Docker Enterprise Container Cloud Deployment Guide

version latest

Contents

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Preface

This documentation provides information on how to use Mirantis products to deploy cloud environments. The information is for reference purposes and is subject to change.

Intended audience

This documentation assumes that the reader is familiar with network and cloud concepts and is intended for the following users:

- Infrastructure Operator
    - Is member of the IT operations team
    - Has working knowledge of Linux, virtualization, Kubernetes API and CLI, and OpenStack to support the application development team
    - Accesses Docker Enterprise (DE) Container Cloud and Kubernetes through a local machine or web UI
    - Provides verified artifacts through a central repository to the Tenant DevOps engineers
- Tenant DevOps engineer
    - Is member of the application development team and reports to line-of-business (LOB)
    - Has working knowledge of Linux, virtualization, Kubernetes API and CLI to support application owners
    - Accesses DE Container Cloud and Kubernetes through a local machine or web UI
    - Consumes artifacts from a central repository approved by the Infrastructure Operator

Documentation history

The documentation set refers to DE Container Cloud GA as to the latest released GA version of the product. For details about the DE Container Cloud GA minor releases dates, refer to DE Container Cloud releases.

Introduction

Docker Enterprise (DE) Container Cloud enables you to create, scale, and upgrade Kubernetes clusters on demand through a declarative API with a centralized identity and access management.

DE Container Cloud is installed once to deploy the management cluster. The management cluster is deployed through the bootstrap procedure on either the OpenStack, AWS, or bare metal provider. StackLight installs on both types of the clusters, management and managed, to provide metrics for each cluster separately. The baremetal-based deployment includes Ceph as a distributed storage system.

Deploy a baremetal-based management cluster

This section describes how to bootstrap a baremetal-based Docker Enterprise (DE) Container Cloud management cluster.

Workflow overview

The bare metal management system enables the Infrastructure Operator to deploy Docker Enterprise (DE) Container Cloud on a set of bare metal servers. It also enables DE Container Cloud to deploy managed clusters on bare metal servers without a pre-provisioned operating system.

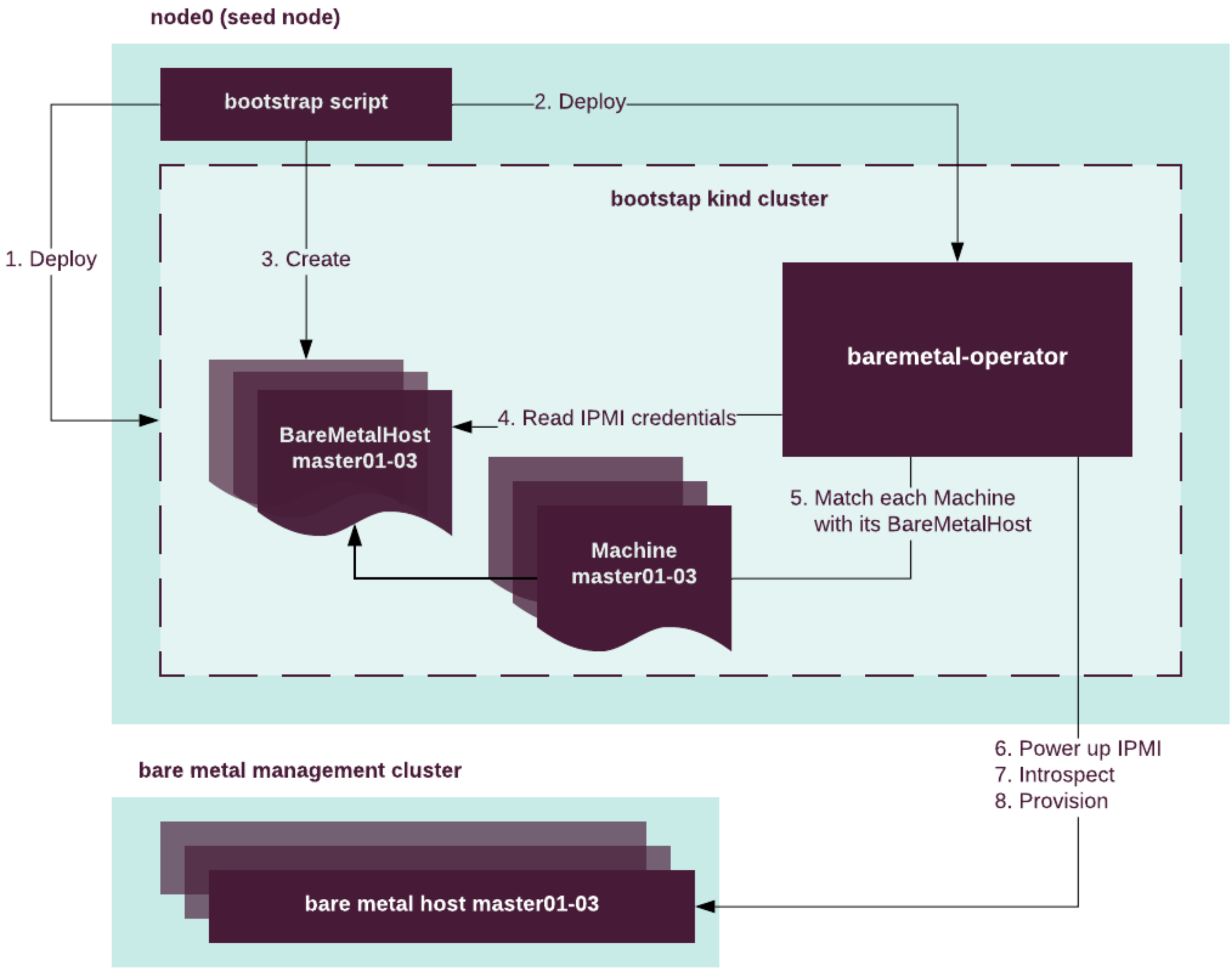
The Infrastructure Operator performs the following steps to install DE Container Cloud in a bare metal environment:

1. Install and connect hardware servers as described in Reference Architecture: Baremetal-based DE Container Cloud cluster.

   > Caution!
   >
   > The baremetal-based DE Container Cloud does not manage the underlay networking fabric but requires specific network configuration to operate.

2. Install Ubuntu 18.04 on one of the bare metal machines to create a seed node and copy the bootstrap tarball to this node.
3. Obtain the Mirantis license file that will be required during the bootstrap.
4. Create the deployment configuration files that include the bare metal hosts metadata.
5. Validate the deployment templates using fast preflight.
6. Run the bootstrap script for the fully automated installation of the management cluster onto the selected bare metal hosts.

Using the bootstrap script, the DE Container Cloud bare metal management system prepares the seed node for the management cluster and starts the deployment of DE Container Cloud itself. The bootstrap script performs all necessary operations to perform the automated management cluster setup. The deployment diagram below illustrates the bootstrap workflow of a baremetal-based management cluster.



Bootstrap a management cluster

This section describes how to prepare and bootstrap a baremetal-based management cluster. The procedure includes:

- A runbook that describes how to create a seed node that is a temporary server used to run the management cluster bootstrap scripts.
- A step-by-step instruction how to prepare metadata for the bootstrap scripts and how to run them.

Prepare the seed node

Before installing Docker Enterprise (DE) Container Cloud on a bare metal environment, complete the following preparation steps:

1. Verify that the hardware allocated for the installation meets the minimal requirements described in Reference Architecture: Requirements for a baremetal-based DE Cluster with UCP.
2. Install basic Ubuntu 18.04 server using standard installation images of the operating system on the bare metal seed node.
3. Log in to the seed node that is running Ubuntu 18.04.
4. Create a virtual bridge to connect to your PXE network on the seed node. Use the following netplan-based configuration file as an example:

```
# cat /etc/netplan/config.yaml
network:
  version: 2
  renderer: networkd
  ethernets:
    ens3:
        dhcp4: false
        dhcp6: false
  bridges:
      br0:
          addresses:
          # Please, adjust for your environment
          - 10.0.0.15/24
          dhcp4: false
          dhcp6: false
          # Please, adjust for your environment
          gateway4: 10.0.0.1
          interfaces:
          # Interface name may be different in your environment
          - ens3
          nameservers:
              addresses:
              # Please, adjust for your environment
              - 8.8.8.8
          parameters:
              forward-delay: 4
              stp: false
```

5. Apply the new network configuration using netplan:

```
sudo netplan apply
```

6. Verify the new network configuration:

```
sudo brctl show
```

Example of system response:

```
bridge name     bridge id               STP enabled     interfaces
br0             8000.fa163e72f146       no              ens3
```

Verify that the interface connected to the PXE network belongs to the previously configured bridge.

7. Install Docker version 18.09:

```
sudo apt install docker.io
```

8. Verify that your logged USER has access to the Docker daemon:

```
sudo usermod -aG docker $USER
```

9. Log out and log in again to the seed node to apply the changes.

10. Verify that Docker is configured correctly and has access to DE Container Cloud CDN. For example:

```
docker run --rm alpine sh -c "apk add --no-cache curl; \
curl https://binary.mirantis.com"
```

The system output must contain a json file with no error messages. In case of errors, follow the steps provided in Troubleshooting.

Proceed with Verify the seed node.

Verify the seed node

Before you proceed to bootstrapping the management cluster on bare metal, perform the following steps:

1. Verify that the seed node has direct access to the Baseboard Management Controller (BMC) of each baremetal host. All target hardware nodes must be in the power off state.

   For example, using the IPMI tool:

   ```
   ipmitool -I lanplus -H 'IPMI IP' -U 'IPMI Login' -P 'IPMI password' \
   chassis power status
   ```

   Example of system response:

   ```
   Chassis Power is off
   ```

2. Verify that you configured each bare metal host as follows:

   - Enable the boot NIC support for UEFI load. Usually, at least the built-in network interfaces support it.
   - Enable the UEFI-LAN-OPROM support in BIOS -> Advanced -> PCIPCIe.

- Enable the IPv4-PXE stack.
- Set the UEFI-DISK => UEFI-PXE boot order.
- If your PXE network is not configured to use the first network interface, fix the UEFI-PXE boot order to make nodes discovering faster by selecting only one required network interface.
- Power off all bare metal hosts.

> Warning
>
> Only one Ethernet port on a host must be connected to the Common/PXE network at any given time. The physical address (MAC) of this interface must be noted and used to configure the BareMetalHost object describing the host.

Proceed with Prepare metadata and deploy the management cluster.

Prepare metadata and deploy the management cluster

Using the example procedure below, replace the addresses and credentials in the configuration YAML files with the data from your environment. Keep everything else as is, including the file names and YAML structure.

The overall network mapping scheme with all L2 parameters, for example, for a single 10.0.0.0/24 network, is described in the following table. The configuration of each parameter indicated in this table is described in the steps below.

Network mapping overview

Deployment file name	Parameters and values
cluster.yaml	• SET_LB_HOST=10.0.0.90 • SET_METALLB_ADDR_POOL=10.0.0.61-10.0.0.80
ipam-objects.yaml	• SET_IPAM_CIDR=10.0.0.0/24 • SET_PXE_NW_GW=10.0.0.1 • SET_PXE_NW_DNS=8.8.8.8 • SET_IPAM_POOL_RANGE=10.0.0.100-10.0.0.252 • SET_LB_HOST=10.0.0.90 • SET_METALLB_ADDR_POOL=10.0.0.61-10.0.0.80

bootstrap.sh	• KAAS_BM_PXE_IP=10.0.0.20 • KAAS_BM_PXE_MASK=24 • KAAS_BM_PXE_BRIDGE=br0 • KAAS_BM_BM_DHCP_RANGE=10.0.0.30,10.0.0.49 • KEYCLOAK_FLOATING_IP=10.0.0.70 • IAM_FLOATING_IP=10.0.0.71 • PROXY_FLOATING_IP=10.0.0.72

1. Log in to the seed node that you configured as described in Prepare the seed node.
2. Change to your preferred work directory, for example, your home directory:

   ```
   cd $HOME
   ```

3. Download and run the DE Container Cloud bootstrap script to this directory:

   ```
   wget https://binary.mirantis.com/releases/get_container_cloud.sh
   chmod 0755 get_container_cloud.sh
   ./get_container_cloud.sh
   ```

4. Change the directory to the kaas-bootstrap folder created by the get_container_cloud.sh script:

   ```
   cd kaas-bootstrap
   ```

5. Obtain your license file that will be required during the bootstrap. See step 3 in Getting Started with DE Container Cloud.
6. Save the license file as mirantis.lic under the kaas-bootstrap directory.
7. Create a copy of the current templates directory for future reference.

   ```
   mkdir templates.backup
   cp -r templates/*  templates.backup/
   ```

8. Update the cluster definition template in templates/bm/cluster.yaml.template according to the environment configuration. Use the table below. Manually set all parameters that start with SET_. For example, SET_METALLB_ADDR_POOL.

Cluster template mandatory parameters

Parameter	Description	Example value

SET_LB_HOST	The IP address of the externally accessible API endpoint of the management cluster. This address must NOT be within the SET_METALLB_ADDR_POOL range but must be from the PXE network. External load balancers are not supported.	10.0.0.90
SET_METALLB_ADDR_POOL	The IP range to be used as external load balancers for the Kubernetes services with the LoadBalancer type. This range must be within the PXE network.	10.0.0.61-10.0.0.80

9. Inspect the default bare metal host profile definition in templates/bm/baremetalhostprofiles.yaml.template. If your hardware configuration differs from the reference, adjust the default profile to match. For details, see Customize the default bare metal host profile.
10. Update the bare metal hosts definition template in templates/bm/baremetalhosts.yaml.template according to the environment configuration. Use the table below. Manually set all parameters that start with SET_.

Bare metal hosts template mandatory parameters

Parameter	Description	Example value
SET_MACHINE_0_IPMI_USERNAME	The IPMI user name in the base64 encoding to access the BMC. [1]	dXNlcg== (base64 encoded user)
SET_MACHINE_0_IPMI_PASSWORD	The IPMI password in the base64 encoding to access the BMC. [1]	cGFzc3dvcmQ= (base64 encoded password)
SET_MACHINE_0_MAC	The MAC address of the first management master node in the PXE network.	ac:1f:6b:02:84:71
SET_MACHINE_0_BMC_ADDRESS	The IP address of the BMC endpoint for the first master node in the management cluster. Must be an address from the OOB network that is accessible through the PXE network default gateway.	192.168.100.11
SET_MACHINE_1_IPMI_USERNAME	The IPMI user name in the base64 encoding to access the BMC. [1]	dXNlcg== (base64 encoded user)
SET_MACHINE_1_IPMI_PASSWORD	The IPMI password in the base64 encoding to access the BMC. [1]	cGFzc3dvcmQ= (base64 encoded password)
SET_MACHINE_1_MAC	The MAC address of the second management master node in the PXE network.	ac:1f:6b:02:84:72

SET_MACHINE_1_BMC_ADDRESS	The IP address of the BMC endpoint for the second master node in the management cluster. Must be an address from the OOB network that is accessible through the PXE network default gateway.	192.168.100.12
SET_MACHINE_2_IPMI_USERNAME	The IPMI user name in the base64 encoding to access the BMC. [1]	dXNlcg== (base64 encoded user)
SET_MACHINE_2_IPMI_PASSWORD	The IPMI password in the base64 encoding to access the BMC. [1]	cGFzc3dvcmQ= (base64 encoded password)
SET_MACHINE_2_MAC	The MAC address of the third management master node in the PXE network.	ac:1f:6b:02:84:73
SET_MACHINE_2_BMC_ADDRESS	The IP address of the BMC endpoint for the third master node in the management cluster. Must be an address from the OOB network that is accessible through the PXE network default gateway.	192.168.100.13

[1] (1, 2, 3, 4, 5, 6) You can obtain the base64-encoded user name and password using the following command in your Linux console:

```
$ echo -n <username|password> | base64
```

11. Update the IP address pools definition template in templates/bm/ipam-objects.yaml.template according to the environment configuration. Use the table below. Manually set all parameters that start with SET_. For example, SET_IPAM_POOL_RANGE.

IP address pools template mandatory parameters

Parameter	Description	Example value
SET_IPAM_CIDR	The address of PXE network in CIDR notation.	10.0.0.0/24
SET_PXE_NW_GW	The default gateway in the PXE network. Since this is the only network that DE Container Cloud will use, this gateway must provide access to: • The Internet to download the Mirantis artifacts • The OOB network of the DE Container Cloud cluster	10.0.0.1
SET_PXE_NW_DNS	An external (non-Kubernetes) DNS server accessible from the PXE network. This server will be used by the bare metal hosts in all DE Container Cloud clusters.	8.8.8.8

SET_IPAM_POOL_RANGE	This pool range includes addresses that will be allocated to bare metal hosts in all DE Container Cloud clusters. The size of this range limits the number of hosts that can be deployed by the instance of DE Container Cloud.	10.0.0.100-10.0.0.252
SET_LB_HOST [2]	The IP address of the externally accessible API endpoint of the management cluster. This address must NOT be within the SET_METALLB_ADDR_POOL range but must be from the PXE network. External load balancers are not supported.	10.0.0.90
SET_METALLB_ADDR_POOL [2]	The IP range to be used as external load balancers for the Kubernetes services with the LoadBalancer type. This range must be within the PXE network.	10.0.0.61-10.0.0.80

[2] (1, 2) Use the same value that you used for this parameter in the cluster.yaml.template file (see above).

12. Optional. Skip this step to use the default password password in the DE Container Cloud web UI.

    Configure the IAM parameters:

    1. Create hashed passwords for every IAM role: reader, writer, and operator for bare metal deployments:

       ```
       ./bin/hash-generate -i 27500
       ```

       The hash-generate utility requests you to enter a password and outputs the parameters required for the next step. Save the password that you enter in a secure location. This password will be used to access the Docker Enterprise (DE) Container Cloud web UI with a specific IAM role.

       Example of system response:

       ```
       passwordSalt: 6ibPZdUfQK8PsOpSmyVJnA==
       passwordHash: 23W1l65FBdI3NL7LMiUQG9Cu62bWLTqIsOgdW8xNsqw=
       passwordHashAlgorithm: pbkdf2-sha256
       passwordHashIterations: 27500
       ```

       Run the tool several times to generate hashed passwords for every IAM role.

    2. Open templates/cluster.yaml.template for editing.
    3. In the initUsers section, add the following parameters for each IAM role that you generated in the previous step:

       - passwordSalt - base64-encoded randomly generated sequence of bytes.

- passwordHash - base64-encoded password hash generated using passwordHashAlgorithm with passwordHashIterations. Supported algorithms include pbkdf2-sha256 and pbkdf-sha512.

13 Configure the Ceph cluster:
.

1. Configure dedicated networks for Ceph components. Set up the disk configuration according to your hardware node specification in templates/bm/kaascephcluster.yaml.template. Also, verify that the storageDevices section has a valid list of the HDD device names. To enable all LCM features of Ceph controller, set manageOsds to true:

```
...
manageOsds: true
...
# This part of KaaSCephCluster should contain valid networks definition
# For production environment, hostNetwork should be always true
network:
  hostNetwork: true
  clusterNet: 10.10.10.0/24
  publicNet: 10.10.11.0/24
...
nodes:
  master-0:
  ...
    # This part of KaaSCephCluster should contain valid device names
    storageDevices:
    - name: sdc
      config:
        deviceClass: hdd
    # Each storageDevices dicts can have several devices
    storageDevices:
    - name: sdc
      config:
        deviceClass: hdd
    # All devices for Ceph also should be described to ``wipe`` in
    # ``baremetalhosts.yaml.template``
    - name: sdd
      config:
       deviceClass: hdd
    # Do not to include first devices here (like vda or sda)
    # because they will be allocated for operating system
...
```

2. Verify that the machine names in the spec:nodes structure are relevant to the metadata:name structure data in machines.yaml.template.

14 Verify that the kaas-bootstrap directory contains the following files:
.

```
# tree  ~/kaas-bootstrap
  ~/kaas-bootstrap/
  ....
  ├── bootstrap.sh
  ├── kaas
  ├── mirantis.lic
  ├── releases
  ...
  ├── templates
  ....
  │   ├── bm
  │   │   ├── baremetalhostprofiles.yaml.template
  │   │   ├── baremetalhosts.yaml.template
  │   │   ├── cluster.yaml.template
  │   │   ├── ipam-objects.yaml.template
  │   │   ├── kaascephcluster.yaml.template
  │   │   └── machines.yaml.template
  ....
  ├── templates.backup
      ....
```

15. Export all required parameters using the table below.

```
export KAAS_BM_ENABLED="true"
#
export KAAS_BM_PXE_IP="10.0.0.20"
export KAAS_BM_PXE_MASK="24"
export KAAS_BM_PXE_BRIDGE="br0"
#
export KAAS_BM_BM_DHCP_RANGE="10.0.0.30,10.0.0.49"
#
export KEYCLOAK_FLOATING_IP="10.0.0.70"
export IAM_FLOATING_IP="10.0.0.71"
export PROXY_FLOATING_IP="10.0.0.72"
```

Bare metal prerequisites data

Parameter	Description	Example value
KAAS_BM_PXE_IP	The provisioning IP address. This address will be assigned to the interface of the seed node defined by the KAAS_BM_PXE_BRIDGE parameter (see below). The PXE service of the bootstrap cluster will use this address to network boot the bare metal hosts for the management cluster.	10.0.0.20

KAAS_BM_PXE_MASK	The CIDR prefix for the PXE network. It will be used with all of the addresses below when assigning them to interfaces.	24
KAAS_BM_PXE_BRIDGE	The PXE network bridge name. The name must match the name of the bridge created on the seed node during the Prepare the seed node stage.	br0
KAAS_BM_BM_DHCP_RANGE	The start_ip and end_ip addresses must be within the PXE network. This range will be used by Dnsmasq to provide IP addresses for nodes during provisioning.	10.0.0.30,10.0.0.49
KEYCLOAK_FLOATING_IP	The spec.loadBalancerIP address for the Keycloak service. This address must be within the METALLB_ADDR_POOL range.	10.0.0.70
IAM_FLOATING_IP	The spec.loadBalancerIP address for the IAM service. This address must be within the METALLB_ADDR_POOL range.	10.0.0.71
PROXY_FLOATING_IP	The spec.loadBalancerIP address for the Squid service. This address must be within the METALLB_ADDR_POOL range.	10.0.0.72

16. Run the verification preflight script to validate the deployment templates configuration:

    ```
    ./bootstrap.sh preflight
    ```

    The report includes the list of verified bare metal nodes and their Chassis Power status. This status is based on the deployment templates configuration used during the verification.

    > Note
    >
    > During the fast preflight validation, a non-voting warning check is preformed to verify whether the MAC address is LAN1 or LAN2 and ensure that the network scheme type is correct on a node being verified.
    >
    > If the system outputs a warning about the MAC address not being from any LANs, verify that you correctly set SET_MACHINE_*_MAC and SET_MACHINE_*_BMC_ADDRESS in baremetalhosts.yaml.template according to the hardware documentation of your bare metal node.

    > Caution!
    >
    > If the report contains information about missing dependencies or incorrect configuration, fix the issues before proceeding to the next step.

17. Run the bootstrap script:

    ```
    ./bootstrap.sh all
    ```

    > Note
    >
    > Due to the known issue #7281, before running the script, verify that there are no spaces in the PATH environment variable.

    > Warning
    >
    > During the bootstrap process, do not manually restart or power off any of the bare metal hosts.

When the bootstrap is complete:

- The script creates the kubeconfig file in the directory where the script is located. This file contains the admin credentials for the management cluster.
- The system outputs the URL and credentials for the DE Container Cloud web UI.
- The system outputs the URL for Keycloak. The admin password for Keycloak is located in kaas-bootstrap/passwords.yml.
- The bootstrap cluster resources are freed up.

Save these management cluster details in a secure location.

18. Optional. Configure the external Identity Provider parameters. For details, see official Keycloak documentation for LDAP and Google OAuth.

Seealso

- Operations Guide: Connect to a DE Container Cloud cluster
- Operations Guide: Remove a management cluster

Customize the default bare metal host profile

This section describes the bare metal host profile settings and instructs how to configure this profile before deploying Docker Enterprise (DE) Container Cloud on physical servers.

The bare metal host profile is a Kubernetes custom resource. It allows the Infrastructure Operator to define how the storage devices and the operating system are provisioned and configured.

The bootstrap templates for a bare metal deployment include the template for the default BareMetalHostProfile object in the following file that defines the default bare metal host profile:

```
templates/bm/baremetalhostprofiles.yaml.template
```

The customization procedure of BareMetalHostProfile is almost the same for the management and managed clusters, with the following differences:

- For a management cluster, the customization automatically applies to machines during bootstrap. And for a managed cluster, you apply the changes using kubectl before creating a managed cluster.
- For a management cluster, you edit the default baremetalhostprofiles.yaml.template. And for a managed cluster, you create a new BareMetalHostProfile with the necessary configuration.

For the procedure details, see Operations Guide: Create a custom bare metal host profile. Use this procedure for both types of clusters considering the differences described above.

Deploy an OpenStack-based management cluster

This section describes how to bootstrap an OpenStack-based Docker Enterprise (DE) Container Cloud management cluster.

Workflow overview

The Infrastructure Operator performs the following steps to install Docker Enterprise (DE) Container Cloud on an OpenStack-based environment:

1. Prepare an OpenStack environment with the requirements described in Reference Architecture: OpenStack-based cluster requirements.
2. Prepare the bootstrap node using Prerequisites.
3. Obtain the Mirantis license file that will be required during the bootstrap.
4. Prepare the OpenStack clouds.yaml file.
5. Create and configure the deployment configuration files that include the cluster and machines metadata.
6. Run the bootstrap script for the fully automated installation of the management cluster.

For more details, see Bootstrap a management cluster.

Prerequisites

Before you start with bootstrapping the OpenStack-based management cluster, complete the following prerequisite steps:

1. Verify that your planned cloud meets the reference hardware bill of material and software requirements as described in Reference Architecture: Requirements for an OpenStack-based Docker Enterprise (DE) Cluster with UCP.
2. Log in to any personal computer or VM running Ubuntu 18.04 that you will be using as the bootstrap node.
3. Install Docker version 18.09:

   ```
   sudo apt install docker.io
   ```

4. Grant your USER access to the Docker daemon:

   ```
   sudo usermod -aG docker $USER
   ```

5. Log off and log in again to the bootstrap node to apply the changes.
6. Verify that Docker is configured correctly and has access to DE Container Cloud CDN. For example:

```
docker run --rm alpine sh -c "apk add --no-cache curl; \
curl https://binary.mirantis.com"
```

The system output must contain no error records. In case of issues, follow the steps provided in Troubleshooting.

7. Proceed to Bootstrap a management cluster.

Bootstrap a management cluster

After you complete the prerequisite steps described in Prerequisites, proceed with bootstrapping your OpenStack-based Docker Enterprise (DE) Container Cloud management cluster.

To bootstrap an OpenStack-based management cluster:

1. Log in to the bootstrap node running Ubuntu 18.04 that is configured as described in Prerequisites.
2. Download and run the DE Container Cloud bootstrap script:

   ```
   wget https://binary.mirantis.com/releases/get_container_cloud.sh
   chmod 0755 get_container_cloud.sh
   ./get_container_cloud.sh
   ```

3. Change the directory to the kaas-bootstrap folder created by the get_container_cloud.sh script.
4. Obtain your license file that will be required during the bootstrap. See step 3 in Getting Started with DE Container Cloud.
5. Save the license file as mirantis.lic under the kaas-bootstrap directory.
6. Log in to the OpenStack Horizon.
7. In the Project section, select API Access.
8. In the right-side drop-down menu Download OpenStack RC File, select OpenStack clouds.yaml File.
9. Add the downloaded clouds.yaml file to the directory with the bootstrap.sh script.
10. In clouds.yaml, add the password field with your OpenStack password under the clouds/openstack/auth section.

    Example:

    ```
    clouds:
      openstack:
        auth:
          auth_url: https://auth.openstack.example.com:5000/v3
          username: your_username
          password: your_secret_password
          project_id: your_project_id
          user_domain_name: your_ldap_password
        region_name: RegionOne
        interface: public
        identity_api_version: 3
    ```

11. Verify access to the target cloud endpoint from Docker. For example:

    ```
    docker run --rm alpine sh -c "apk add --no-cache curl; \
    curl https://auth.openstack.example.com:5000/v3"
    ```

The system output must contain no error records. In case of issues, follow the steps provided in Troubleshooting.

12. In templates/machines.yaml.template, modify the spec:providerSpec:value sections for set: master and set: node by substituting the flavor and image parameters with the corresponding values of your OpenStack cluster. For example:

```
spec:
  providerSpec:
    value:
      apiVersion: "openstackproviderconfig.k8s.io/v1alpha1"
      kind: "OpenstackMachineProviderSpec"
      flavor: kaas.minimal
      image: bionic-server-cloudimg-amd64-20190612
```

    Also, modify other parameters as required.

13. Modify the templates/cluster.yaml.template parameters to fit your deployment. For example, add the corresponding values for cirdBlocks in the spec::clusterNetwork::services section.

    Note

    The passwordSalt and passwordHash values for the IAM roles are automatically re-generated during the IAM configuration described in the next step.

14. Optional. Skip this step to use the default password password in the DE Container Cloud web UI.

    Configure the IAM parameters:

    1. Create hashed passwords for every IAM role: reader, writer, and operator for bare metal deployments:

    ```
    ./bin/hash-generate -i 27500
    ```

       The hash-generate utility requests you to enter a password and outputs the parameters required for the next step. Save the password that you enter in a secure location. This password will be used to access the Docker Enterprise (DE) Container Cloud web UI with a specific IAM role.

       Example of system response:

    ```
    passwordSalt: 6ibPZdUfQK8PsOpSmyVJnA==
    passwordHash: 23W1l65FBdI3NL7LMiUQG9Cu62bWLTqIsOgdW8xNsqw=
    passwordHashAlgorithm: pbkdf2-sha256
    passwordHashIterations: 27500
    ```

   Run the tool several times to generate hashed passwords for every IAM role.

2. Open templates/cluster.yaml.template for editing.
3. In the initUsers section, add the following parameters for each IAM role that you generated in the previous step:

   - passwordSalt - base64-encoded randomly generated sequence of bytes.
   - passwordHash - base64-encoded password hash generated using passwordHashAlgorithm with passwordHashIterations. Supported algorithms include pbkdf2-sha256 and pbkdf-sha512.

15. Run the bootstrap script:

```
./bootstrap.sh all
```

> Note
>
> Due to the known issue #7281, before running the script, verify that there are no spaces in the PATH environment variable.

When the bootstrap is complete:

- The script creates the kubeconfig file in the directory where the script is located. This file contains the admin credentials for the management cluster.
- The system outputs the URL and credentials for the DE Container Cloud web UI.
- The system outputs the URL for Keycloak. The admin password for Keycloak is located in kaas-bootstrap/passwords.yml.
- The bootstrap cluster resources are freed up.

Save these management cluster details in a secure location.

16. In case of deployment issues, collect and inspect the bootstrap and management cluster logs as described in Troubleshooting.
17. Optional. Deploy an additional regional cluster as described in Deploy an additional regional cluster.
18. Optional. Configure the external Identity Provider parameters. For details, see official Keycloak documentation for LDAP and Google OAuth.

Now, you can proceed with operating your management cluster using the DE Container Cloud web UI and deploying managed clusters as described in Create an OpenStack-based managed cluster.

> Seealso

- Operations Guide: Connect to a DE Container Cloud cluster
- Operations Guide: Remove a management cluster

Deploy an AWS-based management cluster

This section describes how to bootstrap a Docker Enterprise (DE) Container Cloud management cluster that is based on the Amazon Web Services (AWS) cloud provider.

Workflow overview

The Infrastructure Operator performs the following steps to install Docker Enterprise (DE) Container Cloud on an AWS-based environment:

1. Prepare an AWS environment with the requirements described in Reference Architecture: AWS-based DE Container Cloud cluster requirements.
2. Prepare the bootstrap node as per Prerequisites.
3. Obtain the Mirantis license file that will be required during the bootstrap.
4. Prepare the AWS environment credentials.
5. Create and configure the deployment configuration files that include the cluster and machines metadata.
6. Run the bootstrap script for the fully automated installation of the management cluster.

For more details, see Bootstrap a management cluster.

Prerequisites

Before you start with bootstrapping the AWS-based management cluster, complete the following prerequisite steps:

1. Inspect the Requirements for an AWS-based Docker Enterprise (DE) Cluster with UCP to understand the potential impact of the DE Container Cloud deployment on your AWS cloud usage.
2. Log in to any personal computer or VM running Ubuntu 18.04 that you will be using as the bootstrap node.
3. If you use a newly created VM, run:

   ```
   sudo apt-get update
   ```

4. Install Docker version 18.09:

   ```
   sudo apt install docker.io
   ```

5. Grant your USER access to the Docker daemon:

   ```
   sudo usermod -aG docker $USER
   ```

6. Log out and log in again to the bootstrap node to apply the changes.
7. Verify that Docker is configured and works correctly. For example:

```
docker run --rm alpine sh -c "apk add --no-cache curl; \
curl https://binary.mirantis.com"
```

The system output must contain no error records. In case of issues, follow the steps provided in Troubleshooting.

8. Proceed to Bootstrap a management cluster.

Bootstrap a management cluster

After you complete the prerequisite steps described in Prerequisites, proceed with bootstrapping your AWS-based Docker Enterprise (DE) Container Cloud management cluster.

To bootstrap an AWS-based management cluster:

1. Log in to the bootstrap node running Ubuntu 18.04 that is configured as described in Prerequisites.
2. Download and run the DE Container Cloud bootstrap script:

   ```
   wget https://binary.mirantis.com/releases/get_container_cloud.sh

   chmod 0755 get_container_cloud.sh

   ./get_container_cloud.sh
   ```

3. Change the directory to the kaas-bootstrap folder created by the get_container_cloud.sh script.
4. Obtain your license file that will be required during the bootstrap. See step 3 in Getting Started with DE Container Cloud.
5. Save the license file as mirantis.lic under the kaas-bootstrap directory.
6. Verify access to the target cloud endpoint from Docker. For example:

   ```
   docker run --rm alpine sh -c "apk add --no-cache curl; \
   curl https://ec2.amazonaws.com"
   ```

   The system output must contain no error records. In case of issues, follow the steps provided in Troubleshooting.
7. In templates/aws/machines.yaml.template, modify the spec:providerSpec:value section by substituting the ami:id parameter with the corresponding value for Ubuntu 18.04 from the required AWS region. For example:

   ```
   spec:
     providerSpec:
       value:
         apiVersion: aws.kaas.mirantis.com/v1alpha1
         kind: AWSMachineProviderSpec
         instanceType: c5d.2xlarge
         ami:
           id: ami-033a0960d9d83ead0
   ```

   Also, modify other parameters as required.
8. Optional. Modify the templates/aws/cluster.yaml.template parameters if required.

9. Generate the AWS Access Key ID with Secret Access Key for the admin user and select the AWS default region name. For details, see AWS General Reference: Programmatic access.

10. Export the following parameters by adding the corresponding values for the AWS admin credentials created in the previous step:

    ```
    export KAAS_AWS_ENABLED=true
    export AWS_SECRET_ACCESS_KEY=XXXXXXX
    export AWS_ACCESS_KEY_ID=XXXXXXX
    export AWS_DEFAULT_REGION=us-east-2
    ```

11. Create the AWS CloudFormation template for IAM policy:

    ```
    ./kaas bootstrap aws policy
    ```

12. Generate the AWS Access Key ID with Secret Access Key for the bootstrapper.cluster-api-provider-aws.kaas.mirantis.com user, that was created in the previous step, and select the AWS default region name.

13. Export the AWS bootstrapper.cluster-api-provider-aws.kaas.mirantis.com user credentials that were created in the previous step:

    ```
    export KAAS_AWS_ENABLED=true
    export AWS_SECRET_ACCESS_KEY=XXXXXXX
    export AWS_ACCESS_KEY_ID=XXXXXXX
    export AWS_DEFAULT_REGION=us-east-2
    ```

14. Optional. Skip this step to use the default password password in the DE Container Cloud web UI.

    Configure the IAM parameters:

    1. Create hashed passwords for every IAM role: reader, writer, and operator for bare metal deployments:

       ```
       ./bin/hash-generate -i 27500
       ```

       The hash-generate utility requests you to enter a password and outputs the parameters required for the next step. Save the password that you enter in a secure location. This password will be used to access the Docker Enterprise (DE) Container Cloud web UI with a specific IAM role.

       Example of system response:

       ```
       passwordSalt: 6ibPZdUfQK8PsOpSmyVJnA==
       passwordHash: 23W1l65FBdI3NL7LMiUQG9Cu62bWLTqIsOgdW8xNsqw=
       passwordHashAlgorithm: pbkdf2-sha256
       passwordHashIterations: 27500
       ```

       Run the tool several times to generate hashed passwords for every IAM role.

2. Open templates/cluster.yaml.template for editing.
3. In the initUsers section, add the following parameters for each IAM role that you generated in the previous step:
    - passwordSalt - base64-encoded randomly generated sequence of bytes.
    - passwordHash - base64-encoded password hash generated using passwordHashAlgorithm with passwordHashIterations. Supported algorithms include pbkdf2-sha256 and pbkdf-sha512.

15. Run the bootstrap script:

```
./bootstrap.sh all
```

> Note
>
> Due to the known issue #7281, before running the script, verify that there are no spaces in the PATH environment variable.

When the bootstrap is complete:

- The script creates the kubeconfig file in the directory where the script is located. This file contains the admin credentials for the management cluster.
- The system outputs the URL and credentials for the DE Container Cloud web UI.
- The system outputs the URL for Keycloak. The admin password for Keycloak is located in kaas-bootstrap/passwords.yml.
- The bootstrap cluster resources are freed up.

Save these management cluster details in a secure location.

16. In case of deployment issues, collect and inspect the bootstrap and management cluster logs as described in Troubleshooting.
17. Optional. Deploy an additional regional cluster of a different provider type as described in Deploy an additional regional cluster.
18. Optional. Configure the external Identity Provider parameters. For details, see official Keycloak documentation for LDAP and Google OAuth.

Now, you can proceed with operating your management cluster using the DE Container Cloud web UI and deploying managed clusters as described in Create an AWS-based managed cluster.

> Seealso
>
> - Operations Guide: Connect to a DE Container Cloud cluster
> - Operations Guide: Remove a management cluster

Deploy an additional regional cluster

After you bootstrap a management cluster of the required cloud provider type, you can deploy an additional regional cluster of the same or different provider type.

Supported combinations of providers types for management and regional clusters

	Bare metal regional cluster	AWS regional cluster	OpenStack regional cluster
Bare metal management cluster	✗	✗	✓
AWS management cluster	✗	✓	✓
OpenStack management cluster	✗	✗	✓

Multi-regional deployment enables you to create managed clusters of several provider types using one management cluster. For example, you can bootstrap an AWS-based management cluster and deploy an OpenStack-based regional cluster on this management cluster. Such cluster enables creation of OpenStack-based and AWS-based managed clusters with Kubernetes deployments.

> Note
>
> The integration of baremetal-based support for deploying additional regional clusters is on the final development stage and will be announced separately in one of the upcoming Docker Enterprise (DE) Container Cloud releases.

This section describes how to deploy an additional OpenStack or AWS-based regional cluster on an existing management cluster.

Deploy an AWS-based regional cluster

If you want to deploy AWS-based managed clusters of different configurations, deploy an additional regional cluster with specific settings that differ from the AWS-based management cluster configuration.

To deploy an AWS-based regional cluster:

1. Log in to the node where you bootstrapped a management cluster.
2. Prepare the AWS configuration for the new regional cluster:

   1. Verify access to the target cloud endpoint from Docker. For example:

      ```
      docker run --rm alpine sh -c "apk add --no-cache curl; \
      curl https://ec2.amazonaws.com"
      ```

      The system output must contain no error records. In case of issues, follow the steps provided in Troubleshooting.
   2. Change the directory to the kaas-bootstrap folder.
   3. In templates/aws/machines.yaml.template, modify the spec:providerSpec:value section by substituting the ami:id parameter with the corresponding value for Ubuntu 18.04 from the required AWS region. For example:

      ```
      spec:
        providerSpec:
          value:
            apiVersion: aws.kaas.mirantis.com/v1alpha1
            kind: AWSMachineProviderSpec
            instanceType: c5d.2xlarge
            ami:
              id: ami-033a0960d9d83ead0
      ```

      Also, modify other parameters as required.
   4. Optional. Modify the templates/aws/cluster.yaml.template parameters if required.
   5. Generate the AWS Access Key ID with Secret Access Key for the bootstrapper.cluster-api-provider-aws.kaas.mirantis.com user, that was created in the previous step, and select the AWS default region name.
   6. Export the AWS bootstrapper.cluster-api-provider-aws.kaas.mirantis.com user credentials that were created in the previous step:

      ```
      export KAAS_AWS_ENABLED=true
      export AWS_SECRET_ACCESS_KEY=XXXXXXX
      export AWS_ACCESS_KEY_ID=XXXXXXX
      export AWS_DEFAULT_REGION=us-east-2
      ```
3. Export the following parameters:

```
export KUBECONFIG=<pathToMgmtClusterKubeconfig>
export REGIONAL_CLUSTER_NAME=<newRegionalClusterName>
export REGION=<NewRegionName>
```

Substitute the parameters enclosed in angle brackets with the corresponding values of your cluster.

4. Run the regional cluster bootstrap script:

```
./bootstrap.sh deploy_regional
```

> Note
>
> Due to the known issue #7281, before running the script, verify that there are no spaces in the PATH environment variable.

The workflow of the regional cluster bootstrap script

#	Description
1	Prepare the bootstrap cluster for the new regional cluster.
2	Load the updated DE Container Cloud CRDs for Credentials, Cluster, and Machines with information about the new regional cluster to the management cluster.
3	Connect to each machine of the management cluster through SSH.
4	Wait for the Machines and Cluster objects of the new regional cluster to be ready on the management cluster.
5	Load the following objects to the new regional cluster: Secret with the management cluster kubeconfig and ClusterRole for the DE Container Cloud provider.
6	Forward the bootstrap cluster endpoint to helm-controller.
7	Wait for all CRDs to be available and verify the objects created using these CRDs.
8	Pivot the cluster API stack to the regional cluster.
9	Switch the LCM agent from the bootstrap cluster to the regional one.
10	Wait for the DE Container Cloud components to start on the regional cluster.

Now, you can proceed with deploying the managed clusters of supported provider types as described in Create and operate a managed cluster.

Deploy an OpenStack-based regional cluster

You can deploy an additional regional OpenStack-based cluster on top of the AWS, bare metal, or OpenStack management cluster to create managed clusters of several provider types if required.

To deploy an OpenStack-based regional cluster:

1. Log in to the node where you bootstrapped a management cluster.
2. Prepare the OpenStack configuration for a new regional cluster:

    1. Log in to the OpenStack Horizon.
    2. In the Project section, select API Access.
    3. In the right-side drop-down menu Download OpenStack RC File, select OpenStack clouds.yaml File.
    4. Add the downloaded clouds.yaml file to the directory with the bootstrap.sh script.
    5. In clouds.yaml, add the password field with your OpenStack password under the clouds/openstack/auth section.

        Example:

        ```
        clouds:
          openstack:
            auth:
              auth_url: https://auth.openstack.example.com:5000/v3
              username: your_username
              password: your_secret_password
              project_id: your_project_id
              user_domain_name: your_ldap_password
            region_name: RegionOne
            interface: public
            identity_api_version: 3
        ```

    6. Verify access to the target cloud endpoint from Docker. For example:

        ```
        docker run --rm alpine sh -c "apk add --no-cache curl; \
        curl https://auth.openstack.example.com:5000/v3"
        ```

        The system output must contain no error records. In case of issues, follow the steps provided in Troubleshooting.

    7. Change the directory to the kaas-bootstrap folder.
    8. In templates/machines.yaml.template, modify the spec:providerSpec:value sections for set: master and set: node by substituting the flavor and image parameters with the corresponding values of your OpenStack cluster. For example:

        ```
        spec:
          providerSpec:
            value:
              apiVersion: "openstackproviderconfig.k8s.io/v1alpha1"
              kind: "OpenstackMachineProviderSpec"
        ```

```
    flavor: kaas.minimal
    image: bionic-server-cloudimg-amd64-20190612
```

   Also, modify other parameters as required.

   9. Modify the templates/cluster.yaml.template parameters to fit your deployment. For example, add the corresponding values for cirdBlocks in the spec::clusterNetwork::services section.

      > Note
      >
      > The passwordSalt and passwordHash values for the IAM roles are automatically re-generated during the IAM configuration described in the next step.

3. Clean up the environment configuration:

   1. If you are deploying the regional cluster on top of a baremetal-based management cluster, unset the following parameters:

      ```
      unset KAAS_BM_ENABLED KAAS_BM_FULL_PREFLIGHT KAAS_BM_PXE_IP \
          KAAS_BM_PXE_MASK KAAS_BM_PXE_BRIDGE KAAS_BM_BM_DHCP_RANGE \
          TEMPLATES_DIR
      ```

   2. If you are deploying the regional cluster on top of an AWS-based management cluster, unset the KAAS_AWS_ENABLED parameter:

      ```
      unset KAAS_AWS_ENABLED
      ```

4. Export the following parameters:

   ```
   export KUBECONFIG=<pathToMgmtClusterKubeconfig>
   export REGIONAL_CLUSTER_NAME=<newRegionalClusterName>
   export REGION=<NewRegionName>
   ```

   Substitute the parameters enclosed in angle brackets with the corresponding values of your cluster.

5. Run the regional cluster bootstrap script:

   ```
   ./bootstrap.sh deploy_regional
   ```

> Note
>
> Due to the known issue #7281, before running the script, verify that there are no spaces in the PATH environment variable.

The workflow of the regional cluster bootstrap script

#	Description
1	Prepare the bootstrap cluster for the new regional cluster.
2	Load the updated DE Container Cloud CRDs for Credentials, Cluster, and Machines with information about the new regional cluster to the management cluster.
3	Connect to each machine of the management cluster through SSH.
4	Wait for the Machines and Cluster objects of the new regional cluster to be ready on the management cluster.
5	Load the following objects to the new regional cluster: Secret with the management cluster kubeconfig and ClusterRole for the DE Container Cloud provider.
6	Forward the bootstrap cluster endpoint to helm-controller.
7	Wait for all CRDs to be available and verify the objects created using these CRDs.
8	Pivot the cluster API stack to the regional cluster.
9	Switch the LCM agent from the bootstrap cluster to the regional one.
10	Wait for the DE Container Cloud components to start on the regional cluster.

Now, you can proceed with deploying the managed clusters of supported provider types as described in Create and operate a managed cluster.

Troubleshooting

This section provides solutions to the issues that may occur while deploying a management cluster.

Collect the bootstrap logs

If the bootstrap script fails during the deployment process, collect and inspect the bootstrap and management cluster logs.

To collect the bootstrap logs:

1. Log in to your local machine where the bootstrap script was executed.
2. Run the following command:

   ```
   ./bootstrap.sh collect_logs
   ```

   The logs are collected in the directory where the bootstrap script is located.

Depending on the type of issue found in logs, apply the corresponding fixes. For example, if you detect the LoadBalancer ERROR state errors during the bootstrap of an OpenStack-based management cluster, contact your system administrator to fix the issue. To troubleshoot other issues, refer to the corresponding section in Troubleshooting.

DNS settings

If you have issues related to the DNS settings, the following error message may occur:

```
curl: (6) Could not resolve host
```

The issue may occur if a VPN is used to connect to the cloud or a local DNS forwarder is set up.

The workaround is to change the default DNS settings for Docker:

1. Log in to your local machine.
2. Identify your internal or corporate DNS server address:

   ```
   systemd-resolve --status
   ```

3. Create or edit /etc/docker/daemon.json by specifying your DNS address:

   ```
   {
     "dns": ["<YOUR_DNS_ADDRESS>"]
   }
   ```

4. Restart the Docker daemon:

   ```
   sudo systemctl restart docker
   ```

Default network address

If you have issues related to the default network address configuration, cURL either hangs or the following error occurs:

```
curl: (7) Failed to connect to xxx.xxx.xxx.xxx port xxxx: Host is unreachable
```

The issue may occur because the default Docker network address 172.17.0.0/16 overlaps with your cloud address or other addresses of the network configuration.

Workaround:

1. Log in to your local machine.
2. Verify routing to the IP addresses of the target cloud endpoints:
    1. Obtain the IP address of your target cloud. For example:

        ```
        nslookup auth.openstack.example.com
        ```

        Example of system response:

        ```
        Name:   auth.openstack.example.com
        Address: 172.17.246.119
        ```

    2. Verify that this IP address is not routed through docker0 but through any other interface, for example, ens3:

        ```
        ip r get 172.17.246.119
        ```

        Example of the system response if the routing is configured correctly:

        ```
        172.17.246.119 via 172.18.194.1 dev ens3 src 172.18.1.1 uid 1000
          cache
        ```

        Example of the system response if the routing is configured incorrectly:

        ```
        172.17.246.119 via 172.18.194.1 dev docker0 src 172.18.1.1 uid 1000
          cache
        ```

3. If the routing is incorrect, change the IP address of the default Docker bridge:
    1. Create or edit /etc/docker/daemon.json by adding the "bip" option:

        ```
        {
          "bip": "192.168.91.1/24"
        }
        ```

2. Restart the Docker daemon:

   ```
   sudo systemctl restart docker
   ```

TLS handshake timeout

If you execute the bootstrap.sh script from an OpenStack VM that is running on the OpenStack environment used for bootstrapping the management cluster, the following error messages may occur that can be related to the MTU settings discrepancy:

```
curl: (35) OpenSSL SSL_connect: SSL_ERROR_SYSCALL in connection to server:port

Failed to check if machine "<machine_name>" exists:
failed to create provider client ... TLS handshake timeout
```

To identify whether the issue is MTU-related:

1. Log in to the OpenStack VM in question.
2. Compare the MTU outputs for the docker0 and ens3 interfaces:

   ```
   ip addr
   ```

   Example of system response:

   ```
   3: docker0: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500...
   ...
   2: ens3: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1450...
   ```

   If the MTU output values differ for docker0 and ens3, proceed with the workaround below. Otherwise, inspect the logs further to identify the root cause of the error messages.

Workaround:

1. In your OpenStack environment used for Docker Enterprise (DE) Container Cloud, log in to any machine with CLI access to OpenStack. For example, you can create a new Ubuntu VM (separate from the bootstrap VM) and install the python-openstackclient package on it.
2. Change the vXLAN MTU size for the VM to the required value depending on your network infrastructure and considering your physical network configuration, such as Jumbo frames, and so on.

   ```
   openstack network set --mtu <YOUR_MTU_SIZE> <network-name>
   ```

3. Stop and start the VM in Nova.
4. Log in to the bootstrap VM dedicated for the management cluster.
5. Re-execute the bootstrap.sh script.