Red Hat OpenStack Platform 15

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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Abstract

This guide contains information on how to install Red Hat OpenStack Platform 15 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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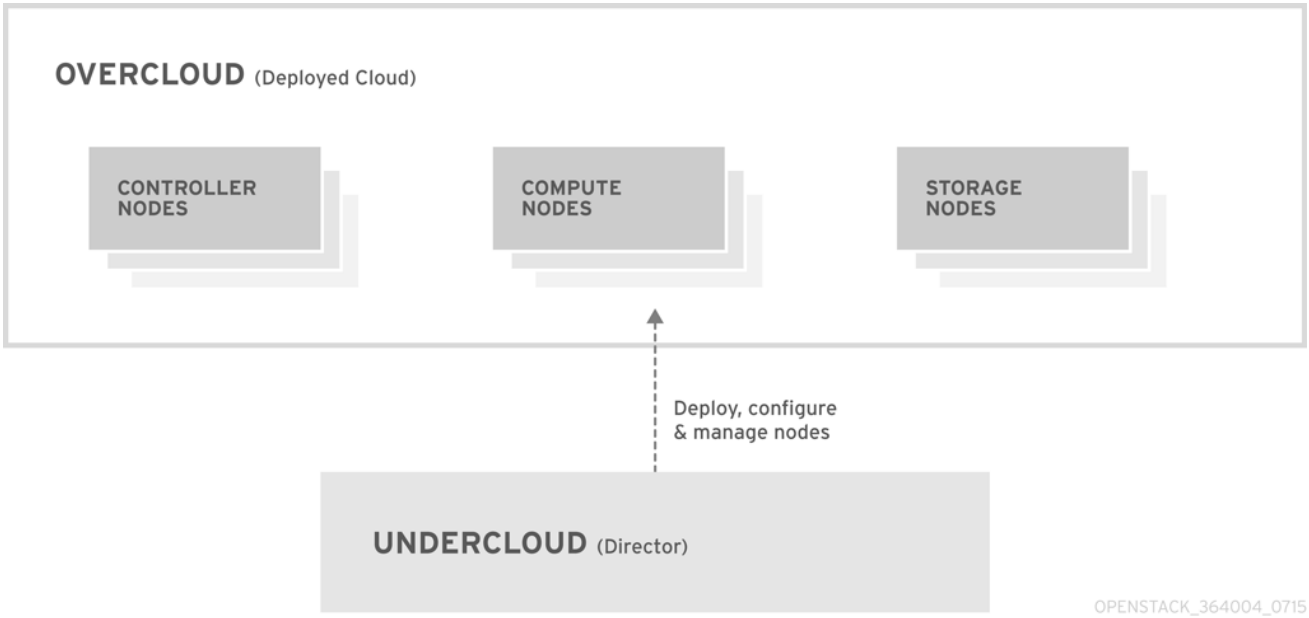
CHAPTER 1. INTRODUCTION

The Red Hat OpenStack Platform director is a toolset for installing and managing a complete OpenStack environment. Director is based primarily on the OpenStack project TripleO, which is an abbreviation of "OpenStack-On-OpenStack". This project consists of OpenStack components that you can use to install a fully operational OpenStack environment. This includes OpenStack components that provision and control bare metal systems to use as OpenStack nodes. This provides a simple method for installing a complete Red Hat OpenStack Platform environment that is both lean and robust.

The Red Hat OpenStack Platform director uses two main concepts: an undercloud and an overcloud. The undercloud installs and configures the overcloud. The next few sections outline the concept of each.



1.1. UNDERCLOUD

The undercloud is the main management node that contains the 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 for users 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. See Appendix A, *Power Management Drivers* for a full list of 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's components.
- OpenStack Bare Metal (ironic) and OpenStack Compute (nova) - Manages bare metal nodes.
- OpenStack Networking (neutron) and Open vSwitch - Controls 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 the director writes the overcloud image to disk.
- OpenStack Telemetry (ceilometer) - Performs monitoring and data collection. This also includes:
  - OpenStack Telemetry Metrics (gnocchi) - Provides a time series database for metrics.
  - OpenStack Telemetry Alarming (aodh) - Provides 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. OVERCLOUD

The overcloud is the resulting Red Hat OpenStack Platform 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 Clustering (sahara)
- 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 that provide storage for the OpenStack environment. The following list contains information about the various types of storage node in Red Hat OpenStack Platform:

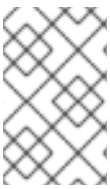
- Ceph Storage nodes - Used to form storage clusters. Each node contains a Ceph Object Storage Daemon (OSD). Additionally, the director installs Ceph Monitor onto the Controller nodes in situations where you deploy Ceph Storage nodes as part of your environment.
- Block storage (cinder) - Used as external 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 a external storage layer for OpenStack Swift. The Controller nodes access object storage nodes through the Swift proxy. Object storage node contains the following components:
  - OpenStack Object Storage (swift) storage
  - OpenStack Telemetry agents
  - Open vSwitch.

1.3. HIGH AVAILABILITY

The Red Hat OpenStack Platform director uses a Controller node cluster to provide highly available services to your OpenStack Platform environment. For each service, the director installs the same components on all Controller node 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 Red Hat OpenStack Platform database across the cluster.
- Memcached - Provides database caching.



NOTE

- From version 13 and later, you can use the 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. CONTAINERIZATION

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 OpenStack Platform.

Red Hat OpenStack Platform 15 supports installation on the Red Hat Enterprise Linux 8 operating system. Red Hat Enterprise Linux 8 no longer includes Docker and provides a new set of tools to replace the Docker ecosystem. This means OpenStack Platform 15 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 Podman can manage resources without a daemon running in the background.
For more information on 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 what you find in a Dockerfile. Buildah also provides a lower-level **coreutils** interface to build container images, which helps you build containers without requiring a Dockerfile. Buildah also uses other scripting languages to build container images without requiring a daemon.
For more information on Buildah, see the Buildah website.

Skopeo

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

Red Hat supports several methods of obtaining container images for your overcloud:

- Pulling container images directly from the Red Hat Container Catalog
- Hosting container images on the undercloud
- Hosting container images on a Satellite 6 server

This guide containers information about configuring your container image registry details and perform basic container operations.

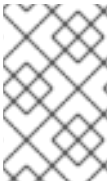
1.5. CEPH STORAGE

It is common for large organizations using OpenStack 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/or 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 Red Hat OpenStack Platform 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.

See Red Hat Ceph Storage for additional information about Red Hat Ceph Storage.



NOTE

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

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 OpenStack Platform environment, which is called the *overcloud*. The undercloud itself uses OpenStack Platform components in the form of containers to create a toolset called *OpenStack Platform director*. This means 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 you can use as a toolset for creating and managing your overcloud.

Since both the undercloud and overcloud uses 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 for configuring services and containers. It is useful to have some familiarity with Heat and Ansible to help you troubleshoot issues 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 the 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 no other DHCP services should exist on this network. The director configures the interface for this network.

- The **External network** that 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 provisioning a large number of nodes in your overcloud environment.

Note the following:

- 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 connected to the Provisioning network during introspection.

    - Include at least one permanent IP address for each node connected 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

Prior to installing the undercloud, it is recommended to determine the scale of your environment. Include the following factors when planningyour environment:

- **How many nodes 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 overcloud nodes.
- **How many simultaneous operations do you want the undercloud 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 undercloud's total CPU thread count [1]. For example, if your undercloud has a CPU with 16 threads, then the director services spawn 8 workers by default. The 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 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) per 10 hosts deployed by the undercloud. If the deployed overcloud will use an existing Ceph cluster, or if it will deploy a new Ceph cluster, then provision undercloud RAM accordingly.

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

- **Minimum:** Use 1.5 GB of memory per thread. For example, a machine with 48 threads should have 72 GB of RAM. This provides the minimum coverage for 24 Heat workers and 12 workers for other services.
- **Recommended:** Use 3 GB of memory per thread. For example, a machine with 48 threads should have 144 GB of RAM. This provides 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 Red Hat Enterprise Linux 8.2 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. CONSIDERATIONS WHEN RUNNING THE UNDERCLOUD WITH A PROXY

If your environment uses a proxy, review these considerations to best understand the different configuration methods of integrating parts of Red Hat OpenStack Platform with a proxy and the limitations of each method.

System-wide proxy configuration

Use this method to configure proxy communication for all network traffic on the undercloud. To configure the proxy settings, edit the **/etc/environment** file and set the following environment variables:

http_proxy
: The proxy that you want to use for standard HTTP requests.

https_proxy
: The proxy that you want to use for HTTPs requests.

no_proxy
: A comma-separated list of domains that you want to exclude from proxy communications.

The system-wide proxy method has the following limitations:

- The **no_proxy** variable primarily uses domain names (**www.example.com**), domain suffixes (**example.com**), and domains with a wildcard (***.example.com**). Most Red Hat OpenStack Platform services interpret IP addresses in **no_proxy** but certain services, such as container health checks, do not interpret IP addresses in the **no_proxy** environment variable due to limitations with cURL and **wget**. To use a system-wide proxy with the undercloud, disable container health checks with the **container_healthcheck_disabled** parameter in the **undercloud.conf** file during installation.

dnf proxy configuration

Use this method to configure **dnf** to run all traffic through a proxy. To configure the proxy settings, edit the **/etc/dnf/dnf.conf** file and set the following parameters:

proxy
: The URL of the proxy server.

proxy_username

The username that you want to use to connect to the proxy server.

proxy_password

The password that you want to use to connect to the proxy server.

proxy_auth_method

The authentication method used by the proxy server.

For more information about these options, run **man dnf.conf**.

The **dnf** proxy method has the following limitations:

- This method provides proxy support only for **dnf**.
- The **dnf** proxy method does not include an option to exclude certain hosts from proxy communication.

Red Hat Subscription Manager proxy

Use this method to configure Red Hat Subscription Manager to run all traffic through a proxy. To configure the proxy settings, edit the **/etc/rhsm/rhsm.conf** file and set the following parameters:

proxy_hostname

Host for the proxy.

proxy_scheme

The scheme for the proxy when writing out the proxy to repo definitions.

proxy_port

The port for the proxy.

proxy_username

The username that you want to use to connect to the proxy server.

proxy_password

The password to use for connecting to the proxy server.

no_proxy

A comma-separated list of hostname suffixes for specific hosts that you want to exclude from proxy communication.

For more information about these options, run **man rhsm.conf**.

The Red Hat Subscription Manager proxy method has the following limitations:

- This method provides proxy support only for Red Hat Subscription Manager.
- The values for the Red Hat Subscription Manager proxy configuration override any values set for the system-wide environment variables.

Transparent proxy

If your network uses a transparent proxy to manage application layer traffic, you do not need to configure the undercloud itself to interact with the proxy because proxy management occurs automatically. A transparent proxy can help overcome limitations associated with client-based proxy configuration in Red Hat OpenStack Platform.

2.8. UNDERCLOUD REPOSITORIES

Enable the following repositories for the installation and configuration of the undercloud.

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)	**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. Used for Controller node high availability.
Red Hat Ansible Engine 2.8 for RHEL 8 x86_64 (RPMs)	**ansible-2.8-for-rhel-8-x86_64-rpms**	Ansible Engine for Red Hat Enterprise Linux. Used to provide the latest version of Ansible.
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 15 for RHEL 8 (RPMs)	**openstack-15-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.

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.

Name	Repository	Description of Requirement
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 15 for RHEL 8 (RPMs)	**openstack-15-for-rhel-8-ppc64le-rpms**	Core Red Hat OpenStack Platform repository for ppc64le systems.

[1] In this instance, thread count refers to the number of CPU cores multiplied by the hyper-threading value

CHAPTER 3. PREPARING FOR DIRECTOR INSTALLATION

3.1. PREPARING THE UNDERCLOUD

The director installation requires the following:

- A non-root user to execute commands.
- Directories to organize images and templates
- A resolvable hostname
- A Red Hat subscription
- The command line tools for image preparation and director installation

This procedure shows how to create these items.

Procedure

1. Log into 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
```

   The 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** to include an entry for the system's 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, then **/etc/hosts** requires an entry like:

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

9. 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
```

10. Find the entitlement pool ID for Red Hat OpenStack Platform director. For example:

```
[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
```

11. Locate the **Pool ID** value and attach the Red Hat OpenStack Platform 15 entitlement:

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

12. Disable all default repositories, and then 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-
rpms --enable=rhel-8-for-x86_64-appstream-rpms --enable=rhel-8-for-x86_64-
highavailability-rpms --enable=ansible-2.8-for-rhel-8-x86_64-rpms --enable=openstack-15-
for-rhel-8-x86_64-rpms --enable=fast-datapath-for-rhel-8-x86_64-rpms
```

These repositories contain packages the director installation requires.

13. Set the RHEL version to RHEL 8.2:

```
[stack@director ~]$ sudo subscription-manager release --set=8.2
```

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

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

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

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

3.2. 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
```

3.3. PREPARING CONTAINER IMAGES

The undercloud configuration requires initial registry configuration to determine where to obtain images and how to store them. Complete the following steps to generate and customize an environment file for preparing 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. This means the director pulls the necessary images from the Red Hat Container Catalog and pushes them to the registry on the undercloud. The director uses this registry as the container image source. To pull directly from the Red Hat Container Catalog, omit this option.
- **--output-env-file** is an environment file name. The contents of this file include the parameters for preparing your container images. In this case, the name of the file is **containers-prepare-parameter.yaml**.

NOTE

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

3. Edit the **containers-prepare-parameter.yaml** and make the modifications to suit your requirements.

3.4. 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 define which images to use and what to do with them. 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.
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**.

Parameter	Description
modify_only_with_labels	A dictionary of image labels that filter the images 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	The namespace of the registry to push images during the upload process. When you specify a namespace for this parameter, all image parameters use this namespace too. If set to **true**, the **push_destination** is set to the undercloud registry namespace. It is not recommended to set this parameters to **false** in production environments. If this is set to **false** or not provided and the remote registry requires authentication, set the **ContainerImageRegistryLogin** parameter to **true** and provide the credentials with the **ContainerImageRegistryCredentials** parameter.
pull_source	The source registry from where to pull the original container images.
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}**.

The **set** parameter accepts a set of **key: value** definitions. The following table contains information about the keys:

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.

Key	Description
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 **latest**.

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 their values with the following syntax:

```
ContainerImagePrepare:
- push_destination: 192.168.24.1:8787
  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
```

3.5. LAYERING IMAGE PREPARATION ENTRIES

The value of the **ContainerImagePrepare** parameter is a YAML list. This means you can specify multiple entries. The following example demonstrates two entries where the director uses the latest version of all images except for the **nova-api** image, which uses the version tagged with **15.0-44**:

```
ContainerImagePrepare:
- tag_from_label: "{version}-{release}"
  push_destination: true
  excludes:
  - nova-api
  set:
    namespace: registry.redhat.io/rhosp15-rhel8
    name_prefix: openstack-
    name_suffix: ''
    tag: latest
- push_destination: true
  includes:
  - nova-api
  set:
    namespace: registry.redhat.io/rhosp15-rhel8
    tag: 15.0-44
```

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 include the **includes** or **excludes** value to be considered a match.

3.6. EXCLUDING CEPH STORAGE CONTAINER IMAGES

The default overcloud role configuration uses the default Controller, Compute, and Ceph Storage roles. However, if you use the default role configuration to deploy an overcloud without Ceph Storage nodes, director still pulls the Ceph Storage container images from the Red Hat Container Registry because the images are included as a part of the default configuration.

If your overcloud does not require Ceph Storage containers, you can configure director to not pull the Ceph Storage containers images from the Red Hat Container Registry.

Procedure

1. Edit the **containers-prepare-parameter.yaml** file to exclude the Ceph Storage containers:

```
parameter_defaults:
  ContainerImagePrepare:
  - push_destination: true
    excludes:
      - ceph
      - prometheus
    set:
      …
```

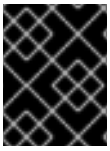
   The **excludes** parameter uses regular expressions to exclude any container images that contain the **ceph** or **prometheus** strings.

2. Save the **containers-prepare-parameter.yaml** file.

3.7. OBTAINING CONTAINER IMAGES FROM PRIVATE REGISTRIES

Some container image registries might 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 upon 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.

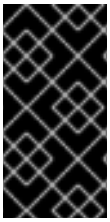
```
parameter_defaults:
  ...
  ContainerImageRegistryCredentials:
    registry.redhat.io:
      myuser: 'p@55w0rd!'
    registry.internalsite.com:
      myuser2: '0th3rp@55w0rd!'
    '192.0.2.1:8787':
      myuser3: '@n0th3rp@55w0rd!'
```

IMPORTANT

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

The **ContainerImageRegistryLogin** parameter is used to control if the system needs to login to the remote registry to fetch the containers.

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



IMPORTANT

You must set this 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.

3.8. MODIFYING IMAGES DURING PREPARATION

It is possible to modify images during image preparation, 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 need to be deployed for testing and development.
- When changes need to be deployed but are not available through an image build pipeline. For example, adding proprietry 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. Modification is controlled using 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. It is recommended to 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, it is recommended to run the image prepare command without any additional options to confirm the image is modified as expected:

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

3.9. UPDATING EXISTING PACKAGES ON CONTAINER IMAGES

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

```
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
  ...
```

3.10. 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 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
  ...
```

3.11. 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
  ...
```

An example **/home/stack/nova-custom/Dockerfile** follows. After running any **USER** root directives, you must switch back to the original image default user:

```
FROM registry.redhat.io/rhosp15-rhel8/openstack-nova-compute:latest

USER "root"

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

USER "nova"
```

3.12. 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 details information on 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/rhosp15-rhel8" | awk '{ print $2 }' | grep -v beta | sed "s/registry.redhat.io\///g" | tail -n+2 > satellite_images
```

2. Copy the **satellite_images_names** 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 (**OSP15 Containers**) in your Satellite organization:

```
$ hammer product create \
  --organization "ACME" \
  --name "OSP15 Containers"
```

This custom product will contain our images.

4. Add the base container image to the product:

```
$ hammer repository create \
  --organization "ACME" \
  --product "OSP15 Containers" \
  --content-type docker \
  --url https://registry.redhat.io \
  --docker-upstream-name rhosp15-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 "OSP15 Containers" \
--content-type docker \
--url https://registry.redhat.io \
--docker-upstream-name $IMAGE \
--upstream-username USERNAME \
--upstream-password PASSWORD \
--name $IMAGENAME ; done < satellite_images_names
```

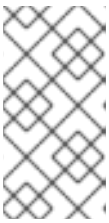
6. Add the Ceph Storage 4 container image:

```
$ hammer repository create \
  --organization "ACME" \
  --product "OSP15 Containers" \
  --content-type docker \
  --url https://registry.redhat.io \
  --docker-upstream-name rhceph-beta/rhceph-4-rhel8 \
  --upstream-username USERNAME \
  --upstream-password PASSWORD \
  --name rhceph-4-rhel8
```

7. Synchronize the container images:

```
$ hammer product synchronize \
  --organization "ACME" \
  --name "OSP15 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 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 Container Images with Content Views".

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

```
$ hammer docker tag list --repository "base" \
  --organization "ACME" \
  --environment "production" \
  --content-view "myosp15" \
  --product "OSP15 Containers"
```

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

10. Return to the undercloud and generate a default environment file for preparing 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 will 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:

- **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-myosp15-osp15_containers-**.
  - If you do not use content views, the structure is **[org]-[product]-**. For example: **acme-osp15_containers-**.
- **ceph_namespace**, **ceph_image**, **ceph_tag** - If using Ceph Storage, include the 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: true
    set:
      ceph_image: acme-production-myosp15-osp15_containers-rhceph-4
      ceph_namespace: satellite.example.com:5000
      ceph_tag: latest
      name_prefix: acme-production-myosp15-osp15_containers-
      name_suffix: ''
      namespace: satellite.example.com:5000
      neutron_driver: null
      tag: latest
      ...
    tag_from_label: '{version}-{release}'
```

Use this environment file when creating both your undercloud and overcloud.

CHAPTER 4. INSTALLING DIRECTOR

4.1. CONFIGURING THE DIRECTOR

The director installation process requires certain settings in the **undercloud.conf** configuration file, which the director reads from the **stack** user's home directory. This procedure demonstrates how to use the default template as a foundation for your configuration.

Procedure

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

```
[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 enabling 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 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** since Red Hat Enterprise Linux 8 only supports **podman**.

container_healthcheck_disabled

Disables containerized service health checks. It is recommended to keep health checks enabled and leave this option set to **false**.

container_images_file

Heat environment file with container image information. This can either be:

- Parameters for all required container images
- Or the **ContainerImagePrepare** parameter to drive the required image preparation. Usually the file containing 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 file to add to the undercloud installation.

deployment_user

The user installing 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 **enable_node_discovery** enabled and you must include the driver in the **enabled_hardware_types** list.

enable_ironic; enable_ironic_inspector; enable_mistral; enable_tempest; enable_validations; enable_zaqar

Defines the core services 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 **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 using other products that consume metrics data, such as Red Hat CloudForms.

enabled_hardware_types

A list of hardware types 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

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 **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. See Configuring hieradata on the undercloud for details on using this feature.

inspection_extras

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

inspection_interface

The bridge the 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.

ipxe_enabled

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

local_interface

The chosen interface for the director's Provisioning NIC. This is also the device the 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's Provisioning NIC. This is also the IP address that the 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 it conflicts with an existing IP address or subnet in your environment.

local_mtu

MTU to use for the **local_interface**. Do not exceed 1500 for the undercloud.

local_subnet

The local subnet 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**. The undercloud ignores the network parameters set in **undercloud.conf**. See **/usr/share/python-tripleoclient/undercloud.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.

overcloud_domain_name

The DNS domain name to use when deploying the overcloud.

NOTE

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

roles_file

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

scheduler_max_attempts

Maximum number of times 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 work around potential race condition 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. See Subnets for more information. The default value includes only the **ctlplane-subnet** subnet.

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.

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 the user must configure all system host name settings appropriately.

undercloud_log_file

The path to a log file to store the undercloud install/upgrade logs. By default, the log file is **install-undercloud.log** within 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 specify no 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.

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 the director or want to use an external gateway directly.

NOTE

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

cidr

The network that the 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 the director.

dhcp_start; dhcp_end

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

dhcp_exclude

IP addresses to exclude in the DHCP allocation range.

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

A range of IP address that the director's introspection service uses during the PXE boot and provisioning process. Use comma-separated values to define the start and end of this range. For example, **192.168.24.100,192.168.24.120**. Make sure this range contains enough IP addresses for your nodes and does not conflict with the range for **dhcp_start** and **dhcp_end**.

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 configure Heat parameters specific to the undercloud installation. You accomplish this with an environment file containing your Heat parameters.

Procedure

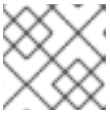
1. Create an environment file at **/home/stack/templates/custom-undercloud-params.yaml**.
2. Edit this file and include your Heat parameters. The following example shows how to enable debugging for certain OpenStack Platform services:

```
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 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 shows some common Heat parameters 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. Perform the following procedure to use this feature.

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 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 to the path of the hieradata file in your **undercloud.conf**:

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

4.6. INSTALLING THE DIRECTOR

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

Procedure

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

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

This launches the director's configuration script. The 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 when complete:

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

2. The script also starts all OpenStack Platform service containers automatically. Check the enabled containers using 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 OpenStack commands authenticate and execute against the undercloud;

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

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

4.7. OBTAINING IMAGES FOR OVERCLOUD NODES

The director requires several disk images for provisioning overcloud nodes. This includes:

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

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

4.7.1. 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's 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 **stack** user's home (/**home**/**stack**/**images**):

```
(undercloud) [stack@director ~]$ cd ~/images
(undercloud) [stack@director images]$ for i in /usr/share/rhosp-director-images/overcloud-full-latest-15.0.tar /usr/share/rhosp-director-images/ironic-python-agent-latest-15.0.tar; do tar -xvf $i; done
```

4. Import these images into the director:

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

This script uploads the following images into the director:

- **agent.kernel**
- **agent.ramdisk**
- **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. The 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
```

4.7.2. Multiple CPU architecture overclouds

These are the images and procedures needed for deployment of the overcloud to enable support of additional CPU architectures.

The procedure that follows uses the ppc64le image in its examples.

Procedure

1. Source the **stackrc** file to enable the director's 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 under the **images** directory on the **stack** user's home (**/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-15.0-${arch}.tar /usr/share/rhosp-
director-images/ironic-python-agent-latest-15.0-${arch}.tar ; do tar -C $arch -xf $i ; done ;
done
```

4. Import these images into the director:

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

```
(undercloud) [stack@director images]$ openstack overcloud image upload --image-path
~/images/x86_64/ --http-boot /tftpboot
```

This uploads the following images into the director:

- **bm-deploy-kernel**
- **bm-deploy-ramdisk**
- **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 |
+--------------------------------------+-------------------------+--------+
| 6d1005ba-ec82-473b-8e33-88aadb5b6792 | bm-deploy-kernel        | active |
| fb723b33-9f11-45f5-b25b-c008bf509290 | bm-deploy-ramdisk       | active |
| 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. The director copies these files to **/tftpboot**.

```
(undercloud) [stack@director images]$ ls -l /tftpboot /tftpboot/ppc64le/
/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

/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
```

4.7.3. 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-15.0.tar
```

4. Import the images into director:

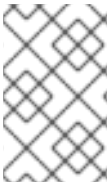
```
(undercloud) [stack@director images]$ openstack overcloud image upload --image-path /home/stack/images/ --os-image-name overcloud-minimal.qcow2
```

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. See Chapter 19, *Creating whole disk images* for more information.

4.8. SETTING A NAMESERVER FOR THE CONTROL PLANE

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

Procedure

1. Source the **stackrc** file to enable the director's 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.

4.9. UPDATING THE UNDERCLOUD CONFIGURATION

In the future, you might have to change the undercloud configuration to suit new requirements. To 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 OpenStack commands authenticate and execute against the undercloud:

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

4. Verify the 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.

4.10. UNDERCLOUD CONTAINER REGISTRY

Red Hat Enterprise Linux 8 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 you run the following command to restart the registry:

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.

```
$ sudo systemctl restart httpd
```

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.

NOTE

The Apache-based registry is a read-only container registry and does not support **podman push** nor **buildah push** commands. This means the registry does not allow you to push non-director and non-OpenStack Platform containers. However, you can modify OpenStack Platform images with the director's container preparation workflow, which uses the **ContainerImagePrepare** parameter.

4.11. NEXT STEPS

This completes the director configuration and installation. The next chapter explores basic overcloud configuration, including registering nodes, inspecting them, and then tagging them into various node roles.

PART II. BASIC OVERCLOUD DEPLOYMENT

CHAPTER 5. PLANNING YOUR OVERCLOUD

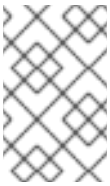
The following section contains some guidelines for planning various aspects of your Red Hat OpenStack Platform environment. This includes defining node roles, planning your network topology, and storage.

5.1. NODE ROLES

The director includes multiple default node types for building your overcloud. These node types are:

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 environment requires three Controller nodes for a highly available production-level environment.



NOTE

Environments with one node can only be used for testing purposes, not for production. Environments with two nodes or more than three nodes are not supported.

Compute

A physical server that acts as a hypervisor and contains the processing capabilities required for running virtual machines in the environment. A basic Red Hat OpenStack Platform 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 the OpenStack Object Storage (swift) service. This deployment role is optional.

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

Table 5.1. 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.

5.2. OVERCLOUD NETWORKS

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

By default, the 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*, which you can customize and assign services.

In a typical Red Hat OpenStack Platform installation, the number of network types often exceeds the number of physical network links. In order to connect all the networks to the proper hosts, the overcloud uses VLAN tagging to deliver more than one network per 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 using VLANs to isolate your network traffic types, 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.

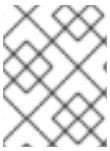
The director also includes a set of templates to configure NICs with isolated composable networks. The following configurations are the default configurations:

- 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 the 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 considering your network configuration:

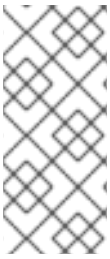
- During the overcloud creation, you refer to NICs using a single name across all overcloud machines. Ideally, you should use the same NIC on each overcloud node for each respective network to avoid confusion. For example, use the primary NIC for the Provisioning network and the secondary NIC for the 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). This allows the director to 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 will be useful later when setting up the overcloud nodes.
- If an instance needs to be accessible from the external internet, you can allocate a floating IP address from a public network and associate it with an instance. The instance still retains its private IP but network traffic uses NAT to traverse through to the floating IP address. Note that a floating IP address can only be assigned to a single instance rather than multiple private IP addresses. However, the floating IP address is reserved only for use by a single tenant, allowing the tenant to associate or disassociate with a particular instance as required. This configuration exposes your infrastructure to the external internet. As a result, you might need to check that you are following suitable security practices.
- To mitigate the risk of network loops in Open vSwitch, only a single interface or a single bond may 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). See Creating virtualized control planes for details.

5.3. 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."

The director includes different storage options for the overcloud environment:

Ceph Storage Nodes

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

- **Images** - Glance manages images for VMs. Images are immutable. OpenStack treats images as binary blobs and downloads them accordingly. You can use glance to store images in a Ceph Block Device.
- **Volumes** - Cinder volumes are block devices. OpenStack uses volumes to boot VMs, or to attach volumes to running VMs. OpenStack manages volumes using cinder services. You can use cinder to boot a VM using a copy-on-write clone of an image.
- **File Systems** - Manila shares are backed by file systems. OpenStack users manage shares using manila services. 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 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 Cinder. As a result, you can perform maintenance operations easily with the live-migration process. Additionally, if your hypervisor dies 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* .

See Red Hat Ceph Storage Architecture Guide for additional information.

Swift Storage Nodes

The 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.

5.4. OVERCLOUD SECURITY

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

- 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 details 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

5.5. OVERCLOUD HIGH AVAILABILITY

To deploy a highly-available overcloud, the 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 information about overcloud high availability architecture and services, see High Availability Deployment and Usage .

You can also configure high availability for Compute instances with the 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 information about how Instance HA works and installation instructions, see the High Availability for Compute Instances guide.

5.6. CONTROLLER NODE REQUIREMENTS

Controller nodes host the core services in a Red Hat OpenStack Platform environment, such as the Horizon dashboard, the back-end database server, 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 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 per vCPU. For example, a machine with 48 vCPUs should have 72 GB of RAM.
- **Controller RAM recommended calculation:**
  - Use 3 GB of memory per 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 (**gnocchi**) and Object Storage services are both installed on the Controller, 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. These defaults also allow the deployment of overclouds with minimal planning but offer little in terms of workload capacity and performance.
In an enterprise environment, however, this could cause a significant bottleneck, as 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. See Deployment Recommendations for Specific Red Hat OpenStack Platform Services for details.

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's motherboard.

Virtualization Support

Red Hat only supports virtualized controller nodes on Red Hat Virtualization platforms. See Virtualized control planes for details.

5.7. 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 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 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's motherboard.

5.8. CEPH STORAGE NODE REQUIREMENTS

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

Placement Groups

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.

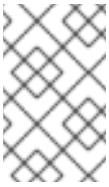
Memory

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 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 node, 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.

See the Deploying an Overcloud with Containerized Red Hat Ceph guide for more information about installing an overcloud with a Ceph Storage cluster.

5.9. OBJECT STORAGE NODE REQUIREMENTS

Object Storage nodes provides 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 number of disks per 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. Ideally, use at minimum 1 GB of memory per 1 TB of hard disk space. For optimal performance, it is recommended to use 2 GB per 1 TB of hard disk space, especially for workloads with files smaller than 100GB.

Disk Space

Storage requirements depends 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 storing 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. The 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's motherboard.

5.10. OVERCLOUD REPOSITORIES

You must enable the following repositories to install and configure the overcloud.

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)	**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. Used for Controller node high availability.
Red Hat Ansible Engine 2.8 for RHEL 8 x86_64 (RPMs)	**ansible-2.8-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.

Name	Repository	Description of Requirement
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 15 for RHEL 8 (RPMs)	**openstack-15-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.

Real Time repositories

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

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. This repository should be enabled for all Compute nodes targeted for RT-KVM. NOTE: You need a separate subscription to a **Red Hat OpenStack Platform for Real Time** SKU before you can 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. This repository should be enabled 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 before you can 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 15 for RHEL 8 (RPMs)	**openstack-15-for-rhel-8-ppc64le-rpms**	Core Red Hat OpenStack Platform repository for ppc64le systems.

CHAPTER 6. 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.

6.1. REGISTERING NODES FOR THE OVERCLOUD

The 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"
```

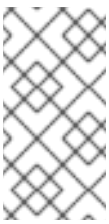
This template contains the following attributes:

name

The logical name for the node.

pm_type

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



NOTE

IPMI is the preferred supported power management driver. For more 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 creating 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 **stack** user's home directory (**/home/stack/nodes.json**), then run the following command to import the template to the director:

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

This command registers each node from the template into the director.

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

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

6.2. INSPECTING THE HARDWARE OF NODES

The 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 it back to the director. The director then stores this introspection data in the OpenStack Object Storage (swift) service running on the director. The 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:

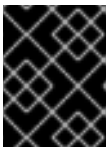
```
(undercloud) $ openstack overcloud node introspect --all-manageable --provide
```

- The **--all-manageable** option introspects only nodes in a managed state. In this example, all nodes are in a managed state.
- The **--provide** option resets all nodes to an **available** state after introspection.

2. Monitor the progress of the introspection using the following command in a separate terminal window:

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

-



IMPORTANT

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

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

6.3. TAGGING NODES INTO PROFILES

After registering and inspecting 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 the 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 the director can decide which nodes to use.
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, the 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:compute,boot_option:local' 58c3d07e-24f2-48a7-bbb6-6843f0e8ee13
(undercloud) $ openstack baremetal node set --property
capabilities='profile:control,boot_option:local' 1a4e30da-b6dc-499d-ba87-0bd8a3819bc0
```

The addition of the **profile:compute** and **profile:control** 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 completing node tagging, check the assigned profiles or possible profiles:

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

6.4. 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
```

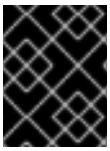
6.5. DEFINING THE ROOT DISK FOR MULTI-DISK CLUSTERS

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, the director writes the overcloud image to the root disk during the provisioning process

There are several properties that you can define to help the 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.

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

6.6. 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 .

Procedure

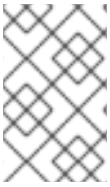
1. To configure director to use the **overcloud-minimal** image, create an environment file that contains the following image definition:

```
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 an OpenStack subscription entitlement.

6.7. 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.

6.8. 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 using 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 as the parameters and resources defined 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. See the following chapters in the Advanced Overcloud Customization guide for more information:
  - "Basic network isolation"
  - "Custom composable networks"

- "Custom network interface templates"

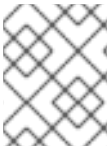
- Any external load balancing environment files if you are using an external load balancer. See External Load Balancing for the Overcloud for more information.
- Any storage environment files such as Ceph Storage, NFS, iSCSI, etc.
- Any environment files for Red Hat CDN or Satellite registration.
- Any other custom environment files.

It is recommended to keep your custom environment files organized in a separate directory, such as the **templates** directory.

You can customize advanced features for your overcloud using 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.

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

By default, the 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, you might want to consider at least 3 Controller nodes and 3 Compute nodes, and assign specific flavors to ensure 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
```

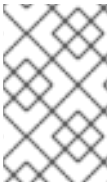
2. Edit the file to include the node counts and flavors your need. This example contains 3 Controller nodes and 3 Compute nodes:

```
parameter_defaults:
  OvercloudControllerFlavor: control
  OvercloudComputeFlavor: compute
```

```
ControllerCount: 3
ComputeCount: 3
```

6.10. 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 the undercloud endpoints 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 undercloud's public endpoint. It is likely that deployments that rely on spine-leaf networking will need to apply this configuration.

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 could be from your own CA, or it might 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. This is enabled using the **generate_service_certificate** option in the **undercloud.conf** file. In this case, the 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 will look 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

BAYTAlVTMQswCQYDVQQIDAJOQzEQMA4GA1UEBwwHUmFsZWlnaDEQMA4GA1UECg
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.

The CA certificate is copied 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 6.13, "Including environment files in an overcloud deployment" .

6.11. DEPLOYMENT COMMAND

The final stage in creating your OpenStack environment is to run the **openstack overcloud deploy** command to create the overcloud. Before running this command, you should 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 run as a background process.

6.12. DEPLOYMENT COMMAND OPTIONS

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

Table 6.1. Deployment command options

Parameter	Description
--templates [TEMPLATES]	The directory containing the Heat templates to deploy. If blank, the command uses the default template location at **/usr/share/openstack-tripleo-heat-templates/**

Parameter	Description
--stack STACK	The name of the stack to create or update
-t [TIMEOUT], --timeout [TIMEOUT]	Deployment timeout in minutes
--libvirt-type [LIBVIRT_TYPE]	Virtualization type to use for hypervisors
--ntp-server [NTP_SERVER]	Network Time Protocol (NTP) server 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 controllers 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 hostnames from proxy communication.
--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 to use for SSH access to overcloud nodes.
-e [EXTRA HEAT TEMPLATE], --extra-template [EXTRA HEAT TEMPLATE]	Extra environment files to pass to the overcloud deployment. You can specify this option more than once. Note that the order of environment files passed 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	The directory containing environment files to include in deployment. The deploy command processes these environment files in numerical, 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**.

Parameter	Description
-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	Do not delete temporary files after deployment and just log their location.
--update-plan-only	Update the plan. Do not perform the actual deployment.
--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	Performs validation check on the overcloud but does not actually create the overcloud.
--run-validations	Run external validations from the **openstack-tripleo-validations** package.
--skip-postconfig	Skip the overcloud post-deployment configuration.
--force-postconfig	Force the overcloud post-deployment configuration.
--skip-deploy-identifier	Skip generation of 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 you do not need to run the software configuration, such as scaling out certain roles.
--answers-file ANSWERS_FILE	Path to a YAML file with arguments and parameters.

Parameter	Description
--disable-password-generation	Disable password generation for the overcloud services.
--deployed-server	Use pre-provisioned overcloud nodes. Used in conjunction with **--disable-validations**.
--no-config-download, --stack-only	Disable the **config-download** workflow and only create the stack and associated OpenStack resources. This command applies no software configuration to the overcloud.
--config-download-only	Disable the overcloud stack creation and only run the **config-download** workflow to apply the software configuration.
--output-dir OUTPUT_DIR	Directory to use for saved **config-download** output. The directory must be writeable by the mistral user. When not specified, the director uses the default, which is **/var/lib/mistral/overcloud**.
--override-ansible-cfg OVERRIDE_ANSIBLE_CFG	Path to Ansible configuration file. The configuration in the file overrides any configuration that **config-download** generates by default.
--config-download-timeout CONFIG_DOWNLOAD_TIMEOUT	Timeout in minutes to use for **config-download** steps. If unset, director sets the default to however much time is left over from the **--timeout** parameter after the stack deployment operation.
--rhel-reg	Register overcloud nodes to the Customer Portal or Satellite 6.
--reg-method	Registration method 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]	Organization to use for registration.
--reg-force	Register the system even if it is already registered.

Parameter	Description
--reg-sat-url [REG_SAT_URL]	The base URL of the Satellite server to register overcloud nodes. Use the Satellite's 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]	Activation key 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 on an environment file. The following table maps deprecated parameters to their Heat Template equivalents.

Table 6.2. 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 Cinder nodes to scale out	**BlockStorageCount**
--swift-storage-scale	The number of Swift nodes to scale out	**ObjectStorageCount**
--control-flavor	The flavor to use for Controller nodes	**OvercloudControllerFlavor**

Parameter	Description	Heat Template Parameter
--compute-flavor	The flavor to use for Compute nodes	**OvercloudComputeFlavor**
--ceph-storage-flavor	The flavor to use for Ceph Storage nodes	**OvercloudCephStorageFlavor**
--block-storage-flavor	The flavor to use for Cinder nodes	**OvercloudBlockStorageFlavor**
--swift-storage-flavor	The flavor to use for Swift storage 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 as 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.

6.13. 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 as the parameters and resources defined 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. See the following chapters in the Advanced Overcloud Customization guide for more information:
  - "Basic network isolation"
  - "Custom composable networks"
  - "Custom network interface templates"
- Any external load balancing environment files if you are using an external load balancer. See External Load Balancing for the Overcloud for more information.
- Any storage environment files such as Ceph Storage, NFS, iSCSI, etc.
- Any environment files for Red Hat CDN or Satellite registration.
- Any other custom environment files.

Any environment files added to the overcloud using the **-e** option become part of your overcloud's stack definition.

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 using custom roles or enabling a multi architecture cloud. See Section 6.7, "Creating architecture specific roles" for more information.

The 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 as such manual configuration gets overridden by the director's configuration when updating the overcloud stack with the director.

6.14. VALIDATING THE OVERCLOUD CONFIGURATION BEFORE DEPLOYMENT OPERATIONS

Before executing an overcloud deployment operation, validate your Heat templates and environment files for any errors.

Procedure

1. The core Heat templates for the overcloud are in a Jinja2 format. To validate your templates, render a version without Jinja2 formatting using the following commands:

```
$ cd /usr/share/openstack-tripleo-heat-templates
$ ./tools/process-templates.py -o ~/overcloud-validation
```

2. Use the following command to validate the template syntax:

```
(undercloud) $ openstack orchestration template validate --show-nested \
  --template ~/overcloud-validation/overcloud.yaml \
  -e ~/overcloud-validation/overcloud-resource-registry-puppet.yaml \
  -e [ENVIRONMENT FILE] \
  -e [ENVIRONMENT FILE]
```

   The validation requires the **overcloud-resource-registry-puppet.yaml** environment file to include overcloud-specific resources. Add any additional environment files to this command with **-e** option. Also include the **--show-nested** option to resolve parameters from nested templates.

3. The validation command identifies any syntax errors in the template. If the template syntax validates successfully, the command returns a preview of the resulting overcloud template.

6.15. OVERCLOUD DEPLOYMENT OUTPUT

Once the overcloud creation completes, the director provides a recap of the Ansible plays 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 ******
===============================================================================
```

The 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
```

6.16. ACCESSING THE OVERCLOUD

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

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

This loads environment variables necessary to interact with your overcloud from the director host's CLI. The command prompt changes to indicate this:

```
(overcloud) $
```

To return to interacting with the director's host, 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 desired node:

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

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

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

6.17. NEXT STEPS

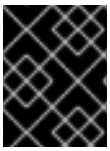
This concludes the creation of the overcloud using the command line tools. For post-creation functions, see Chapter 9, *Performing overcloud post-installation tasks*.

CHAPTER 7. CONFIGURING A BASIC OVERCLOUD WITH PRE-PROVISIONED NODES

This chapter contains basic configuration procedures for using pre-provisioned nodes to configure an OpenStack Platform environment. This scenario differs from the standard overcloud creation scenarios in several ways:

- You can provision nodes using an external tool and let the director control the overcloud configuration only.
- You can use nodes without relying on the director's 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) for managing 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 using the instructions in the Advanced Overcloud Customization guide.



IMPORTANT

Combining pre-provisioned nodes with director-provisioned nodes in an overcloud is not supported.

7.1. PRE-PROVISIONED NODE REQUIREMENTS

- The director node 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.
- 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 the director. The examples for this scenario use following IP address assignments:

Table 7.1. Provisioning Network IP Assignments

Node Name	IP Address
Director	192.168.24.1
Controller 0	192.168.24.2

Node Name	IP Address
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 the director over the Public API endpoint. There are certain caveats to this scenario, which this chapter examines later in Section 7.6, "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.

7.2. CREATING A USER ON PRE-PROVISIONED NODES

When configuring an overcloud with pre-provisioned nodes, the 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 on each node. 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 creating and configuring 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
```

7.3. 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 each respective node to 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 15:

```
[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 15 entitlements:

```
[root@controller-0 ~]# sudo subscription-manager attach --pool=pool_id
```

4. Disable all default repositories:

```
[root@controller-0 ~]# sudo subscription-manager repos --disable=*
```

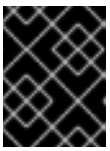
5. Enable the required Red Hat Enterprise Linux repositories.

   a. For x86_64 systems, run:

```
[root@controller-0 ~]# sudo subscription-manager repos --enable=rhel-8-for-x86_64-baseos-rpms --enable=rhel-8-for-x86_64-appstream-rpms --enable=rhel-8-for-x86_64-highavailability-rpms --enable=ansible-2.8-for-rhel-8-x86_64-rpms --enable=openstack-15-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-15-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.

7.4. 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 using 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 the overcloud nodes can access the director's Public API over SSL/TLS.

7.5. CONFIGURING NETWORKING FOR THE CONTROL PLANE

The pre-provisioned overcloud nodes obtain metadata from the director using standard HTTP requests. This means all overcloud nodes require L3 access to either:

- The director's Control Plane network, which is the subnet defined 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's Public API endpoint, specified as 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 you aim to use SSL/TLS communication. See Section 7.6, "Using a separate network for pre-provisioned nodes" for additional information about configuring your overcloud nodes to use the Public API endpoint.

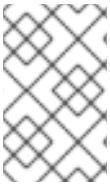
The director uses the Control Plane network to manage and configure a standard overcloud. For an overcloud with pre-provisioned nodes, your network configuration might require some modification to accommodate communication between the director and the pre-provisioned nodes.

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 your NIC templates do not include the NIC used for undercloud access. These template 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 using the director's Provisioning network as the Control Plane, ensure the chosen overcloud IP addresses fall outside of the DHCP ranges for both provisioning (**dhcp_start** and **dhcp_end**) and introspection (**inspection_iprange**).

During standard overcloud creation, the 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 the director to assign different IP addresses to the ones you configure manually for each node. In this situation, use a predictable IP address strategy to force the 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 the director and defines the IP assignments of our pre-provisioned nodes. The **DeployedServerPortMap** parameter defines 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 hostname 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.

7.6. USING A SEPARATE NETWORK FOR PRE-PROVISIONED NODES

By default, the 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's 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 <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 15, *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 7.2. 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 7.5, "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 7.5, "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, we 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 they do not require these parameters.

7.7. MAPPING PRE-PROVISIONED NODE HOSTNAMES

When configuring 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.

7.8. 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. 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.

7.9. CREATING THE OVERCLOUD WITH PRE-PROVISIONED NODES

The overcloud deployment uses the standard CLI methods from Section 6.11, “Deployment command”. For pre-provisioned nodes, the deployment command requires some additional options and environment files from the core Heat template collection:

- **--disable-validations** - Disables basic CLI validations for services not used with pre-provisioned infrastructure, otherwise the deployment will fail.
- **environments/deployed-server-environment.yaml** - Primary environment file for creating and configuring pre-provisioned infrastructure. This environment file substitutes the **OS::Nova::Server** resources with **OS::Heat::DeployedServer** resources.
- **environments/deployed-server-bootstrap-environment-rhel.yaml** - Environment file to execute a bootstrap script on the pre-provisioned servers. This script installs additional packages and includes basic configuration for overcloud nodes.
- **environments/deployed-server-pacemaker-environment.yaml** - Environment file for

Pacemaker configuration on pre-provisioned Controller nodes. The namespace for the resources registered in this file use the Controller role name from **deployed-server/deployed-server-roles-data.yaml**, which is **ControllerDeployedServer** by default.

- **deployed-server/deployed-server-roles-data.yaml** - An example custom roles file. This file replicates the default **roles_data.yaml** but also includes the **disable_constraints: True** parameter for each role. This parameter disables orchestration constraints in the generated role templates. These constraints are for services that pre-provisioned infrastructure does not use. If you want to use a custom roles file, ensure you include the **disable_constraints: True** parameter for each role:

```
- name: ControllerDeployedServer
  disable_constraints: True
  CountDefault: 1
  ServicesDefault:
    - OS::TripleO::Services::CACerts
    - OS::TripleO::Services::CephMon
    - OS::TripleO::Services::CephExternal
    - OS::TripleO::Services::CephRgw
    ...
```

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 /usr/share/openstack-tripleo-heat-templates/environments/deployed-server-bootstrap-environment-rhel.yaml \
  -e /usr/share/openstack-tripleo-heat-templates/environments/deployed-server-pacemaker-environment.yaml \
  -e /home/stack/templates/hostname-map.yaml /
  -r /usr/share/openstack-tripleo-heat-templates/deployed-server/deployed-server-roles-data.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 you specify with the **--overcloud-ssh-key** option, the director never passes this key to any API service, such as Heat or Mistral, and only the director's **openstack overcloud deploy** command uses this key to enable access for the **tripleo-admin** user.

7.10. OVERCLOUD DEPLOYMENT OUTPUT

Once the overcloud creation completes, the director provides a recap of the Ansible plays 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 ******
===============================================================================
```

The 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
```

7.11. ACCESSING THE OVERCLOUD

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

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

This loads environment variables necessary to interact with your overcloud from the director host's CLI. The command prompt changes to indicate this:

```
(overcloud) $
```

To return to interacting with the director's host, 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 desired node:

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

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

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

7.12. SCALING PRE-PROVISIONED NODES

The process for scaling pre-provisioned nodes is similar to the standard scaling procedures in Chapter 12, *Scaling overcloud nodes*. However, the process for adding new pre-provisioned nodes differs since 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's node count.

Perform the following actions to scale up overcloud nodes:

1. Prepare the new pre-provisioned nodes according to the Section 7.1, "Pre-provisioned node requirements".
2. Scale up the nodes. See Chapter 12, *Scaling overcloud nodes* for these instructions.
3. After executing 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 as normal as shown in Chapter 12, *Scaling overcloud nodes*.

In most scaling operations, you must obtain the UUID value of the node 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 actual 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.

Once you have removed 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 shutdown 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.

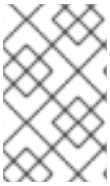
After powering off the removed nodes, reprovision them to a base operating system configuration so that they do not unintentionally join the overcloud in the future

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.

7.13. REMOVING A PRE-PROVISIONED OVERCLOUD

To remove an entire overcloud that uses pre-provisioned nodes, see Section 10.5, "Removing the overcloud" for the standard overcloud remove procedure. After removing 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.

7.14. NEXT STEPS

This concludes the creation of the overcloud using pre-provisioned nodes. For post-creation functions, see Chapter 9, *Performing overcloud post-installation tasks*.

CHAPTER 8. 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 having 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, ensuring 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 deploy command, specifying the core heat templates together with the new configuration files and a new **stack** name.

8.1. 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 deploying 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
```

8.2. 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, as using a non-standard set of core templates can introduce issues with updates and upgrades.

Instead, for ease of management when deploying or maintaining 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 9. PERFORMING OVERCLOUD POST-INSTALLATION TASKS

This chapter contains information about tasks to perform immediately after creating your overcloud. These tasks ensure your overcloud is ready to use.

9.1. 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
```

9.2. 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, use the following commands 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. The following options 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.

9.3. 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 Neutron network named **default**. The overcloud automatically assigns IP addresses from this network to virtual machines using an internal DHCP mechanism.

9.4. CREATING A DEFAULT FLOATING IP NETWORK

This procedure contains information on how to create an external network on the overcloud. This network provides floating IP addresses to so that users can access virtual machines outside of the overcloud.

This procedure provides two examples:

- Native VLAN (flat network)
- Non-Native VLAN (VLAN network)

Use the example that best suits your environment.

Both of these example 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 9.7, "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.

This procedure assumes 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
```

     The **--provider-segment** value defines the VLAN to use. In this case, it is 201.

3. Create a subnet with an allocation pool for floating IP addresses. In this case, 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
```

   Make sure this range does not conflict with other IP addresses in your external network.

9.5. CREATING A DEFAULT PROVIDER NETWORK

A provider network in another type of external network connection that routes traffic from private tenant networks to external infrastructure network. The network is similar to a floating IP network but the provider network uses a logical router to connect private networks to the provide network.

This procedure provides two examples:

- Native VLAN (flat network)
- Non-Native VLAN (VLAN network)

Use the example that best suits your environment.

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
```

     The **--provider-segment** value defines the VLAN to use. In this case, it 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.

9.6. CREATING ADDITIONAL BRIDGE MAPPINGS

Floating IP networks can use any bridge, not just **br-ex**, as long as you meet the following conditions:

- **NeutronExternalNetworkBridge** is set to **""** in your network environment file.
- You have mapped 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"
```

This method provides you with a way to create separate external networks after creating the overcloud. For example, to create a floating IP network that maps to the **floating** physical network, run these 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
```

9.7. 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 instruction on using 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 running this test from the undercloud, ensure that the undercloud host has access to the overcloud's Internal API network. 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 running the OpenStack Integration Test Suite, check 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's 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
```

9.8. PROTECTING THE OVERCLOUD FROM REMOVAL

Heat contains a set of default policies in code that you can override by creating **/etc/heat/policy.json** and adding customized rules. Add the following policy to deny *everyone* the permissions for deleting 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 **/etc/heat/policy.json**.

CHAPTER 10. PERFORMING BASIC OVERCLOUD ADMINISTRATION TASKS

This chapter contains information about basic tasks you might need to perform during the lifecycle of your overcloud.

10.1. MANAGING CONTAINERIZED SERVICES

OpenStack Platform 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 15, the Systemd services interface manages the lifecycle of the containers. Each container is a service and you run these commands to run 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
```

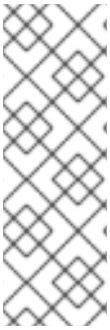
To restart a container, run the **systemctl restart** command:

```
$ sudo systemctl restart tripleo_keystone
```

As 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 node's local file system 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 node's local file system, which overwrites any the changes 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. There is always a possibility to start the check manually.

NOTE

The **podman ps** command does not show the container health status.

Checking container logs

OpenStack Platform 15 introduces a new logging directory: **/var/log/containers/stdout**. It contains all the containers standard output (stdout) and standard errors (stderr) consolidated in one single file per 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 one outputs to the same log file, since **podman** is instructed to use the container name instead of container ID.

You can also check the logs for a containerized service using 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 from the container, run the following command:

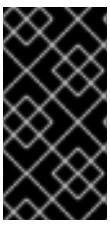
```
# exit
```

10.2. MODIFYING THE OVERCLOUD ENVIRONMENT

Sometimes you might want to modify the overcloud to add additional features, or change the way it operates. 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 6.11, “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
```

The director checks the **overcloud** stack in heat, and then updates each item in the stack with the environment files and heat templates. The director does not recreate the overcloud, but rather changes the existing overcloud.



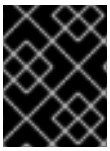
IMPORTANT

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 aim 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 as the director might overwrite these modifications later.

10.3. IMPORTING VIRTUAL MACHINES INTO THE OVERCLOUD

This procedure contains steps migrate virtual machines from an existing OpenStack environment to your Red Hat OpenStack Platform 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 into 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 VM disk from the existing OpenStack environment and into the new Red Hat OpenStack Platform. Snapshots using QCOW will 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
```

-

10.4. RUNNING THE DYNAMIC INVENTORY SCRIPT

The director can run Ansible-based automation on your OpenStack Platform environment. The 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
```

The **--list** option returns 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 to use. For example:
  - **controller** for all Controller nodes
  - **compute** for all Compute nodes
  - **overcloud** for all overcloud child nodes i.e. **controller** and **compute**
  - **undercloud** for the undercloud
  - **"*"** for all nodes
- Replace **[OTHER OPTIONS]** with additional Ansible options. Some useful options include:
  - **--ssh-extra-args='-o StrictHostKeyChecking=no'** to bypasses confirmation on host key checking.
  - **-u [USER]** 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.
  - **-m [MODULE]** to use a specific Ansible module. The default is **command**, which executes Linux commands.
  - **-a [MODULE_ARGS]** 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.

10.5. REMOVING THE OVERCLOUD

Delete any existing overcloud:

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

Confirm the deletion of the overcloud:

```
(undercloud) $ openstack stack list
```

Deletion takes a few minutes.

Once the removal completes, follow the standard steps in the deployment scenarios to recreate your overcloud.

CHAPTER 11. CONFIGURING THE OVERCLOUD WITH ANSIBLE

Ansible is the main method to apply the overcloud configuration. This chapter provides steps how to interact with the overcloud's Ansible configuration.

Although director generates the Ansible playbooks automatically, it is a good idea to familiarize yourself with Ansible syntax. See https://docs.ansible.com/ for more information about how to use Ansible.

NOTE

Ansible also uses the concept of **roles**, which are different to OpenStack Platform director roles.

11.1. ANSIBLE-BASED OVERCLOUD CONFIGURATION (CONFIG-DOWNLOAD)

The **config-download** feature is the director's method of configuring the overcloud. The 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 the 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 running the **openstack overcloud deploy** command, the following process occurs:

- The director creates a new deployment plan based on **openstack-tripleo-heat-templates** and includes any environment files and parameters to customize the plan.
- The director uses Heat to interpret the deployment plan and create the overcloud stack and all descendant resources. This includes provisioning nodes through OpenStack Bare Metal (ironic).
- Heat also creates the software configuration from the deployment plan. The director compiles the Ansible playbooks from this software configuration.
- The director generates a temporary user (`tripleo-admin1) on the overcloud nodes specifically for Ansible SSH access.
- The director downloads the Heat software configuration and generates a set of Ansible playbooks using Heat outputs.
- The director applies the Ansible playbooks to the overcloud nodes using **ansible-playbook**.

11.2. CONFIG-DOWNLOAD WORKING DIRECTORY

The director generates a set of Ansible playbooks for the **config-download** process. These playbooks are stored in a working directory within 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. This helps you track configuration changes between each deployment.

11.3. 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.

11.4. 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
```

11.5. 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 makes it is possible to take further advantage of 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 with 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 defined in your overcloud's **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. For example:

```
$ 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. For example:

```
$ ./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 using 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 iterating over an initial deployment. However, to guarantee a consistent deployment, you must run all tasks from **deploy_steps_playbook.yaml** in order.

11.6. PERFORMING GIT OPERATIONS ON THE WORKING DIRECTORY

The **config-download** working directory is a local Git repository. Each time a deployment operation runs, the 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, using Git to revert to a previous version of the **config-download** working directory only affects 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 prior to rerunning **openstack overcloud deploy**.

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 case, 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
```

11.7. CREATING CONFIG-DOWNLOAD FILES MANUALLY

In certain circumstances, you might 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 overcloud to use for the Ansible file export.
- **--config-dir** is the location 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
```

11.8. 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 upgrading from one long-life version of OpenStack Platform to the next. **Do not use this playbook for this release of OpenStack Platform.**

11.9. CONFIG-DOWNLOAD TAGS

The playbooks use tagged tasks to control the tasks applied 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.

11.10. CONFIG-DOWNLOAD DEPLOYMENT STEPS

The **deploy_steps_playbook.yaml** playbook is used to configure the overcloud. This playbook applies all software configuration necessary to deploy a full overcloud based on the overcloud deployment plan.

This section contains a summary the different Ansible plays used within this playbook. The play names in this section are the same names used within the playbook and 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 against the undercloud node only.
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 against the undercloud node only.
Tags: **external**, **external_deploy_steps**

11.11. NEXT STEPS

You can now continue your regular overcloud operations.

CHAPTER 12. SCALING OVERCLOUD NODES

WARNING

Do not use **openstack server delete** to remove nodes from the overcloud. Read the procedures defined in this section to properly remove and replace nodes.

There might be situations where you need to add or remove nodes after the creation of the overcloud. For example, you might need to add more Compute nodes to the overcloud. This situation requires updating the overcloud.

Use the following table to determine support for scaling each node type:

Table 12.1. 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 13, *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 to leave at least 10 GB free space before scaling the overcloud. This free space accommodates image conversion and caching during the node provisioning process.

12.1. 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**) containing the new node details 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 registering 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]
```

12.2. 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. Scaling the overcloud requires that you 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**:

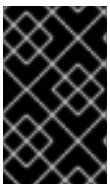
```
(undercloud) $ openstack overcloud deploy --templates -e /home/stack/templates/node-
info.yaml [OTHER_OPTIONS]
```

   Ensure 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.

12.3. 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 removing 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**, is installed on the undercloud.

Procedure

1. Source the overcloud configuration:

```
$ source ~/stack/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 ~/stack/stackrc
```

4. Identify the UUID of the overcloud stack:

```
(undercloud) $ openstack stack list
```

5. Identify the UUIDs of the nodes to delete:

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

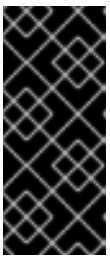
6. Delete the nodes from the overcloud stack and update the plan accordingly:

```
(undercloud) $ openstack overcloud node delete --stack <stack_uuid> [node1_uuid]
[node2_uuid] [node3_uuid]
```

7. Ensure 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.



IMPORTANT

If you intend to redeploy the Compute service using the same host name, then you need to 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.

8. Remove the Compute service from the node:

```
(undercloud) $ source ~/stack/overcloudrc
(overcloud) $ openstack compute service list
(overcloud) $ openstack compute service delete <service-id>
```

9. Remove the Open vSwitch agent from the node:

```
(overcloud) $ openstack network agent list
(overcloud) $ openstack network agent delete <openvswitch-agent-id>
```

10. Remove the deleted Compute service as a resource provider from the Placement service:

```
(overcloud) $ openstack resource provider list
(overcloud) $ openstack resource provider delete <uuid>
```

11. 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 provisions no new nodes when you run **openstack overcloud deploy**.

You are now free to 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 once a Compute node with the same host name is up again.

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. Once the service state of the redeployed Compute node is "up" again, re-enable the service:

```
(overcloud) $ openstack compute service set compute-1.localdomain nova-compute --enable
```

12.4. REPLACING CEPH STORAGE NODES

You can use the director to replace Ceph Storage nodes in a director-created cluster. You can find these instructions in the Deploying an Overcloud with Containerized Red Hat Ceph guide.

12.5. REPLACING OBJECT STORAGE NODES

Follow the instructions in this section to understand how to replace Object Storage nodes while maintaining the integrity of the cluster. This example involves a three-node Object Storage cluster in which the node **overcloud-objectstorage-1** must be replaced. The goal of the procedure is to add one more node and then remove **overcloud-objectstorage-1**, effectively replacing it.

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 containing your node counts:

```
parameter_defaults:
  ObjectStorageCount: 4
```

   The **ObjectStorageCount** parameter defines the quantity of Object Storage nodes in your environment. In this situation, we scale from 3 to 4 nodes.

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 removing 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 the omit the old node. In this case, reduce it 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
```

The 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

Make sure to include all environment files and options from your initial overcloud creation. This includes the same scale parameters for non-Compute nodes.

12.6. BLACKLISTING NODES

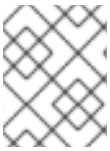
You can exclude overcloud nodes from receiving an updated deployment. This is useful in scenarios where you aim to scale new nodes while excluding existing nodes from receiving an updated set of parameters and resources from the core Heat template collection. In other words, the blacklisted nodes are 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 blacklisting 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 using the blacklist feature. For example, if a cluster configuration changes applies 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. See the *Upgrading Red Hat OpenStack Platform* documentation for more information.
- 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 just omit the **DeploymentServerBlacklist** parameter. If you omit the parameter, the overcloud deployment uses the previously saved value.

CHAPTER 13. 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 using only one Controller node.

13.1. PREPARING FOR CONTROLLER REPLACEMENT

Before attempting to 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 provisioning 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 get the Pacemaker status:

```
(undercloud) $ ssh heat-admin@192.168.0.47 'sudo pcs status'
```

The output should show all services running on the existing nodes and 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 get the 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 only show the two available nodes and not the failed node.

9. Disable fencing, if enabled. 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"
```

10. 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**.

11. Ensure all undercloud containers are running:

```
(undercloud) $ sudo podman ps
```

13.2. REMOVING A CEPH MONITOR DAEMON

Follow this procedure to remove a **ceph-mon** daemon from the storage cluster. If your Controller node is running a Ceph monitor service, complete the following steps to remove the ceph-mon daemon. This procedure assumes the Controller is reachable.

NOTE

Adding a new Controller to the cluster also adds a new Ceph monitor daemon automatically.

Procedure

1. Connect to the Controller you want to replace and become root:

```
# ssh heat-admin@192.168.0.47
# sudo su -
```

NOTE

If the controller is unreachable, skip steps 1 and 2 and continue the procedure at step 3 on any working controller node.

2. As root, stop the monitor:

```
# systemctl stop ceph-mon@<monitor_hostname>
```

For example:

```
# systemctl stop ceph-mon@overcloud-controller-1
```

3. Disconnect from the controller to be replaced.

4. Connect to one of the existing controllers.

```
# ssh heat-admin@192.168.0.46
# sudo su -
```

5. Remove the monitor from the cluster:

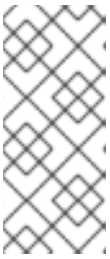
```
# sudo podman exec -it ceph-mon-controller-0 ceph mon remove overcloud-controller-1
```

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

The 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 to ensure consistency in case the other nodes restart before you add the new node.

7. Optionally, 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>
```

13.3. PREPARING THE CLUSTER FOR CONTROLLER REPLACEMENT

Before replacing the old node, you must ensure that Pacemaker is no longer running on the node and then remove that node from the Pacemaker cluster.

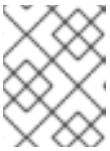
Procedure

1. Get a list of IP addresses for the Controller nodes:

```
(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 stopping 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 is being replaced 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 have removed 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 Pacemaker does not stop Galera during this procedure, select a running Controller node and run the following command on the undercloud using the Controller node's IP address:

```
(undercloud) $ ssh heat-admin@192.168.0.47 "sudo pcs resource unmanage galera-bundle"
```

13.4. 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 ironic node, enable maintenance mode on the outgoing node so that the director does not automatically reprovision the node.

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
```

13.5. TRIGGERING THE CONTROLER 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. Run your overcloud deployment command, including the **remove-controller.yaml** environment file along with any other environment files relevant to your environment:

```
(undercloud) $ openstack overcloud deploy --templates \
    -e /home/stack/templates/remove-controller.yaml \
    -e /home/stack/templates/node-info.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. The director removes the old node, creates a new one, and updates the overcloud stack. You can check the status of the overcloud stack with the following command:

```
(undercloud) $ openstack stack list --nested
```

6. Once the deployment command completes, the director shows the old node 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.

13.6. CLEANING UP AFTER CONTROLLER NODE REPLACEMENT

After completing the node replacement, complete the following steps to finalize the Controller cluster.

Procedure

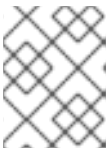
1. Log into a Controller node.

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 make sure 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 the 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
```

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. Compute services for the removed node still exist in the overcloud and require removal. 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
```

CHAPTER 14. REBOOTING NODES

You may need to reboot the nodes in the undercloud and overcloud. Use the following procedures to understand how to reboot different node types. Be aware of the following notes:

- If rebooting all nodes in one role, it is advisable to reboot each node individually. If you reboot all nodes in a role simultaneously, you might encounter service downtime during the reboot operation.
- If rebooting 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

14.1. REBOOTING THE UNDERCLOUD NODE

Complete the following steps to reboot the undercloud node.

Procedure

1. Log into the undercloud as the **stack** user.
2. Reboot the undercloud:

```
$ sudo reboot
```

3. Wait until the node boots.

14.2. 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 the node has rejoined the cluster:

```
[heat-admin@overcloud-controller-0 ~]$ sudo pcs status
```

   b. If the node uses Systemd services, check all services are enabled:

```
[heat-admin@overcloud-controller-0 ~]$ sudo systemctl status
```

   c. If the node uses containerized services, check all containers on the node are active:

```
[heat-admin@overcloud-controller-0 ~]$ sudo podman ps
```

14.3. REBOOTING STANDALONE CEPH MON NODES

Complete the following steps to reboot standalone Ceph MON nodes.

Procedure

1. Log into 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.

14.4. REBOOTING A CEPH STORAGE (OSD) CLUSTER

Complete the following steps to reboot a cluster of Ceph Storage (OSD) nodes.

Procedure

1. Log in to 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 to reboot and log into the node.
3. Reboot the node:

```
$ sudo reboot
```

4. Wait until the node boots.

5. Log in to the node and check the cluster status:

```
$ sudo podman exec -it ceph-mon-controller-0 ceph status
```

   Check 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 enable cluster rebalancing again:

```
$ 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 the cluster reports **HEALTH_OK**:

```
$ sudo podman exec -it ceph-mon-controller-0 ceph status
```

14.5. REBOOTING COMPUTE NODES

Complete the following steps to reboot Compute nodes. To ensure minimal downtime of instances in your OpenStack Platform environment, this procedure also includes instructions about migrating instances from the Compute node 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 will 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 general 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 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 decided not to migrate instances, skip to this step.
6. If you decided to migrate the instances to another Compute node, use one of the following commands:
   a. Migrate the instance to a different host:

```
(overcloud) $ openstack server migrate [instance-id] --live [target-host]--wait
```

   b. Let **nova-scheduler** automatically select the target host:

```
(overcloud) $ nova live-migration [instance-id]
```

   c. 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 the migration was successful:

```
(overcloud) $ openstack server list --host [hostname] --all-projects
```

9. Continue migrating instances until none remain on the chosen Compute Node.
10. Log in to the Compute Node. Reboot the node:

```
[heat-admin@overcloud-compute-0 ~]$ sudo reboot
```

11. Wait until the node boots.

12. Enable the Compute Node again:

```
$ source ~/overcloudrc
(overcloud) $ openstack compute service set [hostname] nova-compute --enable
```

13. Check whether the Compute node is enabled:

```
(overcloud) $ openstack compute service list
```

PART IV. ADDITIONAL DIRECTOR OPERATIONS AND CONFIGURATION

CHAPTER 15. 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.

15.1. 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
```

15.2. 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 asks for certain details about your authority. Enter these details at the prompt.

These commands create a certificate authority file called **ca.crt.pem**.

15.3. 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
```

15.4. CREATING AN SSL/TLS KEY

Enabling SSL/TLS on an OpenStack environment requires an SSL/TLS key to generate your certificates. This procedure shows how to generate this key.

Procedure

1. Run the following command to generate the SSL/TLS key (**server.key.pem**):

```
$ openssl genrsa -out server.key.pem 2048
```

15.5. CREATING AN SSL/TLS CERTIFICATE SIGNING REQUEST

Complete the following procedure 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 to use for the 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 using an IP address to access the director over SSL/TLS, use the **undercloud_public_host** parameter in **undercloud.conf**.
- If using a fully qualified domain name to access the director over SSL/TLS, use the domain name.
  Add **subjectAltName = @alt_names** to the **v3_req** section.

  Edit the **alt_names** section to include the following entries:
- **IP** - A list of IP addresses that clients use to access the director over SSL.
- **DNS** - A list of domain names that clients use to access the 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 results in an **server.csr.pem** file, which is the certificate signing request. Use this file to create your OpenStack SSL/TLS certificate.

15.6. CREATING THE SSL/TLS CERTIFICATE

This procedure shows how to generate the certificate for your OpenStack environment. This requires the following files:

openssl.cnf
The customized configuration file specifying 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 our **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

15.7. 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. Ensure you add the certificate authority that signed the certificate to the undercloud's list of trusted Certificate Authorities 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
```

Continue installing the undercloud.

CHAPTER 16. ADDITIONAL INTROSPECTION OPERATIONS

16.1. 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.

16.2. PERFORMING NODE INTROSPECTION AFTER INITIAL INTROSPECTION

After an initial introspection, all nodes should 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.

16.3. 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. The 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 is enabled by default to retrieve hardware details. You can use these hardware details to configure your overcloud. For more information on the inspection_extras parameter in the undercloud.conf file, see Configuring the Director.

For example, the numa_topology collector is part of these 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

Procedure

1. 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 17. AUTOMATICALLY DISCOVER BARE METAL NODES

You can use *auto-discovery* to register overcloud nodes and generate their metadata, without first having to create an **instackenv.json** file. This improvement can help reduce the time spent initially collecting information about a node, for example, removing the need to collate the IPMI IP addresses and subsequently create the **instackenv.json**.

17.1. REQUIREMENTS

- All overcloud nodes BMCs must be configured to be accessible to director through the IPMI.
- All overcloud nodes must be configured to PXE boot from the NIC connected to the undercloud control plane network.

17.2. ENABLE AUTO-DISCOVERY

1. Enable Bare Metal auto-discovery in **undercloud.conf**:

```
enable_node_discovery = True
discovery_default_driver = ipmi
```

   - **enable_node_discovery** - When enabled, any node that boots the introspection ramdisk using PXE will be enrolled in ironic.
   - **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**. You must 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
```

17.3. TEST 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
```

17.4. USE 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]}"}
        ]
    }
]
```

You must replace the username 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 18. 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.

18.1. 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*.

Description

This 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's 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 (e.g. **/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. The existing value for this same capability is replaced. 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"
  }
]
```

18.2. POLICY FILE EXAMPLE

The following is an example JSON file (**rules.json**) with the introspection rules to apply:

```
[
  {
    "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.

18.3. IMPORTING POLICY FILES

To import policy files to the director, complete the following steps.

Procedure

1. Import the policy file into the 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:

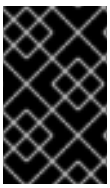
```
$ openstack overcloud profiles list
```

4. If you made a mistake in introspection rules, run the following command to delete all rules:

```
$ openstack baremetal introspection rule purge
```

CHAPTER 19. CREATING WHOLE DISK IMAGES

The main overcloud image is a flat partition image that contains no partitioning information or bootloader on the images itself. The director uses a separate kernel and ramdisk when booting nodes and creates a basic partitioning layout when writing 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's image building feature. Red Hat only supports images built using the guidelines contained in this section. Custom images built outside of these specifications are not supported.

19.1. 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. Consider the following list of recommendations when you create your image:

- 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 as they are installed by default

19.2. 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

19.3. DOWNLOADING THE BASE CLOUD IMAGE

Before building 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 **Download** on the top menu.
3. Click **Red Hat Enterprise Linux 8**

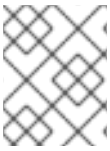
NOTE

Enter your customer Customer Portal login details if a prompt appears.

4. Select the KVM Guest Image 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"

19.4. 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 once 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 containing 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

Gives 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-rpms**
- **rhel-8-for-x86_64-appstream-rpms**
- **rhel-8-for-x86_64-highavailability-rpms**
- **ansible-2.8-for-rhel-8-x86_64-rpms**
- **openstack-15-for-rhel-8-x86_64-rpms**

REG_SAT_URL

The base URL of the Satellite server to register Overcloud nodes. Use the Satellite's 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

Gives the hostname of the subscription service to use. The default is for the Red Hat Customer Portal at **subscription.rhn.redhat.com**. If using a Red Hat Satellite 6 server, set this parameter to the hostname of your Satellite server.

REG_USER

Gives 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-rpms \
    rhel-8-for-x86_64-appstream-rpms \
    rhel-8-for-x86_64-highavailability-rpms \
    ansible-2.8-for-rhel-8-x86_64-rpms \
    openstack-15-for-rhel-8-x86_64-rpms"
```

19.5. 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.

19.6. MODIFYING THE PARTITIONING SCHEMA

You can modify the partitioning schema to alter the partitioning size, create new partitions, or remove existing ones. You can define a new partitioning schema with the following environment variable:

```
$ export DIB_BLOCK_DEVICE_CONFIG='<yaml_schema_with_partitions>'
```

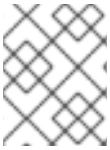
The following YAML structure represents the modified logical volume partitioning layout to accommodate enough space to pull overcloud container images:

```
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 your image's partition schema. Modify the partition sizes and layout to suit your needs.



NOTE

You must define the correct partition sizes for the image as you **cannot** resize them after the deployment.

19.7. 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.

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
```

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.

Save this 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's hard disk.

IMPORTANT

When the director writes the image to the physical disk, the director creates a 64MB configuration drive primary partition at the end of the disk. When you create your whole disk image, ensure the size of the physical disk accommodates this extra partition.

19.8. BUILDING THE WHOLE DISK IMAGE

After you have set the environment variables and customized 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
```

1 This is the custom configuration file containing 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.

This command creates an image called **overcloud-hardened-full.qcow2**, which contains all the necessary security features.

19.9. 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
```

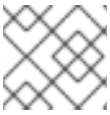
If you want to replace an existing image with the security hardened image, use the **--update-existing** flag. This flag overwrites the original **overcloud-full** image with a new security hardened image.

CHAPTER 20. CONFIGURING DIRECT DEPLOY

When provisioning nodes, the 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.

20.1. 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 providing 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 **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 21. CREATING VIRTUALIZED CONTROL PLANES

A virtualized control plane is a control plane located on virtual machines (VMs) rather than on bare metal. A virtualized control plane reduces the number of bare metal machines required 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.

21.1. VIRTUALIZED CONTROL PLANE ARCHITECTURE

You use the OpenStack Platform 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

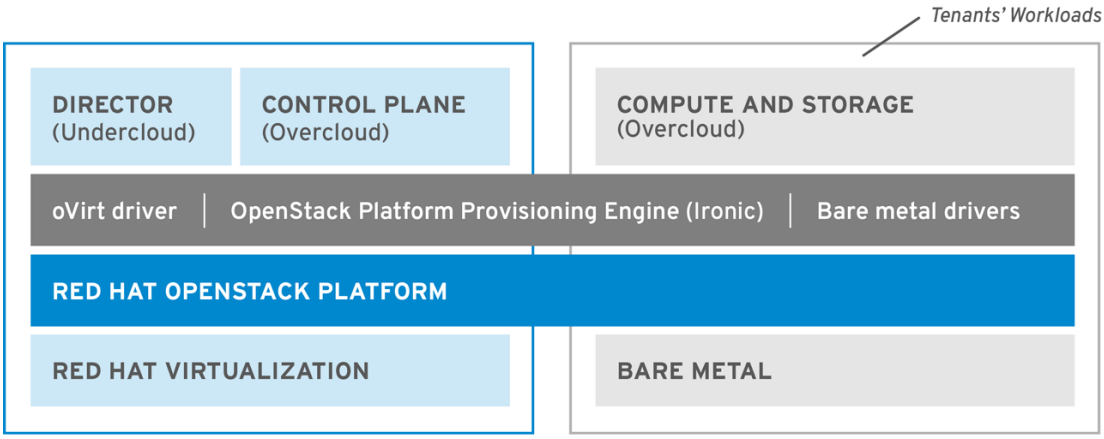
Virtualized Controller nodes are supported only on Red Hat Virtualization.

The following architecture diagram illustrates how to deploy a virtualized control plane. You distribute the overcloud with the Controller nodes running on VMs on Red Hat Virtualization. You run the Compute and storage nodes on bare metal.

NOTE

You run the OpenStack virtualized undercloud on Red Hat Virtualization.

Virtualized control plane architecture



The OpenStack Bare Metal Provisioning (ironic) service 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.

21.2. 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. This allows you to allocate resources to specific components of the control plane.
- You can maintain systems without service interruption by using the VM live migration feature.
- You can integrate third-party or custom tools supported by Red Hat Virtualization.

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 need to create a dedicated role for **cinder-volume** instead of including it on the virtualized controllers. For more information, see Composable Services and Custom Roles.

21.3. PROVISIONING VIRTUALIZED CONTROLLERS USING THE RED HAT VIRTUALIZATION DRIVER

This section details how 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 or 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. This prevents 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. Enable the **staging-ovirt** driver in the director undercloud by adding the driver to **enabled_hardware_types** 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 the undercloud is set up correctly, the 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 instance, **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 to deploy with your overcloud:

Table 21.1. Configuring the VMs for the overcloud

Key	Set to this value
pm_type	OpenStack Bare Metal Provisioning (ironic) service driver for oVirt/RHV VMs, **staging-ovirt**.

Key	Set to this value
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":"{vernum}-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 22. TROUBLESHOOTING DIRECTOR ERRORS

Errors can occur at certain stages of the director's processes. This section contains some information about diagnosing common problems.

22.1. 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]
```

22.2. 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.

This procedure contains information about common scenarios where environment misconfiguration occurs and advice about how to diagnose and resolve them.

Procedure

1. Source the **stackrc** file:

```
$ source ~/stackrc
```

2. The director uses OpenStack Object Storage (swift) to save the hardware data obtained during the introspection process. If this service is not running, the introspection can fail. Check all services related to OpenStack Object Storage to ensure the service is running:

```
(undercloud) $ sudo systemctl list-units tripleo_swift*
```

3. Check your nodes are in a **manageable** state. The introspection does not inspect nodes in an **available** state, which is meant for deployment. In this situation, 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:

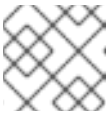
   a. Run the **openssl passwd -1** command with a temporary password to generate an MD5 hash:

```
(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. For example:

```
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
```

   The **--provide** option causes the node state to change to **available** when 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
```

Accessing the node during introspection means you can run diagnostic commands to 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

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.

22.3. TROUBLESHOOTING WORKFLOWS AND EXECUTIONS

The OpenStack Workflow (mistral) service groups multiple OpenStack tasks into workflows. Red Hat OpenStack Platform uses a set of these workflow to perform common functions across the director, including bare metal node control, validations, plan management, and overcloud deployment.

For example, when running 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 once 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. Once 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 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 its 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 used for the execution (for example, **tripleo.plan_management.v1.publish_ui_logs_to_swift**). You can view the full workflow definition using 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.

22.4. TROUBLESHOOTING OVERCLOUD CREATION AND DEPLOYMENT

The initial creation of the overcloud occurs with the OpenStack Orchestration (heat) service. If an overcloud deployment has failed, 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 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
```

22.5. 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.

22.6. TROUBLESHOOTING IP ADDRESS CONFLICTS DURING PROVISIONING

Introspection and deployment tasks will 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 will need to either change the IP address ranges or free up the IP addresses before introspecting or deploying the overcloud nodes.

22.7. 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 suitable for booting the new instance. This usually means there is a mismatch between resources that the Compute service expects to find and resources that the Bare Metal service advertised to Compute. This procedure shows how to check if this is the case.

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 the **properties** JSON field has valid values for keys **cpus**, **cpu_arch**, **memory_mb** and **local_gb**.

3. Check the Compute flavor mapped to the node:

```
(undercloud) $ openstack flavor show [FLAVOR NAME]
```

Make sure it does not exceed the node properties for the required number of nodes.

4. Run the **openstack baremetal node list** command to ensure sufficient nodes in the available state. Nodes in **manageable** state usually signify a failed introspection.

5. Run the **openstack baremetal node list** command to check 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 corresponding 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 should contain **profile:compute**.

7. It takes some time 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 nova. Use the following command to check the total resources in your system:

```
(undercloud) $ openstack hypervisor stats show
```

22.8. TROUBLESHOOTING OVERCLOUD CONFIGURATION

OpenStack Platform director uses Ansible to configure the overcloud. This procedure shows how to diagnose the overcloud's Ansible playbooks (**config-download**) when errors occur.

Procedure

1. Make sure 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 took place.

22.9. 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 the 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 into 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, use the following command:

```
$ sudo podman logs keystone
```

In most cases, this log contains information about the cause of a container's 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:

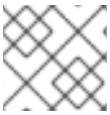
```
$ sudo podman inspect keystone
```

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's 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's file system, run the following command:

```
$ sudo podman export keystone -o keystone.tar
```

This command create the **keystone.tar** archive, which you can extract and explore.

22.10. 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 containing the failure:

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

3. Log into 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, this log file is usually a good place to start a diagnosis.

7. If performing maintenance on the Compute node, migrate the existing instances from the host to an operational Compute node, then disable the node.

22.11. CREATING AN SOSREPORT

If you need to contact Red Hat for support on OpenStack Platform, you might need to generate an **sosreport**. See the following knowledgebase article for more information about creating an **sosreport**:

- "How to collect all required logs for Red Hat Support to investigate an OpenStack issue"

22.12. LOG LOCATIONS

Use the following logs to find out information about the undercloud and overcloud when troubleshooting.

Table 22.1. 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 22.2. 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 22.3. 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 23. TIPS FOR UNDERCLOUD AND OVERCLOUD SERVICES

This section provides advice on tuning and managing specific OpenStack services on the undercloud.

23.1. 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 to control these **cron** jobs.

Table 23.1. 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 23.2. 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 23.3. 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 a half hour, 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.

23.2. TUNING DEPLOYMENT PERFORMANCE

OpenStack Platform director uses OpenStack Orchestration (heat) to handle the main deployment and provisioning functions. Heat uses a series of workers to carry out deployment tasks. To calculate the default number of workers, the director's heat configuration halves the undercloud's total CPU thread count [2]. For example, if your undercloud has a CPU with 16 threads, then 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 using the **HeatWorkers** parameter in an environment file:

heat-workers.yaml

```
parameter_defaults:
  HeatWorkers: 16
```

undercloud.yaml

```
custom_env_files: heat-workers.yaml
```

23.3. 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.

23.4. 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 used with the HAProxy configuration. This hardening helps 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 aim 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 running **openstack undercloud install**:

```
[DEFAULT]
...
hieradata_override = haproxy-hiera-overrides.yaml
...
```

[2] In this instance, thread count refers to the number of CPU cores multiplied by the hyper-threading value

PART VI. APPENDICES

APPENDIX A. POWER MANAGEMENT DRIVERS

Although IPMI is the main method the director uses for power management control, the director also supports other power management types. This appendix contains a list of the power management features that the director supports. Use these power management settings for Section 6.1, "Registering Nodes for the Overcloud".

A.1. INTELLIGENT PLATFORM MANAGEMENT INTERFACE (IPMI)

The standard power management method using 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**.
- The director also requires an additional set of utilities for iLo. Install the **python3-proliantutils** package and restart the **openstack-ironic-conductor** service:

```
$ sudo dnf install python3-proliantutils
$ sudo systemctl restart openstack-ironic-conductor.service
```

- HP nodes must have a minimum ILO firmware version of 1.85 (May 13 2015) for successful introspection. The director has been successfully tested with nodes using this ILO firmware version.
- Using a shared iLO port is not supported.

A.5. CISCO UNIFIED COMPUTING SYSTEM (UCS)

NOTE

Cisco UCS is being deprecated and will be removed from Red Hat OpenStack Platform (RHOSP) 16.0.

UCS from Cisco is a data center platform that combines compute, network, storage access, and virtualization resources. This driver focuses on the power management for bare metal systems connected to the UCS.

pm_type

Set this option to **cisco-ucs-managed**.

pm_user; pm_password

The UCS username and password.

pm_addr

The IP address of the UCS interface.

pm_service_profile

The UCS service profile to use. Usually takes the format of **org-root/ls-[service_profile_name]**. For example:

```
"pm_service_profile": "org-root/ls-Nova-1"
```

- To enable this driver, add **cisco-ucs-managed** to the **enabled_hardware_types** option in your **undercloud.conf** and rerun the **openstack undercloud install** command.
- The director also requires an additional set of utilities for UCS. Install the **python3-UcsSdk** package and restart the **openstack-ironic-conductor** service:

```
$ sudo dnf install python3-UcsSdk
$ sudo systemctl restart openstack-ironic-conductor.service
```

A.6. FUJITSU INTEGRATED REMOTE MANAGEMENT CONTROLLER (IRMC)

Fujitsu's 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 **openstack-ironic-conductor** service:

```
$ dnf install python3-scciclient
$ sudo systemctl restart openstack-ironic-conductor.service
```

A.7. RED HAT VIRTUALIZATION

This driver provides control over virtual machines in Red Hat Virtualization through its RESTful API.

pm_type

Set this option to **staging-ovirt**.

pm_user; pm_password

The username and password for your Red Hat Virtualization environment. The username also includes the authentication provider. For example: **admin@internal**.

pm_addr

The IP address of the Red Hat Virtualization REST API.

pm_vm_name

The name of the virtual machine to control.

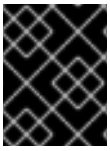
mac

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.8. 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 only available 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 fresh Red Hat OpenStack Platform installation, you can now deploy overcloud Compute nodes on POWER (ppc64le) hardware. For the Compute node cluster, you can choose to use the same architecture, or have a combination of x86_64 and ppc64le systems. The undercloud, Controller nodes, Ceph Storage nodes, and all other systems are only supported on x86_64 hardware. You can find installation details for each system in previous sections within this guide.

B.1. CEPH STORAGE

When configuring access to external Ceph in a multi-architecture cloud, set the **CephAnsiblePlaybook** parameter to **/usr/share/ceph-ansible/site.yml.sample** along with 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:

- **Cinder**
- **Glance**
- **Keystone**
- **Neutron**
- **Swift**

NOTE

Red Hat does not support features in Technology Preview.

For more information, see the documentation for composable services and custom roles for more information. 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
```