

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-karmada-001	Karmada Control Plane	159.138.22.176	Karmada controllers, karmada api
kubeedge-karmada-002	Cluster02	182.160.12.59	K8s, docker
kubeedge-karmada-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
```

```
# mkdir -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, edgemes
Kubeedge-akraino-0003	Edge Node	182.160.10.130	docker, edgecore, edgemes

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@kubernetes-cloud ~]# kubeadm config images list
```

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

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

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

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

Deploy edge nodes (edgework version is release1.7)

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

```
[root@kubernetes-cloud ~]# keadm gettoken
```

- **Install edgework and mqtt**

```
[root@kubernetes-cloud ~]# keadm join --cloudcore-ipport=192.168.1.66:10000 --token="token"
--token="token obtained in the previous step"
```

- **Modify the edgework configuration**

```
[root@kubernetes-cloud ~]# vim /etc/kubeedge/config/edgework.yaml
```

modules:

..

edgeMesh:

enable: false

metaManager:

metaServer:

enable: true

..

- **Restart edgework**

```
[root@kubernetes-cloud ~]# systemctl restart edgework
```

- **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
```

```
[root@ecs-akr-ino-kubeedge-0002 /]# docker ps
CONTAINER ID        IMAGE               COMMAND             CREATED             STATUS              PORTS              NAMES
9c135547ad1b       pooruqa/edgemesh   "edgemesh"         2 weeks ago        Up 2 weeks          0.0.0.0:8080->8080   k8s_edgemesh-edgemesh-xqs55_kubeedge_c96519f3-2adc-4e4f-9c0b-e9d836b08775_0
deafe8df5359       kubeedge/pause:3.1 "/pause"           2 weeks ago        Up 2 weeks          0.0.0.0:8080->8080   k8s_POD_edgemesh-xqs55_kubeedge_c96519f3-2adc-4e4f-9c0b-e9d836b08775_0
3ac13654ab96       cba58fe729c3       "/startup.sh"       2 weeks ago        Up 2 weeks          0.0.0.0:8080->8080   k8s_ros-vnc-slave_ros-vnc-slave-5fb5fdf8f6-9gjw7_default_50a95636-8556-4032-a540-31
ef2a61581b_0
ef7b88178a85       kubeedge/pause:3.1 "/pause"           2 weeks ago        Up 2 weeks          0.0.0.0:8080->8080   k8s_POD_ros-vnc-slave-5fb5fdf8f6-9gjw7_default_50a95636-8556-4032-a540-316f2a61581b_0
[root@ecs-akr-ino-kubeedge-0002 /]#
```

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


```

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

```

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 "roslaunch 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.

