



Red Hat OpenStack Platform 16.2

Transitioning to Containerized Services

A basic guide to working with OpenStack Platform containerized services

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Abstract

This guide provides some basic information to help users get accustomed working with OpenStack Platform services running in containers.

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MAKING OPEN SOURCE MORE INCLUSIVE

Red Hat is committed to replacing problematic language in our code, documentation, and web properties. We are beginning with these four terms: master, slave, blacklist, and whitelist. Because of the enormity of this endeavor, these changes will be implemented gradually over several upcoming releases. For more details, see [our CTO Chris Wright's message](#).

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CHAPTER 1. INTRODUCTION

Past versions of Red Hat OpenStack Platform used services managed with Systemd. However, more recent version of OpenStack Platform now use containers to run services. Some administrators might not have a good understanding of how containerized OpenStack Platform services operate, and so this guide aims to help you understand OpenStack Platform container images and containerized services. This includes:

- How to obtain and modify container images
- How to manage containerized services in the overcloud
- Understanding how containers differ from Systemd services

The main goal is to help you gain enough knowledge of containerized OpenStack Platform services to transition from a Systemd-based environment to a container-based environment.

1.1. CONTAINERIZED SERVICES AND KOLLA

Each of the main Red Hat OpenStack Platform (RHOSP) services run in containers. This provides a method to keep each service within its own isolated namespace separated from the host. This has the following effects:

- During deployment, RHOSP pulls and runs container images from the Red Hat Customer Portal.
- The **podman** command operates management functions, like starting and stopping services.
- To upgrade containers, you must pull new container images and replace the existing containers with newer versions.

Red Hat OpenStack Platform uses a set of containers built and managed with the **Kolla** toolset.

CHAPTER 2. OBTAINING AND MODIFYING CONTAINER IMAGES

A containerized overcloud requires access to a registry with the required container images. This chapter provides information on how to prepare the registry and your undercloud and overcloud configuration to use container images for Red Hat OpenStack Platform.

2.1. PREPARING CONTAINER IMAGES

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



NOTE

If you need to configure specific container image versions for your overcloud, you must pin the images to a specific version. For more information, see [Pinning container images for the overcloud](#).

Procedure

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

```
$ sudo 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 that director pulls the necessary images from the Red Hat Container Catalog and pushes them to the registry on the undercloud. 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 use the same **containers-prepare-parameter.yaml** file to define a container image source for both the undercloud and the overcloud.

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

2.2. CONTAINER IMAGE PREPARATION PARAMETERS

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

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

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

Parameter	Description
excludes	List of regular expressions to exclude image names from a strategy.
includes	List of regular expressions 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 16.2.3-5.161 and set the modify_append_tag to -hotfix , the director tags the final image as 16.2.3-5.161-hotfix.
modify_only_with_labels	A dictionary of image labels that filter the images that you want to modify. If an image matches the labels defined, the director includes the image in the modification process.
modify_role	String of ansible role names to run during upload but before pushing the image to the destination registry.
modify_vars	Dictionary of variables to pass to modify_role .

Parameter	Description
push_destination	<p>Defines the namespace of the registry that you want to push images to during the upload process.</p> <ul style="list-style-type: none"> ● If set to true, the push_destination is set to the undercloud registry namespace using the hostname, which is the recommended method. ● If set to false, the push to a local registry does not occur and nodes pull images directly from the source. ● If set to a custom value, director pushes images to an external local registry. <p>If you set this parameter to false in production environments while pulling images directly from Red Hat Container Catalog, all overcloud nodes will simultaneously pull the images from the Red Hat Container Catalog over your external connection, which can cause bandwidth issues. Only use false to pull directly from a Red Hat Satellite Server hosting the container images.</p> <p>If the push_destination parameter is set to false or is not defined and the remote registry requires authentication, set the ContainerImageRegistryLogin parameter to true and include the credentials with the ContainerImageRegistryCredentials parameter.</p>
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	<p>Use the value of specified container image metadata labels to create a tag for every image and pull that tagged image. For example, if you set tag_from_label: {version}-{release}, director uses the version and release labels to construct a new tag. For one container, version might be set to 16.2.3 and release might be set to 5.161, which results in the tag 16.2.3-5.161. Director uses this parameter only if you have not defined tag in the set dictionary.</p>



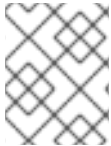
IMPORTANT

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

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

Key	Description
ceph_image	The name of the Ceph Storage container image.
ceph_namespace	The namespace of the Ceph Storage container image.
ceph_tag	The tag of the Ceph Storage container image.
ceph_alertmanager_image ceph_alertmanager_namespace ceph_alertmanager_tag	The name, namespace, and tag of the Ceph Storage Alert Manager container image.
ceph_grafana_image ceph_grafana_namespace ceph_grafana_tag	The name, namespace, and tag of the Ceph Storage Grafana container image.
ceph_node_exporter_image ceph_node_exporter_namespace ceph_node_exporter_tag	The name, namespace, and tag of the Ceph Storage Node Exporter container image.
ceph_prometheus_image ceph_prometheus_namespace ceph_prometheus_tag	The name, namespace, and tag of the Ceph Storage Prometheus container image.
name_prefix	A prefix for each OpenStack service image.
name_suffix	A suffix for each OpenStack service image.
namespace	The namespace for each OpenStack service image.
neutron_driver	The driver to use to determine which OpenStack Networking (neutron) container to use. Use a null value to set to the standard neutron-server container. Set to ovn to use OVN-based containers.

Key	Description
tag	Sets a specific tag for all images from the source. If not defined, director uses the Red Hat OpenStack Platform version number as the default value. This parameter takes precedence over the tag_from_label value.

**NOTE**

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

2.3. GUIDELINES FOR CONTAINER IMAGE TAGGING

The Red Hat Container Registry uses a specific version format to tag all Red Hat OpenStack Platform container images. This format follows the label metadata for each container, which is **version-release**.

version

Corresponds to a major and minor version of Red Hat OpenStack Platform. These versions act as streams that contain one or more releases.

release

Corresponds to a release of a specific container image version within a version stream.

For example, if the latest version of Red Hat OpenStack Platform is 16.2.3 and the release for the container image is **5.161**, then the resulting tag for the container image is 16.2.3-5.161.

The Red Hat Container Registry also uses a set of major and minor **version** tags that link to the latest release for that container image version. For example, both 16.2 and 16.2.3 link to the latest **release** in the 16.2.3 container stream. If a new minor release of 16.2 occurs, the 16.2 tag links to the latest **release** for the new minor release stream while the 16.2.3 tag continues to link to the latest **release** within the 16.2.3 stream.

The **ContainerImagePrepare** parameter contains two sub-parameters that you can use to determine which container image to download. These sub-parameters are the **tag** parameter within the **set** dictionary, and the **tag_from_label** parameter. Use the following guidelines to determine whether to use **tag** or **tag_from_label**.

- The default value for **tag** is the major version for your OpenStack Platform version. For this version it is 16.2. This always corresponds to the latest minor version and release.

```
parameter_defaults:
  ContainerImagePrepare:
    - set:
      ...
      tag: 16.2
      ...
```

- To change to a specific minor version for OpenStack Platform container images, set the tag to a minor version. For example, to change to 16.2.2, set **tag** to 16.2.2.

```
parameter_defaults:
```

```
ContainerImagePrepare:
```

```
- set:
  ...
  tag: 16.2.2
  ...
```

- When you set **tag**, director always downloads the latest container image **release** for the version set in **tag** during installation and updates.
- If you do not set **tag**, director uses the value of **tag_from_label** in conjunction with the latest major version.

```
parameter_defaults:
```

```
ContainerImagePrepare:
- set:
  ...
  # tag: 16.2
  ...
  tag_from_label: '{version}-{release}'
```

- The **tag_from_label** parameter generates the tag from the label metadata of the latest container image release it inspects from the Red Hat Container Registry. For example, the labels for a certain container might use the following **version** and **release** metadata:

```
"Labels": {
  "release": "5.161",
  "version": "16.2.3",
  ...
}
```

- The default value for **tag_from_label** is **{version}-{release}**, which corresponds to the version and release metadata labels for each container image. For example, if a container image has 16.2.3 set for **version** and 5.161 set for **release**, the resulting tag for the container image is 16.2.3-5.161.
- The **tag** parameter always takes precedence over the **tag_from_label** parameter. To use **tag_from_label**, omit the **tag** parameter from your container preparation configuration.
- A key difference between **tag** and **tag_from_label** is that director uses **tag** to pull an image only based on major or minor version tags, which the Red Hat Container Registry links to the latest image release within a version stream, while director uses **tag_from_label** to perform a metadata inspection of each container image so that director generates a tag and pulls the corresponding image.

2.4. OBTAINING CONTAINER IMAGES FROM PRIVATE REGISTRIES

The **registry.redhat.io** registry requires authentication to access and pull images. To authenticate with **registry.redhat.io** and other private registries, include the **ContainerImageRegistryCredentials** and **ContainerImageRegistryLogin** parameters in your **containers-prepare-parameter.yaml** file.

ContainerImageRegistryCredentials

Some container image registries require authentication to access images. In this situation, use the **ContainerImageRegistryCredentials** parameter in your **containers-prepare-parameter.yaml** environment file. The **ContainerImageRegistryCredentials** parameter uses a set of keys based on the

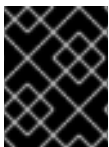
private registry URL. Each private registry URL uses its own key and value pair to define the username (key) and password (value). This provides a method to specify credentials for multiple private registries.

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

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

To specify authentication details for multiple registries, set multiple key-pair values for each registry in **ContainerImageRegistryCredentials**:

```
parameter_defaults:
  ContainerImagePrepare:
    - push_destination: true
      set:
        namespace: registry.redhat.io/...
      ...
    - push_destination: true
      set:
        namespace: registry.internalsite.com/...
      ...
  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.

For more information, see [Red Hat Container Registry Authentication](#) .

ContainerImageRegistryLogin

The **ContainerImageRegistryLogin** parameter is used to control whether an overcloud node system needs to log in to the remote registry to fetch the container images. This situation occurs when you want the overcloud nodes to pull images directly, rather than use the undercloud to host images.

You must set **ContainerImageRegistryLogin** to **true** if **push_destination** is set to false or not used for a given strategy.


```
parameter_defaults:
  ContainerImagePrepare:
  - push_destination: false
  set:
    namespace: registry.redhat.io/...
    ...
  ...
  ContainerImageRegistryCredentials:
  registry.redhat.io:
    myuser: 'p@55w0rd!'
  ContainerImageRegistryLogin: true
```

However, if the overcloud nodes do not have network connectivity to the registry hosts defined in **ContainerImageRegistryCredentials** and you set **ContainerImageRegistryLogin** to **true**, the deployment might fail when trying to perform a login. If the overcloud nodes do not have network connectivity to the registry hosts defined in the **ContainerImageRegistryCredentials**, set **push_destination** to **true** and **ContainerImageRegistryLogin** to **false** so that the overcloud nodes pull images from the undercloud.

```
parameter_defaults:
  ContainerImagePrepare:
  - push_destination: true
  set:
    namespace: registry.redhat.io/...
    ...
  ...
  ContainerImageRegistryCredentials:
  registry.redhat.io:
    myuser: 'p@55w0rd!'
  ContainerImageRegistryLogin: false
```

2.5. LAYERING IMAGE PREPARATION ENTRIES

The value of the **ContainerImagePrepare** parameter is a YAML list. This means that you can specify multiple entries.

The following example demonstrates two entries where director uses the latest version of all images except for the **nova-api** image, which uses the version tagged with **16.2.1-hotfix**:

```
parameter_defaults:
  ContainerImagePrepare:
  - tag_from_label: "{version}-{release}"
    push_destination: true
    excludes:
    - nova-api
    set:
      namespace: registry.redhat.io/rhosp-rhel8
      name_prefix: openstack-
      name_suffix: "
      tag:16.2
  - push_destination: true
    includes:
    - nova-api
```

```
set:
  namespace: registry.redhat.io/rhosp-rhel8
  tag: 16.2.1-hotfix
```

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

A similar technique is used if your Block Storage (cinder) driver requires a vendor supplied cinder-volume image known as a plugin. If your Block Storage driver requires a plugin, see [Deploying a vendor plugin](#) in the *Advanced Openstack Customization* guide.

2.6. MODIFYING IMAGES DURING PREPARATION

It is possible to modify images during image preparation, and then immediately deploy the overcloud with modified images.



NOTE

Red Hat OpenStack Platform (RHOSP) director supports modifying images during preparation for RHOSP containers, not for Ceph containers.

Scenarios for modifying images include:

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

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

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

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

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

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

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



IMPORTANT

To use the **openstack tripleo container image prepare** command, your undercloud must contain a running **image-serve** registry. As a result, you cannot run this command before a new undercloud installation because the **image-serve** registry will not be installed. You can run this command after a successful undercloud installation.

2.7. UPDATING EXISTING PACKAGES ON CONTAINER IMAGES



NOTE

Red Hat OpenStack Platform (RHOSP) director supports updating existing packages on container images for RHOSP containers, not for Ceph containers.

Procedure

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

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

2.8. INSTALLING ADDITIONAL RPM FILES TO CONTAINER IMAGES

You can install a directory of RPM files in your container images. This is useful for installing hotfixes, local package builds, or any package that is not available through a package repository.



NOTE

Red Hat OpenStack Platform (RHOSP) director supports installing additional RPM files to container images for RHOSP containers, not for Ceph containers.



NOTE

When you modify container images in existing deployments, you must then perform a minor update to apply the changes to your overcloud. For more information, see [Keeping Red Hat OpenStack Platform Updated](#).

Procedure

- The following example **ContainerImagePrepare** entry installs some hotfix packages on only 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
...
```

2.9. MODIFYING CONTAINER IMAGES WITH A CUSTOM DOCKERFILE

You can specify a directory that contains 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.



NOTE

Red Hat OpenStack Platform (RHOSP) director supports modifying container images with a custom Dockerfile for RHOSP containers, not for Ceph containers.

Procedure

- The following example runs the custom Dockerfile on the **nova-compute** image:

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

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

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

USER "root"

COPY customize.sh /tmp/
```

```
RUN /tmp/customize.sh
```

```
USER "nova"
```

2.10. PREPARING A SATELLITE SERVER FOR CONTAINER IMAGES

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

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



NOTE

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

Procedure

1. Create a list of all container images:

```
$ sudo podman search --limit 1000 "registry.redhat.io/rhosp-rhel8/openstack" --format="{{
.Name }}" | sort > satellite_images
$ sudo podman search --limit 1000 "registry.redhat.io/rhceph" | grep rhceph-4-dashboard-
rhel8
$ sudo podman search --limit 1000 "registry.redhat.io/rhceph" | grep rhceph-4-rhel8
$ sudo podman search --limit 1000 "registry.redhat.io/openshift" | grep ose-prometheus
```

- If you plan to install Ceph and enable the Ceph Dashboard, you need the following ose-prometheus containers:

```
registry.redhat.io/openshift4/ose-prometheus-node-exporter:v4.6
registry.redhat.io/openshift4/ose-prometheus:v4.6
registry.redhat.io/openshift4/ose-prometheus-alertmanager:v4.6
```

2. Copy the **satellite_images** file to a system that contains the Satellite 6 **hammer** tool. Alternatively, use the instructions in the [Hammer CLI Guide](#) to install the **hammer** tool to the undercloud.
3. Run the following **hammer** command to create a new product (**OSP Containers**) in your Satellite organization:

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

This custom product will contain your images.

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

```
$ while read IMAGE; do \
  IMAGE_NAME=$(echo $IMAGE | cut -d"/" -f3 | sed "s/openstack-//g") ; \
  IMAGE_NOURL=$(echo $IMAGE | sed "s/registry.redhat.io///g") ; \
  hammer repository create \
  --organization "ACME" \
  --product "OSP Containers" \
  --content-type docker \
  --url https://registry.redhat.io \
  --docker-upstream-name $IMAGE_NOURL \
  --upstream-username USERNAME \
  --upstream-password PASSWORD \
  --name $IMAGE_NAME ; done < satellite_images
```

5. Add the Ceph Storage 4 container image:

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

NOTE

If you want to install the Ceph dashboard, include **--name rhceph-4-dashboard-rhel8** in the **hammer repository create** command:

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

6. Synchronize the container images:

```
$ hammer product synchronize \
  --organization "ACME" \
  --name "OSP 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*.

- If your Satellite 6 server uses content views, create a new content view version to incorporate the images and promote it along environments in your application life cycle. This largely depends on how you structure your application lifecycle. For example, if you have an environment called **production** in your lifecycle and you want the container images to be available in that environment, create a content view that includes the container images and promote that content view to the **production** environment. For more information, see [Managing Content Views](#).

- Check the available tags for the **base** image:

```
$ hammer docker tag list --repository "base" \
  --organization "ACME" \
  --lifecycle-environment "production" \
  --product "OSP Containers"
```

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

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

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

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

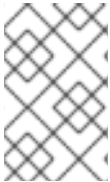
- Edit the **containers-prepare-parameter.yaml** file and modify the following parameters:

- **push_destination** - Set this to **true** or **false** depending on your chosen container image management strategy. If you set this parameter to **false**, the overcloud nodes pull images directly from the Satellite. If you set this parameter to **true**, the director pulls the images from the Satellite to the undercloud registry and the overcloud pulls the images from the undercloud registry.
- **namespace** - The URL and port of the registry on the Satellite server. The default registry port on Red Hat Satellite is 443.
- **name_prefix** - The prefix is based on a Satellite 6 convention. This differs depending on whether you use content views:
 - If you use content views, the structure is **[org]-[environment]-[content view]-[product]-**. For example: **acme-production-myosp16-osp_containers-**.
 - If you do not use content views, the structure is **[org]-[product]-**. For example: **acme-osp_containers-**.

- **ceph_namespace**, **ceph_image**, **ceph_tag** - If you use Ceph Storage, include these additional parameters to define the Ceph Storage container image location. Note that **ceph_image** now includes a Satellite-specific prefix. This prefix is the same value as the **name_prefix** option.

The following example environment file contains Satellite-specific parameters:

```
parameter_defaults:
  ContainerImagePrepare:
    - push_destination: false
  set:
    ceph_image: acme-production-myosp16_1-osp_containers-rhceph-4
    ceph_namespace: satellite.example.com:443
    ceph_tag: latest
    name_prefix: acme-production-myosp16_1-osp_containers-
    name_suffix: ""
    namespace: satellite.example.com:443
    neutron_driver: null
    tag: '16.2'
  ...
```



NOTE

To use a specific container image version stored on your Red Hat Satellite Server, set the **tag** key-value pair to the specific version in the **set** dictionary. For example, to use the 16.2.2 image stream, set **tag: 16.2.2** in the **set** dictionary.

You must define the **containers-prepare-parameter.yaml** environment file in the **undercloud.conf** configuration file, otherwise the undercloud uses the default values:

```
container_images_file = /home/stack/containers-prepare-parameter.yaml
```


CHAPTER 3. INSTALLING THE UNDERCLOUD WITH CONTAINERS

This chapter provides info on how to create a container-based undercloud and keep it updated.

3.1. CONFIGURING DIRECTOR

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

Procedure

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

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

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

3.2. 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.



IMPORTANT

At minimum, you must set the **container_images_file** parameter to the environment file that contains your container image configuration. Without this parameter properly set to the appropriate file, director cannot obtain your container image rule set from the **ContainerImagePrepare** parameter nor your container registry authentication details from the **ContainerImageRegistryCredentials** parameter.

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 in addition to the default **x86_64** architecture.



NOTE

When you enable support for ppc64le, you must also set **ipxe_enabled** to **False**. For more information on configuring your undercloud with multiple CPU architectures, see [Configuring a multiple CPU architecture overcloud](#).

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

Delete temporary files. Set this to **False** to retain the temporary files used during deployment. The temporary files can help you debug the deployment if errors occur.

container_cli

The CLI tool for container management. Leave this parameter set to **podman**. Red Hat Enterprise Linux 8.4 only supports **podman**.

container_healthcheck_disabled

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

container_images_file

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

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

container_insecure_registries

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

container_registry_mirror

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

custom_env_files

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

deployment_user

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

discovery_default_driver

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

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

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

enable_node_discovery

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

enable_novajoin

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

enable_routed_networks

Defines whether to enable support for routed control plane networks.

enable_swift_encryption

Defines whether to enable Swift encryption at-rest.

enable_telemetry

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



WARNING

RBAC is not supported by every component. The Alarming service (aodh) and Gnocchi do not take secure RBAC rules into account.

enabled_hardware_types

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

generate_service_certificate

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

heat_container_image

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

heat_native

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

hieradata_override

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

inspection_extras

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

inspection_interface

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

inspection_runbench

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

ipa_otp

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

ipv6_address_mode

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

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

ipxe_enabled

Defines whether to use iPXE or standard PXE. The default is **true**, which enables iPXE. Set this parameter to **false** to use standard PXE. For PowerPC deployments, or for hybrid PowerPC and x86 deployments, set this value to **false**.

local_interface

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

```
2: em0: <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 em0
        valid_lft 3462sec preferred_lft 3462sec
    inet6 fe80::5054:ff:fe75:2409/64 scope link
        valid_lft forever preferred_lft forever
3: em1: <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 **em0** and the Provisioning NIC uses **em1**, which is currently not configured. In this case, set the **local_interface** to **em1**. The configuration script attaches this interface to a custom bridge defined with the **inspection_interface** parameter.

local_ip

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

For IPv6, the local IP address prefix length must be **/64** to support both stateful and stateless connections.

local_mtu

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

local_subnet

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

net_config_override

Path to network configuration override template. If you set this parameter, the undercloud uses a JSON or YAML format template to configure the networking with **os-net-config** and ignores the

network parameters set in **undercloud.conf**. Use this parameter when you want to configure bonding or add an option to the interface. For more information about customizing undercloud network interfaces, see [Configuring undercloud network interfaces](#).

networks_file

Networks file to override for **heat**.

output_dir

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

overcloud_domain_name

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



NOTE

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

roles_file

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

scheduler_max_attempts

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

service_principal

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

subnets

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

templates

Heat templates file to override.

undercloud_admin_host

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

If the **undercloud_admin_host** is not in the same IP network as the **local_ip**, you must set the **ControlVirtualInterface** parameter to the interface on which you want the admin APIs on the undercloud to listen. By default, the admin APIs listen on the **br-ctlplane** interface. Set the **ControlVirtualInterface** parameter in a custom environment file, and include the custom environment file in the **undercloud.conf** file by configuring the **custom_env_files** parameter.

For information about customizing undercloud network interfaces, see [Configuring undercloud network interfaces](#).

undercloud_debug

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

undercloud_enable_selinux

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

undercloud_hostname

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

undercloud_log_file

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

undercloud_nameservers

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

undercloud_ntp_servers

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

undercloud_public_host

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

If the **undercloud_public_host** is not in the same IP network as the **local_ip**, you must set the **PublicVirtualInterface** parameter to the public-facing interface on which you want the public APIs on the undercloud to listen. By default, the public APIs listen on the **br-ctlplane** interface. Set the **PublicVirtualInterface** parameter in a custom environment file, and include the custom environment file in the **undercloud.conf** file by configuring the **custom_env_files** parameter.

For information about customizing undercloud network interfaces, see [Configuring undercloud network interfaces](#).

undercloud_service_certificate

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

undercloud_timezone

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

undercloud_update_packages

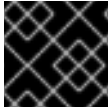
Defines whether to update packages during the undercloud installation.

Subnets

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

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

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



IMPORTANT

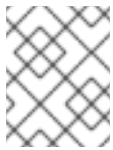
Director cannot change the IP addresses for a subnet after director creates the subnet.

cidr

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

masquerade

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



NOTE

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

dhcp_start; dhcp_end

The start and end of the DHCP allocation range for overcloud nodes. Ensure that this range contains enough IP addresses to allocate to your nodes. If not specified for the subnet, director determines the allocation pools by removing the values set for the **local_ip**, **gateway**, **undercloud_admin_host**, **undercloud_public_host**, and **inspection_iprange** parameters from the subnets full IP range.

You can configure non-contiguous allocation pools for undercloud control plane subnets by specifying a list of start and end address pairs. Alternatively, you can use the **dhcp_exclude** option to exclude IP addresses within an IP address range. For example, the following configurations both create allocation pools **172.20.0.100-172.20.0.150** and **172.20.0.200-172.20.0.250**:

Option 1

```
dhcp_start = 172.20.0.100,172.20.0.200
dhcp_end = 172.20.0.150,172.20.0.250
```

Option 2

```
dhcp_start = 172.20.0.100
dhcp_end = 172.20.0.250
dhcp_exclude = 172.20.0.151-172.20.0.199
```

dhcp_exclude

IP addresses to exclude in the DHCP allocation range. For example, the following configuration excludes the IP address **172.20.0.105** and the IP address range **172.20.0.210-172.20.0.219**:

```
dhcp_exclude = 172.20.0.105,172.20.0.210-172.20.0.219
```

dns_nameservers

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

gateway

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

host_routes

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

inspection_iprange

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

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

3.3. INSTALLING DIRECTOR

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

Procedure

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

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

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

The script generates two files:

- **undercloud-passwords.conf** - A list of all passwords for the director services.
 - **stackrc** - A set of initialization variables to help you access the director command line tools.
2. Confirm that the RHOSP service containers are running:

```
[stack@director ~]$ sudo podman ps -a --format "{{.Names}} {{.Status}}"
```

The following command output indicates that the RHOSP service containers are running (**Up**):

```
memcached Up 3 hours (healthy)
haproxy Up 3 hours
rabbitmq Up 3 hours (healthy)
mysql Up 3 hours (healthy)
iscsid Up 3 hours (healthy)
keystone Up 3 hours (healthy)
keystone_cron Up 3 hours (healthy)
neutron_api Up 3 hours (healthy)
logrotate_cron Up 3 hours (healthy)
neutron_dhcp Up 3 hours (healthy)
neutron_l3_agent Up 3 hours (healthy)
neutron_ovs_agent Up 3 hours (healthy)
ironic_api Up 3 hours (healthy)
ironic_conductor Up 3 hours (healthy)
```



```

ironic_neutron_agent Up 3 hours (healthy)
ironic_pxe_tftp Up 3 hours (healthy)
ironic_pxe_http Up 3 hours (unhealthy)
ironic_inspector Up 3 hours (healthy)
ironic_inspector_dnsmasq Up 3 hours (healthy)
neutron-dnsmasq-qdhcp-30d628e6-45e6-499d-8003-28c0bc066487 Up 3 hours
...

```

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

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

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

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

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

3.4. PERFORMING A MINOR UPDATE OF A CONTAINERIZED UNDERCLOUD

Director provides commands to update the main packages on the undercloud node. Use director to perform a minor update within the current version of your RHOSP environment.

Procedure

- On the undercloud node, log in as the **stack** user.
- Source the **stackrc** file:

```
$ source ~/stackrc
```

- Update the director main packages with the **dnf update** command:

```
$ sudo dnf update -y python3-tripleoclient* tripleo-ansible ansible
```

- Update the undercloud environment with the **openstack undercloud upgrade** command :

```
$ openstack undercloud upgrade
```

- Wait until the undercloud update process completes.
- Reboot the undercloud to update the operating system's kernel and other system packages:

```
$ sudo reboot
```

- Wait until the node boots.

CHAPTER 4. DEPLOYING AND UPDATING AN OVERCLOUD WITH CONTAINERS

This chapter provides info on how to create a container-based overcloud and keep it updated.

4.1. DEPLOYING AN OVERCLOUD

This procedure demonstrates how to deploy an overcloud with minimum configuration. The result will be a basic two-node overcloud (1 Controller node, 1 Compute node).

Procedure

1. Source the **stackrc** file:

```
$ source ~/stackrc
```

2. Run the **deploy** command and include the file containing your overcloud image locations (usually **overcloud_images.yaml**):

```
(undercloud) $ openstack overcloud deploy --templates \  
-e /home/stack/templates/overcloud_images.yaml \  
--ntp-server pool.ntp.org
```

3. Wait until the overcloud completes deployment.

4.2. UPDATING AN OVERCLOUD

For information on updating a containerized overcloud, see the [Keeping Red Hat OpenStack Platform Updated](#) guide.

CHAPTER 5. WORKING WITH CONTAINERIZED SERVICES

This chapter provides some examples of commands to manage containers and how to troubleshoot your OpenStack Platform containers

5.1. MANAGING CONTAINERIZED SERVICES

Red Hat OpenStack Platform (RHOSP) runs services in containers on the undercloud and overcloud nodes. In certain situations, you might need to control the individual services on a host. This section contains information about some common commands you can run on a node to manage containerized services.

Listing containers and images

To list running containers, run the following command:

```
$ sudo podman ps
```

To include stopped or failed containers in the command output, add the **--all** option to the command:

```
$ sudo podman ps --all
```

To list container images, run the following command:

```
$ sudo podman images
```

Inspecting container properties

To view the properties of a container or container images, use the **podman inspect** command. For example, to inspect the **keystone** container, run the following command:

```
$ sudo podman inspect keystone
```

Managing containers with Systemd services

Previous versions of OpenStack Platform managed containers with Docker and its daemon. In OpenStack Platform 16, the Systemd services interface manages the lifecycle of the containers. Each container is a service and you run Systemd commands to perform specific operations for each container.



NOTE

It is not recommended to use the Podman CLI to stop, start, and restart containers because Systemd applies a restart policy. Use Systemd service commands instead.

To check a container status, run the **systemctl status** command:

```
$ sudo systemctl status tripleo_keystone
● tripleo_keystone.service - keystone container
  Loaded: loaded (/etc/systemd/system/tripleo_keystone.service; enabled; vendor preset: disabled)
  Active: active (running) since Fri 2019-02-15 23:53:18 UTC; 2 days ago
  Main PID: 29012 (podman)
  CGroup: /system.slice/tripleo_keystone.service
          └─29012 /usr/bin/podman start -a keystone
```

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

```
$ sudo systemctl stop tripleo_keystone
```

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

```
$ sudo systemctl start tripleo_keystone
```

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

```
$ sudo systemctl restart tripleo_keystone
```

Because no daemon monitors the containers status, Systemd automatically restarts most containers in these situations:

- Clean exit code or signal, such as running **podman stop** command.
- Unclean exit code, such as the podman container crashing after a start.
- Unclean signals.
- Timeout if the container takes more than 1m 30s to start.

For more information about Systemd services, see the [systemd.service documentation](#).



NOTE

Any changes to the service configuration files within the container revert after restarting the container. This is because the container regenerates the service configuration based on files on the local file system of the node in **/var/lib/config-data/puppet-generated/**. For example, if you edit **/etc/keystone/keystone.conf** within the **keystone** container and restart the container, the container regenerates the configuration using **/var/lib/config-data/puppet-generated/keystone/etc/keystone/keystone.conf** on the local file system of the node, which overwrites any the changes that were made within the container before the restart.

Monitoring podman containers with Systemd timers

The Systemd timers interface manages container health checks. Each container has a timer that runs a service unit that executes health check scripts.

To list all OpenStack Platform containers timers, run the **systemctl list-timers** command and limit the output to lines containing **tripleo**:

```
$ sudo systemctl list-timers | grep tripleo
Mon 2019-02-18 20:18:30 UTC 1s left   Mon 2019-02-18 20:17:26 UTC 1min 2s ago
tripleo_nova_metadata_healthcheck.timer   tripleo_nova_metadata_healthcheck.service
Mon 2019-02-18 20:18:33 UTC 4s left   Mon 2019-02-18 20:17:03 UTC 1min 25s ago
tripleo_mistral_engine_healthcheck.timer   tripleo_mistral_engine_healthcheck.service
Mon 2019-02-18 20:18:34 UTC 5s left   Mon 2019-02-18 20:17:23 UTC 1min 5s ago
tripleo_keystone_healthcheck.timer         tripleo_keystone_healthcheck.service
Mon 2019-02-18 20:18:35 UTC 6s left   Mon 2019-02-18 20:17:13 UTC 1min 15s ago
tripleo_memcached_healthcheck.timer        tripleo_memcached_healthcheck.service
(...)
```

To check the status of a specific container timer, run the **systemctl status** command for the healthcheck service:

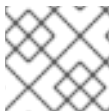
```
$ sudo systemctl status tripleo_keystone_healthcheck.service
● tripleo_keystone_healthcheck.service - keystone healthcheck
   Loaded: loaded (/etc/systemd/system/tripleo_keystone_healthcheck.service; disabled; vendor
   preset: disabled)
   Active: inactive (dead) since Mon 2019-02-18 20:22:46 UTC; 22s ago
   Process: 115581 ExecStart=/usr/bin/podman exec keystone /openstack/healthcheck (code=exited,
   status=0/SUCCESS)
   Main PID: 115581 (code=exited, status=0/SUCCESS)

Feb 18 20:22:46 undercloud.localdomain systemd[1]: Starting keystone healthcheck...
Feb 18 20:22:46 undercloud.localdomain podman[115581]: {"versions": {"values": [{"status": "stable",
"updated": "2019-01-22T00:00:00Z", "..."}]}}
Feb 18 20:22:46 undercloud.localdomain podman[115581]: 300 192.168.24.1:35357 0.012 seconds
Feb 18 20:22:46 undercloud.localdomain systemd[1]: Started keystone healthcheck.
```

To stop, start, restart, and show the status of a container timer, run the relevant **systemctl** command against the **.timer** Systemd resource. For example, to check the status of the **tripleo_keystone_healthcheck.timer** resource, run the following command:

```
$ sudo systemctl status tripleo_keystone_healthcheck.timer
● tripleo_keystone_healthcheck.timer - keystone container healthcheck
   Loaded: loaded (/etc/systemd/system/tripleo_keystone_healthcheck.timer; enabled; vendor preset:
   disabled)
   Active: active (waiting) since Fri 2019-02-15 23:53:18 UTC; 2 days ago
```

If the healthcheck service is disabled but the timer for that service is present and enabled, it means that the check is currently timed out, but will be run according to timer. You can also start the check manually.



NOTE

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

Checking container logs

OpenStack Platform 16 introduces a new logging directory **/var/log/containers/stdout** that contains the standard output (stdout) all of the containers, and standard errors (stderr) consolidated in one single file for each container.

Paunch and the **container-puppet.py** script configure podman containers to push their outputs to the **/var/log/containers/stdout** directory, which creates a collection of all logs, even for the deleted containers, such as **container-puppet-*** containers.

The host also applies log rotation to this directory, which prevents huge files and disk space issues.

In case a container is replaced, the new container outputs to the same log file, because **podman** uses the container name instead of container ID.

You can also check the logs for a containerized service with the **podman logs** command. For example, to view the logs for the **keystone** container, run the following command:

```
$ sudo podman logs keystone
```

Accessing containers

To enter the shell for a containerized service, use the **podman exec** command to launch **/bin/bash**. For example, to enter the shell for the **keystone** container, run the following command:

```
$ sudo podman exec -it keystone /bin/bash
```

To enter the shell for the **keystone** container as the root user, run the following command:

```
$ sudo podman exec --user 0 -it <NAME OR ID> /bin/bash
```

To exit the container, run the following command:

```
# exit
```

5.2. TROUBLESHOOTING CONTAINERIZED SERVICES

If a containerized service fails during or after overcloud deployment, use the following recommendations to determine the root cause for the failure:



NOTE

Before running these commands, check that you are logged into an overcloud node and not running these commands on the undercloud.

Checking the container logs

Each container retains standard output from its main process. This output acts 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 provides the cause of a container's failure.

Inspecting the container

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 provides 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}}:{{if .Mode}}:{{.Mode}}:{{end}}:{{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 the 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, to run a command in the **keystone** container:

```
$ sudo podman exec -ti keystone <COMMAND>
```



NOTE

The **-ti** options run the command through an interactive pseudoterminal.

Replace **<COMMAND>** with your desired command. 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:

```
$ sudo podman exec -ti keystone /bin/bash
```

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.

CHAPTER 6. COMPARING SYSTEMD SERVICES TO CONTAINERIZED SERVICES

This chapter provides some reference material to show how containerized services differ from Systemd services.

6.1. SYSTEMD SERVICES AND CONTAINERIZED SERVICES

The following table shows the correlation between Systemd-based services and the **podman** containers controlled with the Systemd services.

Component	Systemd service	Containers
OpenStack Image Storage (glance)	tripleo_glance_api.service	glance_api
HAProxy	tripleo_haproxy.service	haproxy
OpenStack Orchestration (heat)	tripleo_heat_api.service	heat_api
	tripleo_heat_api_cfn.service	heat_api_cfn
	tripleo_heat_api_cron.service	heat_api_cron
	tripleo_heat_engine.service	heat_engine
OpenStack Bare Metal (ironic)	tripleo_ironic_api.service	ironic_api
	tripleo_ironic_conductor.service	ironic_conductor
	tripleo_ironic_inspector.service	ironic_inspector
	tripleo_ironic_inspector_dnsmasq.service	ironic_inspector_dnsmasq
	tripleo_ironic_neutron_agent.service	ironic_neutron_agent
	tripleo_ironic_pxe_http.service	ironic_pxe_http
	tripleo_ironic_pxe_tftp.service	ironic_pxe_tftp
	tripleo_iscsid.service	iscsid
Keepalived	tripleo_keepalived.service	keepalived
OpenStack Identity (keystone)	tripleo_keystone.service	keystone
	tripleo_keystone_cron.service	keystone_cron
Logrotate	tripleo_logrotate_crond.service	logrotate_crond
Memcached	tripleo_memcached.service	memcached

Component	Systemd service	Containers
OpenStack Workflow (mistral)	tripleo_mistral_api.service tripleo_mistral_engine.service tripleo_mistral_event_engine.service tripleo_mistral_executor.service	mistral_api mistral_engine mistral_event_engine mistral_executor
MySQL	tripleo_mysql.service	mysql
OpenStack Networking (neutron)	tripleo_neutron_api.service tripleo_neutron_dhcp.service tripleo_neutron_l3_agent.service tripleo_neutron_ovs_agent.service	neutron_api neutron_dhcp neutron_l3_agent neutron_ovs_agent
OpenStack Compute (nova)	tripleo_nova_api.service tripleo_nova_api_cron.service tripleo_nova_compute.service tripleo_nova_conductor.service tripleo_nova_metadata.service tripleo_nova_placement.service tripleo_nova_scheduler.service	nova_api nova_api_cron nova_compute nova_conductor nova_metadata nova_placement nova_scheduler
RabbitMQ	tripleo_rabbitmq.service	rabbitmq
OpenStack Object Storage (swift)	tripleo_swift_account_reaper.service tripleo_swift_account_server.service tripleo_swift_container_server.service tripleo_swift_container_updater.service tripleo_swift_object_expirer.service tripleo_swift_object_server.service tripleo_swift_object_updater.service tripleo_swift_proxy.service tripleo_swift_rsync.service	swift_account_reaper swift_account_server swift_container_server swift_container_updater swift_object_expirer swift_object_server swift_object_updater swift_proxy swift_rsync

Component	Systemd service	Containers
OpenStack Messaging (zaqar)	tripleo_zaqar.service	zaqar
	tripleo_zaqar_websocket.service	zaqar_websocket
Aodh	tripleo_aodh_api.service	aodh_api
	tripleo_aodh_evaluator.service	aodh_listener
	tripleo_aodh_api_cron.service	aodh_evaluator
	tripleo_aodh_listener.service	aodh_api_cron
	tripleo_aodh_notifier.service	aodh_notifier
Gnocchi	tripleo_gnocchi_api.service	gnocchi_api
	tripleo_gnocchi_metricd.service	gnocchi_metricd
	tripleo_gnocchi_statsd.service	gnocchi_statsd
Ceilometer	tripleo_ceilometer_agent_central.service	ceilometer_agent_central
	tripleo_ceilometer_agent_compute.service	ceilometer_agent_compute
	tripleo_ceilometer_agent_notification.service	ceilometer_agent_notification

6.2. SYSTEMD LOG LOCATIONS VS CONTAINERIZED LOG LOCATIONS

The following table shows Systemd-based OpenStack logs and their equivalents for containers. All container-based log locations are available on the physical host and are mounted to the container.

OpenStack service	Systemd service logs	Container logs
aodh	<i>/var/log/aodh/</i>	<i>/var/log/containers/aodh/ /var/log/containers/httpd/aodh-api/</i>
ceilometer	<i>/var/log/ceilometer/</i>	<i>/var/log/containers/ceilometer/</i>
cinder	<i>/var/log/cinder/</i>	<i>/var/log/containers/cinder/ /var/log/containers/httpd/cinder-api/</i>
glance	<i>/var/log/glance/</i>	<i>/var/log/containers/glance/</i>

OpenStack service	Systemd service logs	Container logs
gnocchi	/var/log/gnocchi/	/var/log/containers/gnocchi/ /var/log/containers/httpd/gnocchi-api/
heat	/var/log/heat/	/var/log/containers/heat/ /var/log/containers/httpd/heat-api/ /var/log/containers/httpd/heat-api-cfn/
horizon	/var/log/horizon/	/var/log/containers/horizon/ /var/log/containers/httpd/horizon/
keystone	/var/log/keystone/	/var/log/containers/keystone /var/log/containers/httpd/keystone/
databases	/var/log/mariadb/ /var/log/mongodb/ /var/log/mysqld.log	/var/log/containers/mysql/
neutron	/var/log/neutron/	/var/log/containers/neutron/ /var/log/containers/httpd/neutron-api/
nova	/var/log/nova/	/var/log/containers/nova/ /var/log/containers/httpd/nova-api/ /var/log/containers/httpd/placement/
panko		/var/log/containers/panko/ /var/log/containers/httpd/panko-api/
rabbitmq	/var/log/rabbitmq/	/var/log/containers/rabbitmq/
redis	/var/log/redis/	/var/log/containers/redis/

OpenStack service	Systemd service logs	Container logs
swift	/var/log/swift/	/var/log/containers/swift/

6.3. SYSTEMD CONFIGURATION VS CONTAINERIZED CONFIGURATION

The following table shows Systemd-based OpenStack configuration and their equivalents for containers. All container-based configuration locations are available on the physical host, are mounted to the container, and are merged (via **kolla**) into the configuration within each respective container.

OpenStack service	Systemd service configuration	Container configuration
aodh	/etc/aodh/	/var/lib/config-data/puppet-generated/aodh/
ceilometer	/etc/ceilometer/	/var/lib/config-data/puppet-generated/ceilometer/etc/ceilometer/
cinder	/etc/cinder/	/var/lib/config-data/puppet-generated/cinder/etc/cinder/
glance	/etc/glance/	/var/lib/config-data/puppet-generated/glance_api/etc/glance/
gnocchi	/etc/gnocchi/	/var/lib/config-data/puppet-generated/gnocchi/etc/gnocchi/
haproxy	/etc/haproxy/	/var/lib/config-data/puppet-generated/haproxy/etc/haproxy/
heat	/etc/heat/	/var/lib/config-data/puppet-generated/heat/etc/heat/ /var/lib/config-data/puppet-generated/heat_api/etc/heat/ /var/lib/config-data/puppet-generated/heat_api_cfn/etc/heat/
horizon	/etc/openstack-dashboard/	/var/lib/config-data/puppet-generated/horizon/etc/openstack-dashboard/

OpenStack service	Systemd service configuration	Container configuration
keystone	/etc/keystone/	/var/lib/config-data/puppet-generated/keystone/etc/keystone/
databases	/etc/my.cnf.d/ /etc/my.cnf	/var/lib/config-data/puppet-generated/mysql/etc/my.cnf.d/
neutron	/etc/neutron/	/var/lib/config-data/puppet-generated/neutron/etc/neutron/
nova	/etc/nova/	/var/lib/config-data/puppet-generated/nova/etc/nova/ /var/lib/config-data/puppet-generated/etc/placement/
panko		/var/lib/config-data/puppet-generated/panko/etc/panko
rabbitmq	/etc/rabbitmq/	/var/lib/config-data/puppet-generated/rabbitmq/etc/rabbitmq/
redis	/etc/redis/ /etc/redis.conf	/var/lib/config-data/puppet-generated/redis/etc/redis/ /var/lib/config-data/puppet-generated/redis/etc/redis.conf
swift	/etc/swift/	/var/lib/config-data/puppet-generated/swift/etc/swift/ /var/lib/config-data/puppet-generated/swift_ringbuilder/etc/swift/