BareMetal Kubernetes cluster Setup on AWS Using Kubeadm

- Current Kubernetes Version is **v1.22**
- If you are using bare-metal servers or virtual machines (VMs), **Kubeadm** is a good fit
- If you're running on cloud environments, **kops** and **Kubespray** can ease Kubernetes installation, as well as integration with the cloud providers.
- If you want to drop the burden of managing the Kubernetes control plane, almost all cloud providers have their Kubernetes managed services, such as **Google Kubernetes Engine (GKE)**, **Amazon Elastic Kubernetes Service (EKS), Azure Kubernetes Service (AKS)** etc
- If you just want a playground to study Kubernetes, **Minikube** and **Kind** can help you spin up a Kubernetes cluster in minutes.
- Browser based labs: https://www.katacoda.com/courses/kubernetes

Prerequisites

- A compatible Linux hosts
- 2 GB or more of RAM per machine and 2 CPUs or more
- 4 - Ubuntu Serves
    - 1x Manager (4GB RAM, 2 vCPU) **t2.medium** type
    - 3x Workers (1 GB, 1 Core) **t2.micro** type
- Full network connectivity between all machines in the cluster
- Unique hostname, MAC address for each host. Change hostname of the servers at **`/etc/hostname`** or using **`hostnamectl.`** Use **`Master`** for Master nodes and **`worker_01`**, **`worker_02`** and so on for worker nodes
- Swap disabled. You MUST disable swap in order for the kubelet to work properly
- Certain ports are open on your machines(https://kubernetes.io/docs/reference/ports-and-protocols/)

    - **Master**

      Port range Purpose
      6443 These ports are used for Kubernetes API access.
      2379-2380 These ports are used for etcd server client API
      6783/tcp,6784/udp for Weavenet CNI
      10250 This port is used for Kubelet API
      10251 This port is used for kube-scheduler
      10252 This port is used for kube-controller-manager
      10255 Read-Only Kubelet API
      10248 Kubelet health
      80 For accessing demo apps
      8080
      443

Control plane

Protocol	Direction	Port Range	Purpose	Used By
TCP	Inbound	6443	Kubernetes API server	All
TCP	Inbound	2379-2380	etcd server client API	kube-apiserver, etcd
TCP	Inbound	10250	Kubelet API	Self, Control plane
TCP	Inbound	10259	kube-scheduler	Self
TCP	Inbound	10257	kube-controller-manager	Self

IP version	Type	Protocol	Port range	Source
IPv4	Custom TCP	TCP	10250 - 10260	0.0.0.0/0
IPv4	Custom TCP	TCP	6443	0.0.0.0/0
IPv4	HTTPS	TCP	443	0.0.0.0/0
IPv6	Custom TCP	TCP	6443	::/0
IPv4	Custom TCP	TCP	30000 - 32767	0.0.0.0/0
IPv6	HTTP	TCP	80	::/0
IPv6	Custom TCP	TCP	10250 - 10260	::/0
IPv6	Custom TCP	TCP	2379 - 2380	::/0
IPv6	Custom TCP	TCP	6783	::/0
IPv4	SSH	TCP	22	0.0.0.0/0
IPv4	HTTP	TCP	80	0.0.0.0/0
IPv6	HTTPS	TCP	443	::/0
IPv6	Custom UDP	UDP	6784	::/0
IPv4	Custom TCP	TCP	6783	0.0.0.0/0
IPv4	Custom TCP	TCP	2379 - 2380	0.0.0.0/0
IPv4	Custom UDP	UDP	6784	0.0.0.0/0
IPv6	Custom TCP	TCP	30000 - 32767	::/0

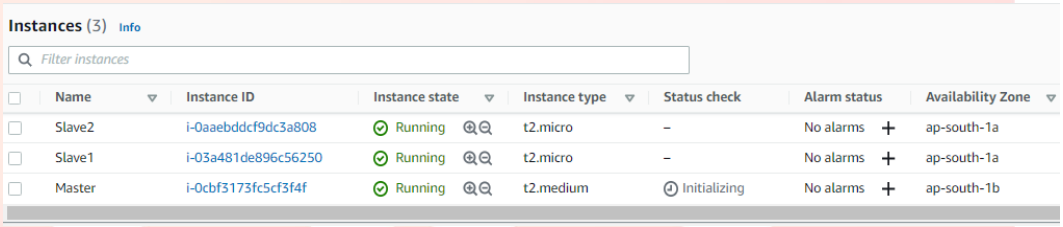
- **Worker**

Port range Purpose
10250 This port is used for Kubelet API
10255 Read-Only Kubelet API
30000-32767 NodePort Services
6783/tcp,6784/udp for Weavenet
80,6443,22,10250-10260,30000-32767

Worker node(s)

Protocol	Direction	Port Range	Purpose	Used By
TCP	Inbound	10250	Kubelet API	Self, Control plane
TCP	Inbound	30000-32767	NodePort Services†	All

IP version	Type	Protocol	Port range	Source
IPv6	Custom TCP	TCP	6783	::/0
IPv4	HTTP	TCP	80	0.0.0.0/0
IPv4	Custom TCP	TCP	10250 - 10260	0.0.0.0/0
IPv6	Custom TCP	TCP	10250 - 10260	::/0
IPv6	Custom TCP	TCP	6443	::/0
IPv4	SSH	TCP	22	0.0.0.0/0
IPv4	Custom TCP	TCP	30000 - 32767	0.0.0.0/0
IPv4	Custom UDP	UDP	6784	0.0.0.0/0
IPv4	Custom TCP	TCP	6783	0.0.0.0/0
IPv4	Custom TCP	TCP	6443	0.0.0.0/0
IPv6	Custom UDP	UDP	6784	::/0
IPv6	Custom TCP	TCP	30000 - 32767	::/0
IPv6	HTTP	TCP	80	::/0



Common Steps for Master & Workers

1. Run all commands as **sudo**
2. Install Docker & required packages

```
sudo su
apt update -y
apt install -y apt-transport-https ca-certificates curl software-properties-common
curl -fsSL https://download.docker.com/linux/ubuntu/gpg | sudo apt-key add -
add-apt-repository "deb [arch=amd64] https://download.docker.com/linux/ubuntu bionic stable"
apt update -y
apt-cache policy docker-ce
apt install -y docker-ce
```

3. Configure the Docker daemon, in particular to use systemd for the management of the container's cgroups

```
mkdir /etc/docker
cat <<EOF | sudo tee /etc/docker/daemon.json
{
  "exec-opts": ["native.cgroupdriver=systemd"]
}
EOF
systemctl enable --now docker
usermod -aG docker ubuntu
systemctl restart docker
```

4. Turn off swap space

```
swapoff -a
```

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

5. Ensure net.bridge.bridge-nf-call-iptables is set to 1 in your sysctl config (https://kubernetes.io/docs/setup/production-environment/tools/kubeadm/install-kubeadm/#letting-iptables-see-bridged-traffic)
   sysctl net.bridge.bridge-nf-call-iptables=1

6. Install kubectl, kubelet and kubeadm
   apt-get update && sudo apt-get install -y apt-transport-https curl
   curl -s https://packages.cloud.google.com/apt/doc/apt-key.gpg | sudo apt-key add -
   cat <<EOF | sudo tee /etc/apt/sources.list.d/kubernetes.list
   deb https://apt.kubernetes.io/ kubernetes-xenial main
   EOF
   apt update -y
   apt install -y kubelet kubeadm kubectl
7. apt-mark hold is used so that these packages will not be updated/removed automatically
   sudo apt-mark hold kubelet kubeadm kubectl
8. Setup kubectl autocompletion
   echo "source <(kubectl completion bash)" >> ~/.bashrc

On Master node

1. Start the cluster using Kubeadm init. This will print a join token. Take backup of that token (https://www.mankier.com/1/kubeadm-init)
   kubeadm config images pull
   kubeadm init
2. Save the kube config to ubuntu's home directory. Switch to ubuntu or type exit from root mode
   mkdir -p $HOME/.kube
   sudo cp -i /etc/kubernetes/admin.conf $HOME/.kube/config
   sudo chown $(id -u):$(id -g) $HOME/.kube/config
3. Install any CNI plugin
   kubectl apply -f "https://cloud.weave.works/k8s/net?k8s-version=$(kubectl version | base64 | tr -d '\n')"

On Slave node

1. Copy the join token obtained from **kubeadm init** output to all Workers node and run it. Example
   **kubeadm join **
   192.168.56.2:6443 --token … --discovery-token-ca-cert-hash sha256:….

Test the setup

1. On master node, run
   kubectl get nodes

Demo App

kubectl run nginx --image=nginx --port=80
kubectl expose pod nginx --port=80 --type=NodePort
Go to browser, visit **http://<master-ip>:<NodePort>** to check the nginx default page.
Make sure the port range 30000-32767 is opened on all/master node

Get PodCIDR

- kubectl get nodes -o jsonpath='{.items[*].spec.podCIDR}'
- kubectl cluster-info dump | grep -m 1 cluster-cidr
-

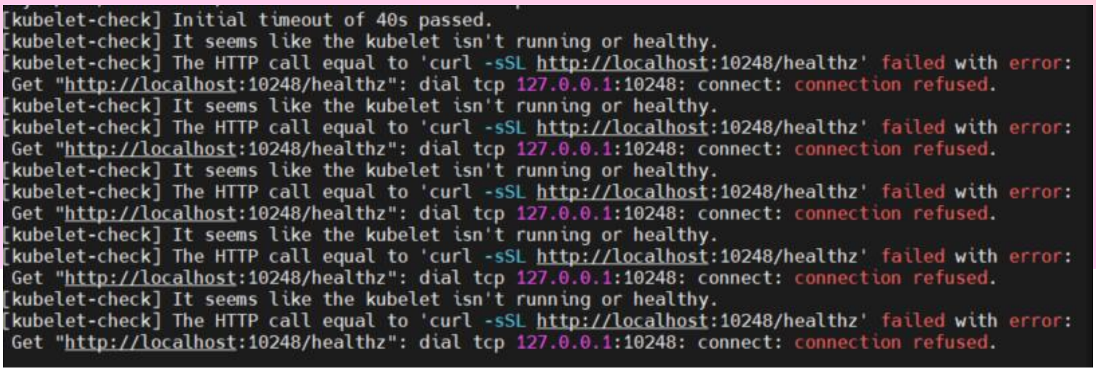
Setup Dashboard

- K8dash/Skooner: https://github.com/skooner-k8s/skooner

References

- https://kubernetes.io/docs/setup/production-environment/tools/kubeadm/install-kubeadm/
- https://kubernetes.io/docs/setup/production-environment/tools/kubeadm/create-cluster-kubeadm/
- https://www.mirantis.com/blog/how-install-kubernetes-kubeadm/
- https://www.mankier.com/1/kubeadm-init
- https://kubernetes.io/docs/setup/production-environment/container-runtimes/#docker
- https://www.weave.works/docs/net/latest/kubernetes/kube-addon/#install
- https://github.com/skooner-k8s/skooner
- https://www.weave.works/docs/net/latest/kubernetes/kube-addon/#eks

Common Errors



```
[kubelet-check] Initial timeout of 40s passed.
[kubelet-check] It seems like the kubelet isn't running or healthy.
[kubelet-check] The HTTP call equal to 'curl -sSL http://localhost:10248/healthz' failed with error:
 Get "http://localhost:10248/healthz": dial tcp 127.0.0.1:10248: connect: connection refused.
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- **kubeadm reset**