R5 Installation Guide

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Overview

The purpose of this blueprint is an end-to-end technology solution for mobile game deployed across multiple heterogeneous edge nodes using various network access protocols such as mobile and WiFi and others. This blueprint demonstrates how an application leverages a distributed and multi access network edge environment in order to get all the benefits of edge computing.

This is the very first release of this new blueprint as part of the Akraino PCEI family. Current focus for this release is to enable open source Karmada based cloud federation & kubeEdge/EdgeMesh based East-West networking functionality.

Multi-cluster Management

Environmental Information (CentOS8.0 4U8G)

Username & Password: root/Akraino2021

CPU Name	Role	IP	Workload
kubeedge-karamda-001	Karmada Control Plane	159.138.22.176	Karmada controllers, karmada api
kubeedge-karamda-002	Cluster02	182.160.12.59	K8s, docker
kubeedge-karamda-003	Cluster01	159.138.43.243	K8s, docker

Deployment Manual

Karmada control plane deployment

- **Disable boot firewall**

systemctl disable firewalld

- **Install Docker**

yum install wget container-selinux -y

wget https://download.docker.com/linux/centos/7/x86_64/stable/Packages/containerd.io-1.2.6-3.3.el7.x86_64.rpm

yum erase runc -y

rpm -ivh containerd.io-1.2.6-3.3.el7.x86_64.rpm

Note: The above steps do not need to be operated in centos7

update-alternatives --set iptables /usr/sbin/iptables-legacy

yum install -y yum-utils device-mapper-persistent-data lvm2 && yum-config-manager --add-repo https://download.docker.com/linux/centos/docker-ce.repo && yum makecache

yum -y install docker-ce

systemctl enable docker.service && systemctl start docker

- **Install Kind**

curl –Lo ./kind https://kind.sigs.k8s.io/d1/v0.10.0/kind-linux-amd64

chmod +x ./kind

mv ./kind /usr/local/bin/kind

kind version

- **Install Go and configure the Golang environment**

wget https://golang.google.cn/dl/go1.17.0.linux-amd64.tar.gz

tar –zxvf go1.17.0.linux-amd64.tar.gz –C /usr/local

vi /etc/profile

Add at the end of file:

golang env

export GOROOT=/usr/local/go

export GOPATH=/data/gopath

export PATH=$PATH:$GOROOT/bin:$GOPATH/bin

source /etc/profile

mkdir -p /data/gopath && cd /data/gopath

mkidr –p src pkg bin

- **Configure yum source**

cat <<EOF > /etc/yum.repos.d/kubernetes.repo

[kubernetes]

name=Kubernetes

baseurl=https://mirrors.aliyun.com/kubernetes/yum/repos/kubernetes-el7-x86_64

enabled=1

gpgcheck=1

repo_gpgcheck=1

gpgkey=https://mirrors.aliyun.com/kubernetes/yum/doc/yum-key.gpg https://mirrors.aliyun.com/kubernetes/yum/doc/rpm-package-key.gpg

EOF

- **Install KubeCtl**

yum makecache

yum instal –y kubectl

- **Install Karmada control plane components**

git clone https://github.com/karmada-io/karmada

cd karmada

hack/local-up-karmada.sh

Edge cluster deployment

- **Disable boot firewall**

systemctl disable firewalld

- **Install Docker**

yum install wget container-selinux -y

wget https://download.docker.com/linux/centos/7/x86_64/stable/Packages/containerd.io-1.2.6-3.3.el7.x86_64.rpm

yum erase runc -y

rpm -ivh containerd.io-1.2.6-3.3.el7.x86_64.rpm

Note: The above steps do not need to be operated in centos7

update-alternatives --set iptables /usr/sbin/iptables-legacy

yum install -y yum-utils device-mapper-persistent-data lvm2 && yum-config-manager --add-repo https://download.docker.com/linux/centos/docker-ce.repo && yum makecache

yum -y install docker-ce

systemctl enable docker.service && systemctl start docker

- **Configure yum source**

[root@kubeEdge-cloud ~]# cat <<EOF > /etc/yum.repos.d/kubernetes.repo

[kubernetes]

name=Kubernetes

baseurl=https://mirrors.aliyun.com/kubernetes/yum/repos/kubernetes-el7-x86_64

enabled=1

gpgcheck=1

repo_gpgcheck=1

gpgkey=https://mirrors.aliyun.com/kubernetes/yum/doc/yum-key.gpg https://mirrors.aliyun.com/kubernetes/yum/doc/rpm-package-key.gpg

EOF

- **Install KubeAdm, KubeCtl**

yum makecache

yum install kubelet-1.21.0-0.x86_64 kubeadm-1.21.0-0.x86_64 kubectl-1.21.0-0.x86_64

- **Configure the kernel parameters**

[root@kubeEdge-cloud ~]# cat <<EOF > /etc/sysctl.d/k8s.conf

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

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

vm.swappiness=0

EOF

[root@kubeEdge-cloud ~]# sysctl --system

[root@kubeEdge-cloud ~]# modprobe br_netfilter

[root@kubeEdge-cloud ~]# sysctl -p /etc/sysctl.d/k8s.conf

Load ipvs related kernel modules

If you reboot, you need to reload (it can be written in /etc/rc.local to automatically load at boot)

[root@ke-cloud ~]# modprobe ip_vs

[root@ke-cloud ~]# modprobe ip_vs_rr

[root@ke-cloud ~]# modprobe ip_vs_wrr

[root@ke-cloud ~]# modprobe ip_vs_sh

[root@ke-cloud ~]# modprobe nf_conntrack_ipv4

Check whether the loading is successful

[root@ke-cloud ~]# lsmod | grep ip_vs

- **Pull Mirror**

[root@kubeEdge-cloud ~]# kubeadm config images list

[root@kubeEdge-cloud ~]# kubeadm config images pull

- **Install Kubelet**

1Get docker cgroups

DOCKER_CGROUPS=$(docker info | grep 'Cgroup Driver' | cut -d' ' -f4)

echo $DOCKER_CGROUPS

cgroupfs

2Configure cgroups for kubelet

cat >/etc/sysconfig/kubelet<<EOF

KUBELET_EXTRA_ARGS="--cgroup-driver=$DOCKER_CGROUPS --pod-infra-container-image=k8s.gcr.io/pause:3.5"

EOF

3Start kubelet

systemctl daemon-reload

systemctl enable kubelet && systemctl start kubelet

- **Initialize the cluster**

kubeadm init --kubernetes-version=v1.17.9 \

--pod-network-cidr=10.244.0.0/16 \

--apiserver-advertise-address=192.168.0.238 \

--ignore-preflight-errors=Swap

- **Install network plugin**

1Download the yaml file of flannel plug-in.

cd ~ && mkdir flannel && cd flannel

curl -O https://raw.githubusercontent.com/coreos/flannel/master/Documentation/kube-flannel.yml

2Startup

kubectl apply -f ~/flannel/kube-flannel.yml

- **Log in to the karmada-host node and join the multi-cluster (the karmada.config below refers to the kubeconfig of the existing k8s cluster)**

hack/create-cluster.sh member1 $HOME/.kube/karmada.config
go get github.com/karmada-io/karmada/cmd/karmadactl

karmadactl join cluster01--cluster-kubeconfig=$HOME/.kube/karmada.config

Nginx application deployment

- Create nginx deployment

```
apiVersion: apps/v1
kind: Deployment
metadata:
  name: nginx
  labels:
    app: nginx
spec:
  selector:
    matchLabels:
      app: nginx
  template:
    metadata:
      labels:
        app: nginx
    spec:
      containers:
      - image: nginx
        name: nginx
```

- Create the nginx propagation policy

```
apiVersion: policy.karmada.io/v1alpha1
kind: PropagationPolicy
metadata:
  name: nginx-propagation
spec:
  resourceSelectors:
    - apiVersion: apps/v1
      kind: Deployment
      name: nginx
  placement:
    clusterAffinity:
      clusterNames:
        - karmada-cluster-01
```

East-West Edge-to-Edge Networking

Environmental Information (CentOS8.0 4U8G)

Username & Password: root/Akraino2021

CPU Name	Role	IP	Workload
Kubeedge-akraino-0001	Cloud	159.138.149.190	K8S, docker, cloudcore
Kubeedge-akraino-0002	Edge Node	119.8.35.111	docker, edgecore, edgemesh
Kubeedge-akraino-0003	Edge Node	182.160.10.130	docker, edgecore, edgemesh

Deployment Manual

Deploy cloud nodes (kubeEdge-cloud)

- **Disable boot firewall**

systemctl disable firewalld

- **Install Docker**

yum install wget container-selinux -y

wget https://download.docker.com/linux/centos/7/x86_64/stable/Packages/containerd.io-1.2.6-3.3.el7.x86_64.rpm

yum erase runc -y

rpm -ivh containerd.io-1.2.6-3.3.el7.x86_64.rpm

Note: The above steps do not need to be operated in centos7

update-alternatives --set iptables /usr/sbin/iptables-legacy

yum install -y yum-utils device-mapper-persistent-data lvm2 && yum-config-manager --add-repo https://download.docker.com/linux/centos/docker-ce.repo && yum makecache

yum -y install docker-ce

systemctl enable docker.service && systemctl start docker

- **Configure yum source**

[root@kubeEdge-cloud ~]# cat <<EOF > /etc/yum.repos.d/kubernetes.repo

[kubernetes]

name=Kubernetes

baseurl=https://mirrors.aliyun.com/kubernetes/yum/repos/kubernetes-el7-x86_64

enabled=1

gpgcheck=1

repo_gpgcheck=1

gpgkey=https://mirrors.aliyun.com/kubernetes/yum/doc/yum-key.gpg https://mirrors.aliyun.com/kubernetes/yum/doc/rpm-package-key.gpg

EOF

- **Install Kubeadm, kubectl**

yum makecache

yum install kubelet-1.21.0-0.x86_64 kubeadm-1.21.0-0.x86_64 kubectl-1.21.0-0.x86_64

Note: The current KubeEdge version does not match the 1.22 version of K8s, and the latest version cannot be installed.

- **Configure the kernel parameters**

[root@kubeEdge-cloud ~]# cat <<EOF > /etc/sysctl.d/k8s.conf

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

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

vm.swappiness=0

EOF

[root@kubeEdge-cloud ~]# sysctl --system

[root@kubeEdge-cloud ~]# modprobe br_netfilter

[root@kubeEdge-cloud ~]# sysctl -p /etc/sysctl.d/k8s.conf

Load ipvs related kernel modules

If you reboot, you need to reload (it can be written in /etc/rc.local to automatically load at boot)

[root@ke-cloud ~]# modprobe ip_vs

[root@ke-cloud ~]# modprobe ip_vs_rr

[root@ke-cloud ~]# modprobe ip_vs_wrr

[root@ke-cloud ~]# modprobe ip_vs_sh

[root@ke-cloud ~]# modprobe nf_conntrack_ipv4

Check whether loading is successful

[root@ke-cloud ~]# lsmod | grep ip_vs

- **Pull Mirror**

[root@kubeEdge-cloud ~]# kubeadm config images list

[root@kubeEdge-cloud ~]# kubeadm config images pull

- **Initialize the cluster**

[root@ke-cloud ~]# kubeadm init --kubernetes-version=v1.17.9 \

--pod-network-cidr=10.244.0.0/16 \

--apiserver-advertise-address=192.168.0.238 \

--ignore-preflight-errors=Swap

- **Deploy Cloudcore**

Prerequisites: install golang

[root@kudeEdge-cloud ~]# git clone https://github.com/kubeedge/kubeedge $GOPATH/src/github.com/kubeedge/kubeedge

[root@kudeEdge-cloud ~]# cd $GOPATH/src/github.com/kubeedge/kubeedge

[root@kudeEdge-cloud ~]# make all WHAT=keadm

[root@kudeEdge-cloud ~]# keadm init --advertise-address="192.168.0.238"

Deploy edge nodes (edgemesh version is release1.7)

- **Install docker same as before**
- **Obtain the token on the cloud node**

[root@kudeEdge-cloud ~]# keadm gettoken

- **Install edgecore and mqtt**

[root@kudeEdge-cloud ~]# keadm join --cloudcore-ipport=192.168.1.66:10000 --token=“token”

--token="token obtained in the previous step"

- **Modify the edgecore configuration**

[root@kudeEdge-cloud ~]# vim /etc/kubeedge/config/edgecore.yaml

```
modules:
  ..
  edgeMesh:
    enable: false
  metaManager:
    metaServer:
      enable: true
..
```

- **Restart edgecore**

[root@kudeEdge-cloud ~]# systemctl restart edgecore

- **Modify cloudcore configuration and restart cloudcore**

[root@kudeEdge-cloud ~]# vim /etc/kubeedge/config/cloudcore.yaml

modules:

..

dynamicController:

enable: true

..

- **Pull EdgeMesh code and build EdgeMesh image**

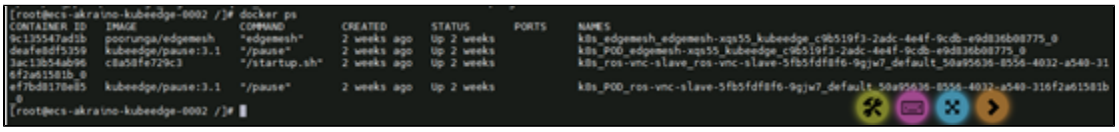
[root@kudeEdge-cloud ~]# docker build -t edgemesh:0.1 -f build/Dockerfile .

- **Deploy EdgeMesh**

Modify the following configuration file, modify service-cluster-ip-range.

[root@kudeEdge-cloud ~]# kubectl apply -f build/kubernetes/edgemesh/03-configmap.yaml

[root@kudeEdge-cloud ~]# kubectl apply -f build/kubernetes/edgemesh/04-daemonset.yaml



Deploy ROS application

- **Create ros-deployment-master.yaml and deploy**

```
apiVersion: apps/v1
kind: Deployment
metadata:
  name: ros-vnc
spec:
  selector:
    matchLabels:
      app: ros-vnc
  replicas: 1
  template:
    metadata:
      labels:
        app: ros-vnc
    spec:
      hostNetwork: true
      containers:
      - name: ros-vnc
        image: njh1195/ros-vnc:kinetic
        imagePullPolicy: IfNotPresent
        ports:
        - containerPort: 80
      nodeSelector:
       ros: master
```

- **Create ros-deployment-slave.yaml and deploy**

```yaml
apiVersion: apps/v1
kind: Deployment
metadata:
  name: ros-vnc-slave
spec:
  selector:
    matchLabels:
      app: ros-vnc-slave
  replicas: 1
  template:
    metadata:
      labels:
        app: ros-vnc-slave
    spec:
      hostNetwork: true
      containers:
      - name: ros-vnc-slave
        image: njh1195/ros-vnc:kinetic
        imagePullPolicy: IfNotPresent
      nodeSelector:
       ros: slave
```

- **Create ros-master-service.yaml and deploy**

```yaml
apiVersion: v1
kind: Service
metadata:
  name: ros-vnc-service
  labels:
    app: ros-vnc
spec:
  selector:
    app: ros-vnc
  ports:
    - name: tcp-0
      protocol: TCP
      port: 11311
      targetPort: 11311
```

- **ros application master node operation**
    - Open the master node page, http://182.160.10.130:80
    - Refer to the operation of https://hub.docker.com/r/njh1195/ros-vnc:
        - Open the terminal page and execute "roscore" to start roscore
        - Open the second terminal page and execute "roslaunch turtlebot3_gazebo multi_turtlebot3.launch”
        - multi_turtlebot3.launch" to start three simulation robots
        - Open the third terminal page and execute "ROS_NAMESPACE=tb3_0 roslaunch
        - turtlebot3_slam turtlebot3_gmapping.launch set_base_frame:=tb3_0/base_footprint set_odom_frame:=tb3_0/odom set_map_frame:=tb3_0/map”, set_map_frame:=tb3_0/map" to start the first robot scan on the master node.
        - Open the fourth terminal page and execute "roslaunch turtlebot3_gazebo
        - multi_map_merge.launch" to open the merge program.
        - Generate a point source map and execute "rosrun rviz rviz -d `rospack find
        - turtlebot3_gazebo`/rviz/multi_turtlebot3_slam.rviz”

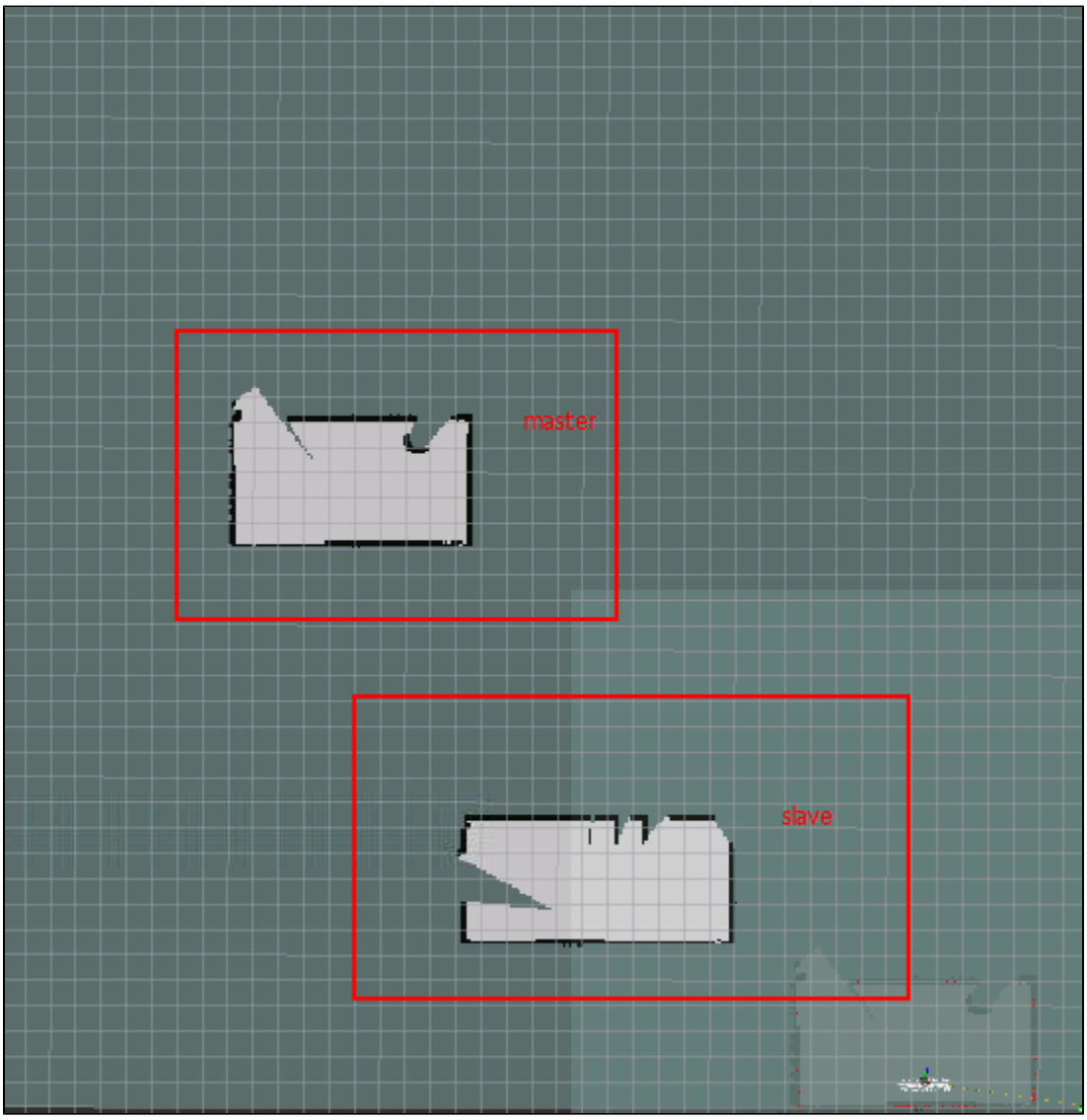
- **ros application master node operation**
    - Open the slave node page, http://159.138.49.1:80
    - Refer to the operation of https://hub.docker.com/r/njh1195/ros-vnc:
        - Open the terminal page and configure ros-master's access service. The file is in /root/.bashrc.

          Add the following configuration at the end of the file to configure the master access address and slave address:

          ```
          export ROS_MASTER_URI=http://ros-vnc-service.default:11311
          export ROS_IP=159.138.49.1
          ```

        - Open the second terminal page and execute "ROS_NAMESPACE=tb3_1 roslaunch
        - turtlebot3_slam turtlebot3_gmapping.launch

          set_base_frame:=tb3_1/base_footprint set_odom_frame:=tb3_1/odom

set_map_frame:=tb3_1/map", open the graphic scan of another room.

- Check whether the point source graph is Merged in the master node.