Red Hat OpenStack Platform 16.1

Director Installation and Usage

An end-to-end scenario on using Red Hat OpenStack Platform director to create an OpenStack cloud

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OpenStack Team
rhos-docs@redhat.com

Legal Notice

Abstract

Install Red Hat OpenStack Platform 16 in an enterprise environment using the Red Hat OpenStack Platform director. This includes installing the director, planning your environment, and creating an OpenStack environment with the director.

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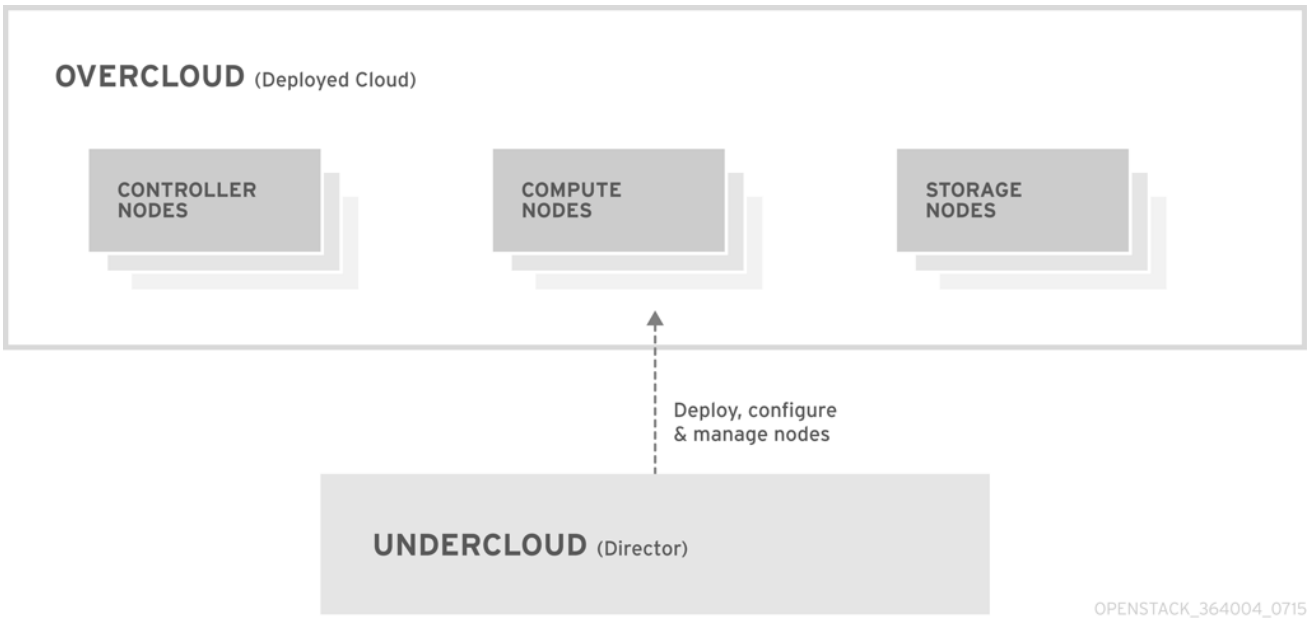
CHAPTER 1. INTRODUCTION TO DIRECTOR

The Red Hat OpenStack Platform (RHOSP) director is a toolset for installing and managing a complete OpenStack environment. Director is based primarily on the OpenStack project TripleO. With director you can install a fully-operational, lean, and robust RHOSP environment that can provision and control bare metal systems to use as OpenStack nodes.

Director uses two main concepts: an undercloud and an overcloud. First you install the undercloud, and then use the undercloud as a tool to install and configure the overcloud.



1.1. UNDERCLOUD

The undercloud is the main management node that contains the Red Hat OpenStack Platform director toolset. It is a single-system OpenStack installation that includes components for provisioning and managing the OpenStack nodes that form your OpenStack environment (the overcloud). The components that form the undercloud have multiple functions:

Environment planning

The undercloud includes planning functions that you can use to create and assign certain node roles. The undercloud includes a default set of nodes: Compute, Controller, and various Storage roles. You can also design custom roles. Additionally, you can select which OpenStack Platform services to include on each node role, which provides a method to model new node types or isolate certain components on their own host.

Bare metal system control

The undercloud uses the out-of-band management interface, usually Intelligent Platform Management Interface (IPMI), of each node for power management control and a PXE-based service to discover hardware attributes and install OpenStack on each node. You can use this feature to provision bare metal systems as OpenStack nodes. For a full list of power management drivers, see Appendix A, *Power management drivers*.

Orchestration

The undercloud contains a set of YAML templates that represent a set of plans for your environment. The undercloud imports these plans and follows their instructions to create the resulting OpenStack environment. The plans also include hooks that you can use to incorporate your own customizations as certain points in the environment creation process.

Undercloud components

The undercloud uses OpenStack components as its base tool set. Each component operates within a separate container on the undercloud:

- OpenStack Identity (keystone) - Provides authentication and authorization for the director components.
- OpenStack Bare Metal (ironic) and OpenStack Compute (nova) - Manages bare metal nodes.
- OpenStack Networking (neutron) and Open vSwitch - Control networking for bare metal nodes.
- OpenStack Image Service (glance) - Stores images that director writes to bare metal machines.
- OpenStack Orchestration (heat) and Puppet - Provides orchestration of nodes and configuration of nodes after director writes the overcloud image to disk.
- OpenStack Telemetry (ceilometer) - Performs monitoring and data collection. Telemetry also includes the following components:
  - OpenStack Telemetry Metrics (gnocchi) - Provides a time series database for metrics.
  - OpenStack Telemetry Alarming (aodh) - Provide an alarming component for monitoring.
  - OpenStack Telemetry Event Storage (panko) - Provides event storage for monitoring.
- OpenStack Workflow Service (mistral) - Provides a set of workflows for certain director-specific actions, such as importing and deploying plans.
- OpenStack Messaging Service (zaqar) - Provides a messaging service for the OpenStack Workflow Service.
- OpenStack Object Storage (swift) - Provides object storage for various OpenStack Platform components, including:
  - Image storage for OpenStack Image Service
  - Introspection data for OpenStack Bare Metal
  - Deployment plans for OpenStack Workflow Service

1.2. UNDERSTANDING THE OVERCLOUD

The overcloud is the resulting Red Hat OpenStack Platform (RHOSP) environment that the undercloud creates. The overcloud consists of multiple nodes with different roles that you define based on the OpenStack Platform environment that you want to create. The undercloud includes a default set of overcloud node roles:

Controller

Controller nodes provide administration, networking, and high availability for the OpenStack environment. A recommended OpenStack environment contains three Controller nodes together in a high availability cluster.
A default Controller node role supports the following components. Not all of these services are enabled by default. Some of these components require custom or pre-packaged environment files to enable:

- OpenStack Dashboard (horizon)
- OpenStack Identity (keystone)
- OpenStack Compute (nova) API
- OpenStack Networking (neutron)
- OpenStack Image Service (glance)
- OpenStack Block Storage (cinder)
- OpenStack Object Storage (swift)
- OpenStack Orchestration (heat)
- OpenStack Telemetry Metrics (gnocchi)
- OpenStack Telemetry Alarming (aodh)
- OpenStack Telemetry Event Storage (panko)
- OpenStack Shared File Systems (manila)
- OpenStack Bare Metal (ironic)
- MariaDB
- Open vSwitch
- Pacemaker and Galera for high availability services.

Compute

Compute nodes provide computing resources for the OpenStack environment. You can add more Compute nodes to scale out your environment over time. A default Compute node contains the following components:

- OpenStack Compute (nova)
- KVM/QEMU
- OpenStack Telemetry (ceilometer) agent
- Open vSwitch

Storage

Storage nodes provide storage for the OpenStack environment. The following list contains information about the various types of Storage node in RHOSP:

- Ceph Storage nodes - Used to form storage clusters. Each node contains a Ceph Object Storage Daemon (OSD). Additionally, director installs Ceph Monitor onto the Controller nodes in situations where you deploy Ceph Storage nodes as part of your environment.
- Block storage (cinder) - Used as external block storage for highly available Controller nodes. This node contains the following components:
  - OpenStack Block Storage (cinder) volume

    - OpenStack Telemetry agents
    - Open vSwitch.

- Object storage (swift) - These nodes provide an external storage layer for OpenStack Swift. The Controller nodes access object storage nodes through the Swift proxy. Object storage nodes contain the following components:
    - OpenStack Object Storage (swift) storage
    - OpenStack Telemetry agents
    - Open vSwitch.

1.3. UNDERSTANDING HIGH AVAILABILITY IN RED HAT OPENSTACK PLATFORM

The Red Hat OpenStack Platform (RHOSP) director uses a Controller node cluster to provide highly available services to your OpenStack Platform environment. For each service, director installs the same components on all Controller nodes and manages the Controller nodes together as a single service. This type of cluster configuration provides a fallback in the event of operational failures on a single Controller node. This provides OpenStack users with a certain degree of continuous operation.

The OpenStack Platform director uses some key pieces of software to manage components on the Controller node:

- Pacemaker - Pacemaker is a cluster resource manager. Pacemaker manages and monitors the availability of OpenStack components across all nodes in the cluster.
- HAProxy - Provides load balancing and proxy services to the cluster.
- Galera - Replicates the RHOSP database across the cluster.
- Memcached - Provides database caching.

NOTE

- From version 13 and later, you can use director to deploy High Availability for Compute Instances (Instance HA). With Instance HA you can automate evacuating instances from a Compute node when the Compute node fails.

1.4. UNDERSTANDING CONTAINERIZATION IN RED HAT OPENSTACK PLATFORM

Each OpenStack Platform service on the undercloud and overcloud runs inside an individual Linux container on their respective node. This containerization provides a method to isolate services, maintain the environment, and upgrade Red Hat OpenStack Platform (RHOSP).

Red Hat OpenStack Platform 16.1 supports installation on the Red Hat Enterprise Linux 8.2 operating system. Red Hat Enterprise Linux 8.2 no longer includes Docker and provides a new set of tools to replace the Docker ecosystem. This means OpenStack Platform 16.1 replaces Docker with these new tools for OpenStack Platform deployment and upgrades.

Podman

Pod Manager (Podman) is a container management tool. It implements almost all Docker CLI commands, not including commands related to Docker Swarm. Podman manages pods, containers, and container images. One of the major differences between Podman and Docker is that Podman can manage resources without a daemon running in the background.
For more information about Podman, see the Podman website.

Buildah

Buildah specializes in building Open Containers Initiative (OCI) images, which you use in conjunction with Podman. Buildah commands replicate the contents of a Dockerfile. Buildah also provides a lower-level **coreutils** interface to build container images, so that you do not require a Dockerfile to build containers. Buildah also uses other scripting languages to build container images without requiring a daemon.
For more information about Buildah, see the Buildah website.

Skopeo

Skopeo provides operators with a method to inspect remote container images, which helps director collect data when it pulls images. Additional features include copying container images from one registry to another and deleting images from registries.

Red Hat supports the following methods for managing container images for your overcloud:

- Pulling container images from the Red Hat Container Catalog to the **image-serve** registry on the undercloud and then pulling the images from the **image-serve** registry. When you pull images to the undercloud first, you avoid multiple overcloud nodes simultaneously pulling container images over an external connection.
- Pulling container images from your Satellite 6 server. You can pull these images directly from the Satellite because the network traffic is internal.

This guide contains information about configuring your container image registry details and performing basic container operations.

1.5. WORKING WITH CEPH STORAGE IN RED HAT OPENSTACK PLATFORM

It is common for large organizations that use Red Hat OpenStack Platform (RHOSP) to serve thousands of clients or more. Each OpenStack client is likely to have their own unique needs when consuming block storage resources. Deploying glance (images), cinder (volumes), and nova (Compute) on a single node can become impossible to manage in large deployments with thousands of clients. Scaling OpenStack externally resolves this challenge.

However, there is also a practical requirement to virtualize the storage layer with a solution like Red Hat Ceph Storage so that you can scale the RHOSP storage layer from tens of terabytes to petabytes, or even exabytes of storage. Red Hat Ceph Storage provides this storage virtualization layer with high availability and high performance while running on commodity hardware. While virtualization might seem like it comes with a performance penalty, Ceph stripes block device images as objects across the cluster, meaning that large Ceph Block Device images have better performance than a standalone disk. Ceph Block devices also support caching, copy-on-write cloning, and copy-on-read cloning for enhanced performance.

For more information about Red Hat Ceph Storage, see Red Hat Ceph Storage .

NOTE

For multi-architecture clouds, Red Hat supports only pre-installed or external Ceph implementation. For more information, see Integrating an Overcloud with an Existing Red Hat Ceph Cluster and Appendix B, *Red Hat OpenStack Platform for POWER*.

PART I. DIRECTOR INSTALLATION AND CONFIGURATION

CHAPTER 2. PLANNING YOUR UNDERCLOUD

2.1. CONTAINERIZED UNDERCLOUD

The undercloud is the node that controls the configuration, installation, and management of your final Red Hat OpenStack Platform (RHOSP) environment, which is called the overcloud. The undercloud itself uses OpenStack Platform components in the form of containers to create a toolset called director. This means that the undercloud pulls a set of container images from a registry source, generates configuration for the containers, and runs each OpenStack Platform service as a container. As a result, the undercloud provides a containerized set of services that you can use as a toolset to create and manage your overcloud.

Since both the undercloud and overcloud use containers, both use the same architecture to pull, configure, and run containers. This architecture is based on the OpenStack Orchestration service (heat) for provisioning nodes and uses Ansible to configure services and containers. It is useful to have some familiarity with heat and Ansible to help you troubleshoot issues that you might encounter.

2.2. PREPARING YOUR UNDERCLOUD NETWORKING

The undercloud requires access to two main networks:

- The **Provisioning or Control Plane network**, which is the network that director uses to provision your nodes and access them over SSH when executing Ansible configuration. This network also enables SSH access from the undercloud to overcloud nodes. The undercloud contains DHCP services for introspection and provisioning other nodes on this network, which means that no other DHCP services should exist on this network. The director configures the interface for this network.

- The **External network**, which enables access to OpenStack Platform repositories, container image sources, and other servers such as DNS servers or NTP servers. Use this network for standard access the undercloud from your workstation. You must manually configure an interface on the undercloud to access the external network.

The undercloud requires a minimum of 2 x 1 Gbps Network Interface Cards: one for the **Provisioning or Control Plane network** and one for the **External network**. However, it is recommended to use a 10 Gbps interface for Provisioning network traffic, especially if you want to provision a large number of nodes in your overcloud environment.

Note:

- Do not use the same Provisioning or Control Plane NIC as the one that you use to access the director machine from your workstation. The director installation creates a bridge by using the Provisioning NIC, which drops any remote connections. Use the External NIC for remote connections to the director system.

- The Provisioning network requires an IP range that fits your environment size. Use the following guidelines to determine the total number of IP addresses to include in this range:

    - Include at least one temporary IP address for each node that connects to the Provisioning network during introspection.

    - Include at least one permanent IP address for each node that connects to the Provisioning network during deployment.

- Include an extra IP address for the virtual IP of the overcloud high availability cluster on the Provisioning network.
- Include additional IP addresses within this range for scaling the environment.

2.3. DETERMINING ENVIRONMENT SCALE

Before you install the undercloud, determine the scale of your environment. Include the following factors when you plan your environment:

How many nodes do you want to deploy in your overcloud?

The undercloud manages each node within an overcloud. Provisioning overcloud nodes consumes resources on the undercloud. You must provide your undercloud with enough resources to adequately provision and control all of your overcloud nodes.

How many simultaneous operations do you want the undercloud to perform?

Most OpenStack services on the undercloud use a set of workers. Each worker performs an operation specific to that service. Multiple workers provide simultaneous operations. The default number of workers on the undercloud is determined by halving the total CPU thread count on the undercloud. In this instance, thread count refers to the number of CPU cores multiplied by the hyper-threading value. For example, if your undercloud has a CPU with 16 threads, then the director services spawn 8 workers by default. Director also uses a set of minimum and maximum caps by default:

Service	Minimum	Maximum
OpenStack Orchestration (heat)	4	24
All other service	2	12

The undercloud has the following minimum CPU and memory requirements:

- An 8-thread 64-bit x86 processor with support for the Intel 64 or AMD64 CPU extensions. This provides 4 workers for each undercloud service.
- A minimum of 24 GB of RAM.
  - The **ceph-ansible** playbook consumes 1 GB resident set size (RSS) for every 10 hosts that the undercloud deploys. If you want to use a new or existing Ceph cluster in your deployment, you must provision the undercloud RAM accordingly.

To use a larger number of workers, increase the vCPUs and memory of your undercloud using the following recommendations:

- **Minimum:** Use 1.5 GB of memory for each thread. For example, a machine with 48 threads requires 72 GB of RAM to provide the minimum coverage for 24 heat workers and 12 workers for other services.
- **Recommended:** Use 3 GB of memory for each thread. For example, a machine with 48 threads requires 144 GB of RAM to provide the recommended coverage for 24 heat workers and 12 workers for other services.

2.4. UNDERCLOUD DISK SIZING

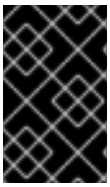
The recommended minimum undercloud disk size is **100 GB** of available disk space on the root disk:

- 20 GB for container images
- 10 GB to accommodate QCOW2 image conversion and caching during the node provisioning process
- 70 GB+ for general usage, logging, metrics, and growth

2.5. VIRTUALIZATION SUPPORT

Red Hat only supports a virtualized undercloud on the following platforms:

Platform	Notes
Kernel-based Virtual Machine (KVM)	Hosted by Red Hat Enterprise Linux 8, as listed on certified hypervisors.
Red Hat Virtualization	Hosted by Red Hat Virtualization 4.x, as listed on certified hypervisors.
Microsoft Hyper-V	Hosted by versions of Hyper-V as listed on the Red Hat Customer Portal Certification Catalogue.
VMware ESX and ESXi	Hosted by versions of ESX and ESXi as listed on the Red Hat Customer Portal Certification Catalogue



IMPORTANT

Red Hat OpenStack Platform director requires that the latest version of Red Hat Enterprise Linux 8 is installed as the host operating system. This means your virtualization platform must also support the underlying Red Hat Enterprise Linux version.

Virtual Machine Requirements

Resource requirements for a virtual undercloud are similar to those of a bare metal undercloud. You should consider the various tuning options when provisioning such as network model, guest CPU capabilities, storage backend, storage format, and caching mode.

Network Considerations

Note the following network considerations for your virtualized undercloud:

Power Management

The undercloud VM requires access to the overcloud nodes' power management devices. This is the IP address set for the **pm_addr** parameter when registering nodes.

Provisioning network

The NIC used for the provisioning (**ctlplane**) network requires the ability to broadcast and serve DHCP requests to the NICs of the overcloud's bare metal nodes. As a recommendation, create a bridge that connects the VM's NIC to the same network as the bare metal NICs.

NOTE

A common problem occurs when the hypervisor technology blocks the undercloud from transmitting traffic from an unknown address. - If using Red Hat Enterprise Virtualization, disable **anti-mac-spoofing** to prevent this. - If using VMware ESX or ESXi, allow forged transmits to prevent this. You must power off and on the director VM after you apply these settings. Rebooting the VM is not sufficient.

2.6. CHARACTER ENCODING CONFIGURATION

Red Hat OpenStack Platform has special character encoding requirements as part of the locale settings:

- Use UTF-8 encoding on all nodes. Ensure the **LANG** environment variable is set to **en_US.UTF-8** on all nodes.
- Avoid using non-ASCII characters if you use Red Hat Ansible Tower to automate the creation of Red Hat OpenStack Platform resources.

2.7. UNDERCLOUD REPOSITORIES

Red Hat OpenStack Platform 16.1 runs on Red Hat Enterprise Linux 8.2. As a result, you must lock the content from these repositories to the respective Red Hat Enterprise Linux version.

NOTE

If you synchronize repositories with Red Hat Satellite, you can enable specific versions of the Red Hat Enterprise Linux repositories. However, the repository remains the same despite the version you choose. For example, you can enable the 8.2 version of the BaseOS repository, but the repository name is still **rhel-8-for-x86_64-baseos-eus-rpms** despite the specific version you choose.

WARNING

Any repositories outside the ones specified here are not supported. Unless recommended, do not enable any other products or repositories outside the ones listed in the following tables or else you might encounter package dependency issues. Do not enable Extra Packages for Enterprise Linux (EPEL).

Core repositories

The following table lists core repositories for installing the undercloud.

Name	Repository	Description of requirement
Red Hat Enterprise Linux 8 for x86_64 - BaseOS (RPMs) Extended Update Support (EUS)	**rhel-8-for-x86_64-baseos-eus-rpms**	Base operating system repository for x86_64 systems.

Name	Repository	Description of requirement
Red Hat Enterprise Linux 8 for x86_64 - AppStream (RPMs)	**rhel-8-for-x86_64-appstream-eus-rpms**	Contains Red Hat OpenStack Platform dependencies.
Red Hat Enterprise Linux 8 for x86_64 - High Availability (RPMs) Extended Update Support (EUS)	**rhel-8-for-x86_64-highavailability-eus-rpms**	High availability tools for Red Hat Enterprise Linux. Used for Controller node high availability.
Red Hat Ansible Engine 2.9 for RHEL 8 x86_64 (RPMs)	**ansible-2.9-for-rhel-8-x86_64-rpms**	Ansible Engine for Red Hat Enterprise Linux. Used to provide the latest version of Ansible.
Advanced Virtualization for RHEL 8 x86_64 (RPMs)	**advanced-virt-for-rhel-8-x86_64-rpms**	Provides virtualization packages for OpenStack Platform.
Red Hat Satellite Tools for RHEL 8 Server RPMs x86_64	**satellite-tools-6.5-for-rhel-8-x86_64-rpms**	Tools for managing hosts with Red Hat Satellite 6.
Red Hat OpenStack Platform 16.1 for RHEL 8 (RPMs)	**openstack-16.1-for-rhel-8-x86_64-rpms**	Core Red Hat OpenStack Platform repository, which contains packages for Red Hat OpenStack Platform director.
Red Hat Fast Datapath for RHEL 8 (RPMS)	**fast-datapath-for-rhel-8-x86_64-rpms**	Provides Open vSwitch (OVS) packages for OpenStack Platform.

Ceph repositories

The following table lists Ceph Storage related repositories for the undercloud.

Name	Repository	Description of Requirement
Red Hat Ceph Storage Tools 4 for RHEL 8 x86_64 (RPMs)	**rhceph-4-tools-for-rhel-8-x86_64-rpms**	Provides tools for nodes to communicate with the Ceph Storage cluster. The undercloud requires the **ceph-ansible** package from this repository if you plan to use Ceph Storage in your overcloud.

IBM POWER repositories

The following table contains a list of repositories for Red Hat Openstack Platform on POWER PC architecture. Use these repositories in place of equivalents in the Core repositories.

Name	Repository	Description of requirement
Red Hat Enterprise Linux for IBM Power, little endian - BaseOS (RPMs)	**rhel-8-for-ppc64le-baseos-rpms**	Base operating system repository for ppc64le systems.
Red Hat Enterprise Linux 8 for IBM Power, little endian - AppStream (RPMs)	**rhel-8-for-ppc64le-appstream-rpms**	Contains Red Hat OpenStack Platform dependencies.
Red Hat Enterprise Linux 8 for IBM Power, little endian - High Availability (RPMs)	**rhel-8-for-ppc64le-highavailability-rpms**	High availability tools for Red Hat Enterprise Linux. Used for Controller node high availability.
Red Hat Ansible Engine 2.8 for RHEL 8 IBM Power, little endian (RPMs)	**ansible-2.8-for-rhel-8-ppc64le-rpms**	Ansible Engine for Red Hat Enterprise Linux. Provides the latest version of Ansible.
Red Hat OpenStack Platform 16.1 for RHEL 8 (RPMs)	**openstack-16.1-for-rhel-8-ppc64le-rpms**	Core Red Hat OpenStack Platform repository for ppc64le systems.

CHAPTER 3. PREPARING FOR DIRECTOR INSTALLATION

3.1. PREPARING THE UNDERCLOUD

Before you can install director, you must complete some basic configuration on the host machine.

Procedure

1. Log in to your undercloud as the **root** user.
2. Create the **stack** user:

```
[root@director ~]# useradd stack
```

3. Set a password for the user:

```
[root@director ~]# passwd stack
```

4. Disable password requirements when using **sudo**:

```
[root@director ~]# echo "stack ALL=(root) NOPASSWD:ALL" | tee -a /etc/sudoers.d/stack
[root@director ~]# chmod 0440 /etc/sudoers.d/stack
```

5. Switch to the new **stack** user:

```
[root@director ~]# su - stack
[stack@director ~]$
```

6. Create directories for system images and heat templates:

```
[stack@director ~]$ mkdir ~/images
[stack@director ~]$ mkdir ~/templates
```

   Director uses system images and heat templates to create the overcloud environment. Red Hat recommends creating these directories to help you organize your local file system.

7. Check the base and full hostname of the undercloud:

```
[stack@director ~]$ hostname
[stack@director ~]$ hostname -f
```

   If either of the previous commands do not report the correct fully-qualified hostname or report an error, use **hostnamectl** to set a hostname:

```
[stack@director ~]$ sudo hostnamectl set-hostname manager.example.com
[stack@director ~]$ sudo hostnamectl set-hostname --transient manager.example.com
```

8. Edit the **/etc/hosts** and include an entry for the system hostname. The IP address in **/etc/hosts** must match the address that you plan to use for your undercloud public API. For example, if the system is named **manager.example.com** and uses **10.0.0.1** for its IP address, add the following line to the **/etc/hosts** file:

```
10.0.0.1  manager.example.com manager
```

3.2. REGISTERING THE UNDERCLOUD AND ATTACHING SUBSCRIPTIONS

Before you can install director, you must run **subscription-manager** to register the undercloud and attach a valid Red Hat OpenStack Platform subscription.

Procedure

1. Log in to your undercloud as the **stack** user.
2. Register your system either with the Red Hat Content Delivery Network or with a Red Hat Satellite. For example, run the following command to register the system to the Content Delivery Network. Enter your Customer Portal user name and password when prompted:

```
[stack@director ~]$ sudo subscription-manager register
```

3. Find the entitlement pool ID for Red Hat OpenStack Platform (RHOSP) director:

```
[stack@director ~]$ sudo subscription-manager list --available --all --matches="Red Hat
OpenStack"
Subscription Name:   Name of SKU
Provides:            Red Hat Single Sign-On
                     Red Hat Enterprise Linux Workstation
                     Red Hat CloudForms
                     Red Hat OpenStack
                     Red Hat Software Collections (for RHEL Workstation)
                     Red Hat Virtualization
SKU:                 SKU-Number
Contract:            Contract-Number
Pool ID:             Valid-Pool-Number-123456
Provides Management: Yes
Available:           1
Suggested:           1
Service Level:       Support-level
Service Type:        Service-Type
Subscription Type:   Sub-type
Ends:                End-date
System Type:         Physical
```

4. Locate the **Pool ID** value and attach the Red Hat OpenStack Platform 16.1 entitlement:

```
[stack@director ~]$ sudo subscription-manager attach --pool=Valid-Pool-Number-123456
```

5. Lock the undercloud to Red Hat Enterprise Linux 8.2:

```
$ sudo subscription-manager release --set=8.2
```

3.3. ENABLING REPOSITORIES FOR THE UNDERCLOUD

Enable the repositories that are required for the undercloud, and update the system packages to the latest versions.

Procedure

1. Log in to your undercloud as the **stack** user.
2. Disable all default repositories, and enable the required Red Hat Enterprise Linux repositories:

```
[stack@director ~]$ sudo subscription-manager repos --disable=*
[stack@director ~]$ sudo subscription-manager repos --enable=rhel-8-for-x86_64-baseos-eus-rpms --enable=rhel-8-for-x86_64-appstream-eus-rpms --enable=rhel-8-for-x86_64-highavailability-eus-rpms --enable=ansible-2.9-for-rhel-8-x86_64-rpms --enable=openstack-16.1-for-rhel-8-x86_64-rpms --enable=fast-datapath-for-rhel-8-x86_64-rpms --enable=advanced-virt-for-rhel-8-x86_64-rpms
```

   These repositories contain packages that the director installation requires.

3. Set the **container-tools** repository module to version **2.0**:

```
[stack@director ~]$ sudo dnf module disable -y container-tools:rhel8
[stack@director ~]$ sudo dnf module enable -y container-tools:2.0
```

4. Set the **virt** repository module to version **8.2**:

```
[stack@director ~]$ sudo dnf module disable -y virt:rhel
[stack@director ~]$ sudo dnf module enable -y virt:8.2
```

5. Perform an update on your system to ensure that you have the latest base system packages:

```
[stack@director ~]$ sudo dnf update -y
[stack@director ~]$ sudo reboot
```

3.4. CONFIGURING AN UNDERCLOUD PROXY

If your environment uses a proxy, you can pre-configure the undercloud to use the proxy details. This procedure is optional and only applies to users requiring proxy configuration.

Procedure

1. Log in to the undercloud host as the **root** user.
2. Edit the **/etc/environment** file:

```
# vi /etc/environment
```

3. Add the following parameters to the **/etc/environment** file:

   http_proxy

   The proxy to use for standard HTTP requests.

   https_proxy

   The proxy to use for HTTPs requests.

no_proxy

A comma-separated list of IP addresses and domains excluded from proxy communications. Include all IP addresses and domains relevant to the undercloud.
For example, use the following syntax to define the **http_proxy**, **https_proxy**, and **no_proxy** parameters:

```
http_proxy=https://10.0.0.1:8080/
https_proxy=https://10.0.0.1:8080/
no_proxy=127.0.0.1,172.16.0.0/16,172.17.0.0/16,172.18.0.0/16,192.168.0.0/16,HOSTNAME.ctlplane.localdomain
```

4. Restart your shell session. For example, logout and re-login to the undercloud.

3.5. INSTALLING DIRECTOR PACKAGES

Install packages relevant to Red Hat OpenStack Platform director.

Procedure

1. Install the command line tools for director installation and configuration:

```
[stack@director ~]$ sudo dnf install -y python3-tripleoclient
```

3.6. INSTALLING CEPH-ANSIBLE

The **ceph-ansible** package is required when you use Ceph Storage with Red Hat OpenStack Platform.

If you use Red Hat Ceph Storage, or if your deployment uses an external Ceph Storage cluster, install the **ceph-ansible** package. For more information about integrating with an existing Ceph Storage cluster, see Integrating an Overcloud with an Existing Red Hat Ceph Cluster .

Procedure

1. Enable the Ceph Tools repository:

```
[stack@director ~]$ sudo subscription-manager repos --enable=rhceph-4-tools-for-rhel-8-x86_64-rpms
```

2. Install the **ceph-ansible** package:

```
[stack@director ~]$ sudo dnf install -y ceph-ansible
```

3.7. PREPARING CONTAINER IMAGES

The undercloud installation requires an environment file to determine where to obtain container images and how to store them. Generate and customize this environment file that you can use to prepare your container images.

Procedure

1. Log in to your undercloud host as the **stack** user.
2. Generate the default container image preparation file:

```
$ openstack tripleo container image prepare default \
  --local-push-destination \
  --output-env-file containers-prepare-parameter.yaml
```

This command includes the following additional options:

- **--local-push-destination** sets the registry on the undercloud as the location for container images. With this option, director pulls the necessary images from the Red Hat Container Catalog and pushes the images to the registry on the undercloud. Director uses the undercloud registry as the container image source. To pull container images directly from the Red Hat Container Catalog, omit this option.
- **--output-env-file** specifies an environment file that includes include the parameters for preparing your container images. In this example, the name of the file is **containers-prepare-parameter.yaml**.

NOTE

You can use the same **containers-prepare-parameter.yaml** file to define a container image source for both the undercloud and the overcloud.

3. Modify the **containers-prepare-parameter.yaml** to suit your requirements.

3.8. CONTAINER IMAGE PREPARATION PARAMETERS

The default file for preparing your containers (**containers-prepare-parameter.yaml**) contains the **ContainerImagePrepare** heat parameter. This parameter defines a list of strategies for preparing a set of images:

```
parameter_defaults:
  ContainerImagePrepare:
  - (strategy one)
  - (strategy two)
  - (strategy three)
  ...
```

Each strategy accepts a set of sub-parameters that defines which images to use and what to do with the images. The following table contains information about the sub-parameters you can use with each **ContainerImagePrepare** strategy:

Parameter	Description
excludes	List of image name substrings to exclude from a strategy.

Parameter	Description
includes	List of image name substrings to include in a strategy. At least one image name must match an existing image. All **excludes** are ignored if **includes** is specified.
modify_append_tag	String to append to the tag for the destination image. For example, if you pull an image with the tag **14.0-89** and set the **modify_append_tag** to **-hotfix**, the director tags the final image as **14.0-89-hotfix**.
modify_only_with_labels	A dictionary of image labels that filter the images that you want to modify. If an image matches the labels defined, the director includes the image in the modification process.
modify_role	String of ansible role names to run during upload but before pushing the image to the destination registry.
modify_vars	Dictionary of variables to pass to **modify_role**.
push_destination	Defines the namespace of the registry that you want to push images to during the upload process. ● If set to **true**, the **push_destination** is set to the undercloud registry namespace using the hostname, which is the recommended method. ● If set to **false**, the push to a local registry does not occur and nodes pull images directly from the source. ● If set to a custom value, director pushes images to an external local registry. If you choose to pull container images directly from the Red Hat Container Catalog, do not set this parameter to **false** in production environments or else all overcloud nodes will simultaneously pull the images from the Red Hat Container Catalog over your external connection, which can cause bandwidth issues. If the **push_destination** parameter is set to **false** or is not defined and the remote registry requires authentication, set the **ContainerImageRegistryLogin** parameter to **true** and include the credentials with the **ContainerImageRegistryCredentials** parameter.
pull_source	The source registry from where to pull the original container images.

Parameter	Description
set	A dictionary of **key: value** definitions that define where to obtain the initial images.
tag_from_label	Defines the label pattern to tag the resulting images. Usually sets to **{version}-{release}**.

IMPORTANT

When you push images to the undercloud, use **push_destination: true** instead of **push_destination: UNDERCLOUD_IP:PORT**. The **push_destination: true** method provides a level of consistency across both IPv4 and IPv6 addresses.

The **set** parameter accepts a set of **key: value** definitions:

Key	Description
ceph_image	The name of the Ceph Storage container image.
ceph_namespace	The namespace of the Ceph Storage container image.
ceph_tag	The tag of the Ceph Storage container image.
name_prefix	A prefix for each OpenStack service image.
name_suffix	A suffix for each OpenStack service image.
namespace	The namespace for each OpenStack service image.
neutron_driver	The driver to use to determine which OpenStack Networking (neutron) container to use. Use a null value to set to the standard **neutron-server** container. Set to **ovn** to use OVN-based containers.
tag	The tag that the director uses to identify the images to pull from the source registry. You usually keep this key set to the default value, which is the Red Hat OpenStack Platform version number.

NOTE

The container images use multi-stream tags based on Red Hat OpenStack Platform version. This means there is no longer a **latest** tag.

The **ContainerImageRegistryCredentials** parameter maps a container registry to a username and password to authenticate to that registry.

If a container registry requires a username and password, you can use **ContainerImageRegistryCredentials** to include credentials with the following syntax:

```
ContainerImagePrepare:
- push_destination: true
  set:
    namespace: registry.redhat.io/...
    ...
ContainerImageRegistryCredentials:
  registry.redhat.io:
    my_username: my_password
```

In the example, replace **my_username** and **my_password** with your authentication credentials. Instead of using your individual user credentials, Red Hat recommends creating a registry service account and using those credentials to access **registry.redhat.io** content. For more information, see "Red Hat Container Registry Authentication".

The **ContainerImageRegistryLogin** parameter is used to control the registry login on the systems being deployed. This must be set to **true** if **push_destination** is set to false or not used.

```
ContainerImagePrepare:
- set:
    namespace: registry.redhat.io/...
    ...
ContainerImageRegistryCredentials:
  registry.redhat.io:
    my_username: my_password
ContainerImageRegistryLogin: true
```

If you have configured **push_destination**, do not set **ContainerImageRegistryLogin** to **true**. If you set this option to **true** and the overcloud nodes do not have network connectivity to the registry hosts defined in **ContainerImageRegistryCredentials**, the deployment might fail when trying to perform a login.

3.9. LAYERING IMAGE PREPARATION ENTRIES

The value of the **ContainerImagePrepare** parameter is a YAML list. This means that you can specify multiple entries. The following example demonstrates two entries where director uses the latest version of all images except for the **nova-api** image, which uses the version tagged with **16.0-44**:

```
ContainerImagePrepare:
- tag_from_label: "{version}-{release}"
  push_destination: true
  excludes:
  - nova-api
  set:
    namespace: registry.redhat.io/rhosp-rhel8
    name_prefix: openstack-
    name_suffix: ''
    tag: 16.1
- push_destination: true
  includes:
  - nova-api
```

```
  set:
    namespace: registry.redhat.io/rhosp-rhel8
    tag: 16.1-44
```

The **includes** and **excludes** entries control image filtering for each entry. The images that match the **includes** strategy take precedence over **excludes** matches. The image name must contain the **includes** or **excludes** value to be considered a match.

3.10. OBTAINING CONTAINER IMAGES FROM PRIVATE REGISTRIES

Some container image registries require authentication to access images. In this situation, use the **ContainerImageRegistryCredentials** parameter in your **containers-prepare-parameter.yaml** environment file.

```
parameter_defaults:
  ContainerImagePrepare:
  - (strategy one)
  - (strategy two)
  - (strategy three)
  ContainerImageRegistryCredentials:
    registry.example.com:
      username: "p@55w0rd!"
```

IMPORTANT

Private registries require **push_destination** set to **true** for their respective strategy in the **ContainerImagePrepare**.

The **ContainerImageRegistryCredentials** parameter uses a set of keys based on the private registry URL. Each private registry URL uses its own key and value pair to define the username (key) and password (value). This provides a method to specify credentials for multiple private registries.

```
parameter_defaults:
  ...
  ContainerImageRegistryCredentials:
    registry.redhat.io:
      myuser: 'p@55w0rd!'
    registry.internalsite.com:
      myuser2: '0th3rp@55w0rd!'
    '192.0.2.1:8787':
      myuser3: '@n0th3rp@55w0rd!'
```

IMPORTANT

The default **ContainerImagePrepare** parameter pulls container images from **registry.redhat.io**, which requires authentication.

The **ContainerImageRegistryLogin** parameter is used to control whether the system needs to log in to the remote registry to fetch the containers.

```
parameter_defaults:
  ...
  ContainerImageRegistryLogin: true
```

IMPORTANT

You must set **ContainerImageRegistryLogin** to **true** if **push_destination** is not configured for a given strategy. If **push_destination** is configured in a **ContainerImagePrepare** strategy and the **ContainerImageRegistryCredentials** parameter is configured, the system logs in to fetch the containers and pushes them to the remote system. If the overcloud nodes do not have network connectivity to the registry hosts defined in the **ContainerImageRegistryCredentials**, set **push_destination** to **true** and **ContainerImageRegistryLogin** to **false** .

3.11. MODIFYING IMAGES DURING PREPARATION

It is possible to modify images during image preparation, and then immediately deploy with modified images. Scenarios for modifying images include:

- As part of a continuous integration pipeline where images are modified with the changes being tested before deployment.
- As part of a development workflow where local changes must be deployed for testing and development.
- When changes must be deployed but are not available through an image build pipeline. For example, adding proprietary add-ons or emergency fixes.

To modify an image during preparation, invoke an Ansible role on each image that you want to modify. The role takes a source image, makes the requested changes, and tags the result. The prepare command can push the image to the destination registry and set the heat parameters to refer to the modified image.

The Ansible role **tripleo-modify-image** conforms with the required role interface and provides the behaviour necessary for the modify use cases. Control the modification with the modify-specific keys in the **ContainerImagePrepare** parameter:

- **modify_role** specifies the Ansible role to invoke for each image to modify.
- **modify_append_tag** appends a string to the end of the source image tag. This makes it obvious that the resulting image has been modified. Use this parameter to skip modification if the **push_destination** registry already contains the modified image. Change **modify_append_tag** whenever you modify the image.
- **modify_vars** is a dictionary of Ansible variables to pass to the role.

To select a use case that the **tripleo-modify-image** role handles, set the **tasks_from** variable to the required file in that role.

While developing and testing the **ContainerImagePrepare** entries that modify images, run the image prepare command without any additional options to confirm that the image is modified as you expect:

```
sudo openstack tripleo container image prepare \
  -e ~/containers-prepare-parameter.yaml
```

3.12. UPDATING EXISTING PACKAGES ON CONTAINER IMAGES

The following example **ContainerImagePrepare** entry updates in all packages on the container images using the dnf repository configuration of the undercloud host:

```
ContainerImagePrepare:
- push_destination: true
  ...
  modify_role: tripleo-modify-image
  modify_append_tag: "-updated"
  modify_vars:
    tasks_from: yum_update.yml
    compare_host_packages: true
    yum_repos_dir_path: /etc/yum.repos.d
  ...
```

3.13. INSTALLING ADDITIONAL RPM FILES TO CONTAINER IMAGES

You can install a directory of RPM files in your container images. This is useful for installing hotfixes, local package builds, or any package that is not available through a package repository. For example, the following **ContainerImagePrepare** entry installs some hotfix packages only on the **nova-compute** image:

```
ContainerImagePrepare:
- push_destination: true
  ...
  includes:
  - nova-compute
  modify_role: tripleo-modify-image
  modify_append_tag: "-hotfix"
  modify_vars:
    tasks_from: rpm_install.yml
    rpms_path: /home/stack/nova-hotfix-pkgs
  ...
```

3.14. MODIFYING CONTAINER IMAGES WITH A CUSTOM DOCKERFILE

For maximum flexibility, you can specify a directory containing a Dockerfile to make the required changes. When you invoke the **tripleo-modify-image** role, the role generates a **Dockerfile.modified** file that changes the **FROM** directive and adds extra **LABEL** directives. The following example runs the custom Dockerfile on the **nova-compute** image:

```
ContainerImagePrepare:
- push_destination: true
  ...
  includes:
  - nova-compute
  modify_role: tripleo-modify-image
  modify_append_tag: "-hotfix"
  modify_vars:
    tasks_from: modify_image.yml
    modify_dir_path: /home/stack/nova-custom
  ...
```

The following example shows the **/home/stack/nova-custom/Dockerfile** file. After you run any **USER** root directives, you must switch back to the original image default user:

```
FROM registry.redhat.io/rhosp-rhel8/openstack-nova-compute:latest

USER "root"

COPY customize.sh /tmp/
RUN /tmp/customize.sh

USER "nova"
```

3.15. PREPARING A SATELLITE SERVER FOR CONTAINER IMAGES

Red Hat Satellite 6 offers registry synchronization capabilities. This provides a method to pull multiple images into a Satellite server and manage them as part of an application life cycle. The Satellite also acts as a registry for other container-enabled systems to use. For more information about managing container images, see Managing Container Images in the *Red Hat Satellite 6 Content Management Guide*.

The examples in this procedure use the **hammer** command line tool for Red Hat Satellite 6 and an example organization called **ACME**. Substitute this organization for your own Satellite 6 organization.

NOTE

This procedure requires authentication credentials to access container images from **registry.redhat.io**. Instead of using your individual user credentials, Red Hat recommends creating a registry service account and using those credentials to access **registry.redhat.io** content. For more information, see "Red Hat Container Registry Authentication".

Procedure

1. Create a list of all container images:

```
$ sudo podman search --limit 1000 "registry.redhat.io/rhosp" | grep rhosp-rhel8 | awk '{ print $2 }' | grep -v beta | sed "s/registry.redhat.io\///g" | tail -n+2 > satellite_images
```

2. Copy the **satellite_images** file to a system that contains the Satellite 6 **hammer** tool. Alternatively, use the instructions in the *Hammer CLI Guide* to install the **hammer** tool to the undercloud.

3. Run the following **hammer** command to create a new product (**OSP16.1 Containers**) in your Satellite organization:

```
$ hammer product create \
  --organization "ACME" \
  --name "OSP16.1 Containers"
```

   This custom product will contain your images.

4. Add the base container image to the product:

```
$ hammer repository create \
```

```
  --organization "ACME" \
  --product "OSP16.1 Containers" \
  --content-type docker \
  --url https://registry.redhat.io \
  --docker-upstream-name rhosp-rhel8/openstack-base \
  --upstream-username USERNAME \
  --upstream-password PASSWORD \
  --name base
```

5. Add the overcloud container images from the **satellite_images** file:

```
$ while read IMAGE; do \
  IMAGENAME=$(echo $IMAGE | cut -d"/" -f2 | sed "s/openstack-//g" | sed "s/:.*//g") ; \
  hammer repository create \
  --organization "ACME" \
  --product "OSP16.1 Containers" \
  --content-type docker \
  --url https://registry.redhat.io \
  --docker-upstream-name $IMAGE \
  --upstream-username USERNAME \
  --upstream-password PASSWORD \
  --name $IMAGENAME ; done < satellite_images
```

6. Add the Ceph Storage 4 container image:

```
$ hammer repository create \
  --organization "ACME" \
  --product "OSP16.1 Containers" \
  --content-type docker \
  --url https://registry.redhat.io \
  --docker-upstream-name rhceph/rhceph-4-rhel8 \
  --upstream-username USERNAME \
  --upstream-password PASSWORD \
  --name rhceph-4-rhel8
```

7. Synchronize the container images:

```
$ hammer product synchronize \
  --organization "ACME" \
  --name "OSP16.1 Containers"
```

   Wait for the Satellite server to complete synchronization.

NOTE

Depending on your configuration, **hammer** might ask for your Satellite server username and password. You can configure **hammer** to automatically login using a configuration file. For more information, see the Authentication section in the *Hammer CLI Guide*.

8. If your Satellite 6 server uses content views, create a new content view version to incorporate the images and promote it along environments in your application life cycle. This largely depends on how you structure your application lifecycle. For example, if you have an environment called **production** in your lifecycle and you want the container images to be

available in that environment, create a content view that includes the container images and promote that content view to the **production** environment. For more information, see Managing Content Views.

9. Check the available tags for the **base** image:

```
$ hammer docker tag list --repository "base" \
  --organization "ACME" \
  --environment "production" \
  --content-view "myosp16_1" \
  --product "OSP16.1 Containers"
```

This command displays tags for the OpenStack Platform container images within a content view for a particular environment.

10. Return to the undercloud and generate a default environment file that prepares images using your Satellite server as a source. Run the following example command to generate the environment file:

```
(undercloud) $ openstack tripleo container image prepare default \
  --output-env-file containers-prepare-parameter.yaml
```

- **--output-env-file** is an environment file name. The contents of this file include the parameters for preparing your container images for the undercloud. In this case, the name of the file is **containers-prepare-parameter.yaml**.

11. Edit the **containers-prepare-parameter.yaml** file and modify the following parameters:

- **push_destination** – Set this to **true** or **false** depending on your chosen container image management strategy. If you set this parameter to **false**, the overcloud nodes pull images directly from the Satellite. If you set this parameter to **true**, the director pulls the images from the Satellite to the undercloud registry and the overcloud pulls the images from the undercloud registry.
- **namespace** – The URL and port of the registry on the Satellite server. The default registry port on Red Hat Satellite is 5000.
- **name_prefix** – The prefix is based on a Satellite 6 convention. This differs depending on whether you use content views:
  - If you use content views, the structure is **[org]-[environment]-[content view]-[product]-**. For example: **acme-production-myosp16-osp16_containers-**.
  - If you do not use content views, the structure is **[org]-[product]-**. For example: **acme-osp16_1_containers-**.
- **ceph_namespace**, **ceph_image**, **ceph_tag** – If you use Ceph Storage, include these additional parameters to define the Ceph Storage container image location. Note that **ceph_image** now includes a Satellite-specific prefix. This prefix is the same value as the **name_prefix** option.

The following example environment file contains Satellite-specific parameters:

```
parameter_defaults:
  ContainerImagePrepare:
  - push_destination: false
```

```
  set:
    ceph_image: acme-production-myosp16_1-osp16_1_containers-rhceph-4
    ceph_namespace: satellite.example.com:5000
    ceph_tag: latest
    name_prefix: acme-production-myosp16_1-osp16_1_containers-
    name_suffix: ''
    namespace: satellite.example.com:5000
    neutron_driver: null
    tag: 16.1
    ...
  tag_from_label: '{version}-{release}'
```

Use this environment file when you create both your undercloud and overcloud.

CHAPTER 4. INSTALLING DIRECTOR

4.1. CONFIGURING DIRECTOR

The director installation process requires certain settings in the **undercloud.conf** configuration file, which director reads from the home directory of the **stack** user. Complete the following steps to copy default template as a foundation for your configuration.

Procedure

1. Copy the default template to the home directory of the **stack** user's:

```
[stack@director ~]$ cp \
  /usr/share/python-tripleoclient/undercloud.conf.sample \
  ~/undercloud.conf
```

2. Edit the **undercloud.conf** file. This file contains settings to configure your undercloud. If you omit or comment out a parameter, the undercloud installation uses the default value.

4.2. DIRECTOR CONFIGURATION PARAMETERS

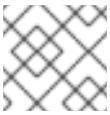
The following list contains information about parameters for configuring the **undercloud.conf** file. Keep all parameters within their relevant sections to avoid errors.

Defaults

The following parameters are defined in the **[DEFAULT]** section of the **undercloud.conf** file:

additional_architectures

A list of additional (kernel) architectures that an overcloud supports. Currently the overcloud supports **ppc64le** architecture.



NOTE

When you enable support for ppc64le, you must also set **ipxe_enabled** to **False**

certificate_generation_ca

The **certmonger** nickname of the CA that signs the requested certificate. Use this option only if you have set the **generate_service_certificate** parameter. If you select the **local** CA, certmonger extracts the local CA certificate to **/etc/pki/ca-trust/source/anchors/cm-local-ca.pem** and adds the certificate to the trust chain.

clean_nodes

Defines whether to wipe the hard drive between deployments and after introspection.

cleanup

Cleanup temporary files. Set this to **False** to leave the temporary files used during deployment in place after you run the deployment command. This is useful for debugging the generated files or if errors occur.

container_cli

The CLI tool for container management. Leave this parameter set to **podman**. Red Hat Enterprise Linux 8.2 only supports **podman**.

container_healthcheck_disabled

Disables containerized service health checks. Red Hat recommends that you enable health checks and leave this option set to **false**.

container_images_file

Heat environment file with container image information. This file can contain the following entries:

- Parameters for all required container images
- The **ContainerImagePrepare** parameter to drive the required image preparation. Usually the file that contains this parameter is named **containers-prepare-parameter.yaml**.

container_insecure_registries

A list of insecure registries for **podman** to use. Use this parameter if you want to pull images from another source, such as a private container registry. In most cases, **podman** has the certificates to pull container images from either the Red Hat Container Catalog or from your Satellite server if the undercloud is registered to Satellite.

container_registry_mirror

An optional **registry-mirror** configured that **podman** uses.

custom_env_files

Additional environment files that you want to add to the undercloud installation.

deployment_user

The user who installs the undercloud. Leave this parameter unset to use the current default user **stack**.

discovery_default_driver

Sets the default driver for automatically enrolled nodes. Requires the **enable_node_discovery** parameter to be enabled and you must include the driver in the **enabled_hardware_types** list.

enable_ironic; enable_ironic_inspector; enable_mistral; enable_nova; enable_tempest; enable_validations; enable_zaqar

Defines the core services that you want to enable for director. Leave these parameters set to **true**.

enable_node_discovery

Automatically enroll any unknown node that PXE-boots the introspection ramdisk. New nodes use the **fake_pxe** driver as a default but you can set **discovery_default_driver** to override. You can also use introspection rules to specify driver information for newly enrolled nodes.

enable_novajoin

Defines whether to install the **novajoin** metadata service in the undercloud.

enable_routed_networks

Defines whether to enable support for routed control plane networks.

enable_swift_encryption

Defines whether to enable Swift encryption at-rest.

enable_telemetry

Defines whether to install OpenStack Telemetry services (gnocchi, aodh, panko) in the undercloud. Set the **enable_telemetry** parameter to **true** if you want to install and configure telemetry services automatically. The default value is **false**, which disables telemetry on the undercloud. This parameter is required if you use other products that consume metrics data, such as Red Hat CloudForms.

enabled_hardware_types

A list of hardware types that you want to enable for the undercloud.

generate_service_certificate

Defines whether to generate an SSL/TLS certificate during the undercloud installation, which is used for the **undercloud_service_certificate** parameter. The undercloud installation saves the resulting certificate **/etc/pki/tls/certs/undercloud-[undercloud_public_vip].pem**. The CA defined in the **certificate_generation_ca** parameter signs this certificate.

heat_container_image

URL for the heat container image to use. Leave unset.

heat_native

Run host-based undercloud configuration using **heat-all**. Leave as **true**.

hieradata_override

Path to **hieradata** override file that configures Puppet hieradata on the director, providing custom configuration to services beyond the **undercloud.conf** parameters. If set, the undercloud installation copies this file to the **/etc/puppet/hieradata** directory and sets it as the first file in the hierarchy. For more information about using this feature, see Configuring hieradata on the undercloud.

inspection_extras

Defines whether to enable extra hardware collection during the inspection process. This parameter requires the **python-hardware** or **python-hardware-detect** packages on the introspection image.

inspection_interface

The bridge that director uses for node introspection. This is a custom bridge that the director configuration creates. The **LOCAL_INTERFACE** attaches to this bridge. Leave this as the default **br-ctlplane**.

inspection_runbench

Runs a set of benchmarks during node introspection. Set this parameter to **true** to enable the benchmarks. This option is necessary if you intend to perform benchmark analysis when inspecting the hardware of registered nodes.

ipa_otp

Defines the one-time password to register the undercloud node to an IPA server. This is required when **enable_novajoin** is enabled.

ipv6_address_mode

IPv6 address configuration mode for the undercloud provisioning network. The following list contains the possible values for this parameter:

- dhcpv6-stateless - Address configuration using router advertisement (RA) and optional information using DHCPv6.
- dhcpv6-stateful - Address configuration and optional information using DHCPv6.

ipxe_enabled

Defines whether to use iPXE or standard PXE. The default is **true**, which enables iPXE. Set this parameter to **false** to use standard PXE.

local_interface

The chosen interface for the director Provisioning NIC. This is also the device that director uses for DHCP and PXE boot services. Change this value to your chosen device. To see which device is connected, use the **ip addr** command. For example, this is the result of an **ip addr** command:

```
2: eth0: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc pfifo_fast state UP qlen
1000
    link/ether 52:54:00:75:24:09 brd ff:ff:ff:ff:ff:ff
    inet 192.168.122.178/24 brd 192.168.122.255 scope global dynamic eth0
```

```
       valid_lft 3462sec preferred_lft 3462sec
    inet6 fe80::5054:ff:fe75:2409/64 scope link
       valid_lft forever preferred_lft forever
3: eth1: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc noop state DOWN
    link/ether 42:0b:c2:a5:c1:26 brd ff:ff:ff:ff:ff:ff
```

In this example, the External NIC uses **eth0** and the Provisioning NIC uses **eth1**, which is currently not configured. In this case, set the **local_interface** to **eth1**. The configuration script attaches this interface to a custom bridge defined with the **inspection_interface** parameter.

local_ip

The IP address defined for the director Provisioning NIC. This is also the IP address that director uses for DHCP and PXE boot services. Leave this value as the default **192.168.24.1/24** unless you use a different subnet for the Provisioning network, for example, if this IP address conflicts with an existing IP address or subnet in your environment.

local_mtu

The maximum transmission unit (MTU) that you want to use for the **local_interface**. Do not exceed 1500 for the undercloud.

local_subnet

The local subnet that you want to use for PXE boot and DHCP interfaces. The **local_ip** address should reside in this subnet. The default is **ctlplane-subnet**.

net_config_override

Path to network configuration override template. If you set this parameter, the undercloud uses a JSON format template to configure the networking with **os-net-config** and ignores the network parameters set in **undercloud.conf**. Use this parameter when you want to configure bonding or add an option to the interface. See **/usr/share/instack-undercloud/templates/net-config.json.template** for an example.

networks_file

Networks file to override for **heat**.

output_dir

Directory to output state, processed heat templates, and Ansible deployment files.

overcloud_domain_name

The DNS domain name that you want to use when you deploy the overcloud.

NOTE

When you configure the overcloud, you must set the **CloudDomain** parameter to a matching value. Set this parameter in an environment file when you configure your overcloud.

roles_file

The roles file that you want to use to override the default roles file for undercloud installation. It is highly recommended to leave this parameter unset so that the director installation uses the default roles file.

scheduler_max_attempts

The maximum number of times that the scheduler attempts to deploy an instance. This value must be greater or equal to the number of bare metal nodes that you expect to deploy at once to avoid potential race conditions when scheduling.

service_principal

The Kerberos principal for the service using the certificate. Use this parameter only if your CA requires a Kerberos principal, such as in FreeIPA.

subnets

List of routed network subnets for provisioning and introspection. The default value includes only the **ctlplane-subnet** subnet. For more information, see Subnets.

templates

Heat templates file to override.

undercloud_admin_host

The IP address or hostname defined for director Admin API endpoints over SSL/TLS. The director configuration attaches the IP address to the director software bridge as a routed IP address, which uses the /**32** netmask.

undercloud_debug

Sets the log level of undercloud services to **DEBUG**. Set this value to **true** to enable **DEBUG** log level.

undercloud_enable_selinux

Enable or disable SELinux during the deployment. It is highly recommended to leave this value set to **true** unless you are debugging an issue.

undercloud_hostname

Defines the fully qualified host name for the undercloud. If set, the undercloud installation configures all system host name settings. If left unset, the undercloud uses the current host name, but you must configure all system host name settings appropriately.

undercloud_log_file

The path to a log file to store the undercloud install and upgrade logs. By default, the log file is **install-undercloud.log** in the home directory. For example, **/home/stack/install-undercloud.log**.

undercloud_nameservers

A list of DNS nameservers to use for the undercloud hostname resolution.

undercloud_ntp_servers

A list of network time protocol servers to help synchronize the undercloud date and time.

undercloud_public_host

The IP address or hostname defined for director Public API endpoints over SSL/TLS. The director configuration attaches the IP address to the director software bridge as a routed IP address, which uses the /**32** netmask.

undercloud_service_certificate

The location and filename of the certificate for OpenStack SSL/TLS communication. Ideally, you obtain this certificate from a trusted certificate authority. Otherwise, generate your own self-signed certificate.

undercloud_timezone

Host timezone for the undercloud. If you do not specify a timezone, director uses the existing timezone configuration.

undercloud_update_packages

Defines whether to update packages during the undercloud installation.

Subnets

Each provisioning subnet is a named section in the **undercloud.conf** file. For example, to create a subnet called **ctlplane-subnet**, use the following sample in your **undercloud.conf** file:

```
[ctlplane-subnet]
cidr = 192.168.24.0/24
dhcp_start = 192.168.24.5
dhcp_end = 192.168.24.24
inspection_iprange = 192.168.24.100,192.168.24.120
gateway = 192.168.24.1
masquerade = true
```

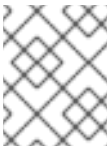
You can specify as many provisioning networks as necessary to suit your environment.

cidr

The network that director uses to manage overcloud instances. This is the Provisioning network, which the undercloud **neutron** service manages. Leave this as the default **192.168.24.0/24** unless you use a different subnet for the Provisioning network.

masquerade

Defines whether to masquerade the network defined in the **cidr** for external access. This provides the Provisioning network with a degree of network address translation (NAT) so that the Provisioning network has external access through director.



NOTE

The director configuration also enables IP forwarding automatically using the relevant **sysctl** kernel parameter.

dhcp_start; dhcp_end

The start and end of the DHCP allocation range for overcloud nodes. Ensure that this range contains enough IP addresses to allocate your nodes.

dhcp_exclude

IP addresses to exclude in the DHCP allocation range.

dns_nameservers

DNS nameservers specific to the subnet. If no nameservers are defined for the subnet, the subnet uses nameservers defined in the **undercloud_nameservers** parameter.

gateway

The gateway for the overcloud instances. This is the undercloud host, which forwards traffic to the External network. Leave this as the default **192.168.24.1** unless you use a different IP address for director or want to use an external gateway directly.

host_routes

Host routes for the Neutron-managed subnet for the overcloud instances on this network. This also configures the host routes for the **local_subnet** on the undercloud.

inspection_iprange

Temporary IP range for nodes on this network to use during the inspection process. This range must not overlap with the range defined by **dhcp_start** and **dhcp_end** but must be in the same IP subnet.

Modify the values of these parameters to suit your configuration. When complete, save the file.

4.3. CONFIGURING THE UNDERCLOUD WITH ENVIRONMENT FILES

You configure the main parameters for the undercloud through the **undercloud.conf** file. You can also perform additional undercloud configuration with an environment file that contains heat parameters.

Procedure

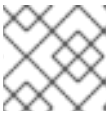
1. Create an environment file named **/home/stack/templates/custom-undercloud-params.yaml**.
2. Edit this file and include your heat parameters. For example, to enable debugging for certain OpenStack Platform services include the following snippet in the **custom-undercloud-params.yaml** file:

```
parameter_defaults:
  Debug: True
```

   Save this file when you have finished.

3. Edit your **undercloud.conf** file and scroll to the **custom_env_files** parameter. Edit the parameter to point to your **custom-undercloud-params.yaml** environment file:

```
custom_env_files = /home/stack/templates/custom-undercloud-params.yaml
```



NOTE

You can specify multiple environment files using a comma-separated list.

The director installation includes this environment file during the next undercloud installation or upgrade operation.

4.4. COMMON HEAT PARAMETERS FOR UNDERCLOUD CONFIGURATION

The following table contains some common heat parameters that you might set in a custom environment file for your undercloud.

Parameter	Description
AdminPassword	Sets the undercloud **admin** user password.
AdminEmail	Sets the undercloud **admin** user email address.
Debug	Enables debug mode.

Set these parameters in your custom environment file under the **parameter_defaults** section:

```
parameter_defaults:
  Debug: True
  AdminPassword: "myp@ssw0rd!"
  AdminEmail: "admin@example.com"
```

4.5. CONFIGURING HIERADATA ON THE UNDERCLOUD

You can provide custom configuration for services beyond the available **undercloud.conf** parameters by configuring Puppet hieradata on the director.

Procedure

1. Create a hieradata override file, for example, **/home/stack/hieradata.yaml**.
2. Add the customized hieradata to the file. For example, add the following snippet to modify the Compute (nova) service parameter **force_raw_images** from the default value of **True** to **False**:

```
nova::compute::force_raw_images: False
```

If there is no Puppet implementation for the parameter you want to set, then use the following method to configure the parameter:

```
nova::config::nova_config:
  DEFAULT/<parameter_name>:
    value: <parameter_value>
```

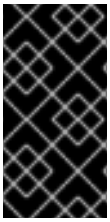
For example:

```
nova::config::nova_config:
  DEFAULT/network_allocate_retries:
    value: 20
  ironic/serial_console_state_timeout:
    value: 15
```

3. Set the **hieradata_override** parameter in the **undercloud.conf** file to the path of the new **/home/stack/hieradata.yaml** file:

```
hieradata_override = /home/stack/hieradata.yaml
```

4.6. CONFIGURING THE UNDERCLOUD FOR BARE METAL PROVISIONING OVER IPV6



IMPORTANT

This feature is available in this release as a *Technology Preview*, and therefore is not fully supported by Red Hat. It should only be used for testing, and should not be deployed in a production environment. For more information about Technology Preview features, see Scope of Coverage Details.

If you have IPv6 nodes and infrastructure, you can configure the undercloud and the provisioning network to use IPv6 instead of IPv4 so that director can provision and deploy Red Hat OpenStack Platform onto IPv6 nodes. However, there are some considerations:

- Dual stack IPv4/6 is not available.
- Tempest validations might not perform correctly.
- IPv4 to IPv6 migration is not available during upgrades.

Modify the **undercloud.conf** file to enable IPv6 provisioning in Red Hat OpenStack Platform.

Prerequisites

- An IPv6 address on the undercloud. For more information, see Configuring an IPv6 address on the undercloud in the *IPv6 Networking for the Overcloud* guide.

Procedure

1. Copy the sample **undercloud.conf** file, or modify your existing **undercloud.conf** file.
2. Set the following parameter values in the **undercloud.conf** file:
   a. Set **ipv6_address_mode** to **dhcpv6-stateless** or **dhcpv6-stateful** if your NIC supports stateful DHCPv6 with Red Hat OpenStack Platform.
   b. Set **enable_routed_networks** to **true** if you do not want the undercloud to create a router on the provisioning network. In this case, the data center router must provide router advertisements. Otherwise, set this value to **false**.
   c. Set **local_ip** to the IPv6 address of the undercloud.
   d. Use IPv6 addressing for the undercloud interface parameters **undercloud_public_host** and **undercloud_admin_host**.
   e. Optional. If you want to use stateful DHCPv6, use the **ironic_enabled_network_interfaces** parameter to specify the neutron interface. You can also use the **ironic_default_network_interface** parameter to set the neutron interface as the default network interface for bare metal nodes:
      - **ironic_enabled_network_interfaces = neutron,flat**
      - **ironic_default_network_interface = neutron**
   f. In the **[ctlplane-subnet]** section, use IPv6 addressing in the following parameters:
      - **cidr**
      - **dhcp_start**
      - **dhcp_end**
      - **gateway**
      - **inspection_iprange**
   g. In the **[ctlplane-subnet]** section, set an IPv6 nameserver for the subnet in the **dns_nameservers** parameter.

```
[DEFAULT]
ipv6_address_mode = dhcpv6-stateless
enable_routed_networks: false
local_ip = <ipv6-address>
ironic_enabled_network_interfaces = neutron,flat
ironic_default_network_interface = neutron
undercloud_admin_host = <ipv6-address>
undercloud_public_host = <ipv6-address>

[ctlplane-subnet]
cidr = <ipv6-address>::<ipv6-mask>
dhcp_start = <ipv6-address>
```

```
dhcp_end = <ipv6-address>
dns_nameservers = <ipv6-dns>
gateway = <ipv6-address>
inspection_iprange = <ipv6-address>,<ipv6-address>
```

4.7. INSTALLING DIRECTOR

Complete the following steps to install director and perform some basic post-installation tasks.

Procedure

1. Run the following command to install director on the undercloud:

```
[stack@director ~]$ openstack undercloud install
```

This command launches the director configuration script. Director installs additional packages and configures its services according to the configuration in the **undercloud.conf**. This script takes several minutes to complete.

The script generates two files:

- **undercloud-passwords.conf** - A list of all passwords for the director services.
- **stackrc** - A set of initialization variables to help you access the director command line tools.

2. The script also starts all OpenStack Platform service containers automatically. You can check the enabled containers with the following command:

```
[stack@director ~]$ sudo podman ps
```

3. To initialize the **stack** user to use the command line tools, run the following command:

```
[stack@director ~]$ source ~/stackrc
```

The prompt now indicates that OpenStack commands authenticate and execute against the undercloud;

```
(undercloud) [stack@director ~]$
```

The director installation is complete. You can now use the director command line tools.

4.8. OBTAINING IMAGES FOR OVERCLOUD NODES

Director requires several disk images to provision overcloud nodes:

- An introspection kernel and ramdisk for bare metal system introspection over PXE boot.
- A deployment kernel and ramdisk for system provisioning and deployment.
- An overcloud kernel, ramdisk, and full image. which form a base overcloud system that is written to the hard disk of the node.

The following procedure shows how to obtain and install these images.

4.8.1. Single CPU architecture overclouds

These images and procedures are necessary for deployment of the overcloud with the default CPU architecture, x86-64.

Procedure

1. Source the **stackrc** file to enable the director command line tools:

```
[stack@director ~]$ source ~/stackrc
```

2. Install the **rhosp-director-images** and **rhosp-director-images-ipa** packages:

```
(undercloud) [stack@director ~]$ sudo dnf install rhosp-director-images rhosp-director-images-ipa
```

3. Extract the images archives to the **images** directory in the home directory of the **stack** user (**/home/stack/images**):

```
(undercloud) [stack@director ~]$ cd ~/images
(undercloud) [stack@director images]$ for i in /usr/share/rhosp-director-images/overcloud-full-latest-16.1.tar /usr/share/rhosp-director-images/ironic-python-agent-latest-16.1.tar; do tar -xvf $i; done
```

4. Import these images into director:

```
(undercloud) [stack@director images]$ openstack overcloud image upload --image-path /home/stack/images/
```

This script uploads the following images into director:

- **overcloud-full**
- **overcloud-full-initrd**
- **overcloud-full-vmlinuz**

The script also installs the introspection images on the director PXE server.

5. Verify that the images uploaded successfully:

```
(undercloud) [stack@director images]$ openstack image list
+--------------------------------------+------------------------+
| ID                                   | Name                   |
+--------------------------------------+------------------------+
| ef793cd0-e65c-456a-a675-63cd57610bd5 | overcloud-full         |
| 9a51a6cb-4670-40de-b64b-b70f4dd44152 | overcloud-full-initrd  |
| 4f7e33f4-d617-47c1-b36f-cbe90f132e5d | overcloud-full-vmlinuz |
+--------------------------------------+------------------------+
```

This list does not show the introspection PXE images. Director copies these files to **/var/lib/ironic/httpboot**.

```
(undercloud) [stack@director images]$ ls -l /var/lib/ironic/httpboot
```

```
total 417296
-rwxr-xr-x. 1 root  root    6639920 Jan 29 14:48 agent.kernel
-rw-r--r--. 1 root  root  420656424 Jan 29 14:48 agent.ramdisk
-rw-r--r--. 1 42422 42422       758 Jan 29 14:29 boot.ipxe
-rw-r--r--. 1 42422 42422       488 Jan 29 14:16 inspector.ipxe
```

4.8.2. Multiple CPU architecture overclouds

These are the images and procedures that are necessary to deploy the overcloud to enable support of additional CPU architectures.

The following example procedure uses the ppc64le image.

Procedure

1. Source the **stackrc** file to enable the director command line tools:

```
[stack@director ~]$ source ~/stackrc
```

2. Install the **rhosp-director-images-all** package:

```
(undercloud) [stack@director ~]$ sudo dnf install rhosp-director-images-all
```

3. Extract the archives to an architecture specific directory in the **images** directory in the home directory of the **stack** user (**/home/stack/images**):

```
(undercloud) [stack@director ~]$ cd ~/images
(undercloud) [stack@director images]$ for arch in x86_64 ppc64le ; do mkdir $arch ; done
(undercloud) [stack@director images]$ for arch in x86_64 ppc64le ; do for i in
/usr/share/rhosp-director-images/overcloud-full-latest-16.1-${arch}.tar /usr/share/rhosp-
director-images/ironic-python-agent-latest-16.1-${arch}.tar ; do tar -C $arch -xf $i ; done ;
done
```

4. Import these images into director:

```
(undercloud) [stack@director ~]$ cd ~/images
(undercloud) [stack@director images]$ openstack overcloud image upload --local --image-
path ~/images/ppc64le --architecture ppc64le --whole-disk --http-boot
/var/lib/ironic/tftpboot/ppc64le
(undercloud) [stack@director images]$ openstack overcloud image upload --local --image-
path ~/images/x86_64/ --http-boot /var/lib/ironic/tftpboot
```

These commands import the following images into director:

- **overcloud-full**
- **overcloud-full-initrd**
- **overcloud-full-vmlinuz**
- **ppc64le-bm-deploy-kernel**
- **ppc64le-bm-deploy-ramdisk**

- **ppc64le-overcloud-full**
  The script also installs the introspection images on the director PXE server.

5. Verify that the images uploaded successfully:

```
(undercloud) [stack@director images]$ openstack image list
+--------------------------------------+-------------------------+--------+
| ID                                   | Name                    | Status |
+--------------------------------------+-------------------------+--------+
| 6a6096ba-8f79-4343-b77c-4349f7b94960 | overcloud-full          | active |
| de2a1bde-9351-40d2-bbd7-7ce9d6eb50d8 | overcloud-full-initrd   | active |
| 67073533-dd2a-4a95-8e8b-0f108f031092 | overcloud-full-vmlinuz  | active |
| 69a9ffe5-06dc-4d81-a122-e5d56ed46c98 | ppc64le-bm-deploy-kernel  | active |
| 464dd809-f130-4055-9a39-cf6b63c1944e | ppc64le-bm-deploy-ramdisk | active |
| f0fedcd0-3f28-4b44-9c88-619419007a03 | ppc64le-overcloud-full  | active |
+--------------------------------------+-------------------------+--------+
```

This list does not show the introspection PXE images. Director copies these files to **/tftpboot**.

```
(undercloud) [stack@director images]$ ls -l /var/lib/ironic/tftpboot
/var/lib/ironic/tftpboot/ppc64le/
/var/lib/ironic/tftpboot:
total 422624
-rwxr-xr-x. 1 root   root     6385968 Aug  8 19:35 agent.kernel
-rw-r--r--. 1 root   root   425530268 Aug  8 19:35 agent.ramdisk
-rwxr--r--. 1 ironic ironic     20832 Aug  8 02:08 chain.c32
-rwxr--r--. 1 ironic ironic    715584 Aug  8 02:06 ipxe.efi
-rw-r--r--. 1 root   root          22 Aug  8 02:06 map-file
drwxr-xr-x. 2 ironic ironic        62 Aug  8 19:34 ppc64le
-rwxr--r--. 1 ironic ironic     26826 Aug  8 02:08 pxelinux.0
drwxr-xr-x. 2 ironic ironic        21 Aug  8 02:06 pxelinux.cfg
-rwxr--r--. 1 ironic ironic     69631 Aug  8 02:06 undionly.kpxe

/var/lib/ironic/tftpboot/ppc64le/:
total 457204
-rwxr-xr-x. 1 root             root             19858896 Aug  8 19:34 agent.kernel
-rw-r--r--. 1 root             root            448311235 Aug  8 19:34 agent.ramdisk
-rw-r--r--. 1 ironic-inspector ironic-inspector       336 Aug  8 02:06 default
```

4.8.3. Minimal overcloud image

You can use the **overcloud-minimal** image to provision a bare OS where you do not want to run any other Red Hat OpenStack Platform services or consume one of your subscription entitlements.

Procedure

1. Source the **stackrc** file to enable the director command line tools:

```
[stack@director ~]$ source ~/stackrc
```

2. Install the **overcloud-minimal** package:

```
(undercloud) [stack@director ~]$ sudo dnf install rhosp-director-images-minimal
```

3. Extract the images archives to the **images** directory in the home directory of the **stack** user (**/home/stack/images**):

```
(undercloud) [stack@director ~]$ cd ~/images
(undercloud) [stack@director images]$ tar xf /usr/share/rhosp-director-images/overcloud-minimal-latest-16.1.tar
```

4. Import the images into director:

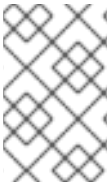
```
(undercloud) [stack@director images]$ openstack overcloud image upload --image-path /home/stack/images/ --os-image-name overcloud-minimal.qcow2
```

This script uploads the following images into director:

- **overcloud-minimal**
- **overcloud-minimal-initrd**
- **overcloud-minimal-vmlinuz**

5. Verify that the images uploaded successfully:

```
(undercloud) [stack@director images]$ openstack image list
+--------------------------------------+-------------------------+
| ID                                   | Name                    |
+--------------------------------------+-------------------------+
| ef793cd0-e65c-456a-a675-63cd57610bd5 | overcloud-full          |
| 9a51a6cb-4670-40de-b64b-b70f4dd44152 | overcloud-full-initrd   |
| 4f7e33f4-d617-47c1-b36f-cbe90f132e5d | overcloud-full-vmlinuz  |
| 32cf6771-b5df-4498-8f02-c3bd8bb93fdd | overcloud-minimal       |
| 600035af-dbbb-4985-8b24-a4e9da149ae5 | overcloud-minimal-initrd |
| d45b0071-8006-472b-bbcc-458899e0d801 | overcloud-minimal-vmlinuz |
+--------------------------------------+-------------------------+
```



NOTE

The default **overcloud-full.qcow2** image is a flat partition image. However, you can also import and use whole disk images. For more information, see Chapter 23, *Creating whole disk images*.

4.9. SETTING A NAMESERVER FOR THE CONTROL PLANE

If you intend for the overcloud to resolve external hostnames, such as **cdn.redhat.com**, set a nameserver on the overcloud nodes. For a standard overcloud without network isolation, the nameserver is defined using the undercloud control plane subnet. Complete the following procedure to define nameservers for the environment.

Procedure

1. Source the **stackrc** file to enable the director command line tools:

```
[stack@director ~]$ source ~/stackrc
```

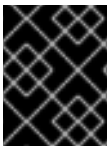
2. Set the nameservers for the **ctlplane-subnet** subnet:

```
(undercloud) [stack@director images]$ openstack subnet set --dns-nameserver
[nameserver1-ip] --dns-nameserver [nameserver2-ip] ctlplane-subnet
```

Use the **--dns-nameserver** option for each nameserver.

3. View the subnet to verify the nameserver:

```
(undercloud) [stack@director images]$ openstack subnet show ctlplane-subnet
+-------------------+-----------------------------------------------+
| Field             | Value                                         |
+-------------------+-----------------------------------------------+
| ...               |                                               |
| dns_nameservers   | 8.8.8.8                                       |
| ...               |                                               |
+-------------------+-----------------------------------------------+
```



IMPORTANT

If you aim to isolate service traffic onto separate networks, the overcloud nodes use the **DnsServers** parameter in your network environment files.

4.10. UPDATING THE UNDERCLOUD CONFIGURATION

If you need to change the undercloud configuration to suit new requirements, you can make changes to your undercloud configuration after installation, edit the relevant configuration files and re-run the **openstack undercloud install** command.

Procedure

1. Modify the undercloud configuration files. For example, edit the **undercloud.conf** file and add the **idrac** hardware type to the list of enabled hardware types:

```
enabled_hardware_types = ipmi,redfish,idrac
```

2. Run the **openstack undercloud install** command to refresh your undercloud with the new changes:

```
[stack@director ~]$ openstack undercloud install
```

Wait until the command runs to completion.

3. Initialize the **stack** user to use the command line tools,:

```
[stack@director ~]$ source ~/stackrc
```

The prompt now indicates that OpenStack commands authenticate and execute against the undercloud:

```
(undercloud) [stack@director ~]$
```

4. Verify that director has applied the new configuration. For this example, check the list of enabled hardware types:

```
(undercloud) [stack@director ~]$ openstack baremetal driver list
+---------------------+----------------+
| Supported driver(s) | Active host(s) |
+---------------------+----------------+
| idrac               | unused         |
| ipmi                | unused         |
| redfish             | unused         |
+---------------------+----------------+
```

The undercloud re-configuration is complete.

4.11. UNDERCLOUD CONTAINER REGISTRY

Red Hat Enterprise Linux 8.2 no longer includes the **docker-distribution** package, which installed a Docker Registry v2. To maintain the compatibility and the same level of feature, the director installation creates an Apache web server with a vhost called **image-serve** to provide a registry. This registry also uses port 8787/TCP with SSL disabled. The Apache-based registry is not containerized, which means that you must run the following command to restart the registry:

```
$ sudo systemctl restart httpd
```

You can find the container registry logs in the following locations:

- /var/log/httpd/image_serve_access.log
- /var/log/httpd/image_serve_error.log.

The image content is served from **/var/lib/image-serve**. This location uses a specific directory layout and **apache** configuration to implement the pull function of the registry REST API.

The Apache-based registry does not support **podman push** nor **buildah push** commands, which means that you cannot push container images using traditional methods. To modify images during deployment, use the container preparation workflow, such as the **ContainerImagePrepare** parameter. To manage container images, use the container management commands:

sudo openstack tripleo container image list

Lists all images stored on the registry.

sudo openstack tripleo container image show

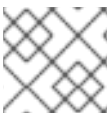
Show metadata for a specific image on the registry.

sudo openstack tripleo container image push

Push an image from a remote registry to the undercloud registry.

sudo openstack tripleo container image delete

Delete an image from the registry.



NOTE

You must run all container image management commands with **sudo** level permissions.

4.12. NEXT STEPS

- Install an undercloud minion to scale undercloud services. See Chapter 5, *Installing undercloud minions*.

- Perform basic overcloud configuration, including registering nodes, inspecting them, and then tagging them into various node roles. For more information, see Chapter 7, *Configuring a basic overcloud with CLI tools*.

CHAPTER 5. INSTALLING UNDERCLOUD MINIONS

IMPORTANT

This feature is available in this release as a *Technology Preview*, and therefore is not fully supported by Red Hat. It should only be used for testing, and should not be deployed in a production environment. For more information about Technology Preview features, see Scope of Coverage Details.

5.1. UNDERCLOUD MINION

An undercloud minion provides additional **heat-engine** and **ironic-conductor** services on a separate host. These additional services support the undercloud with orchestration and provisioning operations. The distribution of undercloud operations across multiple hosts provides more resources to run an overcloud deployment, which can result in potentially faster and larger deployments.

5.2. UNDERCLOUD MINION REQUIREMENTS

The scaled **heat-engine** and **ironic-conductor** services on an undercloud minion use a set of workers. Each worker performs operations specific to that service. Multiple workers provide simultaneous operations. The default number of workers on the minion is determined by halving the total CPU thread count of the minion host. In this instance, total thread count is the number of CPU cores multiplied by the hyper-threading value. For example, if your minion has a CPU with 16 threads, then the minion spawns 8 workers for each service by default. The minion also uses a set of minimum and maximum caps by default:

Service	Minimum	Maximum
heat-engine	4	24
ironic-conductor	2	12

An undercloud minion has the following minimum CPU and memory requirements:

- An 8-thread 64-bit x86 processor with support for the Intel 64 or AMD64 CPU extensions. This processor provides 4 workers for each undercloud service.
- A minimum of 16 GB of RAM.

To use a larger number of workers, increase the vCPUs and memory count on the undercloud using a ratio of 2 GB of RAM for each CPU thread. For example, a machine with 48 threads must have 96 GB of RAM. This provides coverage for 24 **heat-engine** workers and 12 **ironic-conductor** workers.

5.3. PREPARING A MINION

Before you can install a minion, you must complete some basic configuration on the host machine:

- A non-root user to execute commands.
- A resolvable hostname
- A Red Hat subscription

- The command line tools for image preparation and minion installation

Procedure

1. Log in to the minion host as the **root** user.
2. Create the **stack** user:

```
[root@minion ~]# useradd stack
```

3. Set a password for the **stack** user:

```
[root@minion ~]# passwd stack
```

4. Disable password requirements when using **sudo**:

```
[root@minion ~]# echo "stack ALL=(root) NOPASSWD:ALL" | tee -a /etc/sudoers.d/stack
[root@minion ~]# chmod 0440 /etc/sudoers.d/stack
```

5. Switch to the new **stack** user:

```
[root@minion ~]# su - stack
[stack@minion ~]$
```

6. Check the base and full hostname of the minion:

```
[stack@minion ~]$ hostname
[stack@minion ~]$ hostname -f
```

If either of the previous commands do not report the correct fully-qualified hostname or report an error, use **hostnamectl** to set a hostname:

```
[stack@minion ~]$ sudo hostnamectl set-hostname minion.example.com
[stack@minion ~]$ sudo hostnamectl set-hostname --transient minion.example.com
```

7. Edit the **/etc/hosts** file and include an entry for the system hostname. For example, if the system is named **minion.example.com** and uses the IP address **10.0.0.1**, add the following line to the **/etc/hosts** file:

```
10.0.0.1  minion.example.com manager
```

8. Register your system either with the Red Hat Content Delivery Network or Red Hat Satellite. For example, run the following command to register the system to the Content Delivery Network. Enter your Customer Portal user name and password when prompted:

```
[stack@minion ~]$ sudo subscription-manager register
```

9. Find the entitlement pool ID for Red Hat OpenStack Platform (RHOSP) director:

```
[stack@minion ~]$ sudo subscription-manager list --available --all --matches="Red Hat
OpenStack"
Subscription Name:   Name of SKU
```

```
Provides:           Red Hat Single Sign-On
                    Red Hat Enterprise Linux Workstation
                    Red Hat CloudForms
                    Red Hat OpenStack
                    Red Hat Software Collections (for RHEL Workstation)
                    Red Hat Virtualization
SKU:                SKU-Number
Contract:           Contract-Number
Pool ID:            Valid-Pool-Number-123456
Provides Management: Yes
Available:          1
Suggested:          1
Service Level:      Support-level
Service Type:       Service-Type
Subscription Type:  Sub-type
Ends:               End-date
System Type:        Physical
```

10. Locate the **Pool ID** value and attach the Red Hat OpenStack Platform 16.1 entitlement:

```
[stack@minion ~]$ sudo subscription-manager attach --pool=Valid-Pool-Number-123456
```

11. Disable all default repositories, and then enable the required Red Hat Enterprise Linux repositories:

```
[stack@minion ~]$ sudo subscription-manager repos --disable=*
[stack@minion ~]$ sudo subscription-manager repos --enable=rhel-8-for-x86_64-baseos-eus-rpms --enable=rhel-8-for-x86_64-appstream-eus-rpms --enable=rhel-8-for-x86_64-highavailability-eus-rpms --enable=ansible-2.9-for-rhel-8-x86_64-rpms --enable=openstack-16.1-for-rhel-8-x86_64-rpms --enable=fast-datapath-for-rhel-8-x86_64-rpms
```

These repositories contain packages that the minion installation requires.

12. Perform an update on your system to ensure that you have the latest base system packages:

```
[stack@minion ~]$ sudo dnf update -y
[stack@minion ~]$ sudo reboot
```

13. Install the command line tools for minion installation and configuration:

```
[stack@minion ~]$ sudo dnf install -y python3-tripleoclient
```

5.4. COPYING THE UNDERCLOUD CONFIGURATION FILES TO THE MINION

The minion requires some configuration files from the undercloud so that the minion installation can configure the minion services and register them with director:

- **tripleo-undercloud-outputs.yaml**
- **tripleo-undercloud-passwords.yaml**

Procedure

1. Log in to your undercloud as the **stack** user.
2. Copy the files from the undercloud to the minion:

```
$ scp ~/tripleo-undercloud-outputs.yaml ~/tripleo-undercloud-passwords.yaml
stack@<minion-host>:~/.
```

Replace **<minion-host>** with the hostname or IP address of the minion.

5.5. COPYING THE UNDERCLOUD CERTIFICATE AUTHORITY

If the undercloud uses SSL/TLS for endpoint encryption, the minion host must contain the certificate authority that signed the undercloud SSL/TLS certificates. Depending on your undercloud configuration, this certificate authority is one of the following:

- An external certificate authority whose certificate is preloaded on the minion host. No action is required.
- A director-generated self-signed certificate authority, which the director creates at **/etc/pki/ca-trust/source/anchors/cm-local-ca.pem**. Copy this file to the minion host and include the file as a part of the trusted certificate authorities for the minion host. This procedure uses this file as an example.
- A custom self-signed certificate authority, which you create with OpenSSL. Examples in this document refer to this file as **ca.crt.pem**. Copy this file to the minion host and include the file as a part of the trusted certificate authorities for the minion host.

Procedure

1. Log in to the minion host as the **root** user.
2. Copy the certificate authority file from the undercloud to the minion:

```
[root@minion ~]# scp \
    root@<undercloud-host>:/etc/pki/ca-trust/source/anchors/cm-local-ca.pem \
    /etc/pki/ca-trust/source/anchors/undercloud-ca.pem
```

Replace **<undercloud-host>** with the hostname or IP address of the undercloud.

3. Update the trusted certificate authorities for the minion host:

```
[root@minion ~]# update-ca-trust enable
[root@minion ~]# update-ca-trust extract
```

5.6. CONFIGURING THE MINION

The minion installation process requires certain settings in the **minion.conf** configuration file, which the minion reads from the home directory of the **stack** user. Complete the following steps to use the default template as a foundation for your configuration.

Procedure

1. Log in to the minion host as the **stack** user.

2. Copy the default template to the home directory of the **stack** user:

```
[stack@minion ~]$ cp \
 /usr/share/python-tripleoclient/minion.conf.sample \
 ~/minion.conf
```

3. Edit the **minion.conf** file. This file contains settings to configure your minion. If you omit or comment out a parameter, the minion installation uses the default value. Review the following recommended parameters:

   - **minion_hostname**, which you set to the hostname of the minion.
   - **minion_local_interface**, which you set to the interface that connects to the undercloud through the Provisioning Network.
   - **minion_local_ip**, which you set to a free IP address on the Provisioning Network.
   - **minion_nameservers**, which you set to the DNS nameservers so that the minion can resolve hostnames.
   - **enable_ironic_conductor**, which defines whether to enable the **ironic-conductor** service.
   - **enable_heat_engine**, which defines whether to enable the **heat-engine** service.

NOTE

The default **minion.conf** file enables only the **heat-engine** service on the minion. To enable the **ironic-conductor** service, set the **enable_ironic_conductor** parameter to **true**.

5.7. MINION CONFIGURATION PARAMETERS

The following list contains information about parameters for configuring the **minion.conf** file. Keep all parameters within their relevant sections to avoid errors.

Defaults

The following parameters are defined in the **[DEFAULT]** section of the **minion.conf** file:

cleanup

Cleanup temporary files. Set this parmaeter to **False** to leave the temporary files used during deployment in place after the command is run. This is useful for debugging the generated files or if errors occur.

container_cli

The CLI tool for container management. Leave this parameter set to **podman**. Red Hat Enterprise Linux 8.2 only supports **podman**.

container_healthcheck_disabled

Disables containerized service health checks. Red Hat recommends that you enable health checks and leave this option set to **false**.

container_images_file

Heat environment file with container image information. This file can contain the following entries:

- Parameters for all required container images

- The **ContainerImagePrepare** parameter to drive the required image preparation. Usually the file that contains this parameter is named **containers-prepare-parameter.yaml**.

container_insecure_registries

A list of insecure registries for **podman** to use. Use this parameter if you want to pull images from another source, such as a private container registry. In most cases, **podman** has the certificates to pull container images from either the Red Hat Container Catalog or from your Satellite server if the minion is registered to Satellite.

container_registry_mirror

An optional **registry-mirror** configured that **podman** uses.

custom_env_files

Additional environment file that you want to add to the minion installation.

deployment_user

The user who installs the minion. Leave this parameter unset to use the current default user **stack**.

enable_heat_engine

Defines whether to install the heat engine on the minion. The default is **true**.

enable_ironic_conductor

Defines whether to install the ironic conductor service on the minion. The default value is **false**. Set this value to **true** to enable the ironic conductor service.

heat_container_image

URL for the heat container image that you want to use. Leave unset.

heat_native

Use native heat templates. Leave as **true**.

hieradata_override

Path to **hieradata** override file that configures Puppet hieradata on the director, providing custom configuration to services beyond the **minion.conf** parameters. If set, the minion installation copies this file to the **/etc/puppet/hieradata** directory and sets it as the first file in the hierarchy.

minion_debug

Set this value to **true** to enable the **DEBUG** log level for minion services.

minion_enable_selinux

Enable or disable SELinux during the deployment. It is highly recommended to leave this value set to **true** unless you are debugging an issue.

minion_enable_validations

Enable validation services on the minion.

minion_hostname

Defines the fully qualified host name for the minion. If set, the minion installation configures all system host name settings. If left unset, the minion uses the current host name, but you must configure all system host name settings appropriately.

minion_local_interface

The chosen interface for the Provisioning NIC on the undercloud. This is also the device that the minion uses for DHCP and PXE boot services. Change this value to your chosen device. To see which device is connected, use the **ip addr** command. For example, this is the result of an **ip addr** command:

```
2: eth0: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc pfifo_fast state UP qlen
1000
```

```
    link/ether 52:54:00:75:24:09 brd ff:ff:ff:ff:ff:ff
    inet 192.168.122.178/24 brd 192.168.122.255 scope global dynamic eth0
       valid_lft 3462sec preferred_lft 3462sec
    inet6 fe80::5054:ff:fe75:2409/64 scope link
       valid_lft forever preferred_lft forever
3: eth1: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc noop state DOWN
    link/ether 42:0b:c2:a5:c1:26 brd ff:ff:ff:ff:ff:ff
```

In this example, the External NIC uses **eth0** and the Provisioning NIC uses **eth1**, which is currently not configured. In this case, set the **local_interface** to **eth1**. The configuration script attaches this interface to a custom bridge defined with the **inspection_interface** parameter.

minion_local_ip

The IP address defined for the Provisioning NIC on the undercloud. This is also the IP address that the minion uses for DHCP and PXE boot services. Leave this value as the default **192.168.24.1/24** unless you use a different subnet for the Provisioning network, for example, if the default IP address conflicts with an existing IP address or subnet in your environment.

minion_local_mtu

The maximum transmission unit (MTU) that you want to use for the **local_interface**. Do not exceed 1500 for the minion.

minion_log_file

The path to a log file where you want to store the minion install and upgrade logs. By default, the log file is **install-minion.log** in the home directory. For example, **/home/stack/install-minion.log**.

minion_nameservers

A list of DNS nameservers to use for the minion hostname resolution.

minion_ntp_servers

A list of network time protocol servers to help synchronize the minion date and time.

minion_password_file

The file that contains the passwords for the minion to connect to undercloud services. Leave this parameter set to the **tripleo-undercloud-passwords.yaml** file copied from the undercloud.

minion_service_certificate

The location and filename of the certificate for OpenStack SSL/TLS communication. Ideally, you obtain this certificate from a trusted certificate authority. Otherwise, generate your own self-signed certificate.

minion_timezone

Host timezone for the minion. If you do not specify a timezone, the minion uses the existing timezone configuration.

minion_undercloud_output_file

The file that contains undercloud configuration information that the minion can use to connect to undercloud services. Leave this parameter set to the **tripleo-undercloud-outputs.yaml** file copied from the undercloud.

net_config_override

The path to a network configuration override template. If you set this parameter, the minion uses a JSON format template to configure the networking with **os-net-config** and ignores the network parameters set in **minion.conf**. See **/usr/share/python-tripleoclient/minion.conf.sample** for an example.

networks_file

Networks file to override for **heat**.

output_dir

Directory to output state, processed heat templates, and Ansible deployment files.

roles_file

The roles file that you want to use to override the default roles file for minion installation. It is highly recommended to leave this parameter unset so that the minion installation uses the default roles file.

templates

Heat templates file to override.

5.8. INSTALLING THE MINION

Complete the following steps to install the minion.

Procedure

1. Log in to the minion host as the **stack** user.
2. Run the following command to install the minion:

```
[stack@minion ~]$ openstack undercloud minion install
```

This command launches the configuration script for the minion, installs additional packages, and configures minion services according to the configuration in the **minion.conf** file. This script takes several minutes to complete.

5.9. VERIFYING THE MINION INSTALLATION

Complete the following steps to confirm a successful minion installation.

Procedure

1. Log in to your undercloud as the **stack** user.
2. Source the **stackrc** file:

```
[stack@director ~]$ source ~/stackrc
```

3. If you enabled the heat engine service on the minion, verify that the **heat-engine** service from the minion appears on the undercloud service list:

```
[stack@director ~]$ $ openstack orchestration service list
```

The command output displays a table with **heat-engine** workers for both the undercloud and any minions.

4. If you enabled the ironic conductor service on the minion, verify that the **ironic-conductor** service from the minion appears on the undercloud service list:

```
[stack@director ~]$ $ openstack baremetal conductor list
```

The command output displays a table with **ironic-conductor** services for both the undercloud and any minions.

5.10. NEXT STEPS

- Perform basic overcloud configuration, including registering nodes, inspecting nodes, and tagging nodes into various node roles. For more information, see Chapter 7, *Configuring a basic overcloud with CLI tools*.

PART II. BASIC OVERCLOUD DEPLOYMENT

CHAPTER 6. PLANNING YOUR OVERCLOUD

The following section contains some guidelines for planning various aspects of your Red Hat OpenStack Platform (RHOSP) environment. This includes defining node roles, planning your network topology, and storage.

6.1. NODE ROLES

Director includes the following default node types to build your overcloud:

Controller

Provides key services for controlling your environment. This includes the dashboard (horizon), authentication (keystone), image storage (glance), networking (neutron), orchestration (heat), and high availability services. A Red Hat OpenStack Platform (RHOSP) environment requires three Controller nodes for a highly available production-level environment.

NOTE

Use environments with one Controller node only for testing purposes, not for production. Environments with two Controller nodes or more than three Controller nodes are not supported.

Compute

A physical server that acts as a hypervisor and contains the processing capabilities required to run virtual machines in the environment. A basic RHOSP environment requires at least one Compute node.

Ceph Storage

A host that provides Red Hat Ceph Storage. Additional Ceph Storage hosts scale into a cluster. This deployment role is optional.

Swift Storage

A host that provides external object storage to the OpenStack Object Storage (swift) service. This deployment role is optional.

The following table contains some examples of different overclouds and defines the node types for each scenario.

Table 6.1. Node Deployment Roles for Scenarios

	Controller	Compute	Ceph Storage	Swift Storage	Total
Small overcloud	3	1	-	-	4
Medium overcloud	3	3	-	-	6
Medium overcloud with additional object storage	3	3	-	3	9

Medium overcloud with Ceph Storage cluster	3	3	3	-	9

In addition, consider whether to split individual services into custom roles. For more information about the composable roles architecture, see "Composable Services and Custom Roles" in the *Advanced Overcloud Customization* guide.

6.2. OVERCLOUD NETWORKS

It is important to plan the networking topology and subnets in your environment so that you can map roles and services to communicate with each other correctly. Red Hat OpenStack Platform (RHOSP) uses the Openstack Networking (neutron) service, which operates autonomously and manages software-based networks, static and floating IP addresses, and DHCP.

By default, director configures nodes to use the **Provisioning / Control Plane** for connectivity. However, it is possible to isolate network traffic into a series of composable networks, that you can customize and assign services.

In a typical RHOSP installation, the number of network types often exceeds the number of physical network links. To connect all the networks to the proper hosts, the overcloud uses VLAN tagging to deliver more than one network on each interface. Most of the networks are isolated subnets but some networks require a Layer 3 gateway to provide routing for Internet access or infrastructure network connectivity. If you use VLANs to isolate your network traffic types, you must use a switch that supports 802.1Q standards to provide tagged VLANs.

NOTE

It is recommended that you deploy a project network (tunneled with GRE or VXLAN) even if you intend to use a neutron VLAN mode with tunneling disabled at deployment time. This requires minor customization at deployment time and leaves the option available to use tunnel networks as utility networks or virtualization networks in the future. You still create Tenant networks using VLANs, but you can also create VXLAN tunnels for special-use networks without consuming tenant VLANs. It is possible to add VXLAN capability to a deployment with a Tenant VLAN, but it is not possible to add a Tenant VLAN to an existing overcloud without causing disruption.

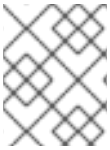
Director also includes a set of templates that you can use to configure NICs with isolated composable networks. The following configurations are the default configurations:

- Single NIC configuration - One NIC for the Provisioning network on the native VLAN and tagged VLANs that use subnets for the different overcloud network types.
- Bonded NIC configuration - One NIC for the Provisioning network on the native VLAN and two NICs in a bond for tagged VLANs for the different overcloud network types.
- Multiple NIC configuration - Each NIC uses a subnet for a different overcloud network type.

You can also create your own templates to map a specific NIC configuration.

The following details are also important when you consider your network configuration:

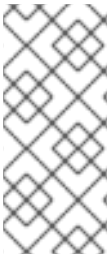
- During the overcloud creation, you refer to NICs using a single name across all overcloud machines. Ideally, you should use the same NIC on each overcloud node for each respective network to avoid confusion. For example, use the primary NIC for the Provisioning network and the secondary NIC for the OpenStack services.
- Set all overcloud systems to PXE boot off the Provisioning NIC, and disable PXE boot on the External NIC and any other NICs on the system. Also ensure that the Provisioning NIC has PXE boot at the top of the boot order, ahead of hard disks and CD/DVD drives.
- All overcloud bare metal systems require a supported power management interface, such as an Intelligent Platform Management Interface (IPMI), so that director can control the power management of each node.
- Make a note of the following details for each overcloud system: the MAC address of the Provisioning NIC, the IP address of the IPMI NIC, IPMI username, and IPMI password. This information is useful later when you configure the overcloud nodes.
- If an instance must be accessible from the external internet, you can allocate a floating IP address from a public network and associate the floating IP with an instance. The instance retains its private IP but network traffic uses NAT to traverse through to the floating IP address. Note that a floating IP address can be assigned only to a single instance rather than multiple private IP addresses. However, the floating IP address is reserved for use only by a single tenant, which means that the tenant can associate or disassociate the floating IP address with a particular instance as required. This configuration exposes your infrastructure to the external internet and you must follow suitable security practices.
- To mitigate the risk of network loops in Open vSwitch, only a single interface or a single bond can be a member of a given bridge. If you require multiple bonds or interfaces, you can configure multiple bridges.
- Red Hat recommends using DNS hostname resolution so that your overcloud nodes can connect to external services, such as the Red Hat Content Delivery Network and network time servers.



NOTE

You can virtualize the overcloud control plane if you are using Red Hat Virtualization (RHV). For more information, see Creating virtualized control planes.

6.3. OVERCLOUD STORAGE



NOTE

Using LVM on a guest instance that uses a back end cinder-volume of any driver or back-end type results in issues with performance, volume visibility and availability, and data corruption. Use an LVM filter to mitigate these issues. For more information, see section 2.1 Back Ends in the *Storage Guide* and KCS article 3213311, "Using LVM on a cinder volume exposes the data to the compute host."

Director includes different storage options for the overcloud environment:

Ceph Storage nodes

Director creates a set of scalable storage nodes using Red Hat Ceph Storage. The overcloud uses these nodes for the following storage types:

- **Images** - The Image service (glance) manages images for virtual machines. Images are immutable. OpenStack treats images as binary blobs and downloads them accordingly. You can use the Image service (glance) to store images in a Ceph Block Device.

- **Volumes** - OpenStack manages volumes with the Block Storage service (cinder). The Block Storage service (cinder) volumes are block devices. OpenStack uses volumes to boot virtual machines, or to attach volumes to running virtual machines. You can use the Block Storage serivce to boot a virtual machine using a copy-on-write clone of an image.

- **File Systems** - Openstack manages shared file systems with the Shared File Systems service (manila). Shares are backed by file systems. You can use manila to manage shares backed by a CephFS file system with data on the Ceph Storage nodes.

- **Guest Disks** - Guest disks are guest operating system disks. By default, when you boot a virtual machine with the Compute service (nova), the virtual machine disk appears as a file on the filesystem of the hypervisor (usually under **/var/lib/nova/instances/<uuid>/**). Every virtual machine inside Ceph can be booted without using the Block Storage service (cinder). As a result, you can perform maintenance operations easily with the live-migration process. Additionally, if your hypervisor fails, it is also convenient to trigger **nova evacuate** and run the virtual machine elsewhere.

IMPORTANT

For information about supported image formats, see the Image Service chapter in the *Instances and Images Guide* .

For more information about Ceph Storage, see the Red Hat Ceph Storage Architecture Guide.

Swift Storage nodes

Director creates an external object storage node. This is useful in situations where you need to scale or replace Controller nodes in your overcloud environment but need to retain object storage outside of a high availability cluster.

6.4. OVERCLOUD SECURITY

Your OpenStack Platform implementation is only as secure as your environment. Follow good security principles in your networking environment to ensure that you control network access properly:

- Use network segmentation to mitigate network movement and isolate sensitive data. A flat network is much less secure.

- Restrict services access and ports to a minimum.

- Enforce proper firewall rules and password usage.

- Ensure that SELinux is enabled.

For more information about securing your system, see the following Red Hat guides:

- Security Hardening for Red Hat Enterprise Linux 8

- Using SELinux for Red Hat Enterprise Linux 8

6.5. OVERCLOUD HIGH AVAILABILITY

To deploy a highly-available overcloud, director configures multiple Controller, Compute and Storage nodes to work together as a single cluster. In case of node failure, an automated fencing and re-spawning process is triggered based on the type of node that failed. For more information about overcloud high availability architecture and services, see High Availability Deployment and Usage.

NOTE

Deploying a highly available overcloud without STONITH is not supported. You must configure a STONITH device for each node that is a part of the Pacemaker cluster in a highly available overcloud. For more information on STONITH and Pacemaker, see Fencing in a Red Hat High Availability Cluster and Support Policies for RHEL High Availability Clusters.

You can also configure high availability for Compute instances with director (Instance HA). This high availability mechanism automates evacuation and re-spawning of instances on Compute nodes in case of node failure. The requirements for Instance HA are the same as the general overcloud requirements, but you must perform a few additional steps to prepare your environment for the deployment. For more information about Instance HA and installation instructions, see the High Availability for Compute Instances guide.

6.6. CONTROLLER NODE REQUIREMENTS

Controller nodes host the core services in a Red Hat OpenStack Platform environment, such as the Dashboard (horizon), the back-end database server, the Identity service (keystone) authentication, and high availability services.

Processor

64-bit x86 processor with support for the Intel 64 or AMD64 CPU extensions.

Memory

The minimum amount of memory is 32 GB. However, the amount of recommended memory depends on the number of vCPUs, which is based on the number of CPU cores multiplied by hyper-threading value. Use the following calculations to determine your RAM requirements:

- **Controller RAM minimum calculation:**
  - Use 1.5 GB of memory for each vCPU. For example, a machine with 48 vCPUs should have 72 GB of RAM.
- **Controller RAM recommended calculation:**
  - Use 3 GB of memory for each vCPU. For example, a machine with 48 vCPUs should have 144 GB of RAM

For more information about measuring memory requirements, see "Red Hat OpenStack Platform Hardware Requirements for Highly Available Controllers" on the Red Hat Customer Portal.

Disk Storage and layout

A minimum amount of 40 GB storage is required if the Object Storage service (swift) is not running on the Controller nodes. However, the Telemetry and Object Storage services are both installed on the Controllers, with both configured to use the root disk. These defaults are suitable for deploying

small overclouds built on commodity hardware. These environments are typical of proof-of-concept and test environments. You can use these defaults to deploy overclouds with minimal planning, but they offer little in terms of workload capacity and performance.
In an enterprise environment, however, the defaults could cause a significant bottleneck because Telemetry accesses storage constantly. This results in heavy disk I/O usage, which severely impacts the performance of all other Controller services. In this type of environment, you must plan your overcloud and configure it accordingly.

Red Hat provides several configuration recommendations for both Telemetry and Object Storage. For more information, see Deployment Recommendations for Specific Red Hat OpenStack Platform Services.

Network Interface Cards

A minimum of 2 x 1 Gbps Network Interface Cards. Use additional network interface cards for bonded interfaces or to delegate tagged VLAN traffic.

Power management

Each Controller node requires a supported power management interface, such as an Intelligent Platform Management Interface (IPMI) functionality, on the server motherboard.

Virtualization support

Red Hat supports virtualized Controller nodes only on Red Hat Virtualization platforms. For more information, see Virtualized control planes.

6.7. COMPUTE NODE REQUIREMENTS

Compute nodes are responsible for running virtual machine instances after they are launched. Compute nodes must support hardware virtualization. Compute nodes must also have enough memory and disk space to support the requirements of the virtual machine instances that they host.

Processor

- 64-bit x86 processor with support for the Intel 64 or AMD64 CPU extensions, and the AMD-V or Intel VT hardware virtualization extensions enabled. It is recommended that this processor has a minimum of 4 cores.
- IBM POWER 8 processor.

Memory

A minimum of 6 GB of RAM. Add additional RAM to this requirement based on the amount of memory that you intend to make available to virtual machine instances.

Disk space

A minimum of 40 GB of available disk space.

Network Interface Cards

A minimum of one 1 Gbps Network Interface Cards, although it is recommended to use at least two NICs in a production environment. Use additional network interface cards for bonded interfaces or to delegate tagged VLAN traffic.

Power management

Each Compute node requires a supported power management interface, such as an Intelligent Platform Management Interface (IPMI) functionality, on the server motherboard.

6.8. CEPH STORAGE NODE REQUIREMENTS

Ceph Storage nodes are responsible for providing object storage in a Red Hat OpenStack Platform environment.

Placement Groups (PGs)

Ceph uses placement groups to facilitate dynamic and efficient object tracking at scale. In the case of OSD failure or cluster rebalancing, Ceph can move or replicate a placement group and its contents, which means a Ceph cluster can re-balance and recover efficiently. The default placement group count that director creates is not always optimal so it is important to calculate the correct placement group count according to your requirements. You can use the placement group calculator to calculate the correct count: Placement Groups (PGs) per Pool Calculator

Processor

64-bit x86 processor with support for the Intel 64 or AMD64 CPU extensions.

Memory

Red Hat typically recommends a baseline of 16 GB of RAM per OSD host, with an additional 2 GB of RAM per OSD daemon.

Disk layout

Sizing is dependent on your storage requirements. Red Hat recommends that your Ceph Storage node configuration includes three or more disks in a layout similar to the following example:

- **/dev/sda** - The root disk. The director copies the main overcloud image to the disk. Ensure that the disk has a minimum of 40 GB of available disk space.
- **/dev/sdb** - The journal disk. This disk divides into partitions for Ceph OSD journals. For example, **/dev/sdb1**, **/dev/sdb2**, and **/dev/sdb3**. The journal disk is usually a solid state drive (SSD) to aid with system performance.
- **/dev/sdc** and onward - The OSD disks. Use as many disks as necessary for your storage requirements.

NOTE

Red Hat OpenStack Platform director uses **ceph-ansible**, which does not support installing the OSD on the root disk of Ceph Storage nodes. This means that you need at least two disks for a supported Ceph Storage node.

Network Interface Cards

A minimum of one 1 Gbps Network Interface Cards, although Red Hat recommends that you use at least two NICs in a production environment. Use additional network interface cards for bonded interfaces or to delegate tagged VLAN traffic. Red Hat recommends that you use a 10 Gbps interface for storage nodes, especially if you want to create an OpenStack Platform environment that serves a high volume of traffic.

Power management

Each Controller node requires a supported power management interface, such as Intelligent Platform Management Interface (IPMI) functionality on the motherboard of the server.

For more information about installing an overcloud with a Ceph Storage cluster, see the Deploying an Overcloud with Containerized Red Hat Ceph guide.

6.9. OBJECT STORAGE NODE REQUIREMENTS

Object Storage nodes provide an object storage layer for the overcloud. The Object Storage proxy is installed on Controller nodes. The storage layer requires bare metal nodes with multiple disks on each node.

Processor

64-bit x86 processor with support for the Intel 64 or AMD64 CPU extensions.

Memory

Memory requirements depend on the amount of storage space. Use at minimum 1 GB of memory for each 1 TB of hard disk space. For optimal performance, it is recommended to use 2 GB for each 1 TB of hard disk space, especially for workloads with files smaller than 100GB.

Disk space

Storage requirements depend on the capacity needed for the workload. It is recommended to use SSD drives to store the account and container data. The capacity ratio of account and container data to objects is approximately 1 per cent. For example, for every 100TB of hard drive capacity, provide 1TB of SSD capacity for account and container data.

However, this depends on the type of stored data. If you want to store mostly small objects, provide more SSD space. For large objects (videos, backups), use less SSD space.

Disk layout

The recommended node configuration requires a disk layout similar to the following example:

- **/dev/sda** - The root disk. Director copies the main overcloud image to the disk.
- **/dev/sdb** - Used for account data.
- **/dev/sdc** - Used for container data.
- **/dev/sdd** and onward - The object server disks. Use as many disks as necessary for your storage requirements.

Network Interface Cards

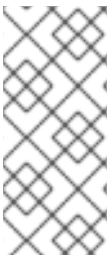
A minimum of 2 x 1 Gbps Network Interface Cards. Use additional network interface cards for bonded interfaces or to delegate tagged VLAN traffic.

Power management

Each Controller node requires a supported power management interface, such as an Intelligent Platform Management Interface (IPMI) functionality, on the server motherboard.

6.10. OVERCLOUD REPOSITORIES

Red Hat OpenStack Platform 16.1 runs on Red Hat Enterprise Linux 8.2. As a result, you must lock the content from these repositories to the respective Red Hat Enterprise Linux version.



NOTE

If you synchronize repositories with Red Hat Satellite, you can enable specific versions of the Red Hat Enterprise Linux repositories. However, the repository remains the same despite the version you choose. For example, you can enable the 8.2 version of the BaseOS repository, but the repository name is still **rhel-8-for-x86_64-baseos-eus-rpms** despite the specific version you choose.

WARNING

Any repositories outside the ones specified here are not supported. Unless recommended, do not enable any other products or repositories outside the ones listed in the following tables or else you might encounter package dependency issues. Do not enable Extra Packages for Enterprise Linux (EPEL).

Core repositories

The following table lists core repositories for installing the overcloud.

Name	Repository	Description of requirement
Red Hat Enterprise Linux 8 for x86_64 - BaseOS (RPMs) Extended Update Support (EUS)	**rhel-8-for-x86_64-baseos-eus-rpms**	Base operating system repository for x86_64 systems.
Red Hat Enterprise Linux 8 for x86_64 - AppStream (RPMs)	**rhel-8-for-x86_64-appstream-eus-rpms**	Contains Red Hat OpenStack Platform dependencies.
Red Hat Enterprise Linux 8 for x86_64 - High Availability (RPMs) Extended Update Support (EUS)	**rhel-8-for-x86_64-highavailability-eus-rpms**	High availability tools for Red Hat Enterprise Linux.
Red Hat Ansible Engine 2.9 for RHEL 8 x86_64 (RPMs)	**ansible-2.9-for-rhel-8-x86_64-rpms**	Ansible Engine for Red Hat Enterprise Linux. Used to provide the latest version of Ansible.
Advanced Virtualization for RHEL 8 x86_64 (RPMs)	**advanced-virt-for-rhel-8-x86_64-rpms**	Provides virtualization packages for OpenStack Platform.
Red Hat Satellite Tools for RHEL 8 Server RPMs x86_64	**satellite-tools-6.5-for-rhel-8-x86_64-rpms**	Tools for managing hosts with Red Hat Satellite 6.
Red Hat OpenStack Platform 16.1 for RHEL 8 (RPMs)	**openstack-16.1-for-rhel-8-x86_64-rpms**	Core Red Hat OpenStack Platform repository.
Red Hat Fast Datapath for RHEL 8 (RPMS)	**fast-datapath-for-rhel-8-x86_64-rpms**	Provides Open vSwitch (OVS) packages for OpenStack Platform.

Ceph repositories

The following table lists Ceph Storage related repositories for the overcloud.

Name	Repository	Description of Requirement
Red Hat Enterprise Linux 8 for x86_64 - BaseOS (RPMs)	**rhel-8-for-x86_64-baseos-rpms**	Base operating system repository for x86_64 systems.
Red Hat Enterprise Linux 8 for x86_64 - AppStream (RPMs)	**rhel-8-for-x86_64-appstream-rpms**	Contains Red Hat OpenStack Platform dependencies.
Red Hat Enterprise Linux 8 for x86_64 - High Availability (RPMs)	**rhel-8-for-x86_64-highavailability-rpms**	High availability tools for Red Hat Enterprise Linux.
Red Hat Ansible Engine 2.9 for RHEL 8 x86_64 (RPMs)	**ansible-2.9-for-rhel-8-x86_64-rpms**	Ansible Engine for Red Hat Enterprise Linux. Used to provide the latest version of Ansible.
Red Hat OpenStack Platform 16.1 Director Deployment Tools for RHEL 8 x86_64 (RPMs)	**openstack-16.1-deployment-tools-for-rhel-8-x86_64-rpms**	Packages to help director configure Ceph Storage nodes.
Red Hat Ceph Storage OSD 4 for RHEL 8 x86_64 (RPMs)	**rhceph-4-osd-for-rhel-8-x86_64-rpms**	(For Ceph Storage Nodes) Repository for Ceph Storage Object Storage daemon. Installed on Ceph Storage nodes.
Red Hat Ceph Storage MON 4 for RHEL 8 x86_64 (RPMs)	**rhceph-4-mon-for-rhel-8-x86_64-rpms**	(For Ceph Storage Nodes) Repository for Ceph Storage Monitor daemon. Installed on Controller nodes in OpenStack environments using Ceph Storage nodes.
Red Hat Ceph Storage Tools 4 for RHEL 8 x86_64 (RPMs)	**rhceph-4-tools-for-rhel-8-x86_64-rpms**	Provides tools for nodes to communicate with the Ceph Storage cluster. This repository should be enabled for all nodes when deploying an overcloud with a Ceph Storage cluster.

Real Time repositories

The following table lists repositories for Real Time Compute (RTC) functionality.

Name	Repository	Description of requirement

Name	Repository	Description of requirement
Red Hat Enterprise Linux 8 for x86_64 - Real Time (RPMs)	**rhel-8-for-x86_64-rt-rpms**	Repository for Real Time KVM (RT-KVM). Contains packages to enable the real time kernel. Enable this repository for all Compute nodes targeted for RT-KVM. NOTE: You need a separate subscription to a **Red Hat OpenStack Platform for Real Time** SKU to access this repository.
Red Hat Enterprise Linux 8 for x86_64 - Real Time for NFV (RPMs)	**rhel-8-for-x86_64-nfv-rpms**	Repository for Real Time KVM (RT-KVM) for NFV. Contains packages to enable the real time kernel. Enable this repository for all NFV Compute nodes targeted for RT-KVM. NOTE: You need a separate subscription to a **Red Hat OpenStack Platform for Real Time** SKU to access this repository.

IBM POWER repositories

The following table lists repositories for Openstack Platform on POWER PC architecture. Use these repositories in place of equivalents in the Core repositories.

Name	Repository	Description of requirement
Red Hat Enterprise Linux for IBM Power, little endian - BaseOS (RPMs)	**rhel-8-for-ppc64le-baseos-rpms**	Base operating system repository for ppc64le systems.
Red Hat Enterprise Linux 8 for IBM Power, little endian - AppStream (RPMs)	**rhel-8-for-ppc64le-appstream-rpms**	Contains Red Hat OpenStack Platform dependencies.
Red Hat Enterprise Linux 8 for IBM Power, little endian - High Availability (RPMs)	**rhel-8-for-ppc64le-highavailability-rpms**	High availability tools for Red Hat Enterprise Linux. Used for Controller node high availability.
Red Hat Ansible Engine 2.8 for RHEL 8 IBM Power, little endian (RPMs)	**ansible-2.8-for-rhel-8-ppc64le-rpms**	Ansible Engine for Red Hat Enterprise Linux. Used to provide the latest version of Ansible.
Red Hat OpenStack Platform 16.1 for RHEL 8 (RPMs)	**openstack-16.1-for-rhel-8-ppc64le-rpms**	Core Red Hat OpenStack Platform repository for ppc64le systems.

6.11. PROVISIONING METHODS

There are three main methods that you can use to provision the nodes for your Red Hat OpenStack Platform environment:

Provisioning with director

Red Hat OpenStack Platform director is the standard provisioning method. In this scenario, the **openstack overcloud deploy** command performs both the provisioning and the configuration of your deployment. For more information about the standard provisioning and deployment method, see Chapter 7, *Configuring a basic overcloud with CLI tools* .

Provisioning with the OpenStack Bare Metal (ironic) service

In this scenario, you can separate the provisioning and configuration stages of the standard director deployment into two distinct processes. This is useful if you want to mitigate some of the risk involved with the standard director deployment and identify points of failure more efficiently. For more information about this scenario, see Chapter 8, *Provisioning bare metal nodes before deploying the overcloud*.

IMPORTANT

This feature is available in this release as a *Technology Preview*, and therefore is not fully supported by Red Hat. It should only be used for testing, and should not be deployed in a production environment. For more information about Technology Preview features, see Scope of Coverage Details.

Provisioning with an external tool

In this scenario, director controls the overcloud configuration on nodes that you pre-provision with an external tool. This is useful if you want to create an overcloud without power management control, use networks that have DHCP/PXE boot restrictions, or if you want to use nodes that have a custom partitioning layout that does not rely on the QCOW2 **overcloud-full** image. This scenario does not use the OpenStack Compute (nova), OpenStack Bare Metal (ironic), or OpenStack Image (glance) services for managing nodes.
For more information about this scenario, see Chapter 9, *Configuring a basic overcloud with pre-provisioned nodes*.

IMPORTANT

You cannot combine pre-provisioned nodes with director-provisioned nodes.

CHAPTER 7. CONFIGURING A BASIC OVERCLOUD WITH CLI TOOLS

This chapter contains basic configuration procedures to deploy an OpenStack Platform environment using the CLI tools. An overcloud with a basic configuration contains no custom features. However, you can add advanced configuration options to this basic overcloud and customize it to your specifications using the instructions in the Advanced Overcloud Customization guide.

7.1. REGISTERING NODES FOR THE OVERCLOUD

Director requires a node definition template, which you create manually. This template uses a JSON or YAML format, and contains the hardware and power management details for your nodes.

Procedure

1. Create a template that lists your nodes. Use the following JSON and YAML template examples to understand how to structure your node definition template:

   Example JSON template

```
{
    "nodes":[
        {
            "mac":[
                "bb:bb:bb:bb:bb:bb"
            ],
            "name":"node01",
            "cpu":"4",
            "memory":"6144",
            "disk":"40",
            "arch":"x86_64",
            "pm_type":"ipmi",
            "pm_user":"admin",
            "pm_password":"p@55w0rd!",
            "pm_addr":"192.168.24.205"
        },
        {
            "mac":[
                "cc:cc:cc:cc:cc:cc"
            ],
            "name":"node02",
            "cpu":"4",
            "memory":"6144",
            "disk":"40",
            "arch":"x86_64",
            "pm_type":"ipmi",
            "pm_user":"admin",
            "pm_password":"p@55w0rd!",
            "pm_addr":"192.168.24.206"
        }
    ]
}
```

   Example YAML template

```
nodes:
  - mac:
      - "bb:bb:bb:bb:bb:bb"
    name: "node01"
    cpu: 4
    memory: 6144
    disk: 40
    arch: "x86_64"
    pm_type: "ipmi"
    pm_user: "admin"
    pm_password: "p@55w0rd!"
    pm_addr: "192.168.24.205"
  - mac:
      - cc:cc:cc:cc:cc:cc
    name: "node02"
    cpu: 4
    memory: 6144
    disk: 40
    arch: "x86_64"
    pm_type: "ipmi"
    pm_user: "admin"
    pm_password: "p@55w0rd!"
    pm_addr: "192.168.24.206"
```

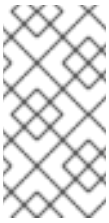
This template contains the following attributes:

name

The logical name for the node.

pm_type

The power management driver that you want to use. This example uses the IPMI driver (**ipmi**).



NOTE

IPMI is the preferred supported power management driver. For more information about supported power management types and their options, see Appendix A, *Power management drivers*. If these power management drivers do not work as expected, use IPMI for your power management.

pm_user; pm_password

The IPMI username and password.

pm_addr

The IP address of the IPMI device.

pm_port (Optional)

The port to access the specific IPMI device.

mac

(Optional) A list of MAC addresses for the network interfaces on the node. Use only the MAC address for the Provisioning NIC of each system.

cpu

(Optional) The number of CPUs on the node.

memory

(Optional) The amount of memory in MB.

disk

(Optional) The size of the hard disk in GB.

arch

(Optional) The system architecture.

IMPORTANT

When building a multi-architecture cloud, the **arch** key is mandatory to distinguish nodes using **x86_64** and **ppc64le** architectures.

2. After you create the template, run the following commands to verify the formatting and syntax:

```
$ source ~/stackrc
(undercloud) $ openstack overcloud node import --validate-only ~/nodes.json
```

3. Save the file to the home directory of the **stack** user (**/home/stack/nodes.json**), then run the following commands to import the template to director:

```
(undercloud) $ openstack overcloud node import ~/nodes.json
```

This command registers each node from the template into director.

4. Wait for the node registration and configuration to complete. When complete, confirm that director has successfully registered the nodes:

```
(undercloud) $ openstack baremetal node list
```

7.2. VALIDATING THE INTROSPECTION REQUIREMENTS

Run the **pre-introspection** validation group to check the introspection requirements.

Procedure

1. Source the **stackrc** file.

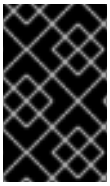
```
$ source ~/stackrc
```

2. Run the **openstack tripleo validator run** command with the **--group pre-introspection** option:

```
$ openstack tripleo validator run --group pre-introspection
```

3. Review the results of the validation report. To view detailed output from a specific validation, run the **openstack tripleo validator show run** command against the UUID of the specific validation from the report:

```
$ openstack tripleo validator show run <UUID>
```



IMPORTANT

A **FAILED** validation does not prevent you from deploying or running Red Hat OpenStack Platform. However, a **FAILED** validation can indicate a potential issue with a production environment.

7.3. INSPECTING THE HARDWARE OF NODES

Director can run an introspection process on each node. This process boots an introspection agent over PXE on each node. The introspection agent collects hardware data from the node and sends the data back to director. Director then stores this introspection data in the OpenStack Object Storage (swift) service running on director. Director uses hardware information for various purposes such as profile tagging, benchmarking, and manual root disk assignment.

Procedure

1. Run the following command to inspect the hardware attributes of each node:

```
(undercloud) $ openstack overcloud node introspect --all-manageable --provide
```

   - Use the **--all-manageable** option to introspect only the nodes that are in a managed state. In this example, all nodes are in a managed state.
   - Use the **--provide** option to reset all nodes to an **available** state after introspection.

2. Monitor the introspection progress logs in a separate terminal window:

```
(undercloud) $ sudo tail -f /var/log/containers/ironic-inspector/ironic-inspector.log
```

IMPORTANT

Ensure that this process runs to completion. This process usually takes 15 minutes for bare metal nodes.

After the introspection completes, all nodes change to an **available** state.

7.4. TAGGING NODES INTO PROFILES

After you register and inspect the hardware of each node, tag the nodes into specific profiles. These profile tags match your nodes to flavors, which assigns the flavors to deployment roles. The following example shows the relationships across roles, flavors, profiles, and nodes for Controller nodes:

Type	Description
Role	The **Controller** role defines how director configures Controller nodes.
Flavor	The **control** flavor defines the hardware profile for nodes to use as controllers. You assign this flavor to the **Controller** role so that director can decide which nodes to use.

Type	Description
Profile	The **control** profile is a tag you apply to the**control** flavor. This defines the nodes that belong to the flavor.
Node	You also apply the **control** profile tag to individual nodes, which groups them to the **control** flavor and, as a result, director configures them using the **Controller** role.

Default profile flavors **compute**, **control**, **swift-storage**, **ceph-storage**, and **block-storage** are created during undercloud installation and are usable without modification in most environments.

Procedure

1. To tag a node into a specific profile, add a **profile** option to the **properties/capabilities** parameter for each node. For example, to tag your nodes to use Controller and Compute profiles respectively, use the following commands:

```
(undercloud) $ openstack baremetal node set --property
capabilities='profile:control,boot_option:local' 1a4e30da-b6dc-499d-ba87-0bd8a3819bc0
(undercloud) $ openstack baremetal node set --property
capabilities='profile:compute,boot_option:local' 58c3d07e-24f2-48a7-bbb6-6843f0e8ee13
```

   The addition of the **profile:control** and **profile:compute** options tag the two nodes into each respective profiles.

   These commands also set the **boot_option:local** parameter, which defines how each node boots.

2. After you complete node tagging, check the assigned profiles or possible profiles:

```
(undercloud) $ openstack overcloud profiles list
```

7.5. SETTING UEFI BOOT MODE

The default boot mode is the legacy BIOS mode. Newer systems might require UEFI boot mode instead of the legacy BIOS mode. Complete the following steps to change the boot mode to UEFI mode.

Procedure

1. Set the following parameters in your **undercloud.conf** file:

```
ipxe_enabled = True
inspection_enable_uefi = True
```

2. Save the **undercloud.conf** file and run the undercloud installation:

```
$ openstack undercloud install
```

Wait until the installation script completes.

3. Set the boot mode to **uefi** for each registered node. For example, to add or replace the existing **boot_mode** parameters in the **capabilities** property, run the following command:

```
$ NODE=<NODE NAME OR ID> ; openstack baremetal node set --property
capabilities="boot_mode:uefi,$(openstack baremetal node show $NODE -f json -c properties
| jq -r .properties.capabilities | sed "s/boot_mode:[^,]*,//g")" $NODE
```

NOTE

Check that you have retained the **profile** and **boot_option** capabilities:

```
$ openstack baremetal node show r530-12 -f json -c properties | jq -r
.properties.capabilities
```

4. Set the boot mode to **uefi** for each flavor:

```
$ openstack flavor set --property capabilities:boot_mode='uefi' control
```

7.6. ENABLING VIRTUAL MEDIA BOOT

IMPORTANT

This feature is available in this release as a *Technology Preview*, and therefore is not fully supported by Red Hat. It should only be used for testing, and should not be deployed in a production environment. For more information about Technology Preview features, see Scope of Coverage Details.

You can use Redfish virtual media boot to supply a boot image to the Baseboard Management Controller (BMC) of a node so that the BMC can insert the image into one of the virtual drives. The node can then boot from the virtual drive into the operating system that exists in the image.

Redfish hardware types support booting deploy, rescue, and user images over virtual media. The Bare Metal service (ironic) uses kernel and ramdisk images associated with a node to build bootable ISO images for UEFI or BIOS boot modes at the moment of node deployment. The major advantage of virtual media boot is that you can eliminate the TFTP image transfer phase of PXE and use HTTP GET, or other methods, instead.

To boot a node with the **redfish** hardware type over virtual media, set the boot interface to **redfish-virtual-media** and, for UEFI nodes, define the EFI System Partition (ESP) image. Then configure an enrolled node to use Redfish virtual media boot.

Prerequisites

- Redfish driver enabled in the **enabled_hardware_types** parameter in the **undercloud.conf** file.
- A bare metal node registered and enrolled.
- IPA and instance images in the Image Service (glance).

- For UEFI nodes, you must also have an EFI system partition image (ESP) available in the Image Service (glance).
- A bare metal flavor.
- A network for cleaning and provisioning.
- Sushy library installed:

```
$ sudo yum install sushy
```

Procedure

1. Set the Bare Metal service (ironic) boot interface to **redfish-virtual-media**:

```
$ openstack baremetal node set --boot-interface redfish-virtual-media $NODE_NAME
```

Replace **$NODE_NAME** with the name of the node.

2. For UEFI nodes, set the boot mode to **uefi**:

```
NODE=<NODE NAME OR ID> ; openstack baremetal node set --property
capabilities="boot_mode:uefi,$(openstack baremetal node show $NODE -f json -c properties
| jq -r .properties.capabilities | sed "s/boot_mode:[^,]*,//g")" $NODE
```

Replace **$NODE** with the name of the node.

NOTE

For BIOS nodes, do not complete this step.

3. For UEFI nodes, define the EFI System Partition (ESP) image:

```
$ openstack baremetal node set --driver-info bootloader=$ESP $NODE_NAME
```

Replace **$ESP** with the glance image UUID or URL for the ESP image, and replace **$NODE_NAME** with the name of the node.

NOTE

For BIOS nodes, do not complete this step.

4. Create a port on the bare metal node and associate the port with the MAC address of the NIC on the bare metal node:

```
$ openstack baremetal port create --pxe-enabled True --node $UUID $MAC_ADDRESS
```

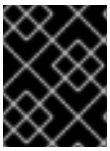
Replace **$UUID** with the UUID of the bare metal node, and replace **$MAC_ADDRESS** with the MAC address of the NIC on the bare metal node.

7.7. DEFINING THE ROOT DISK FOR MULTI-DISK CLUSTERS

Director must identify the root disk during provisioning in the case of nodes with multiple disks. For example, most Ceph Storage nodes use multiple disks. By default, director writes the overcloud image to the root disk during the provisioning process

There are several properties that you can define to help director identify the root disk:

- **model** (String): Device identifier.
- **vendor** (String): Device vendor.
- **serial** (String): Disk serial number.
- **hctl** (String): Host:Channel:Target:Lun for SCSI.
- **size** (Integer): Size of the device in GB.
- **wwn** (String): Unique storage identifier.
- **wwn_with_extension** (String): Unique storage identifier with the vendor extension appended.
- **wwn_vendor_extension** (String): Unique vendor storage identifier.
- **rotational** (Boolean): True for a rotational device (HDD), otherwise false (SSD).
- **name** (String): The name of the device, for example: /dev/sdb1.



IMPORTANT

Use the **name** property only for devices with persistent names. Do not use **name** to set the root disk for any other devices because this value can change when the node boots.

Complete the following steps to specify the root device using its serial number.

Procedure

1. Check the disk information from the hardware introspection of each node. Run the following command to display the disk information of a node:

```
(undercloud) $ openstack baremetal introspection data save 1a4e30da-b6dc-499d-ba87-0bd8a3819bc0 | jq ".inventory.disks"
```

For example, the data for one node might show three disks:

```
[
  {
    "size": 299439751168,
    "rotational": true,
    "vendor": "DELL",
    "name": "/dev/sda",
    "wwn_vendor_extension": "0x1ea4dcc412a9632b",
    "wwn_with_extension": "0x61866da04f3807001ea4dcc412a9632b",
    "model": "PERC H330 Mini",
    "wwn": "0x61866da04f380700",
    "serial": "61866da04f3807001ea4dcc412a9632b"
  }
```

```
  {
    "size": 299439751168,
    "rotational": true,
    "vendor": "DELL",
    "name": "/dev/sdb",
    "wwn_vendor_extension": "0x1ea4e13c12e36ad6",
    "wwn_with_extension": "0x61866da04f380d001ea4e13c12e36ad6",
    "model": "PERC H330 Mini",
    "wwn": "0x61866da04f380d00",
    "serial": "61866da04f380d001ea4e13c12e36ad6"
  }
  {
    "size": 299439751168,
    "rotational": true,
    "vendor": "DELL",
    "name": "/dev/sdc",
    "wwn_vendor_extension": "0x1ea4e31e121cfb45",
    "wwn_with_extension": "0x61866da04f37fc001ea4e31e121cfb45",
    "model": "PERC H330 Mini",
    "wwn": "0x61866da04f37fc00",
    "serial": "61866da04f37fc001ea4e31e121cfb45"
  }
]
```


2. Run the **openstack baremetal node set --property root_device=** command to set the root disk for a node. Include the most appropriate hardware attribute value to define the root disk.

```
(undercloud) $ openstack baremetal node set --property
root_device='{"serial":"<serial_number>"}' <node-uuid>
```

For example, to set the root device to disk 2, which has the serial number **61866da04f380d001ea4e13c12e36ad6** run the following command:

```
(undercloud) $ openstack baremetal node set --property root_device='{"serial":
"61866da04f380d001ea4e13c12e36ad6"}' 1a4e30da-b6dc-499d-ba87-0bd8a3819bc0
```

+

NOTE

Ensure that you configure the BIOS of each node to include booting from the root disk that you choose. Configure the boot order to boot from the network first, then to boot from the root disk.

Director identifies the specific disk to use as the root disk. When you run the **openstack overcloud deploy** command, director provisions and writes the overcloud image to the root disk.

7.8. USING THE OVERCLOUD-MINIMAL IMAGE TO AVOID USING A RED HAT SUBSCRIPTION ENTITLEMENT

By default, director writes the QCOW2 **overcloud-full** image to the root disk during the provisioning process. The **overcloud-full** image uses a valid Red Hat subscription. However, you can also use the **overcloud-minimal** image, for example, to provision a bare OS where you do not want to run any other

OpenStack services and consume your subscription entitlements.

A common use case for this occurs when you want to provision nodes with only Ceph daemons. For this and similar use cases, you can use the **overcloud-minimal** image option to avoid reaching the limit of your paid Red Hat subscriptions. For information about how to obtain the **overcloud-minimal** image, see Obtaining images for overcloud nodes .

NOTE

A Red Hat OpenStack Platform subscription contains Open vSwitch (OVS), but core services, such as OVS, are not available when you use the **overcloud-minimal** image. OVS is not required to deploy Ceph Storage nodes. Instead of using *ovs_bond* to define bonds, use *linux_bond*. For more information about **linux_bond**, see Linux bonding options.

Procedure

1. To configure director to use the **overcloud-minimal** image, create an environment file that contains the following image definition:

```
parameter_defaults:
  <roleName>Image: overcloud-minimal
```

2. Replace **<roleName>** with the name of the role and append **Image** to the name of the role. The following example shows an **overcloud-minimal** image for Ceph storage nodes:

```
parameter_defaults:
  CephStorageImage: overcloud-minimal
```

3. Pass the environment file to the **openstack overcloud deploy** command.

NOTE

The **overcloud-minimal** image supports only standard Linux bridges and not OVS because OVS is an OpenStack service that requires a Red Hat OpenStack Platform subscription entitlement.

7.9. CREATING ARCHITECTURE SPECIFIC ROLES

When building a multi-architecture cloud, you must add any architecture specific roles to the **roles_data.yaml** file. The following example includes the **ComputePPC64LE** role along with the default roles:

```
openstack overcloud roles generate \
   --roles-path /usr/share/openstack-tripleo-heat-templates/roles -o ~/templates/roles_data.yaml \
   Controller Compute ComputePPC64LE BlockStorage ObjectStorage CephStorage
```

The Creating a Custom Role File section has information on roles.

7.10. ENVIRONMENT FILES

The undercloud includes a set of heat templates that form the plan for your overcloud creation. You can customize aspects of the overcloud with environment files, which are YAML-formatted files that

override parameters and resources in the core heat template collection. You can include as many environment files as necessary. However, the order of the environment files is important because the parameters and resources that you define in subsequent environment files take precedence. Use the following list as an example of the environment file order:

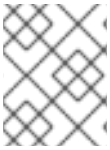
- The number of nodes and the flavors for each role. It is vital to include this information for overcloud creation.
- The location of the container images for containerized OpenStack services.
- Any network isolation files, starting with the initialization file (**environments/network-isolation.yaml**) from the heat template collection, then your custom NIC configuration file, and finally any additional network configurations. For more information, see the following chapters in the Advanced Overcloud Customization guide:
  - "Basic network isolation"
  - "Custom composable networks"
  - "Custom network interface templates"
- Any external load balancing environment files if you are using an external load balancer. For more information, see External Load Balancing for the Overcloud.
- Any storage environment files such as Ceph Storage, NFS, or iSCSI.
- Any environment files for Red Hat CDN or Satellite registration.
- Any other custom environment files.

Red Hat recommends that you organize your custom environment files in a separate directory, such as the **templates** directory.

For more information about customizing advanced features for your overcloud, see the Advanced Overcloud Customization guide.

IMPORTANT

A basic overcloud uses local LVM storage for block storage, which is not a supported configuration. It is recommended to use an external storage solution, such as Red Hat Ceph Storage, for block storage.



NOTE

The environment file extension must be **.yaml** or **.template**, or it will not be treated as a custom template resource.

The next few sections contain information about creating some environment files necessary for your overcloud.

7.11. CREATING AN ENVIRONMENT FILE THAT DEFINES NODE COUNTS AND FLAVORS

By default, director deploys an overcloud with 1 Controller node and 1 Compute node using the **baremetal** flavor. However, this is only suitable for a proof-of-concept deployment. You can override

the default configuration by specifying different node counts and flavors. For a small-scale production environment, deploy at least 3 Controller nodes and 3 Compute nodes, and assign specific flavors to ensure that the nodes have the appropriate resource specifications. Complete the following steps to create an environment file named **node-info.yaml** that stores the node counts and flavor assignments.

Procedure

1. Create a **node-info.yaml** file in the **/home/stack/templates/** directory:

```
(undercloud) $ touch /home/stack/templates/node-info.yaml
```

2. Edit the file to include the node counts and flavors that you need. This example contains 3 Controller nodes and 3 Compute nodes:

```
parameter_defaults:
  OvercloudControllerFlavor: control
  OvercloudComputeFlavor: compute
  ControllerCount: 3
  ComputeCount: 3
```

7.12. CREATING AN ENVIRONMENT FILE FOR UNDERCLOUD CA TRUST

If your undercloud uses TLS and the Certificate Authority (CA) is not publicly trusted, you can use the CA for SSL endpoint encryption that the undercloud operates. To ensure that the undercloud endpoints are accessible to the rest of your deployment, configure your overcloud nodes to trust the undercloud CA.

NOTE

For this approach to work, your overcloud nodes must have a network route to the public endpoint on the undercloud. It is likely that you must apply this configuration for deployments that rely on spine-leaf networking.

There are two types of custom certificates you can use in the undercloud:

- **User-provided certificates** - This definition applies when you have provided your own certificate. This can be from your own CA, or it can be self-signed. This is passed using the **undercloud_service_certificate** option. In this case, you must either trust the self-signed certificate, or the CA (depending on your deployment).

- **Auto-generated certificates** - This definition applies when you use **certmonger** to generate the certificate using its own local CA. Enable auto-generated certificates with the **generate_service_certificate** option in the **undercloud.conf** file. In this case, director generates a CA certificate at **/etc/pki/ca-trust/source/anchors/cm-local-ca.pem** and the director configures the undercloud's HAProxy instance to use a server certificate. Add the CA certificate to the **inject-trust-anchor-hiera.yaml** file to present the certificate to OpenStack Platform.

This example uses a self-signed certificate located in **/home/stack/ca.crt.pem**. If you use auto-generated certificates, use **/etc/pki/ca-trust/source/anchors/cm-local-ca.pem** instead.

Procedure

1. Open the certificate file and copy only the certificate portion. Do not include the key:

```
$ vi /home/stack/ca.crt.pem
```

The certificate portion you need looks similar to this shortened example:

```
-----BEGIN CERTIFICATE-----
MIIDITCCAn2gAwIBAgIJAOnPtx2hHEhrMA0GCSqGSIb3DQEBCwUAMGExCzAJBgNV
BAYTAIVTMQswCQYDVQQIDAJOQzEQMA4GA1UEBwwHUmFsZWlnaDEQMA4GA1UECg
wH
UmVkIEhhdDELMAkGA1UECwwCUUUxFDASBgNVBAMMCzE5Mi4xNjguMC4yMB4XDTE3
-----END CERTIFICATE-----
```

2. Create a new YAML file called **/home/stack/inject-trust-anchor-hiera.yaml** with the following contents, and include the certificate you copied from the PEM file:

```
parameter_defaults:
  CAMap:
    undercloud-ca:
      content: |
        -----BEGIN CERTIFICATE-----
        MIIDITCCAn2gAwIBAgIJAOnPtx2hHEhrMA0GCSqGSIb3DQEBCwUAMGExCzAJBgNV

BAYTAIVTMQswCQYDVQQIDAJOQzEQMA4GA1UEBwwHUmFsZWlnaDEQMA4GA1UECg
wH

UmVkIEhhdDELMAkGA1UECwwCUUUxFDASBgNVBAMMCzE5Mi4xNjguMC4yMB4XDTE3
        -----END CERTIFICATE-----
```

NOTE

The certificate string must follow the PEM format.

NOTE

The **CAMap** parameter might contain other certificates relevant to SSL/TLS configuration.

Director copies the CA certificate to each overcloud node during the overcloud deployment. As a result, each node trusts the encryption presented by the undercloud's SSL endpoints. For more information about environment files, see Section 7.15, "Including environment files in an overcloud deployment" .

7.13. DEPLOYMENT COMMAND

The final stage in creating your OpenStack environment is to run the **openstack overcloud deploy** command to create the overcloud. Before you run this command, familiarize yourself with key options and how to include custom environment files.

WARNING

Do not run **openstack overcloud deploy** as a background process. The overcloud creation might hang mid-deployment if you run it as a background process.

7.14. DEPLOYMENT COMMAND OPTIONS

The following table lists the additional parameters for the **openstack overcloud deploy** command.

IMPORTANT

Some options are available in this release as a *Technology Preview* and therefore are not fully supported by Red Hat. They should only be used for testing and should not be used in a production environment. For more information about Technology Preview features, see Scope of Coverage Details.

Table 7.1. Deployment command options

Parameter	Description
--templates [TEMPLATES]	The directory that contains the heat templates that you want to deploy. If blank, the deployment command uses the default template location at **/usr/share/openstack-tripleo-heat-templates/**
--stack STACK	The name of the stack that you want to create or update
-t [TIMEOUT], --timeout [TIMEOUT]	The deployment timeout duration in minutes
--libvirt-type [LIBVIRT_TYPE]	The virtualization type that you want to use for hypervisors
--ntp-server [NTP_SERVER]	The Network Time Protocol (NTP) server that you want to use to synchronize time. You can also specify multiple NTP servers in a comma-separated list, for example: **--ntp-server 0.centos.pool.org,1.centos.pool.org**. For a high availability cluster deployment, it is essential that your Controller nodes are consistently referring to the same time source. Note that a typical environment might already have a designated NTP time source with established practices.
--no-proxy [NO_PROXY]	Defines custom values for the environment variable **no_proxy**, which excludes certain host names from proxy communication.

Parameter	Description
--overcloud-ssh-user OVERCLOUD_SSH_USER	Defines the SSH user to access the overcloud nodes. Normally SSH access occurs through the **heat-admin** user.
--overcloud-ssh-key OVERCLOUD_SSH_KEY	Defines the key path for SSH access to overcloud nodes.
--overcloud-ssh-network OVERCLOUD_SSH_NETWORK	Defines the network name that you want to use for SSH access to overcloud nodes.
-e [EXTRA HEAT TEMPLATE], **--extra-template [EXTRA HEAT TEMPLATE]**	Extra environment files that you want to pass to the overcloud deployment. You can specify this option more than once. Note that the order of environment files that you pass to the **openstack overcloud deploy** command is important. For example, parameters from each sequential environment file override the same parameters from earlier environment files.
--environment-directory	A directory that contains environment files that you want to include in deployment. The deployment command processes these environment files in numerical order, then alphabetical order.
-r ROLES_FILE	Defines the roles file and overrides the default **roles_data.yaml** in the **--templates** directory. The file location can be an absolute path or the path relative to **--templates**.
-n NETWORKS_FILE	Defines the networks file and overrides the default network_data.yaml in the **--templates** directory. The file location can be an absolute path or the path relative to **--templates**.
-p PLAN_ENVIRONMENT_FILE	Defines the plan Environment file and overrides the default **plan-environment.yaml** in the **--templates** directory. The file location can be an absolute path or the path relative to **--templates**.
--no-cleanup	Use this option if you do not want to delete temporary files after deployment, and log their location.
--update-plan-only	Use this option if you want to update the plan without performing the actual deployment.

Parameter	Description
--validation-errors-nonfatal	The overcloud creation process performs a set of pre-deployment checks. This option exits if any non-fatal errors occur from the pre-deployment checks. It is advisable to use this option as any errors can cause your deployment to fail.
--validation-warnings-fatal	The overcloud creation process performs a set of pre-deployment checks. This option exits if any non-critical warnings occur from the pre-deployment checks. openstack-tripleo-validations
--dry-run	Use this option if you want to perform a validation check on the overcloud without creating the overcloud.
--run-validations	Use this option to run external validations from the **openstack-tripleo-validations** package.
--skip-postconfig	Use this option to skip the overcloud post-deployment configuration.
--force-postconfig	Use this option to force the overcloud post-deployment configuration.
--skip-deploy-identifier	Use this option if you do not want the deployment command to generate a unique identifier for the **DeployIdentifier** parameter. The software configuration deployment steps only trigger if there is an actual change to the configuration. Use this option with caution and only if you are confident that you do not need to run the software configuration, such as scaling out certain roles.
--answers-file ANSWERS_FILE	The path to a YAML file with arguments and parameters.
--disable-password-generation	Use this option if you want to disable password generation for the overcloud services.
--deployed-server	Use this option if you want to deploy pre-provisioned overcloud nodes. Used in conjunction with **--disable-validations**.
--no-config-download, --stack-only	Use this option if you want to disable the **config-download** workflow and create only the stack and associated OpenStack resources. This command applies no software configuration to the overcloud.

Parameter	Description
--config-download-only	Use this option if you want to disable the overcloud stack creation and only run the **config-download** workflow to apply the software configuration.
--output-dir OUTPUT_DIR	The directory that you want to use for saved **config-download** output. The directory must be writeable by the mistral user. When not specified, director uses the default, which is **/var/lib/mistral/overcloud**.
--override-ansible-cfg OVERRIDE_ANSIBLE_CFG	The path to an Ansible configuration file. The configuration in the file overrides any configuration that **config-download** generates by default.
--config-download-timeout CONFIG_DOWNLOAD_TIMEOUT	The timeout duration in minutes that you want to use for **config-download** steps. If unset, director sets the default to the amount of time remaining from the **--timeout** parameter after the stack deployment operation.
--limit NODE1,NODE2	**(Technology Preview)** Use this option with a comma-separated list of nodes to limit the config-download playbook execution to a specific node or set of nodes. For example, the **--limit** option can be useful for scale-up operations, when you want to run config-download only on new nodes.
--tags TAG1,TAG2	**(Technology Preview)** Use this option with a comma-separated list of tags from the config-download playbook to run the deployment with a specific set of config-download tasks.
--skip-tags TAG1,TAG2	**(Technology Preview)** Use this option with a comma-separated list of tags that you want to skip from the config-download playbook.
--rhel-reg	Use this option to register overcloud nodes to the Customer Portal or Satellite 6.
--reg-method	Use this option to define the registration method that you want to use for the overcloud nodes. **satellite** for Red Hat Satellite 6 or Red Hat Satellite 5, **portal** for Customer Portal.
--reg-org [REG_ORG]	The organization that you want to use for registration.

Parameter	Description
--reg-force	Use this option to register the system even if it is already registered.
--reg-sat-url [REG_SAT_URL]	The base URL of the Satellite server to register overcloud nodes. Use the Satellite HTTP URL and not the HTTPS URL for this parameter. For example, use http://satellite.example.com and not https://satellite.example.com. The overcloud creation process uses this URL to determine whether the server is a Red Hat Satellite 5 or Red Hat Satellite 6 server. If the server is a Red Hat Satellite 6 server, the overcloud obtains the **katello-ca-consumer-latest.noarch.rpm** file, registers with **subscription-manager**, and installs **katello-agent**. If the server is a Red Hat Satellite 5 server, the overcloud obtains the **RHN-ORG-TRUSTED-SSL-CERT** file and registers with **rhnreg_ks**.
--reg-activation-key [REG_ACTIVATION_KEY]	Use this option to define the activation key that you want to use for registration.

Run the following command to view a full list of options:

```
(undercloud) $ openstack help overcloud deploy
```

Some command line parameters are outdated or deprecated in favor of using heat template parameters, which you include in the **parameter_defaults** section in an environment file. The following table maps deprecated parameters to their heat template equivalents.

Table 7.2. Mapping deprecated CLI parameters to heat template parameters

Parameter	Description	Heat template parameter
--control-scale	The number of Controller nodes to scale out	**ControllerCount**
--compute-scale	The number of Compute nodes to scale out	**ComputeCount**
--ceph-storage-scale	The number of Ceph Storage nodes to scale out	**CephStorageCount**
--block-storage-scale	The number of Block Storage (cinder) nodes to scale out	**BlockStorageCount**
--swift-storage-scale	The number of Object Storage (swift) nodes to scale out	**ObjectStorageCount**

Parameter	Description	Heat template parameter
--control-flavor	The flavor that you want to use for Controller nodes	**OvercloudControllerFlavor**
--compute-flavor	The flavor that you want to use for Compute nodes	**OvercloudComputeFlavor**
--ceph-storage-flavor	The flavor that you want to use for Ceph Storage nodes	**OvercloudCephStorageFlavor**
--block-storage-flavor	The flavor that you want to use for Block Storage (cinder) nodes	**OvercloudBlockStorageFlavor**
--swift-storage-flavor	The flavor that you want to use for Object Storage (swift) nodes	**OvercloudSwiftStorageFlavor**
--validation-errors-fatal	The overcloud creation process performs a set of pre-deployment checks. This option exits if any fatal errors occur from the pre-deployment checks. It is advisable to use this option because any errors can cause your deployment to fail.	No parameter mapping
--disable-validations	Disable the pre-deployment validations entirely. These validations were built-in pre-deployment validations, which have been replaced with external validations from the **openstack-tripleo-validations** package.	No parameter mapping
--config-download	Run deployment using the **config-download** mechanism. This is now the default and this CLI options may be removed in the future.	No parameter mapping

These parameters are scheduled for removal in a future version of Red Hat OpenStack Platform.

7.15. INCLUDING ENVIRONMENT FILES IN AN OVERCLOUD DEPLOYMENT

Use the **-e** option to include an environment file to customize your overcloud. You can include as many environment files as necessary. However, the order of the environment files is important because the parameters and resources that you define in subsequent environment files take precedence. Use the following list as an example of the environment file order:

- The number of nodes and the flavors for each role. It is vital to include this information for overcloud creation.
- The location of the container images for containerized OpenStack services.
- Any network isolation files, starting with the initialization file (**environments/network-isolation.yaml**) from the heat template collection, then your custom NIC configuration file, and finally any additional network configurations. For more information, see the following chapters in the Advanced Overcloud Customization guide:
  - "Basic network isolation"
  - "Custom composable networks"
  - "Custom network interface templates"
- Any external load balancing environment files if you are using an external load balancer. For more information, see External Load Balancing for the Overcloud .
- Any storage environment files such as Ceph Storage, NFS, or iSCSI.
- Any environment files for Red Hat CDN or Satellite registration.
- Any other custom environment files.

Any environment files that you add to the overcloud using the **-e** option become part of the stack definition of the overcloud.

The following command is an example of how to start the overcloud creation using environment files defined earlier in this scenario:

```
(undercloud) $ openstack overcloud deploy --templates \
  -e /home/stack/templates/node-info.yaml\
  -e /home/stack/containers-prepare-parameter.yaml \
  -e /home/stack/inject-trust-anchor-hiera.yaml
  -r /home/stack/templates/roles_data.yaml \
```

This command contains the following additional options:

--templates

Creates the overcloud using the heat template collection in **/usr/share/openstack-tripleo-heat-templates** as a foundation.

-e /home/stack/templates/node-info.yaml

Adds an environment file to define how many nodes and which flavors to use for each role.

-e /home/stack/containers-prepare-parameter.yaml

Adds the container image preparation environment file. You generated this file during the undercloud installation and can use the same file for your overcloud creation.

-e /home/stack/inject-trust-anchor-hiera.yaml

Adds an environment file to install a custom certificate in the undercloud.

-r /home/stack/templates/roles_data.yaml

(Optional) The generated roles data if you use custom roles or want to enable a multi architecture cloud. For more information, see Section 7.9, “Creating architecture specific roles” .

Director requires these environment files for re-deployment and post-deployment functions. Failure to include these files can result in damage to your overcloud.

To modify the overcloud configuration at a later stage, perform the following actions:

1. Modify parameters in the custom environment files and heat templates.
2. Run the **openstack overcloud deploy** command again with the same environment files.

Do not edit the overcloud configuration directly because director overrides any manual configuration when you update the overcloud stack.

7.16. VALIDATING THE DEPLOYMENT REQUIREMENTS

Run the **pre-deployment** validation group to check the deployment requirements.

Procedure

1. Source the **stackrc** file.

```
$ source ~/stackrc
```

2. This validation requires a copy of your overcloud plan. Upload your overcloud plan with all necessary environment files. To upload your plan only, run the **openstack overcloud deploy** command with the **--update-plan-only** option:

```
$ openstack overcloud deploy --templates \
   -e environment-file1.yaml \
   -e environment-file2.yaml \
   ...
   --update-plan-only
```

3. Run the **openstack tripleo validator run** command with the **--group pre-deployment** option:

```
$ openstack tripleo validator run --group pre-deployment
```

4. If the overcloud uses a plan name that is different to the default **overcloud** name, set the plan name with the --**plan** option:

```
$ openstack tripleo validator run --group pre-deployment \
   --plan myovercloud
```

5. Review the results of the validation report. To view detailed output from a specific validation, run the **openstack tripleo validator show run** command against the UUID of the specific validation from the report:

```
$ openstack tripleo validator show run <UUID>
```

IMPORTANT

A **FAILED** validation does not prevent you from deploying or running Red Hat OpenStack Platform. However, a **FAILED** validation can indicate a potential issue with a production environment.

7.17. OVERCLOUD DEPLOYMENT OUTPUT

When the overcloud creation completes, director provides a recap of the Ansible plays that were executed to configure the overcloud:

```
PLAY RECAP *********************************************************
overcloud-compute-0     : ok=160  changed=67   unreachable=0    failed=0
overcloud-controller-0  : ok=210  changed=93   unreachable=0    failed=0
undercloud              : ok=10   changed=7    unreachable=0    failed=0

Tuesday 15 October 2018  18:30:57 +1000 (0:00:00.107) 1:06:37.514 ******
===============================================================================
```

Director also provides details to access your overcloud.

```
Ansible passed.
Overcloud configuration completed.
Overcloud Endpoint: http://192.168.24.113:5000
Overcloud Horizon Dashboard URL: http://192.168.24.113:80/dashboard
Overcloud rc file: /home/stack/overcloudrc
Overcloud Deployed
```

7.18. ACCESSING THE OVERCLOUD

The director generates a script to configure and help authenticate interactions with your overcloud from the undercloud. The director saves this file, **overcloudrc**, in the home directory of the **stack** user. Run the following command to use this file:

```
(undercloud) $ source ~/overcloudrc
```

This command loads the environment variables that are necessary to interact with your overcloud from the undercloud CLI. The command prompt changes to indicate this:

```
(overcloud) $
```

To return to interacting with the undercloud, run the following command:

```
(overcloud) $ source ~/stackrc
(undercloud) $
```

Each node in the overcloud also contains a **heat-admin** user. The **stack** user has SSH access to this user on each node. To access a node over SSH, find the IP address of the node that you want to access:

```
(undercloud) $ openstack server list
```

Then connect to the node using the **heat-admin** user and the IP address of the node:

```
(undercloud) $ ssh heat-admin@192.168.24.23
```

7.19. VALIDATING THE POST-DEPLOYMENT STATE

Run the **post-deployment** validation group to check the post-deployment state.

Procedure

1. Source the **stackrc** file.

```
$ source ~/stackrc
```

2. Run the **openstack tripleo validator run** command with the **--group post-deployment** option:

```
$ openstack tripleo validator run --group post-deployment
```

3. If the overcloud uses a plan name that is different to the default **overcloud** name, set the plan name with the --**plan** option:

```
$ openstack tripleo validator run --group post-deployment \
    --plan myovercloud
```

4. Review the results of the validation report. To view detailed output from a specific validation, run the **openstack tripleo validator show run** command against the UUID of the specific validation from the report:

```
$ openstack tripleo validator show run <UUID>
```

IMPORTANT

A **FAILED** validation does not prevent you from deploying or running Red Hat OpenStack Platform. However, a **FAILED** validation can indicate a potential issue with a production environment.

7.20. NEXT STEPS

This concludes the creation of the overcloud using the command line tools. For more information about post-creation functions, see Chapter 11, *Performing overcloud post-installation tasks*.

CHAPTER 8. PROVISIONING BARE METAL NODES BEFORE DEPLOYING THE OVERCLOUD

IMPORTANT

This feature is available in this release as a *Technology Preview*, and therefore is not fully supported by Red Hat. It should only be used for testing, and should not be deployed in a production environment. For more information about Technology Preview features, see Scope of Coverage Details.

The overcloud deployment process contains two primary operations:

- Provisioning nodes
- Deploying the overcloud

You can mitigate some of the risk involved with this process and identify points of failure more efficiently if you separate these operations into distinct processes:

1. Provision your bare metal nodes.
   a. Create a node definition file in yaml format.
   b. Run the provisioning command, including the node definition file.
2. Deploy your overcloud.
   a. Run the deployment command, including the heat environment file that the provisioning command generates.

The provisioning process provisions your nodes and generates a heat environment file that contains various node specifications, including node count, predictive node placement, custom images, and custom NICs. When you deploy your overcloud, include this file in the deployment command.

IMPORTANT

You cannot combine pre-provisioned nodes with director-provisioned nodes.

8.1. REGISTERING NODES FOR THE OVERCLOUD

Director requires a node definition template, which you create manually. This template uses a JSON or YAML format, and contains the hardware and power management details for your nodes.

Procedure

1. Create a template that lists your nodes. Use the following JSON and YAML template examples to understand how to structure your node definition template:

   Example JSON template

```
{
    "nodes":[
        {
            "mac":[
```

```
            "bb:bb:bb:bb:bb:bb"
        ],
        "name":"node01",
        "cpu":"4",
        "memory":"6144",
        "disk":"40",
        "arch":"x86_64",
        "pm_type":"ipmi",
        "pm_user":"admin",
        "pm_password":"p@55w0rd!",
        "pm_addr":"192.168.24.205"
    },
    {
        "mac":[
            "cc:cc:cc:cc:cc:cc"
        ],
        "name":"node02",
        "cpu":"4",
        "memory":"6144",
        "disk":"40",
        "arch":"x86_64",
        "pm_type":"ipmi",
        "pm_user":"admin",
        "pm_password":"p@55w0rd!",
        "pm_addr":"192.168.24.206"
    }
  ]
}
```

Example YAML template

```
nodes:
  - mac:
      - "bb:bb:bb:bb:bb:bb"
    name: "node01"
    cpu: 4
    memory: 6144
    disk: 40
    arch: "x86_64"
    pm_type: "ipmi"
    pm_user: "admin"
    pm_password: "p@55w0rd!"
    pm_addr: "192.168.24.205"
  - mac:
      - cc:cc:cc:cc:cc:cc
    name: "node02"
    cpu: 4
    memory: 6144
    disk: 40
    arch: "x86_64"
    pm_type: "ipmi"
    pm_user: "admin"
    pm_password: "p@55w0rd!"
    pm_addr: "192.168.24.206"
```

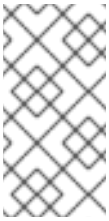
This template contains the following attributes:

name

The logical name for the node.

pm_type

The power management driver that you want to use. This example uses the IPMI driver (**ipmi**).



NOTE

IPMI is the preferred supported power management driver. For more information about supported power management types and their options, see Appendix A, *Power management drivers*. If these power management drivers do not work as expected, use IPMI for your power management.

pm_user; pm_password

The IPMI username and password.

pm_addr

The IP address of the IPMI device.

pm_port (Optional)

The port to access the specific IPMI device.

mac

(Optional) A list of MAC addresses for the network interfaces on the node. Use only the MAC address for the Provisioning NIC of each system.

cpu

(Optional) The number of CPUs on the node.

memory

(Optional) The amount of memory in MB.

disk

(Optional) The size of the hard disk in GB.

arch

(Optional) The system architecture.

IMPORTANT

When building a multi-architecture cloud, the **arch** key is mandatory to distinguish nodes using **x86_64** and **ppc64le** architectures.

2. After you create the template, run the following commands to verify the formatting and syntax:

```
$ source ~/stackrc
(undercloud) $ openstack overcloud node import --validate-only ~/nodes.json
```

3. Save the file to the home directory of the **stack** user (**/home/stack/nodes.json**), then run the following commands to import the template to director:

```
(undercloud) $ openstack overcloud node import ~/nodes.json
```

This command registers each node from the template into director.

4. Wait for the node registration and configuration to complete. When complete, confirm that director has successfully registered the nodes:

```
(undercloud) $ openstack baremetal node list
```

8.2. INSPECTING THE HARDWARE OF NODES

Director can run an introspection process on each node. This process boots an introspection agent over PXE on each node. The introspection agent collects hardware data from the node and sends the data back to director. Director then stores this introspection data in the OpenStack Object Storage (swift) service running on director. Director uses hardware information for various purposes such as profile tagging, benchmarking, and manual root disk assignment.

Procedure

1. Run the following command to inspect the hardware attributes of each node:

```
(undercloud) $ openstack overcloud node introspect --all-manageable --provide
```

- Use the **--all-manageable** option to introspect only the nodes that are in a managed state. In this example, all nodes are in a managed state.
- Use the **--provide** option to reset all nodes to an **available** state after introspection.

2. Monitor the introspection progress logs in a separate terminal window:

```
(undercloud) $ sudo tail -f /var/log/containers/ironic-inspector/ironic-inspector.log
```

IMPORTANT

Ensure that this process runs to completion. This process usually takes 15 minutes for bare metal nodes.

After the introspection completes, all nodes change to an **available** state.

8.3. PROVISIONING BARE METAL NODES

Create a new YAML file ~/**overcloud-baremetal-deploy.yaml**, define the quantity and attributes of the bare metal nodes that you want to deploy, and assign overcloud roles to these nodes. The provisioning process creates a heat environment file that you can include in your **openstack overcloud deploy** command.

Prerequisites

- A successful undercloud installation. For more information, see Section 4.7, “Installing director”.

- Bare metal nodes introspected and available for provisioning and deployment. For more information, see Section 8.1, "Registering nodes for the overcloud" and Section 8.2, "Inspecting the hardware of nodes".

Procedure

1. Source the **stackrc** undercloud credential file:

```
$ source ~/stackrc
```

2. Create a new ~/**overcloud-baremetal-deploy.yaml** file and define the node count for each role that you want to provision. For example, to provision three Controller nodes and three Compute nodes, use the following syntax:

```
- name: Controller
  count: 3
- name: Compute
  count: 3
```

3. In the ~/**overcloud-baremetal-deploy.yaml** file, define any predictive node placements, custom images, custom NICs, or other attributes that you want to assign to your nodes. For example, use the following example syntax to provision three Controller nodes on nodes **node00**, **node01**, and **node02**, and three Compute nodes on **node04**, **node05**, and **node06**:

```
- name: Controller
  count: 3
  instances:
  - hostname: overcloud-controller-0
    name: node00
  - hostname: overcloud-controller-1
    name: node01
  - hostname: overcloud-controller-2
    name: node02
- name: Compute
  count: 3
  instances:
  - hostname: overcloud-novacompute-0
    name: node04
  - hostname: overcloud-novacompute-1
    name: node05
  - hostname: overcloud-novacompute-2
    name: node06
```

By default, the provisioning process uses the **overcloud-full** image. You can use the **image** attribute in the **instances** parameter to define a custom image:

```
- name: Controller
  count: 3
  instances:
  - hostname: overcloud-controller-0
    name: node00
    image:
      href: overcloud-custom
```

You can also override the default parameter values with the **defaults** parameter to avoid manual node definitions for each node entry:

```
- name: Controller
  count: 3
  defaults:
    image:
      href: overcloud-custom
  instances:
  - hostname :overcloud-controller-0
    name: node00
  - hostname: overcloud-controller-1
    name: node01
  - hostname: overcloud-controller-2
    name: node02
```

For more information about the parameters, attributes, and values that you can use in your node definition file, see Section 8.6, "Bare metal node provisioning attributes" .

4. Run the provisioning command, specifying the ~/**overcloud-baremetal-deploy.yaml** file and defining an output file with the **--output** option:

```
(undercloud) $ sudo openstack overcloud node provision \
--stack stack \
--output ~/overcloud-baremetal-deployed.yaml \
~/overcloud-baremetal-deploy.yaml
```

The provisioning process generates a heat environment file with the name that you specify in the **--output** option. This file contains your node definitions. When you deploy the overcloud, include this file in the deployment command.

5. In a separate terminal, monitor your nodes to verify that they provision successfully. The provisioning process changes the node state from **available** to **active**:

```
(undercloud) $ watch openstack baremetal node list
```

Use the **metalsmith** tool to obtain a unified view of your nodes, including allocations and neutron ports:

```
(undercloud) $ metalsmith list
```

You can also use the **openstack baremetal allocation** command to verify association of nodes to hostnames, and to obtain IP addresses for the provisioned nodes:

```
(undercloud) $ openstack baremetal allocation list
```

When your nodes are provisioned successfully, you can deploy the overcloud. For more information, see Chapter 9, *Configuring a basic overcloud with pre-provisioned nodes* .

8.4. SCALING UP BARE METAL NODES

To increase the count of bare metal nodes in an existing overcloud, increment the node count in the ~/**overcloud-baremetal-deploy.yaml** file and redeploy the overcloud.

Prerequisites

- A successful undercloud installation. For more information, see Section 4.7, "Installing director".
- A successful overcloud deployment. For more information, see Chapter 9, *Configuring a basic overcloud with pre-provisioned nodes*.
- Bare metal nodes introspected and available for provisioning and deployment. For more information, see Section 8.1, "Registering nodes for the overcloud" and Section 8.2, "Inspecting the hardware of nodes".

Procedure

1. Source the **stackrc** undercloud credential file:

```
$ source ~/stackrc
```

2. Edit the **~/overcloud-baremetal-deploy.yaml** file that you used to provision your bare metal nodes, and increment the **count** parameter for the roles that you want to scale up. For example, if your overcloud contains three Compute nodes, use the following snippet to increase the Compute node count to 10:

```
- name: Controller
  count: 3
- name: Compute
  count: 10
```

   You can also add predictive node placement with the **instances** parameter. For more information about the parameters and attributes that are available, see Section 8.6, "Bare metal node provisioning attributes".

3. Run the provisioning command, specifying the **~/overcloud-baremetal-deploy.yaml** file and defining an output file with the **--output** option:

```
(undercloud) $ sudo openstack overcloud node provision \
--stack stack \
--output ~/overcloud-baremetal-deployed.yaml \
~/overcloud-baremetal-deploy.yaml
```

4. Monitor the provisioning progress with the **openstack baremetal node list** command.

5. Deploy the overcloud, including the **~/overcloud-baremetal-deployed.yaml** file that the provisioning command generates, along with any other environment files relevant to your deployment:

```
(undercloud) $ openstack overcloud deploy \
  ...
  -e /usr/share/openstack-tripleo-heat-templates/environments/deployed-server-
environment.yaml \
  -e ~/overcloud-baremetal-deployed.yaml \
  --deployed-server \
  --disable-validations \
  ...
```

8.5. SCALING DOWN BARE METAL NODES

Tag the nodes that you want to delete from the stack in the **~/overcloud-baremetal-deploy.yaml** file, redeploy the overcloud, and then include this file in the **openstack overcloud node delete** command with the **--baremetal-deployment** option.

Prerequisites

- A successful undercloud installation. For more information, see Section 4.7, "Installing director".
- A successful overcloud deployment. For more information, see Chapter 9, *Configuring a basic overcloud with pre-provisioned nodes*.
- At least one bare metal node that you want to remove from the stack.

Procedure

1. Source the **stackrc** undercloud credential file:

```
$ source ~/stackrc
```

2. Edit the **~/overcloud-baremetal-deploy.yaml** file that you used to provision your bare metal nodes, and decrement the **count** parameter for the roles that you want to scale down. You must also define the following attributes for each node that you want to remove from the stack:
   - The name of the node.
   - The hostname that is associated with the node.
   - The attribute **provisioned: false**.
     For example, to remove the node **overcloud-controller-1** from the stack, include the following snippet in your **~/overcloud-baremetal-deploy.yaml** file:

```
- name: Controller
  count: 2
  instances:
  - hostname: overcloud-controller-0
    name: node00
  - hostname: overcloud-controller-1
    name: node01
    # Removed from cluster due to disk failure
    provisioned: false
  - hostname: overcloud-controller-2
    name: node02
```

3. Run the provisioning command, specifying the **~/overcloud-baremetal-deploy.yaml** file and defining an output file with the **--output** option:

```
(undercloud) $ sudo openstack overcloud node provision \
--stack stack \
--output ~/overcloud-baremetal-deployed.yaml \
~/overcloud-baremetal-deploy.yaml
```

4. Redeploy the overcloud and include the **~/overcloud-baremetal-deployed.yaml** file that the provisioning command generates, along with any other environment files relevant to your deployment:

```
(undercloud) $ openstack overcloud deploy \
  ...
  -e /usr/share/openstack-tripleo-heat-templates/environments/deployed-server-
environment.yaml \
  -e ~/overcloud-baremetal-deployed.yaml \
  --deployed-server \
  --disable-validations \
  ...
```

After you redeploy the overcloud, the nodes that you define with the **provisioned: false** attribute are no longer present in the stack. However, these nodes are still running in a provisioned state.

NOTE

If you want to remove a node from the stack temporarily, you can deploy the overcloud with the attribute **provisioned: false** and then redeploy the overcloud with the attribute **provisioned: true** to return the node to the stack.

5. Run the **openstack overcloud node delete** command, including the **~/overcloud-baremetal-deploy.yaml** file with the **--baremetal-deployment** option.

```
(undercloud) $ sudo openstack overcloud node delete \
--stack stack \
--baremetal-deployment ~/overcloud-baremetal-deploy.yaml
```

NOTE

Do not include the nodes that you want to remove from the stack as command arguments in the **openstack overcloud node delete** command.

8.6. BARE METAL NODE PROVISIONING ATTRIBUTES

Use the following tables to understand the parameters, attributes, and values that are available for you to use when you provision bare metal nodes with the **openstack baremetal node provision** command.

Table 8.1. Role parameters

Parameter	Value
name	Mandatory role name
count	The number of nodes that you want to provision for this role. The default value is **1**.

Parameter	Value
defaults	A dictionary of default values for **instances** entry properties. An **instances** entry property overrides any defaults that you specify in the **defaults** parameter.
instances	A dictionary of values that you can use to specify attributes for specific nodes. For more information about supported properties in the **instances** parameter, see Table 8.2, "**instances** and **defaults** parameters". The length of this list must not be greater than the value of the **count** parameter.
hostname_format	Overrides the default hostname format for this role. The default format uses the lower case role name. For example, the default format for the Controller role is **%stackname%-controller-%index%**. Only the Compute role does not follow the role name rule. The Compute default format is **%stackname%-novacompute-%index%**

Example syntax

In the following example, the **name** refers to the logical name of the node, and the **hostname** refers to the generated hostname which is derived from the overcloud stack name, the role, and an incrementing index. All Controller servers use a default custom image **overcloud-full-custom** and are on predictive nodes. One of the Compute servers is placed predictively on **node04** with custom host name **overcloud-compute-special**, and the other 99 Compute servers are on nodes allocated automatically from the pool of available nodes:

```
- name: Controller
  count: 3
  defaults:
    image:
      href: file:///var/lib/ironic/images/overcloud-full-custom.qcow2
  instances:
  - hostname: overcloud-controller-0
    name: node00
  - hostname: overcloud-controller-1
    name: node01
  - hostname: overcloud-controller-2
    name: node02
- name: Compute
  count: 100
  instances:
  - hostname: overcloud-compute-special
    name: node04
```

Table 8.2. **instances** and **defaults** parameters

Parameter	Value
hostname	If the hostname complies with the **hostname_format** pattern then other properties apply to the node allocated to this hostname. Otherwise, you can use a custom hostname for this node.
name	The name of the node that you want to provision.
image	Details of the image that you want to provision onto the node. For more information about supported properties in the **image** parameter, see Table 8.3, "**image** parameters".
capabilities	Selection criteria to match the node capabilities.
nics	List of dictionaries that represent requested NICs. For more information about supported properties in the **nics** parameter, see Table 8.4, "**nic** parameters".
profile	Selection criteria to use Advanced Profile Matching.
provisioned	Boolean to determine whether this node is provisioned or unprovisioned. The default value is **true**. Use **false** to unprovision a node. For more information, see Section 8.5, "Scaling down bare metal nodes".
resource_class	Selection criteria to match the resource class of the node. The default value is **baremetal**.
root_size_gb	Size of the root partition in GiB. The default value is **49**
swap_size_mb	Size of the swap partition in MiB.
traits	A list of traits as selection criteria to match the node traits.

Example syntax

In the following example, all Controller servers use a custom default overcloud image **overcloud-full-custom**. The Controller server **overcloud-controller-0** is placed predictively on **node00** and has custom root and swap sizes. The other two Controller servers are on nodes allocated automatically from the pool of available nodes, and have default root and swap sizes:

```
- name: Controller
  count: 3
  defaults:
    image:
```

```
    href: file:///var/lib/ironic/images/overcloud-full-custom.qcow2
instances:
- hostname: overcloud-controller-0
  name: node00
  root_size_gb: 140
  swap_size_mb: 600
```

Table 8.3. **image** parameters

Parameter	Value
href	Glance image reference or URL of the root partition or whole disk image. URL schemes supported are **file:**//, **http:**//, and **https:**//. If the value is not a valid URL, this value must be a valid glance image reference.
checksum	When the href is a URL, this value must be the SHA512 checksum of the root partition or whole disk image.
kernel	Glance image reference or URL of the kernel image. Use this property only for partition images.
ramdisk	Glance image reference or URL of the ramdisk image. Use this property only for partition images.

Example syntax
In the following example, all three Controller servers are on nodes allocated automatically from the pool of available nodes. All Controller servers in this environment use a default custom image **overcloud-full-custom**:

```
- name: Controller
  count: 3
  defaults:
    image:
      href: file:///var/lib/ironic/images/overcloud-full-custom.qcow2
      checksum: 1582054665
      kernel: file:///var/lib/ironic/images/overcloud-full-custom.vmlinuz
      ramdisk: file:///var/lib/ironic/images/overcloud-full-custom.initrd
```

Table 8.4. **nic** parameters

Parameter	Value
fixed_ip	The specific IP address that you want to use for this NIC.
network	The neutron network where you want to create the port for this NIC.

Parameter	Value
subnet	The neutron subnet where you want to create the port for this NIC.
port	Existing Neutron port to use instead of creating a new port.

Example syntax
In the following example, all three Controller servers are on nodes allocated automatically from the pool of available nodes. All Controller servers in this environment use a default custom image **overcloud-full-custom** and have specific networking requirements:

```
- name: Controller
  count: 3
  defaults:
    image:
      href: file:///var/lib/ironic/images/overcloud-full-custom.qcow2
      nics:
        network: custom-network
        subnet: custom-subnet
```

CHAPTER 9. CONFIGURING A BASIC OVERCLOUD WITH PRE-PROVISIONED NODES

This chapter contains basic configuration procedures that you can use to configure a Red Hat OpenStack Platform (RHOSP) environment with pre-provisioned nodes. This scenario differs from the standard overcloud creation scenarios in several ways:

- You can provision nodes with an external tool and let the director control the overcloud configuration only.
- You can use nodes without relying on the director provisioning methods. This is useful if you want to create an overcloud without power management control, or use networks with DHCP/PXE boot restrictions.
- The director does not use OpenStack Compute (nova), OpenStack Bare Metal (ironic), or OpenStack Image (glance) to manage nodes.
- Pre-provisioned nodes can use a custom partitioning layout that does not rely on the QCOW2 overcloud-full image.

This scenario includes only basic configuration with no custom features. However, you can add advanced configuration options to this basic overcloud and customize it to your specifications with the instructions in the Advanced Overcloud Customization guide.

IMPORTANT

You cannot combine pre-provisioned nodes with director-provisioned nodes.

9.1. PRE-PROVISIONED NODE REQUIREMENTS

Before you begin deploying an overcloud with pre-provisioned nodes, ensure that the following configuration is present in your environment:

- The director node that you created in Chapter 4, *Installing director*.
- A set of bare metal machines for your nodes. The number of nodes required depends on the type of overcloud you intend to create. These machines must comply with the requirements set for each node type. These nodes require Red Hat Enterprise Linux 8.2 or later installed as the host operating system. Red Hat recommends using the latest version available.
- One network connection for managing the pre-provisioned nodes. This scenario requires uninterrupted SSH access to the nodes for orchestration agent configuration.
- One network connection for the Control Plane network. There are two main scenarios for this network:
  - Using the Provisioning Network as the Control Plane, which is the default scenario. This network is usually a layer-3 (L3) routable network connection from the pre-provisioned nodes to director. The examples for this scenario use following IP address assignments:

    Table 9.1. Provisioning Network IP assignments

Node name	IP address
Director	192.168.24.1
Controller 0	192.168.24.2
Compute 0	192.168.24.3

    - Using a separate network. In situations where the director's Provisioning network is a private non-routable network, you can define IP addresses for nodes from any subnet and communicate with director over the Public API endpoint. For more information about the requirements for this scenario, see Section 9.6, "Using a separate network for pre-provisioned nodes".

- All other network types in this example also use the Control Plane network for OpenStack services. However, you can create additional networks for other network traffic types.

- If any nodes use Pacemaker resources, the service user **hacluster** and the service group **haclient** must have a UID/GID of **189**. This is due to CVE-2018-16877. If you installed Pacemaker together with the operating system, the installation creates these IDs automatically. If the ID values are set incorrectly, follow the steps in the article OpenStack minor update / fast-forward upgrade can fail on the controller nodes at pacemaker step with "Could not evaluate: backup_cib" to change the ID values.

- To prevent some services from binding to an incorrect IP address and causing deployment failures, make sure that the **/etc/hosts** file does not include the **node-name=127.0.0.1** mapping.

9.2. CREATING A USER ON PRE-PROVISIONED NODES

When you configure an overcloud with pre-provisioned nodes, director requires SSH access to the overcloud nodes as the **stack** user. To create the **stack** user, complete the following steps.

Procedure

1. On each overcloud node, create the **stack** user and set a password. For example, run the following commands on the Controller node:

```
[root@controller-0 ~]# useradd stack
[root@controller-0 ~]# passwd stack  # specify a password
```

2. Disable password requirements for this user when using **sudo**:

```
[root@controller-0 ~]# echo "stack ALL=(root) NOPASSWD:ALL" | tee -a
/etc/sudoers.d/stack
[root@controller-0 ~]# chmod 0440 /etc/sudoers.d/stack
```

3. After you create and configure the **stack** user on all pre-provisioned nodes, copy the **stack** user's public SSH key from the director node to each overcloud node. For example, to copy the director's public SSH key to the Controller node, run the following command:

```
[stack@director ~]$ ssh-copy-id stack@192.168.24.2
```

9.3. REGISTERING THE OPERATING SYSTEM FOR PRE-PROVISIONED NODES

Each node requires access to a Red Hat subscription. Complete the following steps on each node to register your nodes with the Red Hat Content Delivery Network.

Procedure

1. Run the registration command and enter your Customer Portal user name and password when prompted:

```
[root@controller-0 ~]# sudo subscription-manager register
```

2. Find the entitlement pool for the Red Hat OpenStack Platform 16:

```
[root@controller-0 ~]# sudo subscription-manager list --available --all --matches="Red Hat OpenStack"
```

3. Use the pool ID located in the previous step to attach the Red Hat OpenStack Platform 16 entitlements:

```
[root@controller-0 ~]# sudo subscription-manager attach --pool=pool_id
```

4. Disable all default repositories:

```
[root@controller-0 ~]# sudo subscription-manager repos --disable=*
```

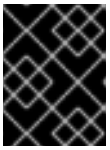
5. Enable the required Red Hat Enterprise Linux repositories.

   a. For x86_64 systems, run:

```
[root@controller-0 ~]# sudo subscription-manager repos --enable=rhel-8-for-x86_64-baseos-eus-rpms --enable=rhel-8-for-x86_64-appstream-eus-rpms --enable=rhel-8-for-x86_64-highavailability-eus-rpms --enable=ansible-2.9-for-rhel-8-x86_64-rpms --enable=openstack-16.1-for-rhel-8-x86_64-rpms --enable=rhceph-4-osd-for-rhel-8-x86_64-rpms --enable=rhceph-4-mon-for-rhel-8-x86_64-rpms --enable=rhceph-4-tools-for-rhel-8-x86_64-rpms --enable=advanced-virt-for-rhel-8-x86_64-rpms --enable=fast-datapath-for-rhel-8-x86_64-rpms
```

   b. For POWER systems, run:

```
[root@controller-0 ~]# sudo subscription-manager repos --enable=rhel-8-for-ppc64le-baseos-rpms --enable=rhel-8-for-ppc64le-appstream-rpms --enable=rhel-8-for-ppc64le-highavailability-rpms --enable=ansible-2.8-for-rhel-8-ppc64le-rpms --enable=openstack-16-for-rhel-8-ppc64le-rpms --enable=advanced-virt-for-rhel-8-ppc64le-rpms
```



IMPORTANT

Enable only the repositories listed. Additional repositories can cause package and software conflicts. Do not enable any additional repositories.

6. Update your system to ensure you have the latest base system packages:

```
[root@controller-0 ~]# sudo dnf update -y
[root@controller-0 ~]# sudo reboot
```

The node is now ready to use for your overcloud.

9.4. CONFIGURING SSL/TLS ACCESS TO DIRECTOR

If the director uses SSL/TLS, the pre-provisioned nodes require the certificate authority file used to sign the director's SSL/TLS certificates. If you use your own certificate authority, perform the following actions on each overcloud node.

Procedure

1. Copy the certificate authority file to the **/etc/pki/ca-trust/source/anchors/** directory on each pre-provisioned node.
2. Run the following command on each overcloud node:

```
[root@controller-0 ~]#  sudo update-ca-trust extract
```

These steps ensure that the overcloud nodes can access the director's Public API over SSL/TLS.

9.5. CONFIGURING NETWORKING FOR THE CONTROL PLANE

The pre-provisioned overcloud nodes obtain metadata from director using standard HTTP requests. This means all overcloud nodes require L3 access to either:

- The director Control Plane network, which is the subnet that you define with the **network_cidr** parameter in your **undercloud.conf** file. The overcloud nodes require either direct access to this subnet or routable access to the subnet.
- The director Public API endpoint, that you specify with the **undercloud_public_host** parameter in your **undercloud.conf** file. This option is available if you do not have an L3 route to the Control Plane or if you want to use SSL/TLS communication. For more information about configuring your overcloud nodes to use the Public API endpoint, see Section 9.6, "Using a separate network for pre-provisioned nodes".

Director uses the Control Plane network to manage and configure a standard overcloud. For an overcloud with pre-provisioned nodes, your network configuration might require some modification to accommodate communication between the director and the pre-provisioned nodes.

Using network isolation

You can use network isolation to group services to use specific networks, including the Control Plane. There are multiple network isolation strategies in the the Advanced Overcloud Customization guide. You can also define specific IP addresses for nodes on the Control Plane. For more information about isolating networks and creating predictable node placement strategies, see the following sections in the *Advanced Overcloud Customizations* guide:

- "Basic network isolation"
- "Controlling Node Placement"

NOTE

If you use network isolation, ensure that your NIC templates do not include the NIC used for undercloud access. These templates can reconfigure the NIC, which introduces connectivity and configuration problems during deployment.

Assigning IP addresses

If you do not use network isolation, you can use a single Control Plane network to manage all services. This requires manual configuration of the Control Plane NIC on each node to use an IP address within the Control Plane network range. If you are using the director Provisioning network as the Control Plane, ensure that the overcloud IP addresses that you choose are outside of the DHCP ranges for both provisioning (**dhcp_start** and **dhcp_end**) and introspection (**inspection_iprange**).

During standard overcloud creation, director creates OpenStack Networking (neutron) ports and automatically assigns IP addresses to the overcloud nodes on the Provisioning / Control Plane network. However, this can cause director to assign different IP addresses to the ones that you configure manually for each node. In this situation, use a predictable IP address strategy to force director to use the pre-provisioned IP assignments on the Control Plane.

For example, you can use an environment file **ctlplane-assignments.yaml** with the following IP assignments to implement a predictable IP strategy:

```
resource_registry:
  OS::TripleO::DeployedServer::ControlPlanePort: /usr/share/openstack-tripleo-heat-
templates/deployed-server/deployed-neutron-port.yaml

parameter_defaults:
  DeployedServerPortMap:
    controller-0-ctlplane:
      fixed_ips:
        - ip_address: 192.168.24.2
      subnets:
        - cidr: 192.168.24.0/24
      network:
        tags:
          192.168.24.0/24
    compute-0-ctlplane:
      fixed_ips:
        - ip_address: 192.168.24.3
      subnets:
        - cidr: 192.168.24.0/24
      network:
        tags:
          - 192.168.24.0/24
```

In this example, the **OS::TripleO::DeployedServer::ControlPlanePort** resource passes a set of parameters to director and defines the IP assignments of your pre-provisioned nodes. Use the **DeployedServerPortMap** parameter to define the IP addresses and subnet CIDRs that correspond to each overcloud node. The mapping defines the following attributes:

1. The name of the assignment, which follows the format **<node_hostname>-<network>** where the **<node_hostname>** value matches the short host name for the node, and **<network>** matches the lowercase name of the network. For example: **controller-0-ctlplane** for **controller-0.example.com** and **compute-0-ctlplane** for **compute-0.example.com**.

2. The IP assignments, which use the following parameter patterns:

    - **fixed_ips/ip_address** - Defines the fixed IP addresses for the control plane. Use multiple **ip_address** parameters in a list to define multiple IP addresses.

    - **subnets/cidr** - Defines the CIDR value for the subnet.

A later section in this chapter uses the resulting environment file (**ctlplane-assignments.yaml**) as part of the **openstack overcloud deploy** command.

9.6. USING A SEPARATE NETWORK FOR PRE-PROVISIONED NODES

By default, director uses the Provisioning network as the overcloud Control Plane. However, if this network is isolated and non-routable, nodes cannot communicate with the director Internal API during configuration. In this situation, you might need to define a separate network for the nodes and configure them to communicate with the director over the Public API.

There are several requirements for this scenario:

- The overcloud nodes must accommodate the basic network configuration from Section 9.5, "Configuring networking for the control plane".

- You must enable SSL/TLS on the director for Public API endpoint usage. For more information, see Section 4.2, "Director configuration parameters" and Chapter 19, *Configuring custom SSL/TLS certificates*.

- You must define an accessible fully qualified domain name (FQDN) for director. This FQDN must resolve to a routable IP address for the director. Use the **undercloud_public_host** parameter in the **undercloud.conf** file to set this FQDN.

The examples in this section use IP address assignments that differ from the main scenario:

Table 9.2. Provisioning network IP assignments

Node Name	IP address or FQDN
Director (Internal API)	192.168.24.1 (Provisioning Network and Control Plane)
Director (Public API)	10.1.1.1 / director.example.com
Overcloud Virtual IP	192.168.100.1
Controller 0	192.168.100.2
Compute 0	192.168.100.3

The following sections provide additional configuration for situations that require a separate network for overcloud nodes.

IP address assignments

The method for IP assignments is similar to Section 9.5, "Configuring networking for the control plane". However, since the Control Plane is not routable from the deployed servers, you must use the

DeployedServerPortMap parameter to assign IP addresses from your chosen overcloud node subnet, including the virtual IP address to access the Control Plane. The following example is a modified version of the **ctlplane-assignments.yaml** environment file from Section 9.5, "Configuring networking for the control plane" that accommodates this network architecture:

```
resource_registry:
  OS::TripleO::DeployedServer::ControlPlanePort: /usr/share/openstack-tripleo-heat-
templates/deployed-server/deployed-neutron-port.yaml
  OS::TripleO::Network::Ports::ControlPlaneVipPort: /usr/share/openstack-tripleo-heat-
templates/deployed-server/deployed-neutron-port.yaml
  OS::TripleO::Network::Ports::RedisVipPort: /usr/share/openstack-tripleo-heat-
templates/network/ports/noop.yaml (1)

parameter_defaults:
  NeutronPublicInterface: eth1
  EC2MetadataIp: 192.168.100.1 (2)
  ControlPlaneDefaultRoute: 192.168.100.1
  DeployedServerPortMap:
    control_virtual_ip:
      fixed_ips:
        - ip_address: 192.168.100.1
      subnets:
        - cidr: 24
    controller-0-ctlplane:
      fixed_ips:
        - ip_address: 192.168.100.2
      subnets:
        - cidr: 24
    compute-0-ctlplane:
      fixed_ips:
        - ip_address: 192.168.100.3
      subnets:
        - cidr: 24
```

1. The **RedisVipPort** resource is mapped to **network/ports/noop.yaml**. This mapping is necessary because the default Redis VIP address comes from the Control Plane. In this situation, use a **noop** to disable this Control Plane mapping.

2. The **EC2MetadataIp** and **ControlPlaneDefaultRoute** parameters are set to the value of the Control Plane virtual IP address. The default NIC configuration templates require these parameters and you must set them to use a pingable IP address to pass the validations performed during deployment. Alternatively, customize the NIC configuration so that they do not require these parameters.

9.7. MAPPING PRE-PROVISIONED NODE HOSTNAMES

When you configure pre-provisioned nodes, you must map heat-based hostnames to their actual hostnames so that **ansible-playbook** can reach a resolvable host. Use the **HostnameMap** to map these values.

Procedure

1. Create an environment file, for example **hostname-map.yaml**, and include the **HostnameMap** parameter and the hostname mappings. Use the following syntax:

```
parameter_defaults:
  HostnameMap:
    [HEAT HOSTNAME]: [ACTUAL HOSTNAME]
    [HEAT HOSTNAME]: [ACTUAL HOSTNAME]
```

The **[HEAT HOSTNAME]** usually conforms to the following convention: **[STACK NAME]-[ROLE]-[INDEX]**:

```
parameter_defaults:
  HostnameMap:
    overcloud-controller-0: controller-00-rack01
    overcloud-controller-1: controller-01-rack02
    overcloud-controller-2: controller-02-rack03
    overcloud-novacompute-0: compute-00-rack01
    overcloud-novacompute-1: compute-01-rack01
    overcloud-novacompute-2: compute-02-rack01
```

2. Save the **hostname-map.yaml** file.

9.8. CONFIGURING CEPH STORAGE FOR PRE-PROVISIONED NODES

Complete the following steps on the undercloud host to configure **ceph-ansible** for nodes that are already deployed.

Procedure

1. On the undercloud host, create an environment variable, **OVERCLOUD_HOSTS**, and set the variable to a space-separated list of IP addresses of the overcloud hosts that you want to use as Ceph clients:

```
export OVERCLOUD_HOSTS="192.168.1.8 192.168.1.42"
```

2. The default overcloud plan name is **overcloud**. If you use a different name, create an environment variable **OVERCLOUD_PLAN** to store your custom name:

```
export OVERCLOUD_PLAN="<custom-stack-name>"
```

Replace **<custom-stack-name>** with the name of your stack.

3. Run the **enable-ssh-admin.sh** script to configure a user on the overcloud nodes that Ansible can use to configure Ceph clients:

```
bash /usr/share/openstack-tripleo-heat-templates/deployed-server/scripts/enable-ssh-admin.sh
```

When you run the **openstack overcloud deploy** command, Ansible configures the hosts that you define in the **OVERCLOUD_HOSTS** variable as Ceph clients.

9.9. CREATING THE OVERCLOUD WITH PRE-PROVISIONED NODES

The overcloud deployment uses the standard CLI methods from Section 7.13, “Deployment command”. For pre-provisioned nodes, the deployment command requires some additional options and environment files from the core heat template collection:

- **--disable-validations** - Use this option to disable basic CLI validations for services not used with pre-provisioned infrastructure. If you do not disable these validations, the deployment fails.

- **environments/deployed-server-environment.yaml** - Include this environment file to create and configure the pre-provisioned infrastructure. This environment file substitutes the **OS::Nova::Server** resources with **OS::Heat::DeployedServer** resources.

The following command is an example overcloud deployment command with the environment files specific to the pre-provisioned architecture:

```
$ source ~/stackrc
(undercloud) $ openstack overcloud deploy \
  [other arguments] \
  --disable-validations \
  -e /usr/share/openstack-tripleo-heat-templates/environments/deployed-server-environment.yaml \
  -e /home/stack/templates/hostname-map.yaml \
  --overcloud-ssh-user stack \
  --overcloud-ssh-key ~/.ssh/id_rsa \
  [OTHER OPTIONS]
```

The **--overcloud-ssh-user** and **--overcloud-ssh-key** options are used to SSH into each overcloud node during the configuration stage, create an initial **tripleo-admin** user, and inject an SSH key into **/home/tripleo-admin/.ssh/authorized_keys**. To inject the SSH key, specify the credentials for the initial SSH connection with **--overcloud-ssh-user** and **--overcloud-ssh-key** (defaults to **~/.ssh/id_rsa**). To limit exposure to the private key that you specify with the **--overcloud-ssh-key** option, director never passes this key to any API service, such as heat or the Workflow service (mistral), and only the director **openstack overcloud deploy** command uses this key to enable access for the **tripleo-admin** user.

9.10. OVERCLOUD DEPLOYMENT OUTPUT

When the overcloud creation completes, director provides a recap of the Ansible plays that were executed to configure the overcloud:

```
PLAY RECAP *********************************************************************
overcloud-compute-0     : ok=160  changed=67   unreachable=0    failed=0
overcloud-controller-0  : ok=210  changed=93   unreachable=0    failed=0
undercloud              : ok=10   changed=7    unreachable=0    failed=0

Tuesday 15 October 2018  18:30:57 +1000 (0:00:00.107) 1:06:37.514 ******
===============================================================================
```

Director also provides details to access your overcloud.

```
Ansible passed.
Overcloud configuration completed.
Overcloud Endpoint: http://192.168.24.113:5000
Overcloud Horizon Dashboard URL: http://192.168.24.113:80/dashboard
Overcloud rc file: /home/stack/overcloudrc
Overcloud Deployed
```

9.11. ACCESSING THE OVERCLOUD

The director generates a script to configure and help authenticate interactions with your overcloud from the undercloud. The director saves this file, **overcloudrc**, in the home directory of the **stack** user. Run the following command to use this file:

```
(undercloud) $ source ~/overcloudrc
```

This command loads the environment variables that are necessary to interact with your overcloud from the undercloud CLI. The command prompt changes to indicate this:

```
(overcloud) $
```

To return to interacting with the undercloud, run the following command:

```
(overcloud) $ source ~/stackrc
(undercloud) $
```

Each node in the overcloud also contains a **heat-admin** user. The **stack** user has SSH access to this user on each node. To access a node over SSH, find the IP address of the node that you want to access:

```
(undercloud) $ openstack server list
```

Then connect to the node using the **heat-admin** user and the IP address of the node:

```
(undercloud) $ ssh heat-admin@192.168.24.23
```

9.12. SCALING PRE-PROVISIONED NODES

The process for scaling pre-provisioned nodes is similar to the standard scaling procedures in Chapter 16, *Scaling overcloud nodes*. However, the process to add new pre-provisioned nodes differs because pre-provisioned nodes do not use the standard registration and management process from OpenStack Bare Metal (ironic) and OpenStack Compute (nova).

Scaling up pre-provisioned nodes

When scaling up the overcloud with pre-provisioned nodes, you must configure the orchestration agent on each node to correspond to the director node count.

Perform the following actions to scale up overcloud nodes:

1. Prepare the new pre-provisioned nodes according to Section 9.1, "Pre-provisioned node requirements".
2. Scale up the nodes. For more information, see Chapter 16, *Scaling overcloud nodes*.
3. After you execute the deployment command, wait until the director creates the new node resources and launches the configuration.

Scaling down pre-provisioned nodes

When scaling down the overcloud with pre-provisioned nodes, follow the scale down instructions in Chapter 16, *Scaling overcloud nodes*.

In most scaling operations, you must obtain the UUID value of the node that you want to remove and pass this value to the **openstack overcloud node delete** command. To obtain this UUID, list the resources for the specific role:

```
$ openstack stack resource list overcloud -c physical_resource_id -c stack_name -n5 --filter
type=OS::TripleO::<RoleName>Server
```

Replace **<RoleName>** with the name of the role that you want to scale down. For example, for the **ComputeDeployedServer** role, run the following command:

```
$ openstack stack resource list overcloud -c physical_resource_id -c stack_name -n5 --filter
type=OS::TripleO::ComputeDeployedServerServer
```

Use the **stack_name** column in the command output to identify the UUID associated with each node. The **stack_name** includes the integer value of the index of the node in the heat resource group:

```
+--------------------------------------+--------------------------------+
| physical_resource_id                 | stack_name                     |
+--------------------------------------+--------------------------------+
| 294d4e4d-66a6-4e4e-9a8b-             | overcloud-ComputeDeployedServer- |
| 03ec80beda41                         | no7yfgnh3z7e-1-ytfqdeclwvcg    |
| d8de016d-                            | overcloud-ComputeDeployedServer- |
| 8ff9-4f29-bc63-21884619abe5          | no7yfgnh3z7e-0-p4vb3meacxwn    |
| 8c59f7b1-2675-42a9-ae2c-             | overcloud-ComputeDeployedServer- |
| 2de4a066f2a9                         | no7yfgnh3z7e-2-mmmaayxqnf3o    |
+--------------------------------------+--------------------------------+
```

The indices 0, 1, or 2 in the **stack_name** column correspond to the node order in the heat resource group. Pass the corresponding UUID value from the **physical_resource_id** column to **openstack overcloud node delete** command.

After you remove overcloud nodes from the stack, power off these nodes. In a standard deployment, the bare metal services on the director control this function. However, with pre-provisioned nodes, you must either manually shut down these nodes or use the power management control for each physical system. If you do not power off the nodes after removing them from the stack, they might remain operational and reconnect as part of the overcloud environment.

After you power off the removed nodes, reprovision them to a base operating system configuration so that they do not unintentionally join the overcloud in the future

NOTE

Do not attempt to reuse nodes previously removed from the overcloud without first reprovisioning them with a fresh base operating system. The scale down process only removes the node from the overcloud stack and does not uninstall any packages.

9.13. REMOVING A PRE-PROVISIONED OVERCLOUD

To remove an entire overcloud that uses pre-provisioned nodes, see Section 12.5, “Removing the overcloud” for the standard overcloud remove procedure. After you remove the overcloud, power off all nodes and reprovision them to a base operating system configuration.

NOTE

Do not attempt to reuse nodes previously removed from the overcloud without first reprovisioning them with a fresh base operating system. The removal process only deletes the overcloud stack and does not uninstall any packages.

9.14. NEXT STEPS

This concludes the creation of the overcloud using pre-provisioned nodes. For post-creation functions, see Chapter 11, *Performing overcloud post-installation tasks*.

CHAPTER 10. DEPLOYING MULTIPLE OVERCLOUDS

IMPORTANT

This feature is available in this release as a *Technology Preview*, and therefore is not fully supported by Red Hat. It should only be used for testing, and should not be deployed in a production environment. For more information about Technology Preview features, see Scope of Coverage Details.

You can use a single undercloud node to deploy and manage multiple overclouds. Each overcloud is a unique heat stack that does not share stack resources. This can be useful for environments where a 1:1 ratio of underclouds to overclouds creates an unmanageable amount of overhead. For example, Edge, multi-site, and multi-product environments.

The overcloud environments in the multi-overcloud scenario are completely separate, and you can use the **source** command to switch between the environments. If you use Ironic for bare metal provisioning, all overclouds must be on the same provisioning network. If it is not possible to use the same provisioning network, you can use the deployed servers method to deploy multiple overclouds with routed networks. In this scenario, you must ensure that the value in the **HostnameMap** parameter matches the stack name for each overcloud.

Use the following workflow to understand the basic process:

Deploying the undercloud

Deploy the undercloud as normal. For more information, see Part I, "Director installation and configuration".

Deploying the first overcloud

Deploy the first overcloud as normal. For more information, see Part II, "Basic overcloud deployment".

Deploying additional overclouds

Create a new set of environment files for the new overcloud. Run the deployment command, and specify the core heat templates together with the new configuration files and a new **stack** name.

10.1. DEPLOYING ADDITIONAL OVERCLOUDS

In this example, **overcloud-one** is the existing overcloud. Complete the following steps to deploy a new overcloud **overcloud-two**.

Prerequisites

Before you begin to deploy additional overclouds, ensure that your environment contains the following configurations:

- Successful undercloud and overcloud deployments.
- Nodes available for your additional overcloud.
- Custom networks for additional overclouds so that each overcloud has a unique network in the resulting stack.

Procedure

1. Create a new directory for the additional overcloud that you want to deploy:

```
$ mkdir ~/overcloud-two
```

2. In the new directory, create new environment files specific to the requirements of the additional overcloud, and copy any relevant environment files from the existing overcloud:

```
$ cp network-data.yaml ~/overcloud-two/network-data.yaml
$ cp network-environment.yaml ~/overcloud-two/network-environment.yaml
```

3. Modify the environment files according to the specification of the new overcloud. For example, the existing overcloud has the name **overcloud-one** and uses the VLANs that you define in the **network-data.yaml** environment file:

```
- name: InternalApi
  name_lower: internal_api_cloud_1
  service_net_map_replace: internal_api
  vip: true
  vlan: 20
  ip_subnet: '172.17.0.0/24'
  allocation_pools: [{'start': '172.17.0.4', 'end': '172.17.0.250'}]
  ipv6_subnet: 'fd00:fd00:fd00:2000::/64'
  ipv6_allocation_pools: [{'start': 'fd00:fd00:fd00:2000::10', 'end':
'fd00:fd00:fd00:2000:ffff:ffff:ffff:fffe'}]
  mtu: 1500
- name: Storage
  ...
```

The new overcloud has the name **overcloud-two** and uses different VLANs. Edit the **~/overcloud-two/network-data.yaml** environment file and include the new VLAN IDs for each subnet. You must also define a unique **name_lower** value, and set the **service_net_map_replace** attribute to the name of the network that you want to replace:

```
- name: InternalApi
  name_lower: internal_api_cloud_2
  service_net_map_replace: internal_api
  vip: true
  vlan: 21
  ip_subnet: '172.21.0.0/24'
  allocation_pools: [{'start': '172.21.0.4', 'end': '172.21.0.250'}]
  ipv6_subnet: 'fd00:fd00:fd00:2001::/64'
  ipv6_allocation_pools: [{'start': 'fd00:fd00:fd00:2001::10', 'end':
'fd00:fd00:fd00:2001:ffff:ffff:ffff:fffe'}]
  mtu: 1500
- name: Storage
  ...
```

4. Modify the following parameters in the **~/overcloud-two/network-environment.yaml** file:

   - Enter a unique value in the **{'provider:physical_network'}** attribute of the **ExternalNetValueSpecs** parameter so that **overcloud-two** has a distinct external network, and define the network type with the **'provider:network_type'** attribute.

   - Set the **ExternalInterfaceDefaultRoute** parameter to the IP address of the gateway for the external network so that the overcloud has external access.

- Set the **DnsServers** parameter to the IP address of your DNS server so that the overcloud can reach the DNS server.

```
parameter_defaults:
  ...
  ExternalNetValueSpecs: {'provider:physical_network': 'external_2',
'provider:network_type': 'flat'}
  ExternalInterfaceDefaultRoute: 10.0.10.1
  DnsServers:
    - 10.0.10.2
  ...
```

5. Run the **openstack overcloud deploy** command. Specify the core heat template collection with the **--templates** option, a new **stack** name with the **--stack** option, and any new environment files from the ~/**overcloud-two** directory:

```
$ openstack overcloud deploy --templates \
   --stack overcloud-two \
   ...
   -n ~/overcloud-two/network-data.yaml \
   -e ~/overcloud-two/network-environment.yaml \
   -e /usr/share/openstack-tripleo-heat-templates/environments/network-isolation.yaml \
   -e /usr/share/openstack-tripleo-heat-templates/environments/net-single-nic-with-
vlans.yaml \
   ...
```

Each overcloud has a unique credential file. In this example, the deployment process creates **overcloud-onerc** for **overcloud-one**, and **overcloud-tworc** for **overcloud-two**. To interact with either overcloud, you must source the appropriate credential file. For example, to source the credential for the first overcloud, run the following command:

```
$ source overcloud-onerc
```

10.2. MANAGING MULTIPLE OVERCLOUDS

Each overcloud that you deploy uses the same set of core heat templates /**usr**/**share**/**openstack-tripleo-heat-templates**. Red Hat recommends that you do not modify or duplicate these templates, because using a non-standard set of core templates can introduce issues with updates and upgrades.

Instead, for ease of management when you deploy or maintain multiple overclouds, create separate directories of environment files specific to each cloud. When you run the deploy command for each cloud, include the core heat templates together with the cloud-specific environment files that you create separately. For example, create the following directories for the undercloud and two overclouds:

~stack/undercloud

Contains the environment files specific to the undercloud.

~stack/overcloud-one

Contains the environment files specific to the first overcloud.

~stack/overcloud-two

Contains the environment files specific to the second overcloud.

When you deploy or redeploy **overcloud-one** or **overcloud-two**, include the core heat templates in the deploy command with the **--templates** option, and then specify any additional environment files from the cloud-specific environment file directories.

Alternatively, create a repository in a version control system and use branches for each deployment. For more information, see the Using Customized Core Heat Templates section of the *Advanced Overcloud Customization guide*.

Use the following command to view a list of overcloud plans that are available:

```
$ openstack overcloud plan list
```

Use the following command to view a list of overclouds that are currently deployed:

```
$ openstack stack list
```

PART III. POST DEPLOYMENT OPERATIONS

CHAPTER 11. PERFORMING OVERCLOUD POST-INSTALLATION TASKS

This chapter contains information about tasks to perform immediately after you create your overcloud. These tasks ensure your overcloud is ready to use.

11.1. CHECKING OVERCLOUD DEPLOYMENT STATUS

To check the deployment status of the overcloud, use the **openstack overcloud status** command. This command returns the result of all deployment steps.

Procedure

1. Source the **stackrc** file:

```
$ source ~/stackrc
```

2. Run the deployment status command:

```
$ openstack overcloud status
```

The output of this command displays the status of the overcloud:

```
+-----------+---------------------+---------------------+-------------------+
| Plan Name |       Created       |       Updated       | Deployment Status |
+-----------+---------------------+---------------------+-------------------+
| overcloud | 2018-05-03 21:24:50 | 2018-05-03 21:27:59 |   DEPLOY_SUCCESS  |
+-----------+---------------------+---------------------+-------------------+
```

If your overcloud uses a different name, use the **--plan** argument to select an overcloud with a different name:

```
$ openstack overcloud status --plan my-deployment
```

11.2. CREATING BASIC OVERCLOUD FLAVORS

Validation steps in this guide assume that your installation contains flavors. If you have not already created at least one flavor, complete the following steps to create a basic set of default flavors that have a range of storage and processing capabilities:

Procedure

1. Source the **overcloudrc** file:

```
$ source ~/overcloudrc
```

2. Run the **openstack flavor create** command to create a flavor. Use the following options to specify the hardware requirements for each flavor:

--disk

Defines the hard disk space for a virtual machine volume.

--ram

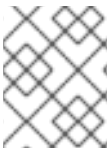
Defines the RAM required for a virtual machine.

--vcpus

Defines the quantity of virtual CPUs for a virtual machine.

3. The following example creates the default overcloud flavors:

```
$ openstack flavor create m1.tiny --ram 512 --disk 0 --vcpus 1
$ openstack flavor create m1.smaller --ram 1024 --disk 0 --vcpus 1
$ openstack flavor create m1.small --ram 2048 --disk 10 --vcpus 1
$ openstack flavor create m1.medium --ram 3072 --disk 10 --vcpus 2
$ openstack flavor create m1.large --ram 8192 --disk 10 --vcpus 4
$ openstack flavor create m1.xlarge --ram 8192 --disk 10 --vcpus 8
```



NOTE

Use **$ openstack flavor create --help** to learn more about the **openstack flavor create** command.

11.3. CREATING A DEFAULT TENANT NETWORK

The overcloud requires a default Tenant network so that virtual machines can communicate internally.

Procedure

1. Source the **overcloudrc** file:

```
$ source ~/overcloudrc
```

2. Create the default Tenant network:

```
(overcloud) $ openstack network create default
```

3. Create a subnet on the network:

```
(overcloud) $ openstack subnet create default --network default --gateway 172.20.1.1 --
subnet-range 172.20.0.0/16
```

4. Confirm the created network:

```
(overcloud) $ openstack network list
+----------------------+-------------+--------------------------------------+
| id                   | name        | subnets                              |
+----------------------+-------------+--------------------------------------+
| 95fadaa1-5dda-4777... | default     | 7e060813-35c5-462c-a56a-1c6f8f4f332f |
+----------------------+-------------+--------------------------------------+
```

These commands create a basic Networking service (neutron) network named **default**. The overcloud automatically assigns IP addresses from this network to virtual machines using an internal DHCP mechanism.

11.4. CREATING A DEFAULT FLOATING IP NETWORK

To access your virtual machines from outside of the overcloud, you must configure an external network that provides floating IP addresses to your virtual machines.

This procedure contains two examples. Use the example that best suits your environment:

- Native VLAN (flat network)
- Non-Native VLAN (VLAN network)

Both of these examples involve creating a network with the name **public**. The overcloud requires this specific name for the default floating IP pool. This name is also important for the validation tests in Section 11.7, “Validating the overcloud”.

By default, Openstack Networking (neutron) maps a physical network name called **datacentre** to the the **br-ex** bridge on your host nodes. You connect the **public** overcloud network to the physical **datacentre** and this provides a gateway through the **br-ex** bridge.

Prerequisites

- A dedicated interface or native VLAN for the floating IP network.

Procedure

1. Source the **overcloudrc** file:

```
$ source ~/overcloudrc
```

2. Create the **public** network:
   - Create a **flat** network for a native VLAN connection:

```
(overcloud) $ openstack network create public --external --provider-network-type flat --
provider-physical-network datacentre
```

   - Create a **vlan** network for non-native VLAN connections:

```
(overcloud) $ openstack network create public --external --provider-network-type vlan --
provider-physical-network datacentre --provider-segment 201
```

     Use the **--provider-segment** option to define the VLAN that you want to use. In this example, the VLAN is **201**.

3. Create a subnet with an allocation pool for floating IP addresses. In this example, the IP range is **10.1.1.51** to **10.1.1.250**:

```
(overcloud) $ openstack subnet create public --network public --dhcp --allocation-pool
start=10.1.1.51,end=10.1.1.250 --gateway 10.1.1.1 --subnet-range 10.1.1.0/24
```

   Ensure that this range does not conflict with other IP addresses in your external network.

11.5. CREATING A DEFAULT PROVIDER NETWORK

A provider network is another type of external network connection that routes traffic from private tenant networks to external infrastructure network. The provider network is similar to a floating IP network but the provider network uses a logical router to connect private networks to the provider network.

This procedure contains two examples. Use the example that best suits your environment:

- Native VLAN (flat network)
- Non-Native VLAN (VLAN network)

By default, Openstack Networking (neutron) maps a physical network name called **datacentre** to the the **br-ex** bridge on your host nodes. You connect the **public** overcloud network to the physical **datacentre** and this provides a gateway through the **br-ex** bridge.

Procedure

1. Source the **overcloudrc** file:

```
$ source ~/overcloudrc
```

2. Create the **provider** network:

   - Create a **flat** network for a native VLAN connection:

```
(overcloud) $ openstack network create provider --external --provider-network-type flat --provider-physical-network datacentre --share
```

   - Create a **vlan** network for non-native VLAN connections:

```
(overcloud) $ openstack network create provider --external --provider-network-type vlan --provider-physical-network datacentre --provider-segment 201 --share
```

     Use the **--provider-segment** option to define the VLAN that you want to use. In this example, the VLAN is **201**.

   These example commands create a shared network. It is also possible to specify a tenant instead of specifying **--share** so that only the tenant has access to the new network.

   + If you mark a provider network as external, only the operator may create ports on that network.

3. Add a subnet to the **provider** network to provide DHCP services:

```
(overcloud) $ openstack subnet create provider-subnet --network provider --dhcp --allocation-pool start=10.9.101.50,end=10.9.101.100 --gateway 10.9.101.254 --subnet-range 10.9.101.0/24
```

4. Create a router so that other networks can route traffic through the provider network:

```
(overcloud) $ openstack router create external
```

5. Set the external gateway for the router to the **provider** network:

```
(overcloud) $ openstack router set --external-gateway provider external
```

6. Attach other networks to this router. For example, run the following command to attach a subnet **subnet1** to the router:

```
(overcloud) $ openstack router add subnet external subnet1
```

This command adds **subnet1** to the routing table and allows traffic from virtual machines using **subnet1** to route to the provider network.

11.6. CREATING ADDITIONAL BRIDGE MAPPINGS

Floating IP networks can use any bridge, not just **br-ex**, provided that you complete the following prerequisite actions:

- Set the **NeutronExternalNetworkBridge** parameter to **""** in your network environment file.
- Map the additional bridge during deployment. For example, to map a new bridge called **br-floating** to the **floating** physical network, include the **NeutronBridgeMappings** parameter in an environment file:

```
parameter_defaults:
  NeutronBridgeMappings: "datacentre:br-ex,floating:br-floating"
```

With this method, you can create separate external networks after creating the overcloud. For example, to create a floating IP network that maps to the **floating** physical network, run the following commands:

```
$ source ~/overcloudrc
(overcloud) $ openstack network create public --external --provider-physical-network floating --
provider-network-type vlan --provider-segment 105
(overcloud) $ openstack subnet create public --network public --dhcp --allocation-pool
start=10.1.2.51,end=10.1.2.250 --gateway 10.1.2.1 --subnet-range 10.1.2.0/24
```

11.7. VALIDATING THE OVERCLOUD

The overcloud uses the OpenStack Integration Test Suite (tempest) tool set to conduct a series of integration tests. This section contains information about preparations for running the integration tests. For full instructions about how to use the OpenStack Integration Test Suite, see the OpenStack Integration Test Suite Guide.

The Integration Test Suite requires a few post-installation steps to ensure successful tests.

Procedure

1. If you run this test from the undercloud, ensure that the undercloud host has access to the Internal API network on the overcloud. For example, add a temporary VLAN on the undercloud host to access the Internal API network (ID: 201) using the 172.16.0.201/24 address:

```
$ source ~/stackrc
(undercloud) $ sudo ovs-vsctl add-port br-ctlplane vlan201 tag=201 -- set interface vlan201
type=internal
(undercloud) $ sudo ip l set dev vlan201 up; sudo ip addr add 172.16.0.201/24 dev vlan201
```

2. Before you run the OpenStack Integration Test Suite, ensure that the **heat_stack_owner** role exists in your overcloud:

```
$ source ~/overcloudrc
(overcloud) $ openstack role list
+----------------------------------+------------------+
| ID                               | Name             |
+----------------------------------+------------------+
| 6226a517204846d1a26d15aae1af208f | swiftoperator    |
| 7c7eb03955e545dd86bbfeb73692738b | heat_stack_owner |
+----------------------------------+------------------+
```

3. If the role does not exist, create it:

```
(overcloud) $ openstack role create heat_stack_owner
```

4. Run the integration tests as described in the OpenStack Integration Test Suite Guide .

5. After completing the validation, remove any temporary connections to the overcloud Internal API. In this example, use the following commands to remove the previously created VLAN on the undercloud:

```
$ source ~/stackrc
(undercloud) $ sudo ovs-vsctl del-port vlan201
```

11.8. PROTECTING THE OVERCLOUD FROM REMOVAL

Heat contains a set of default policies in code that you can override by creating the **/var/lib/config-data/puppet-generated/heat/etc/heat/policy.json** file and adding customized rules. Add the following policy to deny all users the permissions necessary to delete the overcloud.

```
{"stacks:delete": "rule:deny_everybody"}
```

This prevents removal of the overcloud with the **heat** client. To allow removal of the overcloud, delete the custom policy and save **/var/lib/config-data/puppet-generated/heat/etc/heat/policy.json**.

CHAPTER 12. PERFORMING BASIC OVERCLOUD ADMINISTRATION TASKS

This chapter contains information about basic tasks you might need to perform during the lifecycle of your overcloud.

12.1. MANAGING CONTAINERIZED SERVICES

Red Hat OpenStack Platform (RHOSP) runs services in containers on the undercloud and overcloud nodes. In certain situations, you might need to control the individual services on a host. This section contains information about some common commands you can run on a node to manage containerized services.

Listing containers and images

To list running containers, run the following command:

```
$ sudo podman ps
```

To include stopped or failed containers in the command output, add the **--all** option to the command:

```
$ sudo podman ps --all
```

To list container images, run the following command:

```
$ sudo podman images
```

Inspecting container properties

To view the properties of a container or container images, use the **podman inspect** command. For example, to inspect the **keystone** container, run the following command:

```
$ sudo podman inspect keystone
```

Managing containers with Systemd services

Previous versions of OpenStack Platform managed containers with Docker and its daemon. In OpenStack Platform 16, the Systemd services interface manages the lifecycle of the containers. Each container is a service and you run Systemd commands to perform specific operations for each container.

NOTE

It is not recommended to use the Podman CLI to stop, start, and restart containers because Systemd applies a restart policy. Use Systemd service commands instead.

To check a container status, run the **systemctl status** command:

```
$ sudo systemctl status tripleo_keystone
● tripleo_keystone.service - keystone container
  Loaded: loaded (/etc/systemd/system/tripleo_keystone.service; enabled; vendor preset: disabled)
  Active: active (running) since Fri 2019-02-15 23:53:18 UTC; 2 days ago
```

```
Main PID: 29012 (podman)
  CGroup: /system.slice/tripleo_keystone.service
          └─29012 /usr/bin/podman start -a keystone
```

To stop a container, run the **systemctl stop** command:

```
$ sudo systemctl stop tripleo_keystone
```

To start a container, run the **systemctl start** command:

```
$ sudo systemctl start tripleo_keystone
```

To restart a container, run the **systemctl restart** command:

```
$ sudo systemctl restart tripleo_keystone
```

Because no daemon monitors the containers status, Systemd automatically restarts most containers in these situations:

- Clean exit code or signal, such as running **podman stop** command.
- Unclean exit code, such as the podman container crashing after a start.
- Unclean signals.
- Timeout if the container takes more than 1m 30s to start.

For more information about Systemd services, see the **systemd.service** documentation.

NOTE

Any changes to the service configuration files within the container revert after restarting the container. This is because the container regenerates the service configuration based on files on the local file system of the node in **/var/lib/config-data/puppet-generated/**. For example, if you edit **/etc/keystone/keystone.conf** within the **keystone** container and restart the container, the container regenerates the configuration using **/var/lib/config-data/puppet-generated/keystone/etc/keystone/keystone.conf** on the local file system of the node, which overwrites any the changes that were made within the container before the restart.

Monitoring podman containers with Systemd timers

The Systemd timers interface manages container health checks. Each container has a timer that runs a service unit that executes health check scripts.

To list all OpenStack Platform containers timers, run the **systemctl list-timers** command and limit the output to lines containing **tripleo**:

```
$ sudo systemctl list-timers | grep tripleo
Mon 2019-02-18 20:18:30 UTC  1s left       Mon 2019-02-18 20:17:26 UTC  1min 2s ago
tripleo_nova_metadata_healthcheck.timer          tripleo_nova_metadata_healthcheck.service
Mon 2019-02-18 20:18:33 UTC  4s left       Mon 2019-02-18 20:17:03 UTC  1min 25s ago
tripleo_mistral_engine_healthcheck.timer       tripleo_mistral_engine_healthcheck.service
Mon 2019-02-18 20:18:34 UTC  5s left       Mon 2019-02-18 20:17:23 UTC  1min 5s ago
```

```
tripleo_keystone_healthcheck.timer                tripleo_keystone_healthcheck.service
Mon 2019-02-18 20:18:35 UTC  6s left      Mon 2019-02-18 20:17:13 UTC  1min 15s ago
tripleo_memcached_healthcheck.timer               tripleo_memcached_healthcheck.service
(...)
```

To check the status of a specific container timer, run the **systemctl status** command for the healthcheck service:

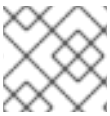
```
$ sudo systemctl status tripleo_keystone_healthcheck.service
● tripleo_keystone_healthcheck.service - keystone healthcheck
   Loaded: loaded (/etc/systemd/system/tripleo_keystone_healthcheck.service; disabled; vendor
preset: disabled)
   Active: inactive (dead) since Mon 2019-02-18 20:22:46 UTC; 22s ago
  Process: 115581 ExecStart=/usr/bin/podman exec keystone /openstack/healthcheck (code=exited,
status=0/SUCCESS)
 Main PID: 115581 (code=exited, status=0/SUCCESS)

Feb 18 20:22:46 undercloud.localdomain systemd[1]: Starting keystone healthcheck...
Feb 18 20:22:46 undercloud.localdomain podman[115581]: {"versions": {"values": [{"status": "stable",
"updated": "2019-01-22T00:00:00Z", "..."}]}]}}
Feb 18 20:22:46 undercloud.localdomain podman[115581]: 300 192.168.24.1:35357 0.012 seconds
Feb 18 20:22:46 undercloud.localdomain systemd[1]: Started keystone healthcheck.
```

To stop, start, restart, and show the status of a container timer, run the relevant **systemctl** command against the **.timer** Systemd resource. For example, to check the status of the **tripleo_keystone_healthcheck.timer** resource, run the following command:

```
$ sudo systemctl status tripleo_keystone_healthcheck.timer
● tripleo_keystone_healthcheck.timer - keystone container healthcheck
   Loaded: loaded (/etc/systemd/system/tripleo_keystone_healthcheck.timer; enabled; vendor preset:
disabled)
   Active: active (waiting) since Fri 2019-02-15 23:53:18 UTC; 2 days ago
```

If the healthcheck service is disabled but the timer for that service is present and enabled, it means that the check is currently timed out, but will be run according to timer. You can also start the check manually.



NOTE

The **podman ps** command does not show the container health status.

Checking container logs

OpenStack Platform 16 introduces a new logging directory **/var/log/containers/stdout** that contains the standard output (stdout) all of the containers, and standard errors (stderr) consolidated in one single file for each container.

Paunch and the **container-puppet.py** script configure podman containers to push their outputs to the **/var/log/containers/stdout** directory, which creates a collection of all logs, even for the deleted containers, such as **container-puppet-*** containers.

The host also applies log rotation to this directory, which prevents huge files and disk space issues.

In case a container is replaced, the new container outputs to the same log file, because **podman** uses the container name instead of container ID.

You can also check the logs for a containerized service with the **podman logs** command. For example, to view the logs for the **keystone** container, run the following command:

```
$ sudo podman logs keystone
```

Accessing containers

To enter the shell for a containerized service, use the **podman exec** command to launch **/bin/bash**. For example, to enter the shell for the **keystone** container, run the following command:

```
$ sudo podman exec -it keystone /bin/bash
```

To enter the shell for the **keystone** container as the root user, run the following command:

```
$ sudo podman exec --user 0 -it <NAME OR ID> /bin/bash
```

To exit the container, run the following command:

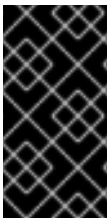
```
# exit
```

12.2. MODIFYING THE OVERCLOUD ENVIRONMENT

You can modify the overcloud to add additional features or alter existing operations. To modify the overcloud, make modifications to your custom environment files and heat templates, then rerun the **openstack overcloud deploy** command from your initial overcloud creation. For example, if you created an overcloud using Section 7.13, "Deployment command", rerun the following command:

```
$ source ~/stackrc
(undercloud) $ openstack overcloud deploy --templates \
  -e ~/templates/node-info.yaml \
  -e /usr/share/openstack-tripleo-heat-templates/environments/network-isolation.yaml \
  -e ~/templates/network-environment.yaml \
  -e ~/templates/storage-environment.yaml \
  --ntp-server pool.ntp.org
```

Director checks the **overcloud** stack in heat, and then updates each item in the stack with the environment files and heat templates. Director does not recreate the overcloud, but rather changes the existing overcloud.



IMPORTANT

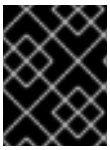
Removing parameters from custom environment files does not revert the parameter value to the default configuration. You must identify the default value from the core heat template collection in **/usr/share/openstack-tripleo-heat-templates** and set the value in your custom environment file manually.

If you want to include a new environment file, add it to the **openstack overcloud deploy** command with the `-e` option. For example:

```
$ source ~/stackrc
(undercloud) $ openstack overcloud deploy --templates \
  -e ~/templates/new-environment.yaml \
```

```
-e /usr/share/openstack-tripleo-heat-templates/environments/network-isolation.yaml \
-e ~/templates/network-environment.yaml \
-e ~/templates/storage-environment.yaml \
-e ~/templates/node-info.yaml \
--ntp-server pool.ntp.org
```

This command includes the new parameters and resources from the environment file into the stack.



IMPORTANT

It is not advisable to make manual modifications to the overcloud configuration because director might overwrite these modifications later.

12.3. IMPORTING VIRTUAL MACHINES INTO THE OVERCLOUD

You can migrate virtual machines from an existing OpenStack environment to your Red Hat OpenStack Platform (RHOSP) environment.

Procedure

1. On the existing OpenStack environment, create a new image by taking a snapshot of a running server and download the image:

```
$ openstack server image create instance_name --name image_name
$ openstack image save image_name --file exported_vm.qcow2
```

2. Copy the exported image to the undercloud node:

```
$ scp exported_vm.qcow2 stack@192.168.0.2:~/.
```

3. Log in to the undercloud as the **stack** user.

4. Source the **overcloudrc** file:

```
$ source ~/overcloudrc
```

5. Upload the exported image into the overcloud:

```
(overcloud) $ openstack image create imported_image --file exported_vm.qcow2 --disk-
format qcow2 --container-format bare
```

6. Launch a new instance:

```
(overcloud) $ openstack server create  imported_instance --key-name default --flavor
m1.demo --image imported_image --nic net-id=net_id
```

IMPORTANT

These commands copy each virtual machine disk from the existing OpenStack environment to the new Red Hat OpenStack Platform. QCOW snapshots lose their original layering system.

This process migrates all instances from a Compute node. You can now perform maintenance on the node without any instance downtime. To return the Compute node to an enabled state, run the following command:

```
$ source ~/overcloudrc
(overcloud) $ openstack compute service set [hostname] nova-compute --enable
```

12.4. RUNNING THE DYNAMIC INVENTORY SCRIPT

Director can run Ansible-based automation in your Red Hat OpenStack Platform (RHOSP) environment. Director uses the **tripleo-ansible-inventory** command to generate a dynamic inventory of nodes in your environment.

Procedure

1. To view a dynamic inventory of nodes, run the **tripleo-ansible-inventory** command after sourcing **stackrc**:

   ```
   $ source ~/stackrc
   (undercloud) $ tripleo-ansible-inventory --list
   ```

   Use the **--list** option to return details about all hosts. This command outputs the dynamic inventory in a JSON format:

   ```
   {"overcloud": {"children": ["controller", "compute"], "vars": {"ansible_ssh_user": "heat-admin"}},
   "controller": ["192.168.24.2"], "undercloud": {"hosts": ["localhost"], "vars":
   {"overcloud_horizon_url": "http://192.168.24.4:80/dashboard", "overcloud_admin_password":
   "abcdefghijklm12345678", "ansible_connection": "local"}}, "compute": ["192.168.24.3"]}
   ```

2. To execute Ansible playbooks on your environment, run the **ansible** command and include the full path of the dynamic inventory tool using the **-i** option. For example:

   ```
   (undercloud) $ ansible [HOSTS] -i /bin/tripleo-ansible-inventory [OTHER OPTIONS]
   ```

   - Replace **[HOSTS]** with the type of hosts that you want to use to use:
     - **controller** for all Controller nodes
     - **compute** for all Compute nodes
     - **overcloud** for all overcloud child nodes. For example, **controller** and **compute** nodes
     - **undercloud** for the undercloud
     - **"*"** for all nodes
   - Replace **[OTHER OPTIONS]** with additional Ansible options.
     - Use the **--ssh-extra-args='-o StrictHostKeyChecking=no'** option to bypass confirmation on host key checking.
     - Use the **-u [USER]** option to change the SSH user that executes the Ansible automation. The default SSH user for the overcloud is automatically defined using the **ansible_ssh_user** parameter in the dynamic inventory. The **-u** option overrides this

parameter.

- Use the **-m [MODULE]** option to use a specific Ansible module. The default is **command**, which executes Linux commands.
- Use the **-a [MODULE_ARGS]** option to define arguments for the chosen module.

IMPORTANT

Custom Ansible automation on the overcloud is not part of the standard overcloud stack. Subsequent execution of the **openstack overcloud deploy** command might override Ansible-based configuration for OpenStack Platform services on overcloud nodes.

12.5. REMOVING THE OVERCLOUD

To remove the overcloud, complete the following steps:

1. Delete an existing overcloud:

```
$ source ~/stackrc
(undercloud) $ openstack overcloud delete overcloud
```

2. Confirm that the overcloud is no longer present in the output of the **openstack stack list** command:

```
(undercloud) $ openstack stack list
```

   Deletion takes a few minutes.

3. When the deletion completes, follow the standard steps in the deployment scenarios to recreate your overcloud.

CHAPTER 13. CONFIGURING THE OVERCLOUD WITH ANSIBLE

Ansible is the main method to apply the overcloud configuration. This chapter provides information about how to interact with the overcloud Ansible configuration.

Although director generates the Ansible playbooks automatically, it is a good idea to familiarize yourself with Ansible syntax. For more information about using Ansible, see https://docs.ansible.com/.

NOTE

Ansible also uses the concept of roles, which are different to OpenStack Platform director roles. **Ansible roles** form reusable components of playbooks, whereas director roles contain mappings of OpenStack services to node types.

13.1. ANSIBLE-BASED OVERCLOUD CONFIGURATION (CONFIG-DOWNLOAD)

The **config-download** feature is the method that director uses to configure the overcloud. Director uses **config-download** in conjunction with OpenStack Orchestration (heat) and OpenStack Workflow Service (mistral) to generate the software configuration and apply the configuration to each overcloud node. Although heat creates all deployment data from **SoftwareDeployment** resources to perform the overcloud installation and configuration, heat does not apply any of the configuration. Heat only provides the configuration data through the heat API. When director creates the stack, a mistral workflow queries the heat API to obtain the configuration data, generate a set of Ansible playbooks, and applies the Ansible playbooks to the overcloud.

As a result, when you run the **openstack overcloud deploy** command, the following process occurs:

- Director creates a new deployment plan based on **openstack-tripleo-heat-templates** and includes any environment files and parameters to customize the plan.
- Director uses heat to interpret the deployment plan and create the overcloud stack and all descendant resources. This includes provisioning nodes with the OpenStack Bare Metal service (ironic).
- Heat also creates the software configuration from the deployment plan. Director compiles the Ansible playbooks from this software configuration.
- Director generates a temporary user (**tripleo-admin**) on the overcloud nodes specifically for Ansible SSH access.
- Director downloads the heat software configuration and generates a set of Ansible playbooks using heat outputs.
- Director applies the Ansible playbooks to the overcloud nodes using **ansible-playbook**.

13.2. CONFIG-DOWNLOAD WORKING DIRECTORY

Director generates a set of Ansible playbooks for the **config-download** process. These playbooks are stored in a working directory in the **/var/lib/mistral/**. This directory is named after the name of the overcloud, which is **overcloud** by default.

The working directory contains a set of sub-directories named after each overcloud role. These sub-directories contain all tasks relevant to the configuration of the nodes in the overcloud role. These sub-directories also contain additional sub-directories named after each specific node. These sub-

directories contain node-specific variables to apply to the overcloud role tasks. As a result, the overcloud roles within the working directory use the following structure:

```
— /var/lib/mistral/overcloud
  |
  ├── Controller
  |   ├── overcloud-controller-0
  |   ├── overcloud-controller-1
  |   └── overcloud-controller-2
  ├── Compute
  |   ├── overcloud-compute-0
  |   ├── overcloud-compute-1
  |   └── overcloud-compute-2
  ...
```

Each working directory is a local Git repository that records changes after each deployment operation. Use the local Git repositories to track configuration changes between each deployment.

13.3. ENABLING ACCESS TO CONFIG-DOWNLOAD WORKING DIRECTORIES

The **mistral** user in the OpenStack Workflow service (mistral) containers own all files in the **/var/lib/mistral/** working directories. You can grant the **stack** user on the undercloud access to all files in this directory. This helps with performing certain operations within the directory.

Procedure

1. Use the **setfacl** command to grant the **stack** user on the undercloud access to the files in the **/var/lib/mistral** directory:

   ```
   $ sudo setfacl -R -m u:stack:rwx /var/lib/mistral
   ```

   This command retains **mistral** user access to the directory.

13.4. CHECKING CONFIG-DOWNLOAD LOG

During the **config-download** process, Ansible creates a log file on the undercloud in the **config-download** working directory.

Procedure

1. View the log with the **less** command within the **config-download** working directory. The following example uses the **overcloud** working directory:

   ```
   $ less /var/lib/mistral/overcloud/ansible.log
   ```

13.5. SEPARATING THE PROVISIONING AND CONFIGURATION PROCESSES

The **openstack overcloud deploy** command runs the heat-based provisioning process and then the **config-download** configuration process. You can also run the command to execute each process individually.

Procedure

1. Source the **stackrc** file:

```
$ source ~/stackrc
```

2. Run the deployment command with the **--stack-only** option. Include any environment files required for your overcloud:

```
$ openstack overcloud deploy \
  --templates \
  -e environment-file1.yaml \
  -e environment-file2.yaml \
  ...
  --stack-only
```

3. Wait until the provisioning process completes.

4. Enable SSH access from the undercloud to the overcloud for the **tripleo-admin** user. The **config-download** process uses the **tripleo-admin** user to perform the Ansible-based configuration:

```
$ openstack overcloud admin authorize
```

5. Run the deployment command with the **--config-download-only** option. Include any environment files required for your overcloud:

```
$ openstack overcloud deploy \
  --templates \
  -e environment-file1.yaml \
  -e environment-file2.yaml \
  ...
  --config-download-only
```

6. Wait until the configuration process completes.

13.6. RUNNING CONFIG-DOWNLOAD MANUALLY

The working directory in **/var/lib/mistral/overcloud** contains the playbooks and scripts necessary to interact with **ansible-playbook** directly. This procedure shows how to interact with these files.

Procedure

1. Change to the directory of the Ansible playbook::

```
$ cd /var/lib/mistral/overcloud/
```

2. Run the **ansible-playbook-command.sh** command to reproduce the deployment:

```
$ ./ansible-playbook-command.sh
```

You can pass additional Ansible arguments to this script, which are then passed unchanged to the **ansible-playbook** command. This means that you can use other Ansible features, such as check mode (**--check**), limiting hosts (**--limit**), or overriding variables (**-e**). For example:

```
$ ./ansible-playbook-command.sh --limit Controller
```

3. The working directory contains a playbook called **deploy_steps_playbook.yaml**, which runs the overcloud configuration. To view this playbook, run the following command:

```
$ less deploy_steps_playbook.yaml
```

The playbook uses various task files contained in the working directory. Some task files are common to all OpenStack Platform roles and some are specific to certain OpenStack Platform roles and servers.

4. The working directory also contains sub-directories that correspond to each role that you define in your overcloud **roles_data** file. For example:

```
$ ls Controller/
```

Each OpenStack Platform role directory also contains sub-directories for individual servers of that role type. The directories use the composable role hostname format:

```
$ ls Controller/overcloud-controller-0
```

5. The Ansible tasks are tagged. To see the full list of tags, use the CLI argument **--list-tags** for **ansible-playbook**:

```
$ ansible-playbook -i tripleo-ansible-inventory.yaml --list-tags deploy_steps_playbook.yaml
```

Then apply tagged configuration using the **--tags**, **--skip-tags**, or **--start-at-task** with the **ansible-playbook-command.sh** script:

```
$ ./ansible-playbook-command.sh --tags overcloud
```

6. When **config-download** configures Ceph, Ansible executes **ceph-ansible** from within the **config-download external_deploy_steps_tasks** playbook. When you run **config-download** manually, the second Ansible execution does not inherit the **ssh_args** argument. To pass Ansible environment variables to this execution, use a heat environment file. For example:

```
parameter_defaults:
  CephAnsibleEnvironmentVariables:
    ANSIBLE_HOST_KEY_CHECKING: 'False'
    ANSIBLE_PRIVATE_KEY_FILE: '/home/stack/.ssh/id_rsa'
```

WARNING

When you use ansible-playbook CLI arguments such as **--tags**, **--skip-tags**, or **--start-at-task**, do not run or apply deployment configuration out of order. These CLI arguments are a convenient way to rerun previously failed tasks or to iterate over an initial deployment. However, to guarantee a consistent deployment, you must run all tasks from **deploy_steps_playbook.yaml** in order.

13.7. PERFORMING GIT OPERATIONS ON THE WORKING DIRECTORY

The **config-download** working directory is a local Git repository. Every time a deployment operation runs, director adds a Git commit to the working directory with the relevant changes. You can perform Git operations to view configuration for the deployment at different stages and compare the configuration with different deployments.

Be aware of the limitations of the working directory. For example, if you use Git to revert to a previous version of the **config-download** working directory, this action affects only the configuration in the working directory. It does not affect the following configurations:

- **The overcloud data schema:** Applying a previous version of the working directory software configuration does not undo data migration and schema changes.
- **The hardware layout of the overcloud:** Reverting to previous software configuration does not undo changes related to overcloud hardware, such as scaling up or down.
- **The heat stack:** Reverting to earlier revisions of the working directory has no effect on the configuration stored in the heat stack. The heat stack creates a new version of the software configuration that applies to the overcloud. To make permanent changes to the overcloud, modify the environment files applied to the overcloud stack before you rerun the **openstack overcloud deploy** command.

Complete the following steps to compare different commits of the **config-download** working directory.

Procedure

1. Change to the **config-download** working directory for your overcloud. In this example, the working directory is for the overcloud named **overcloud**:

```
$ cd /var/lib/mistral/overcloud
```

2. Run the **git log** command to list the commits in your working directory. You can also format the log output to show the date:

```
$ git log --format=format:"%h%x09%cd%x09"
a7e9063 Mon Oct 8 21:17:52 2018 +1000
dfb9d12 Fri Oct 5 20:23:44 2018 +1000
d0a910b Wed Oct 3 19:30:16 2018 +1000
...
```

   By default, the most recent commit appears first.

3. Run the **git diff** command against two commit hashes to see all changes between the deployments:

```
$ git diff a7e9063 dfb9d12
```

13.8. CREATING CONFIG-DOWNLOAD FILES MANUALLY

You can generate your own **config-download** files outside of the standard workflow. For example, you can generate the overcloud heat stack using the **--stack-only** option with the **openstack overcloud deploy** command so that you can apply the configuration separately. Complete the following steps to create your own **config-download** files manually.

Procedure

1. Generate the **config-download** files:

```
$ openstack overcloud config download \
  --name overcloud \
  --config-dir ~/config-download
```

   - **--name** is the name of the overcloud that you want to use for the Ansible file export.
   - **--config-dir** is the location where you want to save the **config-download** files.

2. Change to the directory that contains your **config-download** files:

```
$ cd ~/config-download
```

3. Generate a static inventory file:

```
$ tripleo-ansible-inventory \
  --ansible_ssh_user heat-admin \
  --static-yaml-inventory inventory.yaml
```

Use the **config-download** files and the static inventory file to perform a configuration. To execute the deployment playbook, run the **ansible-playbook** command:

```
$ ansible-playbook \
  -i inventory.yaml \
  --private-key ~/.ssh/id_rsa \
  --become \
  ~/config-download/deploy_steps_playbook.yaml
```

To generate an **overcloudrc** file manually from this configuration, run the following command:

```
$ openstack action execution run \
  --save-result \
  --run-sync \
  tripleo.deployment.overcloudrc \
  '{"container":"overcloud"}' \
  | jq -r '.["result"]["overcloudrc.v3"]' > overcloudrc.v3
```

13.9. CONFIG-DOWNLOAD TOP LEVEL FILES

The following file are important top level files within a **config-download** working directory.

Ansible configuration and execution

The following files are specific to configuring and executing Ansible within the **config-download** working directory.

ansible.cfg

Configuration file used when running **ansible-playbook**.

ansible.log

Log file from the last run of **ansible-playbook**.

ansible-errors.json

JSON structured file that contains any deployment errors.

ansible-playbook-command.sh

Executable script to rerun the **ansible-playbook** command from the last deployment operation.

ssh_private_key

Private SSH key that Ansible uses to access the overcloud nodes.

tripleo-ansible-inventory.yaml

Ansible inventory file that contains hosts and variables for all the overcloud nodes.

overcloud-config.tar.gz

Archive of the working directory.

Playbooks

The following files are playbooks within the **config-download** working directory.

deploy_steps_playbook.yaml

Main deployment steps. This playbook performs the main configuration operations for your overcloud.

pre_upgrade_rolling_steps_playbook.yaml

Pre upgrade steps for major upgrade

upgrade_steps_playbook.yaml

Major upgrade steps.

post_upgrade_steps_playbook.yaml

Post upgrade steps for major upgrade.

update_steps_playbook.yaml

Minor update steps.

fast_forward_upgrade_playbook.yaml

Fast forward upgrade tasks. Use this playbook only when you want to upgrade from one long-life version of Red Hat OpenStack Platform to the next.

13.10. CONFIG-DOWNLOAD TAGS

The playbooks use tagged tasks to control the tasks that they apply to the overcloud. Use tags with the **ansible-playbook** CLI arguments **--tags** or **--skip-tags** to control which tasks to execute. The following list contains information about the tags that are enabled by default:

facts

Fact gathering operations.

common_roles

Ansible roles common to all nodes.

overcloud

All plays for overcloud deployment.

pre_deploy_steps

Deployments that happen before the **deploy_steps** operations.

host_prep_steps

Host preparation steps.

deploy_steps

Deployment steps.

post_deploy_steps

Steps that happen after the **deploy_steps** operations.

external

All external deployment tasks.

external_deploy_steps

External deployment tasks that run on the undercloud only.

13.11. CONFIG-DOWNLOAD DEPLOYMENT STEPS

The **deploy_steps_playbook.yaml** playbook configures the overcloud. This playbook applies all software configuration that is necessary to deploy a full overcloud based on the overcloud deployment plan.

This section contains a summary of the different Ansible plays used within this playbook. The play names in this section are the same names that are used within the playbook and that are displayed in the **ansible-playbook** output. This section also contains information about the Ansible tags that are set on each play.

Gather facts from undercloud

Fact gathering for the undercloud node.
Tags: **facts**

Gather facts from overcloud

Fact gathering for the overcloud nodes.
Tags: **facts**

Load global variables

Loads all variables from **global_vars.yaml**.
Tags: **always**

Common roles for TripleO servers

Applies common Ansible roles to all overcloud nodes, including tripleo-bootstrap for installing bootstrap packages, and tripleo-ssh-known-hosts for configuring ssh known hosts.
Tags: **common_roles**

Overcloud deploy step tasks for step 0

Applies tasks from the deploy_steps_tasks template interface.
Tags: **overcloud**, **deploy_steps**

Server deployments

Applies server-specific heat deployments for configuration such as networking and hieradata. Includes NetworkDeployment, <Role>Deployment, <Role>AllNodesDeployment, etc.
Tags: **overcloud**, **pre_deploy_steps**

Host prep steps

Applies tasks from the host_prep_steps template interface.
Tags: **overcloud**, **host_prep_steps**

External deployment step [1,2,3,4,5]

Applies tasks from the external_deploy_steps_tasks template interface. Ansible runs these tasks only against the undercloud node.
Tags: **external**, **external_deploy_steps**

Overcloud deploy step tasks for [1,2,3,4,5]

Applies tasks from the deploy_steps_tasks template interface.
Tags: **overcloud**, **deploy_steps**

Overcloud common deploy step tasks [1,2,3,4,5]

Applies the common tasks performed at each step, including puppet host configuration, **container-puppet.py**, and paunch (container configuration).
Tags: **overcloud**, **deploy_steps**

Server Post Deployments

Applies server specific heat deployments for configuration performed after the 5-step deployment process.
Tags: **overcloud**, **post_deploy_steps**

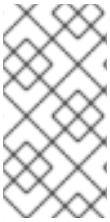
External deployment Post Deploy tasks

Applies tasks from the external_post_deploy_steps_tasks template interface. Ansible runs these tasks only against the undercloud node.
Tags: **external**, **external_deploy_steps**

13.12. NEXT STEPS

You can now continue your regular overcloud operations.

CHAPTER 14. MANAGING CONTAINERS WITH ANSIBLE



NOTE

This feature is available in this release as a *Technology Preview*, and therefore is not fully supported by Red Hat. It should only be used for testing, and should not be deployed in a production environment. For more information about Technology Preview features, see Scope of Coverage Details.

Red Hat OpenStack Platform 16.1 uses Paunch to manage containers. However, you can also use the Ansible role **tripleo-container-manage** to perform management operations on your containers. If you want to use the **tripleo-container-manage** role, you must first disable Paunch. With Paunch disabled, director uses the Ansible role automatically, and you can also write custom playbooks to perform specific container management operations:

- Collect the container configuration data that heat generates. The **tripleo-container-manage** role uses this data to orchestrate container deployment.
- Start containers.
- Stop containers.
- Update containers.
- Delete containers.
- Run a container with a specific configuration.

Although director performs container management automatically, you might want to customize a container configuration, or apply a hotfix to a container without redeploying the overcloud.

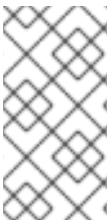
NOTE

This role supports only Podman container management.

Prerequisites

- A successful undercloud installation. For more information, see Section 4.7, “Installing director”.

14.1. ENABLING THE TRIPLEO-CONTAINER-MANAGE ANSIBLE ROLE ON THE UNDERCLOUD



NOTE

This feature is available in this release as a *Technology Preview*, and therefore is not fully supported by Red Hat. It should only be used for testing, and should not be deployed in a production environment. For more information about Technology Preview features, see Scope of Coverage Details.

Paunch is the default container management mechanism in Red Hat OpenStack Platform 16.1. However, you can also use the **tripleo-container-manage** Ansible role. If you want to use this role, you must disable Paunch.

Prerequisites

- A host machine with a base operating system and the **python3-tripleoclient** package installed. For more information, see Chapter 3, *Preparing for director installation*.

Procedure

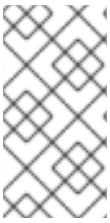
1. Log in to the undercloud host as the **stack** user.
2. Set the **undercloud_enable_paunch** parameter to **false** in the **undercloud.conf** file:

```
undercloud_enable_paunch: false
```

3. Run the **openstack undercloud install** command:

```
$ openstack undercloud install
```

14.2. ENABLING THE TRIPLEO-CONTAINER-MANAGE ANSIBLE ROLE ON THE OVERCLOUD



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Paunch is the default container management mechanism in Red Hat OpenStack Platform 16.1. However, you can also use the **tripleo-container-manage** Ansible role. If you want to use this role, you must disable Paunch.

Prerequisites

- A successful undercloud installation. For more information, see Section 4.7, “Installing director”.

Procedure

1. Log in to the undercloud host as the **stack** user.
2. Source the **stackrc** credentials file:

```
$ source ~/stackrc
```

3. Include the **/usr/share/openstack-tripleo-heat-templates/environments/disable-paunch.yaml** file in the overcloud deployment command, along with any other environment files that are relevant for your deployment:

```
(undercloud) [stack@director ~]$ openstack overcloud deploy --templates \
  -e /usr/share/openstack-tripleo-heat-templates/environments/disable-paunch.yaml
  -e <OTHER_ENVIRONMENT_FILES
  ...
```

14.3. PERFORMING OPERATIONS ON A SINGLE CONTAINER

NOTE

This feature is available in this release as a *Technology Preview*, and therefore is not fully supported by Red Hat. It should only be used for testing, and should not be deployed in a production environment. For more information about Technology Preview features, see Scope of Coverage Details.

You can use the **tripleo-container-manage** role to manage all containers, or a specific container. If you want to manage a specific container, you must identify the container deployment step and the name of the container configuration JSON file so that you can target the specific container with a custom Ansible playbook.

Prerequisites

- A successful undercloud installation. For more information, see Section 4.7, "Installing director".

Procedure

1. Log in to the undercloud as the **stack** user.
2. Source the **overcloudrc** credential file:

```
$ source ~/overcloudrc
```

3. Identify the container deployment step. You can find the container configuration for each step in the **/var/lib/tripleo-config/container-startup-config/step_{1,2,3,4,5,6}** directory.
4. Identify the JSON configuration file for the container. You can find the container configuration file in the relevant **step_*** directory. For example, the configuration file for the HAProxy container in step 1 is **/var/lib/tripleo-config/container-startup-config/step_1/haproxy.json**.
5. Write a suitable Ansible playbook. For example, to replace the HAProxy container image, use the following sample playbook:

```
- hosts: localhost
  become: true
  tasks:
    - name: Manage step_1 containers using tripleo-ansible
      block:
        - name: "Manage HAproxy container at step 1 with tripleo-ansible"
          include_role:
            name: tripleo-container-manage
          vars:
            tripleo_container_manage_systemd_order: true
            tripleo_container_manage_config_patterns: 'haproxy.json'
            tripleo_container_manage_config: "/var/lib/tripleo-config/container-startup-
config/step_1"
            tripleo_container_manage_config_id: "tripleo_step1"
            tripleo_container_manage_config_overrides:
              haproxy:
                image: registry.redhat.io/tripleomaster/<HAProxy-container>:hotfix
```

For more information about the variables that you can use with the **tripleo-container-manage** role, see Section 14.4, "tripleo-container-manage role variables".

6. Run the playbook:

```
(overcloud) [stack@director]$ ansible-playbook <custom_playbook>.yaml
```

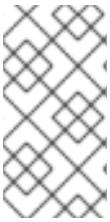
If you want to execute the playbook without applying any changes, include the **--check** option in the **ansible-playbook** command:

```
(overcloud) [stack@director]$ ansible-playbook <custom_playbook>.yaml --check
```

If you want to identify the changes that your playbook makes to your containers without applying the changes, include the **--check** and **--diff** options in the **ansible-playbook** command:

```
(overcloud) [stack@director]$ ansible-playbook <custom_playbook>.yaml --check --diff
```

14.4. TRIPLEO-CONTAINER-MANAGE ROLE VARIABLES



NOTE

This feature is available in this release as a *Technology Preview*, and therefore is not fully supported by Red Hat. It should only be used for testing, and should not be deployed in a production environment. For more information about Technology Preview features, see Scope of Coverage Details.

The **tripleo-container-manage** Ansible role contains the following variables:

Table 14.1. Role variables

Name	Default value	Description
tripleo_container_manage_check_puppet_config	false	Use this variable if you want Ansible to check Puppet container configurations. Ansible can identify updated container configuration using the configuration hash. If a container has a new configuration from Puppet, set this variable to **true** so that Ansible can detect the new configuration and add the container to the list of containers that Ansible must restart.
tripleo_container_manage_cli	podman	Use this variable to set the command line interface that you want to use to manage containers. The **tripleo-container-manage** role supports only Podman.

Name	Default value	Description
tripleo_container_manage_concurrency	1	Use this variable to set the number of containers that you want to manage concurrently.
tripleo_container_manage_config	/var/lib/tripleo-config/	Use this variable to set the path to the container configuration directory.
tripleo_container_manage_config_id	tripleo	Use this variable to set the ID of a specific configuration step. For example, set this value to **tripleo_step2** to manage containers for step two of the deployment.
tripleo_container_manage_config_patterns	*.json	Use this variable to set the bash regular expression that identifies configuration files in the container configuration directory.
tripleo_container_manage_debug	false	Use this variable to enable or disable debug mode. Run the **tripleo-container-manage** role in debug mode if you want to run a container with a specific one-time configuration, to output the container commands that manage the lifecycle of containers, or to run no-op container management operations for testing and verification purposes.
tripleo_container_manage_healthcheck_disable	false	Use this variable to enable or disable healthchecks.
tripleo_container_manage_log_path	/var/log/containers/stdouts	Use this variable to set the stdout log path for containers.
tripleo_container_manage_systemd_order	false	Use this variable to enable or disable systemd shutdown ordering with Ansible.
tripleo_container_manage_systemd_teardown	true	Use this variable to trigger the cleanup of obsolete containers.

Name	Default value	Description
tripleo_container_manage_config_overrides	{}	Use this variable to override any container configuration. This variable takes a dictionary of values where each key is the container name and the parameters that you want to override, for example, the container image or user. This variable does not write custom overrides to the JSON container configuration files and any new container deployments, updates, or upgrades revert to the content of the JSON configuration file.
tripleo_container_manage_valid_exit_code	[]	Use this variable to check if a container returns an exit code. This value must be a list, for example, **[0,3]**.

CHAPTER 15. USING THE VALIDATION FRAMEWORK

Red Hat OpenStack Platform includes a validation framework that you can use to verify the requirements and functionality of the undercloud and overcloud. The framework includes two types of validations:

- Manual Ansible-based validations, which you execute through the **openstack tripleo validator** command set.
- Automatic in-flight validations, which execute during the deployment process.

15.1. ANSIBLE-BASED VALIDATIONS

During the installation of Red Hat OpenStack Platform director, director also installs a set of playbooks from the **openstack-tripleo-validations** package. Each playbook contains tests for certain system requirements and a set of groups that define when to run the test:

no-op

Validations that run a *no-op* (no operation) task to verify to workflow functions correctly. These validations run on both the undercloud and overcloud.

prep

Validations that check the hardware configuration of the undercloud node. Run these validation before you run the **openstack undercloud install** command.

openshift-on-openstack

Validations that check that the environment meets the requirements to be able to deploy OpenShift on OpenStack.

pre-introspection

Validations to run before the nodes introspection using Ironic Inspector.

pre-deployment

Validations to run before the **openstack overcloud deploy** command.

post-deployment

Validations to run after the overcloud deployment has finished.

pre-upgrade

Validations to validate your OpenStack deployment before an upgrade.

post-upgrade

Validations to validate your OpenStack deployment after an upgrade.

15.2. LISTING VALIDATIONS

Run the **openstack tripleo validator list** command to list the different types of validations available.

Procedure

1. Source the **stackrc** file.

```
$ source ~/stackrc
```

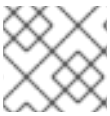
2. Run the **openstack tripleo validator list** command:

- To list all validations, run the command without any options:

```
$ openstack tripleo validator list
```

- To list validations in a group, run the command with the **--group** option:

```
$ openstack tripleo validator list --group prep
```



NOTE

For a full list of options, run **openstack tripleo validator list --help**.

15.3. RUNNING VALIDATIONS

To run a validation or validation group, use the **openstack tripleo validator run** command. To see a full list of options, use the **openstack tripleo validator run --help** command.

Procedure

1. Source the **stackrc** file:

```
$ source ~/stackrc
```

2. Enter the **openstack tripleo validator run** command:

   - To run a single validation, enter the command with the **--validation** option and the name of the validation. For example, to check the undercloud memory requirements, enter **--validation undercloud-ram**:

```
$ openstack tripleo validator run --validation undercloud-ram
```

   - To run all validations in a group, enter the command with the **--group** option:

```
$ openstack tripleo validator run --group prep
```

     To view detailed output from a specific validation, run the **openstack tripleo validator show run** command against the UUID of the specific validation from the report:

```
$ openstack tripleo validator show run <UUID>
```

15.4. IN-FLIGHT VALIDATIONS

Red Hat OpenStack Platform includes in-flight validations in the templates of composable services. In-flight validations verify the operational status of services at key steps of the overcloud deployment process.

In-flight validations run automatically as part of the deployment process. Some in-flight validations also use the roles from the **openstack-tripleo-validations** package.

CHAPTER 16. SCALING OVERCLOUD NODES

WARNING

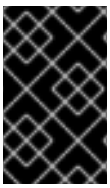
Do not use **openstack server delete** to remove nodes from the overcloud. Follow the procedures in this section to remove and replace nodes correctly.

If you want to add or remove nodes after the creation of the overcloud, you must update the overcloud.

Use the following table to determine support for scaling each node type:

Table 16.1. Scale support for each node type

Node type	Scale up?	Scale down?	Notes
Controller	N	N	You can replace Controller nodes using the procedures in Chapter 17, *Replacing Controller nodes*.
Compute	Y	Y	
Ceph Storage nodes	Y	N	You must have at least 1 Ceph Storage node from the initial overcloud creation.
Object Storage nodes	Y	Y	



IMPORTANT

Ensure that you have at least 10 GB free space before you scale the overcloud. This free space accommodates image conversion and caching during the node provisioning process.

16.1. ADDING NODES TO THE OVERCLOUD

Complete the following steps to add more nodes to the director node pool.

Procedure

1. Create a new JSON file (**newnodes.json**) that contains details of the new node that you want to register:

```
{
  "nodes":[
```

```
    {
        "mac":[
            "dd:dd:dd:dd:dd:dd"
        ],
        "cpu":"4",
        "memory":"6144",
        "disk":"40",
        "arch":"x86_64",
        "pm_type":"ipmi",
        "pm_user":"admin",
        "pm_password":"p@55w0rd!",
        "pm_addr":"192.168.24.207"
    },
    {
        "mac":[
            "ee:ee:ee:ee:ee:ee"
        ],
        "cpu":"4",
        "memory":"6144",
        "disk":"40",
        "arch":"x86_64",
        "pm_type":"ipmi",
        "pm_user":"admin",
        "pm_password":"p@55w0rd!",
        "pm_addr":"192.168.24.208"
    }
  ]
}
```

2. Run the following command to register the new nodes:

```
$ source ~/stackrc
(undercloud) $ openstack overcloud node import newnodes.json
```

3. After you register the new nodes, run the following commands to launch the introspection process for each new node:

```
(undercloud) $ openstack baremetal node manage [NODE UUID]
(undercloud) $ openstack overcloud node introspect [NODE UUID] --provide
```

   This process detects and benchmarks the hardware properties of the nodes.

4. Configure the image properties for the node:

```
(undercloud) $ openstack overcloud node configure [NODE UUID]
```

16.2. INCREASING NODE COUNTS FOR ROLES

Complete the following steps to scale overcloud nodes for a specific role, such as a Compute node.

Procedure

1. Tag each new node with the role you want. For example, to tag a node with the Compute role, run the following command:

```
(undercloud) $ openstack baremetal node set --property
capabilities='profile:compute,boot_option:local' [NODE UUID]
```

2. To scale the overcloud, you must edit the environment file that contains your node counts and re-deploy the overcloud. For example, to scale your overcloud to 5 Compute nodes, edit the **ComputeCount** parameter:

```
parameter_defaults:
  ...
  ComputeCount: 5
  ...
```

3. Rerun the deployment command with the updated file, which in this example is called **node-info.yaml**:

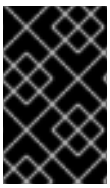
```
(undercloud) $ openstack overcloud deploy --templates -e /home/stack/templates/node-
info.yaml [OTHER_OPTIONS]
```

   Ensure that you include all environment files and options from your initial overcloud creation. This includes the same scale parameters for non-Compute nodes.

4. Wait until the deployment operation completes.

16.3. REMOVING COMPUTE NODES

There might be situations where you need to remove Compute nodes from the overcloud. For example, you might need to replace a problematic Compute node.



IMPORTANT

Before you remove a Compute node from the overcloud, migrate the workload from the node to other Compute nodes. For more information, see Migrating virtual machine instances between Compute nodes.

Prerequisites

- The Placement service package **python3-osc-placement** installed on the undercloud.

Procedure

1. Source the overcloud configuration:

```
$ source ~/overcloudrc
```

2. Disable the Compute service on the outgoing node on the overcloud to prevent the node from scheduling new instances:

```
(overcloud) $ openstack compute service list
(overcloud) $ openstack compute service set <hostname> nova-compute --disable
```

TIP

Use the **--disable-reason** option to add a short explanation on why the service is being disabled. This is useful if you intend to redeploy the Compute service at a later point.

3. Source the undercloud configuration:

```
(overcloud) $ source ~/stackrc
```

4. Identify the UUID of the overcloud stack:

```
(undercloud) $ openstack stack list
```

5. Identify the UUIDs or hostnames of the nodes that you want to delete:

```
(undercloud) $ openstack server list
```

6. Redeploy the overcloud with the **--update-plan-only** option, including all of the environment files that are relevant to your deployment:

```
$ openstack overcloud deploy --update-plan-only \
  --templates  \
  -e /usr/share/openstack-tripleo-heat-templates/environments/network-isolation.yaml \
  -e /home/stack/templates/network-environment.yaml \
  -e /home/stack/templates/storage-environment.yaml \
  -e /home/stack/templates/rhel-registration/environment-rhel-registration.yaml \
  [-e |...]
```

7. Delete the nodes from the stack:

```
$ openstack overcloud node delete --stack [STACK_UUID] --templates -e
[ENVIRONMENT_FILE] [NODE1_UUID] [NODE2_UUID] [NODE3_UUID]
```

Replace [node] with a UUID or hostname of a node.

IMPORTANT

Do not use a mix of UUIDs and hostnames. Use either only UUIDs or only hostnames.

8. Ensure that the **openstack overcloud node delete** command runs to completion:

```
(undercloud) $ openstack stack list
```

The status of the **overcloud** stack shows **UPDATE_COMPLETE** when the delete operation is complete.

a. If the IPMI interface of the node that you want to remove is not reachable, the **openstack overcloud node delete** command fails and the stack is in an **UPDATE_FAILED** status. Move the node to maintenance mode and re-run the **openstack overcloud node delete** command:

```
$ openstack baremetal node maintenance set <NODE_ID>
```

b. Adjust the Compute count and rerun the **openstack overcloud deploy** command that you used to deploy the existing overcloud.

IMPORTANT

If you intend to redeploy the Compute service with the same host name, you must use the existing service records for the redeployed node. If this is the case, skip the remaining steps in this procedure, and proceed with the instructions detailed in Redeploying the Compute service using the same host name.

9. Remove the Compute service from the node:

```
(undercloud) $ source ~/overcloudrc
(overcloud) $ openstack compute service list
(overcloud) $ openstack compute service delete <service-id>
```

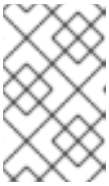
10. Check the network agents in your overcloud environment:

```
(overcloud) $ openstack network agent list
```

11. If any agents appear for the old node, remove them:

```
(overcloud) $ for AGENT in $(openstack network agent list --host <scaled-down-node> -c ID
-f value) ; do openstack network agent delete $AGENT ; done
```

where <scaled-down-node> is the node being removed.



NOTE

In an ML2/OVN deployment, known issues prevent removal of the OVN controller and metadata agents. To track progress on these issues, see BZ1828889 and BZ1738554.

12. Remove the deleted Compute service as a resource provider from the Placement service:

```
(overcloud) $ openstack resource provider list
(overcloud) $ openstack resource provider delete <uuid>
```

13. Decrease the **ComputeCount** parameter in the environment file that contains your node counts. This file is usually named **node-info.yaml**. For example, decrease the node count from five nodes to three nodes if you removed two nodes:

```
parameter_defaults:
  ...
  ComputeCount: 3
  ...
```

Decreasing the node count ensures director does not provision any new nodes when you run **openstack overcloud deploy**.

You can remove the node from the overcloud and re-provision it for other purposes.

Redeploying the Compute service using the same host name

To redeploy a disabled Compute service, re-enable it after you redeploy a Compute node with the same host name.

Procedure

1. Remove the deleted Compute service as a resource provider from the Placement service:

```
(undercloud) $ source ~/overcloudrc
(overcloud) $ openstack resource provider list
(overcloud) $ openstack resource provider delete <uuid>
```

2. Check the status of the Compute service:

```
(overcloud) $ openstack compute service list --long
...
| ID | Binary       | Host                 | Zone  | Status   | State | Updated At                 | Disabled Reason      |
| 80 | nova-compute | compute-1.localdomain | nova  | disabled | up    | 2018-07-13T14:35:04.000000 | gets re-provisioned |
...
```

3. When the service state of the redeployed Compute node changes to **up**, re-enable the service:

```
(overcloud) $ openstack compute service set compute-1.localdomain nova-compute --enable
```

16.4. REPLACING CEPH STORAGE NODES

You can use director to replace Ceph Storage nodes in a director-created cluster. For more information, see the Deploying an Overcloud with Containerized Red Hat Ceph guide.

16.5. REPLACING OBJECT STORAGE NODES

Follow the instructions in this section to understand how to replace Object Storage nodes without impact to the integrity of the cluster. This example involves a three-node Object Storage cluster in which you want to replace the node **overcloud-objectstorage-1** node. The goal of the procedure is to add one more node and then remove the **overcloud-objectstorage-1** node. The new node replaces the **overcloud-objectstorage-1** node.

Procedure

1. Increase the Object Storage count using the **ObjectStorageCount** parameter. This parameter is usually located in **node-info.yaml**, which is the environment file that contains your node counts:

```
parameter_defaults:
  ObjectStorageCount: 4
```

   The **ObjectStorageCount** parameter defines the quantity of Object Storage nodes in your environment. In this example, scale the quantity of Object Storage nodes from **3** to **4**.

2. Run the deployment command with the updated **ObjectStorageCount** parameter:

```
$ source ~/stackrc
(undercloud) $ openstack overcloud deploy --templates -e node-info.yaml
ENVIRONMENT_FILES
```

3. After the deployment command completes, the overcloud contains an additional Object Storage node.

4. Replicate data to the new node. Before you remove a node, in this case, **overcloud-objectstorage-1**, wait for a replication pass to finish on the new node. Check the replication pass progress in the **/var/log/swift/swift.log** file. When the pass finishes, the Object Storage service should log entries similar to the following example:

```
Mar 29 08:49:05 localhost object-server: Object replication complete.
Mar 29 08:49:11 localhost container-server: Replication run OVER
Mar 29 08:49:13 localhost account-server: Replication run OVER
```

5. To remove the old node from the ring, reduce the **ObjectStorageCount** parameter to omit the old node. In this example, reduce the **ObjectStorageCount** parameter to **3**:

```
parameter_defaults:
  ObjectStorageCount: 3
```

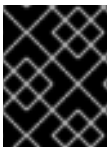
6. Create a new environment file named **remove-object-node.yaml**. This file identifies and removes the specified Object Storage node. The following content specifies the removal of **overcloud-objectstorage-1**:

```
parameter_defaults:
  ObjectStorageRemovalPolicies:
    [{'resource_list': ['1']}]
```

7. Include both the **node-info.yaml** and **remove-object-node.yaml** files in the deployment command:

```
(undercloud) $ openstack overcloud deploy --templates -e node-info.yaml
ENVIRONMENT_FILES -e remove-object-node.yaml
```

Director deletes the Object Storage node from the overcloud and updates the rest of the nodes on the overcloud to accommodate the node removal.



IMPORTANT

Include all environment files and options from your initial overcloud creation. This includes the same scale parameters for non-Compute nodes.

16.6. BLACKLISTING NODES

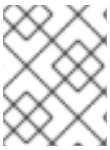
You can exclude overcloud nodes from receiving an updated deployment. This is useful in scenarios where you want to scale new nodes and exclude existing nodes from receiving an updated set of parameters and resources from the core heat template collection. This means that the blacklisted nodes are isolated from the effects of the stack operation.

Use the **DeploymentServerBlacklist** parameter in an environment file to create a blacklist.

Setting the blacklist

The **DeploymentServerBlacklist** parameter is a list of server names. Write a new environment file, or add the parameter value to an existing custom environment file and pass the file to the deployment command:

```
parameter_defaults:
  DeploymentServerBlacklist:
    - overcloud-compute-0
    - overcloud-compute-1
    - overcloud-compute-2
```



NOTE

The server names in the parameter value are the names according to OpenStack Orchestration (heat), not the actual server hostnames.

Include this environment file with your **openstack overcloud deploy** command:

```
$ source ~/stackrc
(undercloud) $ openstack overcloud deploy --templates \
  -e server-blacklist.yaml \
  [OTHER OPTIONS]
```

Heat blacklists any servers in the list from receiving updated heat deployments. After the stack operation completes, any blacklisted servers remain unchanged. You can also power off or stop the **os-collect-config** agents during the operation.

WARNING

- Exercise caution when you blacklist nodes. Only use a blacklist if you fully understand how to apply the requested change with a blacklist in effect. It is possible to create a hung stack or configure the overcloud incorrectly when you use the blacklist feature. For example, if cluster configuration changes apply to all members of a Pacemaker cluster, blacklisting a Pacemaker cluster member during this change can cause the cluster to fail.
- Do not use the blacklist during update or upgrade procedures. Those procedures have their own methods for isolating changes to particular servers. For more information, see the Upgrading Red Hat OpenStack Platform guide.
- When you add servers to the blacklist, further changes to those nodes are not supported until you remove the server from the blacklist. This includes updates, upgrades, scale up, scale down, and node replacement. For example, when you blacklist existing Compute nodes while scaling out the overcloud with new Compute nodes, the blacklisted nodes miss the information added to **/etc/hosts** and **/etc/ssh/ssh_known_hosts**. This can cause live migration to fail, depending on the destination host. The Compute nodes are updated with the information added to **/etc/hosts** and **/etc/ssh/ssh_known_hosts** during the next overcloud deployment where they are no longer blacklisted.

Clearing the blacklist

To clear the blacklist for subsequent stack operations, edit the **DeploymentServerBlacklist** to use an empty array:

```
parameter_defaults:
  DeploymentServerBlacklist: []
```

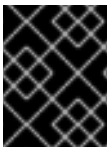
WARNING

Do not omit the **DeploymentServerBlacklist** parameter. If you omit the parameter, the overcloud deployment uses the previously saved value.

CHAPTER 17. REPLACING CONTROLLER NODES

In certain circumstances a Controller node in a high availability cluster might fail. In these situations, you must remove the node from the cluster and replace it with a new Controller node.

Complete the steps in this section to replace a Controller node. The Controller node replacement process involves running the **openstack overcloud deploy** command to update the overcloud with a request to replace a Controller node.



IMPORTANT

The following procedure applies only to high availability environments. Do not use this procedure if you are using only one Controller node.

17.1. PREPARING FOR CONTROLLER REPLACEMENT

Before you replace an overcloud Controller node, it is important to check the current state of your Red Hat OpenStack Platform environment. Checking the current state can help avoid complications during the Controller replacement process. Use the following list of preliminary checks to determine if it is safe to perform a Controller node replacement. Run all commands for these checks on the undercloud.

Procedure

1. Check the current status of the **overcloud** stack on the undercloud:

```
$ source stackrc
(undercloud) $ openstack stack list --nested
```

   The **overcloud** stack and its subsequent child stacks should have either a **CREATE_COMPLETE** or **UPDATE_COMPLETE**.

2. Install the database client tools:

```
(undercloud) $ sudo dnf -y install mariadb
```

3. Configure root user access to the database:

```
(undercloud) $ sudo cp /var/lib/config-data/puppet-generated/mysql/root/.my.cnf /root/.
```

4. Perform a backup of the undercloud databases:

```
(undercloud) $ mkdir /home/stack/backup
(undercloud) $ sudo mysqldump --all-databases --quick --single-transaction | gzip >
/home/stack/backup/dump_db_undercloud.sql.gz
```

5. Check that your undercloud contains 10 GB free storage to accommodate for image caching and conversion when you provision the new node:

```
(undercloud) $ df -h
```

6. Check the status of Pacemaker on the running Controller nodes. For example, if 192.168.0.47 is the IP address of a running Controller node, use the following command to view the Pacemaker status:

```
(undercloud) $ ssh heat-admin@192.168.0.47 'sudo pcs status'
```

The output shows all services that are running on the existing nodes and that are stopped on the failed node.

7. Check the following parameters on each node of the overcloud MariaDB cluster:
   - **wsrep_local_state_comment: Synced**
   - **wsrep_cluster_size: 2**
     Use the following command to check these parameters on each running Controller node. In this example, the Controller node IP addresses are 192.168.0.47 and 192.168.0.46:

     ```
     (undercloud) $ for i in 192.168.24.6 192.168.24.7 ; do echo "*** $i ***" ; ssh heat-admin@$i "sudo podman exec \$(sudo podman ps --filter name=galera-bundle -q) mysql -e \"SHOW STATUS LIKE 'wsrep_local_state_comment'; SHOW STATUS LIKE 'wsrep_cluster_size';\""; done
     ```

8. Check the RabbitMQ status. For example, if 192.168.0.47 is the IP address of a running Controller node, use the following command to view the RabbitMQ status:

   ```
   (undercloud) $ ssh heat-admin@192.168.0.47 "sudo podman exec \$(sudo podman ps -f name=rabbitmq-bundle -q) rabbitmqctl cluster_status"
   ```

   The **running_nodes** key should show only the two available nodes and not the failed node.

9. If you are using Open Virtual Switch (OVS) and replaced Controller nodes in the past without restarting the OVS agents, then restart the agents on the compute nodes before replacing this Controller. Restarting the OVS agents ensures that they have a full complement of RabbitMQ connections.
   Run the following command to restart the OVS agent:

   ```
   [heat-admin@overcloud-compute-0 ~]$ sudo systemctl restart tripleo_neutron_ovs_agent
   ```

10. If fencing is enabled, disable it. For example, if 192.168.0.47 is the IP address of a running Controller node, use the following command to check the status of fencing:

    ```
    (undercloud) $ ssh heat-admin@192.168.0.47 "sudo pcs property show stonith-enabled"
    ```

    Run the following command to disable fencing:

    ```
    (undercloud) $ ssh heat-admin@192.168.0.47 "sudo pcs property set stonith-enabled=false"
    ```

11. Check the Compute services are active on the director node:

    ```
    (undercloud) $ openstack hypervisor list
    ```

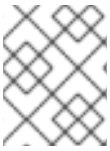
    The output should show all non-maintenance mode nodes as **up**.

12. Ensure all undercloud containers are running:

    ```
    (undercloud) $ sudo podman ps
    ```

17.2. REMOVING A CEPH MONITOR DAEMON

If your Controller node is running a Ceph monitor service, complete the following steps to remove the **ceph-mon** daemon..



NOTE

Adding a new Controller node to the cluster also adds a new Ceph monitor daemon automatically.

Procedure

1. Connect to the Controller node that you want to replace and become the root user:

```
# ssh heat-admin@192.168.0.47
# sudo su -
```

NOTE

If the Controller node is unreachable, skip steps 1 and 2 and continue the procedure at step 3 on any working Controller node.

2. Stop the monitor:

```
# systemctl stop ceph-mon@<monitor_hostname>
```

For example:

```
# systemctl stop ceph-mon@overcloud-controller-1
```

3. Disconnect from the Controller node that you want to replace.

4. Connect to one of the existing Controller nodes.

```
# ssh heat-admin@192.168.0.46
# sudo su -
```

5. Remove the monitor from the cluster:

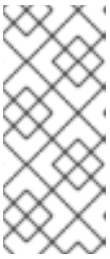
```
# sudo podman exec -it ceph-mon-controller-0 ceph mon remove overcloud-controller-1
```

6. On all Controller nodes, remove the v1 and v2 monitor entries from **/etc/ceph/ceph.conf**. For example, if you remove controller-1, then remove the IPs and hostname for controller-1. Before:

```
mon host = [v2:172.18.0.21:3300,v1:172.18.0.21:6789],
[v2:172.18.0.22:3300,v1:172.18.0.22:6789],[v2:172.18.0.24:3300,v1:172.18.0.24:6789]
mon initial members = overcloud-controller-2,overcloud-controller-1,overcloud-controller-0
```

After:

```
mon host = [v2:172.18.0.21:3300,v1:172.18.0.21:6789],
[v2:172.18.0.24:3300,v1:172.18.0.24:6789]
mon initial members = overcloud-controller-2,overcloud-controller-0
```



NOTE

Director updates the **ceph.conf** file on the relevant overcloud nodes when you add the replacement Controller node. Normally, director manages this configuration file exclusively and you should not edit the file manually. However, you can edit the file manually if you want to ensure consistency in case the other nodes restart before you add the new node.

7. (Optional) Archive the monitor data and save the archive on another server:

```
# mv /var/lib/ceph/mon/<cluster>-<daemon_id> /var/lib/ceph/mon/removed-<cluster>-
<daemon_id>
```

17.3. PREPARING THE CLUSTER FOR CONTROLLER NODE REPLACEMENT

Before you replace the old node, you must ensure that Pacemaker is not running on the node and then remove that node from the Pacemaker cluster.

Procedure

1. To view the list of IP addresses for the Controller nodes, run the following command:

```
(undercloud) $ openstack server list -c Name -c Networks
+------------------------+-----------------------+
| Name                   | Networks              |
+------------------------+-----------------------+
| overcloud-compute-0    | ctlplane=192.168.0.44 |
| overcloud-controller-0 | ctlplane=192.168.0.47 |
| overcloud-controller-1 | ctlplane=192.168.0.45 |
| overcloud-controller-2 | ctlplane=192.168.0.46 |
+------------------------+-----------------------+
```

2. If the old node is still reachable, log in to one of the remaining nodes and stop pacemaker on the old node. For this example, stop pacemaker on overcloud-controller-1:

```
(undercloud) $ ssh heat-admin@192.168.0.47 "sudo pcs status | grep -w Online | grep -w
overcloud-controller-1"
(undercloud) $ ssh heat-admin@192.168.0.47 "sudo pcs cluster stop overcloud-controller-1"
```

NOTE

In case the old node is physically unavailable or stopped, it is not necessary to perform the previous operation, as pacemaker is already stopped on that node.

3. After you stop Pacemaker on the old node, delete the old node from the pacemaker cluster. The following example command logs in to **overcloud-controller-0** to remove **overcloud-controller-1**:

```
(undercloud) $ ssh heat-admin@192.168.0.47 "sudo pcs cluster node remove overcloud-controller-1"
```

   If the node that that you want to replace is unreachable (for example, due to a hardware failure), run the **pcs** command with additional **--skip-offline** and **--force** options to forcibly remove the node from the cluster:

```
(undercloud) $ ssh heat-admin@192.168.0.47 "sudo pcs cluster node remove overcloud-controller-1 --skip-offline --force"
```

4. After you remove the old node from the pacemaker cluster, remove the node from the list of known hosts in pacemaker:

```
(undercloud) $ ssh heat-admin@192.168.0.47 "sudo pcs host deauth overcloud-controller-1"
```

   You can run this command whether the node is reachable or not.

5. The overcloud database must continue to run during the replacement procedure. To ensure that Pacemaker does not stop Galera during this procedure, select a running Controller node and run the following command on the undercloud with the IP address of the Controller node:

```
(undercloud) $ ssh heat-admin@192.168.0.47 "sudo pcs resource unmanage galera-bundle"
```

17.4. REPLACING A CONTROLLER NODE

To replace a Controller node, identify the index of the node that you want to replace.

- If the node is a virtual node, identify the node that contains the failed disk and restore the disk from a backup. Ensure that the MAC address of the NIC used for PXE boot on the failed server remains the same after disk replacement.
- If the node is a bare metal node, replace the disk, prepare the new disk with your overcloud configuration, and perform a node introspection on the new hardware.
- If the node is a part of a high availability cluster with fencing, you might need recover the Galera nodes separately. For more information, see the article How Galera works and how to rescue Galera clusters in the context of Red Hat OpenStack Platform.

Complete the following example steps to replace the the **overcloud-controller-1** node with the **overcloud-controller-3** node. The **overcloud-controller-3** node has the ID **75b25e9a-948d-424a-9b3b-f0ef70a6eacf**.

IMPORTANT

To replace the node with an existing bare metal node, enable maintenance mode on the outgoing node so that the director does not automatically reprovision the node.

IMPORTANT

Replacement of an overcloud Controller might cause swift rings to become inconsistent across nodes. This can result in decreased availability of Object Storage service. This is a known issue. If this happens, log in to the previously existing Controller node using SSH, deploy the updated rings, and restart the Object Storage containers:

```
(undercloud) [stack@undercloud-0 ~]$ source stackrc
(undercloud) [stack@undercloud-0 ~]$ nova list
...
| 3fab687e-99c2-4e66-805f-3106fb41d868 | controller-1 | ACTIVE | -          | Running     |
ctlplane=192.168.24.17 |
| a87276ea-8682-4f27-9426-6b272955b486 | controller-2 | ACTIVE | -          | Running     |
ctlplane=192.168.24.38 |
| a000b156-9adc-4d37-8169-c1af7800788b | controller-3 | ACTIVE | -          | Running     |
ctlplane=192.168.24.35 |
...

(undercloud) [stack@undercloud-0 ~]$ for ip in 192.168.24.17 192.168.24.38 192.168.24.35; do ssh
$ip 'sudo podman restart swift_copy_rings ; sudo podman restart $(sudo podman ps -a --format="
{{.Names}}" --filter="name=swift_*")'; done
```

Procedure

1. Source the **stackrc** file:

   ```
   $ source ~/stackrc
   ```

2. Identify the index of the **overcloud-controller-1** node:

   ```
   $ INSTANCE=$(openstack server list --name overcloud-controller-1 -f value -c ID)
   ```

3. Identify the bare metal node associated with the instance:

   ```
   $ NODE=$(openstack baremetal node list -f csv --quote minimal | grep $INSTANCE | cut -f1
   -d,)
   ```

4. Set the node to maintenance mode:

   ```
   $ openstack baremetal node maintenance set $NODE
   ```

5. If the Controller node is a virtual node, run the following command on the Controller host to replace the virtual disk from a backup:

   ```
   $ cp <VIRTUAL_DISK_BACKUP> /var/lib/libvirt/images/<VIRTUAL_DISK>
   ```

   Replace **<VIRTUAL_DISK_BACKUP>** with the path to the backup of the failed virtual disk, and replace **<VIRTUAL_DISK>** with the name of the virtual disk that you want to replace.

   If you do not have a backup of the outgoing node, you must use a new virtualized node.

   If the Controller node is a bare metal node, complete the following steps to replace the disk with a new bare metal disk:

a. Replace the physical hard drive or solid state drive.

b. Prepare the node with the same configuration as the failed node.

6. List unassociated nodes and identify the ID of the new node:

```
$ openstack baremetal node list --unassociated
```

7. Tag the new node with the **control** profile:

```
(undercloud) $ openstack baremetal node set --property
capabilities='profile:control,boot_option:local' 75b25e9a-948d-424a-9b3b-f0ef70a6eacf
```

17.5. TRIGGERING THE CONTROLLER NODE REPLACEMENT

Complete the following steps to remove the old Controller node and replace it with a new Controller node.

Procedure

1. Determine the UUID of the node that you want to remove and store it in the **NODEID** variable. Ensure that you replace *NODE_NAME* with the name of the node that you want to remove:

```
$ NODEID=$(openstack server list -f value -c ID --name NODE_NAME)
```

2. To identify the Heat resource ID, enter the following command:

```
$ openstack stack resource show overcloud ControllerServers -f json -c attributes | jq --arg
NODEID "$NODEID" -c .attributes.value | keys[] as $k | if .[$k] == $NODEID then "Node
index \($k) for \(.[$k])" else empty end
```

3. Create the following environment file **~/templates/remove-controller.yaml** and include the node index of the Controller node that you want to remove:

```
parameters:
  ControllerRemovalPolicies:
    [{resource_list: [NODE_INDEX]}]
```

4. Enter the overcloud deployment command, and include the **remove-controller.yaml** environment file with any other environment files relevant to your environment:

```
(undercloud) $ openstack overcloud deploy --templates \
    -e /home/stack/templates/remove-controller.yaml \
    [OTHER OPTIONS]
```

NOTE

Include **-e ~/templates/remove-controller.yaml** only for this instance of the deployment command. Remove this environment file from subsequent deployment operations.

5. Director removes the old node, creates a new node, and updates the overcloud stack. You can check the status of the overcloud stack with the following command:

```
(undercloud) $ openstack stack list --nested
```

6. When the deployment command completes, director shows that the old node is replaced with the new node:

```
(undercloud) $ openstack server list -c Name -c Networks
+------------------------+-----------------------+
| Name                   | Networks              |
+------------------------+-----------------------+
| overcloud-compute-0    | ctlplane=192.168.0.44 |
| overcloud-controller-0 | ctlplane=192.168.0.47 |
| overcloud-controller-2 | ctlplane=192.168.0.46 |
| overcloud-controller-3 | ctlplane=192.168.0.48 |
+------------------------+-----------------------+
```

The new node now hosts running control plane services.

17.6. CLEANING UP AFTER CONTROLLER NODE REPLACEMENT

After you complete the node replacement, complete the following steps to finalize the Controller cluster.

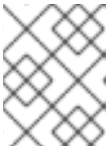
Procedure

1. Log into a Controller node.
2. Enable Pacemaker management of the Galera cluster and start Galera on the new node:

```
[heat-admin@overcloud-controller-0 ~]$ sudo pcs resource refresh galera-bundle
[heat-admin@overcloud-controller-0 ~]$ sudo pcs resource manage galera-bundle
```

3. Perform a final status check to ensure that the services are running correctly:

```
[heat-admin@overcloud-controller-0 ~]$ sudo pcs status
```



NOTE

If any services have failed, use the **pcs resource refresh** command to resolve and restart the failed services.

4. Exit to director:

```
[heat-admin@overcloud-controller-0 ~]$ exit
```

5. Source the **overcloudrc** file so that you can interact with the overcloud:

```
$ source ~/overcloudrc
```

6. Check the network agents in your overcloud environment:

–

```
(overcloud) $ openstack network agent list
```

7. If any agents appear for the old node, remove them:

```
(overcloud) $ for AGENT in $(openstack network agent list --host overcloud-controller-1.localdomain -c ID -f value) ; do openstack network agent delete $AGENT ; done
```

NOTE

In an ML2/OVN deployment, bugs prevent removal of the OVN controller and metadata agents. To track progress on these bugs, see BZ1828889 and BZ1738554.

8. If necessary, add your router to the L3 agent host on the new node. Use the following example command to add a router named **r1** to the L3 agent using the UUID 2d1c1dc1-d9d4-4fa9-b2c8-f29cd1a649d4:

```
(overcloud) $ openstack network agent add router --l3 2d1c1dc1-d9d4-4fa9-b2c8-f29cd1a649d4 r1
```

9. Because compute services for the removed node still exist in the overcloud, you must remove them. First, check the compute services for the removed node:

```
[stack@director ~]$ source ~/overcloudrc
(overcloud) $ openstack compute service list --host overcloud-controller-1.localdomain
```

10. Remove the compute services for the removed node:

```
(overcloud) $ for SERVICE in $(openstack compute service list --host overcloud-controller-1.localdomain -c ID -f value ) ; do openstack compute service delete $SERVICE ; done
```

11. If you are using Open Virtual Switch (OVS), and the IP address for the Controller node has changed, then you must restart the OVS agent on all compute nodes:

```
[heat-admin@overcloud-compute-0 ~]$ sudo systemctl restart tripleo_neutron_ovs_agent
```

CHAPTER 18. REBOOTING NODES

You might need to reboot the nodes in the undercloud and overcloud. Use the following procedures to understand how to reboot different node types.

- If you reboot all nodes in one role, it is advisable to reboot each node individually. If you reboot all nodes in a role simultaneously, service downtime can occurduring the reboot operation.
- If you reboot all nodes in your OpenStack Platform environment, reboot the nodes in the following sequential order:

Recommended node reboot order

1. Reboot the undercloud node.
2. Reboot Controller and other composable nodes.
3. Reboot standalone Ceph MON nodes.
4. Reboot Ceph Storage nodes.
5. Reboot Compute nodes.

18.1. REBOOTING THE UNDERCLOUD NODE

Complete the following steps to reboot the undercloud node.

Procedure

1. Log in to the undercloud as the **stack** user.
2. Reboot the undercloud:

```
$ sudo reboot
```

3. Wait until the node boots.

18.2. REBOOTING CONTROLLER AND COMPOSABLE NODES

Complete the following steps to reboot Controller nodes and standalone nodes based on composable roles, excluding Compute nodes and Ceph Storage nodes.

Procedure

1. Log in to the node that you want to reboot.
2. Optional: If the node uses Pacemaker resources, stop the cluster:

```
[heat-admin@overcloud-controller-0 ~]$ sudo pcs cluster stop
```

3. Reboot the node:

```
[heat-admin@overcloud-controller-0 ~]$ sudo reboot
```

4. Wait until the node boots.
5. Check the services. For example:
   a. If the node uses Pacemaker services, check that the node has rejoined the cluster:

      ```
      [heat-admin@overcloud-controller-0 ~]$ sudo pcs status
      ```

   b. If the node uses Systemd services, check that all services are enabled:

      ```
      [heat-admin@overcloud-controller-0 ~]$ sudo systemctl status
      ```

   c. If the node uses containerized services, check that all containers on the node are active:

      ```
      [heat-admin@overcloud-controller-0 ~]$ sudo podman ps
      ```

18.3. REBOOTING STANDALONE CEPH MON NODES

Complete the following steps to reboot standalone Ceph MON nodes.

Procedure

1. Log in to a Ceph MON node.
2. Reboot the node:

   ```
   $ sudo reboot
   ```

3. Wait until the node boots and rejoins the MON cluster.

Repeat these steps for each MON node in the cluster.

18.4. REBOOTING A CEPH STORAGE (OSD) CLUSTER

Complete the following steps to reboot a cluster of Ceph Storage (OSD) nodes.

Procedure

1. Log into a Ceph MON or Controller node and disable Ceph Storage cluster rebalancing temporarily:

   ```
   $ sudo podman exec -it ceph-mon-controller-0 ceph osd set noout
   $ sudo podman exec -it ceph-mon-controller-0 ceph osd set norebalance
   ```

2. Select the first Ceph Storage node that you want to reboot and log in to the node.
3. Reboot the node:

   ```
   $ sudo reboot
   ```

4. Wait until the node boots.

5. Log into the node and check the cluster status:

```
$ sudo podman exec -it ceph-mon-controller-0 ceph status
```

   Check that the **pgmap** reports all **pgs** as normal (**active+clean**).

6. Log out of the node, reboot the next node, and check its status. Repeat this process until you have rebooted all Ceph storage nodes.

7. When complete, log into a Ceph MON or Controller node and re-enable cluster rebalancing:

```
$ sudo podman exec -it ceph-mon-controller-0 ceph osd unset noout
$ sudo podman exec -it ceph-mon-controller-0 ceph osd unset norebalance
```

8. Perform a final status check to verify that the cluster reports **HEALTH_OK**:

```
$ sudo podman exec -it ceph-mon-controller-0 ceph status
```

18.5. REBOOTING COMPUTE NODES

Complete the following steps to reboot Compute nodes. To ensure minimal downtime of instances in your Red Hat OpenStack Platform environment, this procedure also includes instructions about migrating instances from the Compute node that you want to reboot. This involves the following workflow:

- Decide whether to migrate instances to another Compute node before rebooting the node.
- Select and disable the Compute node you want to reboot so that it does not provision new instances.
- Migrate the instances to another Compute node.
- Reboot the empty Compute node.
- Enable the empty Compute node.

Prerequisites

Before you reboot the Compute node, you must decide whether to migrate instances to another Compute node while the node is rebooting.

If for some reason you cannot or do not want to migrate the instances, you can set the following core template parameters to control the state of the instances after the Compute node reboots:

NovaResumeGuestsStateOnHostBoot

Determines whether to return instances to the same state on the Compute node after reboot. When set to **False**, the instances remain down and you must start them manually. Default value is: **False**

NovaResumeGuestsShutdownTimeout

Number of seconds to wait for an instance to shut down before rebooting. It is not recommended to set this value to **0**. Default value is: 300

For more information about overcloud parameters and their usage, see Overcloud Parameters.

Procedure

1. Log in to the undercloud as the **stack** user.
2. List all Compute nodes and their UUIDs:

```
$ source ~/stackrc
(undercloud) $ openstack server list --name compute
```

   Identify the UUID of the Compute node that you want to reboot.

3. From the undercloud, select a Compute node. Disable the node:

```
$ source ~/overcloudrc
(overcloud) $ openstack compute service list
(overcloud) $ openstack compute service set [hostname] nova-compute --disable
```

4. List all instances on the Compute node:

```
(overcloud) $ openstack server list --host [hostname] --all-projects
```

5. If you decide not to migrate instances, skip to this step.
6. If you decide to migrate the instances to another Compute node, use one of the following commands:
   - Migrate the instance to a different host:

```
(overcloud) $ openstack server migrate [instance-id] --live [target-host]--wait
```

   - Let **nova-scheduler** automatically select the target host:

```
(overcloud) $ nova live-migration [instance-id]
```

   - Live migrate all instances at once:

```
$ nova host-evacuate-live [hostname]
```

NOTE

The **nova** command might cause some deprecation warnings, which are safe to ignore.

7. Wait until migration completes.
8. Confirm that the migration was successful:

```
(overcloud) $ openstack server list --host [hostname] --all-projects
```

9. Continue to migrate instances until none remain on the chosen Compute node.
10. Log in to the Compute node and reboot the node:

```
[heat-admin@overcloud-compute-0 ~]$ sudo reboot
```

11. Wait until the node boots.
12. Re-enable the Compute node:

```
$ source ~/overcloudrc
(overcloud) $ openstack compute service set [hostname] nova-compute --enable
```

13. Check that the Compute node is enabled:

```
(overcloud) $ openstack compute service list
```

PART IV. ADDITIONAL DIRECTOR OPERATIONS AND CONFIGURATION

CHAPTER 19. CONFIGURING CUSTOM SSL/TLS CERTIFICATES

You can configure the undercloud to use SSL/TLS for communication over public endpoints. However, if want to you use a SSL certificate with your own certificate authority, you must complete the following configuration steps.

19.1. INITIALIZING THE SIGNING HOST

The signing host is the host that generates and signs new certificates with a certificate authority. If you have never created SSL certificates on the chosen signing host, you might need to initialize the host so that it can sign new certificates.

Procedure

1. The **/etc/pki/CA/index.txt** file contains records of all signed certificates. Check if this file exists. If it does not exist, create an empty file:

```
$ sudo touch /etc/pki/CA/index.txt
```

2. The **/etc/pki/CA/serial** file identifies the next serial number to use for the next certificate to sign. Check if this file exists. If the file does not exist, create a new file with a new starting value:

```
$ echo '1000' | sudo tee /etc/pki/CA/serial
```

19.2. CREATING A CERTIFICATE AUTHORITY

Normally you sign your SSL/TLS certificates with an external certificate authority. In some situations, you might want to use your own certificate authority. For example, you might want to have an internal-only certificate authority.

Procedure

1. Generate a key and certificate pair to act as the certificate authority:

```
$ openssl genrsa -out ca.key.pem 4096
$ openssl req  -key ca.key.pem -new -x509 -days 7300 -extensions v3_ca -out ca.crt.pem
```

1. The **openssl req** command requests certain details about your authority. Enter these details at the prompt.

These commands create a certificate authority file called **ca.crt.pem**.

19.3. ADDING THE CERTIFICATE AUTHORITY TO CLIENTS

For any external clients aiming to communicate using SSL/TLS, copy the certificate authority file to each client that requires access to your Red Hat OpenStack Platform environment.

Procedure

1. Copy the certificate authority to the client system:
   -

```
$ sudo cp ca.crt.pem /etc/pki/ca-trust/source/anchors/
```

2. After you copy the certificate authority file to each client, run the following command on each client to add the certificate to the certificate authority trust bundle:

```
$ sudo update-ca-trust extract
```

19.4. CREATING AN SSL/TLS KEY

Enabling SSL/TLS on an OpenStack environment requires an SSL/TLS key to generate your certificates.

Procedure

1. Run the following command to generate the SSL/TLS key (**server.key.pem**):

```
$ openssl genrsa -out server.key.pem 2048
```

19.5. CREATING AN SSL/TLS CERTIFICATE SIGNING REQUEST

Complete the following steps to create a certificate signing request.

Procedure

1. Copy the default OpenSSL configuration file:

```
$ cp /etc/pki/tls/openssl.cnf .
```

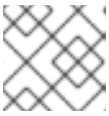
2. Edit the new **openssl.cnf** file and configure the SSL parameters that you want to use for director. An example of the types of parameters to modify include:

```
[req]
distinguished_name = req_distinguished_name
req_extensions = v3_req

[req_distinguished_name]
countryName = Country Name (2 letter code)
countryName_default = AU
stateOrProvinceName = State or Province Name (full name)
stateOrProvinceName_default = Queensland
localityName = Locality Name (eg, city)
localityName_default = Brisbane
organizationalUnitName = Organizational Unit Name (eg, section)
organizationalUnitName_default = Red Hat
commonName = Common Name
commonName_default = 192.168.0.1
commonName_max = 64

[ v3_req ]
# Extensions to add to a certificate request
basicConstraints = CA:FALSE
keyUsage = nonRepudiation, digitalSignature, keyEncipherment
subjectAltName = @alt_names
```

```
[alt_names]
IP.1 = 192.168.0.1
DNS.1 = instack.localdomain
DNS.2 = vip.localdomain
DNS.3 = 192.168.0.1
```

Set the **commonName_default** to one of the following entries:

- If you are using an IP address to access director over SSL/TLS, use the **undercloud_public_host** parameter in the **undercloud.conf** file.
- If you are using a fully qualified domain name to access director over SSL/TLS, use the domain name.
  Edit the **alt_names** section to include the following entries:
- **IP** - A list of IP addresses that clients use to access director over SSL.
- **DNS** - A list of domain names that clients use to access director over SSL. Also include the Public API IP address as a DNS entry at the end of the **alt_names** section.



NOTE

For more information about **openssl.cnf**, run the **man openssl.cnf** command.

3. Run the following command to generate a certificate signing request (**server.csr.pem**):

```
$ openssl req -config openssl.cnf -key server.key.pem -new -out server.csr.pem
```

Ensure that you include your OpenStack SSL/TLS key with the **-key** option.

This command generates a **server.csr.pem** file, which is the certificate signing request. Use this file to create your OpenStack SSL/TLS certificate.

19.6. CREATING THE SSL/TLS CERTIFICATE

To generate the SSL/TLS certificate for your OpenStack environment, the following files must be present:

openssl.cnf
The customized configuration file that specifies the v3 extensions.

server.csr.pem
The certificate signing request to generate and sign the certificate with a certificate authority.

ca.crt.pem
The certificate authority, which signs the certificate.

ca.key.pem
The certificate authority private key.

Procedure

1. Run the following command to create a certificate for your undercloud or overcloud:

```
$ sudo openssl ca -config openssl.cnf -extensions v3_req -days 3650 -in server.csr.pem -out
server.crt.pem -cert ca.crt.pem -keyfile ca.key.pem
```

This command uses the following options:

-config

Use a custom configuration file, which is the **openssl.cnf** file with v3 extensions.

-extensions v3_req

Enabled v3 extensions.

-days

Defines how long in days until the certificate expires.

-in'

The certificate signing request.

-out

The resulting signed certificate.

-cert

The certificate authority file.

-keyfile

The certificate authority private key.

This command creates a new certificate named **server.crt.pem**. Use this certificate in conjunction with your OpenStack SSL/TLS key

19.7. ADDING THE CERTIFICATE TO THE UNDERCLOUD

Complete the following steps to add your OpenStack SSL/TLS certificate to the undercloud trust bundle.

Procedure

1. Run the following command to combine the certificate and key:

```
$ cat server.crt.pem server.key.pem > undercloud.pem
```

This command creates a **undercloud.pem** file.

2. Copy the **undercloud.pem** file to a location within your **/etc/pki** directory and set the necessary SELinux context so that HAProxy can read it:

```
$ sudo mkdir /etc/pki/undercloud-certs
$ sudo cp ~/undercloud.pem /etc/pki/undercloud-certs/.
$ sudo semanage fcontext -a -t etc_t "/etc/pki/undercloud-certs(/.*)?"
$ sudo restorecon -R /etc/pki/undercloud-certs
```

3. Add the **undercloud.pem** file location to the **undercloud_service_certificate** option in the **undercloud.conf** file:

```
undercloud_service_certificate = /etc/pki/undercloud-certs/undercloud.pem
```

4. Add the certificate authority that signed the certificate to the list of trusted Certificate Authorities on the undercloud so that different services within the undercloud have access to the certificate authority:

```
$ sudo cp ca.crt.pem /etc/pki/ca-trust/source/anchors/
$ sudo update-ca-trust extract
```

CHAPTER 20. ADDITIONAL INTROSPECTION OPERATIONS

20.1. PERFORMING INDIVIDUAL NODE INTROSPECTION

To perform a single introspection on an available node, run the following commands to set the node to management mode and perform the introspection:

```
(undercloud) $ openstack baremetal node manage [NODE UUID]
(undercloud) $ openstack overcloud node introspect [NODE UUID] --provide
```

After the introspection completes, the node changes to an **available** state.

20.2. PERFORMING NODE INTROSPECTION AFTER INITIAL INTROSPECTION

After an initial introspection, all nodes enter an **available** state due to the **--provide** option. To perform introspection on all nodes after the initial introspection, set all nodes to a **manageable** state and run the bulk introspection command:

```
(undercloud) $ for node in $(openstack baremetal node list --fields uuid -f value) ; do openstack
baremetal node manage $node ; done
(undercloud) $ openstack overcloud node introspect --all-manageable --provide
```

After the introspection completes, all nodes change to an **available** state.

20.3. PERFORMING NETWORK INTROSPECTION FOR INTERFACE INFORMATION

Network introspection retrieves link layer discovery protocol (LLDP) data from network switches. The following commands show a subset of LLDP information for all interfaces on a node, or full information for a particular node and interface. This can be useful for troubleshooting. Director enables LLDP data collection by default.

To get a list of interfaces on a node, run the following command:

```
(undercloud) $ openstack baremetal introspection interface list [NODE UUID]
```

For example:

```
(undercloud) $ openstack baremetal introspection interface list c89397b7-a326-41a0-907d-
79f8b86c7cd9
+-----------+-------------------+------------------------+-------------------+----------------+
| Interface | MAC Address       | Switch Port VLAN IDs   | Switch Chassis ID | Switch Port ID |
+-----------+-------------------+------------------------+-------------------+----------------+
| p2p2      | 00:0a:f7:79:93:19 | [103, 102, 18, 20, 42] | 64:64:9b:31:12:00 | 510            |
| p2p1      | 00:0a:f7:79:93:18 | [101]                  | 64:64:9b:31:12:00 | 507            |
| em1       | c8:1f:66:c7:e8:2f | [162]                  | 08:81:f4:a6:b3:80 | 515            |
| em2       | c8:1f:66:c7:e8:30 | [182, 183]             | 08:81:f4:a6:b3:80 | 559            |
+-----------+-------------------+------------------------+-------------------+----------------+
```

To view interface data and switch port information, run the following command:

-

```
(undercloud) $ openstack baremetal introspection interface show [NODE UUID] [INTERFACE]
```

For example:

```
(undercloud) $ openstack baremetal introspection interface show c89397b7-a326-41a0-907d-
79f8b86c7cd9 p2p1
+--------------------------------------+------------------------------------------------------------------------------------
--------------------------------------+
| Field                                | Value
|
+--------------------------------------+------------------------------------------------------------------------------------
--------------------------------------+
| interface                            | p2p1
|
| mac                                  | 00:0a:f7:79:93:18
|
| node_ident                           | c89397b7-a326-41a0-907d-79f8b86c7cd9
|
| switch_capabilities_enabled          | [u'Bridge', u'Router']
|
| switch_capabilities_support          | [u'Bridge', u'Router']
|
| switch_chassis_id                    | 64:64:9b:31:12:00
|
| switch_port_autonegotiation_enabled  | True
|
| switch_port_autonegotiation_support  | True
|
| switch_port_description              | ge-0/0/2.0
|
| switch_port_id                       | 507
|
| switch_port_link_aggregation_enabled | False
|
| switch_port_link_aggregation_id      | 0
|
| switch_port_link_aggregation_support | True
|
| switch_port_management_vlan_id       | None
|
| switch_port_mau_type                 | Unknown
|
| switch_port_mtu                      | 1514
|
| switch_port_physical_capabilities    | [u'1000BASE-T fdx', u'100BASE-TX fdx', u'100BASE-TX hdx',
u'10BASE-T fdx', u'10BASE-T hdx', u'Asym and Sym PAUSE fdx'] |
| switch_port_protocol_vlan_enabled    | None
|
| switch_port_protocol_vlan_ids        | None
|
| switch_port_protocol_vlan_support    | None
|
| switch_port_untagged_vlan_id         | 101
|
| switch_port_vlan_ids                 | [101]
```

```
|
| switch_port_vlans                  | [{u'name': u'RHOS13-PXE', u'id': 101}]
|
| switch_protocol_identities         | None
|
| switch_system_name                 | rhos-compute-node-sw1
|
+------------------------------------+-------------------------------------------------------------------------------
--------------------------------------+
```

Retrieving hardware introspection details

The Bare Metal service hardware-inspection-extras feature is enabled by default, and you can use it to retrieve hardware details for overcloud configuration. For more information about the **inspection_extras** parameter in the **undercloud.conf** file, see Configuring the Director.

For example, the **numa_topology** collector is part of the hardware-inspection extras and includes the following information for each NUMA node:

- RAM (in kilobytes)
- Physical CPU cores and their sibling threads
- NICs associated with the NUMA node

To retrieve the information listed above, substitute <UUID> with the UUID of the bare-metal node to complete the following command:

```
# openstack baremetal introspection data save <UUID> | jq .numa_topology
```

The following example shows the retrieved NUMA information for a bare-metal node:

```
{
  "cpus": [
    {
      "cpu": 1,
      "thread_siblings": [
        1,
        17
      ],
      "numa_node": 0
    },
    {
      "cpu": 2,
      "thread_siblings": [
        10,
        26
      ],
      "numa_node": 1
    },
    {
      "cpu": 0,
      "thread_siblings": [
        0,
        16
      ],
```

```
    "numa_node": 0
  },
  {
    "cpu": 5,
    "thread_siblings": [
      13,
      29
    ],
    "numa_node": 1
  },
  {
    "cpu": 7,
    "thread_siblings": [
      15,
      31
    ],
    "numa_node": 1
  },
  {
    "cpu": 7,
    "thread_siblings": [
      7,
      23
    ],
    "numa_node": 0
  },
  {
    "cpu": 1,
    "thread_siblings": [
      9,
      25
    ],
    "numa_node": 1
  },
  {
    "cpu": 6,
    "thread_siblings": [
      6,
      22
    ],
    "numa_node": 0
  },
  {
    "cpu": 3,
    "thread_siblings": [
      11,
      27
    ],
    "numa_node": 1
  },
  {
    "cpu": 5,
    "thread_siblings": [
      5,
      21
    ],
```

```
    "numa_node": 0
   },
   {
    "cpu": 4,
    "thread_siblings": [
     12,
     28
    ],
    "numa_node": 1
   },
   {
    "cpu": 4,
    "thread_siblings": [
     4,
     20
    ],
    "numa_node": 0
   },
   {
    "cpu": 0,
    "thread_siblings": [
     8,
     24
    ],
    "numa_node": 1
   },
   {
    "cpu": 6,
    "thread_siblings": [
     14,
     30
    ],
    "numa_node": 1
   },
   {
    "cpu": 3,
    "thread_siblings": [
     3,
     19
    ],
    "numa_node": 0
   },
   {
    "cpu": 2,
    "thread_siblings": [
     2,
     18
    ],
    "numa_node": 0
   }
  ],
  "ram": [
   {
    "size_kb": 66980172,
    "numa_node": 0
   },
```

```
    {
      "size_kb": 67108864,
      "numa_node": 1
    }
  ],
  "nics": [
    {
      "name": "ens3f1",
      "numa_node": 1
    },
    {
      "name": "ens3f0",
      "numa_node": 1
    },
    {
      "name": "ens2f0",
      "numa_node": 0
    },
    {
      "name": "ens2f1",
      "numa_node": 0
    },
    {
      "name": "ens1f1",
      "numa_node": 0
    },
    {
      "name": "ens1f0",
      "numa_node": 0
    },
    {
      "name": "eno4",
      "numa_node": 0
    },
    {
      "name": "eno1",
      "numa_node": 0
    },
    {
      "name": "eno3",
      "numa_node": 0
    },
    {
      "name": "eno2",
      "numa_node": 0
    }
  ]
}
```

CHAPTER 21. AUTOMATICALLY DISCOVERING BARE METAL NODES

You can use auto-discovery to register overcloud nodes and generate their metadata, without the need to create an **instackenv.json** file. This improvement can help to reduce the time it takes to collect information about a node. For example, if you use auto-discovery, you do not to collate the IPMI IP addresses and subsequently create the **instackenv.json**.

21.1. PREREQUISITES

- You have configured all overcloud nodes BMCs to be accessible to director through the IPMI.
- You have configured all overcloud nodes to PXE boot from the NIC that is connected to the undercloud control plane network.

21.2. ENABLING AUTO-DISCOVERY

1. Enable Bare Metal auto-discovery in the **undercloud.conf** file:

```
enable_node_discovery = True
discovery_default_driver = ipmi
```

   - **enable_node_discovery** - When enabled, any node that boots the introspection ramdisk using PXE is enrolled in the Bare Metal service (ironic) automatically.
   - **discovery_default_driver** - Sets the driver to use for discovered nodes. For example, **ipmi**.

2. Add your IPMI credentials to ironic:

   a. Add your IPMI credentials to a file named **ipmi-credentials.json**. Replace the **SampleUsername**, **RedactedSecurePassword**, and **bmc_address** values in this example to suit your environment:

```
[
  {
    "description": "Set default IPMI credentials",
    "conditions": [
      {"op": "eq", "field": "data://auto_discovered", "value": true}
    ],
    "actions": [
      {"action": "set-attribute", "path": "driver_info/ipmi_username",
       "value": "SampleUsername"},
      {"action": "set-attribute", "path": "driver_info/ipmi_password",
       "value": "RedactedSecurePassword"},
      {"action": "set-attribute", "path": "driver_info/ipmi_address",
       "value": "{data[inventory][bmc_address]}"}
    ]
  }
]
```

3. Import the IPMI credentials file into ironic:

```
$ openstack baremetal introspection rule import ipmi-credentials.json
```

21.3. TESTING AUTO-DISCOVERY

1. Power on the required nodes.
2. Run the **openstack baremetal node list** command. You should see the new nodes listed in an **enrolled** state:

```
$ openstack baremetal node list
+--------------------------------------+------+--------------+-------------+--------------------+-------------
-+
| UUID                                 | Name | Instance UUID | Power State | Provisioning State |
Maintenance |
+--------------------------------------+------+--------------+-------------+--------------------+-------------
-+
| c6e63aec-e5ba-4d63-8d37-bd57628258e8 | None | None          | power off   | enroll             |
False       |
| 0362b7b2-5b9c-4113-92e1-0b34a2535d9b | None | None          | power off   | enroll             |
False       |
+--------------------------------------+------+--------------+-------------+--------------------+-------------
-+
```

3. Set the resource class for each node:

```
$ for NODE in `openstack baremetal node list -c UUID -f value` ; do openstack baremetal
node set $NODE --resource-class baremetal ; done
```

4. Configure the kernel and ramdisk for each node:

```
$ for NODE in `openstack baremetal node list -c UUID -f value` ; do openstack baremetal
node manage $NODE ; done
$ openstack overcloud node configure --all-manageable
```

5. Set all nodes to available:

```
$ for NODE in `openstack baremetal node list -c UUID -f value` ; do openstack baremetal
node provide $NODE ; done
```

21.4. USING RULES TO DISCOVER DIFFERENT VENDOR HARDWARE

If you have a heterogeneous hardware environment, you can use introspection rules to assign credentials and remote management credentials. For example, you might want a separate discovery rule to handle your Dell nodes that use DRAC:

1. Create a file named **dell-drac-rules.json** with the following contents:

```
[
  {
    "description": "Set default IPMI credentials",
    "conditions": [
      {"op": "eq", "field": "data://auto_discovered", "value": true},
      {"op": "ne", "field": "data://inventory.system_vendor.manufacturer",
       "value": "Dell Inc."}
    ],
    "actions": [
```

```
            {"action": "set-attribute", "path": "driver_info/ipmi_username",
             "value": "SampleUsername"},
            {"action": "set-attribute", "path": "driver_info/ipmi_password",
             "value": "RedactedSecurePassword"},
            {"action": "set-attribute", "path": "driver_info/ipmi_address",
             "value": "{data[inventory][bmc_address]}"}
        ]
    },
    {
        "description": "Set the vendor driver for Dell hardware",
        "conditions": [
            {"op": "eq", "field": "data://auto_discovered", "value": true},
            {"op": "eq", "field": "data://inventory.system_vendor.manufacturer",
             "value": "Dell Inc."}
        ],
        "actions": [
            {"action": "set-attribute", "path": "driver", "value": "idrac"},
            {"action": "set-attribute", "path": "driver_info/drac_username",
             "value": "SampleUsername"},
            {"action": "set-attribute", "path": "driver_info/drac_password",
             "value": "RedactedSecurePassword"},
            {"action": "set-attribute", "path": "driver_info/drac_address",
             "value": "{data[inventory][bmc_address]}"}
        ]
    }
]
```

Replace the user name and password values in this example to suit your environment:

2. Import the rule into ironic:

```
$ openstack baremetal introspection rule import dell-drac-rules.json
```

CHAPTER 22. CONFIGURING AUTOMATIC PROFILE TAGGING

The introspection process performs a series of benchmark tests. The director saves the data from these tests. You can create a set of policies that use this data in various ways:

- The policies can identify underperforming or unstable nodes and isolate these nodes from use in the overcloud.
- The policies can define whether to tag nodes into specific profiles automatically.

22.1. POLICY FILE SYNTAX

Policy files use a JSON format that contains a set of rules. Each rule defines a description, a condition, and an action. A **description** is a plain text description of the rule, a **condition** defines an evaluation using a key-value pattern, and an **action** is the performance of the condition.

Description

A description is a plain text description of the rule.

Example:

```
"description": "A new rule for my node tagging policy"
```

Conditions

A condition defines an evaluation using the following key-value pattern:

field

Defines the field to evaluate:

- **memory_mb** - The amount of memory for the node in MB.
- **cpus** - The total number of threads for the node CPU.
- **cpu_arch** - The architecture of the node CPU.
- **local_gb** - The total storage space of the node root disk.

op

Defines the operation to use for the evaluation. This includes the following attributes:

- **eq** - Equal to
- **ne** - Not equal to
- **lt** - Less than
- **gt** - Greater than
- **le** - Less than or equal to
- **ge** - Greater than or equal to
- **in-net** - Checks that an IP address is in a given network

- **matches** - Requires a full match against a given regular expression
- **contains** - Requires a value to contain a given regular expression
- **is-empty** - Checks that **field** is empty

invert

Boolean value to define whether to invert the result of the evaluation.

multiple

Defines the evaluation to use if multiple results exist. This parameter includes the following attributes:

- **any** - Requires any result to match
- **all** - Requires all results to match
- **first** - Requires the first result to match

value

Defines the value in the evaluation. If the field and operation result in the value, the condition return a true result. Otherwise, the condition returns a false result.

Example:

```
"conditions": [
  {
    "field": "local_gb",
    "op": "ge",
    "value": 1024
  }
],
```

Actions

If a condition is **true**, the policy performs an action. The action uses the **action** key and additional keys depending on the value of **action**:

- **fail** - Fails the introspection. Requires a **message** parameter for the failure message.
- **set-attribute** - Sets an attribute on an ironic node. Requires a **path** field, which is the path to an ironic attribute (for example, **/driver_info/ipmi_address**), and a **value** to set.
- **set-capability** - Sets a capability on an ironic node. Requires **name** and **value** fields, which are the name and the value for a new capability. This replaces the existing value for this capability. For example, use this to define node profiles.
- **extend-attribute** - The same as **set-attribute** but treats the existing value as a list and appends value to it. If the optional **unique** parameter is set to True, nothing is added if the given value is already in a list.

Example:

```
"actions": [
  {
    "action": "set-capability",
```

```
    "name": "profile",
    "value": "swift-storage"
  }
]
```

22.2. POLICY FILE EXAMPLE

The following is an example JSON file (**rules.json**) that contains introspection rules:

```
[
  {
    "description": "Fail introspection for unexpected nodes",
    "conditions": [
      {
        "op": "lt",
        "field": "memory_mb",
        "value": 4096
      }
    ],
    "actions": [
      {
        "action": "fail",
        "message": "Memory too low, expected at least 4 GiB"
      }
    ]
  },
  {
    "description": "Assign profile for object storage",
    "conditions": [
      {
        "op": "ge",
        "field": "local_gb",
        "value": 1024
      }
    ],
    "actions": [
      {
        "action": "set-capability",
        "name": "profile",
        "value": "swift-storage"
      }
    ]
  },
  {
    "description": "Assign possible profiles for compute and controller",
    "conditions": [
      {
        "op": "lt",
        "field": "local_gb",
        "value": 1024
      },
      {
        "op": "ge",
        "field": "local_gb",
        "value": 40
```

```
      }
    ],
    "actions": [
      {
        "action": "set-capability",
        "name": "compute_profile",
        "value": "1"
      },
      {
        "action": "set-capability",
        "name": "control_profile",
        "value": "1"
      },
      {
        "action": "set-capability",
        "name": "profile",
        "value": null
      }
    ]
  }
]
```

This example consists of three rules:

- Fail introspection if memory is lower than 4096 MiB. You can apply these types of rules if you want to exclude certain nodes from your cloud.
- Nodes with a hard drive size 1 TiB and bigger are assigned the swift-storage profile unconditionally.
- Nodes with a hard drive less than 1 TiB but more than 40 GiB can be either Compute or Controller nodes. You can assign two capabilities (**compute_profile** and **control_profile**) so that the **openstack overcloud profiles match** command can later make the final choice. For this process to succeed, you must remove the existing profile capability, otherwise the existing profile capability has priority.

The profile matching rules do not change any other nodes.

NOTE

Using introspection rules to assign the **profile** capability always overrides the existing value. However, **[PROFILE]_profile** capabilities are ignored for nodes that already have a profile capability.

22.3. IMPORTING POLICY FILES

To import policy files to director, complete the following steps.

Procedure

1. Import the policy file into director:

```
$ openstack baremetal introspection rule import rules.json
```

2. Run the introspection process:

```
$ openstack overcloud node introspect --all-manageable
```

3. After introspection completes, check the nodes and their assigned profiles:

```
$ openstack overcloud profiles list
```

4. If you made a mistake in introspection rules, run the following command to delete all rules:

```
$ openstack baremetal introspection rule purge
```

CHAPTER 23. CREATING WHOLE DISK IMAGES

The main overcloud image is a flat partition image that contains no partitioning information or bootloader. Director uses a separate kernel and ramdisk when it boots nodes and creates a basic partitioning layout when it writes the overcloud image to disk. However, you can create a whole disk image, which includes a partitioning layout, bootloader, and hardened security.

IMPORTANT

The following process uses the director image building feature. Red Hat only supports images that use the guidelines contained in this section. Custom images built outside of these specifications are not supported.

23.1. SECURITY HARDENING MEASURES

The whole disk image includes extra security hardening measures necessary for Red Hat OpenStack Platform deployments where security is an important feature.

Security recommendations for image creation

- The **/tmp** directory is mounted on a separate volume or partition and has the **rw**, **nosuid**, **nodev**, **noexec**, and **relatime** flags.
- The **/var**, **/var/log** and the **/var/log/audit** directories are mounted on separate volumes or partitions, with the **rw** and **relatime** flags.
- The **/home** directory is mounted on a separate partition or volume and has the **rw**, **nodev**, and **relatime** flags.
- Include the following changes to the **GRUB_CMDLINE_LINUX** setting:
  - To enable auditing, add the **audit=1** kernel boot flag.
  - To disable the kernel support for USB using boot loader configuration, add **nousb**.
  - To remove the insecure boot flags, set **crashkernel=auto**.
- Blacklist insecure modules (**usb-storage**, **cramfs**, **freevxfs**, **jffs2**, **hfs**, **hfsplus**, **squashfs**, **udf**, **vfat**) and prevent these modules from loading.
- Remove any insecure packages (**kdump** installed by **kexec-tools** and **telnet**) from the image because they are installed by default.

23.2. WHOLE DISK IMAGE WORKFLOW

To build a whole disk image, complete the following workflow:

1. Download a base Red Hat Enterprise Linux 8 image.
2. Set the environment variables specific to registration.
3. Customize the image by modifying the partition schema and the size.
4. Create the image.

5. Upload the image to director.

23.3. DOWNLOADING THE BASE CLOUD IMAGE

Before you build a whole disk image, you must download an existing cloud image of Red Hat Enterprise Linux to use as a basis.

Procedure

1. Navigate to the Red Hat Customer Portal:
   - https://access.redhat.com/
2. Click **DOWNLOADS** on the top menu.
3. Click **Red Hat Enterprise Linux 8**

NOTE

Enter your customer Customer Portal login details if a prompt appears.

4. Select the KVM Guest Image that you want to download. For example, the KVM Guest Image for the latest Red Hat Enterprise Linux is available on the following page:
   - "Installers and Images for Red Hat Enterprise Linux Server"

23.4. DISK IMAGE ENVIRONMENT VARIABLES

As a part of the disk image building process, the director requires a base image and registration details to obtain packages for the new overcloud image. Define these attributes with the following Linux environment variables.

NOTE

The image building process temporarily registers the image with a Red Hat subscription and unregisters the system when the image building process completes.

To build a disk image, set Linux environment variables that suit your environment and requirements:

DIB_LOCAL_IMAGE

Sets the local image that you want to use as the basis for your whole disk image.

REG_ACTIVATION_KEY

Use an activation key instead of login details as part of the registration process.

REG_AUTO_ATTACH

Defines whether to attach the most compatible subscription automatically.

REG_BASE_URL

The base URL of the content delivery server that contains packages for the image. The default Customer Portal Subscription Management process uses **https://cdn.redhat.com**. If you use a Red Hat Satellite 6 server, set this parameter to the base URL of your Satellite server.

REG_ENVIRONMENT

Registers to an environment within an organization.

REG_METHOD

Sets the method of registration. Use **portal** to register a system to the Red Hat Customer Portal. Use **satellite** to register a system with Red Hat Satellite 6.

REG_ORG

The organization where you want to register the images.

REG_POOL_ID

The pool ID of the product subscription information.

REG_PASSWORD

Sets the password for the user account that registers the image.

REG_REPOS

A comma-separated string of repository names. Each repository in this string is enabled through **subscription-manager**.

Use the following repositories for a security hardened whole disk image:

- **rhel-8-for-x86_64-baseos-eus-rpms**
- **rhel-8-for-x86_64-appstream-eus-rpms**
- **rhel-8-for-x86_64-highavailability-eus-rpms**
- **ansible-2.9-for-rhel-8-x86_64-rpms**
- **openstack-16.1-for-rhel-8-x86_64-rpms**

REG_SAT_URL

The base URL of the Satellite server to register overcloud nodes. Use the Satellite HTTP URL and not the HTTPS URL for this parameter. For example, use http://satellite.example.com and not https://satellite.example.com.

REG_SERVER_URL

Sets the host name of the subscription service to use. The default host name is for the Red Hat Customer Portal at **subscription.rhn.redhat.com**. If you use a Red Hat Satellite 6 server, set this parameter to the host name of your Satellite server.

REG_USER

Sets the user name for the account that registers the image.

Use the following set of example commands to export a set of environment variables and temporarily register a local QCOW2 image to the Red Hat Customer Portal:

```
$ export DIB_LOCAL_IMAGE=./rhel-8.0-x86_64-kvm.qcow2
$ export REG_METHOD=portal
$ export REG_USER="[your username]"
$ export REG_PASSWORD="[your password]"
$ export REG_REPOS="rhel-8-for-x86_64-baseos-eus-rpms \
    rhel-8-for-x86_64-appstream-eus-rpms \
    rhel-8-for-x86_64-highavailability-eus-rpms \
    ansible-2.9-for-rhel-8-x86_64-rpms \
    openstack-16.1-for-rhel-8-x86_64-rpms"
```

23.5. CUSTOMIZING THE DISK LAYOUT

The default security hardened image size is 20G and uses predefined partitioning sizes. However, you must modify the partitioning layout to accommodate overcloud container images. Complete the steps in the following sections to increase the image size to 40G. You can modify the partitioning layout and disk size to further suit your needs.

To modify the partitioning layout and disk size, perform the following steps:

- Modify the partitioning schema using the **DIB_BLOCK_DEVICE_CONFIG** environment variable.
- Modify the global size of the image by updating the **DIB_IMAGE_SIZE** environment variable.

23.6. MODIFYING THE PARTITIONING SCHEMA

You can modify the partitioning schema to alter the partitioning size, create new partitions, or remove existing partitions. Use the following environment variable to define a new partitioning schema:

```
$ export DIB_BLOCK_DEVICE_CONFIG='<yaml_schema_with_partitions>'
```

The following YAML structure represents the modified logical volume partitioning layout to accommodate enough space to pull overcloud container images:

```
export DIB_BLOCK_DEVICE_CONFIG='''
- local_loop:
    name: image0
- partitioning:
    base: image0
    label: mbr
    partitions:
      - name: root
        flags: [ boot,primary ]
        size: 40G
- lvm:
    name: lvm
    base: [ root ]
    pvs:
        - name: pv
          base: root
          options: [ "--force" ]
    vgs:
        - name: vg
          base: [ "pv" ]
          options: [ "--force" ]
    lvs:
        - name: lv_root
          base: vg
          extents: 23%VG
        - name: lv_tmp
          base: vg
          extents: 4%VG
        - name: lv_var
          base: vg
          extents: 45%VG
        - name: lv_log
          base: vg
```

```
        extents: 23%VG
      - name: lv_audit
        base: vg
        extents: 4%VG
      - name: lv_home
        base: vg
        extents: 1%VG
- mkfs:
    name: fs_root
    base: lv_root
    type: xfs
    label: "img-rootfs"
    mount:
      mount_point: /
      fstab:
        options: "rw,relatime"
        fsck-passno: 1
- mkfs:
    name: fs_tmp
    base: lv_tmp
    type: xfs
    mount:
      mount_point: /tmp
      fstab:
        options: "rw,nosuid,nodev,noexec,relatime"
        fsck-passno: 2
- mkfs:
    name: fs_var
    base: lv_var
    type: xfs
    mount:
      mount_point: /var
      fstab:
        options: "rw,relatime"
        fsck-passno: 2
- mkfs:
    name: fs_log
    base: lv_log
    type: xfs
    mount:
      mount_point: /var/log
      fstab:
        options: "rw,relatime"
        fsck-passno: 3
- mkfs:
    name: fs_audit
    base: lv_audit
    type: xfs
    mount:
      mount_point: /var/log/audit
      fstab:
        options: "rw,relatime"
        fsck-passno: 4
- mkfs:
    name: fs_home
    base: lv_home
```

```
    type: xfs
    mount:
      mount_point: /home
      fstab:
        options: "rw,nodev,relatime"
        fsck-passno: 2
'"
```

Use this sample YAML content as a basis for the partition schema of your image. Modify the partition sizes and layout to suit your needs.

NOTE

You must define the correct partition sizes for the image because you cannot resize them after the deployment.

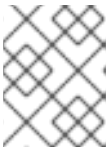
23.7. MODIFYING THE IMAGE SIZE

The global sum of the modified partitioning schema might exceed the default disk size (20G). In this situation, you might need to modify the image size. To modify the image size, edit the configuration files that create the image.

Procedure

1. Create a copy of the **/usr/share/openstack-tripleo-common/image-yaml/overcloud-hardened-images-python3.yaml**:

```
# cp /usr/share/openstack-tripleo-common/image-yaml/overcloud-hardened-images-python3.yaml \
/home/stack/overcloud-hardened-images-python3-custom.yaml
```



NOTE

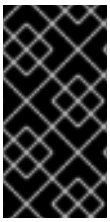
For UEFI whole disk images, use **/usr/share/openstack-tripleo-common/image-yaml/overcloud-hardened-images-uefi-python3.yaml**.

2. Edit the **DIB_IMAGE_SIZE** in the configuration file and adjust the values as necessary:

```
...

environment:
DIB_PYTHON_VERSION: '3'
DIB_MODPROBE_BLACKLIST: 'usb-storage cramfs freevxfs jffs2 hfs hfsplus squashfs udf vfat bluetooth'
DIB_BOOTLOADER_DEFAULT_CMDLINE: 'nofb nomodeset vga=normal console=tty0 console=ttyS0,115200 audit=1 nousb'
DIB_IMAGE_SIZE: '40' 1
COMPRESS_IMAGE: '1'
```

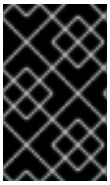
1 Adjust this value to the new total disk size.

3. Save the file.



IMPORTANT

When you deploy the overcloud, the director creates a RAW version of the overcloud image. This means your undercloud must have enough free space to accommodate the RAW image. For example, if you set the security hardened image size to 40G, you must have 40G of space available on the undercloud hard disk.



IMPORTANT

When director writes the image to the physical disk, it creates a 64MB configuration drive primary partition at the end of the disk. When you create your whole disk image, ensure that the size of the physical disk accommodates this extra partition.

23.8. BUILDING THE WHOLE DISK IMAGE

After you set the environment variables and customize the image, create the image using the **openstack overcloud image build** command.

Procedure

1. Run the **openstack overcloud image build** command with all necessary configuration files.

```
# openstack overcloud image build \
--image-name overcloud-hardened-full \
--config-file /home/stack/overcloud-hardened-images-python3-custom.yaml \ 1
--config-file /usr/share/openstack-tripleo-common/image-yaml/overcloud-hardened-images-rhel8.yaml 2
```

1. This is the custom configuration file that contains the new disk size. If you are not using a different custom disk size, use the original **/usr/share/openstack-tripleo-common/image-yaml/overcloud-hardened-images-python3.yaml** file instead. For standard UEFI whole disk images, use **overcloud-hardened-images-uefi-python3.yaml**.

2. For UEFI whole disk images, use **overcloud-hardened-images-uefi-rhel8.yaml**.

This command creates an image called **overcloud-hardened-full.qcow2**, which contains all the necessary security features.

23.9. UPLOADING THE WHOLE DISK IMAGE

Upload the image to the OpenStack Image (glance) service and start using it from the Red Hat OpenStack Platform director. To upload a security hardened image, complete the following steps:

1. Rename the newly generated image and move the image to your **images** directory:

```
# mv overcloud-hardened-full.qcow2 ~/images/overcloud-full.qcow2
```

2. Remove all the old overcloud images:

```
# openstack image delete overcloud-full
# openstack image delete overcloud-full-initrd
# openstack image delete overcloud-full-vmlinuz
```

3. Upload the new overcloud image:

```
# openstack overcloud image upload --image-path /home/stack/images --whole-disk
```

If you want to replace an existing image with the security hardened image, use the **--update-existing** flag. This flag overwrites the original **overcloud-full** image with a new security hardened image.

CHAPTER 24. CONFIGURING DIRECT DEPLOY

When provisioning nodes, director mounts the overcloud base operating system image on an iSCSI mount and then copies the image to disk on each node. Direct deploy is an alternative method that writes disk images from a HTTP location directly to disk on bare metal nodes.

24.1. CONFIGURING THE DIRECT DEPLOY INTERFACE ON THE UNDERCLOUD

The iSCSI deploy interface is the default deploy interface. However, you can enable the direct deploy interface to download an image from a HTTP location to the target disk.

NOTE

Your overcloud node memory **tmpfs** must have at least 8GB of RAM.

Procedure

1. Create or modify a custom environment file **/home/stack/undercloud_custom_env.yaml** and specify the **IronicDefaultDeployInterface**.

```
parameter_defaults:
  IronicDefaultDeployInterface: direct
```

2. By default, the Bare Metal service (ironic) agent on each node obtains the image stored in the Object Storage service (swift) through a HTTP link. Alternatively, ironic can stream this image directly to the node through the **ironic-conductor** HTTP server. To change the service that provides the image, set the **IronicImageDownloadSource** to **http** in the **/home/stack/undercloud_custom_env.yaml** file:

```
parameter_defaults:
  IronicDefaultDeployInterface: direct
  IronicImageDownloadSource: http
```

3. Include the custom environment file in the **DEFAULT** section of the **undercloud.conf** file.

```
custom_env_files = /home/stack/undercloud_custom_env.yaml
```

4. Perform the undercloud installation:

```
$ openstack undercloud install
```

CHAPTER 25. CREATING VIRTUALIZED CONTROL PLANES

A virtualized control plane is a control plane located on virtual machines (VMs) rather than on bare metal. Use a virtualized control plane reduce the number of bare metal machines that you require for the control plane.

This chapter explains how to virtualize your Red Hat OpenStack Platform (RHOSP) control plane for the overcloud using RHOSP and Red Hat Virtualization.

25.1. VIRTUALIZED CONTROL PLANE ARCHITECTURE

Use director to provision an overcloud using Controller nodes that are deployed in a Red Hat Virtualization cluster. You can then deploy these virtualized controllers as the virtualized control plane nodes.

NOTE

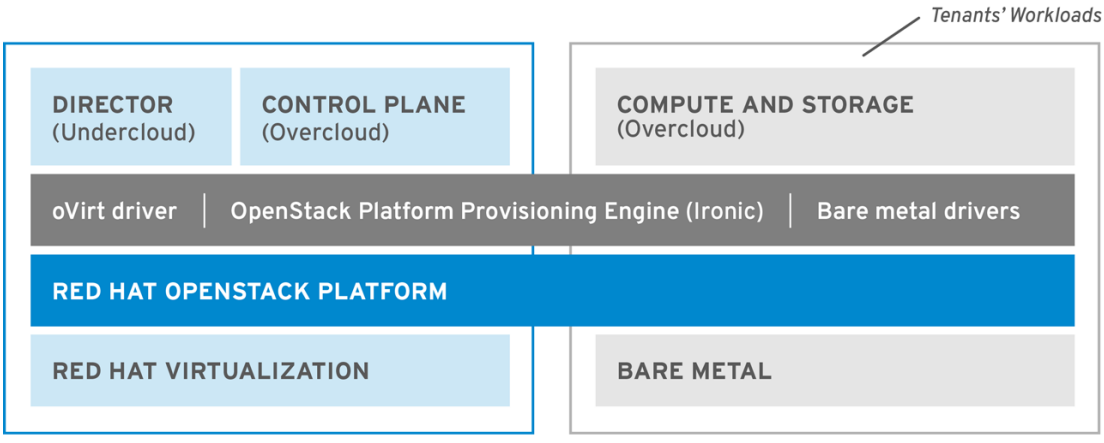
Virtualized Controller nodes are supported only on Red Hat Virtualization.

The following architecture diagram illustrates how to deploy a virtualized control plane. Distribute the overcloud with the Controller nodes running on VMs on Red Hat Virtualization and run the Compute and Storage nodes on bare metal.

NOTE

Run the OpenStack virtualized undercloud on Red Hat Virtualization.

Virtualized control plane architecture



The OpenStack Bare Metal Provisioning service (ironic) includes a driver for Red Hat Virtualization VMs, **staging-ovirt**. You can use this driver to manage virtual nodes within a Red Hat Virtualization environment. You can also use it to deploy overcloud controllers as virtual machines within a Red Hat Virtualization environment.

25.2. BENEFITS AND LIMITATIONS OF VIRTUALIZING YOUR RHOSP OVERCLOUD CONTROL PLANE

Although there are a number of benefits to virtualizing your RHOSP overcloud control plane, this is not an option in every configuration.

Benefits

Virtualizing the overloud control plane has a number of benefits that prevent downtime and improve performance.

- You can allocate resources to the virtualized controllers dynamically, using hot add and hot remove to scale CPU and memory as required. This prevents downtime and facilitates increased capacity as the platform grows.
- You can deploy additional infrastructure VMs on the same Red Hat Virtualization cluster. This minimizes the server footprint in the data center and maximizes the efficiency of the physical nodes.
- You can use composable roles to define more complex RHOSP control planes and allocate resources to specific components of the control plane.
- You can maintain systems without service interruption with the VM live migration feature.
- You can integrate third-party or custom tools that Red Hat Virtualization supports.

Limitations

Virtualized control planes limit the types of configurations that you can use.

- Virtualized Ceph Storage nodes and Compute nodes are not supported.
- Block Storage (cinder) image-to-volume is not supported for back ends that use Fiber Channel. Red Hat Virtualization does not support N_Port ID Virtualization (NPIV). Therefore, Block Storage (cinder) drivers that need to map LUNs from a storage back end to the controllers, where **cinder-volume** runs by default, do not work. You must create a dedicated role for **cinder-volume** instead of including it on the virtualized controllers. For more information, see Composable Services and Custom Roles.

25.3. PROVISIONING VIRTUALIZED CONTROLLERS USING THE RED HAT VIRTUALIZATION DRIVER

Complete the following steps to provision a virtualized RHOSP control plane for the overcloud using RHOSP and Red Hat Virtualization.

Prerequisites

- You must have a 64-bit x86 processor with support for the Intel 64 or AMD64 CPU extensions.
- You must have the following software already installed and configured:
  - Red Hat Virtualization. For more information, see Red Hat Virtualization Documentation Suite.
  - Red Hat OpenStack Platform (RHOSP). For more information, see Director Installation and Usage.
- You must have the virtualized Controller nodes prepared in advance. These requirements are the same as for bare metal Controller nodes. For more information, see Controller Node Requirements.

- You must have the bare metal nodes being used as overcloud Compute nodes, and the storage nodes, prepared in advance. For hardware specifications, see the Compute Node Requirements and Ceph Storage Node Requirements . To deploy overcloud Compute nodes on POWER (ppc64le) hardware, see Red Hat OpenStack Platform for POWER .
- You must have the logical networks created, and your cluster of host networks ready to use network isolation with multiple networks. For more information, see Logical Networks.
- You must have the internal BIOS clock of each node set to UTC to prevent issues with future-dated file timestamps when hwclock synchronizes the BIOS clock before applying the timezone offset.

TIP

To avoid performance bottlenecks, use composable roles and keep the data plane services on the bare metal Controller nodes.

Procedure

1. To enable the **staging-ovirt** driver in director, add the driver to the **enabled_hardware_types** parameter in the **undercloud.conf** configuration file:

```
enabled_hardware_types = ipmi,redfish,ilo,idrac,staging-ovirt
```

2. Verify that the undercloud contains the **staging-ovirt** driver:

```
(undercloud) [stack@undercloud ~]$ openstack baremetal driver list
```

If you have configured the undercloud correctly, this command returns the following result:

```
+---------------------+-----------------------+
| Supported driver(s) | Active host(s)        |
+---------------------+-----------------------+
| idrac               | localhost.localdomain |
| ilo                 | localhost.localdomain |
| ipmi                | localhost.localdomain |
| pxe_drac            | localhost.localdomain |
| pxe_ilo             | localhost.localdomain |
| pxe_ipmitool        | localhost.localdomain |
| redfish             | localhost.localdomain |
| staging-ovirt       | localhost.localdomain |
```

3. Update the overcloud node definition template, for example, **nodes.json**, to register the VMs hosted on Red Hat Virtualization with director. For more information, see Registering Nodes for the Overcloud. Use the following key:value pairs to define aspects of the VMs that you want to deploy with your overcloud:

Table 25.1. Configuring the VMs for the overcloud

Key	Set to this value

Key	Set to this value
pm_type	OpenStack Bare Metal Provisioning (ironic) service driver for oVirt/RHV VMs, **staging-ovirt**.
pm_user	Red Hat Virtualization Manager username.
pm_password	Red Hat Virtualization Manager password.
pm_addr	Hostname or IP of the Red Hat Virtualization Manager server.
pm_vm_name	Name of the virtual machine in Red Hat Virtualization Manager where the controller is created.

For example:

```
{
    "nodes": [
        {
            "name":"osp13-controller-0",
            "pm_type":"staging-ovirt",
            "mac":[
                "00:1a:4a:16:01:56"
            ],
            "cpu":"2",
            "memory":"4096",
            "disk":"40",
            "arch":"x86_64",
            "pm_user":"admin@internal",
            "pm_password":"password",
            "pm_addr":"rhvm.example.com",
            "pm_vm_name":"{osp_curr_ver}-controller-0",
            "capabilities": "profile:control,boot_option:local"
        },
        ...
}
```

Configure one Controller on each Red Hat Virtualization Host

4. Configure an affinity group in Red Hat Virtualization with "soft negative affinity" to ensure high availability is implemented for your controller VMs. For more information, see Affinity Groups.

5. Open the Red Hat Virtualization Manager interface, and use it to map each VLAN to a separate logical vNIC in the controller VMs. For more information, see Logical Networks.

6. Set **no_filter** in the vNIC of the director and controller VMs, and restart the VMs, to disable the MAC spoofing filter on the networks attached to the controller VMs. For more information, see Virtual Network Interface Cards .

7. Deploy the overcloud to include the new virtualized controller nodes in your environment:

```
(undercloud) [stack@undercloud ~]$ openstack overcloud deploy --templates
```

PART V. TROUBLESHOOTING AND TIPS

CHAPTER 26. TROUBLESHOOTING DIRECTOR ERRORS

Errors can occur at certain stages of the director processes. This section contains some information about diagnosing common problems.

26.1. TROUBLESHOOTING NODE REGISTRATION

Issues with node registration usually occur due to issues with incorrect node details. In these situations, validate the template file containing your node details and correct the imported node details.

Procedure

1. Source the **stackrc** file:

```
$ source ~/stackrc
```

2. Run the node import command with the **--validate-only** option. This option validates your node template without performing an import:

```
(undercloud) $ openstack overcloud node import --validate-only ~/nodes.json
Waiting for messages on queue 'tripleo' with no timeout.

Successfully validated environment file
```

3. To fix incorrect details with imported nodes, run the **openstack baremetal** commands to update node details. The following example shows how to change networking details:

   a. Identify the assigned port UUID for the imported node:

```
$ source ~/stackrc
(undercloud) $ openstack baremetal port list --node [NODE UUID]
```

   b. Update the MAC address:

```
(undercloud) $ openstack baremetal port set --address=[NEW MAC] [PORT UUID]
```

   c. Configure a new IPMI address on the node:

```
(undercloud) $ openstack baremetal node set --driver-info ipmi_address=[NEW IPMI
ADDRESS] [NODE UUID]
```

26.2. TROUBLESHOOTING HARDWARE INTROSPECTION

You must run the introspection process to completion. However, **ironic-inspector** times out after a default one hour period if the inspection ramdisk does not respond. Sometimes this indicates a bug in the inspection ramdisk but usually this time-out occurs due to an environment misconfiguration, particularly BIOS boot settings.

To diagnose and resolve common environment misconfiguration issues, complete the following steps:

Procedure

1. Source the **stackrc** file:

```
$ source ~/stackrc
```

2. Director uses OpenStack Object Storage (swift) to save the hardware data that it obtains during the introspection process. If this service is not running, the introspection can fail. Check all services related to OpenStack Object Storage to ensure that the service is running:

```
(undercloud) $ sudo systemctl list-units tripleo_swift*
```

3. Ensure that your nodes are in a **manageable** state. The introspection does not inspect nodes in an **available** state, which is meant for deployment. If you want to inspect nodes that are in an **available** state, change the node status to **manageable** state before introspection:

```
(undercloud) $ openstack baremetal node manage [NODE UUID]
```

4. Configure temporary access to the introspection ramdisk. You can provide either a temporary password or an SSH key to access the node during introspection debugging. Complete the following procedure to configure ramdisk access:

   a. Run the **openssl passwd -1** command with a temporary password to generate an MD5 hash:

```
(undercloud) $ openssl passwd -1 mytestpassword
$1$enjRSyIw$/fYUpJwr6abFy/d.koRgQ/
```

   b. Edit the **/var/lib/ironic/httpboot/inspector.ipxe** file, find the line starting with **kernel**, and append the **rootpwd** parameter and the MD5 hash:

```
kernel http://192.2.0.1:8088/agent.kernel ipa-inspection-callback-
url=http://192.168.0.1:5050/v1/continue ipa-inspection-collectors=default,extra-
hardware,logs systemd.journald.forward_to_console=yes BOOTIF=${mac} ipa-debug=1
ipa-inspection-benchmarks=cpu,mem,disk
rootpwd="$1$enjRSyIw$/fYUpJwr6abFy/d.koRgQ/" selinux=0
```

   Alternatively, append your public SSH key to the **sshkey** parameter.

NOTE

Include quotation marks for both the **rootpwd** and **sshkey** parameters.

5. Run the introspection on the node:

```
(undercloud) $ openstack overcloud node introspect [NODE UUID] --provide
```

   Use the **--provide** option to change the node state to **available** after the introspection completes.

6. Identify the IP address of the node from the **dnsmasq** logs:

```
(undercloud) $ sudo tail -f /var/log/containers/ironic-inspector/dnsmasq.log
```

7. If an error occurs, access the node using the root user and temporary access details:

```
$ ssh root@192.168.24.105
```

Access the node during introspection to run diagnostic commands and troubleshoot the introspection failure.

8. To stop the introspection process, run the following command:

```
(undercloud) $ openstack baremetal introspection abort [NODE UUID]
```

You can also wait until the process times out.

NOTE

Red Hat OpenStack Platform director retries introspection three times after the initial abort. Run the **openstack baremetal introspection abort** command at each attempt to abort the introspection completely.

26.3. TROUBLESHOOTING WORKFLOWS AND EXECUTIONS

The OpenStack Workflow (mistral) service groups multiple OpenStack tasks into workflows. Red Hat OpenStack Platform uses a set of these workflows to perform common functions across the director, including bare metal node control, validations, plan management, and overcloud deployment.

For example, when you run the **openstack overcloud deploy** command, the OpenStack Workflow service executes two workflows. The first workflow uploads the deployment plan:

```
Removing the current plan files
Uploading new plan files
Started Mistral Workflow. Execution ID: aef1e8c6-a862-42de-8bce-073744ed5e6b
Plan updated
```

The second workflow starts the overcloud deployment:

```
Deploying templates in the directory /tmp/tripleoclient-LhRlHX/tripleo-heat-templates
Started Mistral Workflow. Execution ID: 97b64abe-d8fc-414a-837a-1380631c764d
2016-11-28 06:29:26Z [overcloud]: CREATE_IN_PROGRESS  Stack CREATE started
2016-11-28 06:29:26Z [overcloud.Networks]: CREATE_IN_PROGRESS  state changed
2016-11-28 06:29:26Z [overcloud.HeatAuthEncryptionKey]: CREATE_IN_PROGRESS  state
changed
2016-11-28 06:29:26Z [overcloud.ServiceNetMap]: CREATE_IN_PROGRESS  state changed
...
```

The OpenStack Workflow service uses the following objects to track the workflow:

Actions

A particular instruction that OpenStack performs when an associated task runs. Examples include running shell scripts or performing HTTP requests. Some OpenStack components have in-built actions that OpenStack Workflow uses.

Tasks

Defines the action to run and the result of running the action. These tasks usually have actions or other workflows associated with them. When a task completes, the workflow directs to another task, usually depending on whether the task succeeded or failed.

Workflows

A set of tasks grouped together and executed in a specific order.

Executions

Defines a particular action, task, or workflow running.

OpenStack Workflow also provides robust logging of executions, which helps to identify issues with certain command failures. For example, if a workflow execution fails, you can identify the point of failure.

Procedure

1. Source the **stackrc** file:

```
$ source ~/stackrc
```

2. List the workflow executions that have the failed state **ERROR**:

```
(undercloud) $ openstack workflow execution list | grep "ERROR"
```

3. Get the UUID of the failed workflow execution (for example, **dffa96b0-f679-4cd2-a490-4769a3825262**) and view the execution and output:

```
(undercloud) $ openstack workflow execution show dffa96b0-f679-4cd2-a490-4769a3825262
(undercloud) $ openstack workflow execution output show dffa96b0-f679-4cd2-a490-
4769a3825262
```

4. These commands return information about the failed task in the execution. The **openstack workflow execution show** command also displays the workflow that was used for the execution (for example, **tripleo.plan_management.v1.publish_ui_logs_to_swift**). You can view the full workflow definition with the following command:

```
(undercloud) $ openstack workflow definition show
tripleo.plan_management.v1.publish_ui_logs_to_swift
```

This is useful for identifying where in the workflow a particular task occurs.

5. View action executions and their results using a similar command syntax:

```
(undercloud) $ openstack action execution list
(undercloud) $ openstack action execution show 8a68eba3-0fec-4b2a-adc9-5561b007e886
(undercloud) $ openstack action execution output show 8a68eba3-0fec-4b2a-adc9-
5561b007e886
```

This is useful for identifying a specific action that causes issues.

26.4. TROUBLESHOOTING OVERCLOUD CREATION AND DEPLOYMENT

The initial creation of the overcloud occurs with the OpenStack Orchestration (heat) service. If an overcloud deployment fails, use the OpenStack clients and service log files to diagnose the failed deployment.

Procedure

1. Source the **stackrc** file:

```
$ source ~/stackrc
```

2. Run the deployment failures command:

```
$ openstack overcloud failures
```

3. Run the following command to display the details of the failure:

```
(undercloud) $ openstack stack failures list <OVERCLOUD_NAME> --long
```

Replace **<OVERCLOUD_NAME>** with the name of your overcloud.

4. Run the following command to identify the stacks that failed:

```
(undercloud) $ openstack stack list --nested --property status=FAILED
```

26.5. TROUBLESHOOTING NODE PROVISIONING

The OpenStack Orchestration (heat) service controls the provisioning process. If node provisioning fails, use the OpenStack clients and service log files to diagnose the issues.

Procedure

1. Source the **stackrc** file:

```
$ source ~/stackrc
```

2. Check the bare metal service to see all registered nodes and their current status:

```
(undercloud) $ openstack baremetal node list

+----------+------+---------------+-------------+-----------------+-------------+
| UUID     | Name | Instance UUID | Power State | Provision State | Maintenance |
+----------+------+---------------+-------------+-----------------+-------------+
| f1e261...| None | None          | power off   | available       | False       |
| f0b8c1...| None | None          | power off   | available       | False       |
+----------+------+---------------+-------------+-----------------+-------------+
```

All nodes available for provisioning should have the following states set:

- **Maintenance** set to **False**.
- **Provision State** set to **available** before provisioning.

The following table outlines some common provisioning failure scenarios.

Problem	Cause	Solution
Maintenance sets itself to **True** automatically.	The director cannot access the power management for the nodes.	Check the credentials for node power management.
Provision State is set to **available** but nodes do not provision.	The problem occurred before bare metal deployment started.	Check the node details including the profile and flavor mapping. Check that the node hardware details are within the requirements for the flavor.
Provision State is set to **wait call-back** for a node.	The node provisioning process has not yet finished for this node.	Wait until this status changes. Otherwise, connect to the virtual console of the node and check the output.
Provision State is **active** and **Power State** is **power on** but the nodes do not respond.	The node provisioning has finished successfully and there is a problem during the post-deployment configuration step.	Diagnose the node configuration process. Connect to the virtual console of the node and check the output.
Provision State is **error** or **deploy failed**.	Node provisioning has failed.	View the bare metal node details with the **openstack baremetal node show** command and check the **last_error** field, which contains error description.

26.6. TROUBLESHOOTING IP ADDRESS CONFLICTS DURING PROVISIONING

Introspection and deployment tasks fail if the destination hosts are allocated an IP address that is already in use. To prevent these failures, you can perform a port scan of the Provisioning network to determine whether the discovery IP range and host IP range are free.

Procedure

1. Install **nmap**:

```
$ sudo dnf install nmap
```

2. Use **nmap** to scan the IP address range for active addresses. This example scans the 192.168.24.0/24 range, replace this with the IP subnet of the Provisioning network (using CIDR bitmask notation):

```
$ sudo nmap -sn 192.168.24.0/24
```

3. Review the output of the **nmap** scan. For example, you should see the IP address of the undercloud, and any other hosts that are present on the subnet:

```
$ sudo nmap -sn 192.168.24.0/24

Starting Nmap 6.40 ( http://nmap.org ) at 2015-10-02 15:14 EDT
```

```
Nmap scan report for 192.168.24.1
Host is up (0.00057s latency).
Nmap scan report for 192.168.24.2
Host is up (0.00048s latency).
Nmap scan report for 192.168.24.3
Host is up (0.00045s latency).
Nmap scan report for 192.168.24.5
Host is up (0.00040s latency).
Nmap scan report for 192.168.24.9
Host is up (0.00019s latency).
Nmap done: 256 IP addresses (5 hosts up) scanned in 2.45 seconds
```

If any of the active IP addresses conflict with the IP ranges in undercloud.conf, you must either change the IP address ranges or release the IP addresses before you introspect or deploy the overcloud nodes.

26.7. TROUBLESHOOTING "NO VALID HOST FOUND" ERRORS

Sometimes the **/var/log/nova/nova-conductor.log** contains the following error:

```
NoValidHost: No valid host was found. There are not enough hosts available.
```

This error occurs when the Compute Scheduler cannot find a bare metal node that is suitable for booting the new instance. This usually means that there is a mismatch between resources that the Compute service expects to find and resources that the Bare Metal service advertised to Compute. To check that there is a mismatch error, complete the following steps:

Procedure

1. Source the **stackrc** file:

```
$ source ~/stackrc
```

2. Check that the introspection succeeded on the node. If the introspection fails, check that each node contains the required ironic node properties:

```
(undercloud) $ openstack baremetal node show [NODE UUID]
```

Check that the **properties** JSON field has valid values for keys **cpus**, **cpu_arch**, **memory_mb** and **local_gb**.

3. Ensure that the Compute flavor that is mapped to the node does not exceed the node properties for the required number of nodes:

```
(undercloud) $ openstack flavor show [FLAVOR NAME]
```

4. Run the **openstack baremetal node list** command to ensure that there are sufficient nodes in the available state. Nodes in **manageable** state usually signify a failed introspection.

5. Run the **openstack baremetal node list** command and ensure that the nodes are not in maintenance mode. If a node changes to maintenance mode automatically, the likely cause is an issue with incorrect power management credentials. Check the power management credentials and then remove maintenance mode:

```
(undercloud) $ openstack baremetal node maintenance unset [NODE UUID]
```

6. If you are using automatic profile tagging, check that you have enough nodes that correspond to each flavor and profile. Run the **openstack baremetal node show** command on a node and check the **capabilities** key in the **properties** field. For example, a node tagged for the Compute role contains the **profile:compute** value.

7. You must wait for node information to propagate from Bare Metal to Compute after introspection. However, if you performed some steps manually, there might be a short period of time when nodes are not available to the Compute service (nova). Use the following command to check the total resources in your system:

```
(undercloud) $ openstack hypervisor stats show
```

26.8. TROUBLESHOOTING OVERCLOUD CONFIGURATION

OpenStack Platform director uses Ansible to configure the overcloud. Complete the following steps to diagnose Ansible playbook errors (**config-download**) on the overcloud.

Procedure

1. Ensure that the **stack** user has access to the files in the **/var/lib/mistral** directory on the **undercloud**:

```
$ sudo setfacl -R -m u:stack:rwx /var/lib/mistral
```

   This command retains **mistral** user access to the directory.

2. Change to the working directory for the **config-download** files. This is usually **/var/lib/mistral/overcloud/**.

```
$ cd /var/lib/mistral/overcloud/
```

3. Search the **ansible.log** file for the point of failure.

```
$ less ansible.log
```

   Make a note of the step that failed.

4. Find the step that failed in the **config-download** playbooks within the working directory to identify the action that ocurred.

26.9. TROUBLESHOOTING CONTAINER CONFIGURATION

OpenStack Platform director uses **paunch** to launch containers, **podman** to manage containers, and **puppet** to create container configuration. This procedure shows how to diagnose a container when errors occur.

Accessing the host

1. Source the **stackrc** file:

```
$ source ~/stackrc
```

2. Get the IP address of the node with the container failure.

```
(undercloud) $ openstack server list
```

3. Log in to the node:

```
(undercloud) $ ssh heat-admin@192.168.24.60
```

4. Change to the root user:

```
$ sudo -i
```

Identifying failed containers

1. View all containers:

```
$ podman ps --all
```

Identify the failed container. The failed container usually exits with a non-zero status.

Checking container logs

1. Each container retains standard output from its main process. Use this output as a log to help determine what actually occurs during a container run. For example, to view the log for the **keystone** container, run the following command:

```
$ sudo podman logs keystone
```

In most cases, this log contains information about the cause of a container failure.

2. The host also retains the **stdout** log for the failed service. You can find the **stdout** logs in **/var/log/containers/stdouts/**. For example, to view the log for a failed **keystone** container, run the following command:

```
$ cat /var/log/containers/stdouts/keystone.log
```

Inspecting containers

In some situations, you might need to verify information about a container. For example, use the following command to view **keystone** container data:

```
$ sudo podman inspect keystone
```

This command returns a JSON object containing low-level configuration data. You can pipe the output to the **jq** command to parse specific data. For example, to view the container mounts for the **keystone** container, run the following command:

```
$ sudo podman inspect keystone | jq .[0].Mounts
```

You can also use the **--format** option to parse data to a single line, which is useful for running commands against sets of container data. For example, to recreate the options used to run the **keystone** container, use the following **inspect** command with the **--format** option:

```
$ sudo podman inspect --format='{{range .Config.Env}} -e "{{.}}" {{end}} {{range .Mounts}} -v
{{.Source}}:{{.Destination}}:{{ join .Options "," }}{{end}} -ti {{.Config.Image}}' keystone
```

NOTE

The **--format** option uses Go syntax to create queries.

Use these options in conjunction with the **podman run** command to recreate the container for troubleshooting purposes:

```
$ OPTIONS=$( sudo podman inspect --format='{{range .Config.Env}} -e "{{.}}" {{end}} {{range
.Mounts}} -v {{.Source}}:{{.Destination}}{{if .Mode}}:{{.Mode}}{{end}}{{end}} -ti {{.Config.Image}}'
keystone )
$ sudo podman run --rm $OPTIONS /bin/bash
```

Running commands in a container

In some cases, you might need to obtain information from within a container through a specific Bash command. In this situation, use the following **podman** command to execute commands within a running container. For example, run the **podman exec** command to run a command inside the **keystone** container:

```
$ sudo podman exec -ti keystone <COMMAND>
```

NOTE

The **-ti** options run the command through an interactive pseudoterminal.

Replace **<COMMAND>** with the command you want to run. For example, each container has a health check script to verify the service connection. You can run the health check script for **keystone** with the following command:

```
$ sudo podman exec -ti keystone /openstack/healthcheck
```

To access the container shell, run **podman exec** using **/bin/bash** as the command you want to run inside the container:

```
$ sudo podman exec -ti keystone /bin/bash
```

Viewing a container filesystem

1. To view the file system for the failed container, run the **podman mount** command. For example, to view the file system for a failed **keystone** container, run the following command:

   ```
   $ podman mount keystone
   ```

   This provides a mounted location to view the filesystem contents:

   ```
   /var/lib/containers/storage/overlay/78946a109085aeb8b3a350fc20bd8049a08918d74f573396d
   7358270e711c610/merged
   ```

This is useful for viewing the Puppet reports within the container. You can find these reports in the **var/lib/puppet/** directory within the container mount.

Exporting a container

When a container fails, you might need to investigate the full contents of the file. In this case, you can export the full file system of a container as a **tar** archive. For example, to export the **keystone** container file system, run the following command:

```
$ sudo podman export keystone -o keystone.tar
```

This command creates the **keystone.tar** archive, which you can extract and explore.

26.10. TROUBLESHOOTING COMPUTE NODE FAILURES

Compute nodes use the Compute service to perform hypervisor-based operations. This means the main diagnosis for Compute nodes revolves around this service.

Procedure

1. Source the **stackrc** file:

```
$ source ~/stackrc
```

2. Get the IP address of the Compute node that contains the failure:

```
(undercloud) $ openstack server list
```

3. Log in to the node:

```
(undercloud) $ ssh heat-admin@192.168.24.60
```

4. Change to the root user:

```
$ sudo -i
```

5. View the status of the container:

```
$ sudo podman ps -f name=nova_compute
```

6. The primary log file for Compute nodes is **/var/log/containers/nova/nova-compute.log**. If issues occur with Compute node communication, use this file to begin the diagnosis.

7. If you perform maintenance on the Compute node, migrate the existing instances from the host to an operational Compute node, then disable the node.

26.11. CREATING AN SOSREPORT

If you need to contact Red Hat for support with Red Hat OpenStack Platform, you might need to generate an **sosreport**. For more information about creating an **sosreport**, see:

- "How to collect all required logs for Red Hat Support to investigate an OpenStack issue"

26.12. LOG LOCATIONS

Use the following logs to gather information about the undercloud and overcloud when you troubleshoot issues.

Table 26.1. Logs on both the undercloud and overcloud nodes

Information	Log location
Containerized service logs	**/var/log/containers/**
Standard output from containerized services	**/var/log/containers/stdouts**
Ansible configuration logs	**/var/lib/mistral/overcloud/ansible.log**

Table 26.2. Additional logs on the undercloud node

Information	Log location
Command history for **openstack overcloud deploy**	**/home/stack/.tripleo/history**
Undercloud installation log	**/home/stack/install-undercloud.log**

Table 26.3. Additional logs on the overcloud nodes

Information	Log location
Cloud-Init Log	**/var/log/cloud-init.log**
High availability log	**/var/log/pacemaker.log**

CHAPTER 27. TIPS FOR UNDERCLOUD AND OVERCLOUD SERVICES

This section provides advice on tuning and managing specific OpenStack services on the undercloud.

27.1. REVIEW THE DATABASE FLUSH INTERVALS

Some services use a **cron** container to flush old content from the database.

- OpenStack Identity (keystone): Flush expired tokens.
- OpenStack Orchestration (heat): Flush expired deleted template data.
- OpenStack Compute (nova): Flush expired deleted instance data.

The default flush periods for each service are listed in this table:

Service	Database content flushed	Default flush period
OpenStack Identity (keystone)	Expired tokens	Every hour
OpenStack Orchestration (heat)	Deleted template data that has expired and is older than 30 days	Every day
OpenStack Compute (nova)	Archive deleted instance data	Every day
OpenStack Compute (nova)	Flush archived data older than 14 days	Every day

The following tables outline the parameters that you can use to control these **cron** jobs.

Table 27.1. OpenStack Identity (keystone) cron parameters

Parameter	Description
KeystoneCronTokenFlushMinute	Cron to purge expired tokens - Minute. The default value is: **1**
KeystoneCronTokenFlushHour	Cron to purge expired tokens - Hour. The default value is: *****
KeystoneCronTokenFlushMonthday	Cron to purge expired tokens - Month Day. The default value is: *****
KeystoneCronTokenFlushMonth	Cron to purge expired tokens - Month. The default value is: *****
KeystoneCronTokenFlushWeekday	Cron to purge expired tokens - Week Day. The default value is: *****

Table 27.2. OpenStack Orchestration (heat) cron parameters

Parameter	Description
HeatCronPurgeDeletedAge	Cron to purge database entries marked as deleted and older than $age - Age. The default value is: **30**
HeatCronPurgeDeletedAgeType	Cron to purge database entries marked as deleted and older than $age - Age type. The default value is: **days**
HeatCronPurgeDeletedMinute	Cron to purge database entries marked as deleted and older than $age - Minute. The default value is: **1**
HeatCronPurgeDeletedHour	Cron to purge database entries marked as deleted and older than $age - Hour. The default value is: **0**
HeatCronPurgeDeletedMonthday	Cron to purge database entries marked as deleted and older than $age - Month Day. The default value is: *****
HeatCronPurgeDeletedMonth	Cron to purge database entries marked as deleted and older than $age - Month. The default value is: *****
HeatCronPurgeDeletedWeekday	Cron to purge database entries marked as deleted and older than $age - Week Day. The default value is: *****

Table 27.3. OpenStack Compute (nova) cron parameters

Parameter	Description
NovaCronArchiveDeleteRowsMaxRows	Cron to move deleted instances to another table - Max Rows. The default value is: **100**
NovaCronArchiveDeleteRowsPurge	Purge shadow tables immediately after scheduled archiving. The default value is: **False**
NovaCronArchiveDeleteRowsMinute	Cron to move deleted instances to another table - Minute. The default value is: **1**
NovaCronArchiveDeleteRowsHour	Cron to move deleted instances to another table - Hour. The default value is: **0**
NovaCronArchiveDeleteRowsMonthday	Cron to move deleted instances to another table - Month Day. The default value is: *****
NovaCronArchiveDeleteRowsMonth	Cron to move deleted instances to another table - Month. The default value is: *****

NovaCronArchiveDeleteRowsWeekday	Cron to move deleted instances to another table - Week Day. The default value is: *
NovaCronArchiveDeleteRowsUntilComplete	Cron to move deleted instances to another table - Until complete. The default value is: **True**
NovaCronPurgeShadowTablesAge	Cron to purge shadow tables - Age This will define the retention policy when purging the shadow tables in days. 0 means, purge data older than today in shadow tables. The default value is: **14**
NovaCronPurgeShadowTablesMinute	Cron to purge shadow tables - Minute. The default value is: **0**
NovaCronPurgeShadowTablesHour	Cron to purge shadow tables - Hour. The default value is: **5**
NovaCronPurgeShadowTablesMonthday	Cron to purge shadow tables - Month Day. The default value is: *
NovaCronPurgeShadowTablesMonth	Cron to purge shadow tables - Month. The default value is: *
NovaCronPurgeShadowTablesWeekday	Cron to purge shadow tables - Week Day. The default value is: *`

To adjust these intervals, create an environment file that contains your token flush interval for the respective services and add this file to the **custom_env_files** parameter in your **undercloud.conf** file. For example, to change the OpenStack Identity (keystone) token flush to 30 minutes, use the following snippets

keystone-cron.yaml

```
parameter_defaults:
  KeystoneCronTokenFlushMinute: '0/30'
```

undercloud.yaml

```
custom_env_files: keystone-cron.yaml
```

Then rerun the **openstack undercloud install** command.

```
$ openstack undercloud install
```

NOTE

You can also use these parameters for your overcloud. For more information, see the *Overcloud Parameters* guide.

27.2. TUNING DEPLOYMENT PERFORMANCE

OpenStack Platform director uses OpenStack Orchestration (heat) to conduct the main deployment and provisioning functions. Heat uses a series of workers to execute deployment tasks. To calculate the default number of workers, the director heat configuration halves the total CPU thread count of the undercloud. In this instance, thread count refers to the number of CPU cores multiplied by the hyper-threading value]. For example, if your undercloud has a CPU with 16 threads, heat spawns 8 workers by default. The director configuration also uses a minimum and maximum cap by default:

Service	Minimum	Maximum
OpenStack Orchestration (heat)	4	24

However, you can set the number of workers manually with the **HeatWorkers** parameter in an environment file:

heat-workers.yaml

```
parameter_defaults:
  HeatWorkers: 16
```

undercloud.yaml

```
custom_env_files: heat-workers.yaml
```

27.3. RUNNING SWIFT-RING-BUILDER IN A CONTAINER

To manage your Object Storage (swift) rings, use the **swift-ring-builder** commands inside the server containers:

- **swift_object_server**
- **swift_container_server**
- **swift_account_server**

For example, to view information about your swift object rings, run the following command:

```
$ sudo podman exec -ti -u swift swift_object_server swift-ring-builder /etc/swift/object.builder
```

You can run this command on both the undercloud and overcloud nodes.

27.4. CHANGING THE SSL/TLS CIPHER RULES FOR HAPROXY

If you enabled SSL/TLS in the undercloud (see Section 4.2, “Director configuration parameters”), you might want to harden the SSL/TLS ciphers and rules that are used with the HAProxy configuration. This hardening helps to avoid SSL/TLS vulnerabilities, such as the POODLE vulnerability.

Set the following hieradata using the **hieradata_override** undercloud configuration option:

tripleo::haproxy::ssl_cipher_suite

The cipher suite to use in HAProxy.

tripleo::haproxy::ssl_options

The SSL/TLS rules to use in HAProxy.

For example, you might want to use the following cipher and rules:

- Cipher: **ECDHE-ECDSA-CHACHA20-POLY1305:ECDHE-RSA-CHACHA20-POLY1305:ECDHE-ECDSA-AES128-GCM-SHA256:ECDHE-RSA-AES128-GCM-SHA256:ECDHE-ECDSA-AES256-GCM-SHA384:ECDHE-RSA-AES256-GCM-SHA384:DHE-RSA-AES128-GCM-SHA256:DHE-RSA-AES256-GCM-SHA384:ECDHE-ECDSA-AES128-SHA256:ECDHE-RSA-AES128-SHA256:ECDHE-ECDSA-AES128-SHA:ECDHE-RSA-AES256-SHA384:ECDHE-RSA-AES128-SHA:ECDHE-ECDSA-AES256-SHA384:ECDHE-ECDSA-AES256-SHA:ECDHE-RSA-AES256-SHA:DHE-RSA-AES128-SHA256:DHE-RSA-AES128-SHA:DHE-RSA-AES256-SHA256:DHE-RSA-AES256-SHA:ECDHE-ECDSA-DES-CBC3-SHA:ECDHE-RSA-DES-CBC3-SHA:EDH-RSA-DES-CBC3-SHA:AES128-GCM-SHA256:AES256-GCM-SHA384:AES128-SHA256:AES256-SHA256:AES128-SHA:AES256-SHA:DES-CBC3-SHA:!DSS**
- Rules: **no-sslv3 no-tls-tickets**

Create a hieradata override file (**haproxy-hiera-overrides.yaml**) with the following content:

```
tripleo::haproxy::ssl_cipher_suite: ECDHE-ECDSA-CHACHA20-POLY1305:ECDHE-RSA-CHACHA20-POLY1305:ECDHE-ECDSA-AES128-GCM-SHA256:ECDHE-RSA-AES128-GCM-SHA256:ECDHE-ECDSA-AES256-GCM-SHA384:ECDHE-RSA-AES256-GCM-SHA384:DHE-RSA-AES128-GCM-SHA256:DHE-RSA-AES256-GCM-SHA384:ECDHE-ECDSA-AES128-SHA256:ECDHE-RSA-AES128-SHA256:ECDHE-ECDSA-AES128-SHA:ECDHE-RSA-AES256-SHA384:ECDHE-RSA-AES128-SHA:ECDHE-ECDSA-AES256-SHA384:ECDHE-ECDSA-AES256-SHA:ECDHE-RSA-AES256-SHA:DHE-RSA-AES128-SHA256:DHE-RSA-AES128-SHA:DHE-RSA-AES256-SHA256:DHE-RSA-AES256-SHA:ECDHE-ECDSA-DES-CBC3-SHA:ECDHE-RSA-DES-CBC3-SHA:EDH-RSA-DES-CBC3-SHA:AES128-GCM-SHA256:AES256-GCM-SHA384:AES128-SHA256:AES256-SHA256:AES128-SHA:AES256-SHA:DES-CBC3-SHA:!DSS
tripleo::haproxy::ssl_options: no-sslv3 no-tls-tickets
```

NOTE

The cipher collection is one continuous line.

Set the **hieradata_override** parameter in the **undercloud.conf** file to use the hieradata override file you created before you ran **openstack undercloud install**:

```
[DEFAULT]
...
hieradata_override = haproxy-hiera-overrides.yaml
...
```

PART VI. APPENDICES

APPENDIX A. POWER MANAGEMENT DRIVERS

Although IPMI is the main method that director uses for power management control, director also supports other power management types. This appendix contains a list of the power management features that director supports. Use these power management settings when you register nodes for the overcloud. For more information, see Registering nodes for the overcloud.

A.1. INTELLIGENT PLATFORM MANAGEMENT INTERFACE (IPMI)

The standard power management method when you use a baseboard management controller (BMC).

pm_type

Set this option to **ipmi**.

pm_user; pm_password

The IPMI username and password.

pm_addr

The IP address of the IPMI controller.

pm_port (Optional)

The port to connect to the IPMI controller.

A.2. REDFISH

A standard RESTful API for IT infrastructure developed by the Distributed Management Task Force (DMTF)

pm_type

Set this option to **redfish**.

pm_user; pm_password

The Redfish username and password.

pm_addr

The IP address of the Redfish controller.

pm_system_id

The canonical path to the system resource. This path must include the root service, version, and the path/unqiue ID for the system. For example: **/redfish/v1/Systems/CX34R87**.

redfish_verify_ca

If the Redfish service in your baseboard management controller (BMC) is not configured to use a valid TLS certificate signed by a recognized certificate authority (CA), the Redfish client in ironic fails to connect to the BMC. Set the **redfish_verify_ca** option to **false** to mute the error. However, be aware that disabling BMC authentication compromises the access security of your BMC.

A.3. DELL REMOTE ACCESS CONTROLLER (DRAC)

DRAC is an interface that provides out-of-band remote management features including power management and server monitoring.

pm_type

Set this option to **idrac**.

pm_user; pm_password

The DRAC username and password.

pm_addr

The IP address of the DRAC host.

A.4. INTEGRATED LIGHTS-OUT (ILO)

iLO from Hewlett-Packard is an interface that provides out-of-band remote management features including power management and server monitoring.

pm_type

Set this option to **ilo**.

pm_user; pm_password

The iLO username and password.

pm_addr

The IP address of the iLO interface.

- To enable this driver, add **ilo** to the **enabled_hardware_types** option in your **undercloud.conf** and rerun **openstack undercloud install**.
- Director also requires an additional set of utilities for iLo. Install the **python3-proliantutils** package and restart the **tripleo-ironic-conductor** service:

```
$ sudo dnf install python3-proliantutils
$ sudo systemctl restart tripleo-ironic-conductor.service
```

- HP nodes must have a minimum ILO firmware version of 1.85 (May 13 2015) for successful introspection. Director has been successfully tested with nodes using this ILO firmware version.
- Using a shared iLO port is not supported.

A.5. FUJITSU INTEGRATED REMOTE MANAGEMENT CONTROLLER (IRMC)

Fujitsu iRMC is a Baseboard Management Controller (BMC) with integrated LAN connection and extended functionality. This driver focuses on the power management for bare metal systems connected to the iRMC.

IMPORTANT

iRMC S4 or higher is required.

pm_type

Set this option to **irmc**.

pm_user; pm_password

The username and password for the iRMC interface.

pm_addr

The IP address of the iRMC interface.

pm_port (Optional)

The port to use for iRMC operations. The default is 443.

pm_auth_method (Optional)

The authentication method for iRMC operations. Use either **basic** or **digest**. The default is **basic**

pm_client_timeout (Optional)

Timeout (in seconds) for iRMC operations. The default is 60 seconds.

pm_sensor_method (Optional)

Sensor data retrieval method. Use either **ipmitool** or **scci**. The default is **ipmitool**.

- To enable this driver, add **irmc** to the **enabled_hardware_types** option in your **undercloud.conf** and rerun the **openstack undercloud install** command.
- If you enable SCCI as the sensor method, you must also install an additional set of utilities. Install the **python3-scciclient** package and restart the **tripleo-ironic-conductor** service:

```
$ dnf install python3-scciclient
$ sudo systemctl restart tripleo-ironic-conductor.service
```

A.6. RED HAT VIRTUALIZATION

This driver provides control over virtual machines in Red Hat Virtualization (RHV) through its RESTful API.

pm_type

Set this option to **staging-ovirt**.

pm_user; pm_password

The username and password for your RHV environment. The username also includes the authentication provider. For example: **admin@internal**.

pm_addr

The IP address of the RHV REST API.

pm_vm_name

The name of the virtual machine to control.

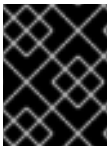
mac

A list of MAC addresses for the network interfaces on the node. Use only the MAC address for the Provisioning NIC of each system.

- To enable this driver, add **staging-ovirt** to the **enabled_hardware_types** option in your **undercloud.conf** and rerun the **openstack undercloud install** command.

A.7. MANUAL-MANAGEMENT DRIVER

Use the **manual-management** driver to control bare metal devices that do not have power management. Director does not control the registered bare metal devices, and you must perform manual power operations at certain points in the introspection and deployment processes.



IMPORTANT

This option is available only for testing and evaluation purposes. It is not recommended for Red Hat OpenStack Platform enterprise environments.

pm_type

Set this option to **manual-management**.

- This driver does not use any authentication details because it does not control power management.
- To enable this driver, add **manual-management** to the **enabled_hardware_types** option in your **undercloud.conf** and rerun the **openstack undercloud install** command.
- In your **instackenv.json** node inventory file, set the **pm_type** to **manual-management** for the nodes that you want to manage manually.
- When performing introspection on nodes, manually start the nodes after running the **openstack overcloud node introspect** command.
- When performing overcloud deployment, check the node status with the **ironic node-list** command. Wait until the node status changes from **deploying** to **deploy wait-callback** and then manually start the nodes.
- After the overcloud provisioning process completes, reboot the nodes. To check the completion of provisioning, check the node status with the **openstack baremetal node list** command, wait until the node status changes to **active**, then manually reboot all overcloud nodes.

APPENDIX B. RED HAT OPENSTACK PLATFORM FOR POWER

In a new Red Hat OpenStack Platform installation, you can deploy overcloud Compute nodes on POWER (ppc64le) hardware. For the Compute node cluster, you can use the same architecture, or use a combination of x86_64 and ppc64le systems. The undercloud, Controller nodes, Ceph Storage nodes, and all other systems are supported only on x86_64 hardware.

B.1. CEPH STORAGE

When you configure access to external Ceph in a multi-architecture cloud, set the **CephAnsiblePlaybook** parameter to **/usr/share/ceph-ansible/site.yml.sample** and include your client key and other Ceph-specific parameters.

For example:

```
parameter_defaults:
  CephAnsiblePlaybook: /usr/share/ceph-ansible/site.yml.sample
  CephClientKey: AQDLOh1VgEp6FRAAFzT7Zw+Y9V6JJExQAsRnRQ==
  CephClusterFSID: 4b5c8c0a-ff60-454b-a1b4-9747aa737d19
  CephExternalMonHost: 172.16.1.7, 172.16.1.8
```

B.2. COMPOSABLE SERVICES

The following services typically form part of the Controller node and are available for use in custom roles as Technology Preview:

- Block Storage service (cinder)
- Image service (glance)
- Identity service (keystone)
- Networking service (neutron)
- Object Storage service (swift)

NOTE

Red Hat does not support features in Technology Preview.

For more information about composable services, see composable services and custom roles in the *Advanced Overcloud Customization* guide. Use the following example to understand how to move the listed services from the Controller node to a dedicated ppc64le node:

```
(undercloud) [stack@director ~]$ rsync -a /usr/share/openstack-tripleo-heat-templates/. ~/templates
(undercloud) [stack@director ~]$ cd ~/templates/roles
(undercloud) [stack@director roles]$ cat <<EO_TEMPLATE >ControllerPPC64LE.yaml
###############################################################################
# Role: ControllerPPC64LE                                                     #
###############################################################################
- name: ControllerPPC64LE
  description: |
    Controller role that has all the controller services loaded and handles
```

```
  Database, Messaging and Network functions.
CountDefault: 1
tags:
  - primary
  - controller
networks:
  - External
  - InternalApi
  - Storage
  - StorageMgmt
  - Tenant
# For systems with both IPv4 and IPv6, you may specify a gateway network for
# each, such as ['ControlPlane', 'External']
default_route_networks: ['External']
HostnameFormatDefault: '%stackname%-controllerppc64le-%index%'
ImageDefault: ppc64le-overcloud-full
ServicesDefault:
  - OS::TripleO::Services::Aide
  - OS::TripleO::Services::AuditD
  - OS::TripleO::Services::CACerts
  - OS::TripleO::Services::CephClient
  - OS::TripleO::Services::CephExternal
  - OS::TripleO::Services::CertmongerUser
  - OS::TripleO::Services::CinderApi
  - OS::TripleO::Services::CinderBackendDellPs
  - OS::TripleO::Services::CinderBackendDellSc
  - OS::TripleO::Services::CinderBackendDellEMCUnity
  - OS::TripleO::Services::CinderBackendDellEMCVMAXISCSI
  - OS::TripleO::Services::CinderBackendDellEMCVNX
  - OS::TripleO::Services::CinderBackendDellEMCXTREMIOISCSI
  - OS::TripleO::Services::CinderBackendNetApp
  - OS::TripleO::Services::CinderBackendScaleIO
  - OS::TripleO::Services::CinderBackendVRTSHyperScale
  - OS::TripleO::Services::CinderBackup
  - OS::TripleO::Services::CinderHPELeftHandISCSI
  - OS::TripleO::Services::CinderScheduler
  - OS::TripleO::Services::CinderVolume
  - OS::TripleO::Services::Collectd
  - OS::TripleO::Services::Docker
  - OS::TripleO::Services::Fluentd
  - OS::TripleO::Services::GlanceApi
  - OS::TripleO::Services::GlanceRegistry
  - OS::TripleO::Services::Ipsec
  - OS::TripleO::Services::Iscsid
  - OS::TripleO::Services::Kernel
  - OS::TripleO::Services::Keystone
  - OS::TripleO::Services::LoginDefs
  - OS::TripleO::Services::MySQLClient
  - OS::TripleO::Services::NeutronApi
  - OS::TripleO::Services::NeutronBgpVpnApi
  - OS::TripleO::Services::NeutronSfcApi
  - OS::TripleO::Services::NeutronCorePlugin
  - OS::TripleO::Services::NeutronDhcpAgent
  - OS::TripleO::Services::NeutronL2gwAgent
  - OS::TripleO::Services::NeutronL2gwApi
  - OS::TripleO::Services::NeutronL3Agent
```

```
    - OS::TripleO::Services::NeutronLbaasv2Agent
    - OS::TripleO::Services::NeutronLbaasv2Api
    - OS::TripleO::Services::NeutronLinuxbridgeAgent
    - OS::TripleO::Services::NeutronMetadataAgent
    - OS::TripleO::Services::NeutronML2FujitsuCfab
    - OS::TripleO::Services::NeutronML2FujitsuFossw
    - OS::TripleO::Services::NeutronOvsAgent
    - OS::TripleO::Services::NeutronVppAgent
    - OS::TripleO::Services::Ntp
    - OS::TripleO::Services::ContainersLogrotateCrond
    - OS::TripleO::Services::OpenDaylightOvs
    - OS::TripleO::Services::Rhsm
    - OS::TripleO::Services::RsyslogSidecar
    - OS::TripleO::Services::Securetty
    - OS::TripleO::Services::SensuClient
    - OS::TripleO::Services::SkydiveAgent
    - OS::TripleO::Services::Snmp
    - OS::TripleO::Services::Sshd
    - OS::TripleO::Services::SwiftProxy
    - OS::TripleO::Services::SwiftDispersion
    - OS::TripleO::Services::SwiftRingBuilder
    - OS::TripleO::Services::SwiftStorage
    - OS::TripleO::Services::Timezone
    - OS::TripleO::Services::TripleoFirewall
    - OS::TripleO::Services::TripleoPackages
    - OS::TripleO::Services::Tuned
    - OS::TripleO::Services::Vpp
    - OS::TripleO::Services::OVNController
    - OS::TripleO::Services::OVNMetadataAgent
    - OS::TripleO::Services::Ptp
EO_TEMPLATE
(undercloud) [stack@director roles]$ sed -i~ -e '/OS::TripleO::Services::\
(Cinder\|Glance\|Swift\|Keystone\|Neutron\)/d' Controller.yaml
(undercloud) [stack@director roles]$ cd ../
(undercloud) [stack@director templates]$ openstack overcloud roles generate \
   --roles-path roles -o roles_data.yaml \
   Controller Compute ComputePPC64LE ControllerPPC64LE BlockStorage ObjectStorage
CephStorage
```