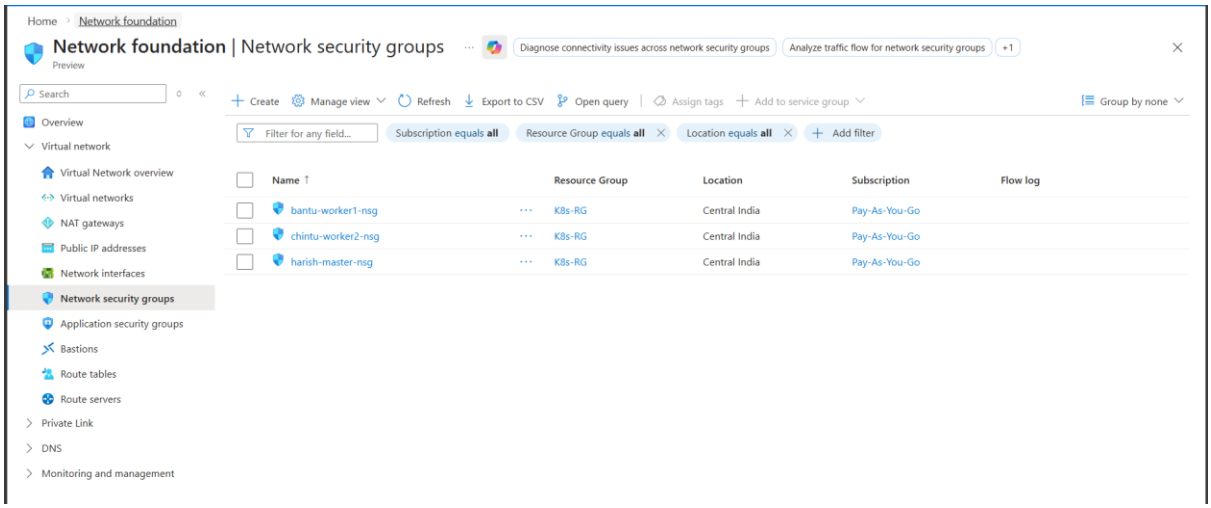
Give feedback
Tell us about your experience with deployment
Cost Manag
Get notified
prevent une
Set up cost
Microsoft D
Secure your
Go to Micro
Free Micros
Start learnin
Work with
Azure exper
who can hel

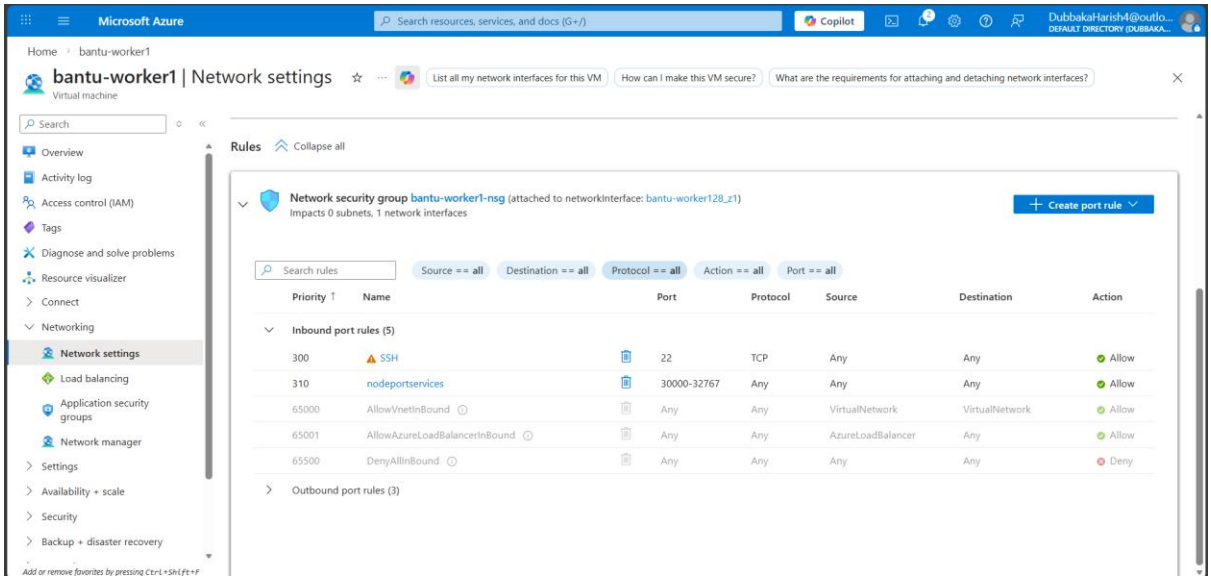

Virtual machines
Get started
Create
Reservations
Manage view
Refresh
Export to CSV
Open query
Assign tags
Start
Restart
Stop
Group by none
Filter for any field...
Subscription equals all
Type equals all
Resource Group equals all
Location equals all
Add filter
Name
Subscription
Resource Group
Location
Status
Operating syst...
Size
Public IP addre...
Disks
bantu-worker1 Pay-As-You-Go K8s-RG Central India Running Linux Standard_B2ms 4.240.112.174 1
chintu-worker2 Pay-As-You-Go K8s-RG Central India Running Linux Standard_B2ms 40.81.232.201 1
harish-master Pay-As-You-Go K8s-RG Central India Running Linux Standard_B2ms 40.81.232.34 1

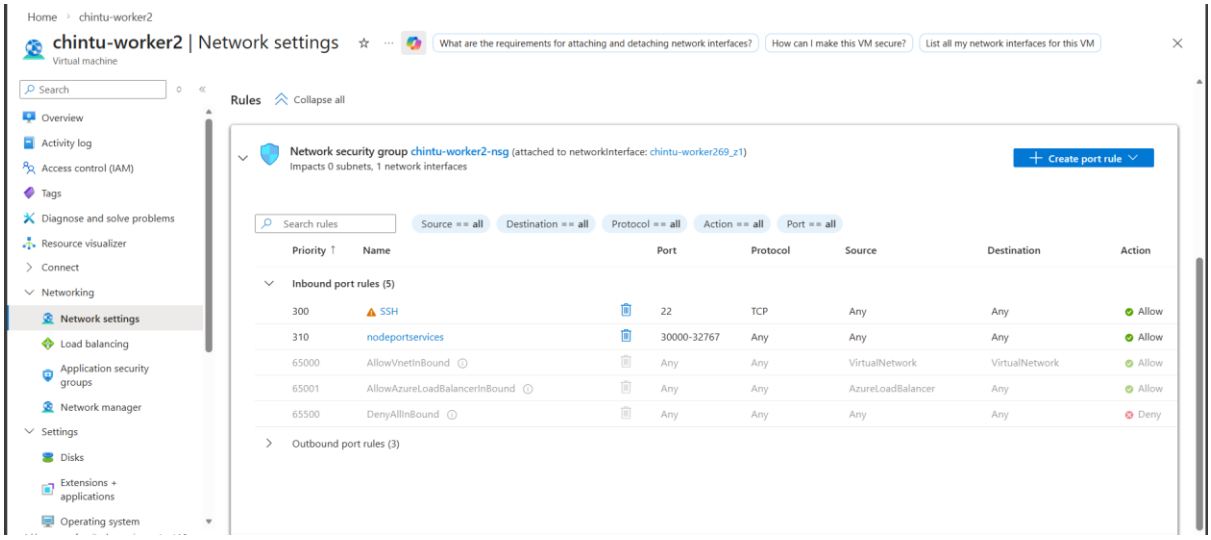
Step 6: Open Kubernetes Ports

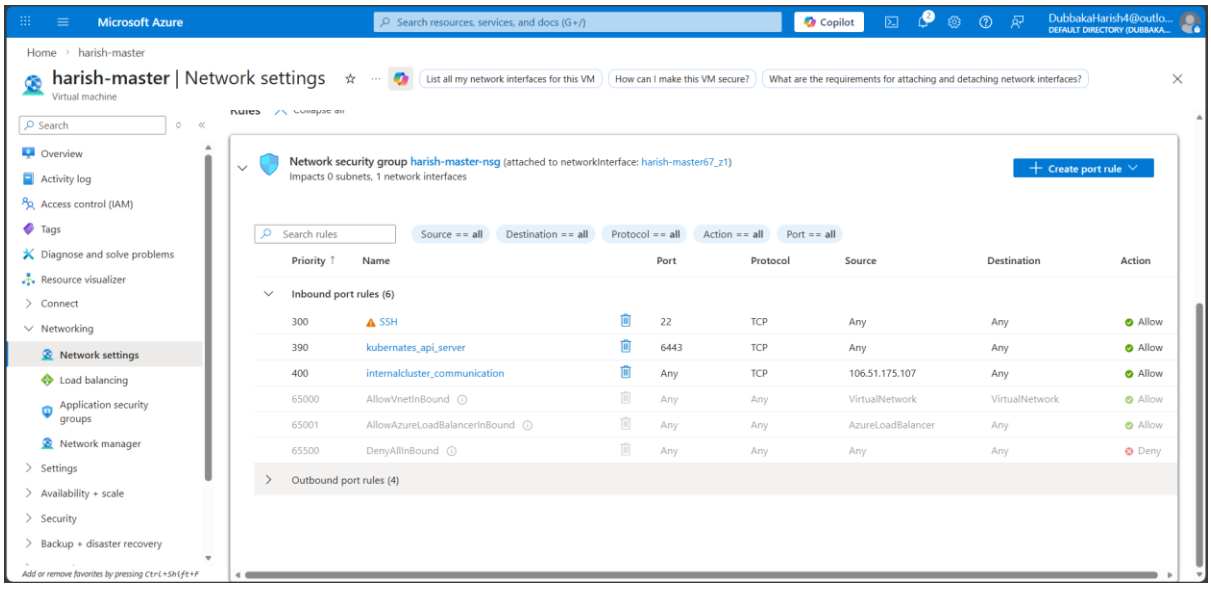
Inside the **Network Security Group (NSG)** of your master node & worker nodes:

- Allow TCP **6443** (Kubernetes API server)
- Allow internal traffic in **10.0.0.0/16** for cluster communication









Step 7: Note Down Ips

Public IPs

- Each VM (master and workers) will have a **public IP** assigned by your cloud provider (Azure in your case).
- These are used for **SSH access** from your local machine.
- Example:
- harish-master → 40.xx.xx.xx
- bantu-worker1 → 40.xx.xx.xx
- chintu-worker2 → 40.81.232.201

🖥️ Step 8: Master VM Setup Process

1. SSH into Master VM

- Connect to harish-master.
- This connects you to the master node where you'll initialize Kubernetes.

---

2. Disable Swap

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

- Kubernetes requires swap disabled for predictable scheduling.

---

3. Enable Kernel Modules & Sysctl

```
cat <<EOF | sudo tee /etc/modules-load.d/k8s.conf
overlay
br_netfilter
EOF

sudo modprobe overlay
sudo modprobe br_netfilter
```

- overlay → container storage.
- br_netfilter → iptables visibility for bridged traffic.

Configure sysctl:

```
cat <<EOF | sudo tee /etc/sysctl.d/k8s.conf
net.bridge.bridge-nf-call-iptables  = 1
net.bridge.bridge-nf-call-ip6tables = 1
net.ipv4.ip_forward                 = 1
EOF
```

sudo sysctl --system

- Ensures pod/service traffic forwarding works.

---

4. Install Container Runtime (containerd)

- Install containerd, configure SystemdCgroup = true, and enable service:

systemctl status containerd

---

5. Install runc

curl -LO https://github.com/opencontainers/runc/releases/download/v1.1.12/runc.amd64

sudo install -m 755 runc.amd64 /usr/local/sbin/runc

- runc is the low-level runtime used by containerd.

---

6. Install CNI Plugins

curl -LO https://github.com/containernetworking/plugins/releases/download/v1.5.0/cni-plugins-linux-amd64-v1.5.0.tgz

sudo mkdir -p /opt/cni/bin

sudo tar Cxzvf /opt/cni/bin cni-plugins-linux-amd64-v1.5.0.tgz

- Provides pod networking binaries.

---

7. Install Kubernetes Binaries

sudo apt-get install -y kubelet kubeadm kubectl

- Version pinned to 1.29.6 for later upgrade to 1.30.

---

8. Configure crictl

sudo crictl config runtime-endpoint unix:///var/run/containerd/containerd.sock

- Ensures crictl talks to containerd.

---

9. Initialize Control Plane (⚠️ Use eth0 IP!)

1. Check eth0 IP:
2. ip addr show eth0

Example: inet 10.0.0.4/24.

3. Run init with that IP:
4. sudo kubeadm init \
5. --pod-network-cidr=192.168.0.0/16 \
6. --apiserver-advertise-address=10.0.0.4 \
7. --node-name master

⚠️ Why:

- 127.0.0.1 would isolate the API server to localhost.
- Using 10.0.0.4 makes it reachable by worker nodes (10.0.1.4, 10.0.2.4).

⚠️ After you run `kubeadm init` on the **master node**, it will generate a **kubeadm join command**. That command is what you'll use to connect each worker node to the cluster.

- It looks something like:

kubeadm join 10.0.0.4:6443 --token <token> \

--discovery-token-ca-cert-hash sha256:<hash>

-

---

10. Configure kubeconfig

mkdir -p $HOME/.kube

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

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

- Lets you run kubectl as your user.

---

11. Install Calico (CNI plugin)

kubectl create -f https://raw.githubusercontent.com/projectcalico/calico/v3.28.0/manifests/tigera-operator.yaml

curl -O https://raw.githubusercontent.com/projectcalico/calico/v3.28.0/manifests/custom-resources.yaml

kubectl apply -f custom-resources.yaml

- Enables pod networking across nodes.
- Without this, pods can't communicate between worker nodes.

✅ **Note:** After completing all the above steps on your **harish-master VM**, the Kubernetes **control plane is ready**.

- The API server is running and bound to your master's eth0 IP (10.0.0.4).
- kubectl is configured, so you can manage the cluster directly from the master.
- Calico networking is installed, enabling pod communication across nodes.
- A kubeadm join command has been generated — this must be run on each worker node (as root) to connect them to the cluster.

Your master node is now fully prepared to accept worker nodes and orchestrate workloads.

🖥️ **Step-by-Step Worker Node Setup Workflow — (bantu-worker1, chintu-worker2)**

🖥️ **Worker VM Setup Process**

1. SSH into Worker VM

ssh <username>@<public-ip-of-worker>

- Example: ssh harish@40.81.232.201
- Do this for each worker node.

---

2. Disable Swap

swapoff -a

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

- Required for stable Kubernetes scheduling.

---

3. Enable Kernel Modules & Sysctl

cat <<EOF | sudo tee /etc/modules-load.d/k8s.conf

overlay

br_netfilter

EOF

sudo modprobe overlay

sudo modprobe br_netfilter

Configure sysctl:

cat <<EOF | sudo tee /etc/sysctl.d/k8s.conf

net.bridge.bridge-nf-call-iptables = 1

net.bridge.bridge-nf-call-ip6tables = 1

net.ipv4.ip_forward   = 1

EOF

sudo sysctl --system

Verify:

lsmod | grep br_netfilter

lsmod | grep overlay

sysctl net.bridge.bridge-nf-call-iptables net.bridge.bridge-nf-call-ip6tables net.ipv4.ip_forward

---

4. Install Container Runtime (containerd)

curl -LO https://github.com/containerd/containerd/releases/download/v1.7.14/containerd-1.7.14-linux-amd64.tar.gz

sudo tar Cxzvf /usr/local containerd-1.7.14-linux-amd64.tar.gz

curl -LO https://raw.githubusercontent.com/containerd/containerd/main/containerd.service

sudo mkdir -p /usr/local/lib/systemd/system/

sudo mv containerd.service /usr/local/lib/systemd/system/

sudo mkdir -p /etc/containerd

containerd config default | sudo tee /etc/containerd/config.toml

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

sudo systemctl daemon-reload

sudo systemctl enable --now containerd

systemctl status containerd

---

5. Install runc

curl -LO https://github.com/opencontainers/runc/releases/download/v1.1.12/runc.amd64

sudo install -m 755 runc.amd64 /usr/local/sbin/runc

---

6. Install CNI Plugins

curl -LO https://github.com/containernetworking/plugins/releases/download/v1.5.0/cni-plugins-linux-amd64-v1.5.0.tgz

sudo mkdir -p /opt/cni/bin

sudo tar Cxzvf /opt/cni/bin cni-plugins-linux-amd64-v1.5.0.tgz

---

7. Install Kubernetes Binaries

sudo apt-get update

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.list

sudo apt-get update

sudo apt-get install -y kubelet=1.29.6-1.1 kubeadm=1.29.6-1.1 kubectl=1.29.6-1.1 --allow-downgrades --allow-change-held-packages

sudo apt-mark hold kubelet kubeadm kubectl

Verify versions:

kubeadm version

kubelet --version

kubectl version --client

---

8. Configure crictl

sudo crictl config runtime-endpoint unix:///var/run/containerd/containerd.sock

---

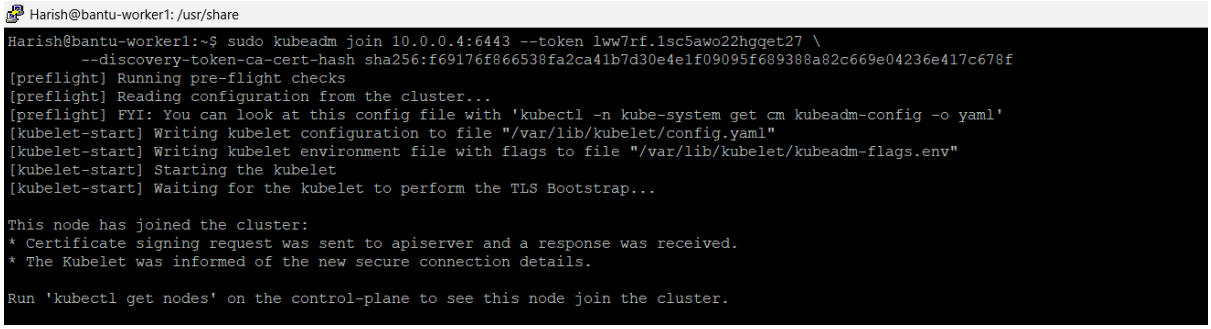
9. Join Worker Nodes to Cluster (which was generated from Masternode)

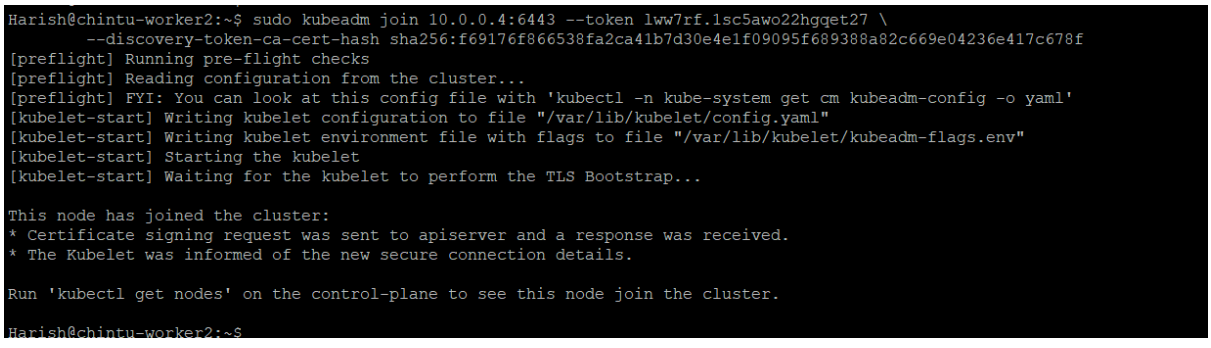
Run the **join command** generated on the master node after kubeadm init. It looks like:

sudo kubeadm join 10.0.0.4:6443 --token <token> \

--discovery-token-ca-cert-hash sha256:<hash>

- 10.0.0.4 → Master's eth0 IP.
- Run this on **both worker nodes** as root.





If you forgot the command, regenerate it on the master:

kubeadm token create --print-join-command

Part 5: Verify & Validation Cluster

If all the above steps were completed, you should be able to run kubectl get nodes on the master node, and it should return all the 3 nodes in ready status.

```
Harish@harish-master:~$ kubectl get nodes -o wide
NAME             STATUS   ROLES           AGE     VERSION   INTERNAL-IP   EXTERNAL-IP   OS-IMAGE             KERNEL-VERSION      CONTAINER-RUNTIME
bantu-worker1    Ready    <none>          3m4s    v1.29.6   10.0.1.4      <none>        Ubuntu 24.04.4 LTS   6.14.0-1017-azure   containerd://1.7.14
chintu-worker2   Ready    <none>          2m58s   v1.29.6   10.0.2.4      <none>        Ubuntu 24.04.4 LTS   6.14.0-1017-azure   containerd://1.7.14
master           Ready    control-plane   5m42s   v1.29.6   10.0.0.4      <none>        Ubuntu 24.04.4 LTS   6.14.0-1017-azure   containerd://1.7.14
Harish@harish-master:~$
```

Also, make sure all the pods are up and running by using the command as below:

kubectl get pods -A

```
Harish@harish-master:~$ kubectl get pods -A
NAMESPACE          NAME                                       READY   STATUS    RESTARTS   AGE
calico-apiserver   calico-apiserver-77c47c897c-c28dg          1/1     Running   0          22s
calico-apiserver   calico-apiserver-77c47c897c-mrkwp          1/1     Running   0          22s
calico-system      calico-kube-controllers-7d57969c98-m7vmz   1/1     Running   0          2m11s
calico-system      calico-node-8s75d                          1/1     Running   0          100s
calico-system      calico-node-mw6jr                          1/1     Running   0          2m11s
calico-system      calico-node-pcbgv                          1/1     Running   0          94s
calico-system      calico-typha-59b5848dc7-8p6hc              1/1     Running   0          2m11s
calico-system      calico-typha-59b5848dc7-srxtp              1/1     Running   0          92s
calico-system      csi-node-driver-d7cll                      2/2     Running   0          100s
calico-system      csi-node-driver-hj887                      2/2     Running   0          2m11s
calico-system      csi-node-driver-jmblt                      2/2     Running   0          94s
kube-system        coredns-76f75df574-4hc6q                   1/1     Running   0          4m
kube-system        coredns-76f75df574-kr44f                   1/1     Running   0          4m
kube-system        etcd-master                                1/1     Running   0          4m14s
kube-system        kube-apiserver-master                      1/1     Running   0          4m15s
kube-system        kube-controller-manager-master             1/1     Running   1          4m14s
kube-system        kube-proxy-cprd5                           1/1     Running   0          100s
kube-system        kube-proxy-vpshr                           1/1     Running   0          4m
kube-system        kube-proxy-x4jzv                           1/1     Running   0          94s
kube-system        kube-scheduler-master                      1/1     Running   1          4m14s
tigera-operator    tigera-operator-76c4974c85-cf7j4           1/1     Running   0          2m19s
```

Step 13: Test with NGINX

kubectl create deployment nginx --image=nginx

kubectl expose deployment nginx --port=80 --type=NodePort

kubectl get svc nginx

```
Harish@harish-master:~$ kubectl create deployment nginx --image=nginx
deployment.apps/nginx created
Harish@harish-master:~$ kubectl expose deployment nginx --port=80 --type=NodePort
service/nginx exposed
Harish@harish-master:~$ kubectl get svc nginx
NAME    TYPE       CLUSTER-IP     EXTERNAL-IP   PORT(S)        AGE
nginx   NodePort   10.96.159.65   <none>        80:30407/TCP   13s
Harish@harish-master:~$ kubectl get pods
NAME                     READY   STATUS    RESTARTS   AGE
nginx-7854ff8877-mnstj   1/1     Running   0          34s
Harish@harish-master:~$ kubectl get pods -o wide
NAME                     READY   STATUS    RESTARTS   AGE   IP               NODE           NOMINATED NODE   READINESS GATES
nginx-7854ff8877-mnstj   1/1     Running   0          44s   192.168.140.195   bantu-worker1   <none>           <none>
```

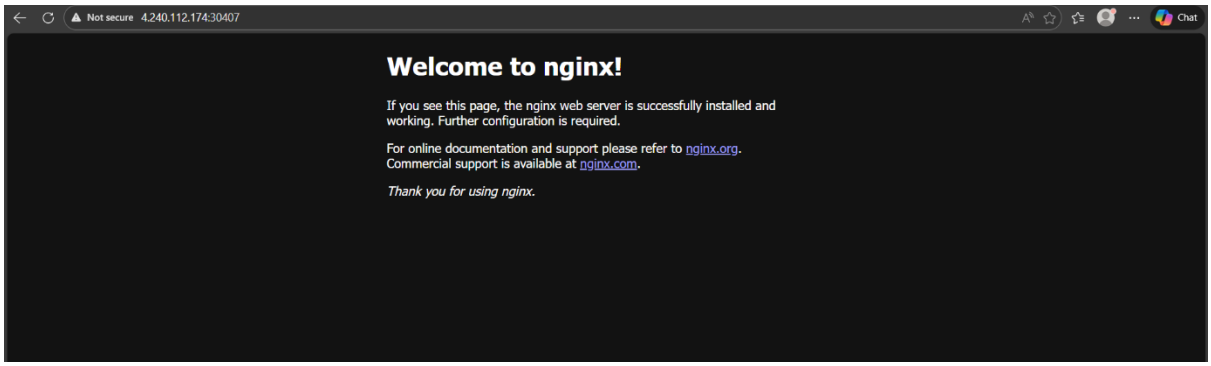
```
Harish@harish-master:/usr/share$ kubectl get all
NAME                         READY   STATUS    RESTARTS   AGE
pod/nginx-7854ff8877-mnstj   1/1     Running   0          19m

NAME                 TYPE        CLUSTER-IP     EXTERNAL-IP   PORT(S)        AGE
service/kubernetes   ClusterIP   10.96.0.1      <none>        443/TCP        27m
service/nginx        NodePort    10.96.159.65   <none>        80:30407/TCP   19m

NAME                    READY   UP-TO-DATE   AVAILABLE   AGE
deployment.apps/nginx   1/1     1            1           19m

NAME                               DESIRED   CURRENT   READY   AGE
replicaset.apps/nginx-7854ff8877   1         1         1       19m
```

Then access: **[http://[WORKER_PUBLIC_IP]:[NODE_PORT]]**



scaled the pods in your nginx deployment.

- The deployment now runs multiple replicas (pods), ensuring higher availability and load distribution.
- Kubernetes automatically scheduled the pods across your worker nodes (bantu-worker1 and chintu-worker2).
- Your NodePort service (30407) is load-balancing traffic between these pods, so requests to the public IP of any node on port 30407 will be distributed seamlessly.

This confirms that scaling is working correctly and your cluster is now capable of handling more traffic with redundancy.

```
Harish@harish-master:~$ kubectl scale deployment nginx --replicas=2
deployment.apps/nginx scaled
```

```
Harish@harish-master:~$ kubectl get nodes -o wide
NAME             STATUS   ROLES           AGE   VERSION   INTERNAL-IP   EXTERNAL-IP   OS-IMAGE             KERNEL-VERSION      CONTAINER-RUNTIME
bantu-worker1    Ready    <none>          37m   v1.29.6   10.0.1.4      <none>        Ubuntu 24.04.4 LTS   6.14.0-1017-azure   containerd://1.7.14
chintu-worker2   Ready    <none>          37m   v1.29.6   10.0.2.4      <none>        Ubuntu 24.04.4 LTS   6.14.0-1017-azure   containerd://1.7.14
master           Ready    control-plane   40m   v1.29.6   10.0.0.4      <none>        Ubuntu 24.04.4 LTS   6.14.0-1017-azure   containerd://1.7.14
Harish@harish-master:~$ kubectl get pods -o wide
NAME                     READY   STATUS    RESTARTS   AGE   IP               NODE             NOMINATED NODE   READINESS GATES
nginx-7854ff8877-kqvwv   1/1     Running   0          35s   192.168.161.67   chintu-worker2   <none>           <none>
nginx-7854ff8877-mnstj   1/1     Running   0          32m   192.168.140.195  bantu-worker1    <none>           <none>
Harish@harish-master:~$ kubectl get all
NAME                         READY   STATUS    RESTARTS   AGE
pod/nginx-7854ff8877-kqvwv   1/1     Running   0          72s
pod/nginx-7854ff8877-mnstj   1/1     Running   0          33m

NAME                 TYPE        CLUSTER-IP      EXTERNAL-IP   PORT(S)        AGE
service/kubernetes   ClusterIP   10.96.0.1       <none>        443/TCP        40m
service/nginx        NodePort    10.96.159.65    <none>        80:30407/TCP   32m

NAME                    READY   UP-TO-DATE   AVAILABLE   AGE
deployment.apps/nginx   2/2     2            2           33m

NAME                               DESIRED   CURRENT   READY   AGE
replicaset.apps/nginx-7854ff8877   2         2         2       33m
```

Then access: **[http://[WORKER_PUBLIC_IP]:[NODE_PORT]]**