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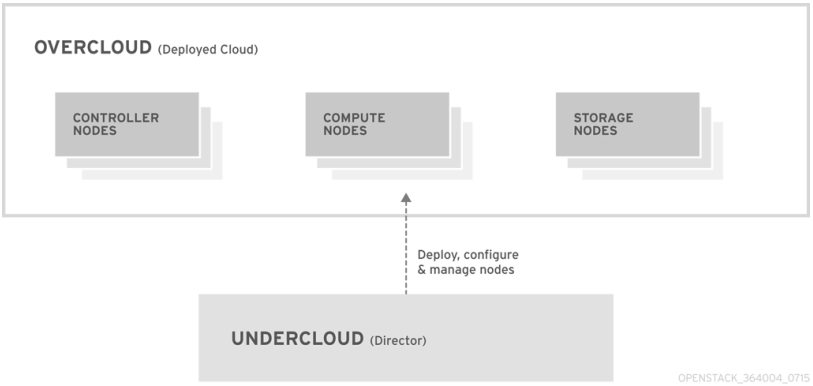
Chapter 1. Introduction

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.

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