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## Introduction

This document describes how to deploy blueprints from Akraino's KNI Blueprint Family. It is common to all blueprints in that family, unless otherwise noted.

## License

All our code is released under Apache license: <https://www.apache.org/licenses/LICENSE-2.0.html>

# How to use this document

This document describes the generic installation for our KNI blueprint family. Specific documentation is provided for Provider Access Edge and Industrial Edge blueprints. See [KNI PAE Installation Guide](#)

## Deployment architecture

See [KNI PAE Architecture document](#)

## Pre-Installation Requirements

### Resource Requirements

The resource requirements for deployment depend on the specific blueprint and deployment target. Please see:

- [Provider Access Edge \(PAE\)](#)
- [Industrial Edge blueprint](#)

### Pre-Requisites for Deploying to AWS

For deploying a KNI blueprint to AWS, you need to

- add a public hosted DNS zone for the cluster to Route53,
- validate your AWS quota in the chosen region is sufficient,
- set up an API user account with the necessarily IAM privileges.

Please see the [upstream documentation](#) for details.

Store the `aws-access-key-id` and `aws-secret-access-key` in a credentials file inside `$HOME/.aws`, with the following format:

```
[default]
aws_access_key_id=xxx
aws_secret_access_key=xxx
```

### Pre-Requisites for Deploying to Bare Metal

The baremetal UPI install can be optionally automated when using knictl (see below). When attempting a manual baremetal UPI install, however, please be sure to read: [https://docs.openshift.com/container-platform/4.4/installing/installing\\_bare\\_metal/installing-bare-metal.html](https://docs.openshift.com/container-platform/4.4/installing/installing_bare_metal/installing-bare-metal.html)

### Minimum hardware requirements

This is minimal configuration example where only 3 servers are used. Servers and their role are given in below table.

| S<br>e<br>r<br>v<br>e<br>r# | Ro<br>le                      | Purpose  |
|-----------------------------|-------------------------------|--|
| 1                           | Ins<br>tall<br>er<br>no<br>de | This host is used for remotely installing and configuring master and worker node. This server also hosts bootstrap node on KVM-QEMU using libvirt. Several components like- HAProxy, DNS server, DHCP server for provisioning and baremetal network, CoreDNS, Matchbox, Terraform, IPMITool, TFTPboot are configured on this server. Since cluster coreDNS is running from here, this node will be required later as well. |
| 2                           | Ma<br>ste<br>r<br>no<br>de    | This is control plane or master node of K8s cluster that is based on openshift 4.x.  |
| 3                           | Wo<br>rke<br>r<br>no<br>de    | This is worker node which hosts the application.   |

|   |                               |   |
|---|-------------------------------|---|
| 4 | Boots<br>tra<br>p<br>no<br>de | Bootstrap node <b>runs as VM on installer node</b> and it exists only during the installation and later automatically deleted by installer. |
|---|-------------------------------|---|

## Other installation requirements

### Network requirements

Each server should have 3 Ethernet ports configured, purpose of these is listed below. **These three are in addition to IPMI port, which is required for PXE boot.**

| Interface              | Purpose   |
|------------------------|---|
| Management interface   | Remote root login from this interface is used for entire setup. This interface needs to have internet connectivity to download various files. This can be shared with external interface. This only needs to be present on the Installer node |
| External interface     | Interface on the installer node that has internet network connectivity. All external traffic from masters/workers is redirected to the external interface of the installer node.  |
| Baremetal interface    | This interface is for baremetal network, also known as SDN network. This interface doesn't need internet connectivity.  |
| Provisioning interface | This interface is for PXE boot. This interface doesn't need internet connectivity.  |

These can be independent NICs or VLANs.

Configure required network interfaces as explained earlier. Be sure that each server has the NIC for PXE configured properly, matching to the interface that you are setting for this deployment. You can set it by entering the BIOS setup, and entering into the NIC configuration of your BIOS setup menu.

Collect IPs and MAC addresses of all the nodes, one sample is given below. This information will be required to populate config files:

| Role      | iDRAC IP/IPMI port IP | Provisioning network IP | Baremetal network IP | Management network IP | Provisioning network port & mac | Baremetal network port & mac | Management network port & mac |
|-----------|-----------------------|-------------------------|----------------------|-----------------------|---------------------------------|------------------------------|-------------------------------|
| Installer | xx.xx.xx.xx           | xx.xx.xx.xx             | xx.xx.xx.xx          | xx.xx.xx.xx           | em1 / 21:02:0E:DC:BC:27         | em2/ 21:02:0E:DC:BC:28       | em3/ 21:02:0E:DC:BC:29        |
| master-0  |                       |                         |                      |                       |                                 |                              |                               |
| worker-0  |                       |                         |                      |                       |                                 |                              |                               |

Enable IPMI over LAN for all master and worker nodes. This is required for remote PXE boot from installer node. Different servers have different ways to enable it.

In absence of this setting, following kind of errors are thrown from installer.

```
Error: Error running command ' ipmitool -I lanplus -H x.x.x.x -U xxx -P xxxxx chassis bootdev pxe;
ipmitool -I lanplus -H x.x.x.x -U xxx -P xxxxx power cycle || ipmitool -I lanplus -H x.x.x.x -U xxx -P xxxxx power on;
': exit status 1. Output: Error: Unable to establish IPMI v2 / RMCP+ session
Error: Unable to establish IPMI v2 / RMCP+ session
Error: Unable to establish IPMI v2 / RMCP+ session
Depending on servers, RMCP session needs to be enabled on security settings of the management console.
```

After enabling this setting, you can run below command to verify that it is working as expected. Give IP address, username and password.

```
ipmitool -I lanplus -H x.x.x.x -U xxx -P xxxxx chassis status
```

(where x.x.x.x is IPMI port IP of your master/worker node, this is followed by root username and password for IPMI e.g. iDRAC)

### Bare metal node requirements

| Node Role | OS requirement |
|-----------|----------------|
|-----------|----------------|

|           |                             |
|-----------|-----------------------------|
| Installer | CentOS 7.6 and above        |
| Bootstrap | RHCOS (Redhat CoreOS)       |
| Master    | RHCOS (Redhat CoreOS)       |
| Worker    | RHCOS/RHEL/CentOS/CentOS-rt |

## Pre-Requisites for Deploying to Google Cloud Platform

For deploying a KNI blueprint to GCP, you need to:

- enable service APIs
- setup DNS
- ensure sufficient quota
- create a installer service account

Please, see the [upstream documentation](#) for details. As mentioned in the KNI installer repo, the service account JSON file should be located inside \$HOME/.gcp with the name osServiceAccount.json.

## Pre-Requisites for Deploying to Libvirt

### Minimum hardware requirements

Only one server is needed, that will be acting as a virthost. Master and worker VMs will be created there

| S<br>e<br>r<br>v<br>e<br>r<br># | Ro<br>le                      | Purpose  |
|---------------------------------|-------------------------------|--|
| 1                               | Inst<br>all<br>er<br>no<br>de | This host is used for remotely installing and configuring master and worker node. This server also hosts bootstrap node on KVM-QEMU using libvirt. Several components like- HAProxy, DNS server, DHCP server for provisioning and baremetal network, CoreDNS, Matchbox, Terraform, IPMItool, TFTPboot are configured on this server. Since cluster coreDNS is running from here, this node will be required later as well. |

### Network requirements

Network connectivity will be the same as the baremetal case, but these can be dummy interfaces as all the network connectivity will be just inside the same host:

| Interface                 | Purpose   |
|---------------------------|---|
| Manageme<br>nt interface  | Remote root login from this interface is used for entire setup. This interface needs to have internet connectivity to download various files. This can be shared with external interface. This only needs to be present on the Installer node |
| External<br>interface     | Interface on the installer node that has internet network connectivity. All external traffic from masters/workers is redirected to the external interface of the installer node.  |
| Baremetal<br>interface    | This interface is for baremetal network, also known as SDN network. This interface doesn't need internet connectivity.  |
| Provisioning<br>interface | This interface is for PXE boot. This interface doesn't need internet connectivity.  |

### Jump host requirements

| Node Role | OS requirement       |
|-----------|----------------------|
| Installer | CentOS 7.6 and above |

## Installation high level overview

# Virtual deployment guide

## Create site for AWS and GCP

In order to deploy a blueprint, you need to create a repository with a site. The site configuration is based in [kustomize](#), and needs to use our blueprints as base, referencing that properly. Sample sites for deploying on libvirt, AWS and baremetal can be seen on: <https://github.com/akraino-edge-stack/kni-blueprint-pae/tree/master/sites>.

Site needs to have this structure:

```
.
├── 00_install-config
│   ├── install-config.name.patch.yaml
│   ├── install-config.patch.yaml
│   ├── kustomization.yaml
│   └── site-config.yaml
├── 01_cluster-mods
│   ├── kustomization.yaml
│   ├── manifests
│   └── openshift
├── 02_cluster-addons
│   └── kustomization.yaml
├── 03_services
│   └── kustomization.yaml
```

### 00\_install-config

This folder will contain the basic settings for the site, including the base blueprint/profile, and the site name/domain. The following files are needed:

- kustomization.yaml: key file, where it will contain a link to the used blueprint/profile, and a reference to the used patches to customize the site bases:

```
bases:
- git::https://gerrit.akraino.org/r/kni/blueprint-pae.git//profiles/production.aws/00_install-config

patches:
- install-config.patch.yaml

patchesJson6902:
- target:
    version: v1
    kind: InstallConfig
    name: cluster
    path: install-config.name.patch.yaml

transformers:
- site-config.yaml
```

The entry in bases needs to reference the blueprint being used (in this case blueprint-pae), and the profile install-config file (in this case production.aws/00\_install-config). The other entries need to be just written literally.

- install-config.patch.yaml: is a patch to modify the domain from the base blueprint. You need to customize with the domain you want to give to your site

```
apiVersion: v1
kind: InstallConfig
metadata:
  name: cluster
  baseDomain: devcluster.openshift.com
```

- install-config.name.patch.yaml: is a patch to modify the site name from the base blueprint. You need to customize with the name you want to give to your site

```
- op: replace
  path: "/metadata/name"
  value: kni-site
```

- `site-config.yaml`: site configuration file, you can add entries in config to override behaviour of knictl (currently just `releaseImageOverride` is supported)

```
apiVersion: kni.akraino.org/v1alpha1
kind: SiteConfig
metadata:
  name: notImportantHere
config:
  releaseImageOverride: registry.svc.ci.openshift.org/origin/release:4.4
```

NOTE: If you are deploying on baremetal, specific configuration needs to be set. This is going to be covered in a specific section for it

## 01\_cluster\_mods

This is the directory that will contain all the customizations for the basic cluster deployment. You could create patches for modifying number of masters/workers, network settings... everything that needs to be modified on cluster deployment time. It needs to have a basic **kustomization.yaml** file, that will reference the same level file for the blueprint. And you could create additional patches following kustomize syntax:

```
bases:
- git::https://gerrit.akraino.org/r/kni/blueprint-pae.git//profiles/production.aws/01_cluster-mods
```

## 02\_cluster\_addons and 03\_services

Follow same structure as 01\_cluster\_mods, but in this case is for adding additional workloads after cluster deployment. They also need to have a **kustomization.yaml** file that references the file of the same level for the blueprint, and can include additional resources and patches.

## How to deploy on AWS and GCP

The whole deployment workflow is based on knictl CLI tool that this repository is providing.

### CLI tool

The current KNI blueprints use the `openshift-install` tool from the OKD Kubernetes distro to stand up a minimal Kubernetes cluster. All other Day 1 and Day 2 operations are then driven purely through manipulation of declarative Kubernetes manifests. To use this in the context of Akraino KNI blueprints, the project has created a helper CLI tool that needs to be installed first on Installer Node.

If necessary, install [golang](#) binary (incl. GOPATH var) using following steps, you can use latest version instead of the one given below.

```
wget https://golang.org/dl/go1.13.4.linux-amd64.tar.gz
tar -C /usr/local -xzf go1.13.4.linux-amd64.tar.gz
export PATH=$PATH:/usr/local/go/bin
```

Next, install the following dependencies:

```
sudo yum install -y make gcc libvirt-devel
```

Then install the knictl:

```
mkdir -p $GOPATH/src/gerrit.akraino.org/kni
cd $GOPATH/src/gerrit.akraino.org/kni
git clone https://gerrit.akraino.org/r/kni/installer
cd installer
make build
mkdir -p $GOPATH/bin/
cp knictl $GOPATH/bin/

cp knictl /usr/local/go/bin/
```

### Secrets

Most secrets (TLS certificates, Kubernetes API keys, etc.) will be auto-generated for you, but you need to provide at least two secrets yourself:

- a public SSH key
- a pull secret

The public SSH key is automatically added to every machine provisioned into the cluster and allows remote access to that machine. In case you don't have / want to use an existing key, you can create a new key pair using:

```
ssh-keygen -t rsa -b 2048 -f ~/.ssh/id_rsa
```

The pull secret is used to download the container images used during cluster deployment. Unfortunately, the OKD Kubernetes distro used by the KNI blueprints does not (yet) provide pre-built container images for all of the deployed components. Instead of going through the hassle of building those from source, we use the ones made available by [openshift.com](https://cloud.redhat.com/openshift/install/metal/user-provisioned). Therefore, you need to go to <https://cloud.redhat.com/openshift/install/metal/user-provisioned>, log in (creating a free account, if necessary), and hit "Download Pull Secret".

Create a `$HOME/.kni` folder and copy the following files:

- `id_rsa.pub` needs to contain the public key that you want to use to access your nodes
- `pull-secret.json` needs to contain the pull secret previously copied

## 1. Fetch requirements for a site.

You need to have a site repository with the structure described above. Then, first thing is to fetch the requirements needed for the blueprint that the site references. This is achieved by:

```
./knictl fetch_requirements github.com/site-repo.git
```

Where the first argument references a site repository, following <https://github.com/hashicorp/go-getter> syntax. This will download the site repository, and will create a folder with the site name inside `$HOME/.kni`. It will also fetch all the binaries needed, and will store them inside `$HOME/.kni/$SITE_NAME/requirements` folder.

## 2. Prepare manifests for a site

NOTE: Before performing this step, you must copy your OpenShift pull secret into your build path (i.e. to `~/.kni/pull-secret.json`).

Next step is to run a procedure to prepare all the manifests for deploying a site. This is achieved by applying `kustomize` on the site repository, combining that with the base manifests for the blueprint, and doing a merge with the manifests generated by the installer at runtime. This is achieved by the following command:

```
./knictl prepare_manifests $SITE_NAME
```

This will generate a set of manifests ready to apply, and will be stored on `$HOME/.kni/$SITE_NAME/final_manifests` folder. Along with manifests, a *profile*.*env* file has been created also in `$HOME/.kni/$SITE_NAME` folder. It includes environment vars that can be sourced before deploying the cluster. Current vars that can be exported are:

- `OPENSHIFT_INSTALL_RELEASE_IMAGE_OVERRIDE` : used when a new image is wanted, instead of the default one
- `TF_VAR_libvirt_master_memory`, `TF_VAR_libvirt_master_vcpu`: Used in the libvirt case, to define the memory and CPU for the vms.

## 3. Deploy the cluster

Before starting the deployment, it is recommended to source the env vars from `profile.env`. You can achieve it with:

```
source $HOME/.kni/$SITE_NAME/profile.env
```

If you are deploying on AWS or libvirt, then you need to deploy the cluster. This can be achieved with:

```
$HOME/.kni/$SITE_NAME/requirements/openshift-install create cluster --dir=$HOME/.kni/$SITE_NAME/final_manifests
```

This will deploy a cluster based on the specified manifests. You can learn more about how to manage cluster deployment and how to interact with it on <https://docs.openshift.com/container-platform/4.4/welcome/index.html>

Specific instructions for baremetal are going to be provided later.

## 4. Apply workloads

After the cluster has been generated, the extra workloads that have been specified in manifests (like `kubevirt`), need to be applied. This can be achieved by:

```
./knictl apply_workloads $SITE_NAME
```

This will execute kustomize on the site manifests and will apply the output to the cluster. After that, the site deployment can be considered as finished.

## Bare metal deployment guide

### Create site for Baremetal

First step to start a baremetal deployment is to have a site defined, with all the network and baremetal settings defined in the yaml files. A sample of site using this baremetal automation can be seen [here](#).

In order to define the settings for a site, the first section 00\_install-config needs to be used.

Start by creating a kustomization file like the following: [https://github.com/akraino-edge-stack/kni-blueprint-pae/blob/master/sites/community.baremetal.edge-sites.net/00\\_install-config/kustomization.yaml](https://github.com/akraino-edge-stack/kni-blueprint-pae/blob/master/sites/community.baremetal.edge-sites.net/00_install-config/kustomization.yaml)

```
bases:
- git::https://gerrit.akraino.org/r/kni/blueprint-pae.git//profiles/production.baremetal/00_install-config

patches:
- install-config.patch.yaml

patchesJson6902:
- target:
    version: v1
    kind: InstallConfig
    name: cluster
    path: install-config.name.patch.yaml

transformers:
- site-config.yaml
```

In this kustomization file we are patching the default install-config, and also adding some extra files to define networking (site-config.yaml).

#### ha-lab-ipmi-creds.yaml:

This file is not shown on the site structure as it contains private content. This file should be present with given name in **00\_install-config**. It needs to have following structure:

```
apiVersion: v1
kind: Secret
metadata:
  name: community-lab-ipmi
stringdata:
  username: xxx <- base64 encoded IPMI username
  password: xxx <- base64 encoded IPMI password

type: Opaque
```

**install-config.name.patch.yaml:** [https://github.com/akraino-edge-stack/kni-blueprint-pae/blob/master/sites/community.baremetal.edge-sites.net/00\\_install-config/install-config.name.patch.yaml](https://github.com/akraino-edge-stack/kni-blueprint-pae/blob/master/sites/community.baremetal.edge-sites.net/00_install-config/install-config.name.patch.yaml)

```
- op: replace
  path: "/metadata/name"
  value: community <- replace with your cluster name here
```

**install-config.patch.yaml :** [https://github.com/akraino-edge-stack/kni-blueprint-pae/blob/master/sites/community.baremetal.edge-sites.net/00\\_install-config/install-config.patch.yaml](https://github.com/akraino-edge-stack/kni-blueprint-pae/blob/master/sites/community.baremetal.edge-sites.net/00_install-config/install-config.patch.yaml)



```

apiVersion: v1
kind: InstallConfig
baseDomain: baremetal.edge-sites.net <- domain of your site
compute:
  - name: worker
    replicas: 2 <- number of needed workers
controlPlane:
  name: master
  platform: {}
  replicas: 1 <- number of needed masters (1/3)
metadata:
  name: cluster <- Do not change this value as this is not cluster name
networking:
  clusterNetworks:
    - cidr: 10.128.0.0/14
      hostPrefix: 23
  networkType: OpenShiftSDN
  serviceNetwork:
    - 172.30.0.0/16
platform:
  none: {}
  apiVIP: 192.168.111.4 <- IP for Kubernetes api endpoint, needs to be on the range of your baremetal network
  ingressVIP: 192.168.111.3 <- IP for the Kubernetes ingress endpoint, needs to be on the range of your
baremetal network
  dnsVIP: 192.168.111.2 <- IP for the Kubernetes DNS endpoint, needs to be on the range of your baremetal network
hosts:
  # Master nodes are always RHCOS
  - name: master-0
    role: master
    bmc:
      address: ipmi://10.11.7.12 <- ipmi address for master
      credentialsName: community-lab-ipmi <- this needs to reference the name of the secret provided in
credentials.yaml
      bootMACAddress: 3C:FD:FE:CD:98:C9 <- mac address for the provisioning interface of your master
      sdnMacAddress: 3C:FD:FE:CD:98:C8 <- mac address for the baremetal interface of your master
      # sdnIPAddress: 192.168.111.11 <- Optional -- Set static IP on your baremetal for your master
      hardwareProfile: default
      osProfile:
        # With role == master, the osType is always rhcos
        # And with type rhcos, the following are settings are available
        type: rhcos
        pxe: bios <- pxe boot type either bios (default if not specified) or uefi
        install_dev: sda <- where to install the operating system (sda is the default)
  # Worker nodes can be either rhcos (default) || centos (7.x) || rhel (8.x)
  - name: worker-0
    role: worker
    bmc:
      address: ipmi://10.11.7.13
      credentialsName: community-lab-ipmi
      bootMACAddress: 3C:FD:FE:CD:9E:91
      sdnMacAddress: 3C:FD:FE:CD:9E:90
      hardwareProfile: default
      provisioning_interface: enp134s0f1 <- specify that if the provisioning interface is different than the
one you will provide on next site-config.yaml
      baremetal_interface: enp134s0f0 <- specify that if the baremetal interface is different than the one you
will provide on next site-config.yaml
      # If an osProfile/type is not defined, rhe node defaults to RHCOS
      osProfile:
        type: centos7
        # With type: rhcos the following are settings are available
        pxe: bios # pxe boot type either bios (default if not specified) or uefi
        install_dev: sda # where to install the operating system (sda is the default)
  - name: worker-1
    role: worker
    bmc:
      address: ipmi://10.11.7.14
      credentialsName: community-lab-ipmi
      bootMACAddress: 3C:FD:FE:CD:9B:81
      sdnMacAddress: 3C:FD:FE:CD:9B:80
      hardwareProfile: default
      # If an osProfile/type is not defined, rhe node defaults to RHCOS
      # osProfile:
      #   type: rhcos
      #   # With type: rhcos the following are settings are available
      #   # pxe: bios|uefi # pxe boot type either bios (default if not specified) or uefi
      #   # install_dev: sda # where to install the operating system (sda is the default)
pullSecret: 'PULL_SECRET' <- Do not change anything here as this is automatically pulled from installer node
sshKey: |
  SSH_PUB_KEY <- Do not change anything here as this is automatically pulled from installer node

```

**site-config.yaml:** [https://github.com/akraino-edge-stack/kni-blueprint-pae/blob/master/sites/community.baremetal.edge-sites.net/00\\_install-config/site-config.yaml](https://github.com/akraino-edge-stack/kni-blueprint-pae/blob/master/sites/community.baremetal.edge-sites.net/00_install-config/site-config.yaml)

```

apiVersion: kni.akraino.org/v1alpha1
kind: SiteConfig
metadata:
  name: notImportantHere
config: {}
provisioningInfrastructure:
  hosts:
    # interface to use for provisioning on the masters
    masterBootInterface: ens787f1 <- name of the provisioning interface for the masters
    # interface to use for provisioning on the workers
    workerBootInterface: ens787f1 <- name of the provisioning interface for the workers
    # interface to use for baremetal on the masters
    masterSdnInterface: ens787f0 <- name of the baremetal interface for the masters
    # interface to use for baremetal on the workers
    workerSdnInterface: ens787f0 <- name of the baremetal interface for the workers

  network:
    # The provisioning network's CIDR
    provisioningIpCidr: 172.22.0.0/24 <- range of the provisioning network
    # PXE boot server IP
    # DHCP range start (usually provHost/interfaces/provisioningIpAddress + 1)
    provisioningDHCPStart: 172.22.0.11 <- DHCP start range of the provisioning network
    provisioningDHCPEnd: 172.22.0.51 -> DHCP end range

    # The baremetal networks's CIDR
    baremetalIpCidr: 192.168.111.0/24 <- range of the baremetal network
    # Address map
    # bootstrap: baremetalDHCPStart i.e. 192.168.111.10
    # master-0: baremetalDHCPStart+1 i.e. 192.168.111.11
    # master-1: baremetalDHCPStart+2 i.e. 192.168.111.12
    # master-2: baremetalDHCPStart+3 i.e. 192.168.111.13
    # worker-0: baremetalDHCPStart+5 i.e. 192.168.111.15
    # worker-N: baremetalDHCPStart+5+N
    baremetalDHCPStart: 192.168.111.10 <- DHCP start range of the baremetal network. Needs to start with an IP
    that does not conflict with previous baremetal VIP definitions
    baremetalDHCPEnd: 192.168.111.50 <- DHCP end range
    # baremetal network default gateway, set to proper IP if /provHost/services/baremetalGateway == false
    # if /provHost/services/baremetalGateway == true, baremetalGWIP will be located on provHost/interfaces
    /baremetal
    # and external traffic will be routed through the provisioning host
    baremetalGWIP: 192.168.111.4
    dns:
    # cluster DNS, change to proper IP address if provHost/services/clusterDNS == false
    # if /provHost/services/clusterDNS == true, cluster (IP) will be located on provHost/interfaces/provisioning
    # and DNS functionality will be provided by the provisioning host
    cluster: 192.168.111.3
    # Up to 3 external DNS servers to which non-local queries will be directed
    external1: 8.8.8.8
    # external2: 10.11.5.19
    # external3: 10.11.5.19

  provHost:
    interfaces:
    # Interface on the provisioning host that connects to the provisioning network
    provisioning: enp136s0f1 <- it typically needs to be a nic, not a vlan (unless your system supports pxe
    booting from vlans)
    # Must be in provisioningIpCidr range
    # pxe boot server will be at port 8080 on this address
    provisioningIpAddress: 172.22.0.1
    # Interface on the provisioning host that connects to the baremetal network
    baremetal: enp136s0f0.3009
    # Must be in baremetalIpCidr range
    baremetalIpAddress: 192.168.111.1
    # Interface on the provisioning host that connects to the internet/external network
    external: enp136s0f0.3008
    bridges:
    # These bridges are created on the bastion host
    provisioning: provisioning <- typically leave those fixed names
    baremetal: baremetal
    services:
    # Does the provisioning host provide DHCP services for the baremetal network?
    baremetalDHCP: true <- set it to false just if you have your own DHCP for the baremetal network
    # Does the provisioning host provide DNS services for the cluster?
    clusterDNS: true <- set it to false just if you have your own DNS in the baremetal network and you can
    configure your names properly
    # Does the provisioning host provide a default gateway for the baremetal network?
    baremetalGateway: true

```

## Setup installer node

Install CentOS operating system there. Once you have it, configure your NIC/VLANs properly (management/external, provisioning, baremetal, ipmi). Be sure that you collect the information of interfaces/vlans.

Configure the system properly to run knictl on it: [Install knictl](#)

## Fetch requirements

Inside knictl path (typically `$HOME/go/src/errit.akraino.org/kni/installer`), run the `fetch-requirements` command, pointing to the github repo of the site you created

```
./knictl fetch_requirements <site repo URI>
```

For example:

```
./knictl fetch_requirements github.com/akraino-edge-stack/kni-blueprint-pae/tree/master/sites/community.baremetal.edge-sites.net
```

## Prepare manifests

Run the `prepare manifests` command, using as a parameter the name of your site

```
./knictl prepare_manifests $SITE_NAME
```

For example:

```
./knictl prepare_manifests community.baremetal.edge-sites.net
```

Remember that the generated files there have a validity of 24 hours. If you don't finish the installation on that time, you'll need to re-run this command.

## Deploy masters

```
./knictl deploy_masters $SITE_NAME
```

This will deploy a bootstrap VM and begin to bring up your master nodes. Once the masters have reached the ready state, you can then deploy your workers. You can monitor the process of installation with:

```
$HOME/.kni/$SITE_NAME/requirements/openshift-install wait-for bootstrap-complete --dir $HOME/.kni/$SITE_NAME/baremetal_automation/ocp/
```

When all master nodes are shown as ready, you can start deployment of your workers

## Deploy workers

```
./knictl deploy_workers $SITE_NAME
```

This will begin to bring up your worker nodes.

You will need to destroy the bootstrap VM once the `deploy_workers` command is initiated with:

```
virsh destroy <bootstrap_vm_name>
```

Monitor your worker nodes as you normally would during this process. If the deployment doesn't hit any errors, you will then have a working baremetal cluster. You can monitor the state of the cluster with:

```
$HOME/.kni/$SITE_NAME/requirements/openshift-install wait-for install-complete --dir $HOME/.kni/$SITE_NAME/baremetal_automation/ocp/
```

It may happen that the monitor of this process stops at 93%-94%. This is fine, you can just launch again, or simply start using the cluster, as mostly all operators will come online over the time. Follow

[https://docs.openshift.com/container-platform/4.4/installing/installing\\_bare\\_metal/installing-bare-metal.html#installation-registry-storage-config\\_installing-bare-metal](https://docs.openshift.com/container-platform/4.4/installing/installing_bare_metal/installing-bare-metal.html#installation-registry-storage-config_installing-bare-metal) to fix image registry operator.

## Accessing the Cluster

After the deployment finishes, a `kubeconfig` file will be placed inside auth directory:

```
export KUBECONFIG=$HOME/.kni/$SITE_NAME/final_manifests/auth/kubeconfig
```

*NOTE: When using automated baremetal deployment, the kubeconfig will be found here instead:*

```
export KUBECONFIG=$HOME/.kni/$SITE_NAME/baremetal_automation/ocp/auth/kubeconfig
```

Then cluster can be managed with the `kubectl` or `oc` (drop-in replacement with advanced functionality) CLI tools.

To verify a correct setup, you can check again the nodes, and see if masters and workers are ready:

```
$HOME/.kni/$SITE_NAME/requirements/oc get nodes
```

You also can check if the cluster is available:

```
$HOME/.kni/$SITE_NAME/requirements/oc get clusterversion
```

You can also verify that the console is working, the console url is the following:

```
https://console-openshift-console.apps.$CLUSTER_NAME.$CLUSTER_DOMAIN
```

You can enter the console with **kubeadmin** user and the password that is shown at the end of the install.

## libvirt deployment guide

### Create site for virtual baremetal

The procedure for virtual baremetal is the same as for the baremetal case, but adding extra flags to indicate that the process is going to be virtual.

First step to start a virtual baremetal deployment is to have a site defined, with all the network and baremetal settings defined in the yaml files. A sample of site using this baremetal automation can be seen [here](#).

In order to define the settings for a site, the first section `00_install-config` needs to be used.

Start by creating a kustomization file like the following: [https://github.com/akraino-edge-stack/kni-blueprint-pae/blob/master/sites/community.baremetal.edge-sites.net/00\\_install-config/kustomization.yaml](https://github.com/akraino-edge-stack/kni-blueprint-pae/blob/master/sites/community.baremetal.edge-sites.net/00_install-config/kustomization.yaml)

```
bases:
- git::https://gerrit.akraino.org/r/kni/blueprint-pae.git//profiles/production.baremetal/00_install-config

patches:
- install-config.patch.yaml

patchesJson6902:
- target:
    version: v1
    kind: InstallConfig
    name: cluster
    path: install-config.name.patch.yaml

transformers:
- site-config.yaml
```

In this kustomization file we are patching the default install-config, and also adding some extra files to define networking (site-config.yaml).

**install-config.name.patch.yaml:** [https://github.com/akraino-edge-stack/kni-blueprint-pae/blob/master/sites/testing.baremetal.edge-sites.net/00\\_install-config/install-config.name.patch.yaml](https://github.com/akraino-edge-stack/kni-blueprint-pae/blob/master/sites/testing.baremetal.edge-sites.net/00_install-config/install-config.name.patch.yaml)

```
- op: replace
  path: "/metadata/name"
  value: testing <- replace with your cluster name here
```

**install-config.patch.yaml :** [https://github.com/akraino-edge-stack/kni-blueprint-pae/blob/master/sites/testing.baremetal.edge-sites.net/00\\_install-config/install-config.patch.yaml](https://github.com/akraino-edge-stack/kni-blueprint-pae/blob/master/sites/testing.baremetal.edge-sites.net/00_install-config/install-config.patch.yaml)

```
apiVersion: v1
kind: InstallConfig
baseDomain: baremetal.edge-sites.net <- domain for your site
compute:
- name: worker
replicas: 2
controlPlane:
  name: master
  platform: {}
  replicas: 1
metadata:
  name: cluster
networking:
  clusterNetworks:
    - cidr: 10.128.0.0/14
      hostPrefix: 23
  networkType: OpenShiftSDN
  serviceNetwork:
    - 172.30.0.0/16
platform:
  none: {}
  apiVIP: 192.168.111.4
  ingressVIP: 192.168.111.3
  dnsVIP: 192.168.111.2
  hosts: {} <- see it's empty, this will be created automatically as it's virtual
pullSecret: 'PULL_SECRET' <- leave like that, it will be replaced in runtime
sshKey: |
  SSH_PUB_KEY <- leave like that, it will be replaced in runtime
```

**site-config.yaml:** [https://github.com/akraino-edge-stack/kni-blueprint-pae/blob/master/sites/testing.baremetal.edge-sites.net/00\\_install-config/site-config.yaml](https://github.com/akraino-edge-stack/kni-blueprint-pae/blob/master/sites/testing.baremetal.edge-sites.net/00_install-config/site-config.yaml)

```

apiVersion: kni.akraino.org/v1alpha1
kind: SiteConfig
metadata:
  name: notImportantHere
config:
  virtualizedInstall: "true" <- this will tell the installer to deploy with virtual baremetal
  provisioningInfrastructure:
    hosts:
      # interface to use for provisioning on the masters
      masterBootInterface: eno1
      # interface to use for provisioning on the workers
      workerBootInterface: eno1
      # interface to use for baremetal on the masters
      masterSdnInterface: eno2
      # interface to use for baremetal on the workers
      workerSdnInterface: eno2

    network:
      # The provisioning network's CIDR
      provisioningIpCidr: 172.22.0.0/24
      # PXE boot server IP
      # DHCP range start (usually provHost/interfaces/provisioningIpAddress + 1)
      provisioningDHCPStart: 172.22.0.11
      provisioningDHCPEnd: 172.22.0.51

      # The baremetal networks's CIDR
      baremetalIpCidr: 192.168.111.0/24
      # Address map
      # bootstrap: baremetalDHCPStart i.e. 192.168.111.10
      # master-0: baremetalDHCPStart+1 i.e. 192.168.111.11
      # master-1: baremetalDHCPStart+2 i.e. 192.168.111.12
      # master-2: baremetalDHCPStart+3 i.e. 192.168.111.13
      # worker-0: baremetalDHCPStart+5 i.e. 192.168.111.15
      # worker-N: baremetalDHCPStart+5+N
      baremetalDHCPStart: 192.168.111.10
      baremetalDHCPEnd: 192.168.111.50
      # baremetal network default gateway, set to proper IP if /provHost/services/baremetalGateway == false
      # if /provHost/services/baremetalGateway == true, baremetalGWIP will be located on provHost/interfaces
/baremetal
      # and external traffic will be routed through the provisioning host
      baremetalGWIP: 192.168.111.4
      dns:
        # cluster DNS, change to proper IP address if provHost/services/clusterDNS == false
        # if /provHost/services/clusterDNS == true, cluster (IP) will be located on provHost/interfaces/provisioning
        # and DNS functionality will be provided by the provisioning host
        cluster: 192.168.111.3
        # Up to 3 external DNS servers to which non-local queries will be directed
        external1: 10.10.160.1
        external2: 10.10.160.2

    provHost:
      interfaces:
        # Interface on the provisioning host that connects to the provisioning network
        provisioning: dummy0
        # Must be in provisioningIpCidr range
        # pxe boot server will be at port 8080 on this address
        provisioningIpAddress: 172.22.0.1
        # Interface on the provisioning host that connects to the baremetal network
        baremetal: eno1
        # Must be in baremetalIpCidr range
        baremetalIpAddress: 192.168.111.199
        # Interface on the provisioning host that connects to the internet/external network
        external: eno3
      bridges:
        # These bridges are created on the bastion host
        provisioning: provisioning
        baremetal: baremetal
      services:
        # Does the provisioning host provide DHCP services for the baremetal network?
        baremetalDHCP: true
        # Does the provisioning host provide DNS services for the cluster?
        clusterDNS: true
        # Does the provisioning host provide a default gateway for the baremetal network?
        baremetalGateway: true

```

## Setup installer node

Install CentOS operating system there. Once you have it, configure your NIC/VLANS properly. You can make use of dummy interfaces if you need it, as the network will all be virtualized.

Configure the system properly to run knictl on it: [Install knictl](#)

## Fetch requirements

Inside knictl path (typically `$HOME/go/src/gerrit.akraino.org/kni/installer`), run the `fetch-requirements` command, pointing to the github repo of the site you created

```
./knictl fetch_requirements <site repo URI>
```

For example:

```
./knictl fetch_requirements github.com/akraino-edge-stack/kni-blueprint-pae/tree/master/sites/testing.baremetal.  
edge-sites.net
```

## Prepare manifests

Run the `prepare manifests` command, using as a parameter the name of your site

```
./knictl prepare_manifests $SITE_NAME
```

For example:

```
./knictl prepare_manifests testing.baremetal.edge-sites.net
```

Remember that the generated files there have a validity of 24 hours. If you don't finish the installation on that time, you'll need to re-run this command.

## Deploy masters

```
./knictl deploy_masters $SITE_NAME
```

This will deploy a bootstrap VM and begin to bring up your master nodes. Once the masters have reached the ready state, you can then deploy your workers. You can monitor the process of installation with:

```
$HOME/.kni/$SITE_NAME/requirements/openshift-install wait-for bootstrap-complete --dir $HOME/.kni/$SITE_NAME  
/baremetal_automation/ocp/
```

When all master nodes are shown as ready, you can start deployment of your workers

## Deploy workers

```
./knictl deploy_workers $SITE_NAME
```

This will begin to bring up your worker nodes. Monitor your worker nodes as you normally would during this process. If the deployment doesn't hit any errors, you will then have a working baremetal cluster.

You can monitor the state of the cluster with:

```
$HOME/.kni/$SITE_NAME/requirements/openshift-install wait-for install-complete --dir $HOME/.kni/$SITE_NAME  
/baremetal_automation/ocp/
```

After masters and workers are up, you can apply the workloads using the general procedure with:

```
./knictl apply_workloads $SITE_NAME --kubeconfig $HOME/.kni/$SITE_NAME/baremetal_automation/ocp/auth/kubeconfig
```

## Verifying the setup

After the deployment finishes, a `kubeconfig` file will be placed inside `auth` directory:

```
export KUBECONFIG=$HOME/.kni/$SITE_NAME/final_manifests/auth/kubeconfig
```

*NOTE: When using automated baremetal deployment, the kubeconfig will be found here instead:*

```
export KUBECONFIG=$HOME/.kni/$SITE_NAME/baremetal_automation/ocp/auth/kubeconfig
```

Then cluster can be managed with the `kubectl` or `oc` (drop-in replacement with advanced functionality) CLI tools.

To verify a correct setup, you can check again the nodes, and see if masters and workers are ready:

```
$HOME/.kni/$SITE_NAME/requirements/oc get nodes
```

You also can check if the cluster is available:

```
$HOME/.kni/$SITE_NAME/requirements/oc get clusterversion
```

You can also verify that the console is working, the console url is the following:

```
https://console-openshift-console.apps.$CLUSTER_NAME.$CLUSTER_DOMAIN
```

You can enter the console with **kubeadmin** user and the password that is shown at the end of the install.

## Developer guide and troubleshooting

Developer guide - See [Developer Documentation](#)

Troubleshooting guide - Please see the [upstream documentation](#) for details.

## Uninstall guide

### Manual

When needed, the site can be destroyed with the openshift-install command, using the following syntax:

```
$HOME/.kni/$SITE_NAME/requirements/openshift-install destroy cluster --dir $HOME/.kni/$SITE_NAME/final_manifests
```

### Automated (Baremetal / virtual baremetal only)

A baremetal UPI cluster that was deployed using knictl's automation commands (*deploy\_masters* / *deploy\_workers*) can be destroyed like so:

```
./knictl destroy_cluster $SITE_NAME
```