



# Red Hat OpenStack Platform 16.2

## Advanced Overcloud Customization

Methods for configuring advanced features using Red Hat OpenStack Platform  
director



# Red Hat OpenStack Platform 16.2 Advanced Overcloud Customization

---

Methods for configuring advanced features using Red Hat OpenStack Platform director

OpenStack Team  
rhos-docs@redhat.com

## Legal Notice

Copyright © 2021 Red Hat, Inc.

The text of and illustrations in this document are licensed by Red Hat under a Creative Commons Attribution–Share Alike 3.0 Unported license ("CC-BY-SA"). An explanation of CC-BY-SA is available at

<http://creativecommons.org/licenses/by-sa/3.0/>

. In accordance with CC-BY-SA, if you distribute this document or an adaptation of it, you must provide the URL for the original version.

Red Hat, as the licensor of this document, waives the right to enforce, and agrees not to assert, Section 4d of CC-BY-SA to the fullest extent permitted by applicable law.

Red Hat, Red Hat Enterprise Linux, the Shadowman logo, the Red Hat logo, JBoss, OpenShift, Fedora, the Infinity logo, and RHCE are trademarks of Red Hat, Inc., registered in the United States and other countries.

Linux<sup>®</sup> is the registered trademark of Linus Torvalds in the United States and other countries.

Java<sup>®</sup> is a registered trademark of Oracle and/or its affiliates.

XFS<sup>®</sup> is a trademark of Silicon Graphics International Corp. or its subsidiaries in the United States and/or other countries.

MySQL<sup>®</sup> is a registered trademark of MySQL AB in the United States, the European Union and other countries.

Node.js<sup>®</sup> is an official trademark of Joyent. Red Hat is not formally related to or endorsed by the official Joyent Node.js open source or commercial project.

The OpenStack<sup>®</sup> Word Mark and OpenStack logo are either registered trademarks/service marks or trademarks/service marks of the OpenStack Foundation, in the United States and other countries and are used with the OpenStack Foundation's permission. We are not affiliated with, endorsed or sponsored by the OpenStack Foundation, or the OpenStack community.

All other trademarks are the property of their respective owners.

## Abstract

Configure certain advanced features for a Red Hat OpenStack Platform (RHOSP) enterprise environment with Red Hat OpenStack Platform director. This includes features such as network isolation, storage configuration, SSL communication, and general configuration methods.

## Table of Contents

<b>MAKING OPEN SOURCE MORE INCLUSIVE</b> .....	<b>6</b>
<b>PROVIDING FEEDBACK ON RED HAT DOCUMENTATION</b> .....	<b>7</b>
<b>CHAPTER 1. INTRODUCTION TO OVERCLOUD CONFIGURATION</b> .....	<b>8</b>
<b>CHAPTER 2. UNDERSTANDING HEAT TEMPLATES</b> .....	<b>9</b>
2.1. HEAT TEMPLATES	9
2.2. ENVIRONMENT FILES	10
2.3. CORE OVERCLOUD HEAT TEMPLATES	11
2.4. PLAN ENVIRONMENT METADATA	12
2.5. INCLUDING ENVIRONMENT FILES IN OVERCLOUD CREATION	13
2.6. USING CUSTOMIZED CORE HEAT TEMPLATES	14
2.7. JINJA2 RENDERING	17
<b>CHAPTER 3. HEAT PARAMETERS</b> .....	<b>20</b>
3.1. EXAMPLE 1: CONFIGURING THE TIME ZONE	20
3.2. EXAMPLE 2: CONFIGURING RABBITMQ FILE DESCRIPTOR LIMIT	20
3.3. EXAMPLE 3: ENABLING AND DISABLING PARAMETERS	20
3.4. EXAMPLE 4: ROLE-BASED PARAMETERS	21
3.5. IDENTIFYING PARAMETERS THAT YOU WANT TO MODIFY	21
<b>CHAPTER 4. CONFIGURATION HOOKS</b> .....	<b>23</b>
4.1. FIRST BOOT: CUSTOMIZING FIRST BOOT CONFIGURATION	23
4.2. PRE-CONFIGURATION: CUSTOMIZING SPECIFIC OVERCLOUD ROLES	24
4.3. PRE-CONFIGURATION: CUSTOMIZING ALL OVERCLOUD ROLES	26
4.4. POST-CONFIGURATION: CUSTOMIZING ALL OVERCLOUD ROLES	28
4.5. PUPPET: CUSTOMIZING HIERADATA FOR ROLES	30
4.6. PUPPET: CUSTOMIZING HIERADATA FOR INDIVIDUAL NODES	31
4.7. PUPPET: APPLYING CUSTOM MANIFESTS	32
<b>CHAPTER 5. ANSIBLE-BASED OVERCLOUD REGISTRATION</b> .....	<b>34</b>
5.1. RED HAT SUBSCRIPTION MANAGER (RHSM) COMPOSABLE SERVICE	34
5.2. RHSMVARS SUB-PARAMETERS	34
5.3. REGISTERING THE OVERCLOUD WITH THE RHSM COMPOSABLE SERVICE	36
5.4. APPLYING THE RHSM COMPOSABLE SERVICE TO DIFFERENT ROLES	36
5.5. REGISTERING THE OVERCLOUD TO RED HAT SATELLITE SERVER	38
5.6. SWITCHING TO THE RHSM COMPOSABLE SERVICE	38
5.7. RHEL-REGISTRATION TO RHSM MAPPINGS	39
5.8. DEPLOYING THE OVERCLOUD WITH THE RHSM COMPOSABLE SERVICE	40
5.9. RUNNING ANSIBLE-BASED REGISTRATION MANUALLY	40
<b>CHAPTER 6. COMPOSABLE SERVICES AND CUSTOM ROLES</b> .....	<b>42</b>
6.1. SUPPORTED ROLE ARCHITECTURE	42
6.2. ROLES	42
6.2.1. Examining the roles_data file	42
6.2.2. Creating a roles_data file	43
6.2.3. Supported custom roles	44
6.2.4. Examining role parameters	47
6.2.5. Creating a new role	49
6.3. COMPOSABLE SERVICES	52
6.3.1. Guidelines and limitations	52
6.3.2. Examining composable service architecture	52

6.3.3. Adding and removing services from roles	54
6.3.4. Enabling disabled services	55
6.3.5. Creating a generic node with no services	55
<b>CHAPTER 7. CONTAINERIZED SERVICES</b>	<b>57</b>
7.1. CONTAINERIZED SERVICE ARCHITECTURE	57
7.2. CONTAINERIZED SERVICE PARAMETERS	57
7.3. PREPARING CONTAINER IMAGES	58
7.4. CONTAINER IMAGE PREPARATION PARAMETERS	59
7.5. GUIDELINES FOR CONTAINER IMAGE TAGGING	62
7.6. OBTAINING CONTAINER IMAGES FROM PRIVATE REGISTRIES	63
7.7. LAYERING IMAGE PREPARATION ENTRIES	65
7.8. MODIFYING IMAGES DURING PREPARATION	66
7.9. UPDATING EXISTING PACKAGES ON CONTAINER IMAGES	67
7.10. INSTALLING ADDITIONAL RPM FILES TO CONTAINER IMAGES	67
7.11. MODIFYING CONTAINER IMAGES WITH A CUSTOM DOCKERFILE	68
7.12. DEPLOYING A VENDOR PLUGIN	68
<b>CHAPTER 8. BASIC NETWORK ISOLATION</b>	<b>71</b>
8.1. NETWORK ISOLATION	71
8.2. MODIFYING ISOLATED NETWORK CONFIGURATION	72
8.3. NETWORK INTERFACE TEMPLATES	73
8.4. DEFAULT NETWORK INTERFACE TEMPLATES	74
8.5. ENABLING BASIC NETWORK ISOLATION	75
<b>CHAPTER 9. CUSTOM COMPOSABLE NETWORKS</b>	<b>77</b>
9.1. COMPOSABLE NETWORKS	77
9.2. ADDING A COMPOSABLE NETWORK	78
9.3. INCLUDING A COMPOSABLE NETWORK IN A ROLE	79
9.4. ASSIGNING OPENSTACK SERVICES TO COMPOSABLE NETWORKS	80
9.5. ENABLING CUSTOM COMPOSABLE NETWORKS	80
9.6. RENAMING THE DEFAULT NETWORKS	81
<b>CHAPTER 10. CUSTOM NETWORK INTERFACE TEMPLATES</b>	<b>83</b>
10.1. CUSTOM NETWORK ARCHITECTURE	83
10.2. RENDERING DEFAULT NETWORK INTERFACE TEMPLATES FOR CUSTOMIZATION	84
10.3. NETWORK INTERFACE ARCHITECTURE	84
10.4. NETWORK INTERFACE REFERENCE	85
10.5. EXAMPLE NETWORK INTERFACE LAYOUT	94
10.6. NETWORK INTERFACE TEMPLATE CONSIDERATIONS FOR CUSTOM NETWORKS	96
10.7. CUSTOM NETWORK ENVIRONMENT FILE	97
10.8. NETWORK ENVIRONMENT PARAMETERS	98
10.9. EXAMPLE CUSTOM NETWORK ENVIRONMENT FILE	102
10.10. ENABLING NETWORK ISOLATION WITH CUSTOM NICs	102
<b>CHAPTER 11. ADDITIONAL NETWORK CONFIGURATION</b>	<b>104</b>
11.1. CONFIGURING CUSTOM INTERFACES	104
11.2. CONFIGURING ROUTES AND DEFAULT ROUTES	105
11.3. CONFIGURING POLICY-BASED ROUTING	106
11.4. CONFIGURING JUMBO FRAMES	108
11.5. CONFIGURING ML2/OVN NORTHBOUND PATH MTU DISCOVERY FOR JUMBO FRAME FRAGMENTATION	109
11.6. CONFIGURING THE NATIVE VLAN ON A TRUNKED INTERFACE	110
<b>CHAPTER 12. NETWORK INTERFACE BONDING</b>	<b>111</b>

12.1. NETWORK INTERFACE BONDING FOR OVERCLOUD NODES	111
12.2. CREATING OPEN VSWITCH (OVS) BONDS	111
12.3. OPEN VSWITCH (OVS) BONDING OPTIONS	112
12.4. USING LINK AGGREGATION CONTROL PROTOCOL (LACP) WITH OPEN VSWITCH (OVS) BONDING MODES	113
12.5. CREATING LINUX BONDS	114
<b>CHAPTER 13. CONTROLLING NODE PLACEMENT</b>	<b>117</b>
13.1. ASSIGNING SPECIFIC NODE IDS	117
13.2. ASSIGNING CUSTOM HOST NAMES	118
13.3. ASSIGNING PREDICTABLE IPS	119
13.4. ASSIGNING PREDICTABLE VIRTUAL IPS	121
<b>CHAPTER 14. ENABLING SSL/TLS ON OVERCLOUD PUBLIC ENDPOINTS</b>	<b>122</b>
14.1. INITIALIZING THE SIGNING HOST	122
14.2. CREATING A CERTIFICATE AUTHORITY	122
14.3. ADDING THE CERTIFICATE AUTHORITY TO CLIENTS	123
14.4. CREATING AN SSL/TLS KEY	123
14.5. CREATING AN SSL/TLS CERTIFICATE SIGNING REQUEST	123
14.6. CREATING THE SSL/TLS CERTIFICATE	124
14.7. ENABLING SSL/TLS	125
14.8. INJECTING A ROOT CERTIFICATE	126
14.9. CONFIGURING DNS ENDPOINTS	127
14.10. ADDING ENVIRONMENT FILES DURING OVERCLOUD CREATION	128
14.11. MANUALLY UPDATING SSL/TLS CERTIFICATES	128
<b>CHAPTER 15. ENABLING SSL/TLS ON INTERNAL AND PUBLIC ENDPOINTS WITH IDENTITY MANAGEMENT</b>	<b>130</b>
15.1. ENROLLING NODES IN RED HAT IDENTITY MANAGER (IDM) WITH NOVAJOIN	130
15.2. ADDING THE UNDERCLOUD NODE TO THE CERTIFICATE AUTHORITY	130
15.3. ADDING THE UNDERCLOUD NODE TO RED HAT IDENTITY MANAGER (IDM)	131
15.4. SETTING RED HAT IDENTITY MANAGER (IDM) AS THE DNS SERVER FOR THE OVERCLOUD	132
15.5. PREPARING ENVIRONMENT FILES AND DEPLOYING THE OVERCLOUD WITH NOVAJOIN ENROLLMENT	132
<b>CHAPTER 16. IMPLEMENTING TLS-E WITH ANSIBLE</b>	<b>136</b>
16.1. CONFIGURING TLS-E ON THE UNDERCLOUD	136
16.2. CONFIGURING TLS-E ON THE OVERCLOUD	137
<b>CHAPTER 17. DEBUG MODES</b>	<b>139</b>
<b>CHAPTER 18. STORAGE CONFIGURATION</b>	<b>140</b>
18.1. CONFIGURING NFS STORAGE	140
18.2. CONFIGURING CEPH STORAGE	141
18.3. USING AN EXTERNAL OBJECT STORAGE CLUSTER	141
18.4. CONFIGURING CEPH OBJECT STORE TO USE EXTERNAL CEPH OBJECT GATEWAY	142
18.5. CONFIGURING THE IMAGE IMPORT METHOD AND SHARED STAGING AREA	144
18.5.1. Creating and deploying the glance-settings.yaml file	145
18.5.2. Controlling image web-import sources	146
18.5.2.1. Example	146
18.5.2.2. Default image import blocklist and allowlist settings	147
18.5.3. Injecting metadata on image import to control where VMs launch	147
18.6. CONFIGURING CINDER BACK END FOR THE IMAGE SERVICE	148
18.7. CONFIGURING THE MAXIMUM NUMBER OF STORAGE DEVICES TO ATTACH TO ONE INSTANCE	149
18.8. IMPROVING SCALABILITY WITH IMAGE SERVICE CACHING	149

18.9. CONFIGURING THIRD PARTY STORAGE	150
<b>CHAPTER 19. SECURITY ENHANCEMENTS</b> .....	<b>151</b>
19.1. MANAGING THE OVERCLOUD FIREWALL	151
19.2. CHANGING THE SIMPLE NETWORK MANAGEMENT PROTOCOL (SNMP) STRINGS	152
19.3. CHANGING THE SSL/TLS CIPHER AND RULES FOR HAPROXY	153
19.4. USING THE OPEN VSWITCH FIREWALL	154
19.5. USING SECURE ROOT USER ACCESS	155
<b>CHAPTER 20. CONFIGURING MONITORING TOOLS</b> .....	<b>157</b>
<b>CHAPTER 21. CONFIGURING NETWORK PLUGINS</b> .....	<b>158</b>
21.1. FUJITSU CONVERGED FABRIC (C-FABRIC)	158
21.2. FUJITSU FOS SWITCH	158
<b>CHAPTER 22. CONFIGURING IDENTITY</b> .....	<b>160</b>
22.1. REGION NAME	160
<b>CHAPTER 23. OTHER CONFIGURATIONS</b> .....	<b>161</b>
23.1. CONFIGURING THE KERNEL ON OVERCLOUD NODES	161
23.2. CONFIGURING THE SERVER CONSOLE	161
23.3. CONFIGURING EXTERNAL LOAD BALANCING	163
23.4. CONFIGURING IPV6 NETWORKING	163





## 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](#).

# PROVIDING FEEDBACK ON RED HAT DOCUMENTATION

We appreciate your input on our documentation. Tell us how we can make it better.

## Using the Direct Documentation Feedback (DDF) function

Use the **Add Feedback** DDF function for direct comments on specific sentences, paragraphs, or code blocks.

1. View the documentation in the *Multi-page HTML* format.
2. Ensure that you see the **Feedback** button in the upper right corner of the document.
3. Highlight the part of text that you want to comment on.
4. Click **Add Feedback**.
5. Complete the **Add Feedback** field with your comments.
6. Optional: Add your email address so that the documentation team can contact you for clarification on your issue.
7. Click **Submit**.

# CHAPTER 1. INTRODUCTION TO OVERCLOUD CONFIGURATION

Red Hat OpenStack Platform (RHOSP) director provides a set of tools that you can use to provision and create a fully featured OpenStack environment, also known as the overcloud. The [Director Installation and Usage Guide](#) covers the preparation and configuration of a basic overcloud. However, a production-level overcloud might require additional configuration:

- Basic network configuration to integrate the overcloud into your existing network infrastructure.
- Network traffic isolation on separate VLANs for certain OpenStack network traffic types.
- SSL configuration to secure communication on public endpoints
- Storage options such as NFS, iSCSI, Red Hat Ceph Storage, and multiple third-party storage devices.
- Red Hat Content Delivery Network node registration, or registration with your internal Red Hat Satellite 5 or 6 server.
- Various system-level options.
- Various OpenStack service options.



## NOTE

The examples in this guide are optional steps to configure the overcloud. These steps are necessary only if you want to provide the overcloud with additional functionality. Use the steps that apply to the requirements of your environment.

## CHAPTER 2. UNDERSTANDING HEAT TEMPLATES

The custom configurations in this guide use heat templates and environment files to define certain aspects of the overcloud. This chapter provides a basic introduction to heat templates so that you can understand the structure and format of these templates in the context of Red Hat OpenStack Platform director.

### 2.1. HEAT TEMPLATES

Director uses Heat Orchestration Templates (HOT) as the template format for the overcloud deployment plan. Templates in HOT format are usually expressed in YAML format. The purpose of a template is to define and create a stack, which is a collection of resources that OpenStack Orchestration (heat) creates, and the configuration of the resources. Resources are objects in Red Hat OpenStack Platform (RHOSP) and can include compute resources, network configuration, security groups, scaling rules, and custom resources.

A heat template has three main sections:

#### parameters

These are settings passed to heat, which provide a way to customize a stack, and any default values for parameters without passed values. These settings are defined in the **parameters** section of a template.

#### resources

Use the **resources** section to define the resources, such as compute instances, networks, and storage volumes, that you can create when you deploy a stack using this template. Red Hat OpenStack Platform (RHOSP) contains a set of core resources that span across all components. These are the specific objects to create and configure as part of a stack. RHOSP contains a set of core resources that span across all components. These are defined in the **resources** section of a template.

#### outputs

Use the **outputs** section to declare the output parameters that your cloud users can access after the stack is created. Your cloud users can use these parameters to request details about the stack, such as the IP addresses of deployed instances, or URLs of web applications deployed as part of the stack.

Example of a basic heat template:

```
heat_template_version: 2013-05-23

description: > A very basic Heat template.

parameters:
  key_name:
    type: string
    default: lars
    description: Name of an existing key pair to use for the instance
  flavor:
    type: string
    description: Instance type for the instance to be created
    default: m1.small
  image:
    type: string
    default: cirros
    description: ID or name of the image to use for the instance
```

```

resources:
  my_instance:
    type: OS::Nova::Server
    properties:
      name: My Cirros Instance
      image: { get_param: image }
      flavor: { get_param: flavor }
      key_name: { get_param: key_name }

output:
  instance_name:
    description: Get the instance's name
    value: { get_attr: [ my_instance, name ] }

```

This template uses the resource type **type: OS::Nova::Server** to create an instance called **my\_instance** with a particular flavor, image, and key that the cloud user specifies. The stack can return the value of **instance\_name**, which is called **My Cirros Instance**.

When heat processes a template, it creates a stack for the template and a set of child stacks for resource templates. This creates a hierarchy of stacks that descend from the main stack that you define with your template. You can view the stack hierarchy with the following command:

```
$ openstack stack list --nested
```

## 2.2. ENVIRONMENT FILES

An environment file is a special type of template that you can use to customize your heat templates. You can include environment files in the deployment command, in addition to the core heat templates. An environment file contains three main sections:

### resource\_registry

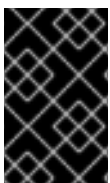
This section defines custom resource names, linked to other heat templates. This provides a method to create custom resources that do not exist within the core resource collection.

### parameters

These are common settings that you apply to the parameters of the top-level template. For example, if you have a template that deploys nested stacks, such as resource registry mappings, the parameters apply only to the top-level template and not to templates for the nested resources.

### parameter\_defaults

These parameters modify the default values for parameters in all templates. For example, if you have a heat template that deploys nested stacks, such as resource registry mappings, the parameter defaults apply to all templates.



### IMPORTANT

Use **parameter\_defaults** instead of **parameters** when you create custom environment files for your overcloud, so that your parameters apply to all stack templates for the overcloud.

Example of a basic environment file:

```
resource_registry:
```

```
OS::Nova::Server::MyServer: myserver.yaml
```

```
parameter_defaults:
  NetworkName: my_network
```

```
parameters:
  MyIP: 192.168.0.1
```

This environment file (**my\_env.yaml**) might be included when creating a stack from a certain heat template (**my\_template.yaml**). The **my\_env.yaml** file creates a new resource type called **OS::Nova::Server::MyServer**. The **myserver.yaml** file is a heat template file that provides an implementation for this resource type that overrides any built-in ones. You can include the **OS::Nova::Server::MyServer** resource in your **my\_template.yaml** file.

**MyIP** applies a parameter only to the main heat template that deploys with this environment file. In this example, **MyIP** applies only to the parameters in **my\_template.yaml**.

**NetworkName** applies to both the main heat template, **my\_template.yaml**, and the templates that are associated with the resources that are included in the main template, such as the **OS::Nova::Server::MyServer** resource and its **myserver.yaml** template in this example.



#### NOTE

For RHOSP to use the heat template file as a custom template resource, the file extension must be either `.yaml` or `.template`.

## 2.3. CORE OVERCLOUD HEAT TEMPLATES

Director contains a core heat template collection and environment file collection for the overcloud. This collection is stored in **/usr/share/openstack-tripleo-heat-templates**.

The main files and directories in this template collection are:

### **overcloud.j2.yaml**

This is the main template file that director uses to create the overcloud environment. This file uses Jinja2 syntax to iterate over certain sections in the template to create custom roles. The Jinja2 formatting is rendered into YAML during the overcloud deployment process.

### **overcloud-resource-registry-puppet.j2.yaml**

This is the main environment file that director uses to create the overcloud environment. It provides a set of configurations for Puppet modules stored on the overcloud image. After director writes the overcloud image to each node, heat starts the Puppet configuration for each node by using the resources registered in this environment file. This file uses Jinja2 syntax to iterate over certain sections in the template to create custom roles. The Jinja2 formatting is rendered into YAML during the overcloud deployment process.

### **roles\_data.yaml**

This file contains the definitions of the roles in an overcloud and maps services to each role.

### **network\_data.yaml**

This file contains the definitions of the networks in an overcloud and their properties such as subnets, allocation pools, and VIP status. The default **network\_data.yaml** file contains the default networks: External, Internal Api, Storage, Storage Management, Tenant, and Management. You can create a custom **network\_data.yaml** file and add it to your **openstack overcloud deploy** command with the **-n** option.

### **plan-environment.yaml**

This file contains the definitions of the metadata for your overcloud plan. This includes the plan name, main template to use, and environment files to apply to the overcloud.

### **capabilities-map.yaml**

This file contains a mapping of environment files for an overcloud plan.

### **deployment**

This directory contains heat templates. The **overcloud-resource-registry-puppet.j2.yaml** environment file uses the files in this directory to drive the application of the Puppet configuration on each node.

### **environments**

This directory contains additional heat environment files that you can use for your overcloud creation. These environment files enable extra functions for your resulting Red Hat OpenStack Platform (RHOSP) environment. For example, the directory contains an environment file to enable Cinder NetApp backend storage (**cinder-netapp-config.yaml**).

### **network**

This directory contains a set of heat templates that you can use to create isolated networks and ports.

### **puppet**

This directory contains templates that control Puppet configuration. The **overcloud-resource-registry-puppet.j2.yaml** environment file uses the files in this directory to drive the application of the Puppet configuration on each node.

### **puppet/services**

This directory contains legacy heat templates for all service configuration. The templates in the **deployment** directory replace most of the templates in the **puppet/services** directory.

### **extraconfig**

This directory contains templates that you can use to enable extra functionality.

### **firstboot**

This directory contains example **first\_boot** scripts that director uses when initially creating the nodes.

## **2.4. PLAN ENVIRONMENT METADATA**

You can define metadata for your overcloud plan in a plan environment metadata file. Director applies metadata during the overcloud creation, and when importing and exporting your overcloud plan.

Use plan environment files to define workflows which director can execute with the OpenStack Workflow (Mistral) service. A plan environment metadata file includes the following parameters:

### **version**

The version of the template.

### **name**

The name of the overcloud plan and the container in OpenStack Object Storage (swift) that you want to use to store the plan files.

### **template**

The core parent template that you want to use for the overcloud deployment. This is most often **overcloud.yaml**, which is the rendered version of the **overcloud.yaml.j2** template.

### **environments**



Defines a list of environment files that you want to use. Specify the name and relative locations of each environment file with the **path** sub-parameter.

#### parameter\_defaults

A set of parameters that you want to use in your overcloud. This functions in the same way as the **parameter\_defaults** section in a standard environment file.

#### passwords

A set of parameters that you want to use for overcloud passwords. This functions in the same way as the **parameter\_defaults** section in a standard environment file. Usually, the director populates this section automatically with randomly generated passwords.

#### workflow\_parameters

Use this parameter to provide a set of parameters to OpenStack Workflow (mistral) namespaces. You can use this to calculate and automatically generate certain overcloud parameters.

The following snippet is an example of the syntax of a plan environment file:

```
version: 1.0
name: myovercloud
description: 'My Overcloud Plan'
template: overcloud.yaml
environments:
- path: overcloud-resource-registry-puppet.yaml
- path: environments/containers-default-parameters.yaml
- path: user-environment.yaml
parameter_defaults:
  ControllerCount: 1
  ComputeCount: 1
  OvercloudComputeFlavor: compute
  OvercloudControllerFlavor: control
workflow_parameters:
  tripleo.derive_params.v1.derive_parameters:
    num_phy_cores_per_numa_node_for_pmd: 2
```

You can include the plan environment metadata file with the **openstack overcloud deploy** command with the **-p** option:

```
(undercloud) $ openstack overcloud deploy --templates \
-p /my-plan-environment.yaml \
[OTHER OPTIONS]
```

You can also view plan metadata for an existing overcloud plan with the following command:

```
(undercloud) $ openstack object save overcloud plan-environment.yaml --file -
```

## 2.5. INCLUDING ENVIRONMENT FILES IN OVERCLOUD CREATION

Include environment files in the deployment command with the **-e** option. You can include as many environment files as necessary. However, the order of the environment files is important as the parameters and resources that you define in subsequent environment files take precedence. For example, you have two environment files that contain a common resource type

**OS::TripleO::NodeExtraConfigPost**, and a common parameter **TimeZone**:

#### environment-file-1.yaml

```
resource_registry:
  OS::TripleO::NodeExtraConfigPost: /home/stack/templates/template-1.yaml

parameter_defaults:
  RabbitFDLimit: 65536
  TimeZone: 'Japan'
```

### environment-file-2.yaml

```
resource_registry:
  OS::TripleO::NodeExtraConfigPost: /home/stack/templates/template-2.yaml

parameter_defaults:
  TimeZone: 'Hongkong'
```

You include both environment files in the deployment command:

```
$ openstack overcloud deploy --templates -e environment-file-1.yaml -e environment-file-2.yaml
```

The **openstack overcloud deploy** command runs through the following process:

1. Loads the default configuration from the core heat template collection.
2. Applies the configuration from **environment-file-1.yaml**, which overrides any common settings from the default configuration.
3. Applies the configuration from **environment-file-2.yaml**, which overrides any common settings from the default configuration and **environment-file-1.yaml**.

This results in the following changes to the default configuration of the overcloud:

- **OS::TripleO::NodeExtraConfigPost** resource is set to **/home/stack/templates/template-2.yaml**, as defined in **environment-file-2.yaml**.
- **TimeZone** parameter is set to **Hongkong**, as defined in **environment-file-2.yaml**.
- **RabbitFDLimit** parameter is set to **65536**, as defined in **environment-file-1.yaml**. **environment-file-2.yaml** does not change this value.

You can use this mechanism to define custom configuration for your overcloud without values from multiple environment files conflicting.

## 2.6. USING CUSTOMIZED CORE HEAT TEMPLATES

When creating the overcloud, director uses a core set of heat templates located in **/usr/share/openstack-tripleo-heat-templates**. If you want to customize this core template collection, use the following Git workflows to manage your custom template collection:

### Initializing a custom template collection

Create an initial Git repository that contains the heat template collection:

1. Copy the template collection to the **/home/stack/templates** directory:

```
$ cd ~/templates
$ cp -r /usr/share/openstack-tripleo-heat-templates .
```

2. Change to the custom template directory and initialize a Git repository:

```
$ cd ~/templates/openstack-tripleo-heat-templates
$ git init .
```

3. Configure your Git user name and email address:

```
$ git config --global user.name "<USER_NAME>"
$ git config --global user.email "<EMAIL_ADDRESS>"
```

Replace **<USER\_NAME>** with the user name that you want to use. Replace **<EMAIL\_ADDRESS>** with your email address.

4. Stage all templates for the initial commit:

```
$ git add *
```

5. Create an initial commit:

```
$ git commit -m "Initial creation of custom core heat templates"
```

This creates an initial **master** branch that contains the latest core template collection. Use this branch as the basis for your custom branch and merge new template versions to this branch.

### Creating a custom branch and committing changes

Use a custom branch to store your changes to the core template collection. Use the following procedure to create a **my-customizations** branch and add customizations:

1. Create the **my-customizations** branch and switch to it:

```
$ git checkout -b my-customizations
```

2. Edit the files in the custom branch.

3. Stage the changes in git:

```
$ git add [edited files]
```

4. Commit the changes to the custom branch:

```
$ git commit -m "[Commit message for custom changes]"
```

This adds your changes as commits to the **my-customizations** branch. When the **master** branch updates, you can rebase **my-customizations** off **master**, which causes git to add these commits on to the updated template collection. This helps track your customizations and replay them on future template updates.

### Updating the custom template collection:

When you update the undercloud, the **openstack-tripleo-heat-templates** package might also receive updates. When this occurs, you must also update your custom template collection:

1. Save the **openstack-tripleo-heat-templates** package version as an environment variable:

```
$ export PACKAGE=$(rpm -qv openstack-tripleo-heat-templates)
```

2. Change to your template collection directory and create a new branch for the updated templates:

```
$ cd ~/templates/openstack-tripleo-heat-templates
$ git checkout -b $PACKAGE
```

3. Remove all files in the branch and replace them with the new versions:

```
$ git rm -rf *
$ cp -r /usr/share/openstack-tripleo-heat-templates/* .
```

4. Add all templates for the initial commit:

```
$ git add *
```

5. Create a commit for the package update:

```
$ git commit -m "Updates for $PACKAGE"
```

6. Merge the branch into master. If you use a Git management system (such as GitLab), use the management workflow. If you use git locally, merge by switching to the **master** branch and run the **git merge** command:

```
$ git checkout master
$ git merge $PACKAGE
```

The **master** branch now contains the latest version of the core template collection. You can now rebase the **my-customization** branch from this updated collection.

## Rebasing the custom branch

Use the following procedure to update the **my-customization** branch,;

1. Change to the **my-customizations** branch:

```
$ git checkout my-customizations
```

2. Rebase the branch off **master**:

```
$ git rebase master
```

This updates the **my-customizations** branch and replays the custom commits made to this branch.

You must also resolve any conflicts that occur during the rebase:

1. Check which files contain the conflicts:

■

```
$ git status
```

2. Resolve the conflicts of the template files identified.
3. Add the resolved files:

```
$ git add [resolved files]
```

4. Continue the rebase:

```
$ git rebase --continue
```

## Deploying custom templates

Use the following procedure to deploy the custom template collection:

1. Ensure that you have switched to the **my-customization** branch:

```
git checkout my-customizations
```

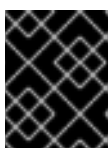
2. Run the **openstack overcloud deploy** command with the **--templates** option to specify your local template directory:

```
$ openstack overcloud deploy --templates /home/stack/templates/openstack-tripleo-heat-templates [OTHER OPTIONS]
```



### NOTE

Director uses the default template directory (**/usr/share/openstack-tripleo-heat-templates**) if you specify the **--templates** option without a directory.



### IMPORTANT

Red Hat recommends using the methods in [Chapter 4, Configuration hooks](#) instead of modifying the heat template collection.

## 2.7. JINJA2 RENDERING

The core heat templates in **/usr/share/openstack-tripleo-heat-templates** contain a number of files that have the **j2.yaml** file extension. These files contain Jinja2 template syntax and director renders these files to their static heat template equivalents that have the **.yaml** extension. For example, the main **overcloud.j2.yaml** file renders into **overcloud.yaml**. Director uses the resulting **overcloud.yaml** file.

The Jinja2-enabled heat templates use Jinja2 syntax to create parameters and resources for iterative values. For example, the **overcloud.j2.yaml** file contains the following snippet:

```
parameters:
...
{% for role in roles %}
...
{{role.name}}Count:
  description: Number of {{role.name}} nodes to deploy
  type: number
```

```

    default: {{role.CountDefault|default(0)}}
    ...
    {% endfor %}

```

When director renders the Jinja2 syntax, director iterates over the roles defined in the **roles\_data.yaml** file and populates the **{{role.name}}Count** parameter with the name of the role. The default **roles\_data.yaml** file contains five roles and results in the following parameters from our example:

- **ControllerCount**
- **ComputeCount**
- **BlockStorageCount**
- **ObjectStorageCount**
- **CephStorageCount**

A example rendered version of the parameter looks like this:

```

parameters:
  ...
  ControllerCount:
    description: Number of Controller nodes to deploy
    type: number
    default: 1
  ...

```

Director renders Jinja2-enabled templates and environment files only from within the directory of your core heat templates. The following use cases demonstrate the correct method to render the Jinja2 templates.

### Use case 1: Default core templates

Template directory: **/usr/share/openstack-tripleo-heat-templates/**

Environment file: **/usr/share/openstack-tripleo-heat-templates/environments/network-isolation.j2.yaml**

Director uses the default core template location (**--templates**) and renders the **network-isolation.j2.yaml** file into **network-isolation.yaml**. When you run the **openstack overcloud deploy** command, use the **-e** option to include the name of the rendered **network-isolation.yaml** file.

```

$ openstack overcloud deploy --templates \
  -e /usr/share/openstack-tripleo-heat-templates/environments/network-isolation.yaml
  ...

```

### Use case 2: Custom core templates

Template directory: **/home/stack/tripleo-heat-templates**

Environment file: **/home/stack/tripleo-heat-templates/environments/network-isolation.j2.yaml**

Director uses a custom core template location (**--templates /home/stack/tripleo-heat-templates**) and director renders the **network-isolation.j2.yaml** file within the custom core templates into **network-isolation.yaml**. When you run the **openstack overcloud deploy** command, use the **-e** option to include the name of the rendered **network-isolation.yaml** file.

```
$ openstack overcloud deploy --templates /home/stack/tripleo-heat-templates \  
-e /home/stack/tripleo-heat-templates/environments/network-isolation.yaml  
...
```

### Use case 3: Incorrect usage

Template directory: **/usr/share/openstack-tripleo-heat-templates/**

Environment file: **/home/stack/tripleo-heat-templates/environments/network-isolation.j2.yaml**

Director uses a custom core template location (**--templates /home/stack/tripleo-heat-templates**). However, the chosen **network-isolation.j2.yaml** is not located within the custom core templates, so it will not render into **network-isolation.yaml**. This causes the deployment to fail.

### Processing Jinja2 syntax into static templates

Use the **process-templates.py** script to render the Jinja2 syntax of the **openstack-tripleo-heat-templates** into a set of static templates. To render a copy of the **openstack-tripleo-heat-templates** collection with the **process-templates.py** script, change to the **openstack-tripleo-heat-templates** directory:

```
$ cd /usr/share/openstack-tripleo-heat-templates
```

Run the **process-templates.py** script, which is located in the **tools** directory, along with the **-o** option to define a custom directory to save the static copy:

```
$ ./tools/process-templates.py -o ~/openstack-tripleo-heat-templates-rendered
```

This converts all Jinja2 templates to their rendered YAML versions and saves the results to **~/openstack-tripleo-heat-templates-rendered**.

## CHAPTER 3. HEAT PARAMETERS

Each heat template in the director template collection contains a **parameters** section. This section contains definitions for all parameters specific to a particular overcloud service. This includes the following:

- **overcloud.j2.yaml** - Default base parameters
- **roles\_data.yaml** - Default parameters for composable roles
- **deployment/\*.yaml** - Default parameters for specific services

You can modify the values for these parameters using the following method:

1. Create an environment file for your custom parameters.
2. Include your custom parameters in the **parameter\_defaults** section of the environment file.
3. Include the environment file with the **openstack overcloud deploy** command.

### 3.1. EXAMPLE 1: CONFIGURING THE TIME ZONE

The Heat template for setting the timezone (**puppet/services/time/timezone.yaml**) contains a **TimeZone** parameter. If you leave the **TimeZone** parameter blank, the overcloud sets the time to **UTC** as a default.

To obtain lists of timezones run the **timedatectl list-timezones** command. The following example command retrieves the timezones for Asia:

```
$ sudo timedatectl list-timezones|grep "Asia"
```

After you identify your timezone, set the *TimeZone* parameter in an environment file. The following example environment file sets the value of *TimeZone* to *Asia/Tokyo*:

```
parameter_defaults:
  TimeZone: 'Asia/Tokyo'
```

### 3.2. EXAMPLE 2: CONFIGURING RABBITMQ FILE DESCRIPTOR LIMIT

For certain configurations, you might need to increase the file descriptor limit for the RabbitMQ server. Use the **deployment/rabbitmq/rabbitmq-container-puppet.yaml** heat template to set a new limit in the **RabbitFDLimit** parameter. Add the following entry to an environment file:

```
parameter_defaults:
  RabbitFDLimit: 65536
```

### 3.3. EXAMPLE 3: ENABLING AND DISABLING PARAMETERS

You might need to initially set a parameter during a deployment, then disable the parameter for a future deployment operation, such as updates or scaling operations. For example, to include a custom RPM during the overcloud creation, include the following entry in an environment file:



```
parameter_defaults:
  DeployArtifactURLs: ["http://www.example.com/myfile.rpm"]
```

To disable this parameter from a future deployment, it is not sufficient to remove the parameter. Instead, you must set the parameter to an empty value:

```
parameter_defaults:
  DeployArtifactURLs: []
```

This ensures the parameter is no longer set for subsequent deployments operations.

### 3.4. EXAMPLE 4: ROLE-BASED PARAMETERS

Use the **[ROLE]Parameters** parameters, replacing **[ROLE]** with a composable role, to set parameters for a specific role.

For example, director configures **sshd** on both Controller and Compute nodes. To set a different **sshd** parameters for Controller and Compute nodes, create an environment file that contains both the **ControllerParameters** and **ComputeParameters** parameter and set the **sshd** parameters for each specific role:

```
parameter_defaults:
  ControllerParameters:
    BannerText: "This is a Controller node"
  ComputeParameters:
    BannerText: "This is a Compute node"
```

### 3.5. IDENTIFYING PARAMETERS THAT YOU WANT TO MODIFY

Red Hat OpenStack Platform director provides many parameters for configuration. In some cases, you might experience difficulty identifying a certain option that you want to configure, and the corresponding director parameter. If there is an option that you want to configure with director, use the following workflow to identify and map the option to a specific overcloud parameter:

1. Identify the option that you want to configure. Make a note of the service that uses the option.
2. Check the corresponding Puppet module for this option. The Puppet modules for Red Hat OpenStack Platform are located under **/etc/puppet/modules** on the director node. Each module corresponds to a particular service. For example, the **keystone** module corresponds to the OpenStack Identity (keystone).
  - If the Puppet module contains a variable that controls the chosen option, move to the next step.
  - If the Puppet module does not contain a variable that controls the chosen option, no hieradata exists for this option. If possible, you can set the option manually after the overcloud completes deployment.
3. Check the core heat template collection for the Puppet variable in the form of hieradata. The templates in **deployment/\*** usually correspond to the Puppet modules of the same services. For example, the **deployment/keystone/keystone-container-puppet.yaml** template provides hieradata to the **keystone** module.

- If the heat template sets hieradata for the Puppet variable, the template should also disclose the director-based parameter that you can modify.
- If the heat template does not set hieradata for the Puppet variable, use the configuration hooks to pass the hieradata using an environment file. See [Section 4.5, “Puppet: Customizing hieradata for roles”](#) for more information on customizing hieradata.

## Workflow example

For example, to change the notification format for OpenStack Identity (keystone), use the workflow and complete the following steps:

1. Identify the OpenStack parameter that you want to configure (**notification\_format**).
2. Search the **keystone** Puppet module for the **notification\_format** setting:

```
$ grep notification_format /etc/puppet/modules/keystone/manifests/*
```

In this case, the **keystone** module manages this option using the **keystone::notification\_format** variable.

3. Search the **keystone** service template for this variable:

```
$ grep "keystone::notification_format" /usr/share/openstack-tripleo-heat-templates/deployment/keystone/keystone-container-puppet.yaml
```

The output shows that director uses the **KeystoneNotificationFormat** parameter to set the **keystone::notification\_format** hieradata.

The following table shows the eventual mapping:

Director parameter	Puppet hieradata	OpenStack Identity (keystone) option
<b>KeystoneNotificationFormat</b>	<b>keystone::notification_format</b>	<b>notification_format</b>

You set the **KeystoneNotificationFormat** in an overcloud environment file, which then sets the **notification\_format** option in the **keystone.conf** file during the overcloud configuration.

## CHAPTER 4. CONFIGURATION HOOKS

Use configuration hooks to inject your own custom configuration functions into the overcloud deployment process. You can create hooks to inject custom configuration before and after the main overcloud services configuration, and hooks for modifying and including Puppet-based configuration.

### 4.1. FIRST BOOT: CUSTOMIZING FIRST BOOT CONFIGURATION

Director uses **cloud-init** to perform configuration on all nodes after the initial creation of the overcloud. You can use the **NodeUserData** resource types to call **cloud-init**.

#### OS::TripleO::NodeUserData

**cloud-init** configuration to apply to all nodes.

#### OS::TripleO::Controller::NodeUserData

**cloud-init** configuration to apply to Controller nodes.

#### OS::TripleO::Compute::NodeUserData

**cloud-init** configuration to apply to Compute nodes.

#### OS::TripleO::CephStorage::NodeUserData

**cloud-init** configuration to apply to Ceph Storage nodes.

#### OS::TripleO::ObjectStorage::NodeUserData

**cloud-init** configuration to apply to Object Storage nodes.

#### OS::TripleO::BlockStorage::NodeUserData

**cloud-init** configuration to apply to Block Storage nodes.

#### OS::TripleO::**[ROLE]**::NodeUserData

**cloud-init** configuration to apply to custom nodes. Replace **[ROLE]** with the composable role name.

In this example, update the nameserver with a custom IP address on all nodes:

1. Create a basic heat template `~/templates/nameserver.yaml` that runs a script to append the **resolv.conf** file on each node with a specific nameserver. You can use the **OS::TripleO::MultipartMime** resource type to send the configuration script.

```
heat_template_version: 2014-10-16

description: >
  Extra hostname configuration

resources:
  userdata:
    type: OS::Heat::MultipartMime
    properties:
      parts:
        - config: {get_resource: nameserver_config}

  nameserver_config:
    type: OS::Heat::SoftwareConfig
    properties:
      config: |
        #!/bin/bash
        echo "nameserver 192.168.1.1" >> /etc/resolv.conf
```

```

outputs:
  OS::stack_id:
    value: {get_resource: userdata}

```

2. Create an environment file `~/templates/firstboot.yaml` that registers your heat template as the **OS::TripleO::NodeUserData** resource type.

```

resource_registry:
  OS::TripleO::NodeUserData: /home/stack/templates/nameserver.yaml

```

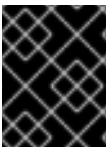
3. To add the first boot configuration to your overcloud, add the environment file to the stack, along with your other environment files:

```

$ openstack overcloud deploy --templates \
...
-e /home/stack/templates/firstboot.yaml \
...

```

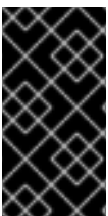
This adds the configuration to all nodes when they are first created and boot for the first time. Subsequent inclusion of these templates, such as updating the overcloud stack, does not run these scripts.



### IMPORTANT

You can only register the **NodeUserData** resources to one heat template per resource. Subsequent usage overrides the heat template to use.

## 4.2. PRE-CONFIGURATION: CUSTOMIZING SPECIFIC OVERCLOUD ROLES



### IMPORTANT

Previous versions of this document used the **OS::TripleO::Tasks::\*PreConfig** resources to provide pre-configuration hooks on a per role basis. The heat template collection requires dedicated use of these hooks, which means that you should not use them for custom use. Instead, use the **OS::TripleO::\*ExtraConfigPre** hooks outlined here.

The overcloud uses Puppet for the core configuration of OpenStack components. Director provides a set of hooks that you can use to perform custom configuration for specific node roles after the first boot completes and before the core configuration begins. These hooks include:

#### **OS::TripleO::ControllerExtraConfigPre**

Additional configuration applied to Controller nodes before the core Puppet configuration.

#### **OS::TripleO::ComputeExtraConfigPre**

Additional configuration applied to Compute nodes before the core Puppet configuration.

#### **OS::TripleO::CephStorageExtraConfigPre**

Additional configuration applied to Ceph Storage nodes before the core Puppet configuration.

#### **OS::TripleO::ObjectStorageExtraConfigPre**

Additional configuration applied to Object Storage nodes before the core Puppet configuration.

#### **OS::TripleO::BlockStorageExtraConfigPre**

Additional configuration applied to Block Storage nodes before the core Puppet configuration.

### OS::TripleO::[ROLE]ExtraConfigPre

Additional configuration applied to custom nodes before the core Puppet configuration. Replace **[ROLE]** with the composable role name.

In this example, append the **resolv.conf** file on all nodes of a particular role with a variable nameserver:

1. Create a basic heat template `~/templates/nameserver.yaml` that runs a script to write a variable nameserver to the **resolv.conf** file of a node:

```
heat_template_version: 2014-10-16

description: >
  Extra hostname configuration

parameters:
  server:
    type: string
  nameserver_ip:
    type: string
  DeployIdentifier:
    type: string

resources:
  CustomExtraConfigPre:
    type: OS::Heat::SoftwareConfig
    properties:
      group: script
      config:
        str_replace:
          template: |
            #!/bin/sh
            echo "nameserver _NAMESERVER_IP_" > /etc/resolv.conf
        params:
          _NAMESERVER_IP_: {get_param: nameserver_ip}

  CustomExtraDeploymentPre:
    type: OS::Heat::SoftwareDeployment
    properties:
      server: {get_param: server}
      config: {get_resource: CustomExtraConfigPre}
      actions: ['CREATE','UPDATE']
      input_values:
        deploy_identifier: {get_param: DeployIdentifier}

outputs:
  deploy_stdout:
    description: Deployment reference, used to trigger pre-deploy on changes
    value: {get_attr: [CustomExtraDeploymentPre, deploy_stdout]}
```

In this example, the **resources** section contains the following parameters:

#### CustomExtraConfigPre

This defines a software configuration. In this example, we define a Bash **script** and heat replaces **\_NAMESERVER\_IP\_** with the value stored in the **nameserver\_ip** parameter.

### CustomExtraDeploymentPre

This executes a software configuration, which is the software configuration from the **CustomExtraConfigPre** resource. Note the following:

- The **config** parameter references the **CustomExtraConfigPre** resource so that heat knows which configuration to apply.
  - The **server** parameter retrieves a map of the overcloud nodes. This parameter is provided by the parent template and is mandatory in templates for this hook.
  - The **actions** parameter defines when to apply the configuration. In this case, you want to apply the configuration when the overcloud is created. Possible actions include **CREATE**, **UPDATE**, **DELETE**, **SUSPEND**, and **RESUME**.
  - **input\_values** contains a parameter called **deploy\_identifier**, which stores the **DeployIdentifier** from the parent template. This parameter provides a timestamp to the resource for each deployment update to ensure that the resource reapplies on subsequent overcloud updates.
2. Create an environment file `~/templates/pre_config.yaml` that registers your heat template to the role-based resource type. For example, to apply the configuration only to Controller nodes, use the **ControllerExtraConfigPre** hook:

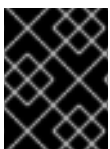
```
resource_registry:
  OS::TripleO::ControllerExtraConfigPre: /home/stack/templates/nameserver.yaml

parameter_defaults:
  nameserver_ip: 192.168.1.1
```

3. Add the environment file to the stack, along with your other environment files:

```
$ openstack overcloud deploy --templates \
...
-e /home/stack/templates/pre_config.yaml \
...
```

This applies the configuration to all Controller nodes before the core configuration begins on either the initial overcloud creation or subsequent updates.



#### IMPORTANT

You can register each resource to only one heat template per hook. Subsequent usage overrides the heat template to use.

## 4.3. PRE-CONFIGURATION: CUSTOMIZING ALL OVERCLOUD ROLES

The overcloud uses Puppet for the core configuration of OpenStack components. Director provides a hook that you can use to configure all node types after the first boot completes and before the core configuration begins:

### OS::TripleO::NodeExtraConfig

Additional configuration applied to all nodes roles before the core Puppet configuration.

In this example, append the **resolv.conf** file on each node with a variable nameserver:

1. Create a basic heat template **~/templates/nameserver.yaml** that runs a script to append the **resolv.conf** file of each node with a variable nameserver:

```

heat_template_version: 2014-10-16

description: >
  Extra hostname configuration

parameters:
  server:
    type: string
  nameserver_ip:
    type: string
  DeployIdentifier:
    type: string

resources:
  CustomExtraConfigPre:
    type: OS::Heat::SoftwareConfig
    properties:
      group: script
      config:
        str_replace:
          template: |
            #!/bin/sh
            echo "nameserver _NAMESERVER_IP_" >> /etc/resolv.conf
        params:
          _NAMESERVER_IP_: {get_param: nameserver_ip}

  CustomExtraDeploymentPre:
    type: OS::Heat::SoftwareDeployment
    properties:
      server: {get_param: server}
      config: {get_resource: CustomExtraConfigPre}
      actions: ['CREATE','UPDATE']
      input_values:
        deploy_identifier: {get_param: DeployIdentifier}

outputs:
  deploy_stdout:
    description: Deployment reference, used to trigger pre-deploy on changes
    value: {get_attr: [CustomExtraDeploymentPre, deploy_stdout]}

```

In this example, the **resources** section contains the following parameters:

#### CustomExtraConfigPre

This parameter defines a software configuration. In this example, you define a Bash **script** and heat replaces **\_NAMESERVER\_IP\_** with the value stored in the **nameserver\_ip** parameter.

#### CustomExtraDeploymentPre

This parameter executes a software configuration, which is the software configuration from the **CustomExtraConfigPre** resource. Note the following:

- The **config** parameter references the **CustomExtraConfigPre** resource so that heat knows which configuration to apply.
  - The **server** parameter retrieves a map of the overcloud nodes. This parameter is provided by the parent template and is mandatory in templates for this hook.
  - The **actions** parameter defines when to apply the configuration. In this case, you only apply the configuration when the overcloud is created. Possible actions include **CREATE, UPDATE, DELETE, SUSPEND,** and **RESUME.**
  - The **input\_values** parameter contains a sub-parameter called **deploy\_identifier**, which stores the **DeployIdentifier** from the parent template. This parameter provides a timestamp to the resource for each deployment update to ensure that the resource reapplies on subsequent overcloud updates.
2. Create an environment file **~/templates/pre\_config.yaml** that registers your heat template as the **OS::TripleO::NodeExtraConfig** resource type.

```
resource_registry:
  OS::TripleO::NodeExtraConfig: /home/stack/templates/nameserver.yaml

parameter_defaults:
  nameserver_ip: 192.168.1.1
```

3. Add the environment file to the stack, along with your other environment files:

```
$ openstack overcloud deploy --templates \
...
-e /home/stack/templates/pre_config.yaml \
...
```

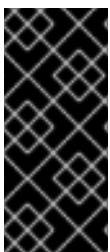
This applies the configuration to all nodes before the core configuration begins on either the initial overcloud creation or subsequent updates.



### IMPORTANT

You can register the **OS::TripleO::NodeExtraConfig** to only one heat template. Subsequent usage overrides the heat template to use.

## 4.4. POST-CONFIGURATION: CUSTOMIZING ALL OVERCLOUD ROLES



### IMPORTANT

Previous versions of this document used the **OS::TripleO::Tasks::\*PostConfig** resources to provide post-configuration hooks on a per role basis. The heat template collection requires dedicated use of these hooks, which means that you should not use them for custom use. Instead, use the **OS::TripleO::NodeExtraConfigPost** hook outlined here.

A situation might occur where you have completed the creation of your overcloud but you want to add additional configuration to all roles, either on initial creation or on a subsequent update of the overcloud. In this case, use the following post-configuration hook:



**OS::TripleO::NodeExtraConfigPost**

Additional configuration applied to all nodes roles after the core Puppet configuration.

In this example, append the **resolv.conf** file on each node with a variable nameserver:

1. Create a basic heat template **~/templates/nameserver.yaml** that runs a script to append the **resolv.conf** file of each node with a variable nameserver:

```

heat_template_version: 2014-10-16

description: >
  Extra hostname configuration

parameters:
  servers:
    type: json
  nameserver_ip:
    type: string
  DeployIdentifier:
    type: string
  EndpointMap:
    default: {}
    type: json

resources:
  CustomExtraConfig:
    type: OS::Heat::SoftwareConfig
    properties:
      group: script
      config:
        str_replace:
          template: |
            #!/bin/sh
            echo "nameserver _NAMESERVER_IP_" >> /etc/resolv.conf
        params:
          _NAMESERVER_IP_: {get_param: nameserver_ip}

  CustomExtraDeployments:
    type: OS::Heat::SoftwareDeploymentGroup
    properties:
      servers: {get_param: servers}
      config: {get_resource: CustomExtraConfig}
      actions: ['CREATE','UPDATE']
      input_values:
        deploy_identifier: {get_param: DeployIdentifier}

```

In this example, the **resources** section contains the following parameters:

**CustomExtraConfig**

This defines a software configuration. In this example, you define a Bash **script** and heat replaces **\_NAMESERVER\_IP\_** with the value stored in the **nameserver\_ip** parameter.

**CustomExtraDeployments**

This executes a software configuration, which is the software configuration from the **CustomExtraConfig** resource. Note the following:

- The **config** parameter references the **CustomExtraConfig** resource so that heat knows which configuration to apply.
  - The **servers** parameter retrieves a map of the overcloud nodes. This parameter is provided by the parent template and is mandatory in templates for this hook.
  - The **actions** parameter defines when to apply the configuration. In this case, you want apply the configuration when the overcloud is created. Possible actions include **CREATE, UPDATE, DELETE, SUSPEND,** and **RESUME.**
  - **input\_values** contains a parameter called **deploy\_identifier**, which stores the **DeployIdentifier** from the parent template. This parameter provides a timestamp to the resource for each deployment update to ensure that the resource reapplies on subsequent overcloud updates.
2. Create an environment file `~/templates/post_config.yaml` that registers your heat template as the **OS::TripleO::NodeExtraConfigPost:** resource type.

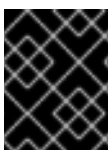
```
resource_registry:
  OS::TripleO::NodeExtraConfigPost: /home/stack/templates/nameserver.yaml

parameter_defaults:
  nameserver_ip: 192.168.1.1
```

3. Add the environment file to the stack, along with your other environment files:

```
$ openstack overcloud deploy --templates \
...
-e /home/stack/templates/post_config.yaml \
...
```

This applies the configuration to all nodes after the core configuration completes on either initial overcloud creation or subsequent updates.



### IMPORTANT

You can register the **OS::TripleO::NodeExtraConfigPost** to only one heat template. Subsequent usage overrides the heat template to use.

## 4.5. PUPPET: CUSTOMIZING HIERADATA FOR ROLES

The heat template collection contains a set of parameters that you can use to pass extra configuration to certain node types. These parameters save the configuration as hieradata for the Puppet configuration on the node:

### ControllerExtraConfig

Configuration to add to all Controller nodes.

### ComputeExtraConfig

Configuration to add to all Compute nodes.

### BlockStorageExtraConfig

Configuration to add to all Block Storage nodes.

### ObjectStorageExtraConfig

Configuration to add to all Object Storage nodes.

### CephStorageExtraConfig

Configuration to add to all Ceph Storage nodes.

### [ROLE]ExtraConfig

Configuration to add to a composable role. Replace **[ROLE]** with the composable role name.

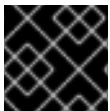
### ExtraConfig

Configuration to add to all nodes.

1. To add extra configuration to the post-deployment configuration process, create an environment file that contains these parameters in the **parameter\_defaults** section. For example, to increase the reserved memory for Compute hosts to 1024 MB and set the VNC keymap to Japanese, use the following entries in the **ComputeExtraConfig** parameter:

```
parameter_defaults:
  ComputeExtraConfig:
    nova::compute::reserved_host_memory: 1024
    nova::compute::vnc_keymap: ja
```

2. Include this environment file in the **openstack overcloud deploy** command, along with any other environment files relevant to your deployment.



### IMPORTANT

You can define each parameter only once. Subsequent usage overrides previous values.

## 4.6. PUPPET: CUSTOMIZING HIERADATA FOR INDIVIDUAL NODES

You can set Puppet hieradata for individual nodes using the heat template collection:

1. Identify the system UUID from the introspection data for a node:

```
$ openstack baremetal introspection data save 9dcc87ae-4c6d-4ede-81a5-9b20d7dc4a14 |
jq .extra.system.product.uuid
```

This command returns a system UUID. For example:

```
"f5055c6c-477f-47fb-afe5-95c6928c407f"
```

2. Create an environment file to define node-specific hieradata and register the **per\_node.yaml** template to a pre-configuration hook. Include the system UUID of the node that you want to configure in the **NodeDataLookup** parameter:

```
resource_registry:
  OS::TripleO::ComputeExtraConfigPre: /usr/share/openstack-tripleo-heat-
  templates/puppet/extraconfig/pre_deploy/per_node.yaml
parameter_defaults:
  NodeDataLookup: '{"f5055c6c-477f-47fb-afe5-95c6928c407f":
  {"nova::compute::vcpu_pin_set": [ "2", "3" ]}}'
```

3. Include this environment file in the **openstack overcloud deploy** command, along with any other environment files relevant to your deployment.

The `per_node.yaml` template generates a set of hieradata files on nodes that correspond to each system UUID and contains the hieradata that you define. If a UUID is not defined, the resulting hieradata file is empty. In this example, the `per_node.yaml` template runs on all Compute nodes as defined by the `OS::TripleO::ComputeExtraConfigPre` hook, but only the Compute node with system UUID `f5055c6c-477f-47fb-afe5-95c6928c407f` receives hieradata.

You can use this mechanism to tailor each node according to specific requirements.

For more information about `NodeDataLookup`, see [Altering the disk layout in Ceph Storage nodes](#) in the *Deploying an overcloud with containerized Red Hat Ceph* guide.

## 4.7. PUPPET: APPLYING CUSTOM MANIFESTS

In certain circumstances, you might want to install and configure some additional components on your overcloud nodes. You can achieve this with a custom Puppet manifest that applies to nodes after the main configuration completes. As a basic example, you might want to install `motd` on each node

1. Create a heat template `~/templates/custom_puppet_config.yaml` that launches Puppet configuration.

```
heat_template_version: 2014-10-16

description: >
  Run Puppet extra configuration to set new MOTD

parameters:
  servers:
    type: json

resources:
  ExtraPuppetConfig:
    type: OS::Heat::SoftwareConfig
    properties:
      config: {get_file: motd.pp}
      group: puppet
      options:
        enable_hiera: True
        enable_factor: False

  ExtraPuppetDeployments:
    type: OS::Heat::SoftwareDeploymentGroup
    properties:
      config: {get_resource: ExtraPuppetConfig}
      servers: {get_param: servers}
```

This example includes the `/home/stack/templates/motd.pp` within the template and passes it to nodes for configuration. The `motd.pp` file contains the Puppet classes necessary to install and configure `motd`.

2. Create an environment file `~/templates/puppet_post_config.yaml` that registers your heat template as the `OS::TripleO::NodeExtraConfigPost:` resource type.

```
resource_registry:
  OS::TripleO::NodeExtraConfigPost: /home/stack/templates/custom_puppet_config.yaml
```

3. Include this environment file in the **openstack overcloud deploy** command, along with any other environment files relevant to your deployment.

```
$ openstack overcloud deploy --templates \  
...  
-e /home/stack/templates/puppet_post_config.yaml \  
...
```

This applies the configuration from **motd.pp** to all nodes in the overcloud.

## CHAPTER 5. ANSIBLE-BASED OVERCLOUD REGISTRATION

Director uses Ansible-based methods to register overcloud nodes to the Red Hat Customer Portal or to a Red Hat Satellite Server.

If you used the **rhel-registration** method from previous Red Hat OpenStack Platform versions, you must disable it and switch to the Ansible-based method. For more information, see [Section 5.6, “Switching to the rhsm composable service”](#) and [Section 5.7, “rhel-registration to rhsm mappings”](#).

In addition to the director-based registration method, you can also manually register after deployment. For more information, see [Section 5.9, “Running Ansible-based registration manually”](#).

### 5.1. RED HAT SUBSCRIPTION MANAGER (RHSM) COMPOSABLE SERVICE

You can use the **rhsm** composable service to register overcloud nodes through Ansible. Each role in the default **roles\_data** file contains a **OS::TripleO::Services::Rhsm** resource, which is disabled by default. To enable the service, register the resource to the **rhsm** composable service file:

```
resource_registry:
  OS::TripleO::Services::Rhsm: /usr/share/openstack-tripleo-heat-templates/deployment/rhsm/rhsm-
  baremetal-ansible.yaml
```

The **rhsm** composable service accepts a **RhsmVars** parameter, which you can use to define multiple sub-parameters relevant to your registration:

```
parameter_defaults:
  RhsmVars:
    rhsm_repos:
      - rhel-8-for-x86_64-baseos-eus-rpms
      - rhel-8-for-x86_64-appstream-eus-rpms
      - rhel-8-for-x86_64-highavailability-eus-rpms
      ...
    rhsm_username: "myusername"
    rhsm_password: "p@55w0rd!"
    rhsm_org_id: "1234567"
    rhsm_release: 8.4
```

You can also use the **RhsmVars** parameter in combination with role-specific parameters, for example, **ControllerParameters**, to provide flexibility when enabling specific repositories for different nodes types.

### 5.2. RHSMVARS SUB-PARAMETERS

Use the following sub-parameters as part of the **RhsmVars** parameter when you configure the **rhsm** composable service. For more information about the Ansible parameters that are available, see the [role documentation](#).

rhsm	Description
<b>rhsm_method</b>	Choose the registration method. Either <b>portal</b> , <b>satellite</b> , or <b>disable</b> .

rhsm	Description
<b>rhsm_org_id</b>	The organization that you want to use for registration. To locate this ID, run <b>sudo subscription-manager orgs</b> from the undercloud node. Enter your Red Hat credentials at the prompt, and use the resulting <b>Key</b> value. For more information on your organization ID, see " <a href="#">Understanding the Red Hat Subscription Management Organization ID</a> ".
<b>rhsm_pool_ids</b>	The subscription pool ID that you want to use. Use this parameter if you do not want to auto-attach subscriptions. To locate this ID, run <b>sudo subscription-manager list --available --all --matches="*Red Hat OpenStack*"</b> from the undercloud node, and use the resulting <b>Pool ID</b> value.
<b>rhsm_activation_key</b>	The activation key that you want to use for registration.
<b>rhsm_autosubscribe</b>	Use this parameter to attach compatible subscriptions to this system automatically. Set the value to <b>true</b> to enable this feature.
<b>rhsm_baseurl</b>	The base URL for obtaining content. The default URL is the Red Hat Content Delivery Network. If you use a Satellite server, change this value to the base URL of your Satellite server content repositories.
<b>rhsm_server_hostname</b>	The hostname of the subscription management service for registration. The default is the Red Hat Subscription Management hostname. If you use a Satellite server, change this value to your Satellite server hostname.
<b>rhsm_repos</b>	A list of repositories that you want to enable.
<b>rhsm_username</b>	The username for registration. If possible, use activation keys for registration.
<b>rhsm_password</b>	The password for registration. If possible, use activation keys for registration.
<b>rhsm_release</b>	Red Hat Enterprise Linux release for pinning the repositories. This is set to 8.4 for Red Hat OpenStack Platform
<b>rhsm_rhsm_proxy_host name</b>	The hostname for the HTTP proxy. For example: <b>proxy.example.com</b> .
<b>rhsm_rhsm_proxy_port</b>	The port for HTTP proxy communication. For example: <b>8080</b> .
<b>rhsm_rhsm_proxy_user</b>	The username to access the HTTP proxy.
<b>rhsm_rhsm_proxy_pass word</b>	The password to access the HTTP proxy.



## IMPORTANT

You can use **rhsm\_activation\_key** and **rhsm\_repos** together only if **rhsm\_method** is set to **portal**. If **rhsm\_method** is set to *satellite*, you can only use either **rhsm\_activation\_key** or **rhsm\_repos**.

## 5.3. REGISTERING THE OVERCLOUD WITH THE RHSM COMPOSABLE SERVICE

Create an environment file that enables and configures the **rhsm** composable service. Director uses this environment file to register and subscribe your nodes.

### Procedure

1. Create an environment file named **templates/rhsm.yml** to store the configuration.
2. Include your configuration in the environment file. For example:

```
resource_registry:
  OS::TripleO::Services::Rhsm: /usr/share/openstack-tripleo-heat-
  templates/deployment/rhsm/rhsm-baremetal-ansible.yaml
parameter_defaults:
  RhsmVars:
    rhsm_repos:
      - rhel-8-for-x86_64-baseos-eus-rpms
      - rhel-8-for-x86_64-appstream-eus-rpms
      - rhel-8-for-x86_64-highavailability-eus-rpms
      ...
    rhsm_username: "myusername"
    rhsm_password: "p@55w0rd!"
    rhsm_org_id: "1234567"
    rhsm_pool_ids: "1a85f9223e3d5e43013e3d6e8ff506fd"
    rhsm_method: "portal"
    rhsm_release: 8.4
```

- The **resource\_registry** section associates the **rhsm** composable service with the **OS::TripleO::Services::Rhsm** resource, which is available on each role.
  - The **RhsmVars** variable passes parameters to Ansible for configuring your Red Hat registration.
3. Save the environment file.

## 5.4. APPLYING THE RHSM COMPOSABLE SERVICE TO DIFFERENT ROLES

You can apply the **rhsm** composable service on a per-role basis. For example, you can apply different sets of configurations to Controller nodes, Compute nodes, and Ceph Storage nodes.

### Procedure

1. Create an environment file named **templates/rhsm.yml** to store the configuration.
2. Include your configuration in the environment file. For example:



```

resource_registry:
  OS::TripleO::Services::Rhsm: /usr/share/openstack-tripleo-heat-
templates/deployment/rhsm/rhsm-baremetal-ansible.yaml
parameter_defaults:
  ControllerParameters:
    RhsmVars:
      rhsm_repos:
        - rhel-8-for-x86_64-baseos-eus-rpms
        - rhel-8-for-x86_64-appstream-eus-rpms
        - rhel-8-for-x86_64-highavailability-eus-rpms
        - ansible-2.9-for-rhel-8-x86_64-rpms
        - advanced-virt-for-rhel-8-x86_64-rpms
        - openstack-16.2-for-rhel-8-x86_64-rpms
        - fast-datapath-for-rhel-8-x86_64-rpms
      rhsm_username: "myusername"
      rhsm_password: "p@55w0rd!"
      rhsm_org_id: "1234567"
      rhsm_pool_ids: "55d251f1490556f3e75aa37e89e10ce5"
      rhsm_method: "portal"
      rhsm_release: 8.4
  ComputeParameters:
    RhsmVars:
      rhsm_repos:
        - rhel-8-for-x86_64-baseos-eus-rpms
        - rhel-8-for-x86_64-appstream-eus-rpms
        - rhel-8-for-x86_64-highavailability-eus-rpms
        - ansible-2.9-for-rhel-8-x86_64-rpms
        - advanced-virt-for-rhel-8-x86_64-rpms
        - openstack-16.2-for-rhel-8-x86_64-rpms
        - fast-datapath-for-rhel-8-x86_64-rpms
      rhsm_username: "myusername"
      rhsm_password: "p@55w0rd!"
      rhsm_org_id: "1234567"
      rhsm_pool_ids: "55d251f1490556f3e75aa37e89e10ce5"
      rhsm_method: "portal"
      rhsm_release: 8.4
  CephStorageParameters:
    RhsmVars:
      rhsm_repos:
        - rhel-8-for-x86_64-baseos-rpms
        - rhel-8-for-x86_64-appstream-rpms
        - rhel-8-for-x86_64-highavailability-rpms
        - ansible-2.9-for-rhel-8-x86_64-rpms
        - openstack-16.2-deployment-tools-for-rhel-8-x86_64-rpms
      rhsm_username: "myusername"
      rhsm_password: "p@55w0rd!"
      rhsm_org_id: "1234567"
      rhsm_pool_ids: "68790a7aa2dc9dc50a9bc39fab55e0d"
      rhsm_method: "portal"
      rhsm_release: 8.4

```

The **resource\_registry** associates the **rhsm** composable service with the **OS::TripleO::Services::Rhsm** resource, which is available on each role.

The **ControllerParameters**, **ComputeParameters**, and **CephStorageParameters** parameters each use a separate **RhsmVars** parameter to pass subscription details to their respective roles.



## NOTE

Set the **RhsmVars** parameter within the **CephStorageParameters** parameter to use a Red Hat Ceph Storage subscription and repositories specific to Ceph Storage. Ensure the **rhsm\_repos** parameter contains the standard Red Hat Enterprise Linux repositories instead of the Extended Update Support (EUS) repositories that Controller and Compute nodes require.

3. Save the environment file.

## 5.5. REGISTERING THE OVERCLOUD TO RED HAT SATELLITE SERVER

Create an environment file that enables and configures the **rhsm** composable service to register nodes to Red Hat Satellite instead of the Red Hat Customer Portal.

### Procedure

1. Create an environment file named **templates/rhsm.yml** to store the configuration.
2. Include your configuration in the environment file. For example:

```
resource_registry:
  OS::TripleO::Services::Rhsm: /usr/share/openstack-tripleo-heat-
  templates/deployment/rhsm/rhsm-baremetal-ansible.yaml
parameter_defaults:
  RhsmVars:
    rhsm_activation_key: "myactivationkey"
    rhsm_method: "satellite"
    rhsm_org_id: "ACME"
    rhsm_server_hostname: "satellite.example.com"
    rhsm_baseurl: "https://satellite.example.com/pulp/repos"
    rhsm_release: 8.4
```

The **resource\_registry** associates the **rhsm** composable service with the **OS::TripleO::Services::Rhsm** resource, which is available on each role.

The **RhsmVars** variable passes parameters to Ansible for configuring your Red Hat registration.

3. Save the environment file.

## 5.6. SWITCHING TO THE RHSM COMPOSABLE SERVICE

The previous **rhel-registration** method runs a bash script to handle the overcloud registration. The scripts and environment files for this method are located in the core heat template collection at **/usr/share/openstack-tripleo-heat-templates/extraconfig/pre\_deploy/rhel-registration/**.

Complete the following steps to switch from the **rhel-registration** method to the **rhsm** composable service.

### Procedure

1. Exclude the **rhel-registration** environment files from future deployments operations. In most cases, exclude the following files:

- **rhel-registration/environment-rhel-registration.yaml**
  - **rhel-registration/rhel-registration-resource-registry.yaml**
2. If you use a custom **roles\_data** file, ensure that each role in your **roles\_data** file contains the **OS::TripleO::Services::Rhsm** composable service. For example:

```
- name: Controller
  description: |
    Controller role that has all the controller services loaded and handles
    Database, Messaging and Network functions.
  CountDefault: 1
  ...
  ServicesDefault:
    ...
    - OS::TripleO::Services::Rhsm
  ...
```

3. Add the environment file for **rhsm** composable service parameters to future deployment operations.

This method replaces the **rhel-registration** parameters with the **rhsm** service parameters and changes the heat resource that enables the service from:

```
resource_registry:
  OS::TripleO::NodeExtraConfig: rhel-registration.yaml
```

To:

```
resource_registry:
  OS::TripleO::Services::Rhsm: /usr/share/openstack-tripleo-heat-templates/deployment/rhsm/rhsm-
  baremetal-ansible.yaml
```

You can also include the **/usr/share/openstack-tripleo-heat-templates/environments/rhsm.yaml** environment file with your deployment to enable the service.

## 5.7. RHEL-REGISTRATION TO RHSM MAPPINGS

To help transition your details from the **rhel-registration** method to the **rhsm** method, use the following table to map your parameters and values.

<b>rhel-registration</b>	<b>rhsm / RhsmVars</b>
<b>rhel_reg_method</b>	<b>rhsm_method</b>
<b>rhel_reg_org</b>	<b>rhsm_org_id</b>
<b>rhel_reg_pool_id</b>	<b>rhsm_pool_ids</b>
<b>rhel_reg_activation_key</b>	<b>rhsm_activation_key</b>

rhel-registration	rhsm / RhsmVars
rhel_reg_auto_attach	rhsm_autosubscribe
rhel_reg_sat_url	rhsm_satellite_url
rhel_reg_repos	rhsm_repos
rhel_reg_user	rhsm_username
rhel_reg_password	rhsm_password
rhel_reg_release	rhsm_release
rhel_reg_http_proxy_host	rhsm_rhsm_proxy_hostname
rhel_reg_http_proxy_port	rhsm_rhsm_proxy_port
rhel_reg_http_proxy_username	rhsm_rhsm_proxy_user
rhel_reg_http_proxy_password	rhsm_rhsm_proxy_password

## 5.8. DEPLOYING THE OVERCLOUD WITH THE RHSM COMPOSABLE SERVICE

Deploy the overcloud with the **rhsm** composable service so that Ansible controls the registration process for your overcloud nodes.

### Procedure

1. Include **rhsm.yml** environment file with the **openstack overcloud deploy** command:

```
openstack overcloud deploy \
  <other cli args> \
  -e ~/templates/rhsm.yaml
```

This enables the Ansible configuration of the overcloud and the Ansible-based registration.

2. Wait until the overcloud deployment completes.
3. Check the subscription details on your overcloud nodes. For example, log in to a Controller node and run the following commands:

```
$ sudo subscription-manager status
$ sudo subscription-manager list --consumed
```

## 5.9. RUNNING ANSIBLE-BASED REGISTRATION MANUALLY

You can perform manual Ansible-based registration on a deployed overcloud with the dynamic

inventory script on the director node. Use this script to define node roles as host groups and then run a playbook against them with **ansible-playbook**. Use the following example playbook to register Controller nodes manually.

## Procedure

1. Create a playbook that uses the **redhat\_subscription** modules to register your nodes. For example, the following playbook applies to Controller nodes:

```
---
- name: Register Controller nodes
  hosts: Controller
  become: yes
  vars:
    repos:
      - rhel-8-for-x86_64-baseos-eus-rpms
      - rhel-8-for-x86_64-appstream-eus-rpms
      - rhel-8-for-x86_64-highavailability-eus-rpms
      - ansible-2.9-for-rhel-8-x86_64-rpms
      - advanced-virt-for-rhel-8-x86_64-rpms
      - openstack-16.2-for-rhel-8-x86_64-rpms
      - fast-datapath-for-rhel-8-x86_64-rpms
  tasks:
    - name: Register system
      redhat_subscription:
        username: myusername
        password: p@55w0rd!
        org_id: 1234567
        release: 8.4
        pool_ids: 1a85f9223e3d5e43013e3d6e8ff506fd
    - name: Disable all repos
      command: "subscription-manager repos --disable *"
    - name: Enable Controller node repos
      command: "subscription-manager repos --enable {{ item }}"
      with_items: "{{ repos }}"
```

- This play contains three tasks:
    - Register the node.
    - Disable any auto-enabled repositories.
    - Enable only the repositories relevant to the Controller node. The repositories are listed with the **repos** variable.
2. After you deploy the overcloud, you can run the following command so that Ansible executes the playbook (**ansible-osp-registration.yml**) against your overcloud:

```
$ ansible-playbook -i /usr/bin/tripleo-ansible-inventory ansible-osp-registration.yml
```

This command performs the following actions:

- Runs the dynamic inventory script to get a list of host and their groups.
- Applies the playbook tasks to the nodes in the group defined in the **hosts** parameter of the playbook, which in this case is the Controller group.

## CHAPTER 6. COMPOSABLE SERVICES AND CUSTOM ROLES

The overcloud usually consists of nodes in predefined roles such as Controller nodes, Compute nodes, and different storage node types. Each of these default roles contains a set of services defined in the core heat template collection on the director node. However, you can also create custom roles that contain specific sets of services.

You can use this flexibility to create different combinations of services on different roles. This chapter explores the architecture of custom roles, composable services, and methods for using them.

### 6.1. SUPPORTED ROLE ARCHITECTURE

The following architectures are available when you use custom roles and composable services:

#### Default architecture

Uses the default **roles\_data** files. All controller services are contained within one Controller role.

#### Supported standalone roles

Use the predefined files in `/usr/share/openstack-tripleo-heat-templates/roles` to generate a custom **roles\_data** file. For more information, see [Section 6.2.3, "Supported custom roles"](#).

#### Custom composable services

Create your own roles and use them to generate a custom **roles\_data** file. Note that only a limited number of composable service combinations have been tested and verified and Red Hat cannot support all composable service combinations.

## 6.2. ROLES

### 6.2.1. Examining the roles\_data file

The **roles\_data** file contains a YAML-formatted list of the roles that director deploys onto nodes. Each role contains definitions of all of the services that comprise the role. Use the following example snippet to understand the **roles\_data** syntax:

```
- name: Controller
  description: |
    Controller role that has all the controller services loaded and handles
    Database, Messaging and Network functions.
  ServicesDefault:
    - OS::TripleO::Services::AuditD
    - OS::TripleO::Services::CACerts
    - OS::TripleO::Services::CephClient
    ...
- name: Compute
  description: |
    Basic Compute Node role
  ServicesDefault:
    - OS::TripleO::Services::AuditD
    - OS::TripleO::Services::CACerts
    - OS::TripleO::Services::CephClient
    ...
```

The core heat template collection contains a default **roles\_data** file located at `/usr/share/openstack-tripleo-heat-templates/roles_data.yaml`. The default file contains definitions of the following role types:

- **Controller**
- **Compute**
- **BlockStorage**
- **ObjectStorage**
- **CephStorage**.

The **openstack overcloud deploy** command includes the default **roles\_data.yaml** file during deployment. However, you can use the **-r** argument to override this file with a custom **roles\_data** file:

```
$ openstack overcloud deploy --templates -r ~/templates/roles_data-custom.yaml
```

## 6.2.2. Creating a roles\_data file

Although you can create a custom **roles\_data** file manually, you can also generate the file automatically using individual role templates. Director provides several commands to manage role templates and automatically generate a custom **roles\_data** file.

1. List the default role templates:

```
$ openstack overcloud roles list
BlockStorage
CephStorage
Compute
ComputeHCI
ComputeOvsDpdk
Controller
...
```

2. View the role definition in YAML format with the **openstack overcloud roles show** command:

```
$ openstack overcloud roles show Compute
```

3. Generate a custom **roles\_data** file. Use the **openstack overcloud roles generate** command to join multiple predefined roles into a single file. For example, run the following command to generate a **roles\_data.yaml** file that contains the **Controller**, **Compute**, and **Networker** roles:

```
$ openstack overcloud roles generate -o ~/roles_data.yaml Controller Compute Networker
```

Use the **-o** option to define the name out of the output file.

This command creates a custom **roles\_data** file. However, the previous example uses the **Controller** and **Networker** roles, which both contain the same networking agents. This means that the networking services scale from the **Controller** role to the **Networker** role and the overcloud balances the load for networking services between the **Controller** and **Networker** nodes.

To make this **Networker** role standalone, you can create your own custom **Controller** role, as well as any other role that you require. This allows you to generate a **roles\_data** file from your own custom roles.

- Copy the directory from the core heat template collection to the home directory of the **stack** user:

```
$ cp -r /usr/share/openstack-tripleo-heat-templates/roles ~/.
```

- Add or modify the custom role files in this directory. Use the **--roles-path** option with any of the role sub-commands to use this directory as the source for your custom roles:

```
$ openstack overcloud roles generate -o my_roles_data.yaml \
  --roles-path ~/roles \
  Controller Compute Networker
```

This command generates a single **my\_roles\_data.yaml** file from the individual roles in the **~/roles** directory.



#### NOTE

The default roles collection also contains the **ControllerOpenStack** role, which does not include services for **Networker**, **Messaging**, and **Database** roles. You can use the **ControllerOpenStack** in combination with the standalone **Networker**, **Messaging**, and **Database** roles.

### 6.2.3. Supported custom roles

The following table contains information about the available custom roles. You can find custom role templates in the **/usr/share/openstack-tripleo-heat-templates/roles** directory.

Role	Description	File
<b>BlockStorage</b>	OpenStack Block Storage (cinder) node.	<b>BlockStorage.yaml</b>
<b>CephAll</b>	Full standalone Ceph Storage node. Includes OSD, MON, Object Gateway (RGW), Object Operations (MDS), Manager (MGR), and RBD Mirroring.	<b>CephAll.yaml</b>
<b>CephFile</b>	Standalone scale-out Ceph Storage file role. Includes OSD and Object Operations (MDS).	<b>CephFile.yaml</b>
<b>CephObject</b>	Standalone scale-out Ceph Storage object role. Includes OSD and Object Gateway (RGW).	<b>CephObject.yaml</b>
<b>CephStorage</b>	Ceph Storage OSD node role.	<b>CephStorage.yaml</b>
<b>ComputeAlt</b>	Alternate Compute node role.	<b>ComputeAlt.yaml</b>
<b>ComputeDVR</b>	DVR enabled Compute node role.	<b>ComputeDVR.yaml</b>



Role	Description	File
<b>ComputeHCI</b>	Compute node with hyper-converged infrastructure. Includes Compute and Ceph OSD services.	<b>ComputeHCI.yaml</b>
<b>ComputeInstanceHA</b>	Compute Instance HA node role. Use in conjunction with the <b>environments/compute-instanceha.yaml</b> environment file.	<b>ComputeInstanceHA.yaml</b>
<b>ComputeLiquidio</b>	Compute node with Cavium Liquidio Smart NIC.	<b>ComputeLiquidio.yaml</b>
<b>ComputeOvsDpdkRT</b>	Compute OVS DPDK RealTime role.	<b>ComputeOvsDpdkRT.yaml</b>
<b>ComputeOvsDpdk</b>	Compute OVS DPDK role.	<b>ComputeOvsDpdk.yaml</b>
<b>ComputePPC64LE</b>	Compute role for ppc64le servers.	<b>ComputePPC64LE.yaml</b>
<b>ComputeRealTime</b>	Compute role optimized for real-time behaviour. When using this role, it is mandatory that an <b>overcloud-realtime-compute</b> image is available and the role specific parameters <b>IsolCpusList</b> , <b>NovaComputeCpuDedicatedSet</b> and <b>NovaComputeCpuSharedSet</b> are set according to the hardware of the real-time compute nodes.	<b>ComputeRealTime.yaml</b>
<b>ComputeSriovRT</b>	Compute SR-IOV RealTime role.	<b>ComputeSriovRT.yaml</b>
<b>ComputeSriov</b>	Compute SR-IOV role.	<b>ComputeSriov.yaml</b>
<b>Compute</b>	Standard Compute node role.	<b>Compute.yaml</b>
<b>ControllerAllNovaStandalone</b>	Controller role that does not contain the database, messaging, networking, and OpenStack Compute (nova) control components. Use in combination with the <b>Database</b> , <b>Messaging</b> , <b>Networker</b> , and <b>Novacontrol</b> roles.	<b>ControllerAllNovaStandalone.yaml</b>
<b>ControllerNoCeph</b>	Controller role with core Controller services loaded but no Ceph Storage (MON) components. This role handles database, messaging, and network functions but not any Ceph Storage functions.	<b>ControllerNoCeph.yaml</b>

Role	Description	File
<b>ControllerNovaStand alone</b>	Controller role that does not contain the OpenStack Compute (nova) control component. Use in combination with the <b>Novacontrol</b> role.	<b>ControllerNovaStand alone.yaml</b>
<b>ControllerOpenstack</b>	Controller role that does not contain the database, messaging, and networking components. Use in combination with the <b>Database, Messaging,</b> and <b>Networker</b> roles.	<b>ControllerOpenstack .yaml</b>
<b>ControllerStorageNfs</b>	Controller role with all core services loaded and uses Ceph NFS. This roles handles database, messaging, and network functions.	<b>ControllerStorageNfs.yaml</b>
<b>Controller</b>	Controller role with all core services loaded. This roles handles database, messaging, and network functions.	<b>Controller.yaml</b>
<b>ControllerSriov (ML2/OVN)</b>	Same as the normal Controller role but with the OVN Metadata agent deployed.	<b>ControllerSriov.yaml</b>
<b>Database</b>	Standalone database role. Database managed as a Galera cluster using Pacemaker.	<b>Database.yaml</b>
<b>HciCephAll</b>	Compute node with hyper-converged infrastructure and all Ceph Storage services. Includes OSD, MON, Object Gateway (RGW), Object Operations (MDS), Manager (MGR), and RBD Mirroring.	<b>HciCephAll.yaml</b>
<b>HciCephFile</b>	Compute node with hyper-converged infrastructure and Ceph Storage file services. Includes OSD and Object Operations (MDS).	<b>HciCephFile.yaml</b>
<b>HciCephMon</b>	Compute node with hyper-converged infrastructure and Ceph Storage block services. Includes OSD, MON, and Manager.	<b>HciCephMon.yaml</b>
<b>HciCephObject</b>	Compute node with hyper-converged infrastructure and Ceph Storage object services. Includes OSD and Object Gateway (RGW).	<b>HciCephObject.yaml</b>
<b>IronicConductor</b>	Ironic Conductor node role.	<b>IronicConductor.yaml</b>
<b>Messaging</b>	Standalone messaging role. RabbitMQ managed with Pacemaker.	<b>Messaging.yaml</b>

Role	Description	File
<b>Networker</b>	Standalone networking role. Runs OpenStack networking (neutron) agents on their own. If your deployment uses the ML2/OVN mechanism driver, see additional steps in <a href="#">Deploying a Custom Role with ML2/OVN</a> .	<b>Networker.yaml</b>
<b>NetworkerSriov</b>	Same as the normal Networker role but with the OVN Metadata agent deployed. See additional steps in <a href="#">Deploying a Custom Role with ML2/OVN</a>	<b>NetworkerSriov.yaml</b>
<b>Novacontrol</b>	Standalone <b>nova-control</b> role to run OpenStack Compute (nova) control agents on their own.	<b>Novacontrol.yaml</b>
<b>ObjectStorage</b>	Swift Object Storage node role.	<b>ObjectStorage.yaml</b>
<b>Telemetry</b>	Telemetry role with all the metrics and alarming services.	<b>Telemetry.yaml</b>

### 6.2.4. Examining role parameters

Each role contains the following parameters:

#### name

**(Mandatory)** The name of the role, which is a plain text name with no spaces or special characters. Check that the chosen name does not cause conflicts with other resources. For example, use **Networker** as a name instead of **Network**.

#### description

**(Optional)** A plain text description for the role.

#### tags

**(Optional)** A YAML list of tags that define role properties. Use this parameter to define the primary role with both the **controller** and **primary** tags together:

```
- name: Controller
  ...
  tags:
    - primary
    - controller
  ...
```



#### IMPORTANT

If you do not tag the primary role, the first role that you define becomes the primary role. Ensure that this role is the Controller role.

#### networks

A YAML list or dictionary of networks that you want to configure on the role. If you use a YAML list, list each composable network:

```
networks:
- External
- InternalApi
- Storage
- StorageMgmt
- Tenant
```

If you use a dictionary, map each network to a specific **subnet** in your composable networks.

```
networks:
  External:
    subnet: external_subnet
  InternalApi:
    subnet: internal_api_subnet
  Storage:
    subnet: storage_subnet
  StorageMgmt:
    subnet: storage_mgmt_subnet
  Tenant:
    subnet: tenant_subnet
```

Default networks include **External**, **InternalApi**, **Storage**, **StorageMgmt**, **Tenant**, and **Management**.

### CountDefault

**(Optional)** Defines the default number of nodes that you want to deploy for this role.

### HostnameFormatDefault

**(Optional)** Defines the default hostname format for the role. The default naming convention uses the following format:

```
[STACK NAME]-[ROLE NAME]-[NODE ID]
```

For example, the default Controller nodes are named:

```
overcloud-controller-0
overcloud-controller-1
overcloud-controller-2
...
```

### disable\_constraints

**(Optional)** Defines whether to disable OpenStack Compute (nova) and OpenStack Image Storage (glance) constraints when deploying with director. Use this parameter when you deploy an overcloud with pre-provisioned nodes. For more information, see [Configuring a Basic Overcloud with Pre-Provisioned Nodes](#) in the *Director Installation and Usage* guide.

### update\_serial

**(Optional)** Defines how many nodes to update simultaneously during the OpenStack update options. In the default **roles\_data.yaml** file:

- The default is **1** for Controller, Object Storage, and Ceph Storage nodes.

- The default is **25** for Compute and Block Storage nodes.

If you omit this parameter from a custom role, the default is **1**.

### ServicesDefault

**(Optional)** Defines the default list of services to include on the node. For more information, see [Section 6.3.2, “Examining composable service architecture”](#).

You can use these parameters to create new roles and also define which services to include in your roles.

The **openstack overcloud deploy** command integrates the parameters from the **roles\_data** file into some of the Jinja2-based templates. For example, at certain points, the **overcloud.j2.yaml** heat template iterates over the list of roles from **roles\_data.yaml** and creates parameters and resources specific to each respective role.

For example, the following snippet contains the resource definition for each role in the **overcloud.j2.yaml** heat template:

```

{{role.name}}:
  type: OS::Heat::ResourceGroup
  depends_on: Networks
  properties:
    count: {get_param: {{role.name}}Count}
    removal_policies: {get_param: {{role.name}}RemovalPolicies}
    resource_def:
      type: OS::TripleO::{{role.name}}
      properties:
        CloudDomain: {get_param: CloudDomain}
        ServiceNetMap: {get_attr: [ServiceNetMap, service_net_map]}
        EndpointMap: {get_attr: [EndpointMap, endpoint_map]}
...

```

This snippet shows how the Jinja2-based template incorporates the **{{role.name}}** variable to define the name of each role as an **OS::Heat::ResourceGroup** resource. This in turn uses each **name** parameter from the **roles\_data** file to name each respective **OS::Heat::ResourceGroup** resource.

### 6.2.5. Creating a new role

You can use the composable service architecture to create new roles according to the requirements of your deployment. For example, you might want to create a new **Horizon** role to host only the OpenStack Dashboard (**horizon**):

#### Procedure

1. Create a custom copy of the default **roles** directory:

```
$ cp -r /usr/share/openstack-tripleo-heat-templates/roles ~/.
```

2. Create a new file called **~/roles/Horizon.yaml** and create a new **Horizon** role that contains base and core OpenStack Dashboard services:

```
- name: Horizon
  CountDefault: 1
  HostnameFormatDefault: '%stackname%-horizon-%index%'
```

```

ServicesDefault:
- OS::TripleO::Services::CACerts
- OS::TripleO::Services::Kernel
- OS::TripleO::Services::Ntp
- OS::TripleO::Services::Snmp
- OS::TripleO::Services::Sshd
- OS::TripleO::Services::Timezone
- OS::TripleO::Services::TripleoPackages
- OS::TripleO::Services::TripleoFirewall
- OS::TripleO::Services::SensuClient
- OS::TripleO::Services::FluentdClient
- OS::TripleO::Services::AuditD
- OS::TripleO::Services::Collectd
- OS::TripleO::Services::MySQLClient
- OS::TripleO::Services::Apache
- OS::TripleO::Services::Horizon

```

Set the **CountDefault** to **1** so that a default overcloud always includes the **Horizon** node.

- Optional: If you want to scale the services in an existing overcloud, retain the existing services on the **Controller** role. If you want to create a new overcloud and you want the OpenStack Dashboard to remain on the standalone role, remove the OpenStack Dashboard components from the **Controller** role definition:

```

- name: Controller
  CountDefault: 1
  ServicesDefault:
  ...
  - OS::TripleO::Services::GnocchiMetricd
  - OS::TripleO::Services::GnocchiStatsd
  - OS::TripleO::Services::HAproxy
  - OS::TripleO::Services::HeatApi
  - OS::TripleO::Services::HeatApiCfn
  - OS::TripleO::Services::HeatApiCloudwatch
  - OS::TripleO::Services::HeatEngine
  # - OS::TripleO::Services::Horizon           # Remove this service
  - OS::TripleO::Services::IronicApi
  - OS::TripleO::Services::IronicConductor
  - OS::TripleO::Services::lscsid
  - OS::TripleO::Services::Keepalived
  ...

```

- Generate the new **roles\_data-horizon.yaml** file using the **~/roles** directory as the source:

```

$ openstack overcloud roles generate -o roles_data-horizon.yaml \
  --roles-path ~/roles \
  Controller Compute Horizon

```

- Define a new flavor for this role so that you can tag specific nodes. For this example, use the following commands to create a **horizon** flavor:

- Create a **horizon** flavor:

```
(undercloud)$ openstack flavor create --id auto --ram 6144 --disk 40 --vcpus 4 horizon
```

**NOTE**

These properties are not used for scheduling instances, however, the Compute scheduler does use the disk size to determine the root partition size.

- b. Tag each bare metal node that you want to designate for the Dashboard service (horizon) with a custom resource class:

```
(undercloud)$ openstack baremetal node set --resource-class baremetal.HORIZON
<NODE>
```

Replace **<NODE>** with the ID of the bare metal node.

- c. Associate the **horizon** flavor with the custom resource class:

```
(undercloud)$ openstack flavor set --property
resources:CUSTOM_BAREMETAL_HORIZON=1 horizon
```

To determine the name of a custom resource class that corresponds to a resource class of a bare metal node, convert the resource class to uppercase, replace punctuation with an underscore, and prefix the value with **CUSTOM\_**.

**NOTE**

A flavor can request only one instance of a bare metal resource class.

- d. Set the following flavor properties to prevent the Compute scheduler from using the bare metal flavor properties for scheduling instances:

```
(undercloud)$ openstack flavor set --property resources:VCPU=0 --property
resources:MEMORY_MB=0 --property resources:DISK_GB=0 horizon
```

6. Define the Horizon node count and flavor using the following environment file snippet:

```
parameter_defaults:
  OvercloudHorizonFlavor: horizon
  HorizonCount: 1
```

7. Include the new **roles\_data-horizon.yaml** file and environment file in the **openstack overcloud deploy** command, along with any other environment files relevant to your deployment:

```
$ openstack overcloud deploy --templates -r ~/templates/roles_data-horizon.yaml -e
~/templates/node-count-flavor.yaml
```

This configuration creates a three-node overcloud that consists of one Controller node, one Compute node, and one Networker node. To view the list of nodes in your overcloud, run the following command:

```
$ openstack server list
```

## 6.3. COMPOSABLE SERVICES

### 6.3.1. Guidelines and limitations

Note the following guidelines and limitations for the composable role architecture.

For services not managed by Pacemaker:

- You can assign services to standalone custom roles.
- You can create additional custom roles after the initial deployment and deploy them to scale existing services.

For services managed by Pacemaker:

- You can assign Pacemaker-managed services to standalone custom roles.
- Pacemaker has a 16 node limit. If you assign the Pacemaker service (`OS::TripleO::Services::Pacemaker`) to 16 nodes, subsequent nodes must use the Pacemaker Remote service (`OS::TripleO::Services::PacemakerRemote`) instead. You cannot have the Pacemaker service and Pacemaker Remote service on the same role.
- Do not include the Pacemaker service (`OS::TripleO::Services::Pacemaker`) on roles that do not contain Pacemaker-managed services.
- You cannot scale up or scale down a custom role that contains `OS::TripleO::Services::Pacemaker` or `OS::TripleO::Services::PacemakerRemote` services.

General limitations:

- You cannot change custom roles and composable services during a major version upgrade.
- You cannot modify the list of services for any role after deploying an overcloud. Modifying the service lists after Overcloud deployment can cause deployment errors and leave orphaned services on nodes.

### 6.3.2. Examining composable service architecture

The core heat template collection contains two sets of composable service templates:

- **deployment** contains the templates for key OpenStack services.
- **puppet/services** contains legacy templates for configuring composable services. In some cases, the composable services use templates from this directory for compatibility. In most cases, the composable services use the templates in the **deployment** directory.

Each template contains a description that identifies its purpose. For example, the **deployment/time/ntp-baremetal-puppet.yaml** service template contains the following description:

```
description: >
  NTP service deployment using puppet, this YAML file
  creates the interface between the HOT template
  and the puppet manifest that actually installs
  and configure NTP.
```

These service templates are registered as resources specific to a Red Hat OpenStack Platform



deployment. This means that you can call each resource using a unique heat resource namespace defined in the **overcloud-resource-registry-puppet.j2.yaml** file. All services use the **OS::TripleO::Services** namespace for their resource type.

Some resources use the base composable service templates directly:

```
resource_registry:
  ...
  OS::TripleO::Services::Ntp: deployment/time/ntp-baremetal-puppet.yaml
  ...
```

However, core services require containers and use the containerized service templates. For example, the **keystone** containerized service uses the following resource:

```
resource_registry:
  ...
  OS::TripleO::Services::Keystone: deployment/keystone/keystone-container-puppet.yaml
  ...
```

These containerized templates usually reference other templates to include dependencies. For example, the **deployment/keystone/keystone-container-puppet.yaml** template stores the output of the base template in the **ContainersCommon** resource:

```
resources:
  ContainersCommon:
    type: ../containers-common.yaml
```

The containerized template can then incorporate functions and data from the **containers-common.yaml** template.

The **overcloud.j2.yaml** heat template includes a section of Jinja2-based code to define a service list for each custom role in the **roles\_data.yaml** file:

```
{{role.name}}Services:
  description: A list of service resources (configured in the heat
    resource_registry) which represent nested stacks
    for each service that should get installed on the {{role.name}} role.
  type: comma_delimited_list
  default: {{role.ServicesDefault|default([])}}
```

For the default roles, this creates the following service list parameters: **ControllerServices**, **ComputeServices**, **BlockStorageServices**, **ObjectStorageServices**, and **CephStorageServices**.

You define the default services for each custom role in the **roles\_data.yaml** file. For example, the default Controller role contains the following content:

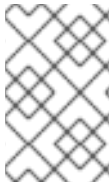
```
- name: Controller
  CountDefault: 1
  ServicesDefault:
    - OS::TripleO::Services::CACerts
    - OS::TripleO::Services::CephMon
    - OS::TripleO::Services::CephExternal
    - OS::TripleO::Services::CephRgw
    - OS::TripleO::Services::CinderApi
```

```

- OS::TripleO::Services::CinderBackup
- OS::TripleO::Services::CinderScheduler
- OS::TripleO::Services::CinderVolume
- OS::TripleO::Services::Core
- OS::TripleO::Services::Kernel
- OS::TripleO::Services::Keystone
- OS::TripleO::Services::GlanceApi
- OS::TripleO::Services::GlanceRegistry
...

```

These services are then defined as the default list for the **ControllerServices** parameter.



#### NOTE

You can also use an environment file to override the default list for the service parameters. For example, you can define **ControllerServices** as a **parameter\_default** in an environment file to override the services list from the **roles\_data.yaml** file.

### 6.3.3. Adding and removing services from roles

The basic method of adding or removing services involves creating a copy of the default service list for a node role and then adding or removing services. For example, you might want to remove OpenStack Orchestration (heat) from the Controller nodes.

1. Create a custom copy of the default **roles** directory:

```
$ cp -r /usr/share/openstack-tripleo-heat-templates/roles ~/.
```

2. Edit the **~/roles/Controller.yaml** file and modify the service list for the **ServicesDefault** parameter. Scroll to the OpenStack Orchestration services and remove them:

```

- OS::TripleO::Services::GlanceApi
- OS::TripleO::Services::GlanceRegistry
- OS::TripleO::Services::HeatApi      # Remove this service
- OS::TripleO::Services::HeatApiCfn  # Remove this service
- OS::TripleO::Services::HeatApiCloudwatch # Remove this service
- OS::TripleO::Services::HeatEngine  # Remove this service
- OS::TripleO::Services::MySQL
- OS::TripleO::Services::NeutronDhcpAgent

```

3. Generate the new **roles\_data** file:

```
$ openstack overcloud roles generate -o roles_data-no_heat.yaml \
--roles-path ~/roles \
Controller Compute Networker
```

4. Include this new **roles\_data** file when you run the **openstack overcloud deploy** command:

```
$ openstack overcloud deploy --templates -r ~/templates/roles_data-no_heat.yaml
```

This command deploys an overcloud without OpenStack Orchestration services installed on the Controller nodes.

**NOTE**

You can also disable services in the **roles\_data** file using a custom environment file. Redirect the services to disable to the **OS::Heat::None** resource. For example:

```
resource_registry:
  OS::TripleO::Services::HeatApi: OS::Heat::None
  OS::TripleO::Services::HeatApiCfn: OS::Heat::None
  OS::TripleO::Services::HeatApiCloudwatch: OS::Heat::None
  OS::TripleO::Services::HeatEngine: OS::Heat::None
```

**6.3.4. Enabling disabled services**

Some services are disabled by default. These services are registered as null operations (**OS::Heat::None**) in the **overcloud-resource-registry-puppet.j2.yaml** file. For example, the Block Storage backup service (**cinder-backup**) is disabled:

```
OS::TripleO::Services::CinderBackup: OS::Heat::None
```

To enable this service, include an environment file that links the resource to its respective heat templates in the **puppet/services** directory. Some services have predefined environment files in the **environments** directory. For example, the Block Storage backup service uses the **environments/cinder-backup.yaml** file, which contains the following entry:

```
resource_registry:
  OS::TripleO::Services::CinderBackup: ../podman/services/pacemaker/cinder-backup.yaml
  ...
```

This entry overrides the default null operation resource and enables the service. Include this environment file when you run the **openstack overcloud deploy** command.

```
$ openstack overcloud deploy --templates -e /usr/share/openstack-tripleo-heat-templates/environments/cinder-backup.yaml
```

**6.3.5. Creating a generic node with no services**

You can create generic Red Hat Enterprise Linux 8.4 nodes without any OpenStack services configured. This is useful when you need to host software outside of the core Red Hat OpenStack Platform (RHOSP) environment. For example, RHOSP provides integration with monitoring tools such as Kibana and Sensu. For more information, see the [Monitoring Tools Configuration Guide](#). While Red Hat does not provide support for the monitoring tools themselves, director can create a generic Red Hat Enterprise Linux 8.4 node to host these tools.

**NOTE**

The generic node still uses the base **overcloud-full** image rather than a base Red Hat Enterprise Linux 8 image. This means the node has some Red Hat OpenStack Platform software installed but not enabled or configured.

1. Create a generic role in your custom **roles\_data.yaml** file that does not contain a **ServicesDefault** list:

```

- name: Generic
- name: Controller
  CountDefault: 1
  ServicesDefault:
    - OS::TripleO::Services::AuditD
    - OS::TripleO::Services::CACerts
    - OS::TripleO::Services::CephClient
    ...
- name: Compute
  CountDefault: 1
  ServicesDefault:
    - OS::TripleO::Services::AuditD
    - OS::TripleO::Services::CACerts
    - OS::TripleO::Services::CephClient
    ...

```

Ensure that you retain the existing **Controller** and **Compute** roles.

2. Create an environment file **generic-node-params.yaml** to specify how many generic Red Hat Enterprise Linux 8 nodes you require and the flavor when selecting nodes to provision:

```

parameter_defaults:
  OvercloudGenericFlavor: baremetal
  GenericCount: 1

```

3. Include both the roles file and the environment file when you run the **openstack overcloud deploy** command:

```

$ openstack overcloud deploy --templates \
-r ~/templates/roles_data_with_generic.yaml \
-e ~/templates/generic-node-params.yaml

```

This configuration deploys a three-node environment with one Controller node, one Compute node, and one generic Red Hat Enterprise Linux 8 node.

## CHAPTER 7. CONTAINERIZED SERVICES

Director installs the core OpenStack Platform services as containers on the overcloud. This section provides some background information on how containerized services work.

### 7.1. CONTAINERIZED SERVICE ARCHITECTURE

Director installs the core OpenStack Platform services as containers on the overcloud. The templates for the containerized services are located in the `/usr/share/openstack-tripleo-heat-templates/deployment/`.

You must enable the `OS::TripleO::Services::Podman` service in the role for all nodes that use containerized services. When you create a `roles_data.yaml` file for your custom roles configuration, include the `OS::TripleO::Services::Podman` service along with the base composable services. For example, the `IronicConductor` role uses the following role definition:

```
- name: IronicConductor
  description: |
    Ironic Conductor node role
  networks:
    InternalApi:
      subnet: internal_api_subnet
  Storage:
    subnet: storage_subnet
  HostnameFormatDefault: '%stackname%-ironic-%index%'
  ServicesDefault:
    - OS::TripleO::Services::Aide
    - OS::TripleO::Services::AuditD
    - OS::TripleO::Services::BootParams
    - OS::TripleO::Services::CACerts
    - OS::TripleO::Services::CertmongerUser
    - OS::TripleO::Services::Collectd
    - OS::TripleO::Services::Docker
    - OS::TripleO::Services::Fluentd
    - OS::TripleO::Services::IpaClient
    - OS::TripleO::Services::Ipsec
    - OS::TripleO::Services::IronicConductor
    - OS::TripleO::Services::IronicPxe
    - OS::TripleO::Services::Kernel
    - OS::TripleO::Services::LoginDefs
    - OS::TripleO::Services::MetricsQdr
    - OS::TripleO::Services::MySQLClient
    - OS::TripleO::Services::ContainersLogrotateCron
    - OS::TripleO::Services::Podman
    - OS::TripleO::Services::Rhsm
    - OS::TripleO::Services::SensuClient
    - OS::TripleO::Services::Snmp
    - OS::TripleO::Services::Timesync
    - OS::TripleO::Services::Timezone
    - OS::TripleO::Services::TripleoFirewall
    - OS::TripleO::Services::TripleoPackages
    - OS::TripleO::Services::Tuned
```

### 7.2. CONTAINERIZED SERVICE PARAMETERS

Each containerized service template contains an **outputs** section that defines a data set passed to the OpenStack Orchestration (heat) service. In addition to the standard composable service parameters (see [Section 6.2.4, “Examining role parameters”](#)), the template contains a set of parameters specific to the container configuration.

### puppet\_config

Data to pass to Puppet when configuring the service. In the initial overcloud deployment steps, director creates a set of containers used to configure the service before the actual containerized service runs. This parameter includes the following sub-parameters:

- **config\_volume** - The mounted volume that stores the configuration.
- **puppet\_tags** - Tags to pass to Puppet during configuration. OpenStack uses these tags to restrict the Puppet run to the configuration resource of a particular service. For example, the OpenStack Identity (keystone) containerized service uses the **keystone\_config** tag to ensure that all require only the **keystone\_config** Puppet resource run on the configuration container.
- **step\_config** - The configuration data passed to Puppet. This is usually inherited from the referenced composable service.
- **config\_image** - The container image used to configure the service.

### kolla\_config

A set of container-specific data that defines configuration file locations, directory permissions, and the command to run on the container to launch the service.

### docker\_config

Tasks to run on the configuration container for the service. All tasks are grouped into the following steps to help director perform a staged deployment:

- **Step 1** - Load balancer configuration
- **Step 2** - Core services (Database, Redis)
- **Step 3** - Initial configuration of OpenStack Platform service
- **Step 4** - General OpenStack Platform services configuration
- **Step 5** - Service activation

### host\_prep\_tasks

Preparation tasks for the bare metal node to accommodate the containerized service.

## 7.3. 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.

## 7.4. 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)
    ...
```

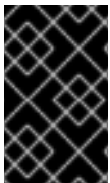
Each strategy accepts a set of sub-parameters that defines which images to use and what to do with the images. The following table contains information about the sub-parameters that you can use with each **ContainerImagePrepare** strategy:

Parameter	Description
<b>excludes</b>	List of regular expressions to exclude image names from a strategy.

Parameter	Description
<b>includes</b>	List of regular expressions to include in a strategy. At least one image name must match an existing image. All <b>excludes</b> are ignored if <b>includes</b> is specified.
<b>modify_append_tag</b>	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 <b>modify_append_tag</b> to <b>-hotfix</b> , the director tags the final image as 16.2.3-5.161-hotfix.
<b>modify_only_with_labels</b>	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.
<b>modify_role</b>	String of ansible role names to run during upload but before pushing the image to the destination registry.
<b>modify_vars</b>	Dictionary of variables to pass to <b>modify_role</b> .
<b>push_destination</b>	<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"> <li>● If set to <b>true</b>, the <b>push_destination</b> is set to the undercloud registry namespace using the hostname, which is the recommended method.</li> <li>● If set to <b>false</b>, the push to a local registry does not occur and nodes pull images directly from the source.</li> <li>● If set to a custom value, director pushes images to an external local registry.</li> </ul> <p>If you set this parameter to <b>false</b> 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 <b>false</b> to pull directly from a Red Hat Satellite Server hosting the container images.</p> <p>If the <b>push_destination</b> parameter is set to <b>false</b> or is not defined and the remote registry requires authentication, set the <b>ContainerImageRegistryLogin</b> parameter to <b>true</b> and include the credentials with the <b>ContainerImageRegistryCredentials</b> parameter.</p>



Parameter	Description
<b>pull_source</b>	The source registry from where to pull the original container images.
<b>set</b>	A dictionary of <b>key: value</b> definitions that define where to obtain the initial images.
<b>tag_from_label</b>	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 <b>tag_from_label: {version}-{release}</b> , director uses the <b>version</b> and <b>release</b> labels to construct a new tag. For one container, <b>version</b> might be set to 16.2.3 and <b>release</b> might be set to <b>5.161</b> , which results in the tag 16.2.3-5.161. Director uses this parameter only if you have not defined <b>tag</b> in the <b>set</b> dictionary.



### 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
<b>ceph_image</b>	The name of the Ceph Storage container image.
<b>ceph_namespace</b>	The namespace of the Ceph Storage container image.
<b>ceph_tag</b>	The tag of the Ceph Storage container image.
<b>name_prefix</b>	A prefix for each OpenStack service image.
<b>name_suffix</b>	A suffix for each OpenStack service image.
<b>namespace</b>	The namespace for each OpenStack service image.
<b>neutron_driver</b>	The driver to use to determine which OpenStack Networking (neutron) container to use. Use a null value to set to the standard <b>neutron-server</b> container. Set to <b>ovn</b> to use OVN-based containers.

Key	Description
<b>tag</b>	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 <b>tag_from_label</b> 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.

## 7.5. 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.

## 7.6. 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

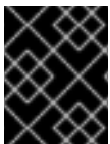
Some container image registries require authentication to access images. In this situation, use the **ContainerImageRegistryCredentials** parameter in your **containers-prepare-parameter.yaml** environment file. The **ContainerImageRegistryCredentials** parameter uses a set of keys based on the private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

## 7.7. LAYERING IMAGE PREPARATION ENTRIES

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

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

```
set:
  namespace: registry.redhat.io/rhosp-rhel8
  tag: 16.2-44
```

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

## 7.8. 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.

## 7.9. 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
...
```

## 7.10. 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 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.

### 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
...

```

## 7.11. 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

1. 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
...

```

2. 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"

```

## 7.12. DEPLOYING A VENDOR PLUGIN

To use some third-party hardware as a Block Storage back end, you must deploy a vendor plugin. The following example demonstrates how to deploy a vendor plugin to use Dell EMC hardware as a Block Storage back end.

For more information about supported back end appliances and drivers, see [Third-Party Storage Providers](#) in the *Storage Guide*.

### Procedure



1. Create a new container images file for your overcloud:

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

2. Edit the `containers-prepare-parameter-dellemc.yaml` file.
3. Add an **exclude** parameter to the strategy for the main Red Hat OpenStack Platform container images. Use this parameter to exclude the container image that the vendor container image will replace. In the example, the container image is the **cinder-volume** image:

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

4. Add a new strategy to the **ContainerImagePrepare** parameter that includes the replacement container image for the vendor plugin:

```
parameter_defaults:
  ContainerImagePrepare:
    ...
    - push_destination: true
    includes:
      - cinder-volume
    set:
      namespace: registry.connect.redhat.com/dellemc
      name_prefix: openstack-
      name_suffix: -dellemc-rhosp16
      tag: 16.2-2
    ...
```

5. Add the authentication details for the `registry.connect.redhat.com` registry to the **ContainerImageRegistryCredentials** parameter:

```
parameter_defaults:
  ContainerImageRegistryCredentials:
    registry.redhat.io:
      [service account username]: [service account password]
    registry.connect.redhat.com:
      [service account username]: [service account password]
```

6. Save the **containers-prepare-parameter-dellemc.yaml** file.
7. Include the **containers-prepare-parameter-dellemc.yaml** file with any deployment commands, such as as **openstack overcloud deploy**:

```
$ openstack overcloud deploy --templates
...
-e containers-prepare-parameter-dellemc.yaml
...
```

When director deploys the overcloud, the overcloud uses the vendor container image instead of the standard container image.

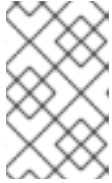
#### IMPORTANT

The **containers-prepare-parameter-dellemc.yaml** file replaces the standard **containers-prepare-parameter.yaml** file in your overcloud deployment. Do not include the standard **containers-prepare-parameter.yaml** file in your overcloud deployment. Retain the standard **containers-prepare-parameter.yaml** file for your undercloud installation and updates.

## CHAPTER 8. BASIC NETWORK ISOLATION

Configure the overcloud to use isolated networks so that you can host specific types of network traffic in isolation. Red Hat OpenStack Platform (RHOSP) includes a set of environment files that you can use to configure this network isolation. You might also require additional environment files to further customize your networking parameters:

- An environment file that you can use to enable network isolation (`/usr/share/openstack-tripleo-heat-templates/environments/network-isolation.yaml`).



### NOTE

Before you deploy RHOSP with director, the files `network-isolation.yaml` and `network-environment.yaml` are only in Jinja2 format and have a `.j2.yaml` extension. Director renders these files to `.yaml` versions during deployment.

- An environment file that you can use to configure network defaults (`/usr/share/openstack-tripleo-heat-templates/environments/network-environment.yaml`).
- A `network_data` file that you can use to define network settings such as IP ranges, subnets, and virtual IPs. This example shows you how to create a copy of the default and edit it to suit your own network.
- Templates that you can use to define your NIC layout for each node. The overcloud core template collection contains a set of defaults for different use cases.
- An environment file that you can use to enable NICs. This example uses a default file located in the `environments` directory.

### 8.1. NETWORK ISOLATION

The overcloud assigns services to the provisioning network by default. However, director can divide overcloud network traffic into isolated networks. To use isolated networks, the overcloud contains an environment file that enables this feature. The `environments/network-isolation.j2.yaml` file in the core heat templates is a Jinja2 file that defines all ports and VIPs for each network in your composable network file. When rendered, it results in a `network-isolation.yaml` file in the same location with the full resource registry:

```
resource_registry:
  # networks as defined in network_data.yaml
  OS::TripleO::Network::Storage: ../network/storage.yaml
  OS::TripleO::Network::StorageMgmt: ../network/storage_mgmt.yaml
  OS::TripleO::Network::InternalApi: ../network/internal_api.yaml
  OS::TripleO::Network::Tenant: ../network/tenant.yaml
  OS::TripleO::Network::External: ../network/external.yaml

  # Port assignments for the VIPs
  OS::TripleO::Network::Ports::StorageVipPort: ../network/ports/storage.yaml
  OS::TripleO::Network::Ports::StorageMgmtVipPort: ../network/ports/storage_mgmt.yaml
  OS::TripleO::Network::Ports::InternalApiVipPort: ../network/ports/internal_api.yaml
  OS::TripleO::Network::Ports::ExternalVipPort: ../network/ports/external.yaml
  OS::TripleO::Network::Ports::RedisVipPort: ../network/ports/vip.yaml

  # Port assignments by role, edit role definition to assign networks to roles.
```

```

# Port assignments for the Controller
OS::TripleO::Controller::Ports::StoragePort: ../network/ports/storage.yaml
OS::TripleO::Controller::Ports::StorageMgmtPort: ../network/ports/storage_mgmt.yaml
OS::TripleO::Controller::Ports::InternalApiPort: ../network/ports/internal_api.yaml
OS::TripleO::Controller::Ports::TenantPort: ../network/ports/tenant.yaml
OS::TripleO::Controller::Ports::ExternalPort: ../network/ports/external.yaml

# Port assignments for the Compute
OS::TripleO::Compute::Ports::StoragePort: ../network/ports/storage.yaml
OS::TripleO::Compute::Ports::InternalApiPort: ../network/ports/internal_api.yaml
OS::TripleO::Compute::Ports::TenantPort: ../network/ports/tenant.yaml

# Port assignments for the CephStorage
OS::TripleO::CephStorage::Ports::StoragePort: ../network/ports/storage.yaml
OS::TripleO::CephStorage::Ports::StorageMgmtPort: ../network/ports/storage_mgmt.yaml

```

The first section of this file has the resource registry declaration for the **OS::TripleO::Network::\*** resources. By default, these resources use the **OS::Heat::None** resource type, which does not create any networks. By redirecting these resources to the YAML files for each network, you enable the creation of these networks.

The next several sections create the IP addresses for the nodes in each role. The controller nodes have IPs on each network. The compute and storage nodes each have IPs on a subset of the networks.

Other functions of overcloud networking, such as [Chapter 9, Custom composable networks](#) and [Chapter 10, Custom network interface templates](#) rely on the **network-isolation.yaml** environment file. Therefore you must include the rendered environment file in your deployment commands:

```

$ openstack overcloud deploy --templates \
...
-e /usr/share/openstack-tripleo-heat-templates/environments/network-isolation.yaml \
...

```

## 8.2. MODIFYING ISOLATED NETWORK CONFIGURATION

Copy the default **network\_data.yaml** file and modify the copy to configure the default isolated networks.

### Procedure

1. Copy the default **network\_data.yaml** file:

```
$ cp /usr/share/openstack-tripleo-heat-templates/network_data.yaml /home/stack/.
```

2. Edit the local copy of the **network\_data.yaml** file and modify the parameters to suit your networking requirements. For example, the Internal API network contains the following default network details:

```

- name: InternalApi
  name_lower: internal_api
  vip: true
  vlan: 201
  ip_subnet: '172.16.2.0/24'
  allocation_pools: [{'start': '172.16.2.4', 'end': '172.16.2.250'}]

```

Edit the following values for each network:

- **vlan** defines the VLAN ID that you want to use for this network.
- **ip\_subnet** and **ip\_allocation\_pools** set the default subnet and IP range for the network.
- **gateway** sets the gateway for the network. Use this value to define the default route for the External network, or for other networks if necessary.

Include the custom **network\_data.yaml** file with your deployment using the **-n** option. Without the **-n** option, the deployment command uses the default network details.

## 8.3. NETWORK INTERFACE TEMPLATES

The overcloud network configuration requires a set of the network interface templates. These templates are standard heat templates in YAML format. Each role requires a NIC template so that director can configure each node within that role correctly.

All NIC templates contain the same sections as standard heat templates:

### heat\_template\_version

The syntax version to use.

### description

A string description of the template.

### parameters

Network parameters to include in the template.

### resources

Takes parameters defined in **parameters** and applies them to a network configuration script.

### outputs

Renders the final script used for configuration.

The default NIC templates in **/usr/share/openstack-tripleo-heat-templates/network/config** use Jinja2 syntax to render the template. For example, the following snippet from the **single-nic-vlans** configuration renders a set of VLANs for each network:

```
{%- for network in networks if network.enabled|default(true) and network.name in role.networks %}
- type: vlan
  vlan_id:
    get_param: {{network.name}}NetworkVlanID
  addresses:
  - ip_netmask:
    get_param: {{network.name}}IpSubnet
{%- if network.name in role.default_route_networks %}
```

For default Compute nodes, this renders only the network information for the Storage, Internal API, and Tenant networks:

```
- type: vlan
  vlan_id:
    get_param: StorageNetworkVlanID
  device: bridge_name
  addresses:
```

```

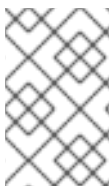
- ip_netmask:
  get_param: StorageIpSubnet
- type: vlan
  vlan_id:
    get_param: InternalApiNetworkVlanID
  device: bridge_name
  addresses:
  - ip_netmask:
    get_param: InternalApiIpSubnet
- type: vlan
  vlan_id:
    get_param: TenantNetworkVlanID
  device: bridge_name
  addresses:
  - ip_netmask:
    get_param: TenantIpSubnet

```

[Chapter 10, Custom network interface templates](#) explores how to render the default Jinja2-based templates to standard YAML versions, which you can use as a basis for customization.

## 8.4. DEFAULT NETWORK INTERFACE TEMPLATES

Director contains templates in `/usr/share/openstack-tripleo-heat-templates/network/config/` to suit most common network scenarios. The following table outlines each NIC template set and the respective environment file that you must use to enable the templates.



### NOTE

Each environment file for enabling NIC templates uses the suffix `.j2.yaml`. This is the unrendered Jinja2 version. Ensure that you include the rendered file name, which uses the `.yaml` suffix, in your deployment.

NIC directory	Description	Environment file
<b>single-nic-vlans</b>	Single NIC ( <b>nic1</b> ) with control plane and VLANs attached to default Open vSwitch bridge.	<b>environments/net-single-nic-with-vlans.j2.yaml</b>
<b>single-nic-linux-bridge-vlans</b>	Single NIC ( <b>nic1</b> ) with control plane and VLANs attached to default Linux bridge.	<b>environments/net-single-nic-linux-bridge-with-vlans</b>
<b>bond-with-vlans</b>	Control plane attached to <b>nic1</b> . Default Open vSwitch bridge with bonded NIC configuration ( <b>nic2</b> and <b>nic3</b> ) and VLANs attached.	<b>environments/net-bond-with-vlans.yaml</b>

NIC directory	Description	Environment file
<b>multiple-nics</b>	Control plane attached to <b>nic1</b> . Assigns each sequential NIC to each network defined in the <b>network_data.yaml</b> file. By default, this is Storage to <b>nic2</b> , Storage Management to <b>nic3</b> , Internal API to <b>nic4</b> , Tenant to <b>nic5</b> on the <b>br-tenant</b> bridge, and External to <b>nic6</b> on the default Open vSwitch bridge.	<b>environments/net-multiple-nics.yaml</b>



## NOTE

Environment files exist for deploying the overcloud without an external network, for example, **net-bond-with-vlans-no-external.yaml**, and for IPv6 deployments, for example, **net-bond-with-vlans-v6.yaml**. These are provided for backwards compatibility and do not function with composable networks.

Each default NIC template set contains a **role.role.j2.yaml** template. This file uses Jinja2 to render additional files for each composable role. For example, if your overcloud uses Compute, Controller, and Ceph Storage roles, the deployment renders new templates based on **role.role.j2.yaml**, such as the following templates:

- **compute.yaml**
- **controller.yaml**
- **ceph-storage.yaml**.

## 8.5. ENABLING BASIC NETWORK ISOLATION

Director includes templates that you can use to enable basic network isolation. These files are located in the **/usr/share/openstack-tripleo-heat-templates/environments** directory. For example, you can use the templates to deploy an overcloud on a single NIC with VLANs with basic network isolation. In this scenario, use the **net-single-nic-with-vlans** template.

### Procedure

1. When you run the **openstack overcloud deploy** command, ensure that you include the following rendered environment files:
  - The custom **network\_data.yaml** file.
  - The rendered file name of the default network isolation file.
  - The rendered file name of the default network environment file.
  - The rendered file name of the default network interface configuration file.
  - Any additional environment files relevant to your configuration.

For example:

```
$ openstack overcloud deploy --templates \  
...  
-n /home/stack/network_data.yaml \  
-e /usr/share/openstack-tripleo-heat-templates/environments/network-isolation.yaml \  
-e /usr/share/openstack-tripleo-heat-templates/environments/network-environment.yaml \  
-e /usr/share/openstack-tripleo-heat-templates/environments/net-single-nic-with-vlans.yaml \  
...
```



## CHAPTER 9. CUSTOM COMPOSABLE NETWORKS

You can create custom composable networks if you want to host specific network traffic on different networks. To configure the overcloud with an additional composable network, you must configure the following files and templates:

- The environment file to enable network isolation (**/usr/share/openstack-tripleo-heat-templates/environments/network-isolation.yaml**).
- The environment file to configure network defaults (**/usr/share/openstack-tripleo-heat-templates/environments/network-environment.yaml**).
- A custom **network\_data** file to create additional networks outside of the defaults.
- A custom **roles\_data** file to assign custom networks to roles.
- Templates to define your NIC layout for each node. The overcloud core template collection contains a set of defaults for different use cases.
- An environment file to enable NICs. This example uses a default file that is located in the **environments** directory.
- Any additional environment files to customize your networking parameters. This example uses an environment file to customize OpenStack service mappings to composable networks.



### NOTE

Some of the files in the previous list are Jinja2 format files and have a **.j2.yaml** extension. Director renders these files to **.yaml** versions during deployment.

### 9.1. COMPOSABLE NETWORKS

The overcloud uses the following pre-defined set of network segments by default:

- Control Plane
- Internal API
- Storage
- Storage Management
- Tenant
- External
- Management (optional)

You can use composable networks to add networks for various services. For example, if you have a network that is dedicated to NFS traffic, you can present it to multiple roles.

Director supports the creation of custom networks during the deployment and update phases. You can use these additional networks for ironic bare metal nodes, system management, or to create separate networks for different roles. You can also use them to create multiple sets of networks for split deployments where traffic is routed between networks.

A single data file (**network\_data.yaml**) manages the list of networks that you want to deploy. Include this file with your deployment command using the **-n** option. Without this option, the deployment uses the default `/usr/share/openstack-tripleo-heat-templates/network_data.yaml` file.

## 9.2. ADDING A COMPOSABLE NETWORK

Use composable networks to add networks for various services. For example, if you have a network that is dedicated to storage backup traffic, you can present the network to multiple roles.

### Procedure

1. Copy the default **network\_data.yaml** file:

```
$ cp /usr/share/openstack-tripleo-heat-templates/network_data.yaml /home/stack/.
```

2. Edit the local copy of the **network\_data.yaml** file and add a section for your new network:

```
- name: StorageBackup
  name_lower: storage_backup
  vlan: 21
  vip: true
  ip_subnet: '172.21.1.0/24'
  allocation_pools: [{'start': '171.21.1.4', 'end': '172.21.1.250'}]
  gateway_ip: '172.21.1.1'
```

You can use the following parameters in your **network\_data.yaml** file:

#### **name**

Sets the human readable name of the network. This parameter is the only mandatory parameter. You can also use **name\_lower** to normalize names for readability. For example, change **InternalApi** to **internal\_api**.

#### **name\_lower**

Sets the lowercase version of the name, which director maps to respective networks assigned to roles in the **roles\_data.yaml** file.

#### **vlan**

Sets the VLAN that you want to use for this network.

#### **vip: true**

Creates a virtual IP address (VIP) on the new network. This IP is used as the target IP for services listed in the service-to-network mapping parameter (**ServiceNetMap**). Note that VIPs are used only by roles that use Pacemaker. The overcloud load-balancing service redirects traffic from these IPs to their respective service endpoint.

#### **ip\_subnet**

Sets the default IPv4 subnet in CIDR format.

#### **allocation\_pools**

Sets the IP range for the IPv4 subnet

#### **gateway\_ip**

Sets the gateway for the network.

#### **routes**

Adds additional routes to the network. Uses a JSON list that contains each additional route. Each list item contains a dictionary value mapping. Use the following example syntax:

```
routes: [{'destination':'10.0.0.0/16', 'nexthop':'10.0.2.254'}]
```

### subnets

Creates additional routed subnets that fall within this network. This parameter accepts a **dict** value that contains the lowercase name of the routed subnet as the key and the **vlan**, **ip\_subnet**, **allocation\_pools**, and **gateway\_ip** parameters as the value mapped to the subnet. The following example demonstrates this layout:

```
- name: StorageBackup
  name_lower: storage_backup
  vlan: 200
  vip: true
  ip_subnet: '172.21.0.0/24'
  allocation_pools: [{'start': '171.21.0.4', 'end': '172.21.0.250'}]
  gateway_ip: '172.21.0.1'
  subnets:
    storage_backup_leaf1:
      vlan: 201
      ip_subnet: '172.21.1.0/24'
      allocation_pools: [{'start': '171.21.1.4', 'end': '172.21.1.250'}]
      gateway_ip: '172.19.1.254'
```

This mapping is common in spine leaf deployments. For more information, see the [Spine Leaf Networking](#) guide.

Include the custom **network\_data.yaml** file in your deployment command using the **-n** option. Without the **-n** option, the deployment command uses the default set of networks.

## 9.3. INCLUDING A COMPOSABLE NETWORK IN A ROLE

You can assign composable networks to the overcloud roles defined in your environment. For example, you might include a custom **StorageBackup** network with your Ceph Storage nodes.

### Procedure

1. If you do not already have a custom **roles\_data.yaml** file, copy the default to your home directory:

```
$ cp /usr/share/openstack-tripleo-heat-templates/roles_data.yaml /home/stack/.
```

2. Edit the custom **roles\_data.yaml** file.
3. Include the network name in the **networks** list for the role that you want to add the network to. For example, to add the **StorageBackup** network to the Ceph Storage role, use the following example snippet:

```
- name: CephStorage
  description: |
    Ceph OSD Storage node role
  networks:
```

- Storage
- StorageMgmt
- StorageBackup

4. After you add custom networks to their respective roles, save the file.

When you run the **openstack overcloud deploy** command, include the custom **roles\_data.yaml** file using the **-r** option. Without the **-r** option, the deployment command uses the default set of roles with their respective assigned networks.

## 9.4. ASSIGNING OPENSTACK SERVICES TO COMPOSABLE NETWORKS

Each OpenStack service is assigned to a default network type in the resource registry. These services are bound to IP addresses within the network type's assigned network. Although the OpenStack services are divided among these networks, the number of actual physical networks can differ as defined in the network environment file. You can reassign OpenStack services to different network types by defining a new network map in an environment file, for example, **/home/stack/templates/service-reassignments.yaml**. The **ServiceNetMap** parameter determines the network types that you want to use for each service.

For example, you can reassign the Storage Management network services to the Storage Backup Network by modifying the highlighted sections:

```
parameter_defaults:
  ServiceNetMap:
    SwiftMgmtNetwork: storage_backup
    CephClusterNetwork: storage_backup
```

Changing these parameters to **storage\_backup** places these services on the Storage Backup network instead of the Storage Management network. This means that you must define a set of **parameter\_defaults** only for the Storage Backup network and not the Storage Management network.

Director merges your custom **ServiceNetMap** parameter definitions into a pre-defined list of defaults that it obtains from **ServiceNetMapDefaults** and overrides the defaults. Director returns the full list, including customizations, to **ServiceNetMap**, which is used to configure network assignments for various services.

Service mappings apply to networks that use **vip: true** in the **network\_data.yaml** file for nodes that use Pacemaker. The overcloud load balancer redirects traffic from the VIPs to the specific service endpoints.



### NOTE

You can find a full list of default services in the **ServiceNetMapDefaults** parameter in the **/usr/share/openstack-tripleo-heat-templates/network/service\_net\_map.j2.yaml** file.

## 9.5. ENABLING CUSTOM COMPOSABLE NETWORKS

Enable custom composable networks using one of the default NIC templates. In this example, use the Single NIC with VLANs template (**net-single-nic-with-vlans**).

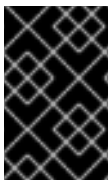
### Procedure

1. When you run the **openstack overcloud deploy** command, ensure that you include the following files:
  - The custom **network\_data.yaml** file.
  - The custom **roles\_data.yaml** file with network-to-role assignments.
  - The rendered file name of the default network isolation.
  - The rendered file name of the default network environment file.
  - The rendered file name of the default network interface configuration.
  - Any additional environment files related to your network, such as the service reassignments.

For example:

```
$ openstack overcloud deploy --templates \
...
-n /home/stack/network_data.yaml \
-r /home/stack/roles_data.yaml \
-e /usr/share/openstack-tripleo-heat-templates/environments/network-isolation.yaml \
-e /usr/share/openstack-tripleo-heat-templates/environments/network-environment.yaml \
-e /usr/share/openstack-tripleo-heat-templates/environments/net-single-nic-with-vlans.yaml \
-e /home/stack/templates/service-reassignments.yaml \
...
```

This example command deploys the composable networks, including your additional custom networks, across nodes in your overcloud.



### IMPORTANT

Remember that you must render the templates again if you are introducing a new custom network, such as a management network. Simply adding the network name to the **roles\_data.yaml** file is not sufficient.

## 9.6. RENAMING THE DEFAULT NETWORKS

You can use the **network\_data.yaml** file to modify the user-visible names of the default networks:

- InternalApi
- External
- Storage
- StorageMgmt
- Tenant

To change these names, do not modify the **name** field. Instead, change the **name\_lower** field to the new name for the network and update the ServiceNetMap with the new name.

### Procedure

1. In your **network\_data.yaml** file, enter new names in the **name\_lower** parameter for each network that you want to rename:

```
- name: InternalApi  
  name_lower: MyCustomInternalApi
```

2. Include the default value of the **name\_lower** parameter in the **service\_net\_map\_replace** parameter:

```
- name: InternalApi  
  name_lower: MyCustomInternalApi  
  service_net_map_replace: internal_api
```

## CHAPTER 10. CUSTOM NETWORK INTERFACE TEMPLATES

After you configure [Chapter 8, Basic network isolation](#), you can create a set of custom network interface templates to suit the nodes in your environment. For example, you can include the following files:

- The environment file to enable network isolation (**/usr/share/openstack-tripleo-heat-templates/environments/network-isolation.yaml**).
- The environment file to configure network defaults (**/usr/share/openstack-tripleo-heat-templates/environments/network-environment.yaml**).
- Templates to define your NIC layout for each node. The overcloud core template collection contains a set of defaults for different use cases. To create a custom NIC template, render a default Jinja2 template as the basis for your custom templates.
- A custom environment file to enable NICs. This example uses a custom environment file (**/home/stack/templates/custom-network-configuration.yaml**) that references your custom interface templates.
- Any additional environment files to customize your networking parameters.
- If you customize your networks, a custom **network\_data.yaml** file.
- If you create additional or custom composable networks, a custom **network\_data.yaml** file and a custom **roles\_data.yaml** file.



### NOTE

Some of the files in the previous list are Jinja2 format files and have a **.j2.yaml** extension. Director renders these files to **.yaml** versions during deployment.

## 10.1. CUSTOM NETWORK ARCHITECTURE

The default NIC templates might not suit a specific network configuration. For example, you might want to create your own custom NIC template that suits a specific network layout. You might want to separate the control services and data services on to separate NICs. In this situation, you can map the service to NIC assignments in the following way:

- NIC1 (Provisioning)
  - Provisioning / Control Plane
- NIC2 (Control Group)
  - Internal API
  - Storage Management
  - External (Public API)
- NIC3 (Data Group)
  - Tenant Network (VXLAN tunneling)
  - Tenant VLANs / Provider VLANs

- Storage
- External VLANs (Floating IP/SNAT)
- NIC4 (Management)
  - Management

## 10.2. RENDERING DEFAULT NETWORK INTERFACE TEMPLATES FOR CUSTOMIZATION

To simplify the configuration of custom interface templates, render the Jinja2 syntax of a default NIC template and use the rendered templates as the basis for your custom configuration.

### Procedure

1. Render a copy of the **openstack-tripleo-heat-templates** collection with the **process-templates.py** script:

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

This converts all Jinja2 templates to their rendered YAML versions and saves the results to **~/openstack-tripleo-heat-templates-rendered**.

If you use a custom network file or custom roles file, you can include these files using the **-n** and **-r** options respectively:

```
$ ./tools/process-templates.py -o ~/openstack-tripleo-heat-templates-rendered -n
/home/stack/network_data.yaml -r /home/stack/roles_data.yaml
```

2. Copy the multiple NIC example:

```
$ cp -r ~/openstack-tripleo-heat-templates-rendered/network/config/multiple-nics/
~/templates/custom-nics/
```

3. Edit the template set in **custom-nics** to suit your own network configuration.

## 10.3. NETWORK INTERFACE ARCHITECTURE

The custom NIC templates that you render in [Section 10.2, “Rendering default network interface templates for customization”](#) contain the **parameters** and **resources** sections.

### Parameters

The **parameters** section contains all network configuration parameters for network interfaces. This includes information such as subnet ranges and VLAN IDs. This section should remain unchanged as the heat template inherits values from its parent template. However, you can use a network environment file to modify the values for some parameters.

### Resources



The **resources** section is where the main network interface configuration occurs. In most cases, the **resources** section is the only one that requires modification. Each **resources** section begins with the following header:

```
resources:
  OsNetConfigImpl:
    type: OS::Heat::SoftwareConfig
    properties:
      group: script
      config:
        str_replace:
          template:
            get_file: /usr/share/openstack-tripleo-heat-templates/network/scripts/run-os-net-config.sh
        params:
          $network_config:
            network_config:
```

This snippet runs a script (**run-os-net-config.sh**) that creates a configuration file for **os-net-config** to use to configure network properties on a node. The **network\_config** section contains the custom network interface data sent to the **run-os-net-config.sh** script. You arrange this custom interface data in a sequence based on the type of device.



### IMPORTANT

If you create custom NIC templates, you must set the **run-os-net-config.sh** script location to an absolute path for each NIC template. The script is located at **/usr/share/openstack-tripleo-heat-templates/network/scripts/run-os-net-config.sh** on the undercloud.

## 10.4. NETWORK INTERFACE REFERENCE

Network interface configuration contains the following parameters:

### interface

Defines a single network interface. The configuration defines each interface using either the actual interface name ("eth0", "eth1", "enp0s25") or a set of numbered interfaces ("nic1", "nic2", "nic3"):

```
- type: interface
  name: nic2
```

Table 10.1. interface options

Option	Default	Description
name		Name of the interface.
use_dhcp	False	Use DHCP to get an IP address.
use_dhcpv6	False	Use DHCP to get a v6 IP address.
addresses		A list of IP addresses assigned to the interface.

Option	Default	Description
routes		A list of routes assigned to the interface. For more information, see <a href="#">routes</a> .
mtu	1500	The maximum transmission unit (MTU) of the connection.
primary	False	Defines the interface as the primary interface.
defroute	True	Use a default route provided by the DHCP service. Only applies when you enable <b>use_dhcp</b> or <b>use_dhcpv6</b> .
persist_mapping	False	Write the device alias configuration instead of the system names.
dhclient_args	None	Arguments that you want to pass to the DHCP client.
dns_servers	None	List of DNS servers that you want to use for the interface.
ethtool_opts		Set this option to " <b>rx-flow-hash udp4 sdfn</b> " to improve throughput when you use VXLAN on certain NICs.

## vlan

Defines a VLAN. Use the VLAN ID and subnet passed from the **parameters** section.

For example:

```
- type: vlan
  vlan_id:{get_param: ExternalNetworkVlanID}
  addresses:
    - ip_netmask: {get_param: ExternalIpSubnet}
```

Table 10.2. vlan options

Option	Default	Description
vlan_id		The VLAN ID.

Option	Default	Description
device		The parent device to attach the VLAN. Use this parameter when the VLAN is not a member of an OVS bridge. For example, use this parameter to attach the VLAN to a bonded interface device.
use_dhcp	False	Use DHCP to get an IP address.
use_dhcpv6	False	Use DHCP to get a v6 IP address.
addresses		A list of IP addresses assigned to the VLAN.
routes		A list of routes assigned to the VLAN. For more information, see <a href="#">routes</a> .
mtu	1500	The maximum transmission unit (MTU) of the connection.
primary	False	Defines the VLAN as the primary interface.
defroute	True	Use a default route provided by the DHCP service. Only applies when you enable <b>use_dhcp</b> or <b>use_dhcpv6</b> .
persist_mapping	False	Write the device alias configuration instead of the system names.
dhclient_args	None	Arguments that you want to pass to the DHCP client.
dns_servers	None	List of DNS servers that you want to use for the VLAN.

## ovs\_bond

Defines a bond in Open vSwitch to join two or more **interfaces** together. This helps with redundancy and increases bandwidth.

For example:

```
- type: ovs_bond
  name: bond1
  members:
```

- type: interface  
name: nic2
- type: interface  
name: nic3

Table 10.3. ovs\_bond options

Option	Default	Description
name		Name of the bond.
use_dhcp	False	Use DHCP to get an IP address.
use_dhcpv6	False	Use DHCP to get a v6 IP address.
addresses		A list of IP addresses assigned to the bond.
routes		A list of routes assigned to the bond. For more information, see <a href="#">routes</a> .
mtu	1500	The maximum transmission unit (MTU) of the connection.
primary	False	Defines the interface as the primary interface.
members		A sequence of interface objects that you want to use in the bond.
ovs_options		A set of options to pass to OVS when creating the bond.
ovs_extra		A set of options to set as the OVS_EXTRA parameter in the network configuration file of the bond.
defroute	True	Use a default route provided by the DHCP service. Only applies when you enable <b>use_dhcp</b> or <b>use_dhcpv6</b> .
persist_mapping	False	Write the device alias configuration instead of the system names.
dhclient_args	None	Arguments that you want to pass to the DHCP client.

Option	Default	Description
dns_servers	None	List of DNS servers that you want to use for the bond.

## ovs\_bridge

Defines a bridge in Open vSwitch, which connects multiple **interface**, **ovs\_bond**, and **vlan** objects together.

The network interface type, **ovs\_bridge**, takes a parameter **name**.



### NOTE

If you have multiple bridges, you must use distinct bridge names other than accepting the default name of **bridge\_name**. If you do not use distinct names, then during the converge phase, two network bonds are placed on the same bridge.

If you are defining an OVS bridge for the external tripleo network, then retain the values **bridge\_name** and **interface\_name** as your deployment framework automatically replaces these values with an external bridge name and an external interface name, respectively.

For example:

```
- type: ovs_bridge
  name: bridge_name
  addresses:
  - ip_netmask:
    list_join:
      - /
      - - {get_param: ControlPlaneIp}
        - {get_param: ControlPlaneSubnetCidr}
  members:
  - type: interface
    name: interface_name
- type: vlan
  device: bridge_name
  vlan_id:
    {get_param: ExternalNetworkVlanID}
  addresses:
  - ip_netmask:
    {get_param: ExternalIpSubnet}
```

**NOTE**

The OVS bridge connects to the Networking service (neutron) server to obtain configuration data. If the OpenStack control traffic, typically the Control Plane and Internal API networks, is placed on an OVS bridge, then connectivity to the neutron server is lost whenever you upgrade OVS, or the OVS bridge is restarted by the admin user or process. This causes some downtime. If downtime is not acceptable in these circumstances, then you must place the Control group networks on a separate interface or bond rather than on an OVS bridge:

- You can achieve a minimal setting when you put the Internal API network on a VLAN on the provisioning interface and the OVS bridge on a second interface.
- To implement bonding, you need at least two bonds (four network interfaces). Place the control group on a Linux bond (Linux bridge). If the switch does not support LACP fallback to a single interface for PXE boot, then this solution requires at least five NICs.

**Table 10.4. ovs\_bridge options**

Option	Default	Description
name		Name of the bridge.
use_dhcp	False	Use DHCP to get an IP address.
use_dhcpv6	False	Use DHCP to get a v6 IP address.
addresses		A list of IP addresses assigned to the bridge.
routes		A list of routes assigned to the bridge. For more information, see <a href="#">routes</a> .
mtu	1500	The maximum transmission unit (MTU) of the connection.
members		A sequence of interface, VLAN, and bond objects that you want to use in the bridge.
ovs_options		A set of options to pass to OVS when creating the bridge.
ovs_extra		A set of options to to set as the OVS_EXTRA parameter in the network configuration file of the bridge.

Option	Default	Description
defroute	True	Use a default route provided by the DHCP service. Only applies when you enable <b>use_dhcp</b> or <b>use_dhcpv6</b> .
persist_mapping	False	Write the device alias configuration instead of the system names.
dhclient_args	None	Arguments that you want to pass to the DHCP client.
dns_servers	None	List of DNS servers that you want to use for the bridge.

## linux\_bond

Defines a Linux bond that joins two or more **interfaces** together. This helps with redundancy and increases bandwidth. Ensure that you include the kernel-based bonding options in the **bonding\_options** parameter.

For example:

```
- type: linux_bond
  name: bond1
  members:
  - type: interface
    name: nic2
    primary: true
  - type: interface
    name: nic3
  bonding_options: "mode=802.3ad"
```

Note that **nic2** uses **primary: true** to ensure that the bond uses the MAC address for **nic2**.

**Table 10.5. linux\_bond options**

Option	Default	Description
name		Name of the bond.
use_dhcp	False	Use DHCP to get an IP address.
use_dhcpv6	False	Use DHCP to get a v6 IP address.

Option	Default	Description
addresses		A list of IP addresses assigned to the bond.
routes		A list of routes assigned to the bond. See <a href="#">routes</a> .
mtu	1500	The maximum transmission unit (MTU) of the connection.
primary	False	Defines the interface as the primary interface.
members		A sequence of interface objects that you want to use in the bond.
bonding_options		A set of options when creating the bond.
defroute	True	Use a default route provided by the DHCP service. Only applies when you enable <b>use_dhcp</b> or <b>use_dhcpv6</b> .
persist_mapping	False	Write the device alias configuration instead of the system names.
dhclient_args	None	Arguments that you want to pass to the DHCP client.
dns_servers	None	List of DNS servers that you want to use for the bond.

## linux\_bridge

Defines a Linux bridge, which connects multiple **interface**, **linux\_bond**, and **vlan** objects together. The external bridge also uses two special values for parameters:

- **bridge\_name**, which is replaced with the external bridge name.
- **interface\_name**, which is replaced with the external interface.

For example:

```
- type: linux_bridge
  name: bridge_name
  addresses:
    - ip_netmask:
      list_join:
```



```

- /
- - {get_param: ControlPlaneIp}
- {get_param: ControlPlaneSubnetCidr}
members:
- type: interface
  name: interface_name
- type: vlan
  device: bridge_name
  vlan_id:
  {get_param: ExternalNetworkVlanID}
addresses:
- ip_netmask:
  {get_param: ExternalIpSubnet}

```

Table 10.6. linux\_bridge options

Option	Default	Description
name		Name of the bridge.
use_dhcp	False	Use DHCP to get an IP address.
use_dhcpv6	False	Use DHCP to get a v6 IP address.
addresses		A list of IP addresses assigned to the bridge.
routes		A list of routes assigned to the bridge. For more information, see <a href="#">routes</a> .
mtu	1500	The maximum transmission unit (MTU) of the connection.
members		A sequence of interface, VLAN, and bond objects that you want to use in the bridge.
defroute	True	Use a default route provided by the DHCP service. Only applies when you enable <b>use_dhcp</b> or <b>use_dhcpv6</b> .
persist_mapping	False	Write the device alias configuration instead of the system names.
dhclient_args	None	Arguments that you want to pass to the DHCP client.

Option	Default	Description
dns_servers	None	List of DNS servers that you want to use for the bridge.

## routes

Defines a list of routes to apply to a network interface, VLAN, bridge, or bond.

For example:

```
- type: interface
  name: nic2
  ...
  routes:
    - ip_netmask: 10.1.2.0/24
      default: true
      next_hop:
        get_param: EC2MetadataIp
```

Option	Default	Description
ip_netmask	None	IP and netmask of the destination network.
default	False	Sets this route to a default route. Equivalent to setting <b>ip_netmask: 0.0.0.0/0</b> .
next_hop	None	The IP address of the router used to reach the destination network.

## 10.5. EXAMPLE NETWORK INTERFACE LAYOUT

The following snippet for an example Controller node NIC template demonstrates how to configure the custom network scenario to keep the control group separate from the OVS bridge:

```
resources:
  OsNetConfigImpl:
    type: OS::Heat::SoftwareConfig
    properties:
      group: script
      config:
        str_replace:
          template:
            get_file: /usr/share/openstack-tripleo-heat-templates/network/scripts/run-os-net-config.sh
        params:
          $network_config:
            network_config:

      # NIC 1 - Provisioning
```

```

- type: interface
  name: nic1
  use_dhcp: false
  addresses:
  - ip_netmask:
    list_join:
      - /
      - - get_param: ControlPlaneIp
        - get_param: ControlPlaneSubnetCidr
  routes:
  - ip_netmask: 169.254.169.254/32
    next_hop:
      get_param: EC2MetadataIp

# NIC 2 - Control Group
- type: interface
  name: nic2
  use_dhcp: false
- type: vlan
  device: nic2
  vlan_id:
    get_param: InternalApiNetworkVlanID
  addresses:
  - ip_netmask:
    get_param: InternalApiIpSubnet
- type: vlan
  device: nic2
  vlan_id:
    get_param: StorageMgmtNetworkVlanID
  addresses:
  - ip_netmask:
    get_param: StorageMgmtIpSubnet
- type: vlan
  device: nic2
  vlan_id:
    get_param: ExternalNetworkVlanID
  addresses:
  - ip_netmask:
    get_param: ExternalIpSubnet
  routes:
  - default: true
    next_hop:
      get_param: ExternalInterfaceDefaultRoute

# NIC 3 - Data Group
- type: ovs_bridge
  name: bridge_name
  dns_servers:
    get_param: DnsServers
  members:
  - type: interface
    name: nic3
    primary: true
  - type: vlan
    vlan_id:
      get_param: StorageNetworkVlanID

```

```

addresses:
- ip_netmask:
  get_param: StorageIpSubnet
- type: vlan
  vlan_id:
  get_param: TenantNetworkVlanID
addresses:
- ip_netmask:
  get_param: TenantIpSubnet

# NIC 4 - Management
- type: interface
  name: nic4
  use_dhcp: false
  addresses:
  - ip_netmask: {get_param: ManagementIpSubnet}
  routes:
  - default: true
    next_hop: {get_param: ManagementInterfaceDefaultRoute}

```

This template uses four network interfaces and assigns a number of tagged VLAN devices to the numbered interfaces, **nic1** to **nic4**. On **nic3** this template creates the OVS bridge that hosts the Storage and Tenant networks. As a result, it creates the following layout:

- NIC1 (Provisioning)
  - Provisioning / Control Plane
- NIC2 (Control Group)
  - Internal API
  - Storage Management
  - External (Public API)
- NIC3 (Data Group)
  - Tenant Network (VXLAN tunneling)
  - Tenant VLANs / Provider VLANs
  - Storage
  - External VLANs (Floating IP/SNAT)
- NIC4 (Management)
  - Management

## 10.6. NETWORK INTERFACE TEMPLATE CONSIDERATIONS FOR CUSTOM NETWORKS

When you use composable networks, the **process-templates.py** script renders the static templates to include networks and roles that you define in your **network\_data.yaml** and **roles\_data.yaml** files. Ensure that your rendered NIC templates contain the following items:

- A static file for each role, including custom composable networks.
- The correct network definitions in the static file for each role.

Each static file requires all of the parameter definitions for any custom networks, even if the network is not used on the role. Ensure that the rendered templates contain these parameters. For example, if you add a **StorageBackup** network only to the Ceph nodes, you must also include this definition in the **parameters** section in the NIC configuration templates for all roles:

```
parameters:
...
StorageBackupIpSubnet:
  default: "
  description: IP address/subnet on the external network
  type: string
...
```

You can also include the **parameters** definitions for VLAN IDs and/or gateway IP, if necessary:

```
parameters:
...
StorageBackupNetworkVlanID:
  default: 60
  description: Vlan ID for the management network traffic.
  type: number
StorageBackupDefaultRoute:
  description: The default route of the storage backup network.
  type: string
...
```

The **IpSubnet** parameter for the custom network appears in the parameter definitions for each role. However, since the Ceph role might be the only role that uses the **StorageBackup** network, only the NIC configuration template for the Ceph role uses the **StorageBackup** parameters in the **network\_config** section of the template.

```
$network_config:
  network_config:
  - type: interface
    name: nic1
    use_dhcp: false
    addresses:
  - ip_netmask:
    get_param: StorageBackupIpSubnet
```

## 10.7. CUSTOM NETWORK ENVIRONMENT FILE

The custom network environment file (in this case, **/home/stack/templates/custom-network-configuration.yaml**) is a heat environment file that describes the overcloud network environment and points to the custom network interface configuration templates. You can define the subnets and VLANs for your network along with IP address ranges. You can then customize these values for the local environment.

The **resource\_registry** section contains references to the custom network interface templates for each node role. Each resource registered uses the following format:

- **OS::TripleO::[ROLE]::Net::SoftwareConfig: [FILE]**

**[ROLE]** is the role name and **[FILE]** is the respective network interface template for that particular role. For example:

```
resource_registry:
  OS::TripleO::Controller::Net::SoftwareConfig: /home/stack/templates/custom-nics/controller.yaml
```

The **parameter\_defaults** section contains a list of parameters that define the network options for each network type.

## 10.8. NETWORK ENVIRONMENT PARAMETERS

The following table is a list of parameters that you can use in the **parameter\_defaults** section of a network environment file to override the default parameter values in your NIC templates.

Parameter	Description	Type
<b>ControlPlaneDefaultRoute</b>	The IP address of the router on the Control Plane, which is used as a default route for roles other than the Controller nodes. Set this value to the undercloud IP if you use IP masquerade instead of a router.	string
<b>ControlPlaneSubnetCidr</b>	The CIDR netmask of the IP network used on the Control Plane. If the Control Plane network uses 192.168.24.0/24, the CIDR is <b>24</b> .	string (though is always a number)
<b>*NetCidr</b>	The full network and CIDR netmask for a particular network. The default is automatically set to the network <b>ip_subnet</b> setting in the <b>network_data.yaml</b> file. For example, <b>InternalApiNetCidr: 172.16.0.0/24</b> .	string
<b>*AllocationPools</b>	The IP allocation range for a particular network. The default is automatically set to the network <b>allocation_pools</b> setting in the <b>network_data.yaml</b> file. For example, <b>InternalApiAllocationPools: [{'start': '172.16.0.10', 'end': '172.16.0.200'}]</b> .	hash

Parameter	Description	Type
<b>*NetworkVlanID</b>	The VLAN ID for a node on a particular network. The default is set automatically to the network <b>vlan</b> setting in the <b>network_data.yaml</b> file. For example, <b>InternalApiNetworkVlanID: 201.</b>	number
<b>*InterfaceDefaultRoute</b>	The router address for a particular network, which you can use as a default route for roles or for routes to other networks. The default is automatically set to the network <b>gateway_ip</b> setting in the <b>network_data.yaml</b> file. For example, <b>InternalApiInterfaceDefaultRoute: 172.16.0.1.</b>	string
<b>DnsServers</b>	A list of DNS servers added to <code>resolv.conf</code> . Usually allows a maximum of 2 servers.	comma delimited list
<b>EC2MetadataIp</b>	The IP address of the metadata server used to provision overcloud nodes. Set this value to the IP address of the undercloud on the Control Plane.	string
<b>BondInterfaceOvsOptions</b>	The options for bonding interfaces. For example, <b>BondInterfaceOvsOptions: "bond_mode=balance-slb".</b>	string
<b>NeutronExternalNetworkBridge</b>	Legacy value for the name of the external bridge that you want to use for OpenStack Networking (neutron). This value is empty by default, which means that you can define multiple physical bridges in the <b>NeutronBridgeMappings</b> . In normal circumstances, do not override this value.	string

Parameter	Description	Type
<b>NeutronFlatNetworks</b>	Defines the flat networks that you want to configure in neutron plugins. The default value is <b>datacentre</b> to permit external network creation. For example, <b>NeutronFlatNetworks: "datacentre"</b> .	string
<b>NeutronBridgeMappings</b>	The logical to physical bridge mappings that you want to use. The default value maps the external bridge on hosts ( <b>br-ex</b> ) to a physical name ( <b>datacentre</b> ). Refer to the logical name when you create OpenStack Networking (neutron) provider networks or floating IP networks. For example <b>NeutronBridgeMappings: "datacentre:br-ex,tenant:br-tenant"</b> .	string
<b>NeutronPublicInterface</b>	Defines the interface that you want to bridge onto <b>br-ex</b> for network nodes when you do not use network isolation. Usually not used except in small deployments with only two networks. For example: <b>NeutronPublicInterface: "eth0"</b> .	string
<b>NeutronNetworkType</b>	The tenant network type for OpenStack Networking (neutron). To specify multiple values, use a comma separated list. The first type that you specify is used until all available networks are exhausted, then the next type is used. For example, <b>NeutronNetworkType: "vxlan"</b> . Note that vxlan is not supported by the ML2/OVN mechanism driver, which is the default ML2 mechanism driver.	string



Parameter	Description	Type
<b>NeutronTunnelTypes</b>	The tunnel types for the neutron tenant network. To specify multiple values, use a comma separated string. For example, <b>NeutronTunnelTypes: 'gre,vxlan'</b> . Note that vxlan is not supported by the ML2/OVN mechanism driver, which is the default ML2 mechanism driver.	string / comma separated list
<b>NeutronTunnelIdRanges</b>	Ranges of GRE tunnel IDs that you want to make available for tenant network allocation. For example, <b>NeutronTunnelIdRanges "1:1000"</b> .	string
<b>NeutronVniRanges</b>	Ranges of VXLAN VNI IDs that you want to make available for tenant network allocation. For example, <b>NeutronVniRanges: "1:1000"</b> .	string
<b>NeutronEnableTunnelling</b>	Defines whether to enable or completely disable all tunnelled networks. Leave this enabled unless you are sure that you do not want to create tunnelled networks in future. The default value is <b>true</b> .	Boolean
<b>NeutronNetworkVLANRanges</b>	The ML2 and Open vSwitch VLAN mapping range that you want to support. Defaults to permitting any VLAN on the <b>datacentre</b> physical network. To specify multiple values, use a comma separated list. For example, <b>NeutronNetworkVLANRanges: "datacentre:1:1000,tenant:100:299,tenant:310:399"</b> .	string

Parameter	Description	Type
<b>NeutronMechanismDrivers</b>	The mechanism drivers for the neutron tenant network. The default value is <b>ovn</b> . To specify multiple values, use a comma-separated string. For example, <b>NeutronMechanismDrivers: 'openvswitch,l2population'</b> .	string / comma separated list

## 10.9. EXAMPLE CUSTOM NETWORK ENVIRONMENT FILE

The following snippet is an example of an environment file that you can use to enable your NIC templates and set custom parameters.

```
resource_registry:
  OS::TripleO::BlockStorage::Net::SoftwareConfig:
    /home/stack/templates/nic-configs/cinder-storage.yaml
  OS::TripleO::Compute::Net::SoftwareConfig:
    /home/stack/templates/nic-configs/compute.yaml
  OS::TripleO::Controller::Net::SoftwareConfig:
    /home/stack/templates/nic-configs/controller.yaml
  OS::TripleO::ObjectStorage::Net::SoftwareConfig:
    /home/stack/templates/nic-configs/swift-storage.yaml
  OS::TripleO::CephStorage::Net::SoftwareConfig:
    /home/stack/templates/nic-configs/ceph-storage.yaml

parameter_defaults:
  # Gateway router for the provisioning network (or Undercloud IP)
  ControlPlaneDefaultRoute: 192.0.2.254
  # The IP address of the EC2 metadata server. Generally the IP of the Undercloud
  EC2MetadataIp: 192.0.2.1
  # Define the DNS servers (maximum 2) for the overcloud nodes
  DnsServers: ["8.8.8.8", "8.8.4.4"]
  NeutronExternalNetworkBridge: ""
```

## 10.10. ENABLING NETWORK ISOLATION WITH CUSTOM NICs

To deploy the overcloud with network isolation and custom NIC templates, include all of the relevant networking environment files in the overcloud deployment command.

### Procedure

- When you run the **openstack overcloud deploy** command, include the following files:
  - The custom **network\_data.yaml** file.
  - The rendered file name of the default network isolation.
  - The rendered file name of the default network environment file.
  - The custom environment network configuration that includes resource references to your custom NIC templates.

- Any additional environment files relevant to your configuration.

For example:

```
$ openstack overcloud deploy --templates \  
...  
-n /home/stack/network_data.yaml \  
-e /usr/share/openstack-tripleo-heat-templates/environments/network-isolation.yaml \  
-e /usr/share/openstack-tripleo-heat-templates/environments/network-environment.yaml \  
-e /home/stack/templates/custom-network-configuration.yaml \  
...
```

- Include the **network-isolation.yaml** file first, then the **network-environment.yaml** file. The subsequent **custom-network-configuration.yaml** overrides the **OS::TripleO::[ROLE]::Net::SoftwareConfig** resources from the previous two files.
- If you use composable networks, include the **network\_data.yaml** and **roles\_data.yaml** files with this command.

## CHAPTER 11. ADDITIONAL NETWORK CONFIGURATION

This chapter follows on from the concepts and procedures outlined in [Chapter 10, Custom network interface templates](#) and provides some additional information to help configure parts of your overcloud network.

### 11.1. CONFIGURING CUSTOM INTERFACES

Individual interfaces might require modification. The following example shows the modifications that are necessary to use a second NIC to connect to an infrastructure network with DHCP addresses, and to use a third and fourth NIC for the bond:

```
network_config:
  # Add a DHCP infrastructure network to nic2
  - type: interface
    name: nic2
    use_dhcp: true
  - type: ovs_bridge
    name: br-bond
    members:
      - type: ovs_bond
        name: bond1
        ovs_options:
          get_param: BondInterfaceOvsOptions
        members:
          # Modify bond NICs to use nic3 and nic4
          - type: interface
            name: nic3
            primary: true
          - type: interface
            name: nic4
```

The network interface template uses either the actual interface name (**eth0**, **eth1**, **enp0s25**) or a set of numbered interfaces (**nic1**, **nic2**, **nic3**). The network interfaces of hosts within a role do not have to be exactly the same when you use numbered interfaces (**nic1**, **nic2**, etc.) instead of named interfaces (**eth0**, **eno2**, etc.). For example, one host might have interfaces **em1** and **em2**, while another has **eno1** and **eno2**, but you can refer to the NICs of both hosts as **nic1** and **nic2**.

The order of numbered interfaces corresponds to the order of named network interface types:

- **ethX** interfaces, such as **eth0**, **eth1**, etc. These are usually onboard interfaces.
- **enoX** interfaces, such as **eno0**, **eno1**, etc. These are usually onboard interfaces.
- **enX** interfaces, sorted alpha numerically, such as **enp3s0**, **enp3s1**, **ens3**, etc. These are usually add-on interfaces.

The numbered NIC scheme includes only live interfaces, for example, if the interfaces have a cable attached to the switch. If you have some hosts with four interfaces and some with six interfaces, use **nic1** to **nic4** and attach only four cables on each host.

You can hardcode physical interfaces to specific aliases so that you can pre-determine which physical NIC maps as **nic1** or **nic2** and so on. You can also map a MAC address to a specified alias.

**NOTE**

Normally, **os-net-config** registers only the interfaces that are already connected in an **UP** state. However, if you hardcode interfaces with a custom mapping file, the interface is registered even if it is in a **DOWN** state.

Interfaces are mapped to aliases with an environment file. In this example, each node has predefined entries for **nic1** and **nic2**.

**NOTE**

If you want to use the **NetConfigDataLookup** configuration, you must also include the **os-net-config-mappings.yaml** file in the **NodeUserData** resource registry.

```
resource_registry:
  OS::TripleO::NodeUserData: /usr/share/openstack/tripleo-heat-templates/firstboot/os-net-config-
  mappings.yaml
parameter_defaults:
  NetConfigDataLookup:
    node1:
      nic1: "em1"
      nic2: "em2"
    node2:
      nic1: "00:50:56:2F:9F:2E"
      nic2: "em2"
```

The resulting configuration is applied by **os-net-config**. On each node, you can see the applied configuration in the **interface\_mapping** section of the **/etc/os-net-config/mapping.yaml** file.

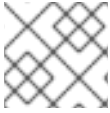
## 11.2. CONFIGURING ROUTES AND DEFAULT ROUTES

You can set the default route of a host in one of two ways. If the interface uses DHCP and the DHCP server offers a gateway address, the system uses a default route for that gateway. Otherwise, you can set a default route on an interface with a static IP.

Although the Linux kernel supports multiple default gateways, it uses only the gateway with the lowest metric. If there are multiple DHCP interfaces, this can result in an unpredictable default gateway. In this case, it is recommended to set **defroute: false** for interfaces other than the interface that uses the default route.

For example, you might want a DHCP interface (**nic3**) to be the default route. Use the following YAML snippet to disable the default route on another DHCP interface (**nic2**):

```
# No default route on this DHCP interface
- type: interface
  name: nic2
  use_dhcp: true
  defroute: false
# Instead use this DHCP interface as the default route
- type: interface
  name: nic3
  use_dhcp: true
```

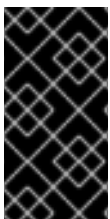
**NOTE**

The **defroute** parameter applies only to routes obtained through DHCP.

To set a static route on an interface with a static IP, specify a route to the subnet. For example, you can set a route to the 10.1.2.0/24 subnet through the gateway at 172.17.0.1 on the Internal API network:

```
- type: vlan
  device: bond1
  vlan_id:
    get_param: InternalApiNetworkVlanID
  addresses:
  - ip_netmask:
      get_param: InternalApiIpSubnet
  routes:
  - ip_netmask: 10.1.2.0/24
    next_hop: 172.17.0.1
```

### 11.3. CONFIGURING POLICY-BASED ROUTING

**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](#).

On Controller nodes, to configure unlimited access from different networks, configure policy-based routing. Policy-based routing uses route tables where, on a host with multiple interfaces, you can send traffic through a particular interface depending on the source address. You can route packets that come from different sources to different networks, even if the destinations are the same.

For example, you can configure a route to send traffic to the Internal API network, based on the source address of the packet, even when the default route is for the External network. You can also define specific route rules for each interface.

Red Hat OpenStack Platform uses the **os-net-config** tool to configure network properties for your overcloud nodes. The **os-net-config** tool manages the following network routing on Controller nodes:

- Routing tables in the **/etc/iproute2/rtables** file
- IPv4 rules in the **/etc/sysconfig/network-scripts/rule-{ifname}** file
- IPv6 rules in the **/etc/sysconfig/network-scripts/rule6-{ifname}** file
- Routing table specific routes in the **/etc/sysconfig/network-scripts/route-{ifname}**

**Prerequisites**

- You have installed the undercloud successfully. For more information, see [Installing director](#) in the *Director Installation and Usage* guide.

- You have rendered the default `.j2` network interface templates from the **openstack-tripleo-heat-templates** directory. For more information, see [Section 10.2, "Rendering default network interface templates for customization"](#).

## Procedure

1. Create **route\_table** and **interface** entries in a custom NIC template from the `~/templates/custom-nics` directory, define a route for the interface, and define rules that are relevant to your deployment:

```
$network_config:
network_config:

- type: route_table
  name: <custom>
  table_id: 200

- type: interface
  name: em1
  use_dhcp: false
  addresses:
    - ip_netmask: {get_param: ExternalIpSubnet}
  routes:
    - ip_netmask: 10.1.3.0/24
      next_hop: {get_param: ExternalInterfaceDefaultRoute}
      table: 200
  rules:
    - rule: "iif em1 table 200"
      comment: "Route incoming traffic to em1 with table 200"
    - rule: "from 192.0.2.0/24 table 200"
      comment: "Route all traffic from 192.0.2.0/24 with table 200"
    - rule: "add blackhole from 172.19.40.0/24 table 200"
    - rule: "add unreachable iif em1 from 192.168.1.0/24"
```

2. Set the **run-os-net-config.sh** script location to an absolute path in each custom NIC template that you create. The script is located in the `/usr/share/openstack-tripleo-heat-templates/network/scripts/` directory on the undercloud:

```
resources:
  OsNetConfigImpl:
    type: OS::Heat::SoftwareConfig
    properties:
      group: script
      config:
        str_replace:
          template:
            get_file: /usr/share/openstack-tripleo-heat-templates/network/scripts/run-os-net-config.sh
```

3. Include your custom NIC configuration and network environment files in the deployment command, along with any other environment files relevant to your deployment:

```
$ openstack overcloud deploy --templates \
-e ~/templates/<custom-nic-template>
-e <OTHER_ENVIRONMENT_FILES>
```

## Verification steps

- Enter the following commands on a Controller node to verify that the routing configuration is functioning correctly:

```
$ cat /etc/iproute2/rt_tables
$ ip route
$ ip rule
```

## 11.4. CONFIGURING JUMBO FRAMES

The Maximum Transmission Unit (MTU) setting determines the maximum amount of data transmitted with a single Ethernet frame. Using a larger value results in less overhead because each frame adds data in the form of a header. The default value is 1500 and using a higher value requires the configuration of the switch port to support jumbo frames. Most switches support an MTU of at least 9000, but many are configured for 1500 by default.

The MTU of a VLAN cannot exceed the MTU of the physical interface. Ensure that you include the MTU value on the bond or interface.

The Storage, Storage Management, Internal API, and Tenant networks all benefit from jumbo frames.



### WARNING

Routers typically cannot forward jumbo frames across Layer 3 boundaries. To avoid connectivity issues, do not change the default MTU for the Provisioning interface, External interface, and any floating IP interfaces.

```
- type: ovs_bond
  name: bond1
  mtu: 9000
  ovs_options: {get_param: BondInterfaceOvsOptions}
  members:
    - type: interface
      name: nic3
      mtu: 9000
      primary: true
    - type: interface
      name: nic4
      mtu: 9000

# The external interface should stay at default
- type: vlan
  device: bond1
  vlan_id:
    get_param: ExternalNetworkVlanID
  addresses:
    - ip_netmask:
        get_param: ExternalIpSubnet
  routes:
```



```

- ip_netmask: 0.0.0.0/0
  next_hop:
    get_param: ExternalInterfaceDefaultRoute

# MTU 9000 for Internal API, Storage, and Storage Management
- type: vlan
  device: bond1
  mtu: 9000
  vlan_id:
    get_param: InternalApiNetworkVlanID
  addresses:
    - ip_netmask:
      get_param: InternalApiIpSubnet

```

## 11.5. CONFIGURING ML2/OVN NORTHBOUND PATH MTU DISCOVERY FOR JUMBO FRAME FRAGMENTATION

If a VM on your internal network sends jumbo frames to an external network, and the maximum transmission unit (MTU) of the internal network exceeds the MTU of the external network, a northbound frame can easily exceed the capacity of the external network.

ML2/OVS automatically handles this oversized packet issue, and ML2/OVN handles it automatically for TCP packets.

But to ensure proper handling of oversized northbound UDP packets in a deployment that uses the ML2/OVN mechanism driver, you need to perform additional configuration steps.

These steps configure ML2/OVN routers to return ICMP "fragmentation needed" packets to the sending VM, where the sending application can break the payload into smaller packets.



### NOTE

In east/west traffic OVN does not support fragmentation of packets that are larger than the smallest MTU on the east/west path.

### Prerequisites

- RHEL 8.2.0.4 or later with kernel-4.18.0-193.20.1.el8\_2 or later.

### Procedure

1. Check the kernel version.

```
ovs-appctl -t ovs-vswitchd dpif/show-dp-features br-int
```

2. If the output includes **Check pkt length action: No**, or if there is no **Check pkt length action** string in the output, upgrade to RHEL 8.2.0.4 or later, or do not send jumbo frames to an external network that has a smaller MTU.
3. If the output includes **Check pkt length action: Yes**, set the following value in the [ovn] section of ml2\_conf.ini.

```
ovn_emit_need_to_frag = True
```

## 11.6. CONFIGURING THE NATIVE VLAN ON A TRUNKED INTERFACE

If a trunked interface or bond has a network on the native VLAN, the IP addresses are assigned directly to the bridge and there is no VLAN interface.

For example, if the External network is on the native VLAN, a bonded configuration looks like this:

```
network_config:
- type: ovs_bridge
  name: bridge_name
  dns_servers:
    get_param: DnsServers
  addresses:
    - ip_netmask:
      get_param: ExternalIpSubnet
  routes:
    - ip_netmask: 0.0.0.0/0
      next_hop:
        get_param: ExternalInterfaceDefaultRoute
  members:
    - type: ovs_bond
      name: bond1
      ovs_options:
        get_param: BondInterfaceOvsOptions
      members:
        - type: interface
          name: nic3
          primary: true
        - type: interface
          name: nic4
```



### NOTE

When you move the address or route statements onto the bridge, remove the corresponding VLAN interface from the bridge. Make the changes to all applicable roles. The External network is only on the controllers, so only the controller template requires a change. The Storage network is attached to all roles, so if the Storage network is on the default VLAN, all roles require modifications.

## CHAPTER 12. NETWORK INTERFACE BONDING

You can use various bonding options in your custom network configuration.

### 12.1. NETWORK INTERFACE BONDING FOR OVERCLOUD NODES

You can bundle multiple physical NICs together to form a single logical channel known as a bond. You can configure bonds to provide redundancy for high availability systems or increased throughput.

Red Hat OpenStack Platform supports Open vSwitch (OVS) kernel bonds, OVS-DPDK bonds, and Linux kernel bonds.

**Table 12.1. Supported interface bonding types**

Bond type	Type value	Allowed bridge types	Allowed members
OVS kernel bonds	<b>ovs_bond</b>	<b>ovs_bridge</b>	<b>interface</b>
OVS-DPDK bonds	<b>ovs_dpdk_bond</b>	<b>ovs_user_bridge</b>	<b>ovs_dpdk_port</b>
Linux kernel bonds	<b>linux_bond</b>	<b>ovs_bridge</b> or <b>linux_bridge</b>	<b>interface</b>



#### IMPORTANT

Do not combine **ovs\_bridge** and **ovs\_user\_bridge** on the same node.

### 12.2. CREATING OPEN VSWITCH (OVS) BONDS

You create OVS bonds in your network interface templates. For example, you can create a bond as part of an OVS user space bridge:

```
...
  params:
    $network_config:
      network_config:
        - type: ovs_user_bridge
          name: br-ex
          use_dhcp: false
          members:
            - type: ovs_dpdk_bond
              name: dpdkbond0
              mtu: 2140
              ovs_options: {get_param: BondInterfaceOvsOptions}
              rx_queue:
                get_param: NumDpdkInterfaceRxQueues
            members:
              - type: ovs_dpdk_port
                name: dpdk0
                mtu: 2140
                members:
                  - type: interface
```

```

    name: p1p1
  - type: ovs_dpdk_port
    name: dpdk1
    mtu: 2140
    members:
  - type: interface
    name: p1p2

```

In this example, you create the bond from two DPDK ports.

The **ovs\_options** parameter contains the bonding options. You can configure a bonding options in a network environment file with the **BondInterfaceOvsOptions** parameter:

```

parameter_defaults:
  BondInterfaceOvsOptions: "bond_mode=balance-slb"

```

## 12.3. OPEN VSWITCH (OVS) BONDING OPTIONS

You can set various Open vSwitch (OVS) bonding options with the **ovs\_options** heat parameter in your NIC template files.

**Table 12.2. Bonding options**

Option	Description
<b>bond_mode=balance-slb</b>	Balances flows based on source MAC address and output VLAN, with periodic rebalancing as traffic patterns change. Bonding with <b>balance-slb</b> allows a limited form of load balancing without the remote switch's knowledge or cooperation. SLB assigns each source MAC and VLAN pair to a link and transmits all packets from that MAC and VLAN through that link. This mode uses a simple hashing algorithm based on source MAC address and VLAN number, with periodic rebalancing as traffic patterns change. This mode is similar to mode 2 bonds used by the Linux bonding driver. You can use this mode to provide load balancing even when the switch is not configured to use LACP.
<b>bond_mode=active-backup</b>	This mode offers active/standby failover where the standby NIC resumes network operations when the active connection fails. Only one MAC address is presented to the physical switch. This mode does not require any special switch support or configuration, and works when the links are connected to separate switches. This mode does not provide load balancing.
<b>lACP=[active passive off]</b>	Controls the Link Aggregation Control Protocol (LACP) behavior. Only certain switches support LACP. If your switch does not support LACP, use <b>bond_mode=balance-slb</b> or <b>bond_mode=active-backup</b> .

<b>other-config:lacp-fallback-ab=true</b>	Sets the LACP behavior to switch to <b>bond_mode=active-backup</b> as a fallback.
<b>other_config:lacp-time=[fast slow]</b>	Set the LACP heartbeat to 1 second (fast) or 30 seconds (slow). The default is slow.
<b>other_config:bond-detect-mode=[miimon carrier]</b>	Set the link detection to use miimon heartbeats (miimon) or monitor carrier (carrier). The default is carrier.
<b>other_config:bond-miimon-interval=100</b>	If using miimon, set the heartbeat interval in milliseconds.
<b>bond_updelay=1000</b>	Number of milliseconds a link must be up to be activated to prevent flapping.
<b>other_config:bond-rebalance-interval=10000</b>	Milliseconds between rebalancing flows between bond members. Set this value to zero to disable rebalancing flows between bond members.

## 12.4. USING LINK AGGREGATION CONTROL PROTOCOL (LACP) WITH OPEN VSWITCH (OVS) BONDING MODES

You can use bonds with the optional Link Aggregation Control Protocol (LACP). LACP is a negotiation protocol that creates a dynamic bond for load balancing and fault tolerance.

Use the following table to understand support compatibility for OVS kernel and OVS-DPDK bonded interfaces in conjunction with LACP options.



### IMPORTANT

The OVS/OVS-DPDK **balance-tcp** mode is available as a technology preview only.



### IMPORTANT

On control and storage networks, Red Hat recommends that you use Linux bonds with VLAN and LACP, because OVS bonds carry the potential for control plane disruption that can occur when OVS or the neutron agent is restarted for updates, hot fixes, and other events. The Linux bond/LACP/VLAN configuration provides NIC management without the OVS disruption potential.

Table 12.3. LACP options for OVS kernel and OVS-DPDK bond modes

Objective	OVS bond mode	Compatible LACP options	Notes
High availability (active-passive)	<b>active-backup</b>	<b>active, passive, or off</b>	

Increased throughput (active-active)	<b>balance-slb</b>	<b>active, passive, or off</b>	<ul style="list-style-type: none"> <li>● Performance is affected by extra parsing per packet.</li> <li>● There is a potential for vhost-user lock contention.</li> </ul>
	<b>balance-tcp</b>	<b>active or passive</b>	<ul style="list-style-type: none"> <li>● <b>Tech preview only.</b> Not recommended for use in production.</li> <li>● Recirculation needed for L4 hashing has a performance impact.</li> <li>● As with balance-slb, performance is affected by extra parsing per packet and there is a potential for vhost-user lock contention.</li> <li>● LACP must be enabled.</li> </ul>

## 12.5. CREATING LINUX BONDS

You create linux bonds in your network interface templates. For example, you can create a linux bond that bond two interfaces:

```
...
  params:
    $network_config:
      network_config:
        - type: linux_bond
          name: bond1
          members:
            - type: interface
              name: nic2
            - type: interface
              name: nic3
          bonding_options: "mode=802.3ad lacp_rate=[fast|slow] updelay=1000 miimon=100"
```

The **bonding\_options** parameter sets the specific bonding options for the Linux bond.

### mode

Sets the bonding mode, which in the example is **802.3ad** or LACP mode. For more information about Linux bonding modes, see "[Upstream Switch Configuration Depending on the Bonding Modes](#)" in the Red Hat Enterprise Linux 8 Configuring and Managing Networking guide.

### lacp\_rate

Defines whether LACP packets are sent every 1 second, or every 30 seconds.

### updelay

Defines the minimum amount of time that an interface must be active before it is used for traffic. This minimum configuration helps to mitigate port flapping outages.

### miimon

The interval in milliseconds that is used for monitoring the port state using the MIIMON functionality of the driver.

Use the following additional examples as guides to configure your own Linux bonds:

- Linux bond set to **active-backup** mode with one VLAN:

```
....
  params:
    $network_config:
      network_config:
        - type: linux_bond
          name: bond_api
          bonding_options: "mode=active-backup"
          use_dhcp: false
          dns_servers:
            get_param: DnsServers
          members:
            - type: interface
              name: nic3
              primary: true
            - type: interface
              name: nic4

        - type: vlan
          vlan_id:
            get_param: InternalApiNetworkVlanID
          device: bond_api
          addresses:
            - ip_netmask:
                get_param: InternalApiIpSubnet
```

- Linux bond set to **802.3ad** LACP mode with one VLAN:

```
...
  params:
    $network_config:
      network_config:
        - type: ovs_bridge
          name: br-tenant
          use_dhcp: false
```

```
mtu: 9000
members:
- type: linux_bond
  name: bond_tenant
  bonding_options: "mode=802.3ad updelay=1000 miimon=100"
  use_dhcp: false
  dns_servers:
    get_param: DnsServers
  members:
- type: interface
  name: p1p1
  primary: true
- type: interface
  name: p1p2
- type: vlan
  device: bond_tenant
  vlan_id: {get_param: TenantNetworkVlanID}
addresses:
-
  ip_netmask: {get_param: TenantIpSubnet}
```



## CHAPTER 13. CONTROLLING NODE PLACEMENT

By default, director selects nodes for each role randomly, usually according to the profile tag of the node. However, you can also define specific node placement. This is useful in the following scenarios:

- Assign specific node IDs, for example, **controller-0**, **controller-1**
- Assign custom host names
- Assign specific IP addresses
- Assign specific Virtual IP addresses



### NOTE

Manually setting predictable IP addresses, virtual IP addresses, and ports for a network alleviates the need for allocation pools. However, it is recommended to retain allocation pools for each network to ease with scaling new nodes. Ensure that any statically defined IP addresses fall outside the allocation pools. For more information about setting allocation pools, see [Section 10.7, “Custom network environment file”](#).

### 13.1. ASSIGNING SPECIFIC NODE IDS

You can assign node IDs to specific nodes, for example, **controller-0**, **controller-1**, **compute-0**, and **compute-1**.

#### Procedure

1. Assign the ID as a per-node capability that the Compute scheduler matches on deployment:

```
openstack baremetal node set --property capabilities='node:controller-0,boot_option:local'
<id>
```

This command assigns the capability **node:controller-0** to the node. Repeat this pattern using a unique continuous index, starting from 0, for all nodes. Ensure that all nodes for a given role (Controller, Compute, or each of the storage roles) are tagged in the same way, or the Compute scheduler cannot match the capabilities correctly.

2. Create a heat environment file (for example, **scheduler\_hints\_env.yaml**) that uses scheduler hints to match the capabilities for each node:

```
parameter_defaults:
  ControllerSchedulerHints:
    'capabilities:node': 'controller-%index%'
```

Use the following parameters to configure scheduler hints for other role types:

- **ControllerSchedulerHints** for Controller nodes.
- **ComputeSchedulerHints** for Compute nodes.
- **BlockStorageSchedulerHints** for Block Storage nodes.
- **ObjectStorageSchedulerHints** for Object Storage nodes.

- **CephStorageSchedulerHints** for Ceph Storage nodes.
  - **[ROLE]SchedulerHints** for custom roles. Replace **[ROLE]** with the role name.
3. Include the **scheduler\_hints\_env.yaml** environment file in the **overcloud deploy** command.



## NOTE

Node placement takes priority over profile matching. To avoid scheduling failures, use the default **baremetal** flavor for deployment and not the flavors that are designed for profile matching (**compute**, **control**):. Set the respective flavor parameters to baremetal in an environment file:

```
parameter_defaults:
  OvercloudControllerFlavor: baremetal
  OvercloudComputeFlavor: baremetal
```

## 13.2. ASSIGNING CUSTOM HOST NAMES

In combination with the node ID configuration in [Section 13.1, "Assigning specific node IDs"](#), director can also assign a specific custom host name to each node. This is useful when you need to define where a system is located (for example, **rack2-row12**), match an inventory identifier, or other situations where a custom hostname is desirable.



## IMPORTANT

Do not rename a node after it has been deployed. Renaming a node after deployment creates issues with instance management.

### Procedure

- Use the **HostnameMap** parameter in an environment file, such as the **scheduler\_hints\_env.yaml** file from [Section 13.1, "Assigning specific node IDs"](#):

```
parameter_defaults:
  ControllerSchedulerHints:
    'capabilities:node': 'controller-%index%'
  ComputeSchedulerHints:
    'capabilities:node': 'compute-%index%'
  HostnameMap:
    overcloud-controller-0: overcloud-controller-prod-123-0
    overcloud-controller-1: overcloud-controller-prod-456-0
    overcloud-controller-2: overcloud-controller-prod-789-0
    overcloud-novacompute-0: overcloud-compute-prod-abc-0
```

Define the **HostnameMap** in the **parameter\_defaults** section, and set each mapping as the original hostname that heat defines with **HostnameFormat** parameters (for example, **overcloud-controller-0**) and the second value is the desired custom hostname for that node (**overcloud-controller-prod-123-0**).

Use this method in combination with the node ID placement to ensure that each node has a custom hostname.

### 13.3. ASSIGNING PREDICTABLE IPS

For further control over the resulting environment, director can assign overcloud nodes with specific IP addresses on each network.

#### Procedure

1. Create an environment file to define the predictive IP addressing:

```
$ touch ~/templates/predictive_ips.yaml
```

2. Create a **parameter\_defaults** section in the `~/templates/predictive_ips.yaml` file and use the following syntax to define predictive IP addressing for each node on each network:

```
parameter_defaults:
  <role_name>IPs:
    <network>:
      - <IP_address>
    <network>:
      - <IP_address>
```

Each node role has a unique parameter. Replace **<role\_name>IPs** with the relevant parameter:

- **ControllerIPs** for Controller nodes.
  - **ComputeIPs** for Compute nodes.
  - **CephStorageIPs** for Ceph Storage nodes.
  - **BlockStorageIPs** for Block Storage nodes.
  - **SwiftStorageIPs** for Object Storage nodes.
  - **[ROLE]IPs** for custom roles. Replace **[ROLE]** with the role name.
- Each parameter is a map of network names to a list of addresses. Each network type must have at least as many addresses as there will be nodes on that network. Director assigns addresses in order. The first node of each type receives the first address on each respective list, the second node receives the second address on each respective lists, and so forth.

For example, use the following example syntax if you want to deploy three Ceph Storage nodes in your overcloud with predictive IP addresses:

```
parameter_defaults:
  CephStorageIPs:
    storage:
      - 172.16.1.100
      - 172.16.1.101
      - 172.16.1.102
    storage_mgmt:
      - 172.16.3.100
      - 172.16.3.101
      - 172.16.3.102
```

The first Ceph Storage node receives two addresses: 172.16.1.100 and 172.16.3.100. The second receives 172.16.1.101 and 172.16.3.101, and the third receives 172.16.1.102 and 172.16.3.102. The same pattern applies to the other node types.

To configure predictable IP addresses on the control plane, copy the `/usr/share/openstack-tripleo-heat-templates/environments/ips-from-pool-ctlplane.yaml` file to the `templates` directory of the `stack` user:

```
$ cp /usr/share/openstack-tripleo-heat-templates/environments/ips-from-pool-ctlplane.yaml ~/templates/.
```

Configure the new `ips-from-pool-ctlplane.yaml` file with the following parameter example. You can combine the control plane IP address declarations with the IP address declarations for other networks and use only one file to declare the IP addresses for all networks on all roles. You can also use predictable IP addresses for spine/leaf. Each node must have IP addresses from the correct subnet.

```
parameter_defaults:
  ControllerIPs:
    ctlplane:
      - 192.168.24.10
      - 192.168.24.11
      - 192.168.24.12
    internal_api:
      - 172.16.1.20
      - 172.16.1.21
      - 172.16.1.22
    external:
      - 10.0.0.40
      - 10.0.0.57
      - 10.0.0.104
  ComputeLeaf1IPs:
    ctlplane:
      - 192.168.25.100
      - 192.168.25.101
    internal_api:
      - 172.16.2.100
      - 172.16.2.101
  ComputeLeaf2IPs:
    ctlplane:
      - 192.168.26.100
      - 192.168.26.101
    internal_api:
      - 172.16.3.100
      - 172.16.3.101
```

Ensure that the IP addresses that you choose fall outside the allocation pools for each network that you define in your network environment file (see [Section 10.7, “Custom network environment file”](#)). For example, ensure that the `internal_api` assignments fall outside of the `InternalApiAllocationPools` range to avoid conflicts with any IPs chosen automatically. Also ensure that the IP assignments do not conflict with the VIP configuration, either for standard predictable VIP placement (see [Section 13.4, “Assigning predictable Virtual IPs”](#)) or external load balancing (see [Section 23.3, “Configuring external load balancing”](#)).

**IMPORTANT**

If an overcloud node is deleted, do not remove its entries in the IP lists. The IP list is based on the underlying heat indices, which do not change even if you delete nodes. To indicate a given entry in the list is no longer used, replace the IP value with a value such as **DELETED** or **UNUSED**. Entries should never be removed from the IP lists, only changed or added.

- To apply this configuration during a deployment, include the **predictive\_ips.yaml** environment file with the **openstack overcloud deploy** command.

**IMPORTANT**

If you use network isolation, include the **predictive\_ips.yaml** file after the **network-isolation.yaml** file:

```
$ openstack overcloud deploy --templates \
  -e /usr/share/openstack-tripleo-heat-templates/environments/network-
  isolation.yaml \
  -e ~/templates/predictive_ips.yaml \
  [OTHER OPTIONS]
```

## 13.4. ASSIGNING PREDICTABLE VIRTUAL IPS

In addition to defining predictable IP addresses for each node, you can also define predictable Virtual IPs (VIPs) for clustered services.

### Procedure

- Edit the network environment file from [Section 10.7, “Custom network environment file”](#) and add the VIP parameters in the **parameter\_defaults** section:

```
parameter_defaults:
  ...
  # Predictable VIPs
  ControlFixedIPs: [{'ip_address':'192.168.201.101'}]
  InternalApiVirtualFixedIPs: [{'ip_address':'172.16.0.9'}]
  PublicVirtualFixedIPs: [{'ip_address':'10.1.1.9'}]
  StorageVirtualFixedIPs: [{'ip_address':'172.18.0.9'}]
  StorageMgmtVirtualFixedIPs: [{'ip_address':'172.19.0.9'}]
  RedisVirtualFixedIPs: [{'ip_address':'172.16.0.8'}]
  OVNDBsVirtualFixedIPs: [{'ip_address':'172.16.0.7'}]
```

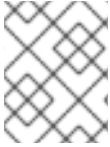
Select these IPs from outside of their respective allocation pool ranges. For example, select an IP address for **InternalApiVirtualFixedIPs** that is not within the **InternalApiAllocationPools** range.

**NOTE**

This step is only for overclouds that use the default internal load balancing configuration. If you want to assign VIPs with an external load balancer, use the procedure in the dedicated [External Load Balancing for the Overcloud](#) guide.

## CHAPTER 14. ENABLING SSL/TLS ON OVERCLOUD PUBLIC ENDPOINTS

By default, the overcloud uses unencrypted endpoints for the overcloud services. To enable SSL/TLS in your overcloud, you must configure the SSL/TLS certificate and include it in the overcloud deployment command.



### NOTE

This process enables SSL/TLS only for Public API endpoints. The Internal and Admin APIs remain unencrypted.

### Prerequisites

- Network isolation to define the endpoints for the Public API.
- The **openssl-perl** package is installed.

## 14.1. 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 the file does not exist, create the directory path if needed, then create an empty file, **index.txt**:

```
$ sudo mkdir -p /etc/pki/CA
$ 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, **serial**, with a starting value of **1000**:

```
$ echo '1000' | sudo tee /etc/pki/CA/serial
```

## 14.2. 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
```

2. The **openssl req** command requests certain details about your authority. Enter these details at the prompt.

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

## 14.3. ADDING THE CERTIFICATE AUTHORITY TO CLIENTS

For any external clients that need to communicate using SSL/TLS, you can add the certificate authority to the client.

### Procedure

1. Copy the certificate authority file to each client that requires access to your Red Hat OpenStack Platform environment:

```
$ 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
```

For example, the undercloud requires a copy of the certificate authority file so that it can communicate with the overcloud endpoints during creation.

## 14.4. CREATING AN SSL/TLS KEY

Run the following command to generate the SSL/TLS key (**server.key.pem**) that you use at different points to generate your undercloud or overcloud certificates:

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

## 14.5. CREATING AN SSL/TLS CERTIFICATE SIGNING REQUEST

Create a certificate signing request for the overcloud.

### Procedure

1. Copy the default OpenSSL configuration file so that you can complete your customization:

```
$ cp /etc/pki/tls/openssl.cnf .
```

2. Edit the custom **openssl.cnf** file and set the SSL parameters that you want to use for the overcloud. For example, modify the following parameters:

```
[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 = 10.0.0.1
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 = 10.0.0.1
DNS.1 = 10.0.0.1
DNS.2 = myovercloud.example.com

```

Set the **commonName\_default** to one of the following:

- If you use an IP to access over SSL/TLS, use the Virtual IP for the Public API. Set this VIP by using the **PublicVirtualFixedIPs** parameter in an environment file. For more information, see [Section 13.4, “Assigning predictable Virtual IPs”](#). If you are not using predictable VIPs, director assigns the first IP address from the range that you define in the **ExternalAllocationPools** parameter.
  - If you use a fully qualified domain name to access over SSL/TLS, use the domain name instead.  
Include the same Public API IP address as an IP entry and a DNS entry in the **alt\_names** section. If you also use DNS, include the host name for the server as DNS entries in the same section. For more information about **openssl.cnf**, run **man openssl.cnf**.
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 the SSL/TLS key that you created in [Section 14.4, “Creating an SSL/TLS key”](#) in the **-key** option.

Use the **server.csr.pem** file to create the SSL/TLS certificate in the next section.

## 14.6. CREATING THE SSL/TLS CERTIFICATE

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
```





## NOTE

If the **openssl-perl** package is not installed, this command fails with the following error:  
**/etc/pki/CA/newcerts: No such file or directory.**

This command uses the following options:

- The configuration file that specifies the v3 extensions. Include the configuration file with the **-config** option.
- The certificate signing request from [Section 14.5, “Creating an SSL/TLS Certificate Signing Request”](#) to generate and sign the certificate with a certificate authority. Include the certificate signing request with the **-in** option.
- The certificate authority that you created in [Section 14.2, “Creating a Certificate Authority”](#), which signs the certificate. Include the certificate authority with the **-cert** option.
- The certificate authority private key that you created in [Section 14.2, “Creating a Certificate Authority”](#). Include the private key with the **-keyfile** option.

This command creates a new certificate named **server.crt.pem**. Use this certificate in conjunction with the SSL/TLS key from [Section 14.4, “Creating an SSL/TLS key”](#) to enable SSL/TLS.

## 14.7. ENABLING SSL/TLS

### Procedure

1. Copy the **enable-tls.yaml** environment file from the heat template collection:

```
$ cp -r /usr/share/openstack-tripleo-heat-templates/environments/ssl/enable-tls.yaml
~/templates/.
```

2. Edit this file and make the following changes for these parameters:

#### SSLCertificate

Copy the contents of the certificate file (**server.crt.pem**) into the **SSLCertificate** parameter:

```
parameter_defaults:
  SSLCertificate: |
    -----BEGIN CERTIFICATE-----
    MIIDgzCCAmugAwIBAgIJAKk46qw6ncJaMA0GCSqGS
    ...
    sFW3S2roS4X0Af/kSSD8mIBBTFTCMBAj6rtLBKLaQ
    -----END CERTIFICATE-----
```



## IMPORTANT

The certificate contents require the same indentation level for all new lines.

#### SSLIntermediateCertificate

If you have an intermediate certificate, copy the contents of the intermediate certificate into the **SSLIntermediateCertificate** parameter:

```
parameter_defaults:
  SSLIntermediateCertificate: |
    -----BEGIN CERTIFICATE-----
    sFW3S2roS4X0Af/kSSD8mlBBTFTCMBAj6rtLBKLaQblxEplzrgvpBCwUAMFgxCzAJB
    ...
    MIIDgzCCAmugAwIBAgIJAKk46qw6ncJaMA0GCSqGSIb3DQE
    -----END CERTIFICATE-----
```



### IMPORTANT

The certificate contents require the same indentation level for all new lines.

### SSLKey

Copy the contents of the private key (**server.key.pem**) into the **SSLKey** parameter:

```
parameter_defaults:
  ...
  SSLKey: |
    -----BEGIN RSA PRIVATE KEY-----
    MIIEowIBAAKCAQEAqVw8lnQ9Rbel1EdLN5PJP0IVO
    ...
    ctIKn3rAAadyumi4JDjESAXHIKFjJNOLrBmpQyES4X
    -----END RSA PRIVATE KEY-----
```



### IMPORTANT

The private key contents require the same indentation level for all new lines.

## 14.8. INJECTING A ROOT CERTIFICATE

If the certificate signer is not in the default trust store on the overcloud image, you must inject the certificate authority into the overcloud image.

### Procedure

1. Copy the **inject-trust-anchor-hiera.yaml** environment file from the heat template collection:

```
$ cp -r /usr/share/openstack-tripleo-heat-templates/environments/ssl/inject-trust-anchor-hiera.yaml ~/templates/.
```

Edit this file and make the following changes for these parameters:

### CAMap

Lists each certificate authority content (CA) to inject into the overcloud. The overcloud requires the CA files used to sign the certificates for both the undercloud and the overcloud. Copy the contents of the root certificate authority file (**ca.crt.pem**) into an entry. For example, your **CAMap** parameter might look like the following:

```

parameter_defaults:
  CAMap:
    ...
  undercloud-ca:
    content: |
      -----BEGIN CERTIFICATE-----
      MIIDITCCAn2gAwIBAgIJAOOnPtx2hHEhrMA0GCS
      BAYTAIVTMQswCQYDVQQIDAJOQzEQMA4GA1UEBw
      UmVkiEhhdDELMAkGA1UECwwCUUUxFDASBgNVBA
      -----END CERTIFICATE-----
  overcloud-ca:
    content: |
      -----BEGIN CERTIFICATE-----
      MIIDBzCCAe+gAwIBAgIJAlc75A7FD++DMA0GCS
      BAMMD3d3dy5leGFtcGxlMnVbTAeFw0xOTAxMz
      Um54yGCARyp3LpkxvyfMXX1DokpS1uKi7s6CkF
      -----END CERTIFICATE-----

```



### IMPORTANT

The certificate authority contents require the same indentation level for all new lines.

You can also inject additional CAs with the **CAMap** parameter.

## 14.9. CONFIGURING DNS ENDPOINTS

If you use a DNS hostname to access the overcloud through SSL/TLS, copy the **/usr/share/openstack-tripleo-heat-templates/environments/predictable-placement/custom-domain.yaml** file into the **/home/stack/templates** directory.



### NOTE

It is not possible to redeploy with a TLS-everywhere architecture if this environment file is not included in the initial deployment.

Configure the host and domain names for all fields, adding parameters for custom networks if needed:

#### CloudDomain

the DNS domain for hosts.

#### CloudName

The DNS hostname of the overcloud endpoints.

#### CloudNameCtlplane

The DNS name of the provisioning network endpoint.

#### CloudNameInternal

The DNS name of the Internal API endpoint.

#### CloudNameStorage

The DNS name of the storage endpoint.

#### DnsServers

A list of DNS servers that you want to use. The configured DNS servers must contain an entry for the configured **CloudName** that matches the IP address of the Public API.

### CloudNameStorageManagement

The DNS name of the storage management endpoint.

1. Add a list of DNS servers to use under parameter defaults, in either a new or existing environment file:

```
parameter_defaults:
  DnsServers: ["10.0.0.254"]
  ....
```

## 14.10. ADDING ENVIRONMENT FILES DURING OVERCLOUD CREATION

Use the **-e** option with the deployment command **openstack overcloud deploy** to include environment files in the deployment process. Add the environment files from this section in the following order:

- The environment file to enable SSL/TLS (**enable-tls.yaml**)
- The environment file to set the DNS hostname (**cloudname.yaml**)
- The environment file to inject the root certificate authority (**inject-trust-anchor-hiera.yaml**)
- The environment file to set the public endpoint mapping:
  - If you use a DNS name for accessing the public endpoints, use **/usr/share/openstack-tripleo-heat-templates/environments/ssl/tls-endpoints-public-dns.yaml**
  - If you use a IP address for accessing the public endpoints, use **/usr/share/openstack-tripleo-heat-templates/environments/ssl/tls-endpoints-public-ip.yaml**

Example deployment command:

```
$ openstack overcloud deploy --templates \
[...]\
-e /home/stack/templates/enable-tls.yaml \
-e ~/templates/cloudname.yaml \
-e ~/templates/inject-trust-anchor-hiera.yaml \
-e /usr/share/openstack-tripleo-heat-templates/environments/ssl/tls-endpoints-public-dns.yaml
```

## 14.11. MANUALLY UPDATING SSL/TLS CERTIFICATES

Complete the following steps if you are using your own SSL/TLS certificates that are not auto-generated from the TLS everywhere (TLS-e) process:

1. Edit your heat templates with the following content:
  - Edit the **enable-tls.yaml** file and update the **SSLCertificate**, **SSLKey**, and **SSLIntermediateCertificate** parameters.
  - If your certificate authority has changed, edit the **inject-trust-anchor-hiera.yaml** file and update the **CAMap** parameter.
2. Rerun the deployment command:

```
$ openstack overcloud deploy --templates \  
[...]  
-e /home/stack/templates/enable-tls.yaml \  
-e ~/templates/cloudname.yaml \  
-e ~/templates/inject-trust-anchor-hiera.yaml \  
-e /usr/share/openstack-tripleo-heat-templates/environments/ssl/tls-endpoints-public-  
dns.yaml
```

3. Run **/usr/bin/certmonger-haproxy-refresh.sh** on each controller to notify haproxy of the change.

## CHAPTER 15. ENABLING SSL/TLS ON INTERNAL AND PUBLIC ENDPOINTS WITH IDENTITY MANAGEMENT

You can enable SSL/TLS on certain overcloud endpoints. Due to the number of certificates required, director integrates with a Red Hat Identity Management (IdM) server to act as a certificate authority and manage the overcloud certificates. This process uses **novajoin** to enroll overcloud nodes to the IdM server.

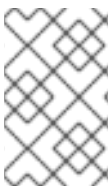
To check the status of TLS support across the OpenStack components, refer to the [TLS Enablement status matrix](#).

### 15.1. ENROLLING NODES IN RED HAT IDENTITY MANAGER (IDM) WITH NOVAJOIN

Novajoin is the default tool that you use to enroll your nodes with Red Hat Identity Manager (IdM) as part of the deployment process. As a result, you can integrate IdM features with your Red Hat OpenStack Platform deployment, including identities, kerberos credentials, and access controls. You must perform the enrollment process before you proceed with the rest of the IdM integration.

The enrollment process includes the following steps:

1. Adding the undercloud node to the certificate authority (CA)
2. Adding the undercloud node to IdM
3. Optional: Setting the IdM server as the DNS server for the overcloud
4. Preparing the environment files and deploying the overcloud
5. Testing the overcloud enrollment in IdM and in RHOSP
6. Optional: Adding DNS entries for novajoin in IdM



#### NOTE

IdM enrollment with novajoin is currently only available for the undercloud and overcloud nodes. Novajoin integration for overcloud instances is expected to be supported in a later release.

### 15.2. ADDING THE UNDERCLOUD NODE TO THE CERTIFICATE AUTHORITY

Before you deploy the overcloud, add the undercloud to the certificate authority (CA) by installing the **python3-novajoin** package on the undercloud node and running the **novajoin-ipa-setup** script.

#### Procedure

1. On the undercloud node, install the **python3-novajoin** package:

```
$ sudo dnf install python3-novajoin
```

2. On the undercloud node, run the **novajoin-ipa-setup** script, and adjust the values to suit your deployment:

```
$ sudo /usr/libexec/novajoin-ipa-setup \
--principal admin \
--password <IdM admin password> \
--server <IdM server hostname> \
--realm <realm> \
--domain <overcloud cloud domain> \
--hostname <undercloud hostname> \
--precreate
```

Use the resulting One-Time Password (OTP) to enroll the undercloud.

### 15.3. ADDING THE UNDERCLOUD NODE TO RED HAT IDENTITY MANAGER (IDM)

After you add the undercloud node to the certificate authority (CA), register the undercloud with IdM and configure novajoin. Configure the following settings in the **[DEFAULT]** section of the **undercloud.conf** file.

#### Procedure

1. Enable the **novajoin** service:

```
[DEFAULT]
enable_novajoin = true
```

2. Set a One-Time Password (OTP) so that you can register the undercloud node with IdM:

```
ipa_otp = <otp>
```

3. Set the overcloud's domain name to be served by neutron's DHCP server:

```
overcloud_domain_name = <domain>
```

4. Set the hostname for the undercloud:

```
undercloud_hostname = <undercloud FQDN>
```

5. Set IdM as the nameserver for the undercloud:

```
undercloud_nameservers = <IdM IP>
```

6. For larger environments, review the novajoin connection timeout values. In the **undercloud.conf** file, add a reference to a new file called **undercloud-timeout.yaml**:

```
hieradata_override = /home/stack/undercloud-timeout.yaml
```

Add the following options to **undercloud-timeout.yaml**. You can specify the timeout value in seconds, for example, **5**:

```
nova::api::vendordata_dynamic_connect_timeout: <timeout value>
nova::api::vendordata_dynamic_read_timeout: <timeout value>
```

Optional: If you want the local openssl certificate authority to generate the SSL certificates for the public endpoints in director, set the **generate\_service\_certificate** parameter to **true**:

+

```
generate_service_certificate = true
```

1. Save the **undercloud.conf** file.
2. Run the undercloud deployment command to apply the changes to your existing undercloud:

```
$ openstack undercloud install
```

## 15.4. SETTING RED HAT IDENTITY MANAGER (IDM) AS THE DNS SERVER FOR THE OVERCLOUD

To enable automatic detection of your IdM environment and easier enrollment, set IdM as your DNS server. This procedure is optional but recommended.

### Procedure

1. Connect to your undercloud:

```
$ source ~/stackrc
```

2. Configure the control plane subnet to use IdM as the DNS name server:

```
$ openstack subnet set ctlplane-subnet --dns-nameserver <idm_server_address>
```

3. Set the **DnsServers** parameter in an environment file to use your IdM server:

```
parameter_defaults:
  DnsServers: ["<idm_server_address>"]
```

This parameter is usually defined in a custom **network-environment.yaml** file.

## 15.5. PREPARING ENVIRONMENT FILES AND DEPLOYING THE OVERCLOUD WITH NOVAJOIN ENROLLMENT

To deploy the overcloud with IdM integration, you create and edit environment files to configure the overcloud to use the custom domain parameters **CloudDomain** and **CloudName** based on the domains that you define in the overcloud. You then deploy the overcloud with all the environment files and any additional environment files that you need for the deployment.

### Procedure

1. Create a copy of the **/usr/share/openstack-tripleo-heat-templates/environments/predictable-placement/custom-domain.yaml** environment file:

```
$ cp /usr/share/openstack-tripleo-heat-templates/environments/predictable-
placement/custom-domain.yaml \
/home/stack/templates/custom-domain.yaml
```



- 
2. Edit the `/home/stack/templates/custom-domain.yaml` environment file and set the **CloudDomain** and **CloudName\*** values to suit your deployment:

```
parameter_defaults:
  CloudDomain: lab.local
  CloudName: overcloud.lab.local
  CloudNameInternal: overcloud.internalapi.lab.local
  CloudNameStorage: overcloud.storage.lab.local
  CloudNameStorageManagement: overcloud.storageemgmt.lab.local
  CloudNameCtlplane: overcloud.ctlplane.lab.local
```

3. Choose the implementation of TLS appropriate for your environment:
  - Use the **enable-tls.yaml** environment file to protect external endpoints with your custom certificate:
    - a. Copy `/usr/share/openstack-tripleo-heat-templates/environments/ssl/enable-tls.yaml` to `/home/stack/templates`.
    - b. Modify the `/home/stack/enable-tls.yaml` environment file to include your custom certificate and key.
    - c. Include the following environment files in your deployment to protect internal and external endpoints:
      - `enable-internal-tls.yaml`
      - `tls-every-endpoints-dns.yaml`
      - `custom-domain.yaml`
      - `enable-tls.yaml`

```
openstack overcloud deploy \
  --templates \
  -e /usr/share/openstack-tripleo-heat-templates/environments/ssl/enable-internal-tls.yaml \
  -e /usr/share/openstack-tripleo-heat-templates/environments/ssl/tls-everywhere-endpoints-dns.yaml \
  -e /home/stack/templates/custom-domain.yaml \
  -e /home/stack/templates/enable-tls.yaml
```

- Use the **haproxy-public-tls-certmonger.yaml** environment file to protect external endpoints with an IdM issued certificate. For this implementation, you must create DNS entries for the VIP endpoints used by novajoin:
  - a. You must create DNS entries for the VIP endpoints used by novajoin. Identify the overcloud networks located in your custom **network-environment.yaml** file in `/home/stack/templates`:

```
parameter_defaults:
  ControlPlaneDefaultRoute: 192.168.24.1
  ExternalAllocationPools:
    - end: 10.0.0.149
      start: 10.0.0.101
```

```

InternalApiAllocationPools:
- end: 172.17.1.149
  start: 172.17.1.10
StorageAllocationPools:
- end: 172.17.3.149
  start: 172.17.3.10
StorageMgmtAllocationPools:
- end: 172.17.4.149
  start: 172.17.4.10

```

- b. Create a list of virtual IP addresses for each overcloud network in a heat template, for example, `/home/stack/public_vib.yaml`.

```

parameter_defaults:
  ControlFixedIPs: [{'ip_address': '192.168.24.101'}]
  PublicVirtualFixedIPs: [{'ip_address': '10.0.0.101'}]
  InternalApiVirtualFixedIPs: [{'ip_address': '172.17.1.101'}]
  StorageVirtualFixedIPs: [{'ip_address': '172.17.3.101'}]
  StorageMgmtVirtualFixedIPs: [{'ip_address': '172.17.4.101'}]
  RedisVirtualFixedIPs: [{'ip_address': '172.17.1.102'}]

```

- c. Add DNS entries to the IdM for each of the VIPs, and zones as needed:

```

ipa dnsrecord-add lab.local overcloud --a-rec 10.0.0.101
ipa dnszone-add ctlplane.lab.local
ipa dnsrecord-add ctlplane.lab.local overcloud --a-rec 192.168.24.101
ipa dnszone-add internalapi.lab.local
ipa dnsrecord-add internalapi.lab.local overcloud --a-rec 172.17.1.101
ipa dnszone-add storage.lab.local
ipa dnsrecord-add storage.lab.local overcloud --a-rec 172.17.3.101
ipa dnszone-add storagemgmt.lab.local
ipa dnsrecord-add storagemgmt.lab.local overcloud --a-rec 172.17.4.101

```

- d. Include the following environment files in your deployment to protect internal and external endpoints:

- `enable-internal-tls.yaml`
- `tls-everywhere-endpoints-dns.yaml`
- `haproxy-public-tls-certmonger.yaml`
- `custom-domain.yaml`
- `public_vib.yaml`

```

openstack overcloud deploy \
  --templates \
  -e /usr/share/openstack-tripleo-heat-templates/environments/ssl/enable-
internal-tls.yaml \
  -e /usr/share/openstack-tripleo-heat-templates/environments/ssl/tls-
everywhere-endpoints-dns.yaml \
  -e /usr/share/openstack-tripleo-heat-templates/environments/services/haproxy-

```

```
public-tls-certmonger.yaml \  
-e /home/stack/templates/custom-domain.yaml \  
-e /home/stack/templates/public-vip.yaml
```

**NOTE**

You cannot use novajoin to implement TLS everywhere (TLS-e) on a pre-existing deployment.

**Additional resources**

- [Chapter 16, \*Implementing TLS-e with Ansible\*](#)

## CHAPTER 16. IMPLEMENTING TLS-E WITH ANSIBLE

Red Hat recommends the new ansible-based **tripleo-ipa** method over the default **novajoin** method to configure your undercloud and overcloud with TLS-e. You can use the following procedure to implement TLS-e on either a new installation of Red Hat OpenStack Platform, or an existing deployment you wish to configure with TLS-e. You must use this method if you deploy Red Hat OpenStack Platform with TLS-e on pre-provisioned nodes.



### NOTE

If you are implementing TLS-e for an existing environment, you are still required to run commands such as the **openstack undercloud install**, and the **openstack overcloud deploy** commands. These are procedures are idempotent and will only adjust your existing deployment configuration to match updated templates and configuration files.

### 16.1. CONFIGURING TLS-E ON THE UNDERCLOUD

#### Prerequisites

Ensure that all configuration steps for the undercloud, such as the creation of the stack user, are complete. For more details, see [Director Installation and Usage](#) for more details

#### Procedure

1. Configure the hosts file  
Set the appropriate search domains and the nameserver on the undercloud in **/etc/resolv.conf**. For example, if the deployment domain is **example.com**, and the domain of the FreeIPA server is **bigcorp.com**, then add the following lines to **/etc/resolv.conf**:

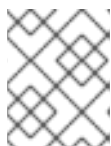
```
search example.com bigcorp.com
nameserver $IDM_SERVER_IP_ADDR
```

2. Install required software:

```
sudo dnf install -y python3-ipalib python3-ipaclient krb5-devel
```

3. Export environmental variables with values specific to your environment.:

```
export IPA_DOMAIN=bigcorp.com
export IPA_REALM=BIGCORP.COM
export IPA_ADMIN_USER=$IPA_USER
export IPA_ADMIN_PASSWORD=$IPA_PASSWORD
export IPA_SERVER_HOSTNAME=ipa.bigcorp.com
export UNDERCLOUD_FQDN=undercloud.example.com
export USER=stack
export CLOUD_DOMAIN=example.com
```



### NOTE

The IdM user credentials must be an administrative user that can add new hosts and services.

- Run the **undercloud-ipa-install.yaml** ansible playbook on the undercloud:

```
ansible-playbook \
--ssh-extra-args "-o StrictHostKeyChecking=no -o UserKnownHostsFile=/dev/null" \
/usr/share/ansible/tripleo-playbooks/undercloud-ipa-install.yaml
```

- Add the following parameters to `undercloud.conf`

```
undercloud_nameservers = $IDM_SERVER_IP_ADDR
overcloud_domain_name = example.com
```

- Deploy the undercloud:

```
openstack undercloud install
```

## Verification

Verify that the undercloud was enrolled correctly by completing the following steps:

- List the hosts in IdM:

```
$ kinit admin
$ ipa host-find
```

- Confirm that `/etc/novajoin/krb5.keytab` exists on the undercloud.

```
ls /etc/novajoin/krb5.keytab
```



### NOTE

The **novajoin** directory name is for legacy naming purposes only.

## 16.2. CONFIGURING TLS-E ON THE OVERCLOUD

When you deploy the overcloud with TLS everywhere (TLS-e), IP addresses from the Undercloud and Overcloud will automatically be registered with IdM.



### NOTE

To disable automatic IP address registration, set the **IDMModifyDNS** heat parameter to false:

```
parameter_defaults:
  ....
  IdMModifyDNS: false
```

- Before deploying the overcloud, create a YAML file **tls-parameters.yaml** with contents similar to the following. The values you select will be specific for your environment:
  - The **DnsServers** parameter should have a value that reflects the IP address of the IdM server.

- If the domain of the IdM server is different than the cloud domain, include it in the **DnsSearchDomains** parameter. For example: **DnsSearchDomains: ["example.com", "bigcorp.com"]**
- If you have preprovisioned nodes, set the value of the **IDMInstallClientPackages** parameter to **true** to install required packages on overcloud nodes.
- The shown value of the **OS::TripleO::Services::IpaClient** parameter overrides the default setting in the **enable-internal-tls.yaml** file. You must ensure the **tls-parameters.yaml** file follows **enable-internal-tls.yaml** in the **openstack overcloud deploy** command.
- If you are running a distributed compute node (DCN) architecture with cinder configured as active-active, you must add and set the **EnableEtcdInternalTLS** parameter to **true**.

```
parameter_defaults:
  DnsSearchDomains: ["example.com"]
  DnsServers: ["192.168.1.13"]
  CloudDomain: example.com
  CloudName: overcloud.example.com
  CloudNameInternal: overcloud.internalapi.example.com
  CloudNameStorage: overcloud.storage.example.com
  CloudNameStorageManagement: overcloud.storagemgmt.example.com
  CloudNameCtlplane: overcloud.ctlplane.example.com
  IdMServer: freeipa-0.redhat.local
  IdMDomain: redhat.local
  IDMInstallClientPackages: False

resource_registry:
  OS::TripleO::Services::IpaClient: /usr/share/openstack-tripleo-heat-
  templates/deployment/ipa/ipaservices-baremetal-ansible.yaml
```

2. Deploy the overcloud. You will need to include the **tls-parameters.yaml** in the deployment command:

```
DEFAULT_TEMPLATES=/usr/share/openstack-tripleo-heat-templates/
CUSTOM_TEMPLATES=/home/stack/templates

openstack overcloud deploy \
-e ${DEFAULT_TEMPLATES}/environments/ssl/tls-everywhere-endpoints-dns.yaml \
-e ${DEFAULT_TEMPLATES}/environments/services/haproxy-public-tls-certmonger.yaml \
-e ${DEFAULT_TEMPLATES}/environments/ssl/enable-internal-tls.yaml \
-e ${CUSTOM_TEMPLATES}/tls-parameters.yaml \
...
```

3. Confirm each endpoint is using HTTPS by querying keystone for a list of endpoints:

```
openstack overcloud endpoint list
```

## CHAPTER 17. DEBUG MODES

You can enable and disable the **DEBUG** level logging mode for certain services in the overcloud.

To configure debug mode for a service, set the respective debug parameter. For example, OpenStack Identity (keystone) uses the **KeystoneDebug** parameter.

- Set the parameter in the **parameter\_defaults** section of an environment file:

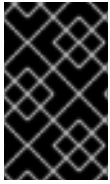
```
parameter_defaults:  
  KeystoneDebug: True
```

After you have set the **KeystoneDebug** parameter to **True**, the **/var/log/containers/keystone/keystone.log** standard keystone log file is updated with **DEBUG** level logs.

For a full list of debug parameters, see "[Debug Parameters](#)" in the *Overcloud Parameters* guide.

## CHAPTER 18. STORAGE CONFIGURATION

This chapter outlines several methods that you can use to configure storage options for your overcloud.

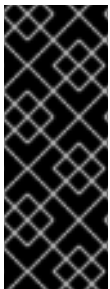


### IMPORTANT

The overcloud uses local and LVM storage for the default storage options. Because these options are not supported for enterprise-level overclouds, you must configure your overcloud to use one of the storage options detailed in this chapter.

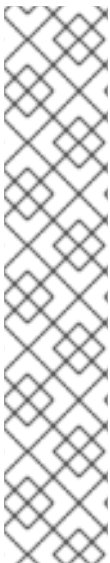
### 18.1. CONFIGURING NFS STORAGE

To configure the overcloud to use an NFS share, create a custom environment file.



### IMPORTANT

Red Hat recommends that you use a certified storage back end and driver. Red Hat does not recommend that you use NFS that comes from the generic NFS back end, because its capabilities are limited when compared to a certified storage back end and driver. For example, the generic NFS back end does not support features such as volume encryption and volume multi-attach. For information about supported drivers, see the [Red Hat Ecosystem Catalog](#).



### NOTE

There are several director heat parameters that control whether an NFS back end or a NetApp NFS Block Storage back end supports a NetApp feature called NAS secure:

- CinderNetappNasSecureFileOperations
- CinderNetappNasSecureFilePermissions
- CinderNasSecureFileOperations
- CinderNasSecureFilePermissions

Red Hat does not recommend that you enable the feature, because it interferes with normal volume operations. Director disables the feature by default, and Red Hat OpenStack Platform does not support it.



### NOTE

For Block Storage (cinder) and Compute (nova) services, you must use NFS version 4.0 or later.

### Procedure

1. Create a custom environment file:

```
$ vi /home/stack/templates/custom_env.yaml
```

2. Add the following parameters to configure NFS storage:



```
parameter_defaults:
  CinderEnableScsiBackend: false
  CinderEnableNfsBackend: true
  GlanceBackend: file
  CinderNfsServers: 192.0.2.230:/cinder
  GlanceNfsEnabled: true
  GlanceNfsShare: 192.0.2.230:/glance
```



#### NOTE

The default values of the **CinderNfsMountOptions** and **GlanceNfsOptions** parameters enable NFS mount options that are sufficient for most Red Hat OpenStack Platform (RHOSP) installations. If you experience issues when you configure multiple services to share the same NFS server, contact Red Hat support.

3. Include the environment file that contains your new content in the **openstack overcloud deploy** by using the **-e** option. Ensure that you include all other environment files that are relevant to your deployment.

```
$ openstack overcloud deploy \
...
-e /home/stack/templates/custom_env.yaml
```

## 18.2. CONFIGURING CEPH STORAGE

Use one of the following methods to integrate Red Hat Ceph Storage into a Red Hat OpenStack Platform overcloud.

### Creating an overcloud with its own Ceph Storage cluster

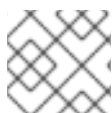
You can create a Ceph Storage Cluster during the creation on the overcloud. Director creates a set of Ceph Storage nodes that use the Ceph OSD to store data. Director also installs the Ceph Monitor service on the overcloud Controller nodes. This means that if an organization creates an overcloud with three highly available Controller nodes, the Ceph Monitor also becomes a highly available service. For more information, see the [Deploying an Overcloud with Containerized Red Hat Ceph](#).

### Integrating an existing Ceph Storage cluster into an overcloud

If you have an existing Ceph Storage Cluster, you can integrate this cluster into a Red Hat OpenStack Platform overcloud during deployment. This means that you can manage and scale the cluster outside of the overcloud configuration. For more information, see the [Integrating an Overcloud with an Existing Red Hat Ceph Cluster](#).

## 18.3. USING AN EXTERNAL OBJECT STORAGE CLUSTER

You can reuse an external OpenStack Object Storage (swift) cluster by disabling the default Object Storage service deployment on your Controller nodes. This disables both the proxy and storage services for Object Storage and configures haproxy and OpenStack Identify (keystone) to use the given external Object Storage endpoint.



#### NOTE

You must manage user accounts on the external Object Storage (swift) cluster manually.

## Prerequisites

- You need the endpoint IP address of the external Object Storage cluster as well as the **authtoken** password from the external Object Storage **proxy-server.conf** file. You can find this information by using the **openstack endpoint list** command.

## Procedure

- Create a new file named **swift-external-params.yaml** with the following content:
  - Replace **EXTERNAL.IP:PORT** with the IP address and port of the external proxy and
  - Replace **AUTHTOKEN** with the **authtoken** password for the external proxy on the **SwiftPassword** line.

```
parameter_defaults:
  ExternalSwiftPublicUrl: 'https://EXTERNAL.IP:PORT/v1/AUTH_%(tenant_id)s'
  ExternalSwiftInternalUrl: 'http://192.168.24.9:8080/v1/AUTH_%(tenant_id)s'
  ExternalSwiftAdminUrl: 'http://192.168.24.9:8080'
  ExternalSwiftUserTenant: 'service'
  SwiftPassword: AUTHTOKEN
```

- Save this file as **swift-external-params.yaml**.
- Deploy the overcloud with the following external Object Storage service environment files, as well as any other environment files that are relevant to your deployment:

```
openstack overcloud deploy --templates \
-e [your environment files] \
-e /usr/share/openstack-tripleo-heat-templates/environments/swift-external.yaml \
-e swift-external-params.yaml
```

## 18.4. CONFIGURING CEPH OBJECT STORE TO USE EXTERNAL CEPH OBJECT GATEWAY

Red Hat OpenStack Platform (RHOSP) director supports configuring an external Ceph Object Gateway (RGW) as an Object Store service. To authenticate with the external RGW service, you must configure RGW to verify users and their roles in the Identity service (keystone).

For more information about how to configure an external Ceph Object Gateway, see [Configuring the Ceph Object Gateway to use Keystone authentication](#) in the *Using Keystone with the Ceph Object Gateway Guide*.

## Procedure

- Add the following **parameter\_defaults** to a custom environment file, for example, **swift-external-params.yaml**, and adjust the values to suit your deployment:

```
parameter_defaults:
  ExternalSwiftPublicUrl: 'http://<Public RGW endpoint or loadbalancer>:8080/swift/v1/AUTH_%(project_id)s'
  ExternalSwiftInternalUrl: 'http://<Internal RGW endpoint>:8080/swift/v1/AUTH_%(project_id)s'
```

```
ExternalSwiftAdminUrl: 'http://<Admin RGW endpoint>:8080/swift/v1/AUTH_%(project_id)s'
ExternalSwiftUserTenant: 'service'
SwiftPassword: 'choose_a_random_password'
```

## NOTE

The example code snippet contains parameter values that might differ from values that you use in your environment:

- The default port where the remote RGW instance listens is **8080**. The port might be different depending on how the external RGW is configured.
- The **swift** user created in the overcloud uses the password defined by the **SwiftPassword** parameter. You must configure the external RGW instance to use the same password to authenticate with the Identity service by using the **rgw\_keystone\_admin\_password**.

2. Add the following code to the Ceph config file to configure RGW to use the Identity service. Replace the variable values to suit your environment:

```
rgw_keystone_api_version = 3
rgw_keystone_url = http://<public Keystone endpoint>:5000/
rgw_keystone_accepted_roles = member, Member, admin
rgw_keystone_accepted_admin_roles = ResellerAdmin, swiftoperator
rgw_keystone_admin_domain = default
rgw_keystone_admin_project = service
rgw_keystone_admin_user = swift
rgw_keystone_admin_password =
<password_as_defined_in_the_environment_parameters>
rgw_keystone_implicit_tenants = true
rgw_keystone_revocation_interval = 0
rgw_s3_auth_use_keystone = true
rgw_swift_versioning_enabled = true
rgw_swift_account_in_url = true
```

## NOTE

Director creates the following roles and users in the Identity service by default:

- **rgw\_keystone\_accepted\_admin\_roles**: ResellerAdmin, swiftoperator
- **rgw\_keystone\_admin\_domain**: default
- **rgw\_keystone\_admin\_project**: service
- **rgw\_keystone\_admin\_user**: swift

3. Deploy the overcloud with the additional environment files with any other environment files that are relevant to your deployment:

```
openstack overcloud deploy --templates \
-e <your_environment_files>
-e /usr/share/openstack-tripleo-heat-templates/environments/swift-external.yaml
-e swift-external-params.yaml
```

## Verification

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

```
$ source ~/stackrc
```

3. Verify that the endpoints exist in the Identity service (keystone):

```
$ openstack endpoint list --service object-store
```

```
+-----+-----+-----+-----+-----+-----+-----+
| ID | Region | Service Name | Service Type | Enabled | Interface | URL |
+-----+-----+-----+-----+-----+-----+-----+
| 233b7ea32aaf40c1ad782c696128aa0e | regionOne | swift | object-store | True | admin | http://192.168.24.3:8080/v1/AUTH_%(project_id)s |
| 4ccde35ac76444d7bb82c5816a97abd8 | regionOne | swift | object-store | True | public | https://192.168.24.2:13808/v1/AUTH_%(project_id)s |
| b4ff283f445348639864f560aa2b2b41 | regionOne | swift | object-store | True | internal | http://192.168.24.3:8080/v1/AUTH_%(project_id)s |
+-----+-----+-----+-----+-----+-----+-----+
```

4. Create a test container:

```
$ openstack container create <testcontainer>
```

```
+-----+-----+-----+-----+
| account | container | x-trans-id |
+-----+-----+-----+-----+
| AUTH_2852da3cf2fc490081114c434d1fc157 | testcontainer | tx6f5253e710a2449b8ef7e-005f2d29e8 |
+-----+-----+-----+-----+
```

5. Create a configuration file to confirm that you can upload data to the container:

```
$ openstack object create testcontainer undercloud.conf
```

```
+-----+-----+-----+-----+
| object | container | etag |
+-----+-----+-----+-----+
| undercloud.conf | testcontainer | 09fcffe126cac1dbac7b89b8fd7a3e4b |
+-----+-----+-----+-----+
```

6. Delete the test container:

```
$ openstack container delete -r <testcontainer>
```

## 18.5. CONFIGURING THE IMAGE IMPORT METHOD AND SHARED STAGING AREA

The default settings for the OpenStack Image service (glance) are determined by the heat templates that you use when you install Red Hat OpenStack Platform. The Image service heat template is **deployment/glance/glance-api-container-puppet.yaml**.

You can import images with the following methods:

#### web-download

Use the **web-download** method to import an image from a URL.

#### glance-direct

Use the **glance-direct** method to import an image from a local volume.

### 18.5.1. Creating and deploying the `glance-settings.yaml` file

Use a custom environment file to configure the import parameters. These parameters override the default values that are present in the core heat template collection. The example environment content contains parameters for the interoperable image import.

```
parameter_defaults:
  # Configure NFS backend
  GlanceBackend: file
  GlanceNfsEnabled: true
  GlanceNfsShare: 192.168.122.1:/export/glance

  # Enable glance-direct import method
  GlanceEnabledImportMethods: glance-direct,web-download

  # Configure NFS staging area (required for glance-direct import method)
  GlanceStagingNfsShare: 192.168.122.1:/export/glance-staging
```

The **GlanceBackend**, **GlanceNfsEnabled**, and **GlanceNfsShare** parameters are defined in the [Storage Configuration](#) section in the *Advanced Openstack Customization Guide*.

Use two new parameters for interoperable image import to define the import method and a shared NFS staging area.

#### GlanceEnabledImportMethods

Defines the available import methods, `web-download` (default) and `glance-direct`. This parameter is necessary only if you want to enable additional methods besides `web-download`.

#### GlanceStagingNfsShare

Configures the NFS staging area that the `glance-direct` import method uses. This space can be shared among nodes in a high-availability cluster configuration. If you want to use this parameter, you must also set the **GlanceNfsEnabled** parameter to **true**.

#### Procedure

1. Create a new file, for example, **glance-settings.yaml**. Use the syntax from the example to populate this file.
2. Include the **glance-settings.yaml** file in the **openstack overcloud deploy** command, as well as any other environment files that are relevant to your deployment:

```
$ openstack overcloud deploy --templates -e glance-settings.yaml
```

For more information about using environment files, see the [Including Environment Files in Openstack Creation](#) section in the *Advanced Openstack Customization Guide*.

## 18.5.2. Controlling image web-import sources

You can limit the sources of web-import image downloads by adding URI blocklists and allowlists to the optional **glance-image-import.conf** file.

You can allow or block image source URIs at three levels:

- scheme (allowed\_schemes, disallowed\_schemes)
- host (allowed\_hosts, disallowed\_hosts)
- port (allowed\_ports, disallowed\_ports)

If you specify both allowlist and blocklist at any level, the allowlist is honored and the blocklist is ignored.

The Image service (glance) applies the following decision logic to validate image source URIs:

1. The scheme is checked.
  - a. Missing scheme: reject
  - b. If there is an allowlist, and the scheme is not present in the allowlist: reject. Otherwise, skip C and continue on to 2.
  - c. If there is a blocklist, and the scheme is present in the blocklist: reject.
2. The host name is checked.
  - a. Missing host name: reject
  - b. If there is an allowlist, and the host name is not present in the allowlist: reject. Otherwise, skip C and continue on to 3.
  - c. If there is a blocklist, and the host name is present in the blocklist: reject.
3. If there is a port in the URI, the port is checked.
  - a. If there is a allowlist, and the port is not present in the allowlist: reject. Otherwise, skip B and continue on to 4.
  - b. If there is a blocklist, and the port is present in the blocklist: reject.
4. The URI is accepted as valid.

If you allow a scheme, either by adding it to an allowlist or by not adding it to a blocklist, any URI that uses the default port for that scheme by not including a port in the URI is allowed. If it does include a port in the URI, the URI is validated according to the default decision logic.

### 18.5.2.1. Example

For example, the default port for FTP is 21. Because *ftp* is an allowlisted scheme, this URL is allowed: <ftp://example.org/some/resource> But because 21 is not in the port allowlist, this URL to the same resource is rejected: <ftp://example.org:21/some/resource>

```
allowed_schemes = [http,https,ftp]
disallowed_schemes = []
allowed_hosts = []
```

```
disallowed_hosts = []
allowed_ports = [80,443]
disallowed_ports = []
```

### 18.5.2.2. Default image import blocklist and allowlist settings

The **glance-image-import.conf** file is an optional file that contains the following default options:

- `allowed_schemes` - [*http, https*]
- `disallowed_schemes` - empty list
- `allowed_hosts` - empty list
- `disallowed_hosts` - empty list
- `allowed_ports` - [80, 443]
- `disallowed_ports` - empty list

If you use the defaults, end users can access URIs by using only the **http** or **https** scheme. The only ports that users can specify are **80** and **443**. Users do not have to specify a port, but if they do, it must be either **80** or **443**.

You can find the **glance-image-import.conf** file in the **etc/** subdirectory of the Image service source code tree. Ensure that you are looking in the correct branch for your release of Red Hat OpenStack Platform.

### 18.5.3. Injecting metadata on image import to control where VMs launch

End users can upload images to the Image service and use these images to launch VMs. These user-provided (non-admin) images must be launched on a specific set of compute nodes. The assignment of an instance to a compute node is controlled by image metadata properties.

The Image Property Injection plugin injects metadata properties to images during import. Specify the properties by editing the `[image_import_opts]` and `[inject_metadata_properties]` sections of the **glance-image-import.conf** file.

To enable the Image Property Injection plugin, add the following line to the `[image_import_opts]` section:

```
[image_import_opts]
image_import_plugins = [inject_image_metadata]
```

To limit the metadata injection to images provided by a certain set of users, set the **ignore\_user\_roles** parameter. For example, use the following configuration to inject one value for **property1** and two values for **property2** into images downloaded by any non-admin user.

```
[DEFAULT]
[image_conversion]
[image_import_opts]
image_import_plugins = [inject_image_metadata]
[import_filtering_opts]
```

```
[inject_metadata_properties]
ignore_user_roles = admin
inject = PROPERTY1:value,PROPERTY2:value;another value
```

The parameter **ignore\_user\_roles** is a comma-separated list of the Identity service (keystone) roles that the plugin ignores. This means that if the user that makes the image import call has any of these roles, the plugin does not inject any properties into the image.

The parameter **inject** is a comma-separated list of properties and values that are injected into the image record for the imported image. Each property and value must be quoted and separated by a colon (':').

You can find the **glance-image-import.conf** file in the **etc/** subdirectory of the Image service source code tree. Ensure that you are looking in the correct branch for your release of Red Hat OpenStack Platform.

## 18.6. CONFIGURING CINDER BACK END FOR THE IMAGE SERVICE

Use the **GlanceBackend** parameter to set the back end that the Image service uses to store images.



### IMPORTANT

The default maximum number of volumes you can create for a project is 10.

### Procedure

1. To configure **cinder** as the Image service back end, add the following line to an environment file:

```
parameter_defaults:
  GlanceBackend: cinder
```

2. If the **cinder** back end is enabled, the following parameters and values are set by default:

```
cinder_store_auth_address = http://172.17.1.19:5000/v3
cinder_store_project_name = service
cinder_store_user_name = glance
cinder_store_password = ****secret****
```

3. To use a custom user name, or any custom value for the **cinder\_store\_** parameters, add the **ExtraConfig** parameter to **parameter\_defaults** and include your custom values:

```
ExtraConfig:
  glance::config::api_config:
    glance_store/cinder_store_auth_address:
      value: "%{hiera('glance::api::authtoken::auth_url')}/v3"
    glance_store/cinder_store_user_name:
      value: <user-name>
    glance_store/cinder_store_password:
      value: "%{hiera('glance::api::authtoken::password')}"
    glance_store/cinder_store_project_name:
      value: "%{hiera('glance::api::authtoken::project_name')}"
```



## 18.7. CONFIGURING THE MAXIMUM NUMBER OF STORAGE DEVICES TO ATTACH TO ONE INSTANCE

By default, you can attach an unlimited number of storage devices to a single instance. To limit the maximum number of devices, add the **max\_disk\_devices\_to\_attach** parameter to your Compute environment file. Use the following example to change the value of **max\_disk\_devices\_to\_attach** to "30":

```
parameter_defaults:
  ComputeExtraConfig:
    nova::config::nova_config:
      compute/max_disk_devices_to_attach:
        value: '30'
```

### Guidelines and considerations

- The number of storage disks supported by an instance depends on the bus that the disk uses. For example, the IDE disk bus is limited to 4 attached devices.
- Changing the **max\_disk\_devices\_to\_attach** on a Compute node with active instances can cause rebuilds to fail if the maximum number is lower than the number of devices already attached to instances. For example, if instance **A** has 26 devices attached and you change **max\_disk\_devices\_to\_attach** to 20, a request to rebuild instance **A** will fail.
- During cold migration, the configured maximum number of storage devices is enforced only on the source for the instance that you want to migrate. The destination is not checked before the move. This means that if Compute node A has 26 attached disk devices, and Compute node B has a configured maximum of 20 attached disk devices, a cold migration of an instance with 26 attached devices from Compute node A to Compute node B succeeds. However, a subsequent request to rebuild the instance in Compute node B fails because 26 devices are already attached which exceeds the configured maximum of 20.
- The configured maximum is not enforced on shelved offloaded instances, as they have no Compute node.
- Attaching a large number of disk devices to instances can degrade performance on the instance. Tune the maximum number based on the boundaries of what your environment can support.
- Instances with machine type Q35 can attach a maximum of 500 disk devices.

## 18.8. IMPROVING SCALABILITY WITH IMAGE SERVICE CACHING

Use the glance-api caching mechanism to store copies of images on Image service (glance) API servers and retrieve them automatically to improve scalability. With Image service caching, glance-api can run on multiple hosts. This means that it does not need to retrieve the same image from back end storage multiple times. Image service caching does not affect any Image service operations.

Configure Image service caching with the Red Hat OpenStack Platform director (tripleo) heat templates:

### Procedure

1. In an environment file, set the value of the **GlanceCacheEnabled** parameter to **true**, which automatically sets the **flavor** value to **keystone+cachemanagement** in the **glance-api.conf** heat template:

```
parameter_defaults:
  GlanceCacheEnabled: true
```

2. Include the environment file in the **openstack overcloud deploy** command when you redeploy the overcloud.
3. Optional: Tune the **glance\_cache\_pruner** to an alternative frequency when you redeploy the overcloud. The following example shows a frequency of 5 minutes:

```
parameter_defaults:
  ControllerExtraConfig:
    glance::cache::pruner::minute: '*/*5'
```

Adjust the frequency according to your needs to avoid file system full scenarios. Include the following elements when you choose an alternative frequency:

- The size of the files that you want to cache in your environment.
- The amount of available file system space.
- The frequency at which the environment caches images.

## 18.9. CONFIGURING THIRD PARTY STORAGE

The following environment files are present in the core heat template collection **/usr/share/openstack-tripleo-heat-templates**.

### Dell EMC Storage Center

Deploys a single Dell EMC Storage Center back end for the Block Storage (cinder) service. The environment file is located at **/usr/share/openstack-tripleo-heat-templates/environments/cinder-dellsc-config.yaml**.

See the [Dell Storage Center Back End Guide](#) for full configuration information.

### Dell EMC PS Series

Deploys a single Dell EMC PS Series back end for the Block Storage (cinder) service. The environment file is located at **/usr/share/openstack-tripleo-heat-templates/environments/cinder-dellps-config.yaml**.

See the [Dell EMC PS Series Back End Guide](#) for full configuration information.

### NetApp Block Storage

Deploys a NetApp storage appliance as a back end for the Block Storage (cinder) service. The environment file is located at **/usr/share/openstack-tripleo-heat-templates/environments/storage/cinder-netapp-config.yaml**.

See the [NetApp Block Storage Back End Guide](#) for full configuration information.

## CHAPTER 19. SECURITY ENHANCEMENTS

The following sections provide some suggestions to harden the security of your overcloud.

### 19.1. MANAGING THE OVERCLOUD FIREWALL

Each of the core OpenStack Platform services contains firewall rules in their respective composable service templates. This automatically creates a default set of firewall rules for each overcloud node.

The overcloud heat templates contain a set of parameters that can help with additional firewall management:

#### ManageFirewall

Defines whether to automatically manage the firewall rules. Set this parameter to **true** to allow Puppet to automatically configure the firewall on each node. Set to **false** if you want to manually manage the firewall. The default is **true**.

#### PurgeFirewallRules

Defines whether to purge the default Linux firewall rules before configuring new ones. The default is **false**.

If you set the **ManageFirewall** parameter to **true**, you can create additional firewall rules on deployment. Set the **tripleo::firewall::firewall\_rules** hieradata using a configuration hook (see [Section 4.5, “Puppet: Customizing hieradata for roles”](#)) in an environment file for your overcloud. This hieradata is a hash containing the firewall rule names and their respective parameters as keys, all of which are optional:

#### port

The port associated to the rule.

#### dport

The destination port associated to the rule.

#### sport

The source port associated to the rule.

#### proto

The protocol associated to the rule. Defaults to **tcp**.

#### action

The action policy associated to the rule. Defaults to **accept**.

#### jump

The chain to jump to. If present, it overrides **action**.

#### state

An Array of states associated to the rule. Defaults to **['NEW']**.

#### source

The source IP address associated to the rule.

#### iface

The network interface associated to the rule.

#### chain

The chain associated to the rule. Defaults to **INPUT**.

#### destination

The destination CIDR associated to the rule.

The following example demonstrates the syntax of the firewall rule format:

```
ExtraConfig:
  tripleo::firewall::firewall_rules:
    '300 allow custom application 1':
      port: 999
      proto: udp
      action: accept
    '301 allow custom application 2':
      port: 8081
      proto: tcp
      action: accept
```

This applies two additional firewall rules to all nodes through **ExtraConfig**.



#### NOTE

Each rule name becomes the comment for the respective **iptables** rule. Each rule name starts with a three-digit prefix to help Puppet order all defined rules in the final **iptables** file. The default Red Hat OpenStack Platform rules use prefixes in the 000 to 200 range.

## 19.2. CHANGING THE SIMPLE NETWORK MANAGEMENT PROTOCOL (SNMP) STRINGS

Director provides a default read-only SNMP configuration for your overcloud. It is advisable to change the SNMP strings to mitigate the risk of unauthorized users learning about your network devices.



#### NOTE

When you configure the **ExtraConfig** interface with a string parameter, you must use the following syntax to ensure that heat and Hiera do not interpret the string as a Boolean value: `"<VALUE>"`.

Set the following hieradata using the **ExtraConfig** hook in an environment file for your overcloud:

### SNMP traditional access control settings

#### **snmp::ro\_community**

IPv4 read-only SNMP community string. The default value is **public**.

#### **snmp::ro\_community6**

IPv6 read-only SNMP community string. The default value is **public**.

#### **snmp::ro\_network**

Network that is allowed to **RO query** the daemon. This value can be a string or an array. Default value is **127.0.0.1**.

#### **snmp::ro\_network6**

Network that is allowed to **RO query** the daemon with IPv6. This value can be a string or an array. The default value is **::1/128**.

#### **tripleo::profile::base::snmp::snmpd\_config**

Array of lines to add to the *snmpd.conf* file as a safety valve. The default value is `[]`. See the [SNMP Configuration File](#) web page for all available options.

For example:

```
parameter_defaults:
  ExtraConfig:
    snmp::ro_community: mysecurestring
    snmp::ro_community6: myv6securestring
```

This changes the read-only SNMP community string on all nodes.

### SNMP view-based access control settings (VACM)

#### snmp::com2sec

IPv4 security name.

#### snmp::com2sec6

IPv6 security name.

For example:

```
parameter_defaults:
  ExtraConfig:
    snmp::com2sec: mysecurestring
    snmp::com2sec6: myv6securestring
```

This changes the read-only SNMP community string on all nodes.

For more information, see the **snmpd.conf** man page.

## 19.3. CHANGING THE SSL/TLS CIPHER AND RULES FOR HAPROXY

If you enabled SSL/TLS in the overcloud (see [Chapter 14, Enabling SSL/TLS on overcloud public endpoints](#)), you might want to harden the SSL/TLS ciphers and rules used with the HAProxy configuration. This helps avoid SSL/TLS vulnerabilities, such as the [POODLE vulnerability](#).

Set the following hieradata using the **ExtraConfig** hook in an environment file for your overcloud:

#### 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 an environment file with the following content:

```
parameter_defaults:
  ExtraConfig:
    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.

Include this environment file with your overcloud creation.

## 19.4. USING THE OPEN VSWITCH FIREWALL

You can configure security groups to use the Open vSwitch (OVS) firewall driver in Red Hat OpenStack Platform director. Use the **NeutronOVSEnabledFirewallDriver** parameter to specify firewall driver that you want to use:

- **iptables\_hybrid** - Configures the Networking service (neutron) to use the iptables/hybrid based implementation.
- **openvswitch** - Configures the Networking service to use the OVS firewall flow-based driver.

The **openvswitch** firewall driver includes higher performance and reduces the number of interfaces and bridges used to connect guests to the project network.



#### IMPORTANT

Multicast traffic is handled differently by the Open vSwitch (OVS) firewall driver than by the iptables firewall driver. With iptables, by default, VRRP traffic is denied, and you must enable VRRP in the security group rules for any VRRP traffic to reach an endpoint. With OVS, all ports share the same OpenFlow context, and multicast traffic cannot be processed individually per port. Because security groups do not apply to all ports (for example, the ports on a router), OVS uses the **NORMAL** action and forwards multicast traffic to all ports as specified by RFC 4541.



#### NOTE

The **iptables\_hybrid** option is not compatible with OVS-DPDK. The **openvswitch** option is not compatible with OVS Hardware Offload.

Configure the **NeutronOVSFirewallDriver** parameter in the **network-environment.yaml** file:

**NeutronOVSFirewallDriver**: openvswitch

- **NeutronOVSFirewallDriver**: Configures the name of the firewall driver that you want to use when you implement security groups. Possible values depend on your system configuration. Some examples are **noop**, **openvswitch**, and **iptables\_hybrid**. The default value of an empty string results in a supported configuration.

## 19.5. USING SECURE ROOT USER ACCESS

The overcloud image automatically contains hardened security for the **root** user. For example, each deployed overcloud node automatically disables direct SSH access to the **root** user. You can still access the **root** user on overcloud nodes:

1. Log in to the undercloud node as the **stack** user.
2. Each overcloud node has a **heat-admin** user account. This user account contains the undercloud public SSH key, which provides SSH access without a password from the undercloud to the overcloud node. On the undercloud node, log in to the an overcloud node through SSH as the **heat-admin** user.
3. Switch to the **root** user with **sudo -i**.

### Reducing root user security

Some situations might require direct SSH access to the **root** user. In this case, you can reduce the SSH restrictions on the **root** user for each overcloud node.



#### WARNING

This method is intended for debugging purposes only. It is not recommended for use in a production environment.

The method uses the first boot configuration hook (see [Section 4.1, “First boot: customizing first boot configuration”](#)). Enter the following content in an environment file:

```
resource_registry:
  OS::TripleO::NodeUserData: /usr/share/openstack-tripleo-heat-
  templates/firstboot/userdata_root_password.yaml

parameter_defaults:
  NodeRootPassword: "p@55w0rd!"
```

Note:

- The **OS::TripleO::NodeUserData** resource refers to a template that configures the **root** user during the first boot **cloud-init** stage.

- The **NodeRootPassword** parameter sets the password for the **root** user. Change the value of this parameter to your desired password. The environment file contains the password as a plain text string, which is considered a security risk.

Include this environment file with the **openstack overcloud deploy** command when you create your overcloud.



## CHAPTER 20. CONFIGURING MONITORING TOOLS

Monitoring tools are an optional suite of tools that you can use for availability monitoring and centralized logging. Use availability monitoring to monitor the functionality of all components, and use centralized logging to view all of the logs across your Red Hat OpenStack Platform environment in one central place.

For more information about configuring monitoring tools, see the [Monitoring Tools Configuration Guide](#).

## CHAPTER 21. CONFIGURING NETWORK PLUGINS

Director includes environment files that you can use when you configure third-party network plugins:

### 21.1. FUJITSU CONVERGED FABRIC (C-FABRIC)

You can enable the Fujitsu Converged Fabric (C-Fabric) plugin by using the environment file located at **/usr/share/openstack-tripleo-heat-templates/environments/neutron-ml2-fujitsu-cfab.yaml**.

1. Copy the environment file to your **templates** subdirectory:

```
$ cp /usr/share/openstack-tripleo-heat-templates/environments/neutron-ml2-fujitsu-cfab.yaml
/home/stack/templates/
```

2. Edit the **resource\_registry** to use an absolute path:

```
resource_registry:
  OS::TripleO::Services::NeutronML2FujitsuCfab: /usr/share/openstack-tripleo-heat-
  templates/puppet/services/neutron-plugin-ml2-fujitsu-cfab.yaml
```

3. Review the **parameter\_defaults** in **/home/stack/templates/neutron-ml2-fujitsu-cfab.yaml**:

- **NeutronFujitsuCfabAddress** - The telnet IP address of the C-Fabric. (string)
- **NeutronFujitsuCfabUserName** - The C-Fabric username to use. (string)
- **NeutronFujitsuCfabPassword** - The password of the C-Fabric user account. (string)
- **NeutronFujitsuCfabPhysicalNetworks** - List of **<physical\_network>:<vfab\_id>** tuples that specify **physical\_network** names and their corresponding vfab IDs. (comma\_delimited\_list)
- **NeutronFujitsuCfabSharePprofile** - Determines whether to share a C-Fabric pprofile among neutron ports that use the same VLAN ID. (boolean)
- **NeutronFujitsuCfabPprofilePrefix** - The prefix string for pprofile name. (string)
- **NeutronFujitsuCfabSaveConfig** - Determines whether to save the configuration. (boolean)

4. To apply the template to your deployment, include the environment file in the **openstack overcloud deploy** command:

```
$ openstack overcloud deploy --templates -e /home/stack/templates/neutron-ml2-fujitsu-
cfab.yaml [OTHER OPTIONS] ...
```

### 21.2. FUJITSU FOS SWITCH

You can enable the Fujitsu FOS Switch plugin by using the environment file located at **/usr/share/openstack-tripleo-heat-templates/environments/neutron-ml2-fujitsu-fossw.yaml**.

#### Procedure

1. Copy the environment file to your **templates** subdirectory:

```
$ cp /usr/share/openstack-tripleo-heat-templates/environments/neutron-ml2-fujitsu-fossw.yaml /home/stack/templates/
```

2. Edit the **resource\_registry** to use an absolute path:

```
resource_registry:
  OS::TripleO::Services::NeutronML2FujitsuFossw: /usr/share/openstack-tripleo-heat-templates/puppet/services/neutron-plugin-ml2-fujitsu-fossw.yaml
```

3. Review the **parameter\_defaults** in **/home/stack/templates/neutron-ml2-fujitsu-fossw.yaml**:
  - **NeutronFujitsuFosswIps** - The IP addresses of all FOS switches. (comma\_delimited\_list)
  - **NeutronFujitsuFosswUserName** - The FOS username to use. (string)
  - **NeutronFujitsuFosswPassword** - The password of the FOS user account. (string)
  - **NeutronFujitsuFosswPort** - The port number to use for the SSH connection. (number)
  - **NeutronFujitsuFosswTimeout** - The timeout period of the SSH connection. (number)
  - **NeutronFujitsuFosswUdpDestPort** - The port number of the VXLAN UDP destination on the FOS switches. (number)
  - **NeutronFujitsuFosswOvsdbVlanidRangeMin** - The minimum VLAN ID in the range that is used for binding VNI and physical port. (number)
  - **NeutronFujitsuFosswOvsdbPort** - The port number for the OVSDb server on the FOS switches. (number)
4. To apply the template to your deployment, include the environment file in the **openstack overcloud deploy** command:

```
$ openstack overcloud deploy --templates -e /home/stack/templates/neutron-ml2-fujitsu-fossw.yaml [OTHER OPTIONS] ...
```

## CHAPTER 22. CONFIGURING IDENTITY

Director includes parameters to help configure Identity Service (keystone) settings:

### 22.1. REGION NAME

By default, your overcloud region is named **regionOne**. You can change this by adding a **KeystoneRegion** entry your environment file. You cannot modify this value after you deploy the overcloud.

```
parameter_defaults:  
  KeystoneRegion: 'SampleRegion'
```

## CHAPTER 23. OTHER CONFIGURATIONS

### 23.1. CONFIGURING THE KERNEL ON OVERCLOUD NODES

Red Hat OpenStack Platform director includes parameters that configure the kernel on overcloud nodes.

#### ExtraKernelModules

Kernel modules to load. The modules names are listed as a hash key with an empty value:

```
ExtraKernelModules:
  <MODULE_NAME>: {}
```

#### ExtraKernelPackages

Kernel-related packages to install prior to loading the kernel modules from **ExtraKernelModules**. The package names are listed as a hash key with an empty value.

```
ExtraKernelPackages:
  <PACKAGE_NAME>: {}
```

#### ExtraSysctlSettings

Hash of sysctl settings to apply. Set the value of each parameter using the **value** key.

```
ExtraSysctlSettings:
  <KERNEL_PARAMETER>:
    value: <VALUE>
```

This example shows the syntax of these parameters in an environment file:

```
parameter_defaults:
  ExtraKernelModules:
    iscsi_target_mod: {}
  ExtraKernelPackages:
    iscsi-initiator-utils: {}
  ExtraSysctlSettings:
    dev.scsi.logging_level:
      value: 1
```

### 23.2. CONFIGURING THE SERVER CONSOLE

Console output from overcloud nodes is not always sent to the server console. If you want to view this output in the server console, you must configure the overcloud to use the correct console for your hardware. Use one of the following methods to perform this configuration:

- Modify the **KernelArgs** heat parameter for each overcloud role.
- Customize the **overcloud-full.qcow2** image that director uses to provision the overcloud nodes.

#### Prerequisites

- A successful undercloud installation. For more information, see the [Director Installation and Usage](#) guide.
- Overcloud nodes ready for deployment.

### Modifying KernelArgs with heat during deployment

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

```
$ source stackrc
```

3. Create an environment file **overcloud-console.yaml** with the following content:

```
parameter_defaults:
  <role>Parameters:
    KernelArgs: "console=<console-name>"
```

Replace **<role>** with the name of the overcloud role that you want to configure, and replace **<console-name>** with the ID of the console that you want to use. For example, use the following snippet to configure all overcloud nodes in the default roles to use **tty0**:

```
parameter_defaults:
  ControllerParameters:
    KernelArgs: "console=tty0"
  ComputeParameters:
    KernelArgs: "console=tty0"
  BlockStorageParameters:
    KernelArgs: "console=tty0"
  ObjectStorageParameters:
    KernelArgs: "console=tty0"
  CephStorageParameters:
    KernelArgs: "console=tty0"
```

4. Include the **overcloud-console-tty0.yaml** file in your deployment command with the **-e** option.

### Modifying the overcloud-full.qcow2 image

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

```
$ source stackrc
```

3. Modify the kernel arguments in the **overcloud-full.qcow2** image to set the correct console for your hardware. For example, set the console to **tty0**:

```
$ virt-customize --selinux-relabel -a overcloud-full.qcow2 --run-command 'grubby --update-kernel=ALL --args="console=tty0"'
```

4. Import the image into director:

```
$ openstack overcloud image upload --image-path overcloud-full.qcow2
```

- 
- 5. Deploy the overcloud.

### Verification

1. Log in to an overcloud node from the undercloud:

```
$ ssh heat-admin@<IP-address>
```

Replace **<IP-address>** with the IP address of an overcloud node.

2. Inspect the contents of the `/proc/cmdline` file and ensure that **console=** parameter is set to the value of the console that you want to use:

```
[heat-admin@controller-0 ~]$ cat /proc/cmdline
BOOT_IMAGE=(hd0,msdos2)/boot/vmlinuz-4.18.0-193.29.1.el8_2.x86_64
root=UUID=0ec3dea5-f293-4729-b676-5d38a611ce81 ro console=tty0
console=ttyS0,115200n81 no_timer_check crashkernel=auto rhgb quiet
```

## 23.3. CONFIGURING EXTERNAL LOAD BALANCING

An overcloud uses multiple Controllers together as a high availability cluster, which ensures maximum operational performance for your OpenStack services. In addition, the cluster provides load balancing for access to the OpenStack services, which evenly distributes traffic to the Controller nodes and reduces server overload for each node. You can also use an external load balancer to perform this distribution. For example, you can use your own hardware-based load balancer to handle traffic distribution to the Controller nodes.

For more information about configuring external load balancing, see the dedicated [External Load Balancing for the Overcloud](#) guide.

## 23.4. CONFIGURING IPV6 NETWORKING

By default, the overcloud uses Internet Protocol version 4 (IPv4) to configure the service endpoints. However, the overcloud also supports Internet Protocol version 6 (IPv6) endpoints, which is useful for organizations that support IPv6 infrastructure. Director includes a set of environment files that you can use to create IPv6-based Overclouds.

For more information about configuring IPv6 in the Overcloud, see the dedicated [IPv6 Networking for the Overcloud](#) guide for full instructions.