Red Hat OpenStack Platform 16.1

Security and Hardening Guide

Good Practices, Compliance, and Security Hardening

Last Updated: 2023-10-12

Red Hat OpenStack Platform 16.1 Security and Hardening Guide

Good Practices, Compliance, and Security Hardening

OpenStack Team
rhos-docs@redhat.com

Legal Notice

Abstract

This guide provides good practice advice and conceptual information about hardening the security of a Red Hat OpenStack Platform environment.

Table of Contents

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 SECURITY

Use the tools provided with Red Hat Openstack Platform (RHOSP) to prioritize security in planning, and in operations, to meet users' expectations of privacy and the security of their data. Failure to implement security standards can lead to downtime or data breaches. Your use case might be subject to laws that require passing audits and compliance processes.

NOTE

Follow the instructions in this guide to harden the security of your environment. However, these recommendations do not guarantee security or compliance. You must assess security from the unique requirements of your environment.

- For information about hardening Ceph, see Data security and hardening guide .

1.1. RED HAT OPENSTACK PLATFORM SECURITY

By default, Red Hat OpenStack Platform (RHOSP) director creates the overcloud with the following tools and access controls for security:

SElinux

SELinux provides security enhancement for RHOSP by providing access controls that require each process to have explicit permissions for every action.

Podman

Podman as a container tool is a secure option for RHOSP as it does not use a client/server model that requires processes with root access to function.

System access restriction

You can only log into overcloud nodes using either the SSH key that director creates for heat-admin during the overcloud deployment, or a SSH key that you have created on the overcloud. You cannot use SSH with a password to log into overcloud nodes, or log into overcloud nodes using root.

You can configure director with the following additional security features based on the needs and trust level of your organization:

- Public TLS and TLS-everywhere
- Hardware security module integration with OpenStack Key Manager (barbican)
- Signed images and encrypted volumes
- Password and fernet key rotation using workflow executions

1.2. UNDERSTANDING THE RED HAT OPENSTACK PLATFORM ADMIN ROLE

When you assign a user the role of **admin**, this user has permissions to view, change, create, or delete any resource on any project. This user can create shared resources that are accessible across projects, such as publicly available glance images, or provider networks. Additionally, a user with the **admin** role can create or delete users and manage roles.

The project to which you assign a user the **admin** role is the default project in which **openstack** commands are executed. For example, if an **admin** user in a project named **development** runs the following command, a network called **internal-network** is created in the **development** project:

```
openstack network create internal-network
```

The **admin** user can create an **internal-network** in any project by using the **--project** parameter:

```
openstack network create internal-network --project testing
```

1.3. IDENTIFYING SECURITY ZONES IN RED HAT OPENSTACK PLATFORM

Security zones are common resources, applications, networks and servers that share common security concerns. Security zones should share the same authentication and authorization requirements, and users.

For example, a you can segment a default installation of Red Hat OpenStack Platform into the following zones:

Table 1.1. Security zones

Zone	Networks	Details
Public	external	The public zone hosts the external networks, public APIs, and floating IP addresses for the external connectivity of instances. This zone allows access from networks outside of your administrative control and is an untrusted area of the cloud infrastructure.
Guest	tenant	The guest zone hosts project networks. It is untrusted for public and private cloud providers that allow unrestricted access to instances.
Storage access	storage, storage_mgmt	The storage access zone is for storage management, monitoring and clustering, and storage traffic.
Control	ctlplane, internal_api, ipmi	The control zone also includes the undercloud, host operating system, server hardware, physical networking, and the Red Hat OpenStack Platform director control plane.

1.4. LOCATING SECURITY ZONES IN RED HAT OPENSTACK PLATFORM

Run the following commands to collect information on the physical configuration of your Red Hat OpenStack Platform deployment:

Procedure

1. Log on to the undercloud, and source **stackrc**:

```
$ source /home/stack/stackrc
```

2. Run **openstack subnet list** to match the assigned ip networks to their associated zones:

```
openstack subnet list -c Name -c Subnet
+--------------------+-----------------+
| Name               | Subnet          |
+--------------------+-----------------+
| ctlplane-subnet    | 192.168.101.0/24 |
| storage_mgmt_subnet | 172.16.105.0/24  |
| tenant_subnet      | 172.16.102.0/24  |
| external_subnet    | 10.94.81.0/24    |
| internal_api_subnet | 172.16.103.0/24  |
| storage_subnet     | 172.16.104.0/24  |
+--------------------+-----------------+
```

3. Run **openstack server list** to list the physical servers in your infrastructure:

```
openstack server list -c Name -c Networks
+------------------------+------------------------+
| Name                   | Networks               |
+------------------------+------------------------+
| overcloud-controller-0  | ctlplane=192.168.101.15 |
| overcloud-controller-1  | ctlplane=192.168.101.19 |
| overcloud-controller-2  | ctlplane=192.168.101.14 |
| overcloud-novacompute-0 | ctlplane=192.168.101.18 |
| overcloud-novacompute-2 | ctlplane=192.168.101.17 |
| overcloud-novacompute-1 | ctlplane=192.168.101.11 |
+------------------------+------------------------+
```

4. Use the **ctlplane** address from the **openstack server list** command to query the configuration of a physical node:

```
ssh heat-admin@192.168.101.15 ip addr
```

1.5. CONNECTING SECURITY ZONES

You must carefully configure any component that spans multiple security zones with varying trust levels or authentication requirements. These connections are often the weak points in network architecture. Ensure that you configure these connections to meet the security requirements of the highest trust level of any of the zones being connected. In many cases, the security controls of the connected zones

are a primary concern due to the likelihood of attack. The points where zones meet present an additional potential point of attack and adds opportunities for attackers to migrate their attack to more sensitive parts of the deployment.

In some cases, OpenStack operators might want to consider securing the integration point at a higher standard than any of the zones in which it resides. Given the above example of an API endpoint, an adversary could potentially target the Public API endpoint from the public zone, leveraging this foothold in the hopes of compromising or gaining access to the internal or admin API within the management zone if these zones were not completely isolated.

The design of OpenStack is such that separation of security zones is difficult. Because core services will usually span at least two zones, special consideration must be given when applying security controls to them.

1.6. THREAT MITIGATION

Most types of cloud deployment, public, private, or hybrid, are exposed to some form of security threat. The following practices help mitigate security threats:

- Apply the principle of least privilege.
- Use encryption on internal and external interfaces.
- Use centralized identity management.
- Keep Red Hat OpenStack Platform updated.

Compute services can provide malicious actors with a tool for DDoS and brute force attacks. Methods of prevention include egress security groups, traffic inspection, intrusion detection systems, and customer education and awareness. For deployments accessible by public networks or with access to public networks, such as the Internet, ensure that processes and infrastructure are in place to detect and address outbound abuse.

Additional resources

- Implementing TLS-e with Ansible
- Integrating OpenStack Identity (keystone) with Red Hat Identity Manager (IdM)
- Keeping Red Hat OpenStack Platform Updated

CHAPTER 2. DOCUMENTING YOUR RHOSP ENVIRONMENT

Documenting the system components, networks, services, and software is important in identifying security concerns, attack vectors, and possible security zone bridging points. The documentation for your Red Hat OpenStack Platform (RHOSP) deployment should include the following information:

- A description of the system components, networks, services, and software in your RHOSP production, development, and test environments.
- An inventory of any ephemeral resources, such as virtual machines or virtual disk volumes.

2.1. DOCUMENTING THE SYSTEM ROLES

Each node in your Red Hat OpenStack Platform (RHOSP) deployment serves a specific role, either contributing to the infrastructure of the cloud, or providing cloud resources.

Nodes that contribute to the infrastructure run the cloud-related services, such as the message queuing service, storage management, monitoring, networking, and other services required to support the operation and provisioning of the cloud. Examples of infrastructure roles include the following:

- Controller
- Networker
- Database
- Telemetry

Nodes that provide cloud resources offer compute or storage capacity for instances running on your cloud. Examples of resource roles include the following:

- CephStorage
- Compute
- ComputeOvsDpdk
- ObjectStorage

Document the system roles that are used in your environment. These roles can be identified within the templates used to deploy RHOSP. For example, there is a NIC configuration file for each role in use in your environment.

Procedure

1. Check the existing templates for your deployment for files that specify the roles currently in use. There is a NIC configuration file for each role in use in your environment. In the following example, the RHOSP environment includes the **ComputeHCI** role, the **Compute** role, and the **Controller** role:

```
$ cd ~/templates
$ tree
.
├── environments
│   └── network-environment.yaml
├── hci.yaml
```

```
├── network
│   └── config
│       └── multiple-nics
│           ├── computehci.yaml
│           ├── compute.yaml
│           └── controller.yaml
├── network_data.yaml
├── plan-environment.yaml
└── roles_data_hci.yaml
```

2. Each role for your RHOSP environment performs many interrelated services. You can document the services used by each role by inspecting a **roles** file.

   a. If a **roles** file was generated for your templates, you can find it in the **~/templates** directory:

   ```
   $ cd ~/templates
   $ find . -name *role*
   > ./templates/roles_data_hci.yaml
   ```

   b. If a **roles** file was not generated for your templtes, you can generate one for the roles you currently use to inspect for documentation purposes:

   ```
   $ openstack overcloud roles generate \
   > --roles-path /usr/share/openstack-tripleo-heat-templates/roles \
   > -o roles_data.yaml Controller Compute
   ```

2.2. CREATING A HARDWARE INVENTORY

You can retrieve hardware information aobut your Red Hat OpenStack Platform deployment by viewing data that is collected during introspection. Introspection gathers hardware information from the nodes about the CPU, memory, disks, and so on.

Procedure

1. From the undercloud, source the **stackrc** file:

   ```
   $ source ~/stackrc
   ```

2. List the nodes in your environment:

   ```
   $ openstack baremetal node list -c Name
   +--------------+
   | Name         |
   +--------------+
   | controller-0 |
   | controller-1 |
   | controller-2 |
   | compute-0    |
   | compute-1    |
   | compute-2    |
   +--------------+
   ```

3. For each baremetal node from which to gather information, and run the following command to retrieve the introspection data:

```
$ openstack baremetal introspection data save <node> | jq
```

Replace **<node>** with the name of the node from the list you retrieved in step 1.

4. Optional: To limit the output to a specific type of hardware, you can retrieve a list of the inventory keys and view introspection data for a specific key:

   a. Run the following command to get a list of top level keys from introspection data:

```
$ openstack baremetal introspection data save controller-0 | jq '.inventory | keys'

[
  "bmc_address",
  "bmc_v6address",
  "boot",
  "cpu",
  "disks",
  "hostname",
  "interfaces",
  "memory",
  "system_vendor"
]
```

   b. Select a key, for example **disks**, and run the following to get more information:

```
$ openstack baremetal introspection data save controller-1 | jq '.inventory.disks'
[
  {
    "name": "/dev/sda",
    "model": "QEMU HARDDISK",
    "size": 85899345920,
    "rotational": true,
    "wwn": null,
    "serial": "QM00001",
    "vendor": "ATA",
    "wwn_with_extension": null,
    "wwn_vendor_extension": null,
    "hctl": "0:0:0:0",
    "by_path": "/dev/disk/by-path/pci-0000:00:01.1-ata-1"
  }
]
```

2.3. CREATING A SOFTWARE INVENTORY

Document the software components in use on nodes deployed in your Red Hat OpenStack Platform (RHOSP) infrastructure. System databases, RHOSP software services and supporting components such as load balancers, DNS, or DHCP services, are critical when assessing the impact of a compromise or vulnerability in a library, application, or class of software.

Procedure

1. Ensure that you know the entry points for systems and services that can be subject to malicious activity. Run the following commands on the undercloud:

```
$ cat /etc/hosts
$ source stackrc ; openstack endpoint list
$ source overcloudrc ; openstack endpoint list
```

2. RHOSP is deployed in containerized services, therefore you can view the software components on an overcloud node by checking the running containers on that node. Use **ssh** to connect to an overcloud node and list the running containers. For example, to view the overcloud services on **compute-0**, run a command similar to the following:

```
$ ssh heat-admin@compute-0 podman ps
```

CHAPTER 3. SECURING RED HAT OPENSTACK DEPLOYMENTS WITH TLS AND PKI

Red Hat OpenStack Platform consists of many networks and endpoints that handle sensitive or confidential data that you can secure. When you use Transport Layer Security (TLS), you secure traffic with symmetric key encryption. The key and cipher are negotiated in the TLS handshake, which requires validation of the server's identity through a shared trust in an intermediary called a Certificate Authority (CA).

Public Key Infrastructure (PKI) is a framework for validating an entity through a certificate authority.

3.1. COMPONENTS OF PUBLIC KEY INFRASTRUCTURE (PKI)

The core components of PKI are shown in the folling table:

Table 3.1. Key Terms

Term	Definition
End entity	The user, process, or system that validates itself through the use of a digital certificate.
Certificate Authority (CA)	The CA is an entity that is trusted by both the end entity, and the relying party that validates the end entity.
Relying party	The relying party receives the digital certificate as validation of the end entity, and has the capability of verifying the digital certificate.
Digital certificates	Signed public key certificates have a verifiable entity and a public key, and are issued by a CA. When a CA signs a certificate, it creates a message digest from the certificate encrypted with its private key. You can verify the signature using the public key associated with CA. The X.509 standard is used to define the certificates.
Registration Authority (RA)	An RA is an optional dedicated authority that can perform management functions such as authenticating end entities before they are issued a certificate by a CA. The CA authenticates end entities if there is no RA.
Certificate Revocation List (CRL)	A CRL is a list of certificate serial numbers that have been revoked. End entities presenting certificates with revoked serial numbers are not trusted in a PKI model.
CRL issuer	An optional system to which a CA delegates the publication of certificate revocation lists.

Term	Definition
Certificate Repository	The location where the end entity certificates and certificate revocation lists are stored and queried.

3.2. CERTIFICATE AUTHORITY REQUIREMENTS AND RECOMMENDATIONS

You must get certificates signed by a widely recognized certificate authority (CA) for publicly available Red Hat OpenStack Platform Dashboards or publicly accessible APIs.

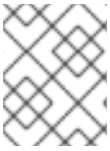
You must give a DNS domain or subdomain to each endpoint that you secure with TLS. The domains you provide are used to create the certificates issued by a CA. Customers access the dashboard or the API using the DNS name so that the CA can validate the endpoint.

Red Hat recommends using a separate and internally managed CA to secure internal traffic. This allows the cloud deployer to maintain control of their Private Key Infrastructure (PKI) implementation and makes requesting, signing and deploying certificates for internal systems easier.

You can enable SSL/TLS on your overcloud endpoints. Due to the number of certificates required to configure TLS everywhere (TLS-e), director integrates with a Red Hat Identity Management (IdM) server to act as a certificate authority and manage the overcloud certificates. For more information on configuring TLS-e, see Implementing TLS-e with Ansible .

To check the status of TLS support across the OpenStack components, refer to the TLS Enablement status matrix.

If want to you use a SSL certificate with your own certificate authority, see Enabling SSL/TLS on overcloud public endpoints.



NOTE

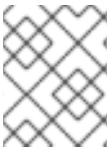
This will configure Red Hat OpenStack Platform with SSL/TLS on publicly accessible endpoints only.

3.3. IDENTIFYING TLS VERSIONS IN YOUR ENVIRONMENT

IMPORTANT

TLS version 1.0 is is deprecated for Red Hat OpenStack platform. Additionally, you must at minimum use TLS 1.2 for NIST-approval. For more information, see Guidelines for the Selection, Configuration, and Use of Transport Layer Security (TLS) Implementations.

You can use **cipherscan** to determine the versions of TLS being presented by your deployment. Cipherscan can be cloned from https://github.com/mozilla/cipherscan. This example output demonstrates results received from **horizon**:



NOTE

Run **cipherscan** from a non-production system, as it might install additional dependencies when you first run it.

```
$ ./cipherscan https://openstack.lab.local
...........................
Target: openstack.lab.local:443

prio  ciphersuite              protocols  pfs              curves
1     ECDHE-RSA-AES128-GCM-SHA256  TLSv1.2    ECDH,P-256,256bits  prime256v1
2     ECDHE-RSA-AES256-GCM-SHA384  TLSv1.2    ECDH,P-256,256bits  prime256v1
3     DHE-RSA-AES128-GCM-SHA256    TLSv1.2    DH,1024bits         None
4     DHE-RSA-AES256-GCM-SHA384    TLSv1.2    DH,1024bits         None
5     ECDHE-RSA-AES128-SHA256      TLSv1.2    ECDH,P-256,256bits  prime256v1
6     ECDHE-RSA-AES256-SHA384      TLSv1.2    ECDH,P-256,256bits  prime256v1
7     ECDHE-RSA-AES128-SHA         TLSv1.2    ECDH,P-256,256bits  prime256v1
8     ECDHE-RSA-AES256-SHA         TLSv1.2    ECDH,P-256,256bits  prime256v1
9     DHE-RSA-AES128-SHA256        TLSv1.2    DH,1024bits         None
10    DHE-RSA-AES128-SHA           TLSv1.2    DH,1024bits         None
11    DHE-RSA-AES256-SHA256        TLSv1.2    DH,1024bits         None
12    DHE-RSA-AES256-SHA           TLSv1.2    DH,1024bits         None
13    ECDHE-RSA-DES-CBC3-SHA       TLSv1.2    ECDH,P-256,256bits  prime256v1
14    EDH-RSA-DES-CBC3-SHA         TLSv1.2    DH,1024bits         None
15    AES128-GCM-SHA256            TLSv1.2    None                None
16    AES256-GCM-SHA384            TLSv1.2    None                None
17    AES128-SHA256                TLSv1.2    None                None
18    AES256-SHA256                TLSv1.2    None                None
19    AES128-SHA                   TLSv1.2    None                None
20    AES256-SHA                   TLSv1.2    None                None
21    DES-CBC3-SHA                 TLSv1.2    None                None

Certificate: trusted, 2048 bits, sha256WithRSAEncryption signature
TLS ticket lifetime hint: None
NPN protocols: None
OCSP stapling: not supported
Cipher ordering: server
Curves ordering: server - fallback: no
Server supports secure renegotiation
Server supported compression methods: NONE
TLS Tolerance: yes

Intolerance to:
 SSL 3.254          : absent
 TLS 1.0            : PRESENT
 TLS 1.1            : PRESENT
 TLS 1.2            : absent
 TLS 1.3            : absent
 TLS 1.4            : absent
```

When scanning a server, Cipherscan advertises support for a specific TLS version, which is the highest TLS version it is willing to negotiate. If the target server correctly follows TLS protocol, it will respond with the highest version that is mutually supported, which may be lower than what Cipherscan initially advertised. If the server does proceed to establish a connection with the client using that specific version, it is not considered to be intolerant to that protocol version. If it does not establish the connection (with the specified version, or any lower version), then intolerance for that version of protocol is considered to be present. For example:

```
Intolerance to:
 SSL 3.254          : absent
```

```
TLS 1.0         : PRESENT
TLS 1.1         : PRESENT
TLS 1.2         : absent
TLS 1.3         : absent
TLS 1.4         : absent
```

In this output, intolerance of **TLS 1.0** and **TLS 1.1** is reported as **PRESENT**, meaning that the connection could not be established, and that Cipherscan was unable to connect while advertising support for those TLS versions. As a result, it is reasonable to conclude that those (and any lower) versions of the protocol are not enabled on the scanned server.

3.4. IDENTITY MANAGEMENT (IDM) SERVER RECOMMENDATIONS FOR OPENSTACK

Red Hat provides the following information to help you integrate your IdM server and OpenStack environment.

For information on preparing Red Hat Enterprise Linux for an IdM installation, see Installing Identity Management.

Run the **ipa-server-install** command to install and configure IdM. You can use command parameters to skip interactive prompts. Use the following recommendations so that your IdM server can integrate with your Red Hat OpenStack Platform environment:

Table 3.2. Parameter recommendations

Option	Recommendation
--admin-password	Note the value you provide. You will need this password when configuring Red Hat OpenStack Platform to work with IdM.
--ip-address	Note the value you provide. The undercloud and overcloud nodes require network access to this ip address.
--setup-dns	Use this option to install an integrated DNS service on the IdM server. The undercloud and overcloud nodes use the IdM server for domain name resolution.
--auto-forwarders	Use this option to use the addresses in **/etc/resolv.conf** as DNS forwarders.
--auto-reverse	Use this option to resolve reverse records and zones for the IdM server IP addresses. If neither reverse records or zones are resolvable, IdM creates the reverse zones. This simplifies the IdM deployment.
--ntp-server, **--ntp-pool**	You can use both or either of these options to configure your NTP source. Both the IdM server and your OpenStack environment must have correct and synchronized time.

You must open the firewall ports required by IdM to enable communication with Red Hat OpenStack Platform nodes. For more information, see Opening the ports required by IdM .

Additional resources

- Configuring and Managing Identity Management
- Red Hat Identity Management Documentation

3.5. IMPLEMENTING TLS-E WITH ANSIBLE

You can use the new **tripleo-ipa** method to enable SSL/TLS on overcloud endpoints, called TLS everywhere (TLS-e). Due to the number of certificates required, Red Hat OpenStack Platform integrates with Red Hat Identity management (IdM). When you use **tripleo-ipa** to configure TLS-e, IdM is the certificate authority.

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

Use the following procedure to implement TLS-e on a new installation of Red Hat OpenStack Platform, or an existing deployment that you want 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 required to run commands such as **openstack undercloud install**, and **openstack overcloud deploy**. These procedures are idempotent and only adjust your existing deployment configuration to match updated templates and configuration files.

1. Configure the **/etc/resolv.conf** 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.

4. 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
```

5. Add the following parameters to undercloud.conf

```
undercloud_nameservers = $IDM_SERVER_IP_ADDR
overcloud_domain_name = example.com
```

6. Deploy the undercloud:

```
openstack undercloud install
```

Verification

Verify that the undercloud was enrolled correctly by completing the following steps:

1. List the hosts in IdM:

```
$ kinit admin
$ ipa host-find
```

2. 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.

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.

1. 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:

```
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
```

- 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.
- For more information about the parameters that you use to implement TLS-e, see Parameters for tripleo-ipa.

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 endpoint list
```

3.6. PARAMETERS FOR TRIPLEO-IPA

Use the fully qualified domain name (FQDN) of your cloud to define the cloud name and cloud domain parameters required for **tripleo-ipa**. For example, with an FQDN of **overcloud.example.com**, use the following values:

- CloudDomain: example.com
- CloudName: overcloud.example.com
- CloudNameCtlplane: overcloud.ctlplane.example.com
- CloudNameInternal: overcloud.internalapi.example.com
- CloudNameStorage: overcloud.storage.example.com
- CloudNameStorageManagement: overcloud.storagemgmt.example.com

Set the following additional parameters based on the requirements of your environment:

CertmongerKerberosRealm

Set **CertmongerKerberosRealm** parameter to the value of the IPA realm. This is required if the IPA realm does not match the IPA domain.

DnsSearchDomains

The **DnsSearchDomains** parameter is a comma-separated list. If the domain of the IdM server is different than the cloud domain, include the domain of the IdM server in the **DnsSearchDomains** parameter.

DnsServers

Set the **DnsServers** parameter to a value that reflects the IP address of the IdM server.

EnableEtcdInternalTLS

If you deploy TLSe on a distributed compute node (DCN) architecture, you must add the **EnableEtcdInternalTLS** parameter with the value of **True**.

IDMInstallClientPackages

If you have preprovisioned your compute nodes, set the **IDMInstallClientPackages** parameter to a value of **True**. Otherwise, set the value to **False**.

IDMModifyDNS

Set the **IDMModifyDNS** parameter to **false** to disable automatic IP registration of the overcloud nodes on Red Hat Identity Server.

IdmDomain

Set the **IdmDomain** parameter to the domain portion of the FQDN of your Red Hat Identity server. The value that you specify is also used as the value of the IdM realm. If the IdM domain and IdM realm differ, set the realm explicitly using the **CertmongerKerberosRealm** parameter.

IdmServer

Set the **IdmServer** parameter to the FQDN of your Red Hat Identity server. If you use a replicated IdM environment, then set multiple values using a comma delimited list. For more information on IdM replicas, see Installing an IdM replica .

CHAPTER 4. IDENTITY AND ACCESS MANAGEMENT

The Identity service (keystone) provides authentication and authorization for cloud users in a Red Hat OpenStack Platform environment. You can use the Identity service for direct end-user authentication, or configure it to use external authentication methods to meet your security requirements or to match your current authentication infrastructure.

4.1. RED HAT OPENSTACK PLATFORM FERNET TOKENS

After you authenticate, the Identity service (keystone):

- Issues an encrypted bearer token known as a fernet token. This token represents your identity.
- Authorizes you you to perform operations based on your role.

Each fernet token remains valid for up to an hour, by default. This allows a user to perform a series of tasks without needing to reauthenticate.

Fernet is the default token provider that replaces the **UUID** token provider.

Additional resources

- Using Fernet keys for encryption in the overcloud

4.2. OPENSTACK IDENTITY SERVICE ENTITIES

The Red Hat OpenStack Identity service (keystone) recognizes the following entities:

Users

OpenStack Identity service (keystone) users are the atomic unit of authentication. A user must be assigned a role on a project in order to authenticate.

Groups

OpenStack Identity service groups are a logical grouping of users. A group can be provided access to projects under specific roles. Managing groups instead of users can simplify the management of roles.

Roles

OpenStack Identity service roles define the OpenStack APIs that are accessible to users or groups who are assigned those roles.

Projects

OpenStack Identity service projects are isolated groups of users who have common access to a shared quota of physical resources and the virtual infrastructure built from those physical resources.

Domains

OpenStack Identity service domains are high-level security boundaries for projects, users, and groups. You can use OpenStack Identity domains to centrally manage all keystone-based identity components. Red Hat OpenStack Platform supports multiple domains. You can represent users of different domains by using separate authentication backends.

4.3. AUTHENTICATING WITH KEYSTONE

You can adjust the authentication security requirements required by OpenStack Identity service (keystone).

When you deploy Red Hat OpenStack Platform (RHOSP), it is possible to specify password requirements that are more complex than the default passwords that are generated for services. When this occurs, services cannot authenticate, and the deployment fails.

You must initially deploy RHOSP without password complexity requirements. After the deployment completes, add the **KeystonePasswordRegex** parameter to your templates, and re-run the deployment.

To harden your environment, implement password complexity requirements that meet the standards of your organization. For information about NIST recommended password complexity requirements, see publication 88-63B, Appendix A.

Parameter	Description
KeystoneChangePasswordUponFirstUse	Enabling this option requires users to change their password when the user is created, or upon administrative reset.
KeystoneDisableUserAccountDaysInactive	The maximum number of days a user can go without authenticating before being considered "inactive" and automatically disabled (locked).
KeystoneLockoutDuration	The number of seconds a user account is locked when the maximum number of failed authentication attempts (as specified by **KeystoneLockoutFailureAttempts**) is exceeded.
KeystoneLockoutFailureAttempts	The maximum number of times that a user can fail to authenticate before the user account is locked for the number of seconds specified by **KeystoneLockoutDuration**.
KeystoneMinimumPasswordAge	The number of days that a password must be used before the user can change it. This prevents users from changing their passwords immediately in order to wipe out their password history and reuse an old password.
KeystonePasswordExpiresDays	The number of days for which a password is considered valid before requiring users to change it.
KeystonePasswordRegex	The regular expression that is used to validate password strength requirements.
KeystonePasswordRegexDescription	Describe your password regular expression here in language for humans.
KeystoneUniqueLastPasswordCount	This controls the number of previous user password iterations to keep in history, in order to enforce that newly created passwords are unique.

Additional resources

- Identity (keystone) parameters.

4.3.1. Using Identity service heat parameters to stop invalid login attempts

Repetitive failed login attempts can be a sign of an attempted brute-force attack. You can use the Identity Service to limit access to accounts after repeated unsuccessful login attempts.

Procedure

1. To configure the maximum number of times that a user can fail to authenticate before the user account is locked, set the value of the **KeystoneLockoutFailureAttempts** and **KeystoneLockoutDuration** heat parameters in an environment file. In the following example, the **KeystoneLockoutDuration** is set to one hour:

```
parameter_defaults
  KeystoneLockoutDuration: 3600
  KeystoneLockoutFailureAttempts: 3
```

2. Include the environment file in your deploy script. When you run your deploy script on a previously deployed environment, it is updated with the additional parameters:

```
openstack overcloud deploy --templates \
...
-e keystone_config.yaml
...
```

4.4. AUTHENTICATING WITH EXTERNAL IDENTITY PROVIDERS

You can use an external identity provider (IdP) to authenticate to OpenStack service providers (SP). SPs are the services provided by an OpenStack cloud.

When you use a separate IdP, external authentication credentials are separate from the databases used by other OpenStack services. This separation reduces the risk of a compromise of stored credentials.

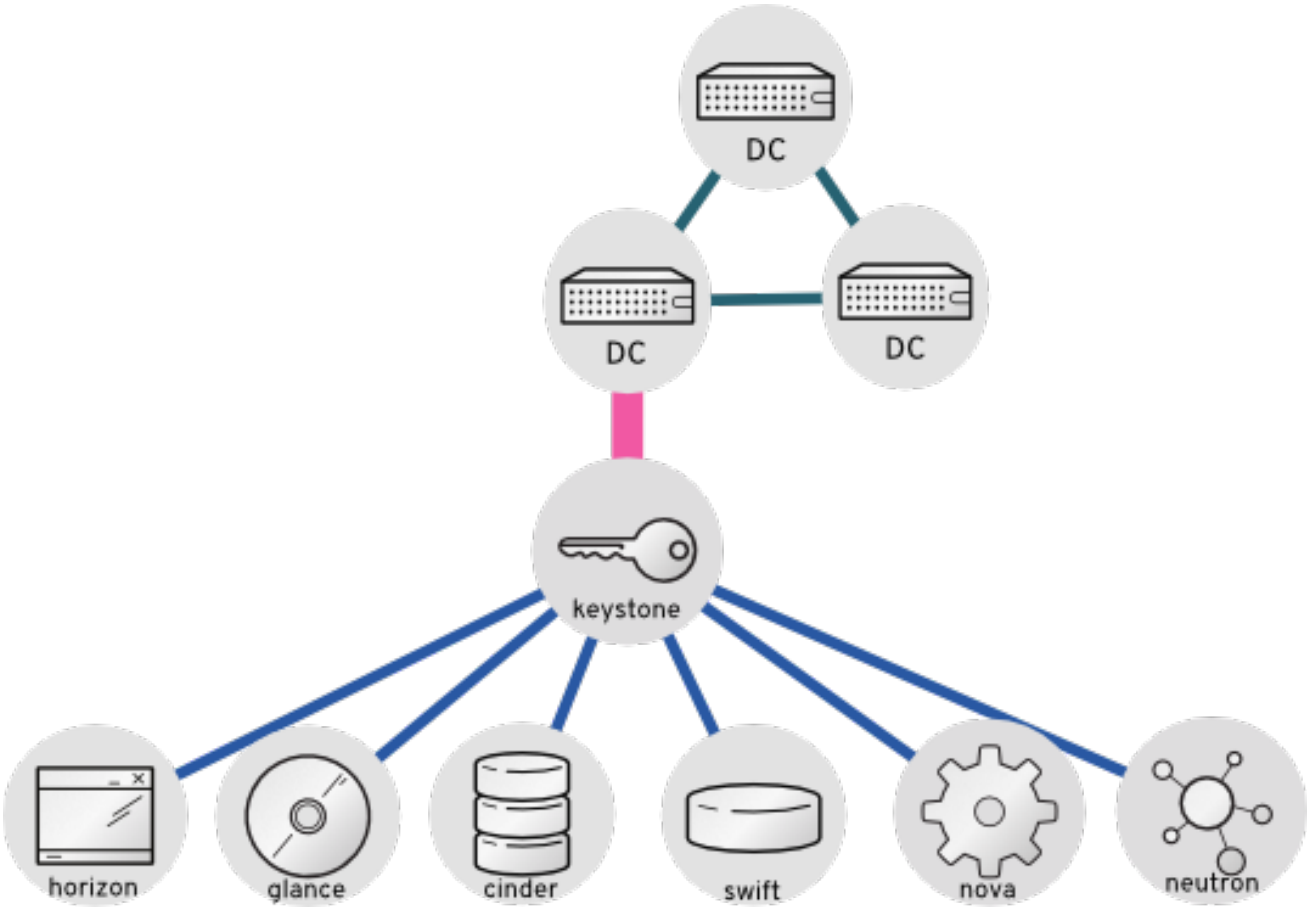
Each external IdP has a one-to-one mapping to an OpenStack Identity service (keystone) domain. You can have multiple coexisting domains with Red Hat OpenStack Platform.

External authentication provides a way to use existing credentials to access resources in Red Hat OpenStack Platform without creating additional identities. The credential is maintained by the user's IdP.

You can use IdPs such as Red Hat Identity Management (IdM), and Microsoft Active Directory Domain Services (AD DS) for identity management. In this configuration, the OpenStack Identity service has read-only access to the LDAP user database. The management of API access based on user or group role is performed by keystone. Roles are assigned to the LDAP accounts by using the OpenStack Identity service.

4.4.1. How LDAP integration works

In the diagram below, keystone uses an encrypted LDAPS connection to connect to an Active Directory Domain Controller. When a user logs in to horizon, keystone receives the supplied user credentials and passes them to Active Directory.



Additional resources

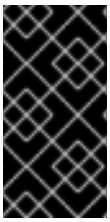
- Integrating OpenStack Identity (keystone) with Active Directory
- Integrating OpenStack Identity (keystone) with Red Hat Identity Manager (IdM)
- Configuring director to use domain specific LDAP backends

CHAPTER 5. POLICIES

Each OpenStack service contains resources that are managed by access policies. For example, a resource might include the following functions:

- Permission to create and start instances
- The ability to attach a volume to an instance

If you are a Red Hat OpenStack Platform (RHOSP) administrator, you can create custom policies to introduce new roles with varying levels of access, or to change the default behavior of existing roles.



IMPORTANT

Red Hat does not support customized roles and policies. Syntax errors can lead to downtime, and misapplied authorization can negatively impact security or usability. If you need custom policies in your production environment, contact Red Hat support for a support exception.

5.1. REVIEWING EXISTING POLICIES

Policy files for services traditionally existed in the **/etc/$service** directory. For example, the full path of the **policy.json** file for Compute (nova) was **/etc/nova/policy.json**.

There are two important architectural changes that affect how you can find existing policies:

- Red Hat OpenStack Platform is now containerized.
  - Policy files, if present, are in the traditional path if you view them from inside the service container:
    /etc/$service/policy.json
  - Policy files, if present, are in the following path if you view them from outside the service container:
    /var/lib/config-data/puppet-generated/$service/etc/$service/policy.json
- Each service has default policies that are provided in code, with files that are available only if you created them manually, or if they are generated with **oslopolicy** tooling. To generate a policy file, use the **oslopolicy-policy-generator** from within a container, as in the following example:

```
podman exec -it keystone oslopolicy-policy-generator --namespace keystone
```

By default, generated policies are pushed to stdout by oslo.policy CLI tools.

5.2. UNDERSTANDING SERVICE POLICIES

Service policy file statements are either alias definitions or rules. Alias definitions exist at the top of the file. The following list contains an explanation of the alias definitions from the generated **policy.json** file for Compute (nova):

- "context_is_admin": "role:admin"
  When **rule:context_is_admin** appears after a target, the policy checks that the user is operating with an administrative context before it allows that action.

- "admin_or_owner": "is_admin:True or project_id:%(project_id)s"
  When **admin_or_owner** appears after a target, the policy checks that the user is either an admin, or that their project ID matches the owning project ID of the target object before it allows that action.

- "admin_api": "is_admin:True
  When **admin_api** appears after a target, the policy checks that the user is an admin before it allows that action.

5.3. POLICY SYNTAX

Policy.json files support certain operators so that you can control the target scope of these settings. For example, the following keystone setting contains the rule that only admin users can create users:

```
"identity:create_user": "rule:admin_required"
```

The section to the left of the **:** character describes the privilege, and the section to the right defines who can use the privilege. You can also use operators to the right side to further control the scope:

- **!** - No user (including admin) can perform this action.
- **@** and **""** - Any user can perform this action.
- **not**, **and**, **or** - Standard operator functions are available.

For example, the following setting means that no users have permission to create new users:

```
"identity:create_user": "!"
```

5.4. USING POLICY FILES FOR ACCESS CONTROL

To override the default rules, edit the **policy.json** file for the appropriate OpenStack service. For example, the Compute service has a **policy.json** in the nova directory, which is the correct location of the file for containerized services when you view it from inside the container.

NOTE

- You must thoroughly test changes to policy files in a staging environment before implementing them in production.
- You must check that any changes to the access control policies do not unintentionally weaken the security of any resource. In addition, any changes to a **policy.json** file are effective immediately and do not require a service restart.

5.5. EXAMPLE: CREATING A POWER USER ROLE

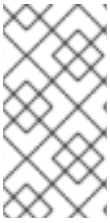
To customize the permissions of a keystone role, update the **policy.json** file of a service. This means that you can more granularly define the permissions that you assign to a class of users. This example creates a *power user* role for your deployment with the following privileges:

- Start an instance.
- Stop an instance.

- Manage the volumes that are attached to instances.

The intention of this role is to grant additional permissions to certain users, without the need to then grant **admin** access. To use these privileges, you must grant the following permissions to a custom role:

- Start an instance: **"os_compute_api:servers:start": "role:PowerUsers"**
- Stop an instance: **"os_compute_api:servers:stop": "role:PowerUsers"**
- Configure an instance to use a particular volume: **"os_compute_api:servers:create:attach_volume": "role:PowerUsers"**
- List the volumes that are attached to an instance: **"os_compute_api:os-volumes-attachments:index": "role:PowerUsers"**
- Attach a volume: **"os_compute_api:os-volumes-attachments:create": "role:PowerUsers"**
- View the details of an attached volume: **"os_compute_api:os-volumes-attachments:show": "role:PowerUsers"**
- Change the volume that is attached to an instance: **"os_compute_api:os-volumes-attachments:update": "role:PowerUsers"**
- Delete a volume that is attached to an instance: **"os_compute_api:os-volumes-attachments:delete": "role:PowerUsers"**



NOTE

When you modify the **policy.json** file, you override the default policy. As a result, members of **PowerUsers** are the only users that can perform these actions. To allow **admin** users to retain these permissions, you can create rules for *admin_or_power_user*. You can also use some basic conditional logic to define **role:PowerUsers or role:Admin**.

1. Create the custom keystone role:

```
$ openstack role create PowerUsers
+-----------+----------------------------------+
| Field     | Value                            |
+-----------+----------------------------------+
| domain_id | None                             |
| id        | 7061a395af43455e9057ab631ad49449 |
| name      | PowerUsers                       |
+-----------+----------------------------------+
```

2. Add an existing user to the role, and assign the role to a project:

```
$ openstack role add --project [PROJECT_NAME] --user [USER_ID] [PowerUsers-ROLE_ID]
```

NOTE

A role assignment is paired exclusively with one project. This means that when you assign a role to a user, you also define the target project at the same time. If you want the user to receive the same role but for a different project, you must assign the role to them again separately but target the different project.

3. View the default nova policy settings:

```
$ oslopolicy-policy-generator --namespace nova
```

4. Create custom permissions for the new **PowerUsers** role by adding the following entries to **/var/lib/config-data/puppet-generated/nova/etc/nova/policy.json**:

NOTE

Test your policy changes before deployment to verify that they work as you expect.

```
{
"os_compute_api:servers:start": "role:PowerUsers",
"os_compute_api:servers:stop": "role:PowerUsers",
"os_compute_api:servers:create:attach_volume": "role:PowerUsers",
"os_compute_api:os-volumes-attachments:index": "role:PowerUsers",
"os_compute_api:os-volumes-attachments:create": "role:PowerUsers",
"os_compute_api:os-volumes-attachments:show": "role:PowerUsers",
"os_compute_api:os-volumes-attachments:update": "role:PowerUsers",
"os_compute_api:os-volumes-attachments:delete": "role:PowerUsers"
}
```

You implement the changes when you save this file and restart the nova container. Users that are added to the **PowerUsers** keystone role receive these privileges.

5.6. EXAMPLE: LIMITING ACCESS BASED ON ATTRIBUTES

You can create policies that will restrict access to API calls based on the attributes of the user making that API call. For example, the following default rule states that keypair deletion is allowed if run from an administrative context, or if the user ID of the token matches the user ID associated with the target.

```
"os_compute_api:os-keypairs:delete": "rule:admin_api or user_id:%(user_id)s"
```

NOTE: * Newly implemented features are not guaranteed to be in every service with each release. Therefore, it is important to write rules using the conventions of the target service's existing policies. For details on viewing these policies, see Reviewing existing policies. * All policies should be rigorously tested in a non-production environment for every version on which they will be deployed, as policies are not guaranteed for compatibility across releases.

Based on the above example, you can craft API rules to expand or restrict access to users based on whether or not they own a resource. Additionally, attributes can be combined with other restrictions to form rules as seen in the example below:

```
"admin_or_owner": "is_admin:True or project_id:%(project_id)s"
```

Considering the examples above, you can create a unique rule limited to administrators and users, and then use that rule to further restrict actions:

```
"admin_or_user": "is_admin:True or user_id:%(user_id)s"
"os_compute_api:os-instance-actions": "rule:admin_or_user"
```

For more information about the **policy.json** syntax options that are available, see Policy syntax.

5.7. MODIFYING POLICIES WITH HEAT

You can use heat to configure access policies for certain services in the overcloud. Use the following parameters to set policies on the respective services:

Table 5.1. Policy Parameters

Parameter	Description
KeystonePolicies	A hash of policies to configure for OpenStack Identity (keystone).
IronicApiPolicies	A hash of policies to configure for OpenStack Bare Metal (ironic) API.
BarbicanPolicies	A hash of policies to configure for OpenStack Key Manager (barbican).
NeutronApiPolicies	A hash of policies to configure for OpenStack Networking (neutron) API.
SaharaApiPolicies	A hash of policies to configure for OpenStack Clustering (sahara) API.
NovaApiPolicies	A hash of policies to configure for OpenStack Compute (nova) API.
CinderApiPolicies	A hash of policies to configure for OpenStack Block Storage (cinder) API.
GlanceApiPolicies	A hash of policies to configure for OpenStack Image Storage (glance) API.
HeatApiPolicies	A hash of policies to configure for OpenStack Orchestration (heat) API.

To configure policies for a service, give the policy parameter a hash value that contains the service's policies For example:

- OpenStack Identity (keystone) uses the **KeystonePolicies** parameter. Set this parameter in the **parameter_defaults** section of an environment file:

```
parameter_defaults:
  KeystonePolicies: { keystone-context_is_admin: { key: context_is_admin, value: 'role:admin' } }
```

- OpenStack Compute (nova) uses the **NovaApiPolicies** parameter. Set this parameter in the **parameter_defaults** section of an environment file:

```
parameter_defaults:
  NovaApiPolicies: { nova-context_is_admin: { key: 'compute:get_all', value: '@' } }
```

5.8. AUDITING YOUR USERS AND ROLES

You can use tools available in Red Hat OpenStack Platform to build a report of role assignments per user and associated privileges.

1. Run the **openstack role list** command to see the roles currently in your environment:

```
openstack role list -c Name -f value

swiftoperator
ResellerAdmin
admin
_member_
heat_stack_user
```

2. Run the **openstack role assignment list** command to list all users that are members of a particular role. For example, to see all users that have the admin role, run the following:

```
$ openstack role assignment list --names --role admin
+-------+-----------------------------------+-------+----------------+-----------+--------+-----------+
| Role  | User                              | Group | Project        | Domain    | System | Inherited |
+-------+-----------------------------------+-------+----------------+-----------+--------+-----------+
| admin | heat-cfn@Default                  |       | service@Default |           |        | False     |
| admin | placement@Default                 |       | service@Default |           |        | False     |
| admin | neutron@Default                   |       | service@Default |           |        | False     |
| admin | zaqar@Default                     |       | service@Default |           |        | False     |
| admin | swift@Default                     |       | service@Default |           |        | False     |
| admin | admin@Default                     |       | admin@Default   |           |        | False     |
| admin | zaqar-websocket@Default           |       | service@Default |           |        | False     |
| admin | heat@Default                      |       | service@Default |           |        | False     |
| admin | ironic-inspector@Default          |       | service@Default |           |        | False     |
| admin | nova@Default                      |       | service@Default |           |        | False     |
| admin | ironic@Default                    |       | service@Default |           |        | False     |
| admin | glance@Default                    |       | service@Default |           |        | False     |
| admin | mistral@Default                   |       | service@Default |           |        | False     |
| admin | heat_stack_domain_admin@heat_stack |       |                | heat_stack |        | False
|
| admin | admin@Default                     |       |                | all       | False  |
+-------+-----------------------------------+-------+----------------+-----------+--------+-----------+
```

NOTE

You can use the **-f {csv,json,table,value,yaml}** parameter to export these results.

5.9. AUDITING API ACCESS

You can audit the API calls a given role can access. Repeating this process for each role will result in a comprehensive report on the accessible APIs for each role. For the following steps you need:

- An authentication file to source as a user in the target role.
- An access token in JSON format.

- A policy file for each service's API you wish to audit.

Procedure

1. Start by sourcing an authentication file of a user in the desired role.
2. Capture a Keystone generated token and save it to a file. You can do this by running any openstack-cli command and using the --debug option, which prints the provided token to stdout. You can copy this token and save it to an access file. Use the following command to do this as a single step:

```
openstack token issue --debug 2>&1 | egrep ^'{\"token\":' > access.file.json
```

3. Create a policy file. This can be done on an overcloud node that hosts the containerized service of interest. The following example creates a policy file for the cinder service:

```
ssh heat-admin@CONTROLLER-1 sudo podman exec cinder_api \
oslopolicy-policy-generator \
--config-file /etc/cinder/cinder.conf \
--namespace cinder > cinderpolicy.json
```

4. Using these files, you can now audit the role in question for access to cinder's APIs:

```
oslopolicy-checker --policy cinderpolicy.json --access access.file.json
```

CHAPTER 6. ROTATING SERVICE ACCOUNT PASSWORDS

You can periodically rotate service account passwords to improve your security posture.

6.1. OVERVIEW OF OVERCLOUD PASSWORD MANAGEMENT

OpenStack services that run on the overcloud are authenticated by their Identity service (keystone) credentials. These passwords are generated during the initial deployment process and are defined as heat parameters. For example:

```
        'MistralPassword',
        'BarbicanPassword',
        'AdminPassword',
        'CeilometerMeteringSecret',
        'ZaqarPassword',
        'NovaPassword',
        'MysqlRootPassword'
```

You can rotate the passwords used by the service accounts by using a Workflow service (mistral) workflow. However, passwords are not rotated if they are listed in **DO_NOT_ROTATE**, such as Key Encrypting Keys (KEK) and Fernet keys:

```
DO_NOT_ROTATE_LIST = (
    'BarbicanSimpleCryptoKek',
    'SnmpdReadonlyUserPassword',
    'KeystoneCredential0',
    'KeystoneCredential1',
    'KeystoneFernetKey0',
    'KeystoneFernetKey1',
    'KeystoneFernetKeys',
)
```

These passwords are on the **DO_NOT_ROTATE** list for the following reasons:

- **BarbicanSimpleCryptoKek** - changing this password requires you to re-encrypt all the secrets.
- **KeystoneFernetKey** and **KeystoneCredential** - separate workflows already exist to rotate these. For more information, see Rotating the Fernet keys by using the Workflow service .

6.2. ROTATING THE PASSWORDS

Use the following procedure to rotate eligible passwords. The next time you complete a stack update by running the **openstack overcloud deploy** command, your rotated password changes are applied. Any passwords specified in environment files take precedence over password changes that use this method. For information about outage requirements and service impact, see Outage requirements .

IMPORTANT

Do not use this procedure to rotate the **swift** password, because this is not currently supported.

1. As the stack user, run the password rotation workflow. This rotates all passwords, except for those on the **DO_NOT_ROTATE** list:

```
$ openstack workflow execution create tripleo.plan_management.v1.rotate_passwords
'{"container": "overcloud"}'
```

If you want to rotate only specific passwords, you can use **password_list**. You can also use this method to rotate passwords on the **DO_NOT_ROTATE** list. For example:

```
$ openstack workflow execution create tripleo.plan_management.v1.rotate_passwords
'{"container": "overcloud", "password_list": ["SaharaPassword", "ManilaPassword"]}'
```

The Workflow service Mistral workflow generates new passwords for the service accounts.

2. Run a stack update to apply the new passwords.

3. You can retrieve and view the new passwords, by creating a workflow to retrieve the passwords, and then viewing the output:

   a. Create a new workflow to retrieve the passwords. Note the ID of the workflow:

```
$ openstack workflow execution create tripleo.plan_management.v1.get_passwords
'{"container": "overcloud"}'
+-------------------+--------------------------------------------+
| Field             | Value                                      |
+-------------------+--------------------------------------------+
| ID                | edcf9103-e1a8-42f9-85c1-e505c055e0ed       |
| Workflow ID       | 8aa2ac9b-22ee-4e7d-8240-877237ef0d0a       |
| Workflow name     | tripleo.plan_management.v1.rotate_passwords |
| Workflow namespace |                                           |
| Description       |                                           |
| Task Execution ID | <none>                                    |
| Root Execution ID | <none>                                    |
| State             | RUNNING                                   |
| State info        | None                                      |
| Created at        | 2020-01-22 15:47:57                       |
| Updated at        | 2020-01-22 15:47:57                       |
+-------------------+--------------------------------------------+
```

   b. Use the workflow ID to check the workflow status. You must wait until the workflow has a state of **SUCCESS** before you continue:

```
$ openstack workflow execution show edcf9103-e1a8-42f9-85c1-e505c055e0ed
    +-------------------+--------------------------------------------+
    | Field             | Value                                      |
    +-------------------+--------------------------------------------+
    | ID                | edcf9103-e1a8-42f9-85c1-e505c055e0ed       |
    | Workflow ID       | 8aa2ac9b-22ee-4e7d-8240-877237ef0d0a       |
    | Workflow name     | tripleo.plan_management.v1.rotate_passwords |
    | Workflow namespace |                                           |
    | Description       |                                           |
    | Task Execution ID | <none>                                    |
    | Root Execution ID | <none>                                    |
    | State             | SUCCESS                                   |
    | State info        | None                                      |
```

```
| Created at         | 2020-01-22 15:47:57                          |
| Updated at         | 2020-01-22 15:48:39                          |
+--------------------+----------------------------------------------+
```

c. When the workflow is complete, retrieve the passwords by using the following command:

```
openstack workflow execution output show edcf9103-e1a8-42f9-85c1-e505c055e0ed
    {
        "status": "SUCCESS",
        "message": {
            "AdminPassword": "FSn0sS1aAHp8YK2fU5niM3rxu",
            "AdminToken": "dTP0Wdy7DtblG80M54r4a2yoC",
            "AodhPassword": "fB5NQdRe37BaBVEWDHVuj4etk",
            "BarbicanPassword": "rn7yk7KPafKw2PWN71MvXpnBt",
            "BarbicanSimpleCryptoKek": "lrC3sGlV7-D7-
V_PI4vbDfF1Ujm5OjnAVFcnihOpbCg=",
            "CeilometerMeteringSecret": "DQ69HdlJobhnGWoBC0jM3drPF",
            "CeilometerPassword": "qI6xOpofuiXZnG95iUe8Oxv5d",
            "CephAdminKey": "AQDGVPpdAAAAABAAZMP56/VY+zCVcDT81+TOjg==",
            "CephClientKey": "AQDGVPpdAAAAABAAanYtA0ggpcoCbS1nLeDN7w==",
            "CephClusterFSID": "141a5ede-21b4-11ea-8132-52540031f76b",
            "CephDashboardAdminPassword":
"AQDGVPpdAAAAABAAKhsx630YKDhQrocS4o4KzA==",
            "CephGrafanaAdminPassword":
"AQDGVPpdAAAAABAAKBojG+CO72B0TdBRR0paEg==",
            "CephManilaClientKey":
"AQDGVPpdAAAAABAAA1TVHrTVCC8xQ4skG4+d5A=="
        }
    }
```

6.3. OUTAGE REQUIREMENTS

Outage requirements and service impacts can occur when you change passwords for the overcloud service accounts.

After a password has been rotated as part of the stack update, the old password becomes invalid. As a result, services are unavailable with an HTTP **401** error for the duration that it takes for the new password to be added to the service configuration settings.

In addition, you can expect to encounter brief outages when you change passwords for the supporting services, including MySQL, RabbitMQ, and High Availability.

CHAPTER 7. NETWORK TIME PROTOCOL

You need to ensure that systems within your Red Hat OpenStack Platform cluster have accurate and consistent timestamps between systems.

Red Hat OpenStack Platform on Red Hat Enterprise Linux 8 supports Chrony for time management. For more information, see Using the Chrony suite to configure NTP .

7.1. WHY CONSISTENT TIME IS IMPORTANT

Consistent time throughout your organization is important for both operational and security needs:

Identifying a security event

Consistent timekeeping helps you correlate timestamps for events on affected systems so that you can understand the sequence of events.

Authentication and security systems

Security systems can be sensitive to time skew, for example:

- A kerberos-based authentication system might refuse to authenticate clients that are affected by seconds of clock skew.
- Transport layer security (TLS) certificates depend on a valid source of time. A client to server TLS connection fails if the difference between client and server system times exceeds the *Valid From* date range.

Red Hat OpenStack Platform services

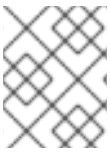
Some core OpenStack services are especially dependent on accurate timekeeping, including High Availability (HA) and Ceph.

7.2. NTP DESIGN

Network time protocol (NTP) is organized in a hierarchical design. Each layer is called a stratum. At the top of the hierarchy are stratum 0 devices such as atomic clocks. In the NTP hierarchy, stratum 0 devices provide reference for publicly available stratum 1 and stratum 2 NTP time servers.

Do not connect your data center clients directly to publicly available NTP stratum 1 or 2 servers. The number of direct connections would put unnecessary strain on the public NTP resources. Instead, allocate a dedicated time server in your data center, and connect the clients to that dedicated server.

Configure instances to receive time from your dedicated time servers, not the host on which they reside.



NOTE

Service containers running within the Red Hat OpenStack Platform environment still receive time from the host on which they reside.

CHAPTER 8. HARDENING INFRASTRUCTURE AND VIRTUALIZATION

Check with hardware and software vendors periodically to get available information about new vulnerabilities and security updates. Red Hat Product Security maintains the following sites to inform you of security updates:

- RHSA-announce
- Errata notifications
- Security Advisories

Keep the following in mind as you regularly update your deployment of Red Hat OpenStack Platform.

- Ensure all security updates are included.
- Kernel updates require a reboot.
- Update hosted Image service (glance) images to ensure that newly created instances have the latest updates.

8.1. HYPERVISORS

When you evaluate a hypervisor platform, consider the supportability of the hardware on which the hypervisor will run. Additionally, consider the additional features available in the hardware and how those features are supported by the hypervisor you chose as part of the OpenStack deployment. To that end, hypervisors each have their own hardware compatibility lists (HCLs). When selecting compatible hardware it is important to know in advance which hardware-based virtualization technologies are important from a security perspective.

8.1.1. Hypervisor versus bare metal

It is important to recognize the difference between using Linux containers or bare metal systems versus using a hypervisor like KVM. Specifically, the focus of this security guide is largely based on having a hypervisor and virtualization platform. However, should your implementation require the use of a bare metal or containerized environment, you must pay attention to the particular differences in regard to deployment of that environment.

For bare metal, make sure the node has been properly sanitized of data prior to re-provisioning and decommissioning. In addition, before reusing a node, you must provide assurances that the hardware has not been tampered or otherwise compromised. For more information see https://docs.openstack.org/ironic/queens/admin/cleaning.html

8.1.2. Hypervisor memory optimization

Certain hypervisors use memory optimization techniques that overcommit memory to guest virtual machines. This is a useful feature that allows you to deploy very dense compute clusters. One approach to this technique is through deduplication or sharing of memory pages: When two virtual machines have identical data in memory, there are advantages to having them reference the same memory. Typically this is performed through Copy-On-Write (COW) mechanisms, such as kernel same-page merging (KSM). These mechanisms are vulnerable to attack:

- Memory deduplication systems are vulnerable to side-channel attacks. In academic studies, attackers were able to identify software packages and versions running on neighboring virtual

machines as well as software downloads and other sensitive information through analyzing memory access times on the attacker VM. Consequently, one VM can infer something about the state of another, which might not be appropriate for multi-project environments where not all projects are trusted or share the same levels of trust

- More importantly, row-hammer type attacks have been demonstrated against KSM to enact cross-VM modification of executable memory. This means that a hostile instance can gain code-execution access to other instances on the same Compute host.

Deployers should disable KSM if they require strong project separation (as with public clouds and some private clouds):

- To disable KSM, refer to Deactivating KSM.

8.2. PCI PASSTHROUGH

PCI passthrough allows an instance to have direct access to a piece of hardware on the node. For example, this could be used to allow instances to access video cards or GPUs offering the compute unified device architecture (CUDA) for high performance computation. This feature carries two types of security risks: direct memory access and hardware infection.

Direct memory access (DMA) is a feature that permits certain hardware devices to access arbitrary physical memory addresses in the host computer. Often video cards have this capability. However, an instance should not be given arbitrary physical memory access because this would give it full view of both the host system and other instances running on the same node. Hardware vendors use an input/output memory management unit (IOMMU) to manage DMA access in these situations. You should confirm that the hypervisor is configured to use this hardware feature.

A hardware infection occurs when an instance makes a malicious modification to the firmware or some other part of a device. As this device is used by other instances or the host OS, the malicious code can spread into those systems. The end result is that one instance can run code outside of its security zone. This is a significant breach as it is harder to reset the state of physical hardware than virtual hardware, and can lead to additional exposure such as access to the management network.

Due to the risk and complexities associated with PCI passthrough, it should be disabled by default. If enabled for a specific need, you will need to have appropriate processes in place to help ensure the hardware is clean before reuse.

8.3. SELINUX

Mandatory access controls limit the impact an attempted attack, by restricting the privileges on QEMU process to only what is needed. On Red Hat OpenStack Platform, SELinux is configured to run each QEMU process under a separate security context. SELinux policies have been pre-configured for Red Hat OpenStack Platform services.

OpenStack's SELinux policies intend to help protect hypervisor hosts and virtual machines against two primary threat vectors:

- Hypervisor threats - A compromised application running within a virtual machine attacks the hypervisor to access underlying resources. For example, when a virtual machine is able to access the hypervisor OS, physical devices, or other applications. This threat vector represents considerable risk as a compromise on a hypervisor can infect the physical hardware as well as exposing other virtual machines and network segments.

- Virtual Machine (multi-project) threats - A compromised application running within a VM attacks the hypervisor to access or control another virtual machine and its resources. This is a threat

vector unique to virtualization and represents considerable risk as a multitude of virtual machine file images could be compromised due to vulnerability in a single application. This virtual network attack is a major concern as the administrative techniques for protecting real networks do not directly apply to the virtual environment. Each KVM-based virtual machine is a process which is labeled by SELinux, effectively establishing a security boundary around each virtual machine. This security boundary is monitored and enforced by the Linux kernel, restricting the virtual machine's access to resources outside of its boundary, such as host machine data files or other VMs.

Red Hat's SELinux-based isolation is provided regardless of the guest operating system running inside the virtual machine. Linux or Windows VMs can be used.

8.3.1. Labels and Categories

KVM-based virtual machine instances are labelled with their own SELinux data type, known as **svirt_image_t**. Kernel level protections prevent unauthorized system processes, such as malware, from manipulating the virtual machine image files on disk. When virtual machines are powered off, images are stored as **svirt_image_t** as shown below:

```
system_u:object_r:svirt_image_t:SystemLow image1
system_u:object_r:svirt_image_t:SystemLow image2
system_u:object_r:svirt_image_t:SystemLow image3
system_u:object_r:svirt_image_t:SystemLow image4
```

The **svirt_image_t label** uniquely identifies image files on disk, allowing for the SELinux policy to restrict access. When a KVM-based compute image is powered on, SELinux appends a random numerical identifier to the image. SELinux is capable of assigning numeric identifiers to a maximum of 524,288 virtual machines per hypervisor node, however most OpenStack deployments are highly unlikely to encounter this limitation . This example shows the SELinux category identifier:

```
system_u:object_r:svirt_image_t:s0:c87,c520 image1
system_u:object_r:svirt_image_t:s0:419,c172 image2
```

8.3.2. SELinux users and roles

SELinux manages user roles. These can be viewed through the **-Z** flag, or with the **semanage** command. On the hypervisor, only administrators should be able to access the system, and should have an appropriate context around both the administrative users and any other users that are on the system.

8.4. INVESTIGATING CONTAINERIZED SERVICES

The OpenStack services that come with Red Hat OpenStack Platform run within containers. Containerization allows for the development and upgrade of services without dependency related conflicts. When a service runs within a container, potential vulnerabilities to that service are also contained.

You can get information about the service that are running in your environment by using the following steps:

Procedure

- Use `podman inspect to get information, such as bind mounted host directories:
  Example:

```
$ sudo podman inspect <container_name> | less
```

Replace <container_name> with the name of your container. For example, **nova compute**.

- Check the logs for the service located in **/var/log/containers**:
  Example:

```
sudo less /var/log/containers/nova/nova-compute.log
```

- Run an interactive CLI session within the container:
  Example:

```
podman exec -it nova_compute /bin/bash
```

NOTE

You can make changes to the service for testing purposes directly within the container. All changes are lost when the container is restarted.

8.5. MAKING TEMPORARY CHANGES TO CONTAINERIZED SERVICES

You can make changes to containerized services that persist when the container is restarted, but that do not affect the permanent configuration of your Red Hat OpenStack Platform (RHOSP) cluster. This is useful for testing configuration changes, or enabling debug-level logs when troubleshooting. You can revert changes manually. Alternatively, running a redeploy on your RHOSP cluster resets all parameters to their permanent configurations.

Use configuration files that are located in **/var/lib/config-data/puppet-generated/[service]** to make temporary changes to a service. The following example enables debugging on the nova service:

Procedure

1. Edit the **nova.conf** configuration file that is bind mounted to the **nova_compute** container. Set the value of the **debug** parameter to **True**:

```
$ sudo sed -i 's/^debug=.*/debug=True' \
/var/lib/config-data/puppet-generated/nova/etc/nova/nova.conf
```

WARNING

Configuration files for OpenStack files are **ini** files with multiple sections, such as **[DEFAULT]** and **[database]**. Parameters that are unique to each section might not be unique across the entire file. Use **sed** with caution. You can check to see if a **parameter** appears more than once in a configuration file by running **egrep -v "^$|^#" [configuration_file] | grep [parameter]**.

2. Restart the nova container:

```
sudo podman restart nova_compute
```

8.6. MAKING PERMANENT CHANGES TO CONTAINERIZED SERVICES

You can make permanent changes to containerized services in Red Hat OpenStack Platform (RHOSP) services with heat. Use an existing template that you used when you first deployed RHOSP, or create a new template to add to your deployment script. In the following example, the private key size for libvirt is increased to **4096**.

Procedure

1. Create a new **yaml** template called **libvirt-keysize.yaml**, and use the **LibvirtCertificateKeySize** parameter to increase the default value from **2048** to **4096**.

```
cat > /home/stack/templates/libvirt-keysize.yaml
parameter_defaults:
      LibvirtCertificateKeySize: 4096
EOF
```

2. Add the **libvirt-keysize.yaml** configuration file to your deployment script:

```
openstack overcloud deploy --templates \
...
-e /home/stack/templates/libvirt-keysize.yaml
...
```

3. Rerun the deployment script:

```
./deploy.sh
```

8.7. FIRMWARE UPDATES

Physical servers use complex firmware to enable and operate server hardware and lights-out management cards, which can have their own security vulnerabilities, potentially allowing system access and interruption. To address these, hardware vendors will issue firmware updates, which are installed separately from operating system updates. You will need an operational security process that retrieves, tests, and implements these updates on a regular schedule, noting that firmware updates often require a reboot of physical hosts to become effective.

8.8. USE SSH BANNER TEXT

You can set a banner that displays a console message to all users that connect over SSH. You can add banner text to **/etc/issue** using the following parameters in an environment file. Consider customizing this sample text to suit your requirements.

```
resource_registry:
  OS::TripleO::Services::Sshd:
    /usr/share/openstack-tripleo-heat-templates/deployment/sshd/sshd-baremetal-puppet.yaml

parameter_defaults:
  BannerText: |
    ******************************************************************
```

```
* This system is for the use of authorized users only. Usage of  *
* this system may be monitored and recorded by system personnel. *
* Anyone using this system expressly consents to such monitoring *
* and is advised that if such monitoring reveals possible        *
* evidence of criminal activity, system personnel may provide    *
* the evidence from such monitoring to law enforcement officials.*
*****************************************************************
```

To apply this change to your deployment, save the settings as a file called **ssh_banner.yaml**, and then pass it to the **overcloud deploy** command as follows. The **<full environment>** indicates that you must still include all of your original deployment parameters. For example:

```
openstack overcloud deploy --templates \
  -e <full environment> -e  ssh_banner.yaml
```

8.9. AUDIT FOR SYSTEM EVENTS

Maintaining a record of all audit events helps you establish a system baseline, perform troubleshooting, or analyze the sequence of events that led to a certain outcome. The audit system is capable of logging many types of events, such as changes to the system time, changes to Mandatory/Discretionary Access Control, and creating/deleting users or groups.

Rules can be created using an environment file, which are then injected by director into **/etc/audit/audit.rules**. For example:

```
  resource_registry:
    OS::TripleO::Services::AuditD: /usr/share/openstack-tripleo-heat-
templates/deployment/auditd/auditd-baremetal-puppet.yaml
  parameter_defaults:
    AuditdRules:
      'Record Events that Modify User/Group Information':
        content: '-w /etc/group -p wa -k audit_rules_usergroup_modification'
        order  : 1
      'Collects System Administrator Actions':
        content: '-w /etc/sudoers -p wa -k actions'
        order  : 2
      'Record Events that Modify the Systems Mandatory Access Controls':
        content: '-w /etc/selinux/ -p wa -k MAC-policy'
        order  : 3
```

8.10. MANAGE FIREWALL RULES

Firewall rules are automatically applied on overcloud nodes during deployment, and are intended to only expose the ports required to get OpenStack working. You can specify additional firewall rules as needed. For example, to add rules for a Zabbix monitoring system:

```
parameter_defaults:
  ControllerExtraConfig:
    tripleo::firewall::firewall_rules:
      '301 allow zabbix':
        dport: 10050
```

```
      proto: tcp
      source: 10.0.0.8
      action: accept
```

You can also add rules that restrict access. The number used during rule definition will determine the rule's precedence. For example, RabbitMQ's rule number is **109** by default. If you want to restrain it, you switch it to use a lower value:

```
parameter_defaults:
  ControllerExtraConfig:
    tripleo::firewall::firewall_rules:
      '098 allow rabbit from internalapi network':
        dport: [4369,5672,25672]
        proto: tcp
        source: 10.0.0.0/24
        action: accept
      '099 drop other rabbit access':
        dport: [4369,5672,25672]
        proto: tcp
        action: drop
```

In this example, **098** and **099** are arbitrarily chosen numbers that are lower than RabbitMQ's rule number **109**. To determine a rule's number, you can inspect the iptables rule on the appropriate node; for RabbitMQ, you would check the controller:

```
iptables-save
[...]
-A INPUT -p tcp -m multiport --dports 4369,5672,25672 -m comment --comment "109 rabbitmq" -m
state --state NEW -j ACCEPT
```

Alternatively, you can extract the port requirements from the puppet definition. For example, RabbitMQ's rules are stored in **puppet/services/rabbitmq.yaml**:

```
tripleo.rabbitmq.firewall_rules:
  '109 rabbitmq':
    dport:
      - 4369
      - 5672
      - 25672
```

The following parameters can be set for a rule:

- **port**: The port associated to the rule. Deprecated by **puppetlabs-firewall**.
- **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.
- **state**: Array of states associated to the rule. Default to [*NEW*]

- **source**: The source IP address associated to the rule.
- **iniface**: The network interface associated to the rule.
- **chain**: The chain associated to the rule. Default to *INPUT*
- **destination**: The destination cidr associated to the rule.
- **extras**: Hash of any additional parameters supported by the **puppetlabs-firewall** module.

8.11. INTRUSION DETECTION WITH AIDE

AIDE (Advanced Intrusion Detection Environment) is a file and directory integrity checker. It is used to detect incidents of unauthorized file tampering or changes. For example, AIDE can alert you if system password files are changed.

AIDE works by analyzing system files and then compiling an integrity database of file hashes. The database then serves as a comparison point to verify the integrity of the files and directories and detect changes.

The director includes the AIDE service, allowing you to add entries into an AIDE configuration, which is then used by the AIDE service to create an integrity database. For example:

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

parameter_defaults:
  AideRules:
    'TripleORules':
      content: 'TripleORules = p+sha256'
      order: 1
    'etc':
      content: '/etc/ TripleORules'
      order: 2
    'boot':
      content: '/boot/ TripleORules'
      order: 3
    'sbin':
      content: '/sbin/ TripleORules'
      order: 4
    'var':
      content: '/var/ TripleORules'
      order: 5
    'not var/log':
      content: '!/var/log.*'
      order: 6
    'not var/spool':
      content: '!/var/spool.*'
      order: 7
    'not nova instances':
      content: '!/var/lib/nova/instances.*'
      order: 8
```

NOTE

The above example is not actively maintained or benchmarked, so you should select the AIDE values that suit your requirements.

1. An alias named **TripleORules** is declared to avoid having to repeatedly out the same attributes each time.

2. The alias receives the attributes of **p+sha256**. In AIDE terms, this reads as the following instruction: monitor all file permissions **p** with an integrity checksum of **sha256**.

For a complete list of attributes available for AIDE's config files, see the AIDE MAN page at https://aide.github.io/.

Complete the following to apply changes to your deployment:

1. Save the settings as a file called **aide.yaml** in the **/home/stack/templates/** directory.

2. Edit the **aide.yaml** environment file to have the parameters and values suitable for your environment.

3. Include the **/home/stack/templates/aide.yaml** environment file in the **openstack overcloud deploy** command, along with all other necessary heat templates and environment files specific to your environment:

```
openstack overcloud deploy --templates
...
-e /home/stack/templates/aide.yaml
```

8.11.1. Using complex AIDE rules

Complex rules can be created using the format described previously. For example:

```
MyAlias = p+i+n+u+g+s+b+m+c+sha512
```

The above would translate as the following instruction: monitor permissions, inodes, number of links, user, group, size, block count, mtime, ctime, using sha256 for checksum generation.

Note, the alias should always have an order position of **1**, which means that it is positioned at the top of the AIDE rules and is applied recursively to all values below.

Following after the alias are the directories to monitor. Note that regular expressions can be used. For example we set monitoring for the **var** directory, but overwrite with a not clause using **!** with **'!/var/log.*'** and **'!/var/spool.*'**.

8.11.2. Additional AIDE values

The following AIDE values are also available:

AideConfPath: The full POSIX path to the aide configuration file, this defaults to **/etc/aide.conf**. If no requirement is in place to change the file location, it is recommended to stick with the default path.

AideDBPath: The full POSIX path to the AIDE integrity database. This value is configurable to allow operators to declare their own full path, as often AIDE database files are stored off node perhaps on a read only file mount.

AideDBTempPath: The full POSIX path to the AIDE integrity temporary database. This temporary files is created when AIDE initializes a new database.

AideHour: This value is to set the hour attribute as part of AIDE cron configuration.

AideMinute: This value is to set the minute attribute as part of AIDE cron configuration.

AideCronUser: This value is to set the linux user as part of AIDE cron configuration.

AideEmail: This value sets the email address that receives AIDE reports each time a cron run is made.

AideMuaPath: This value sets the path to the Mail User Agent that is used to send AIDE reports to the email address set within **AideEmail**.

8.11.3. Cron configuration for AIDE

The AIDE director service allows you to configure a cron job. By default, it will send reports to **/var/log/audit/**; if you want to use email alerts, then enable the **AideEmail** parameter to send the alerts to the configured email address. Note that a reliance on email for critical alerts can be vulnerable to system outages and unintentional message filtering.

8.11.4. Considering the effect of system upgrades

When an upgrade is performed, the AIDE service will automatically regenerate a new integrity database to ensure all upgraded files are correctly recomputed to possess an updated checksum.

If **openstack overcloud deploy** is called as a subsequent run to an initial deployment, and the AIDE configuration rules are changed, the director AIDE service will rebuild the database to ensure the new config attributes are encapsulated in the integrity database.

8.12. REVIEW SECURETTY

SecureTTY allows you to disable root access for any console device (tty). This behavior is managed by entries in the **/etc/securetty** file. For example:

```
resource_registry:
  OS::TripleO::Services::Securetty: ../puppet/services/securetty.yaml

parameter_defaults:
  TtyValues:
    - console
    - tty1
    - tty2
    - tty3
    - tty4
    - tty5
    - tty6
```

8.13. CADF AUDITING FOR IDENTITY SERVICE

A thorough auditing process can help you review the ongoing security posture of your OpenStack deployment. This is especially important for keystone, due to its role in the security model.

Red Hat OpenStack Platform has adopted Cloud Auditing Data Federation (CADF) as the data format for audit events, with the keystone service generating CADF events for Identity and Token operations. You can enable CADF auditing for keystone using **KeystoneNotificationFormat**:

```
parameter_defaults:
  KeystoneNotificationFormat: cadf
```

8.14. REVIEW THE LOGIN.DEFS VALUES

To enforce password requirements for new system users (non-keystone), director can add entries to **/etc/login.defs** by following these example parameters:

```
resource_registry:
  OS::TripleO::Services::LoginDefs: ../puppet/services/login-defs.yaml

parameter_defaults:
  PasswordMaxDays: 60
  PasswordMinDays: 1
  PasswordMinLen: 5
  PasswordWarnAge: 7
  FailDelay: 4
```

CHAPTER 9. HARDENING THE DASHBOARD SERVICE

The Dashboard service (horizon) gives users a self-service portal for provisioning their own resources within the limits set by administrators. Manage the security of the Dashboard service with the same sensitivity as the OpenStack APIs.

9.1. DEBUGGING THE DASHBOARD SERVICE

The default value for the **DEBUG** parameter is false. Keep the default value in your production environment. Change this setting only during investigation. When you change the value of the **DEBUG** parameter to **True**, Django can output stack straces to browser users that contain sensitive web server state information.

When the value of the **DEBUG** parameter is **True**, the **ALLOWED_HOSTS** settings are also disabled. For more information on configuring **ALLOWED_HOSTS**, see Configure ALLOWED_HOSTS.

9.2. SELECTING A DOMAIN NAME

It is a best practice to deploy the Dashboard service (horizon) to a second level domain, as opposed to a shared domain on any level. Examples of each are provided below:

- Second level domain: **https://example.com**
- Shared subdomain: **https://example.public-url.com**

Deploying the Dashboard service to a dedicated second level domain isolates cookies and security tokens from other domains, based on browsers' **same-origin** policy. When deployed on a subdomain, the security of the Dashboard service is equivalent to the least secure application deployed on the same second-level domain.

You can further mitigate this risk by avoiding a cookie-backed session store, and configuring HTTP Strict Transport Security (HSTS) (described in this guide).

NOTE

Deploying the Dashboard service on a bare domain, like **https://example/**, is unsupported.

9.3. CONFIGURE ALLOWED_HOSTS

Horizon is built on the python Django web framework, which requires protection against security threats associated with misleading HTTP Host headers. To apply this protection, configure the **ALLOWED_HOSTS** setting to use the FQDN that is served by the OpenStack dashboard.

When you configure the **ALLOWED_HOSTS** setting, any HTTP request with a Host header that does not match the values in this list is denied, and an error is raised.

Procedure

1. Under **parameter_defaults** in your templates, set the value of the **HorizonAllowedHosts** parameter:

```
parameter_defaults:
  HorizonAllowedHosts: <value>
```

Replace **<value>** with the FQDN that is served by the OpenStack dashboard.

2. Deploy the overcloud with the modified template, and all other templates required for your environment.

9.4. CROSS SITE SCRIPTING (XSS)

The OpenStack Dashboard accepts the entire Unicode character set in most fields. Malicious actors can attempt to use this extensibility to test for cross-site scripting (XSS) vulnerabilities. The OpenStack Dashboard service (horizon) has tools that harden against XSS vulnerabilites. It is important to ensure the correct use of these tools in custom dashboards. When you perform an audit against custom dashboards, pay attention to the following:

- The **mark_safe** function.
- **is_safe** - when used with custom template tags.
- The **safe** template tag.
- Anywhere auto escape is turned off, and any JavaScript which might evaluate improperly escaped data.

9.5. CROSS SITE REQUEST FORGERY (CSRF)

Dashboards that use multiple JavaScript instances should be audited for vulnerabilities such as inappropriate use of the **@csrf_exempt** decorator. Evaluate any dashboard that does not follow recommended security settings before lowering CORS (Cross Origin Resource Sharing) restrictions. Configure your web server to send a restrictive CORS header with each response. Allow only the dashboard domain and protocol, for example:**Access-Control-Allow-Origin: https://example.com/**. You should never allow the wild card origin.

9.6. ALLOW IFRAME EMBEDDING

The **DISALLOW_IFRAME_EMBED** setting disallows Dashboard from being embedded within an iframe. Legacy browsers can still be vulnerable to Cross-Frame Scripting (XFS) vulnerabilities, so this option adds extra security hardening for deployments that do not require iframes. The setting is set to **True** by default, however it can be disabled using an environment file, if needed.

Procedure

- You can allow iframe embedding using the following parameter:

```
parameter_defaults:
  ControllerExtraConfig:
    horizon::disallow_iframe_embed: false
```

NOTE

These settings should only be set to **False** once the potential security impacts are fully understood.

9.7. USING HTTPS ENCRYPTION FOR DASHBOARD TRAFFIC

It is recommended you use HTTPS to encrypt Dashboard traffic. You can do this by configuring it to use a valid, trusted certificate from a recognized certificate authority (CA). Private organization-issued certificates are only appropriate when the root of trust is pre-installed in all user browsers.

Configure HTTP requests to the dashboard domain to redirect to the fully qualified HTTPS URL.

For more information, see Implementing TLS-e with Ansible

9.8. HTTP STRICT TRANSPORT SECURITY (HSTS)

HTTP Strict Transport Security (HSTS) prevents browsers from making subsequent insecure connections after they have initially made a secure connection. If you have deployed your HTTP services on a public or an untrusted zone, HSTS is especially important.

For director-based deployments, this setting is enabled by default in the **/usr/share/openstack-tripleo-heat-templates/deployment/horizon/horizon-container-puppet.yaml** file:

```
horizon::enable_secure_proxy_ssl_header: true
```

Verification

After the overcloud is deployed, check the **local_settings** file for Red Hat OpenStack Dashboard (horizon) for verification.

1. Use **ssh** to connect to a controller:

```
$ ssh heat-admin@controller-0
```

2. Check that the **SECURE_PROXY_SSL_HEADER** parameter has a value of **('HTTP_X_FORWARDED_PROTO', 'https')**:

```
sudo egrep ^SECURE_PROXY_SSL_HEADER /var/lib/config-data/puppet-generated/horizon/etc/openstack-dashboard/local_settings
SECURE_PROXY_SSL_HEADER = ('HTTP_X_FORWARDED_PROTO', 'https')
```

9.9. FRONT-END CACHING

It is not recommended to use front-end caching tools with the Dashboard, as it renders dynamic content resulting directly from OpenStack API requests. As a result, front-end caching layers such as **varnish** can prevent the correct content from being displayed. The Dashboard uses Django, which serves static media directly served from the web service and already benefits from web host caching.

9.10. SESSION BACKEND

For director-based deployments, the default session backend for horizon is **django.contrib.sessions.backends.cache**, which is combined with memcached. This approach is preferred to local-memory cache for performance reasons, is safer for highly-available and load balanced installs, and has the ability to share cache over multiple servers, while still treating it as a single cache.

You can review these settings in director's **horizon.yaml** file:

```
horizon::cache_backend: django.core.cache.backends.memcached.MemcachedCache
horizon::django_session_engine: 'django.contrib.sessions.backends.cache'
```

9.11. REVIEWING THE SECRET KEY

The Dashboard depends on a shared **SECRET_KEY** setting for some security functions. The secret key should be a randomly generated string at least 64 characters long, which must be shared across all active dashboard instances. Compromise of this key might allow a remote attacker to execute arbitrary code. Rotating this key invalidates existing user sessions and caching. Do not commit this key to public repositories.

For director deployments, this setting is managed as the **HorizonSecret** value.

9.12. CONFIGURING SESSION COOKIES

The Dashboard session cookies can be open to interaction by browser technologies, such as JavaScript. For director deployments with TLS everywhere, you can harden this behavior using the **HorizonSecureCookies** setting.

NOTE

Never configure CSRF or session cookies to use a wildcard domain with a leading dot.

9.13. STATIC MEDIA

The dashboard's static media should be deployed to a subdomain of the dashboard domain and served by the web server. The use of an external content delivery network (CDN) is also acceptable. This subdomain should not set cookies or serve user-provided content. The media should also be served with HTTPS.

Dashboard's default configuration uses **django_compressor** to compress and minify CSS and JavaScript content before serving it. This process should be statically done before deploying the dashboard, rather than using the default in-request dynamic compression and copying the resulting files along with deployed code or to the CDN server. Compression should be done in a non-production build environment. If this is not practical, consider disabling resource compression entirely. Online compression dependencies (less, Node.js) should not be installed on production machines.

9.14. VALIDATING PASSWORD COMPLEXITY

The OpenStack Dashboard (horizon) can use a password validation check to enforce password complexity.

You can specify a regular expression for password validation, as well as help text to be displayed for failed tests. The following example requires users to create a password of between 8 to 18 characters in length:

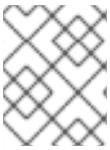
```
parameter_defaults:
  HorizonPasswordValidator: '^.{8,18}$'
  HorizonPasswordValidatorHelp: 'Password must be between 8 and 18 characters.'
```

To apply this change to your deployment, save the settings as a file called **horizon_password.yaml**, and then pass it to the **overcloud deploy** command as follows. The **<full environment>** indicates that you must still include all of your original deployment parameters. For example:

```
openstack overcloud deploy --templates \
  -e <full environment> -e  horizon_password.yaml
```

9.15. ENFORCE THE ADMINISTRATOR PASSWORD CHECK

The following setting is set to **True** by default, however it can be disabled using an environment file, if needed.



NOTE

These settings should only be set to **False** once the potential security impacts are fully understood.

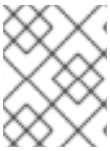
The **ENFORCE_PASSWORD_CHECK** setting in Dashboard's **local_settings.py** file displays an *Admin Password* field on the *Change Password* form, which helps verify that an administrator is initiating the password change.

You can disable **ENFORCE_PASSWORD_CHECK** using an environment file:

```
parameter_defaults:
  ControllerExtraConfig:
    horizon::enforce_password_check: false
```

9.16. DISABLE PASSWORD REVEAL

The following setting is set to **True** by default, however it can be disabled using an environment file, if needed.



NOTE

These settings should only be set to **False** once the potential security impacts are fully understood.

The password reveal button allows a user at the Dashboard to view the password they are about to enter. This option can be toggled using the **DISABLE_PASSWORD_REVEAL** parameter:

```
parameter_defaults:
  ControllerExtraConfig:
    horizon::disable_password_reveal: false
```

9.17. DISPLAYING A LOGIN BANNER FOR THE DASHBOARD

Regulated industries such as HIPAA, PCI-DSS, and the U.S. Government, require you to display a user logon banner. The Red Hat OpenStack Platform (RHOSP) dashboard (horizon) uses a default theme (RCUE), which is stored inside the horizon container. For information on customizing the Dashboard container, see Customizing the dashboard.

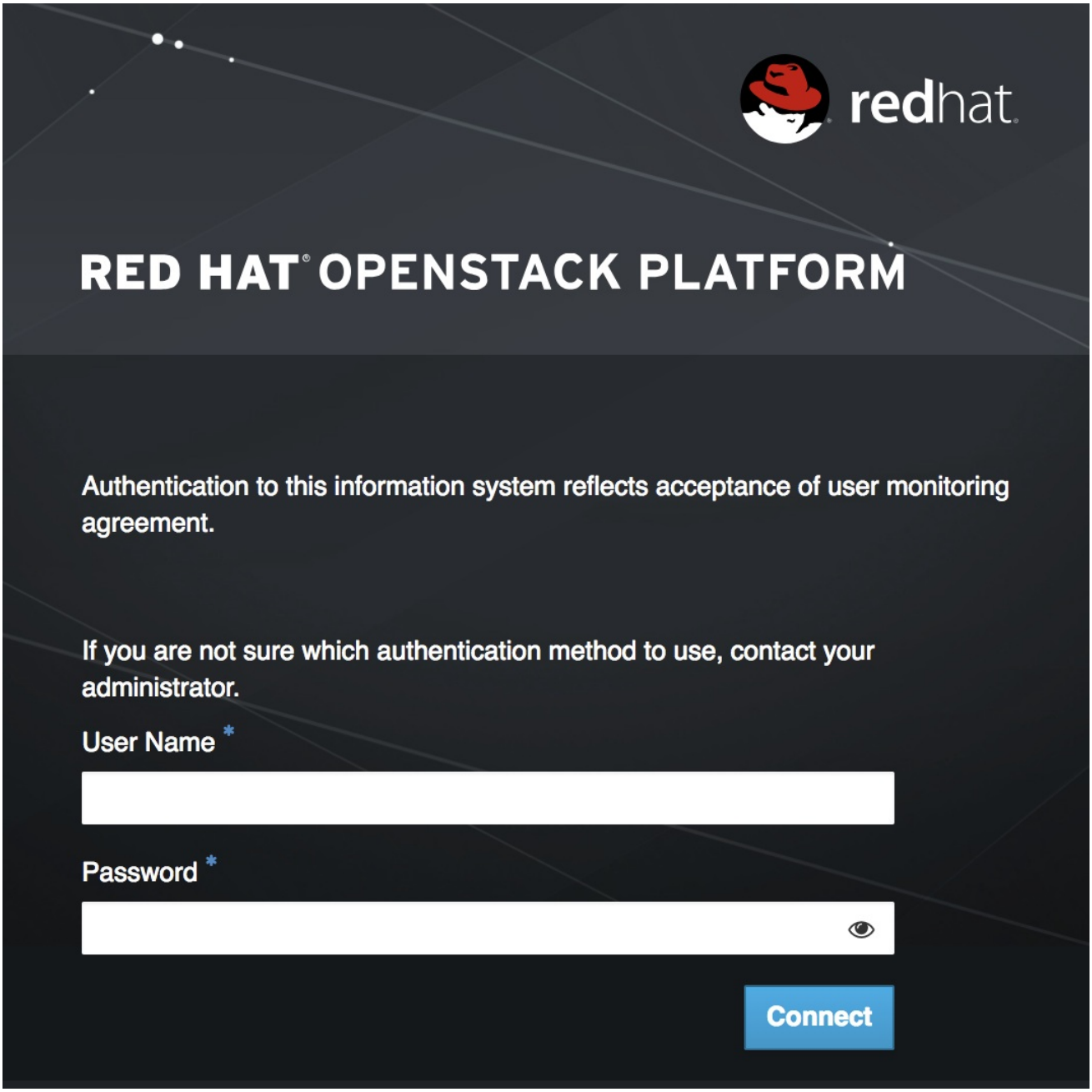
9.18. CUSTOMIZING THE THEME

Within the custom Dashboard container, you can create a logon banner by manually editing the **/usr/share/openstack-dashboard/openstack_dashboard/themes/rcue/templates/auth/login.html** file:

1. Enter the required logon banner immediately before the **{% include 'auth/_login.html' %}** section. Note that HTML tags are allowed. For example:

```
<snip>
<div class="container">
  <div class="row-fluid">
    <div class="span12">
      <div id="brand">
        <img src="../../static/themes/rcue/images/RHOSP-Login-Logo.svg">
      </div><!--/#brand-->
    </div><!--/.span*-->

    <!-- Start of Logon Banner -->
    <p>Authentication to this information system reflects acceptance of user monitoring
agreement.</p>
    <!-- End of Logon Banner -->

    {% include 'auth/_login.html' %}
  </div><!--/.row-fluid→
</div><!--/.container-->

{% block js %}
  {% include "horizon/_scripts.html" %}
{% endblock %}

  </body>
</html>
```

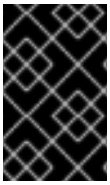
The updated dashboard will look similar to the following:



9.19. LIMITING THE SIZE OF FILE UPLOADS

You can optionally configure the dashboard to limit the size of file uploads; this setting might be a requirement for various security hardening policies.

LimitRequestBody - This value (in bytes) limits the maximum size of a file that you can transfer using the Dashboard, such as images and other large files.



IMPORTANT

This setting has not been formally tested by Red Hat. It is recommended that you thoroughly test the effect of this setting before deploying it to your production environment.

NOTE

File uploads will fail if the value is too small.

For example, this setting limits each file upload to a maximum size of 10 GB (**10737418240**). You will need to adjust this value to suit your deployment.

- **/var/lib/config-data/puppet-generated/horizon/etc/httpd/conf/httpd.conf**

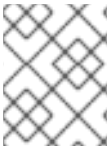
```
<Directory />
  LimitRequestBody 10737418240
</Directory>
```

- **/var/lib/config-data/puppet-generated/horizon/etc/httpd/conf.d/10-horizon_vhost.conf**

```
<Directory "/var/www">
  LimitRequestBody 10737418240
</Directory>
```

- **/var/lib/config-data/puppet-generated/horizon/etc/httpd/conf.d/15-horizon_ssl_vhost.conf**

```
<Directory "/var/www">
  LimitRequestBody 10737418240
</Directory>
```



NOTE

These configuration files are managed by Puppet, so any unmanaged changes are overwritten whenever you run the **openstack overcloud deploy** process.

CHAPTER 10. RED HAT OPENSTACK PLATFORM NETWORKING SERVICE

The OpenStack Networking service (neutron) enables the end-user or project to define and consume networking resources. OpenStack Networking provides a project-facing API for defining network connectivity and IP addressing for instances in the cloud, in addition to orchestrating the network configuration. With the transition to an API-centric networking service, cloud architects and administrators should take into consideration good practices to secure physical and virtual network infrastructure and services.

OpenStack Networking was designed with a plug-in architecture that provides extensibility of the API through open source community or third-party services. As you evaluate your architectural design requirements, it is important to determine what features are available in OpenStack Networking core services, any additional services that are provided by third-party products, and what supplemental services are required to be implemented in the physical infrastructure.

This section is a high-level overview of what processes and good practices should be considered when implementing OpenStack Networking.

10.1. NETWORKING ARCHITECTURE

OpenStack Networking is a standalone service that deploys multiple processes across a number of nodes. These processes interact with each other and other OpenStack services. The main process of the OpenStack Networking service is neutron-server, a Python daemon that exposes the OpenStack Networking API and passes project requests to a suite of plug-ins for additional processing.

The OpenStack Networking components are:

- **Neutron server (neutron-server and neutron-*-plugin)** - The neutron-server service runs on the Controller node to service the Networking API and its extensions (or plugins). It also enforces the network model and IP addressing of each port. The neutron-server requires direct access to a persistent database. Agents have indirect access to the database through neutron-server, with which they communicate using AMQP (Advanced Message Queuing Protocol).

- **Neutron database** - The database is the centralized source of neutron information, with the API recording all transactions in the database. This allows multiple Neutron servers to share the same database cluster, which keeps them all in sync, and allows persistence of network configuration topology.

- **Plugin agent (neutron-*-agent)** - Runs on each compute node and networking node (together with the L3 and DHCP agents) to manage local virtual switch (vswitch) configuration. The enabled plug-in determines which agents are enabled. These services require message queue access and depending on the plug-in being used, access to external network controllers or SDN implementations. Some plug-ins, like OpenDaylight(ODL) and Open Virtual Network (OVN), do not require any python agents on compute nodes, requiring only an enabled Neutron plug-in for integration.

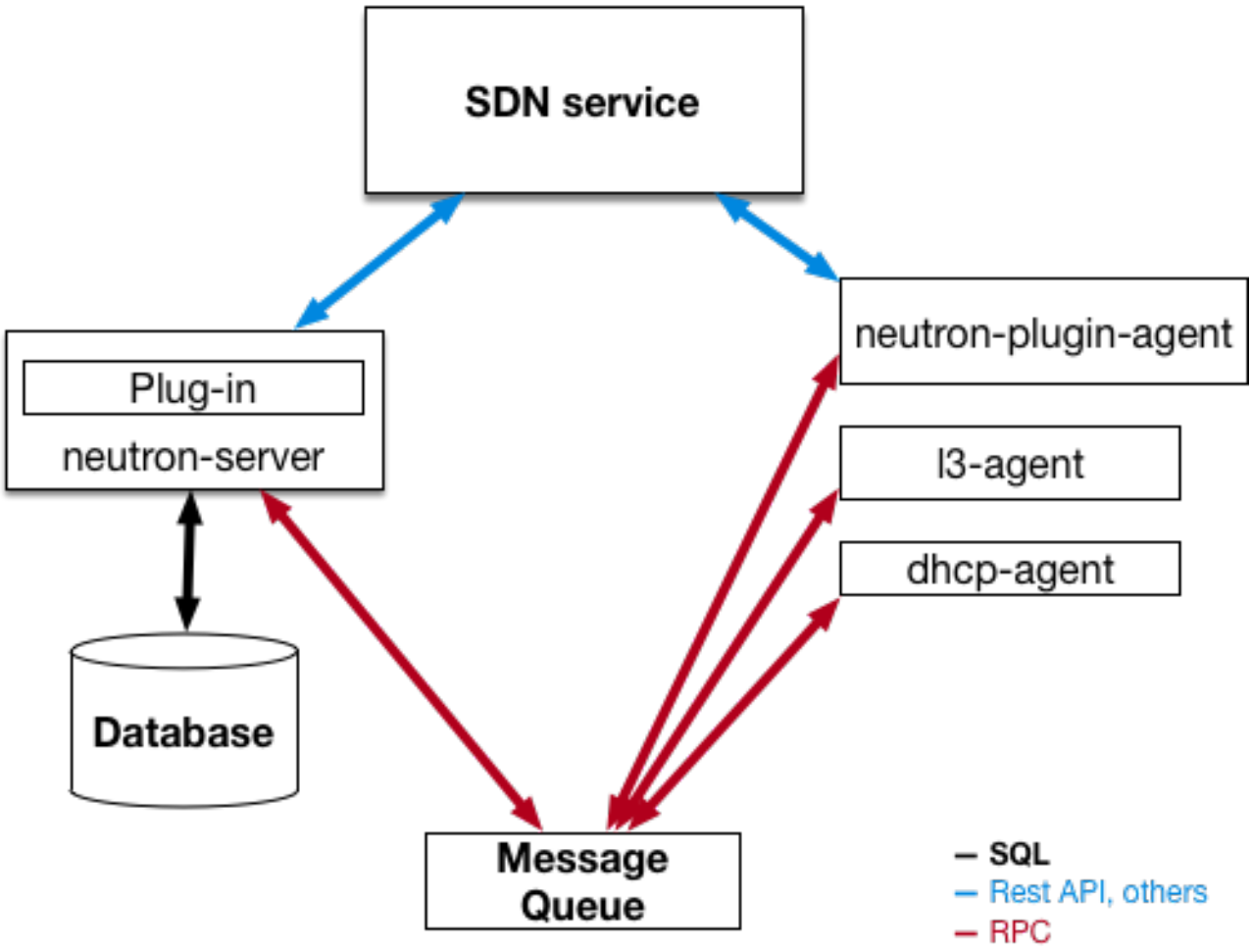
- **DHCP agent (neutron-dhcp-agent)** - Provides DHCP services to project networks. This agent is the same across all plug-ins and is responsible for maintaining DHCP configuration. The neutron-dhcp-agent requires message queue access. Optional depending on plug-in.

- **Metadata agent (neutron-metadata-agent, neutron-ns-metadata-proxy)** - Provides metadata services used to apply instance operating system configuration and user-supplied initialisation scripts ('userdata'). The implementation requires the **neutron-ns-metadata-proxy**

running in the L3 or DHCP agent namespace to intercept metadata API requests sent by cloud-init to be proxied to the metadata agent.

- **L3 agent (neutron-l3-agent)** - Provides L3/NAT forwarding for external network access of VMs on project networks. Requires message queue access. Optional depending on plug-in.
- **Network provider services (SDN server/services)**- Provides additional networking services to project networks. These SDN services might interact with neutron-server, neutron-plugin, and plugin-agents through communication channels such as REST APIs.

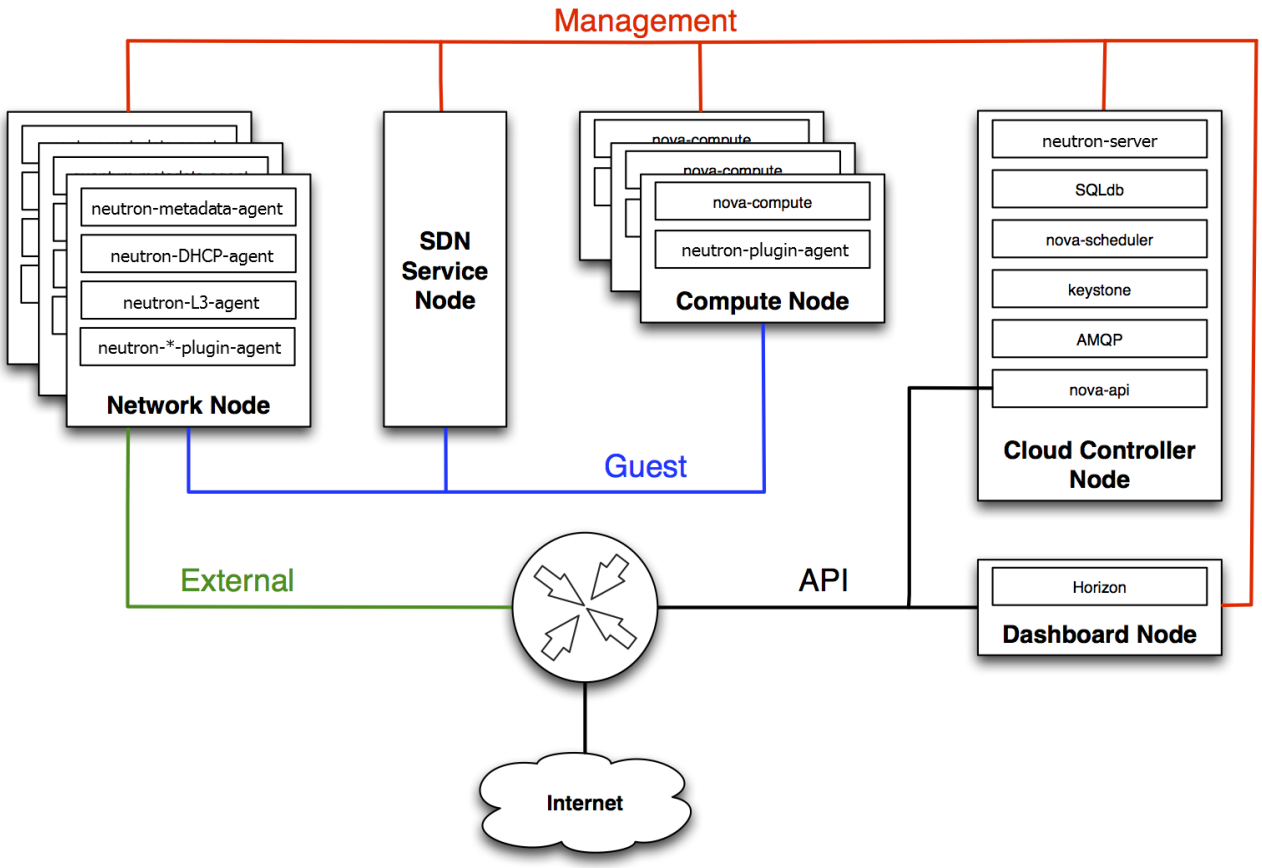
The following diagram shows an architectural and networking flow diagram of the OpenStack Networking components:



Note that this approach changes significantly when Distributed Virtual Routing (DVR) and Layer-3 High Availability (L3HA) are used. These modes change the security landscape of neutron, since L3HA implements VRRP between routers. The deployment needs to be correctly sized and hardened to help mitigate DoS attacks against routers, and local-network traffic between routers must be treated as sensitive, to help address the threat of VRRP spoofing. DVR moves networking components (such as routing) to the Compute nodes, while still requiring network nodes. As a result, the Compute nodes require access to and from public networks, increasing their exposure and requiring additional security consideration for customers, as they will need to make sure firewall rules and security model support this approach.

10.2. NEUTRON SERVICE PLACEMENT ON PHYSICAL SERVERS

This section describes a standard architecture that includes a controller node, a network node, and a set of compute nodes for running instances. To establish network connectivity for physical servers, a typical neutron deployment has up to four distinct physical data center networks:



- **Management network** - Used for internal communication between OpenStack Components. The IP addresses on this network should be reachable only within the data center and is considered the Management Security zone. By default, the Management network role is performed by the *Internal API* network.

- **Guest network(s)** - Used for VM data communication within the cloud deployment. The IP addressing requirements of this network depend on the OpenStack Networking plug-in in use and the network configuration choices of the virtual networks made by the project. This network is considered the Guest Security zone.

- **External network** - Used to provide VMs with Internet access in some deployment scenarios. The IP addresses on this network should be reachable by anyone on the Internet. This network is considered to be in the Public Security zone. This network is provided by the neutron *External* network(s). These neutron VLANs are hosted on the external bridge. They are not created by Red Hat OpenStack Platform director, but are created by neutron in post-deployment.

- **Public API network** - Exposes all OpenStack APIs, including the OpenStack Networking API, to projects. The IP addresses on this network should be reachable by anyone on the Internet. This might be the same network as the external network, as it is possible to create a subnet for the external network that uses IP allocation ranges smaller than the full range of IP addresses in an IP block. This network is considered to be in the Public Security zone.

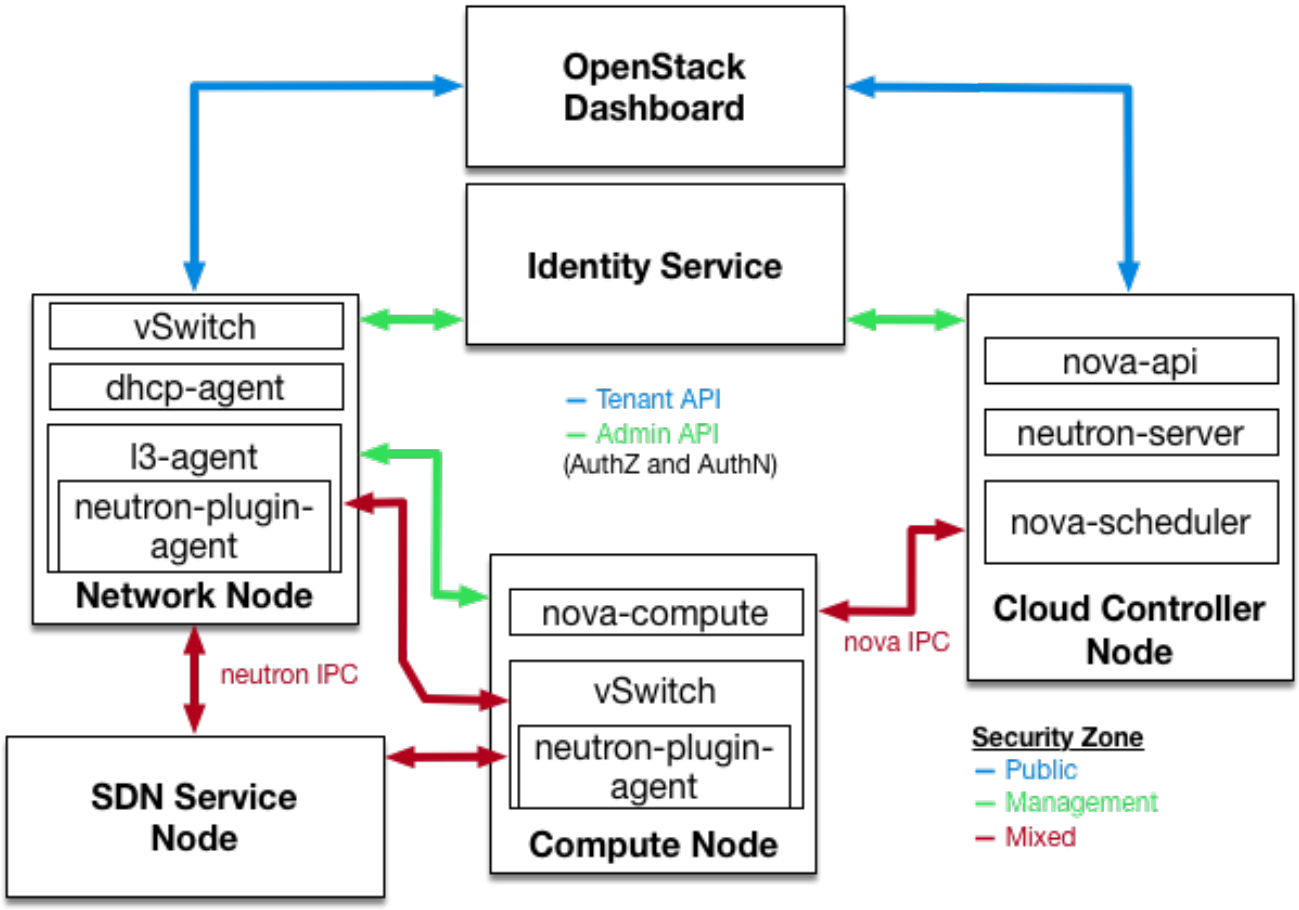
It is recommended you segment this traffic into separate zones. See the next section for more information.

10.3. SECURITY ZONES

It is recommended that you use the concept of security zones to keep critical systems separate from each other. In a practical sense, this means isolating network traffic using VLANs and firewall rules. This sho uld be done with granular detail, and the result should be that only the services that need to connect to neutron are able to do so.

In the following diagram, you can see that zones have been created to separate certain components:

- Dashboard: Accessible to public network and management network.
- Keystone: Accessible to management network.
- Compute node: Accessible to management network and Compute instances.
- Network node: Accessible to management network, Compute instances, and possibly public network depending upon neutron-plugin in use.
- SDN service node: Management services, Compute instances, and possibly public depending upon product used and configuration.



10.4. NETWORKING SERVICES

In the initial architectural phases of designing your OpenStack Network infrastructure it is important to ensure appropriate expertise is available to assist with the design of th e physical networking infrastructure, to identify proper security controls and auditing mechanisms.

OpenStack Networking adds a layer of virtualized network services which gives projects the capability to architect their own virtual networks. Currently, these virtualized service s are not as mature as their traditional networking counterparts. Consider the current state of these virtualized services before adopting them as it dictates what controls you mi ght have to implement at the virtualized and traditional network boundaries.

10.5. L2 ISOLATION USING VLANS AND TUNNELING

OpenStack Networking can employ two different mechanisms for traffic segregation on a per project/network combination: VLANs (IEEE 802.1Q tagging) or L2 tunnels using VXLAN or GRE encapsulation. The scope and scale of your OpenStack deployment determines which method you should use for traffic segregation or isolation.

VLANs

VLANs are realized as packets on a specific physical network containing IEEE 802.1Q headers with a specific VLAN ID (VID) field value. VLAN networks sharing the same physical netw ork are isolated from each other at L2, and can even have overlapping IP address spaces. Each distinct physical network supporting VLAN networks is treated as a separate VLAN trunk k, with a distinct space of VID values. Valid VID values are 1 through 4094.

VLAN configuration complexity depends on your OpenStack design requirements. To allow OpenStack Networking to more efficiently use VLANs, you must allocate a VLAN range (one for each project) and turn each Compute node physical switch port into a VLAN trunk port.

Tunneling

Network tunneling encapsulates each project/network combination with a unique **tunnel-id** that is used to identify the network traffic belonging to that combination. The project's L2 network connectivity is independent of physical locality or underlying network design. By encapsulating traffic inside IP packets, that traffic can cross Layer-3 boundaries, removing the need for pre-configured VLANs and VLAN trunking. Tunneling adds a layer of obfuscation to network data traffic, reducing the visibility of individual project traffic from a monitoring point of view.

OpenStack Networking currently supports both GRE and VXLAN encapsulation. The choice of technology to provide L2 isolation is dependent upon the scope and size of project networks that will be created in your deployment.

10.6. ACCESS CONTROL LISTS

Compute supports project network traffic access controls through use of the OpenStack Networking service. Security groups allow administrators and projects the ability to specify the type of traffic, and direction (ingress/egress) that is allowed to pass through a virtual interface port. Security groups rules are stateful L2-L4 traffic filters.

10.7. L3 ROUTING AND NAT

OpenStack Networking routers can connect multiple L2 networks, and can also provide a gateway that connects one or more private L2 networks to a shared external network, such as a public network for access to the Internet.

The L3 router provides basic Network Address Translation (SNAT and DNAT) capabilities on gateway ports that uplink the router to external networks. This router SNATs (Source NAT) all egress traffic by default, and supports floating IPs, which creates a static one-to-one bidirectional mapping from a public IP on the external network to a private IP on one o f the other subnets attached to the router. Floating IPs (through DNAT) provide external inbound connectivity to instances, and can be moved from one instances to another.

Consider using per-project L3 routing and Floating IPs for more granular connectivity of project instances. Special consideration should be given to instances connected to public networks or using Floating IPs. Usage of carefully considered security groups is recommended to filter access to only services which need to be exposed externally.

10.8. QUALITY OF SERVICE (QOS)

By default, Quality of Service (QoS) policies and rules are managed by the cloud administrator, which results in projects being unable to create specific QoS rules, or to attach s pecific policies to ports. In some use cases, such as some telecommunications applications, the administrator might trust the projects and therefore let them create and attach the ir own policies to ports. This can be done by modifying the **policy.json** file.

From Red Hat OpenStack Platform 12, neutron supports bandwidth-limiting QoS rules for both ingress and egress traffic. This QoS rule is named **QosBandwidthLimitRule** and it accept s two non-negative integers measured in kilobits per second:

- **max-kbps**: bandwidth
- **max-burst-kbps**: burst buffer

The **QoSBandwidthLimitRule** has been implemented in the neutron Open vSwitch, Linux bridge and SR-IOV drivers. However, for SR-IOV drivers, the **max-burst-kbps** value is not used, and is ignored if set.

The QoS rule **QosDscpMarkingRule** sets the Differentiated Service Code Point (DSCP) value in the type of service header on IPv4 (RFC 2474) and traffic class header on IPv6 on all traffic leaving a virtual machine, where the rule is applied. This is a 6-bit header with 21 valid values that denote the drop priority of a packet as it crosses networks should it meet congestion. It can also be used by firewalls to match valid or invalid traffic against its access control list.

10.9. LOAD BALANCING

The OpenStack Load-balancing service (octavia) provides a load balancing-as-a-service (LBaaS) implementation for Red Hat OpenStack platform director installations. To achieve load balancing, octavia supports enabling multiple provider drivers. The reference provider driver (Amphora provider driver) is an open-source, scalable, and highly available load bal ancing provider. It accomplishes its delivery of load balancing services by managing a fleet of virtual machines—collectively known as amphorae—which it spins up on demand.

For more information about the Load-balancing service, see the Using Octavia for Load Balancing-as-a-Service guide.

10.10. HARDENING THE NETWORKING SERVICE

This section discusses OpenStack Networking configuration good practices as they apply to project network security within your OpenStack deployment.

10.10.1. Restrict bind address of the API server: neutron-server

To restrict the interface or IP address on which the OpenStack Networking API service binds a network socket for incoming client connections, specify the **bind_host** and **bind_por t** in the **/var/lib/config-data/puppet-generated/neutron/etc/neutron/neutron.conf** file:

```
# Address to bind the API server
bind_host = IP ADDRESS OF SERVER

# Port the bind the API server to
bind_port = 9696
```

10.10.2. Project network services workflow

OpenStack Networking provides users self-service configuration of network resources. It is important that cloud architects and operators evaluate their design use cases in providing users the ability to create, update, and destroy available network resources.

10.10.3. Networking resource policy engine

A policy engine and its configuration file (**policy.json**) within OpenStack Networking provides a method to provide finer grained authorization of users on project networking methods and objects. The OpenStack N etworking policy definitions affect network availability, network security and overall OpenStack security. Cloud architects and operators should carefully evaluate their policy towards user and project access to administration of network resources.

NOTE

It is important to review the default networking resource policy, as this policy can be modified to suit your security posture.

If your deployment of OpenStack provides multiple external access points into different security zones it is important that you limit the project's ability to attach multiple vNICs to multiple external access po ints – this would bridge these security zones and could lead to unforeseen security compromise. You can help mitigate this risk by using the host aggregates functionality provided by Compute, or by splitting th e project instances into multiple projects with different virtual network configurations. For more information on host aggregates, see Creating and managing host aggregates .

10.10.4. Security groups

A security group is a collection of security group rules. Security groups and their rules allow administrators and projects the ability to specify the type of traffic and direction (ingress/egress) that is allow ed to pass through a virtual interface port. When a virtual interface port is created in OpenStack Networking it is associated with a security group. Rules can be added to the default security group in order to change the behavior on a per-deployment basis.

When using the Compute API to modify security groups, the updated security group applies to all virtual interface ports on an instance. This is due to the Compute security group APIs being instance-based rather than port-based, as found in neutron.

10.10.5. Mitigate ARP spoofing

OpenStack Networking has a built-in feature to help mitigate the threat of ARP spoofing for instances. This should not be disabled unless careful consideration is given to the resulting risks.

10.10.6. Use a Secure Protocol for Authentication

In **/var/lib/config-data/puppet-generated/neutron/etc/neutron/neutron.conf** check that the value of **auth_uri** under the **[keystone_authtoken]** section is set to an Identity API endpoint that starts with `https:

CHAPTER 11. HARDENING BLOCK STORAGE ON RED HAT OPENSTACK PLATFORM

OpenStack Block Storage (cinder) is a service that provides software (services and libraries) to self-service manage persistent block-level storage devices. This creates on-demand access to Block Storage resources for use with Compute (nova) instances. This creates software-defined storage through abstraction by virtualizing pools of block storage to a variety of back-end storage devices which can be either software implementations or traditional hardware storage products. The primary functions of this is to manage the creation, attachment, and detachment of the block devices. The consumer requires no knowledge of the type of back-end storage equipment or where it is located.

Compute instances store and retrieve block storage using industry-standard storage protocols such as iSCSI, ATA over Ethernet, or Fibre-Channel. These resources are managed and configured using OpenStack native standard HTTP RESTful API.

11.1. SET THE MAX SIZE FOR THE BODY OF A REQUEST

If the maximum body size per request is not defined, the attacker can craft an arbitrary OSAPI request of large size, causing the service to crash and finally resulting in a Denial Of Service attack. Assigning t he maximum value ensures that any malicious oversized request gets blocked ensuring continued availability of the service.

Review whether **max_request_body_size** under the **[oslo_middleware]** section in **cinder.conf** is set to **114688**.

11.2. ENABLE VOLUME ENCRYPTION

Unencrypted volume data makes volume-hosting platforms especially high-value targets for attackers, as it allows the attacker to read the data for many different VMs. In addition, the physical storage medium could be stolen, remounted, and accessed from a different machine. Encrypting volume data and volume backups can help mitgate these risks and provides defense-in-depth to volume-hosting platforms. Block Storage (cinder) is able to encrypt volume data before it is written to disk, so consider enabling volume encryption, and using Barbican for private key storage.

11.3. VOLUME WIPING

There are multiple ways to wipe a block storage device. The traditional approach is to set the **lvm_type** to thin, and then use the **volume_clear** parameter. Alternatively, if the volume encryption feature is us ed, then volume wiping is not necessary if the volume encryption key is deleted.

NOTE

Previously, **lvm_type=default** was used to signify a wipe. While this method still works, **lvm_type=default** is not recommended for setting secure delete.

The **volume_clear** parameter can accept either **zero** or **shred** as arguments. **zero** will write a single pass of zeroes to the device. The **shred** operation will write three passes of predetermined bit patterns.

CHAPTER 12. HARDENING THE SHARED FILE SYSTEM (MANILA)

The Shared File Systems service (manila) provides a set of services for managing shared file systems in a multi-project cloud environment. With manila, you can create a shared file system and manage its properties, such as visibility, accessibility, and quotas.

For more information on manila, see the Storage Guide: https://access.redhat.com/documentation/en-us/red_hat_openstack_platform/16.1/html-single/storage_guide/

12.1. SECURITY CONSIDERATIONS FOR MANILA

Manila is registered with keystone, allowing you to the locate the API using the **manila endpoints** command. For example:

```
$ manila endpoints
+-------------+-----------------------------------------+
| manila      | Value                                   |
+-------------+-----------------------------------------+
| adminURL    | http://172.18.198.55:8786/v1/20787a7b...|
| region      | RegionOne                               |
| publicURL   | http://172.18.198.55:8786/v1/20787a7b...|
| internalURL | http://172.18.198.55:8786/v1/20787a7b...|
| id          | 82cc5535aa444632b64585f138cb9b61        |
+-------------+-----------------------------------------+

+-------------+-----------------------------------------+
| manilav2    | Value                                   |
+-------------+-----------------------------------------+
| adminURL    | http://172.18.198.55:8786/v2/20787a7b...|
| region      | RegionOne                               |
| publicURL   | http://172.18.198.55:8786/v2/20787a7b...|
| internalURL | http://172.18.198.55:8786/v2/20787a7b...|
| id          | 2e8591bfcac4405fa7e5dc3fd61a2b85        |
+-------------+-----------------------------------------+
```

By default, the manila API service only listens on port **8786** with **tcp6**, which supports both IPv4 and IPv6.

Manila uses multiple configurations files; these are stored in **/var/lib/config-data/puppet-generated/manila/**:

```
api-paste.ini
manila.conf
policy.json
rootwrap.conf
rootwrap.d

./rootwrap.d:
share.filters
```

It is recommended that you configure manila to run under a non-root service account, and change file permissions so that only the system administrator can modify them. Manila expects that only administrators can write to configuration files, and services can only read them through their group

membership in the **manila** group. Other users must not be able to read these files, as they contain service account passwords.

NOTE

Only the root user should own be able to write to the configuration for **manila-rootwrap** in **rootwrap.conf**, and the **manila-rootwrap** command filters for share nodes in **rootwrap.d/share.filters**.

12.2. NETWORK AND SECURITY MODELS FOR MANILA

A share driver in manila is a Python class that can be set for the back end to manage share operations, some of which are vendor-specific. The back end is an instance of the **manila-share** service. Manila has share drivers for many different storage systems, supporting both commercial vendors and open source solutions. Each share driver supports one or more back end modes: **share servers** and **no share servers**. An administrator selects a mode by specifying it in **manila.conf**, using **driver_handles_share_servers**.

A share server is a logical Network Attached Storage (NAS) server that exports shared file systems. Back-end storage systems today are sophisticated and can isolate data paths and network paths between different OpenStack projects.

A share server provisioned by a manila share driver would be created on an isolated network that belongs to the project user creating it. The **share servers** mode can be configured with either a flat network, or a segmented network, depending on the network provider.

It is possible to have separate drivers for different modes use the same hardware. Depending on the chosen mode, you might need to provide more configuration details through the configuration file.

12.3. SHARE BACKEND MODES

Each share driver supports at least one of the available driver modes:

- Share servers - **driver_handles_share_servers = True** - The share driver creates share servers and manages the share server life cycle.
- No share servers - **driver_handles_share_servers = False** - An administrator (rather than a share driver) manages the bare metal storage with a network interface, instead of relying on the presence of the share servers.

No share servers mode - In this mode, drivers will not set up share servers, and consequently will not need to set up any new network interfaces. It is assumed that storage controller being managed by the driver has all of the network interfaces it is going to need. Drivers create shares directly without previously creating a share server. To create shares using drivers operating in this mode, manila does not require users to create any private share networks either.

NOTE

In **no share servers mode**, manila will assume that the network interfaces through which any shares are exported are already reachable by all projects.

In the **no share servers** mode a share driver does not handle share server life cycle. An administrator is expected to handle the storage, networking, and other host-side configuration that might be necessary to provide project isolation. In this mode an administrator can set storage as a host which exports shares.

All projects within the OpenStack cloud share a common network pipe. Lack of isolation can impact security and quality of service. When using share drivers that do not handle share servers, cloud users cannot be sure that their shares cannot be accessed by untrusted users by a tree walk over the top directory of their file systems. In public clouds it is possible that all network bandwidth is used by one client, so an administrator should care for this not to happen. Network balancing can be done by any means, and not necessarily just with OpenStack tools.

Share servers mode - In this mode, a driver is able to create share servers and plug them to existing OpenStack networks. Manila determines if a new share server is required, and provides all the networking information necessary for the share drivers to create the requisite share server.

When creating shares in the driver mode that handles share servers, users must provide a share network that they expect their shares to be exported upon. Manila uses this network to create network ports for the share server on this network.

Users can configure **security services** in both **share servers** and **no share servers** back end modes. But with the **no share servers** back end mode, an administrator must set the required authentication services manually on the host. And in **share servers** mode manila can configure security services identified by the users on the share servers it spawns.

12.4. NETWORKING REQUIREMENTS FOR MANILA

Manila can integrate with different network types: **flat**, **GRE**, **VLAN**, **VXLAN**.

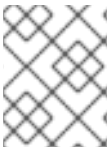
NOTE

Manila is only storing the network information in the database, with the real networks being supplied by the network provider. Manila supports using the OpenStack Networking service (neutron) and also "standalone" pre-configured networking.

In the **share servers** back end mode, a share driver creates and manages a share server for each share network. This mode can be divided in two variations:

- Flat network in **share servers** backend mode
- Segmented network in **share servers** backend mode

Users can use a network and subnet from the OpenStack Networking (neutron) service to create share networks. If the administrator decides to use the **StandAloneNetworkPlugin**, users need not provide any networking information since the administrator pre-configures this in the configuration file.

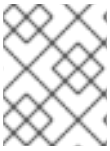


NOTE

Share servers spawned by some share drivers are Compute servers created with the Compute service. A few of these drivers do not support network plugins.

After a share network is created, manila retrieves network information determined by a network provider: network type, segmentation identifier (if the network uses segmentation) and the IP block in CIDR notation from which to allocate the network.

Users can create security services that specify security requirements such as AD or LDAP domains or a Kerberos realm. Manila assumes that any hosts referred to in security service are reachable from a subnet where a share server is created, which limits the number of cases where this mode could be used.



NOTE

Some share drivers might not support all types of segmentation, for more details see the specification for the driver you are using.

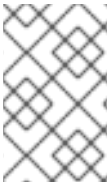
12.5. SECURITY SERVICES WITH MANILA

Manila can restrict access to file shares by integrating with network authentication protocols. Each project can have its own authentication domain that functions separately from the cloud's keystone authentication domain. This project domain can be used to provide authorization (AuthZ) services to applications that run within the OpenStack cloud, including manila. Available authentication protocols include LDAP, Kerberos, and Microsoft Active Directory authentication service.

12.6. INTRODUCTION TO SECURITY SERVICES

After creating a share and getting its export location, users have no permissions to mount it and operate with files. Users need to explicitly grant access to the new share.

The client authentication and authorization (authN/authZ) can be performed in conjunction with security services. Manila can use LDAP, Kerberos, or Microsoft Active directory if they are supported by the share drivers and back ends.



NOTE

In some cases, it is required to explicitly specify one of the security services, for example, NetApp, EMC and Windows drivers require Active Directory for the creation of shares with the CIFS protocol.

12.7. SECURITY SERVICES MANAGEMENT

A *security service* is a manila entity that abstracts a set of options that define a security zone for a particular shared file system protocol, such as an Active Directory domain or a Kerberos domain. The security service contains all of the information necessary for manila to create a server that joins a given domain.

Using the API, users can create, update, view, and delete a security service. Security Services are designed on the following assumptions:

- Projects provide details for the security service.
- Administrators care about security services: they configure the server side of such security services.
- Inside the manila API, a **security_service** is associated with the **share_networks**.
- Share drivers use data in the security service to configure newly created share servers.

When creating a security service, you can select one of these authentication services:

- **LDAP** - The Lightweight Directory Access Protocol. An application protocol for accessing and maintaining distributed directory information services over an IP network.
- **Kerberos** - The network authentication protocol which works on the basis of tickets to allow nodes communicating over a non-secure network to prove their identity to one another in a secure manner.

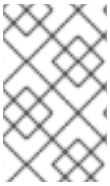
- **Active Directory** - A directory service that Microsoft developed for Windows domain networks. Uses LDAP, Microsoft's version of Kerberos, and DNS.

Manila allows you to configure a security service with these options:

- A DNS IP address that is used inside the project network.
- An IP address or hostname of a security service.
- A domain of a security service.
- A user or group name that is used by a project.
- A password for a user, if you specify a username.

An existing security service entity can be associated with share network entities that inform manila about security and network configuration for a group of shares. You can also see the list of all security services for a specified share network and disassociate them from a share network.

An administrator and users as share owners can manage access to the shares by creating access rules with authentication through an IP address, user, group, or TLS certificates. Authentication methods depend on which share driver and security service you configure and use. You can then configure a back end to use a specific authentication service, which can operate with clients without manila and keystone.



NOTE

Different authentication services are supported by different share drivers. For details of supporting of features by different drivers, see https://docs.openstack.org/manila/latest/admin/share_back_ends_feature_support_mappi

Support for a specific authentication service by a driver does not mean that it can be configured with any shared file system protocol. Supported shared file systems protocols are NFS, CEPHFS, CIFS, GlusterFS, and HDFS. See the driver vendor's documentation for information on a specific driver and its configuration for security services.

Some drivers support security services and other drivers do not support any of the security services mentioned above. For example, Generic Driver with the NFS or the CIFS shared file system protocol supports only authentication method through the IP address.

NOTE

In most cases, drivers that support the CIFS shared file system protocol can be configured to use Active Directory and manage access through the user authentication.

- Drivers that support the GlusterFS protocol can be used with authentication using TLS certificates.
- With drivers that support NFS protocol authentication using an IP address is the only supported option.
- Since the HDFS shared file system protocol uses NFS access it also can be configured to authenticate using an IP address.

The recommended configuration for production manila deployments is to create a share with the CIFS share protocol and add to it the Microsoft Active Directory directory service. With this configuration you will get the centralized database and the service that integrates the Kerberos and LDAP approaches.

12.8. SHARE ACCESS CONTROL

Users can specify which specific clients have access to the shares they create. Due to the keystone service, shares created by individual users are only visible to themselves and other users within the same project. Manila allows users to create shares that are "publicly" visible. These shares are visible in dashboards of users that belong to other OpenStack projects if the owners grant them access, they might even be able to mount these shares if they are made accessible on the network.

While creating a share, use key **--public** to make your share public for other projects to see it in a list of shares and see its detailed information.

According to the **policy.json** file, an administrator and the users as share owners can manage access to shares by means of creating access rules. Using the **manila access-allow**, **manila access-deny**, and **manila access-list** commands, you can grant, deny and list access to a specified share correspondingly.

NOTE

Manila does not provide end-to-end management of the storage system. You will still need to separately protect the backend system from unauthorized access. As a result, the protection offered by the manila API can still be circumvented if someone compromises the backend storage device, thereby gaining out of band access.

When a share is just created there are no default access rules associated with it and permission to mount it. This could be seen in mounting config for export protocol in use. For example, there is an NFS command **exportfs** or **/etc/exports** file on the storage which controls each remote share and defines hosts that can access it. It is empty if nobody can mount a share. For a remote CIFS server there is **net conf list** command which shows the configuration. The **hosts deny** parameter should be set by the share driver to **0.0.0.0/0** which means that any host is denied to mount the share.

Using manila, you can grant or deny access to a share by specifying one of these supported share access levels:

- **rw** - Read and write (RW) access. This is the default value.
- **ro**- Read-only (RO) access.

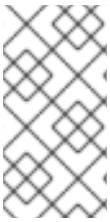
NOTE

The RO access level can be helpful in public shares when the administrator gives read and write (RW) access for some certain editors or contributors and gives read-only (RO) access for the rest of users (viewers).

You must also specify one of these supported authentication methods:

- **ip** - Uses an IP address to authenticate an instance. IP access can be provided to clients addressable by well-formed IPv4 or IPv6 addresses or subnets denoted in CIDR notation.
- **cert** - Uses a TLS certificate to authenticate an instance. Specify the TLS identity as the **IDENTKEY**. A valid value is any string up to 64 characters long in the common name (CN) of the certificate.

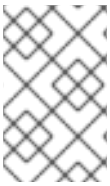
- **user** - Authenticates by a specified user or group name. A valid value is an alphanumeric string that can contain some special characters and is from 4 to 32 characters long.



NOTE

Supported authentication methods depend on which share driver, security service and shared file system protocol you use. Supported shared file system protocols are MapRFS, CEPHFS, NFS, CIFS, GlusterFS, and HDFS. Supported security services are LDAP, Kerberos protocols, or Microsoft Active Directory service.

To verify that access rules (ACL) were configured correctly for a share, you can list its permissions.



NOTE

When selecting a security service for your share, you will need to consider whether the share driver is able to create access rules using the available authentication methods. Supported security services are LDAP, Kerberos, and Microsoft Active Directory.

12.9. SHARE TYPE ACCESS CONTROL

A share type is an administrator-defined *type of service*, comprised of a project visible description, and a list of non-project-visible key-value pairs called *extra specifications*. The **manila-scheduler** uses extra specifications to make scheduling decisions, and drivers control the share creation.

An administrator can create and delete share types, and can also manage extra specifications that give them meaning inside manila. Projects can list the share types and can use them to create new shares. Share types can be created as **public** and **private**. This is the level of visibility for the share type that defines whether other projects can or cannot see it in a share types list and use it to create a new share.

By default, share types are created as public. While creating a share type, use **--is_public** parameter set to **False** to make your share type private which will prevent other projects from seeing it in a list of share types and creating new shares with it. On the other hand, **public** share types are available to every project in a cloud.

Manila allows an administrator to grant or deny access to the **private** share types for projects. You can also get information about the access for a specified private share type.

NOTE

Since share types due to their extra specifications help to filter or choose back ends before users create a share, using access to the share types you can limit clients in choice of specific back ends.

For example, an administrator user in the **admin** project can create a private share type named **my_type** and see it in the list. In the console examples below, the logging in and out is omitted, and environment variables are provided to show the currently logged in user.

```
$ env | grep OS_
...
OS_USERNAME=admin
OS_TENANT_NAME=admin
...
$ manila type-list --all
+----+--------+-----------+-----------+----------------------------------+----------------------+
```

```
| ID | Name   | Visibility| is_default| required_extra_specs              | optional_extra_specs  |
+----+--------+-----------+-----------+----------------------------------+-----------------------+
| 4..| my_type| private   | -         | driver_handles_share_servers:False| snapshot_support:True |
| 5..| default| public    | YES       | driver_handles_share_servers:True | snapshot_support:True |
+----+--------+-----------+-----------+----------------------------------+-----------------------+
```

The **demo** user in the **demo** project can list the types and the private share type named **my_type** is not visible for him.

```
$ env | grep OS_
...
OS_USERNAME=demo
OS_TENANT_NAME=demo
...
$ manila type-list --all
+----+--------+-----------+-----------+----------------------------------+----------------------+
| ID | Name   | Visibility| is_default| required_extra_specs              | optional_extra_specs |
+----+--------+-----------+-----------+----------------------------------+----------------------+
| 5..| default| public    | YES       | driver_handles_share_servers:True| snapshot_support:True|
+----+--------+-----------+-----------+----------------------------------+----------------------+
```

The administrator can grant access to the private share type for the demo project with the project ID equal to **df29a37db5ae48d19b349fe947fada46**:

```
$ env | grep OS_
...
OS_USERNAME=admin
OS_TENANT_NAME=admin
...
$ openstack project list
+----------------------------------+--------------------+
| ID                               | Name               |
+----------------------------------+--------------------+
| ...                              | ...                |
| df29a37db5ae48d19b349fe947fada46 | demo               |
+----------------------------------+--------------------+
$ manila type-access-add my_type df29a37db5ae48d19b349fe947fada46
```

As a result, users in the **demo** project can see the private share type and use it in the share creation:

```
$ env | grep OS_
...
OS_USERNAME=demo
OS_TENANT_NAME=demo
...
$ manila type-list --all
+----+--------+-----------+-----------+----------------------------------+----------------------+
| ID | Name   | Visibility| is_default| required_extra_specs              | optional_extra_specs  |
+----+--------+-----------+-----------+----------------------------------+----------------------+
| 4..| my_type| private   | -         | driver_handles_share_servers:False| snapshot_support:True |
| 5..| default| public    | YES       | driver_handles_share_servers:True | snapshot_support:True |
+----+--------+-----------+-----------+----------------------------------+----------------------+
```

To deny access for a specified project, use **manila type-access-remove <share_type> <project_id>**.

NOTE

For an example that demonstrates the purpose of the share types, consider a situation where you have two back ends: LVM as a public storage and Ceph as a private storage. In this case you can grant access to certain projects and control access with **user/group** authentication method.

12.10. POLICIES

The Shared File Systems service API is gated with role-based access control policies. These policies determine which user can access certain APIs in a certain way, and are defined in the service's **policy.json** file.

NOTE

The configuration file **policy.json** may be placed anywhere. The path **/var/lib/config-data/puppet-generated/manila/etc/manila/policy.json** is expected by default.

Whenever an API call is made to manila, the policy engine uses the appropriate policy definitions to determine if the call can be accepted. A policy rule determines under which circumstances the API call is permitted. The **/var/lib/config-data/puppet-generated/manila/etc/manila/policy.json** file has rules where an action is always permitted, when the rule is an empty string: **""**; the rules based on the user role or rules; rules with boolean expressions. Below is a snippet of the **policy.json** file for manila. It can be expected to change between OpenStack releases.

```
{
    "context_is_admin": "role:admin",
    "admin_or_owner": "is_admin:True or project_id:%(project_id)s",
    "default": "rule:admin_or_owner",
    "share_extension:quotas:show": "",
    "share_extension:quotas:update": "rule:admin_api",
    "share_extension:quotas:delete": "rule:admin_api",
    "share_extension:quota_classes": "",
}
```

Users must be assigned to groups and roles that you refer to in your policies. This is done automatically by the service when user management commands are used.

NOTE

Any changes to **/var/lib/config-data/puppet-generated/manila/etc/manila/policy.json** are effective immediately, which allows new policies to be implemented while manila is running. Manual modification of the policy can have unexpected side effects and is not encouraged. Manila does not provide a default policy file; all the default policies are within the code base. You can generate the default policies from the manila code by executing: **oslopolicy-sample-generator --config-file=var/lib/config-data/puppet-generated/manila/etc/manila/manila-policy-generator.conf**

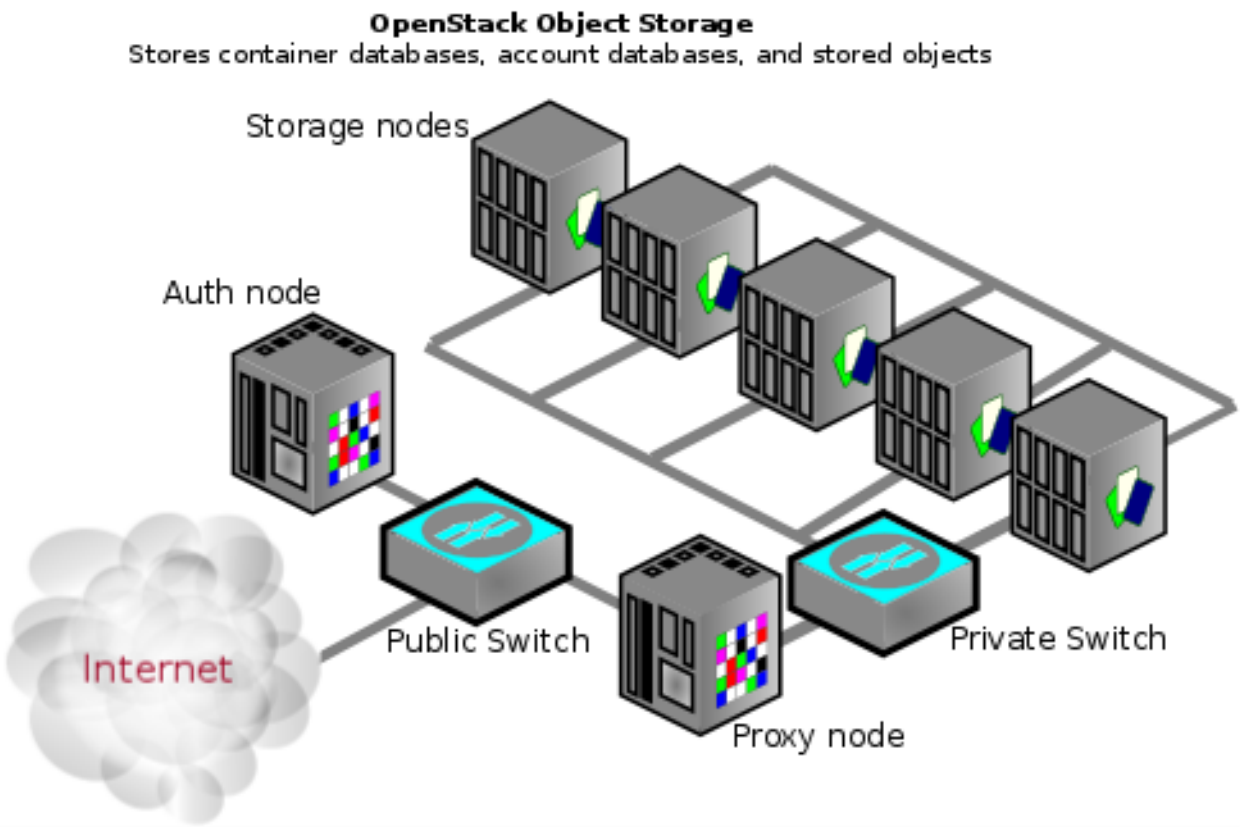
CHAPTER 13. OBJECT STORAGE

The Object Storage (swift) service stores and retrieves data over HTTP. Objects (blobs of data) are stored in an organizational hierarchy that can be configured to offer anonymous read-only access, ACL defined access, or even temporary access. Swift supports multiple token-based authentication mechanisms implemented through middleware.

Applications store and retrieve data in Object Storage using an industry-standard HTTP RESTful API. The back end swift components follow the same RESTful model, although some APIs (such as those managing durability) are kept private to the cluster.

The components of swift fall into the following primary groups:

- Proxy services
- Auth services
- Storage services
  - Account service
  - Container service
  - Object service



NOTE

An Object Storage installation does not have to be internet-facing and could also be a private cloud with the public switch a part of the organization's internal network infrastructure.

13.1. NETWORK SECURITY

Security hardening for swift begins with securing the networking component. See the networking chapter for more information.

For high availability, the rsync protocol is used to replicate data between storage service nodes. In addition, the proxy service communicates with the storage service when relaying data between the client end-point and the cloud environment.

NOTE

Swift does not use encryption or authentication with inter-node communications. This is because swift uses the native rsync protocol for performance reasons, and does not use SSH for rsync communications.This is why you see a private switch or private network ([V]LAN) in the architecture diagrams. This data zone should be separate from other OpenStack data networks as well.

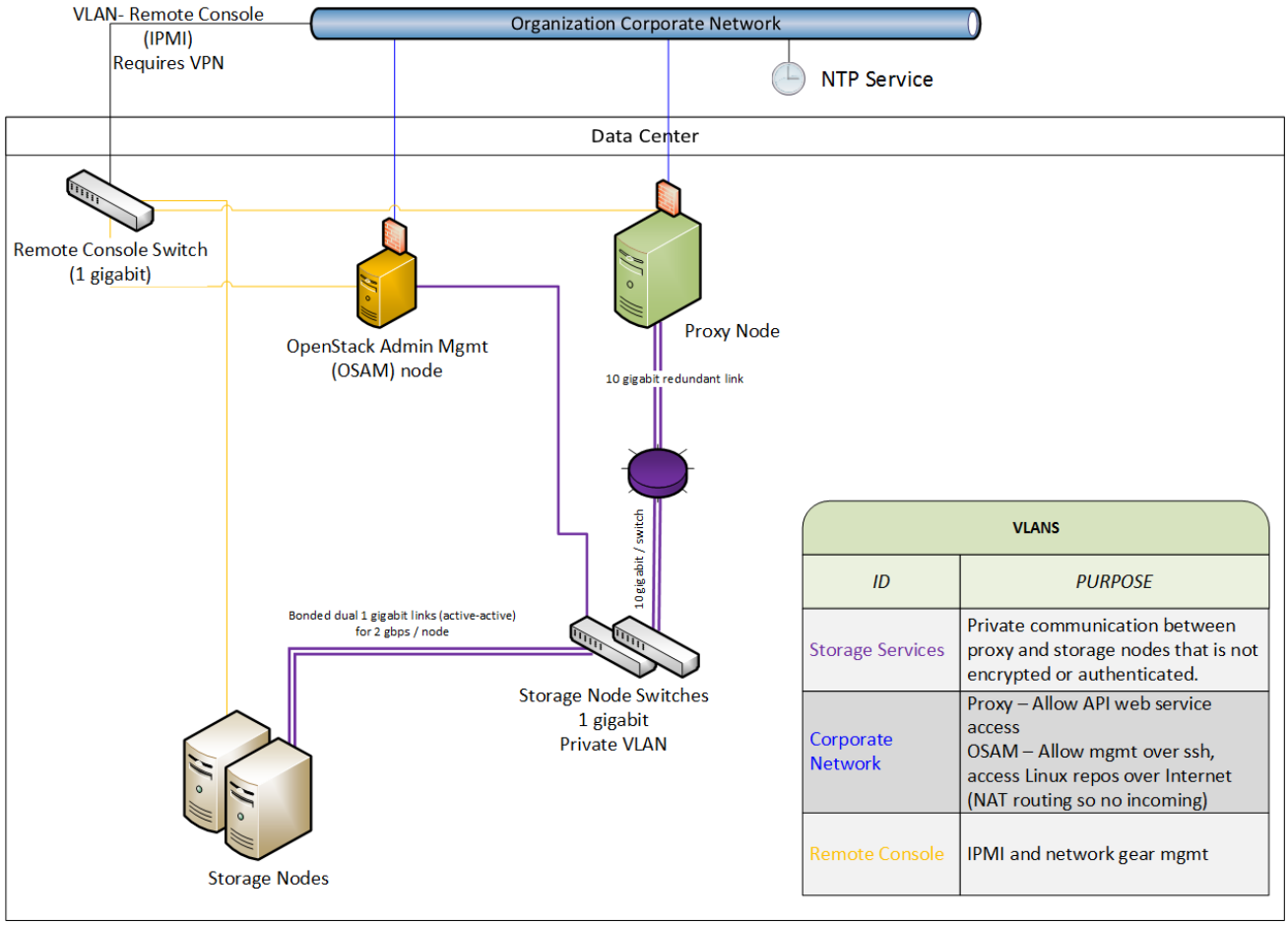
NOTE

Use a private (V)LAN network segment for your storage nodes in the data zone.

This requires that the proxy nodes have dual interfaces (physical or virtual):

- One interface as a public interface for consumers to reach.
- Another interface as a private interface with access to the storage nodes.

The following figure demonstrates one possible network architecture, using the Object Storage network architecture with a management node (OSAM):



13.2. RUN SERVICES AS NON-ROOT USER

It is recommend that you configure swift to run under a non-root (**UID 0**) service account. One recommendation is the username **swift** with the primary group **swift**, as deployed by director. Object Storage services include, for example, **proxy-server**, **container-server**, **account-server**.

13.3. FILE PERMISSIONS

The **/var/lib/config-data/puppet-generated/swift/etc/swift/** directory contains information about the ring topology and environment configuration. The following permissions are recommended:

```
chown -R root:swift /var/lib/config-data/puppet-generated/swift/etc/swift/*
find /var/lib/config-data/puppet-generated/swift/etc/swift/ -type f -exec chmod 640 {} \;
find /var/lib/config-data/puppet-generated/swift/etc/swift/ -type d -exec chmod 750 {} \;
```

This restriction only allows root to modify configuration files, while still allowing the services to read them, due to their membership in the **swift** group.

13.4. SECURING STORAGE SERVICES

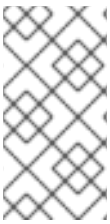
The following are the default listening ports for the various storage services:

- Account service - **TCP/6002**
- Container service - **TCP/6001**
- Object Service - **TCP/6000**

- Rsync - **TCP/873**

NOTE

If ssync is used instead of rsync, the object service port is used for maintaining durability.



NOTE

Authentication does not occur at the storage nodes. If you are able to connect to a storage node on one of these ports, you can access or modify data without authentication. To help mitigate this issue, you should follow the recommendations given previously about using a private storage network.

13.5. OBJECT STORAGE ACCOUNT TERMINOLOGY

A swift account is not a user account or credential. The following distinctions exist:

- Swift account - A collection of containers (not user accounts or authentication). The authentication system you use will determine which users are associated with the account and how they might access it.
- Swift containers - A collection of objects. Metadata on the container is available for ACLs. The usage of ACLs is dependent on the authentication system used.
- Swift objects - The actual data objects. ACLs at the object level are also available with metadata, and are dependent on the authentication system used.

At each level, you have ACLs that control user access; ACLs are interpreted based on the authentication system in use. The most common type of authentication provider is the Identity Service (keystone); custom authentication providers are also available.

13.6. SECURING PROXY SERVICES

A proxy node should have at least two interfaces (physical or virtual): one public and one private. You can use firewalls or service binding to help protect the public interface. The public-facing service is an HTTP web server that processes end-point client requests, authenticates them, and performs the appropriate action. The private interface does not require any listening services, but is instead used to establish outgoing connections to storage nodes on the private storage network.

13.7. HTTP LISTENING PORT

Director configures the web services to run under a non-root (no UID 0) user. Using port numbers higher than **1024** help avoid running any part of the web container as root. Normally, clients that use the HTTP REST API (and perform automatic authentication) will retrieve the full REST API URL they require from the authentication response. The OpenStack REST API allows a client to authenticate to one URL and then be redirected to use a completely different URL for the actual service. For example, a client can authenticate to **https://identity.cloud.example.org:55443/v1/auth** and get a response with their authentication key and storage URL (the URL of the proxy nodes or load balancer) of **https://swift.cloud.example.org:44443/v1/AUTH_8980**.

13.8. LOAD BALANCER

If the option of using Apache is not feasible, or for performance you wish to offload your TLS work, you might employ a dedicated network device load balancer. This is a common way to provide redundancy and load balancing when using multiple proxy nodes.

If you choose to offload your TLS, ensure that the network link between the load balancer and your proxy nodes are on a private (V)LAN segment such that other nodes on the network (possibly compromised) cannot wiretap (sniff) the unencrypted traffic. If such a breach was to occur, the attacker could gain access to endpoint client or cloud administrator credentials and access the cloud data.

The authentication service you use will determine how you configure a different URL in the responses to endpoint clients, allowing them to use your load balancer instead of an individual proxy node.

13.9. OBJECT STORAGE AUTHENTICATION

Object Storage (swift) uses a WSGI model to provide for a middleware capability that not only provides general extensibility, but is also used for authentication of endpoint clients. The authentication provider defines what roles and user types exist. Some use traditional username and password credentials, while others might leverage API key tokens or even client-side x.509 certificates. Custom providers can be integrated using custom middleware.

Object Storage comes with two authentication middleware modules by default, either of which can be used as sample code for developing a custom authentication middleware.

13.10. ENCRYPT AT-REST SWIFT OBJECTS

Swift can integrate with Barbican to transparently encrypt and decrypt your stored (at-rest) objects. At-rest encryption is distinct from in-transit encryption, and refers to the objects being encrypted while being stored on disk.

Swift performs these encryption tasks transparently, with the objects being automatically encrypted when uploaded to swift, then automatically decrypted when served to a user. This encryption and decryption is done using the same (symmetric) key, which is stored in Barbican.

For more information, see the Barbican integration guide:
https://access.redhat.com/documentation/en-us/red_hat_openstack_platform/16.1/html-single/manage_secrets_with_openstack_key_manager/

13.11. ADDITIONAL ITEMS

In **/var/lib/config-data/puppet-generated/swift/etc/swift/swift.conf** on every node, there is a **swift_hash_path_prefix** setting and a **swift_hash_path_suffix** setting. These are provided to reduce the chance of hash collisions for objects being stored and avert one user overwriting the data of another user.

This value should be initially set with a cryptographically secure random number generator and consistent across all nodes. Ensure that it is protected with proper ACLs and that you have a backup copy to avoid data loss.

CHAPTER 14. MONITORING AND LOGGING

Log management is an important component of monitoring the security status of your OpenStack deployment. Logs provide insight into the BAU actions of administrators, projects, and instances, in addition to the component activities that comprise your OpenStack deployment.

Logs are not only valuable for proactive security and continuous compliance activities, but they are also a valuable information source for investigation and incident response. For example, analyzing the keystone access logs could alert you to failed logins, their frequency, origin IP, and whether the events are restricted to select accounts, among other pertinent information.

The director includes intrusion detection capabilities using AIDE, and CADF auditing for keystone. For more information, see Hardening infrastructure and virtualization.

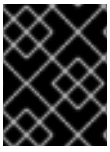
14.1. HARDEN THE MONITORING INFRASTRUCTURE

Centralized logging systems are a high value target for intruders, as a successful breach could allow them to erase or tamper with the record of events. It is recommended you harden the monitoring platform with this in mind. In addition, consider making regular backups of these systems, with failover planning in the event of an outage or DoS.

14.2. EXAMPLE EVENTS TO MONITOR

Event monitoring is a more proactive approach to securing an environment, providing real-time detection and response. Multiple tools exist which can aid in monitoring. For an OpenStack deployment, you will need to monitor the hardware, the OpenStack services, and the cloud resource usage.

This section describes some example events you might need to be aware of.



IMPORTANT

This list is not exhaustive. You will need to consider additional use cases that might apply to your specific network, and that you might consider anomalous behavior.

- Detecting the absence of log generation is an event of high value. Such a gap might indicate a service failure, or even an intruder who has temporarily switched off logging or modified the log level to hide their tracks.
- Application events, such as start or stop events, that were unscheduled might have possible security implications.
- Operating system events on the OpenStack nodes, such as user logins or restarts. These can provide valuable insight into distinguishing between proper and improper usage of systems.
- Networking bridges going down. This would be an actionable event due to the risk of service outage.
- IPtables flushing events on Compute nodes, and the resulting loss of access to instances.

To reduce security risks from orphaned instances on a user, project, or domain deletion in the Identity service there is discussion to generate notifications in the system and have OpenStack components respond to these events as appropriate such as terminating instances, disconnecting attached volumes, reclaiming CPU and storage resources and so on.

Security monitoring controls such as intrusion detection software, antivirus software, and spyware detection and removal utilities can generate logs that show when and how an attack or intrusion took place. These tools can provide a layer of protection when deployed on the OpenStack nodes. Project users might also want to run such tools on their instances.

CHAPTER 15. DATA PRIVACY FOR PROJECTS

OpenStack is designed to support multi-tenancy between projects with different data requirements. A cloud operator will need to consider their applicable data privacy concerns and regulations. This chapter addresses aspects of data residency and disposal for OpenStack deployments.

15.1. DATA RESIDENCY

The privacy and isolation of data has consistently been cited as the primary barrier to cloud adoption over the past few years. Concerns over who owns data in the cloud and whether the cloud operator can be ultimately trusted as a custodian of this data have been significant issues in the past.

Certain OpenStack services have access to data and metadata belonging to projects or reference project information. For example, project data stored in an OpenStack cloud might include the following items:

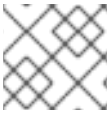
- Object Storage objects.
- Compute instance ephemeral filesystem storage.
- Compute instance memory.
- Block Storage volume data.
- Public keys for Compute access.
- Virtual machine images in the Image service.
- Instance snapshots.
- Data passed to Compute's configuration-drive extension.

Metadata stored by an OpenStack cloud includes the following items (this list is non-exhaustive):

- Organization name.
- User's "Real Name".
- Number or size of running instances, buckets, objects, volumes, and other quota-related items.
- Number of hours running instances or storing data.
- IP addresses of users.
- Internally generated private keys for compute image bundling.

15.2. DATA DISPOSAL

Good practices suggest that the operator must sanitize cloud system media (digital and non-digital) prior to disposal, prior to release out of organization control, or prior to release for reuse. Sanitization methods should implement an appropriate level of strength and integrity given the specific security domain and sensitivity of the information.



NOTE

The NIST Special Publication 800-53 Revision 4 takes a particular view on this topic:

> The sanitization process removes information from the media such that the information cannot be retrieved or reconstructed. Sanitization techniques, including clearing, purging, cryptographic erase, and destruction, prevent the disclosure of information to unauthorized individuals when such media is reused or released for disposal.

Cloud operators should consider the following when developing general data disposal and sanitization guidelines (as per the NIST recommended security controls):

- Track, document and verify media sanitization and disposal actions.
- Test sanitation equipment and procedures to verify proper performance.
- Sanitize portable, removable storage devices prior to connecting such devices to the cloud infrastructure.
- Destroy cloud system media that cannot be sanitized.

As a result, an OpenStack deployment will need to address the following practices (among others):

- Secure data erasure
- Instance memory scrubbing
- Block Storage volume data
- Compute instance ephemeral storage
- Bare metal server sanitization

15.2.1. Data not securely erased

Within OpenStack some data might be deleted, but not securely erased in the context of the NIST standards outlined above. This is generally applicable to most or all of the above-defined metadata and information stored in the database. This might be remediated with database and/or system configuration for auto vacuuming and periodic free-space wiping.

15.2.2. Instance memory scrubbing

Specific to various hypervisors is the treatment of instance memory. This behavior is not defined in Compute, although it is generally expected of hypervisors that they will make a best effort to scrub memory either upon deletion of an instance, upon creation of an instance, or both.

15.3. ENCRYPTING CINDER VOLUME DATA

Use of the OpenStack volume encryption feature is highly encouraged. This is discussed below in the Data Encryption section under Volume Encryption. When this feature is used, destruction of data is accomplished by securely deleting the encryption key. The end user can select this feature while creating a volume, but note that an admin must perform a one-time set up of the volume encryption feature first.

If the OpenStack volume encryption feature is not used, then other approaches generally would be

more difficult to enable. If a back-end plug-in is being used, there might be independent ways of doing encryption or non-standard overwrite solutions. Plug-ins to OpenStack Block Storage will store data in a variety of ways. Many plug-ins are specific to a vendor or technology, whereas others are more DIY solutions around filesystems (such as LVM or ZFS). Methods for securely destroying data will vary between plug-ins, vendors, and filesystems.

Some back ends (such as ZFS) will support copy-on-write to prevent data exposure. In these cases, reads from unwritten blocks will always return zero. Other back ends (such as LVM) might not natively support this, so the cinder plug-in takes the responsibility to override previously written blocks before handing them to users. It is important to review what assurances your chosen volume back-end provides and to see what remediation might be available for those assurances not provided.

15.4. IMAGE SERVICE DELAY DELETE FEATURES

Image Service has a delayed delete feature, which will pend the deletion of an image for a defined time period. Consider disabling this feature if this behavior is a security concern; you can do this by editing **glance-api.conf** file and setting the **delayed_delete** option to **False**.

15.5. COMPUTE SOFT DELETE FEATURES

Compute has a soft-delete feature, which enables an instance that is deleted to be in a soft-delete state for a defined time period. The instance can be restored during this time period. To disable the soft-delete feature, edit the **/var/lib/config-data/puppet-generated/nova_libvirt/etc/nova/nova.conf** file and leave the **reclaim_instance_interval** option empty.

15.6. SECURITY HARDENING FOR BARE METAL PROVISIONING

For your bare metal provisioning infrastructure, you should consider security hardening the baseboard management controllers (BMC) in general, and IPMI in particular. For example, you might isolate these systems within a provisioning network, configure non-default and strong passwords, and disable unwanted management functions. For more information, you can refer to the vendor's guidance on security hardening these components.

NOTE

If possible, consider evaluating Redfish-based BMCs over legacy ones.

15.7. HARDWARE IDENTIFICATION

When deploying a server, there might not always have a reliable way to distinguish it from an attacker's server. This capability might be dependent on the hardware/BMC to some extent, but generally it seems that there is no verifiable means of identification built into servers.

15.8. DATA ENCRYPTION

The option exists for implementers to encrypt project data wherever it is stored on disk or transported over a network, such as the OpenStack volume encryption feature described below. This is above and beyond the general recommendation that users encrypt their own data before sending it to their provider.

The importance of encrypting data on behalf of projects is largely related to the risk assumed by a provider that an attacker could access project data. There might be requirements here in government, as well as requirements per-policy, in private contract, or even in case law in regard to private contracts

for public cloud providers. Consider getting a risk assessment and legal advice before choosing project encryption policies.

Per-instance or per-object encryption is preferable over, in descending order, per-project, per-host, and per-cloud aggregations. This recommendation is inverse to the complexity and difficulty of implementation. Presently, in some projects it is difficult or impossible to implement encryption as loosely granular as even per-project. Implementers should give serious consideration to encrypting project data.

Often, data encryption relates positively to the ability to reliably destroy project and per-instance data, simply by throwing away the keys. It should be noted that in doing so, it becomes of great importance to destroy those keys in a reliable and secure manner.

Opportunities to encrypt data for users are present:

- Object Storage objects
- Network data

15.8.1. Volume encryption

A volume encryption feature in OpenStack supports privacy on a per-project basis. The following features are supported:

- Creation and usage of encrypted volume types, initiated through the dashboard or a command line interface
- Enable encryption and select parameters such as encryption algorithm and key size
- Volume data contained within iSCSI packets is encrypted
- Supports encrypted backups if the original volume is encrypted
- Dashboard indication of volume encryption status. Includes indication that a volume is encrypted, and includes the encryption parameters such as algorithm and key size
- Interface with the Key management service

15.8.2. Object Storage objects

Object Storage (swift) supports the optional encryption of object data at rest on storage nodes. The encryption of object data is intended to mitigate the risk of user's` data being read if an unauthorized party were to gain physical access to a disk.

Encryption of data at rest is implemented by middleware that may be included in the proxy server WSGI pipeline. The feature is internal to a swift cluster and not exposed through the API. Clients are unaware that data is encrypted by this feature internally to the swift service; internally encrypted data should never be returned to clients through the swift API.

The following data are encrypted while at rest in swift:

- Object content, for example, the content of an object **PUT** request's body.
- The entity tag (**ETag**) of objects that have non-zero content.
- All custom user object metadata values. For example, metadata sent using **X-Object-Meta-** prefixed headers with **PUT** or **POST** requests.

Any data or metadata not included in the list above is not encrypted, including:

- Account, container, and object names
- Account and container custom user metadata values
- All custom user metadata names
- Object Content-Type values
- Object size
- System metadata

15.8.3. Block Storage performance and back ends

When enabling the operating system, you can enhance the OpenStack Volume Encryption performance by using the hardware acceleration features available in both Intel and AMD processors.

The OpenStack volume encryption feature uses either **dm-crypt** on the host or native **QEMU** encryption support to secure volume data. Red Hat recommends that you use the **LUKS** volume encryption type when creating encrypted volumes.

15.8.4. Network data

Project data for Compute nodes could be encrypted over IPsec or other tunnels. This practice is not common or standard in OpenStack, but is an option available to motivated and interested implementers. Likewise, encrypted data remains encrypted as it is transferred over the network.

15.9. KEY MANAGEMENT

To address the often mentioned concern of project data privacy, there is significant interest within the OpenStack community to make data encryption more ubiquitous. It is relatively easy for an end-user to encrypt their data prior to saving it to the cloud, and this is a viable path for project objects such as media files, database archives among others. In some instances, client-side encryption is used to encrypt data held by the virtualization technologies which requires client interaction, such as presenting keys, to decrypt data for future use.

Barbican can help projects more seamlessly encrypt the data and have it accessible without burdening the user with key management. Providing encryption and key management services as part of OpenStack eases data-at-rest security adoption and can help address customer concerns about privacy or misuse of data.

The volume encryption feature relies on a key management service, such as the Key Manager service (barbican), for the creation and security-hardened storage of keys.

CHAPTER 16. MANAGING INSTANCE SECURITY

One of the benefits of running instances in a virtualized environment is the new opportunities for security controls that are not typically available when deploying onto bare metal. Certain technologies can be applied to the virtualization stack that bring improved information assurance for OpenStack deployments. Operators with strong security requirements might want to consider deploying these technologies, however, not all are applicable in every situation. In some cases, technologies might be ruled out for use in a cloud because of prescriptive business requirements. Similarly some technologies inspect instance data such as run state which might be undesirable to the users of the system.

This chapter describes these technologies and the situations where they can be used to help improve security for instances or the underlying nodes. Possible privacy concerns are also highlighted, which can include data passthrough, introspection, or entropy sources.

16.1. SUPPLYING ENTROPY TO INSTANCES

This chapter uses the term *entropy* to refer to the quality and source of random data that is available to an instance. Cryptographic technologies typically rely heavily on randomness, which requires drawing from a high quality pool of entropy. It is typically difficult for an instance to get enough entropy to support these operations; this is referred to as entropy starvation. This condition can manifest in instances as something seemingly unrelated. For example, slow boot time might be caused by the instance waiting for SSH key generation. This condition can also risk motivating users to use poor quality entropy sources from within the instance, making applications running in the cloud less secure overall.

Fortunately, you can help address these issues by providing a high quality source of entropy to the instances. This can be done by having enough hardware random number generators (HRNG) in the cloud to support the instances. In this case, enough is somewhat domain-specific. For everyday operations, a modern HRNG is likely to produce enough entropy to support 50-100 compute nodes. High bandwidth HRNGs, such as the RdRand instruction available with Intel Ivy Bridge and newer processors could potentially handle more nodes. For a given cloud, an architect needs to understand the application requirements to ensure that sufficient entropy is available.

The Virtio RNG is a random number generator that uses **/dev/random** as the source of entropy by default. It can also can be configured to use a hardware RNG, or a tool such as the entropy gathering daemon (EGD) to provide a way to fairly distribute entropy through a deployment. You can enable Virtio RNG at instance creation time using the **hw_rng** metadata property.

16.2. SCHEDULING INSTANCES TO NODES

Before an instance is created, a host for the image instantiation must be selected. This selection is performed by the **nova-scheduler** which determines how to dispatch compute and volume requests.

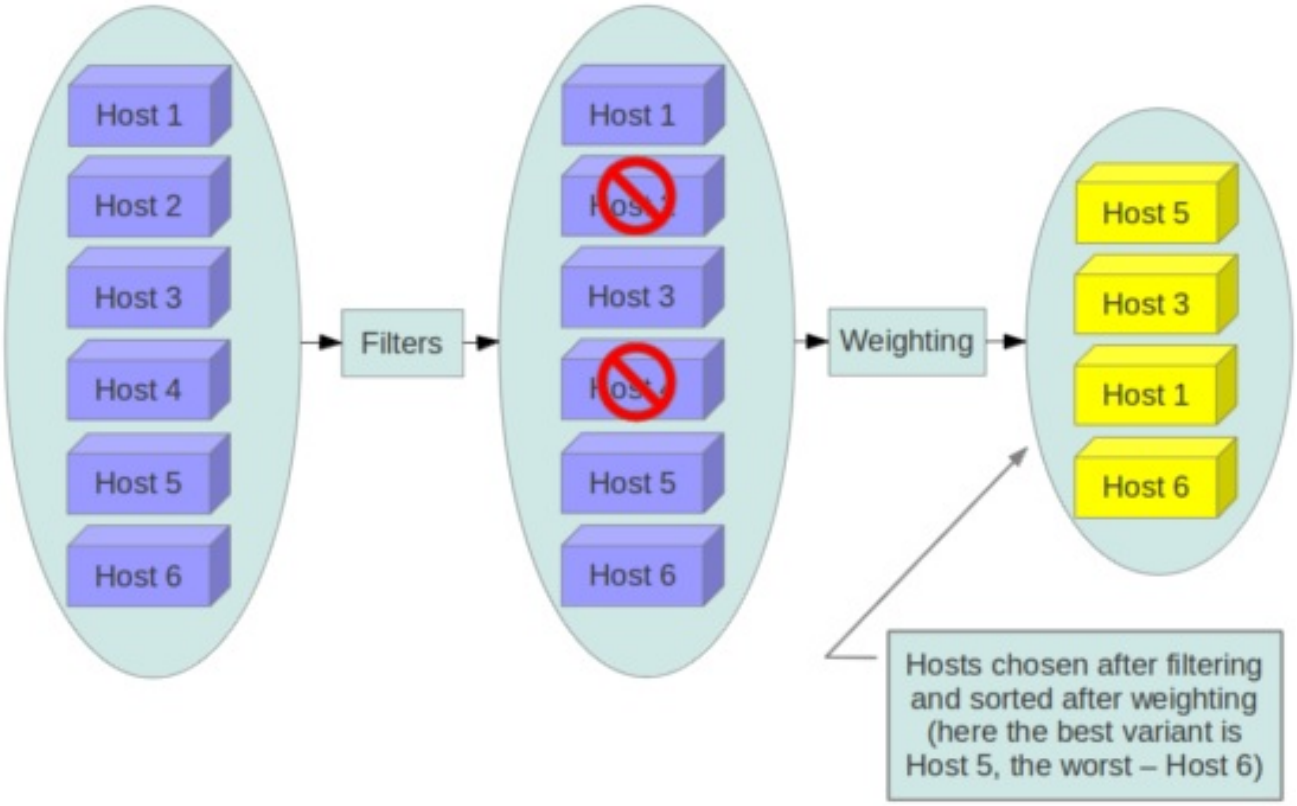
The **FilterScheduler** is the default scheduler for Compute, although other schedulers exist. This capability works in collaboration with *filter hints* to determine where an instance should be started. This process of host selection allows administrators to fulfill many different security and compliance requirements. If data isolation is a primary concern, you could choose to have project instances reside on the same hosts whenever possible. Conversely, you could attempt to have instances reside on as many different hosts as possible for availability or fault tolerance reasons.

Filter schedulers fall under the following main categories:

- *Resource based filters* - Determines the placement of an instance, based on the system resource usage of the hypervisor host sets, and can trigger on free or used properties such as RAM, IO, or CPU utilization.

- *Image based filters* - Delegates instance creation based on the image metadata used, such as the operating system of the VM or type of image used.
- *Environment based filters* - Determines the placement of an instance based on external details, such as within a specific IP range, across availability zones, or on the same host as another instance.
- *Custom criteria* - Delegates instance creation based on user or administrator-provided criteria such as trusts or metadata parsing.

Multiple filters can be applied at once. For example, the **ServerGroupAffinity** filter checks that an instance is created on a member of a specific set of hosts, and the **ServerGroupAntiAffinity** filter checks that same instance is not created on another specific set of hosts. Note that these two filters would usually be both enabled at the same time, and can never conflict with each other as they each check for the value of a given property, and cannot both be true at the same time.



IMPORTANT

Consider disabling filters that parse objects that are provided by users, or could be manipulated (such as metadata).

16.3. USING TRUSTED IMAGES

In a cloud environment, users work with either pre-installed images or images they upload themselves. In both cases, users should be able to ensure the image they are using has not been tampered with. The ability to verify images is a fundamental imperative for security. A chain of trust is needed from the source of the image to the destination where it is used. This can be accomplished by signing images

obtained from trusted sources and by verifying the signature prior to use. Various ways to obtain and create verified images will be discussed below, followed by a description of the image signature verification feature.

16.4. CREATING IMAGES

The OpenStack documentation provides guidance on how to create and upload an image to the Image service. In addition, it is assumed that you have a process for installing and hardening the guest operating systems. The following items will provide additional guidance on how transferring your images into OpenStack. There are a variety of options for obtaining images. Each has specific steps that help validate the image's provenance.

- **Option 1**: Obtain boot media from a trusted source. For example, you can download images from official Red Hat sources and then perform additional checksum validation.
- **Option 2**: Use the OpenStack Virtual Machine Image Guide. In this case, you will want to follow your organizations OS hardening guidelines.
- **Option 3**: Use an automated image builder. The following example uses the Oz image builder. The OpenStack community has recently created a newer tool called **disk-image-builder**, which has not yet undergone a security evaluation.

In this example, **RHEL 6 CCE-26976-1** helps implement NIST 800-53 Section AC-19(d) within Oz.

```
<template>
<name>centos64</name>
<os>
  <name>RHEL-6</name>
  <version>4</version>
  <arch>x86_64</arch>
  <install type='iso'>
  <iso>http://trusted_local_iso_mirror/isos/x86_64/RHEL-6.4-x86_64-bin-DVD1.iso</iso>
  </install>
  <rootpw>CHANGE THIS TO YOUR ROOT PASSWORD</rootpw>
</os>
<description>RHEL 6.4 x86_64</description>
<repositories>
  <repository name='epel-6'>
  <url>http://download.fedoraproject.org/pub/epel/6/$basearch</url>
  <signed>no</signed>
  </repository>
</repositories>
<packages>
  <package name='epel-release'/>
  <package name='cloud-utils'/>
  <package name='cloud-init'/>
</packages>
<commands>
  <command name='update'>
  yum update
  yum clean all
  sed -i '/^HWADDR/d' /etc/sysconfig/network-scripts/ifcfg-eth0
  echo -n > /etc/udev/rules.d/70-persistent-net.rules
  echo -n > /lib/udev/rules.d/75-persistent-net-generator.rules
  chkconfig --level 0123456 autofs off
  service autofs stop
```

```
  </command>
</commands>
</template>
```

Consider avoiding the manual image building process as it is complex and prone to error. In addition, using an automated system like Oz for image building, or a configuration management utility (like Chef or Puppet) for post-boot image hardening, gives you the ability to produce a consistent image as well as track compliance of your base image to its respective hardening guidelines over time.

If subscribing to a public cloud service, you should check with the cloud provider for an outline of the process used to produce their default images. If the provider allows you to upload your own images, you will want to ensure that you are able to verify that your image was not modified before using it to create an instance. To do this, refer to the following section on _ Verifying image signatures_, or the following paragraph if signatures cannot be used.

The Image Service (glance) is used to upload the image to the Compute service on a node. This transfer should be further hardened over TLS. Once the image is on the node, it is checked with a basic checksum and then its disk is expanded based on the size of the instance being launched. If, at a later time, the same image is launched with the same instance size on this node, it is launched from the same expanded image. Since this expanded image is not re-verified by default before launching, there is a risk that it has undergone tampering. The user would not be aware of tampering, unless a manual inspection of the files is performed in the resulting image. To help mitigate this, see the following section on the topic of verifying image signatures.

16.5. VERIFYING IMAGE SIGNATURES

You can enable image signature verification to ensure that your Image service (glance) images do not contain unauthorized changes before the Compute service (nova) starts the instance. With this feature enabled, you prevent a new instance from starting that may include malware or security vulnerabilities.

Procedure

1. In your heat templates, enable instance signature verfication by setting the value of **True** to the **VerifyGlanceSignatures** parameter:

```
parameter_defaults:
  VerifyGlanceSignatures: True
```

2. Ensure that the template that you use to modify the **VerifyGlanceSignatures** parameter is included in your **openstack overcloud deploy** script, and rerun the deploy script.

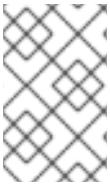
NOTE

If you create an instance with an image that you have not signed, the image fails verification and the instance does not start. For more information on signing your images, see Signing Image service images .

16.6. MIGRATING INSTANCES

OpenStack and the underlying virtualization layers provide for the live migration of images between OpenStack nodes, allowing you to seamlessly perform rolling upgrades of your Compute nodes without instance downtime. However, live migrations also carry significant risk. To understand the risks involved, the following are the high-level steps performed during a live migration:

1. Start instance on destination host
2. Transfer memory
3. Stop the guest and sync disks
4. Transfer the state
5. Start the guest



NOTE

Certain operations, such as cold migration, resize, and shelve can all result in some amount of transferring the instance's data to other services, across the network, among others.

16.6.1. Live migration risks

At various stages of the live migration process, the contents of an instance's run time memory and disk are transmitted over the network in plain text. Consequently there are multiple risks that need to be addressed when using live migration. The following non-exhaustive list details some of these risks:

- Denial of Service (DoS): If something fails during the migration process, the instance could be lost.
- Data exposure: Memory or disk transfers must be handled securely.
- Data manipulation: If memory or disk transfers are not handled securely, then an attacker could manipulate user data during the migration.
- Code injection: If memory or disk transfers are not handled securely, then an attacker could manipulate executables, either on disk or in memory, during the migration.

16.6.2. Disable live migration

Currently, live migration is enabled in OpenStack by default. Live migrations are admin-only tasks by default, so a user cannot initiate this operation, only administrators (which are presumably trusted). Live migrations can be disabled by adding the following lines to the nova **policy.json** file:

```
"compute_extension:admin_actions:migrate": "!",
"compute_extension:admin_actions:migrateLive": "!",
```

Alternatively, live migration can be expected to fail when blocking TCP ports **49152** through **49261**, or ensuring that the nova user does not have passwordless SSH access between compute hosts.

Note that SSH configuration for live migration is significantly locked down: A new user is created (nova_migration) and the SSH keys are restricted to that user, and only for use on the allowed networks. A wrapper script then restricts the commands that can be run (for example, netcat on the libvirt socket).

16.6.3. Encrypted live migration

Live migration traffic transfers the contents of disk and memory of a running instance in plain text, and is currently hosted on the Internal API network by default.

If there is a sufficient requirement (such as upgrades) for keeping live migration enabled, then libvirtd

can provide encrypted tunnels for the live migrations. However, this feature is not exposed in either the OpenStack Dashboard or nova-client commands, and can only be accessed through manual configuration of libvirtd. The live migration process then changes to the following high-level steps:

1. Instance data is copied from the hypervisor to libvirtd.
2. An encrypted tunnel is created between libvirtd processes on both source and destination hosts.
3. The destination libvirtd host copies the instances back to an underlying hypervisor.

NOTE

For Red Hat OpenStack Platform 13, the recommended approach is to use tunnelled migration, which is enabled by default when using Ceph as the back end. For more information, see https://docs.openstack.org/nova/queens/configuration/config.html#libvirt.live_migration_t

16.7. MONITORING, ALERTING, AND REPORTING

Instances are a server image capable of being replicated across hosts. Consequently, it would be a good practice to apply logging similarly between physical and virtual hosts. Operating system and application events should be logged, including access events to hosts and data, user additions and removals, privilege changes, and others as dictated by your requirements. Consider exporting the results to a log aggregator that collects log events, correlates them for analysis, and stores them for reference or further action. One common tool to do this is an ELK stack, or Elasticsearch, Logstash, and Kibana.

NOTE

These logs should be reviewed regularly, or even monitored within a live view performed by a network operations center (NOC).

You will need to further determine which events will trigger an alert that is subsequently sent to a responder for action.

For more information, see the Monitoring Tools Configuration Guide

16.8. UPDATES AND PATCHES

A hypervisor runs independent virtual machines. This hypervisor can run in an operating system or directly on the hardware (called bare metal). Updates to the hypervisor are not propagated down to the virtual machines. For example, if a deployment is using KVM and has a set of CentOS virtual machines, an update to KVM will not update anything running on the CentOS virtual machines.

Consider assigning clear ownership of virtual machines to owners, who are then responsible for the hardening, deployment, and continued functionality of the virtual machines. You should also have a plan to regularly deploy updates, while first testing them in an environment that resembles production.

16.9. FIREWALLS AND INSTANCE PROFILES

Most common operating systems include host-based firewalls for an additional layer of security. While instances should run as few applications as possible (to the point of being single-purpose instances, if possible), all applications running on an instance should be profiled to determine which system resources the application needs access to, the lowest level of privilege required for it to run, and what

the expected network traffic is that will be going into and coming from the virtual machine. This expected traffic should be added to the host-based firewall as allowed traffic, along with any necessary logging and management communication such as SSH or RDP. All other traffic should be explicitly denied in the firewall configuration.

On Linux instances, the application profile above can be used in conjunction with a tool like **audit2allow** to build an SELinux policy that will further protect sensitive system information on most Linux distributions. SELinux uses a combination of users, policies and security contexts to compartmentalize the resources needed for an application to run, and segmenting it from other system resources that are not needed.

NOTE

Red Hat OpenStack Platform has SELinux enabled by default, with policies that are customized for OpenStack services. Consider reviewing these polices regularly, as required.

16.10. SECURITY GROUPS

OpenStack provides security groups for both hosts and the network to add defense-in-depth to the instances in a given project. These are similar to host-based firewalls as they allow or deny incoming traffic based on port, protocol, and address. However, security group rules are applied to incoming traffic only, while host-based firewall rules can be applied to both incoming and outgoing traffic. It is also possible for host and network security group rules to conflict and deny legitimate traffic. Consider checking that security groups are configured correctly for the networking being used. See Security groups in this guide for more detail.

NOTE

You should keep security groups and port security enabled unless you specifically need them to be disabled. To build on the defense-in-depth approach, it is recommended that you apply granular rules to instances.

16.11. ACCESSING THE INSTANCE CONSOLE

By default, an instance's console is remotely accessible through a virtual console. This can be useful for troubleshooting purposes. Red Hat OpenStack Platform uses VNC for remote console access.

- Consider locking down the VNC port using firewall rules. By default, **nova_vnc_proxy** uses **6080** and **13080**.
- Confirm that the VNC traffic is encrypted by TLS. For director-based deployments, start with **UseTLSTransportForVnc**.

16.12. CERTIFICATE INJECTION

If you need to SSH into your instances, you can configure Compute to automatically inject the required SSH key into the instance upon creation.

For more information, see Creating an image in the *Creating and Managing Images* guide.

CHAPTER 17. MESSAGE QUEUING

Message queuing services facilitate inter-process communication in OpenStack. This is done using these message queuing service back ends:

- RabbitMQ - Red Hat OpenStack Platform uses RabbitMQ by default.
- Qpid

Both RabbitMQ and Qpid are Advanced Message Queuing Protocol (AMQP) frameworks, which provide message queues for peer-to-peer communication. Queue implementations are typically deployed as a centralized or decentralized pool of queue servers.

Message queues effectively facilitate command and control functions across OpenStack deployments. Once access to the queue is permitted, no further authorization checks are performed. Services accessible through the queue do validate the contexts and tokens within the actual message payload. However, you must note the expiration date of the token because tokens are potentially re-playable and can authorize other services in the infrastructure.

OpenStack does not support message-level confidence, such as message signing. Consequently, you must secure and authenticate the message transport itself. For high-availability (HA) configurations, you must perform queue-to-queue authentication and encryption.

17.1. MESSAGING TRANSPORT SECURITY

AMQP based solutions (Qpid and RabbitMQ) support transport-level security using TLS.

Consider enabling transport-level cryptography for your message queue. Using TLS for the messaging client connections provides protection of the communications from tampering and eavesdropping in-transit to the messaging server. Guidance is included below on how TLS is typically configured for the two popular messaging servers: Qpid and RabbitMQ. When configuring the trusted certificate authority (CA) bundle that your messaging server uses to verify client connections, it is recommended that this be limited to only the CA used for your nodes, preferably an internally managed CA. The bundle of trusted CAs will determine which client certificates will be authorized and pass the client-server verification step of the setting up the TLS connection.

NOTE

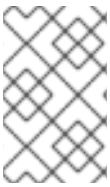
When installing the certificate and key files, ensure that the file permissions are restricted, for example using **chmod 0600**, and the ownership is restricted to the messaging server daemon user to prevent unauthorized access by other processes and users on the messaging server.

17.1.1. RabbitMQ server SSL configuration

The following lines should be added to the system-wide RabbitMQ configuration file, typically **/etc/rabbitmq/rabbitmq.config**:

```
[
  {rabbit, [
    {tcp_listeners, [] },
    {ssl_listeners, [{"<IP address or hostname of management network interface>", 5671}] },
    {ssl_options, [{cacertfile,"/etc/ssl/cacert.pem"},
                   {certfile,"/etc/ssl/rabbit-server-cert.pem"},
                   {keyfile,"/etc/ssl/rabbit-server-key.pem"},
```

```
                {verify,verify_peer},
                {fail_if_no_peer_cert,true}]}
    ]}
].
```



NOTE

The **tcp_listeners** option is set to **[]** to prevent it from listening on a non-SSL port. The **ssl_listeners** option should be restricted to only listen on the management network for the services.

17.2. QUEUE AUTHENTICATION AND ACCESS CONTROL

RabbitMQ and Qpid offer authentication and access control mechanisms for controlling access to queues.

Simple Authentication and Security Layer (SASL) is a framework for authentication and data security in Internet protocols. Both RabbitMQ and Qpid offer SASL and other pluggable authentication mechanisms beyond simple usernames and passwords that allow for increased authentication security. While RabbitMQ supports SASL, support in OpenStack does not currently allow for requesting a specific SASL authentication mechanism. RabbitMQ support in OpenStack allows for either username and password authentication over an unencrypted connection or user name and password in conjunction with X.509 client certificates to establish the secure TLS connection.

Consider configuring X.509 client certificates on all the OpenStack service nodes for client connections to the messaging queue and where possible (currently only Qpid) perform authentication with X.509 client certificates. When using usernames and passwords, accounts should be created per-service and node for finer grained auditability of access to the queue.

Before deployment, consider the TLS libraries that the queuing servers use. Qpid uses Mozilla's NSS library, whereas RabbitMQ uses Erlang's TLS module which uses OpenSSL.

17.3. OPENSTACK SERVICE CONFIGURATION FOR RABBITMQ

This section describes the typical RabbitMQ configuration for OpenStack services:

```
[DEFAULT]
rpc_backend = nova.openstack.common.rpc.impl_kombu
rabbit_use_ssl = True
rabbit_host = RABBIT_HOST
rabbit_port = 5671
rabbit_user = compute01
rabbit_password = RABBIT_PASS
kombu_ssl_keyfile = /etc/ssl/node-key.pem
kombu_ssl_certfile = /etc/ssl/node-cert.pem
kombu_ssl_ca_certs = /etc/ssl/cacert.pem
```

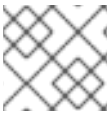
NOTE

Replace **RABBIT_PASS** with a suitable password.

17.4. OPENSTACK SERVICE CONFIGURATION FOR QPID

This section describes the typical Qpid configuration for OpenStack services:

```
[DEFAULT]
rpc_backend = nova.openstack.common.rpc.impl_qpid
qpid_protocol = ssl
qpid_hostname = <IP or hostname of management network interface of messaging server>
qpid_port = 5671
qpid_username = compute01
qpid_password = QPID_PASS
```



NOTE

Replace **QPID_PASS** with a suitable password.

Optionally, if using SASL with Qpid specify the SASL mechanisms in use by adding:

```
qpid_sasl_mechanisms = <space separated list of SASL mechanisms to use for auth>
```

17.5. MESSAGE QUEUE PROCESS ISOLATION AND POLICY

Each project provides a number of services which send and consume messages. Each binary which sends a message is expected to consume messages, if only replies, from the queue.

Message queue service processes should be isolated from each other and other processes on a machine.

17.6. NAMESPACES

Linux uses namespaces to assign processes into independent domains. Other parts of this guide cover system compartmentalization in more detail.

CHAPTER 18. SECURING ENDPOINTS IN RED HAT OPENSTACK PLATFORM

The process of engaging with an OpenStack cloud begins by querying an API endpoint. While there are different challenges for public and private endpoints, these are high value assets that can pose a significant risk if compromised.

This chapter recommends security enhancements for both public and private-facing API endpoints.

18.1. INTERNAL API COMMUNICATIONS

OpenStack provides both public-facing, internal admin, and private API endpoints. By default, OpenStack components use the publicly defined endpoints. The recommendation is to configure these components to use the API endpoint within the proper security domain. The internal admin endpoint allows further elevated access to keystone, so it might be desirable to further isolate this.

Services select their respective API endpoints based on the OpenStack service catalog. These services might not obey the listed public or internal API endpoint values. This can lead to internal management traffic being routed to external API endpoints.

18.2. CONFIGURE INTERNAL URLS IN THE IDENTITY SERVICE CATALOG

The Identity service catalog should be aware of your internal URLs. While this feature is not used by default, it may be available through configuration. In addition, it should be forward-compatible with expectant changes once this behavior becomes the default.

Consider isolating the configured endpoints from a network level, given that they have different levels of access. The Admin endpoint is intended for access by cloud administrators, as it provides elevated access to keystone operations not available on the internal or public endpoints. The internal endpoints are intended for uses internal to the cloud (for example, by OpenStack services), and usually would not be accessible outside of the deployment network. The public endpoints should be TLS-enabled, and the only API endpoints accessible outside of the deployment for cloud users to operate on.

Registration of an internal URL for an endpoint is automated by director. For more information, see https://github.com/openstack/tripleo-heat-templates/blob/a7857d6dfcc875eb2bc611dd9334104c18fe8ac6/network/endpoints/build_endpoint_map

18.3. CONFIGURE APPLICATIONS FOR INTERNAL URLS

You can force some services to use specific API endpoints. As a result, it is recommended that any OpenStack service that contacts the API of another service must be explicitly configured to access the proper internal API endpoint.

Each project might present an inconsistent way of defining target API endpoints. Future releases of OpenStack seek to resolve these inconsistencies through consistent use of the Identity service catalog.

18.4. PASTE AND MIDDLEWARE

Most API endpoints and other HTTP services in OpenStack use the Python Paste Deploy library. From a security perspective, this library enables manipulation of the request filter pipeline through the application's configuration. Each element in this chain is referred to as middleware. Changing the order of filters in the pipeline or adding additional middleware might have unpredictable security impact.

Commonly, implementers add middleware to extend OpenStack's base functionality. Consider giving careful consideration to the potential exposure introduced by the addition of non-standard software components to the HTTP request pipeline.

18.5. API ENDPOINT PROCESS ISOLATION AND POLICY

Isolate API endpoint processes, especially those that reside within the public security domain must be isolated as much as possible. Where deployments allow, API endpoints must be deployed on separate hosts for increased isolation.

18.5.1. Secure metadef APIs

In Red Hat OpenStack Platform (RHOSP), users can define key value pairs and tag metadata with metadata definition (metadef) APIs. Currently, there is no limit on the number of metadef namespaces, objects, properties, resources, or tags that users can create.

Metadef APIs can leak information to unauthorized users. A malicious user can exploit the lack of restrictions and fill the Image service (glance) database with unlimited resources, which can create a Denial of Service (DoS) style attack.

Image service policies control metadef APIs. However, the default policy setting for metadef APIs allows all users to create or read the metadef information. Because metadef resources are not isolated to the owner, metadef resources with potentially sensitive names, such as internal infrastructure details or customer names, can expose that information to malicious users.

18.5.2. Configuring a policy to restrict metadef APIs

To make the Image service (glance) more secure, restrict metadef modification APIs to admin-only access by default in your Red Hat OpenStack Platform (RHOSP) deployments.

Procedure

1. As a cloud administrator, create a separate heat template environment file, such as **lock-down-glance-metadef-api.yaml**, to contain policy overrides for the Image service metadef API:

```
...
parameter_defaults:
  GlanceApiPolicies: {
 glance-metadef_default: { key: 'metadef_default', value: '' },
 glance-metadef_admin: { key: 'metadef_admin', value: 'role:admin' },
 glance-get_metadef_namespace: { key: 'get_metadef_namespace', value:
'rule:metadef_default' },
 glance-get_metadef_namespaces: { key: 'get_metadef_namespaces', value:
'rule:metadef_default' },
 glance-modify_metadef_namespace: { key: 'modify_metadef_namespace', value:
'rule:metadef_admin' },
 glance-add_metadef_namespace: { key: 'add_metadef_namespace', value:
'rule:metadef_admin' },
 glance-delete_metadef_namespace: { key: 'delete_metadef_namespace', value:
'rule:metadef_admin' },
 glance-get_metadef_object: { key: 'get_metadef_object', value: 'rule:metadef_default' },
 glance-get_metadef_objects: { key: 'get_metadef_objects', value: 'rule:metadef_default' },
 glance-modify_metadef_object: { key: 'modify_metadef_object', value: 'rule:metadef_admin'
},
 glance-add_metadef_object: { key: 'add_metadef_object', value: 'rule:metadef_admin' },
```

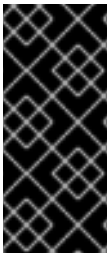
```
 glance-delete_metadef_object: { key: 'delete_metadef_object', value: 'rule:metadef_admin' },
 glance-list_metadef_resource_types: { key: 'list_metadef_resource_types', value:
'rule:metadef_default' },
 glance-get_metadef_resource_type: { key: 'get_metadef_resource_type', value:
'rule:metadef_default' },
 glance-add_metadef_resource_type_association: { key:
'add_metadef_resource_type_association', value: 'rule:metadef_admin' },
 glance-remove_metadef_resource_type_association: { key:
'remove_metadef_resource_type_association', value: 'rule:metadef_admin' },
 glance-get_metadef_property: { key: 'get_metadef_property', value: 'rule:metadef_default' },
 glance-get_metadef_properties: { key: 'get_metadef_properties', value: 'rule:metadef_default'
},
 glance-modify_metadef_property: { key: 'modify_metadef_property', value:
'rule:metadef_admin' },
 glance-add_metadef_property: { key: 'add_metadef_property', value: 'rule:metadef_admin' },
 glance-remove_metadef_property: { key: 'remove_metadef_property', value:
'rule:metadef_admin' },
 glance-get_metadef_tag: { key: 'get_metadef_tag', value: 'rule:metadef_default' },
 glance-get_metadef_tags: { key: 'get_metadef_tags', value: 'rule:metadef_default' },
 glance-modify_metadef_tag: { key: 'modify_metadef_tag', value: 'rule:metadef_admin' },
 glance-add_metadef_tag: { key: 'add_metadef_tag', value: 'rule:metadef_admin' },
 glance-add_metadef_tags: { key: 'add_metadef_tags', value: 'rule:metadef_admin' },
 glance-delete_metadef_tag: { key: 'delete_metadef_tag', value: 'rule:metadef_admin' },
 glance-delete_metadef_tags: { key: 'delete_metadef_tags', value: 'rule:metadef_admin' }
  }

...
```

2. Include the environment file that contains the policy overrides in the deployment command with the **-e** option when you deploy the overcloud:

```
$ openstack overcloud deploy -e lock-down-glance-metadef-api.yaml
```

18.5.3. Enabling metadef APIs

If you previously restricted metadata definition (metadef) APIs or want to relax the new defaults, you can override metadef modification policies to allow users to update their respective resources.



IMPORTANT

Cloud administrators with users who depend on write access to the metadef APIs can make those APIs accessible to all users. In this type of configuration, however, there is the potential to unintentionally leak sensitive resource names, such as customer names and internal projects. Administrators must audit their systems to identify previously created resources that might be vulnerable even if only read access is enabled for all users.

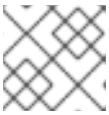
Procedure

1. As a cloud administrator, log in to the undercloud and create a file for policy overrides. For example:

```
$ cat open-up-glance-api-metadef.yaml
```

2. Configure the policy override file to allow metadef API read-write access to all users:

```
GlanceApiPolicies: {
    glance-metadef_default: { key: 'metadef_default', value: '' },
    glance-get_metadef_namespace: { key: 'get_metadef_namespace', value:
'rule:metadef_default' },
    glance-get_metadef_namespaces: { key: 'get_metadef_namespaces', value:
'rule:metadef_default' },
    glance-modify_metadef_namespace: { key: 'modify_metadef_namespace', value:
'rule:metadef_default' },
    glance-add_metadef_namespace: { key: 'add_metadef_namespace', value:
'rule:metadef_default' },
    glance-delete_metadef_namespace: { key: 'delete_metadef_namespace', value:
'rule:metadef_default' },
    glance-get_metadef_object: { key: 'get_metadef_object', value: 'rule:metadef_default' },
    glance-get_metadef_objects: { key: 'get_metadef_objects', value: 'rule:metadef_default' },
    glance-modify_metadef_object: { key: 'modify_metadef_object', value:
'rule:metadef_default' },
    glance-add_metadef_object: { key: 'add_metadef_object', value: 'rule:metadef_default' },
    glance-delete_metadef_object: { key: 'delete_metadef_object', value: 'rule:metadef_default'
},
    glance-list_metadef_resource_types: { key: 'list_metadef_resource_types', value:
'rule:metadef_default' },
    glance-get_metadef_resource_type: { key: 'get_metadef_resource_type', value:
'rule:metadef_default' },
    glance-add_metadef_resource_type_association: { key:
'add_metadef_resource_type_association', value: 'rule:metadef_default' },
    glance-remove_metadef_resource_type_association: { key:
'remove_metadef_resource_type_association', value: 'rule:metadef_default' },
    glance-get_metadef_property: { key: 'get_metadef_property', value: 'rule:metadef_default'
},
    glance-get_metadef_properties: { key: 'get_metadef_properties', value:
'rule:metadef_default' },
    glance-modify_metadef_property: { key: 'modify_metadef_property', value:
'rule:metadef_default' },
    glance-add_metadef_property: { key: 'add_metadef_property', value: 'rule:metadef_default'
},
    glance-remove_metadef_property: { key: 'remove_metadef_property', value:
'rule:metadef_default' },
    glance-get_metadef_tag: { key: 'get_metadef_tag', value: 'rule:metadef_default' },
    glance-get_metadef_tags: { key: 'get_metadef_tags', value: 'rule:metadef_default' },
    glance-modify_metadef_tag: { key: 'modify_metadef_tag', value: 'rule:metadef_default' },
    glance-add_metadef_tag: { key: 'add_metadef_tag', value: 'rule:metadef_default' },
    glance-add_metadef_tags: { key: 'add_metadef_tags', value: 'rule:metadef_default' },
    glance-delete_metadef_tag: { key: 'delete_metadef_tag', value: 'rule:metadef_default' },
    glance-delete_metadef_tags: { key: 'delete_metadef_tags', value: 'rule:metadef_default' }
  }
```



NOTE

You must configure all metadef policies to use **rule:metadeta_default**.

3. Include the new policy file in the deployment command with the **-e** option when you deploy the overcloud:

```
$ openstack overcloud deploy -e open-up-glance-api-metadef.yaml
```

18.6. CHANGING THE SSL/TLS CIPHER AND RULES FOR HAPROXY

If you enabled SSL/TLS in the overcloud, consider hardening the SSL/TLS ciphers and rules that are used with the HAProxy configuration. By hardening the SSL/TLS ciphers, you help avoid SSL/TLS vulnerabilities, such as the POODLE vulnerability.

1. Create a heat template environment file called **tls-ciphers.yaml**:

```
touch ~/templates/tls-ciphers.yaml
```

2. Use the **ExtraConfig** hook in the environment file to apply values to the **tripleo::haproxy::ssl_cipher_suite** and **tripleo::haproxy::ssl_options** hieradata:

```
parameter_defaults:
  ExtraConfig:
    tripleo::haproxy::ssl_cipher_suite: 'DHE-RSA-AES128-CCM:DHE-RSA-AES256-
CCM:DHE-RSA-AES128-GCM-SHA256:DHE-RSA-AES256-GCM-SHA384:ECDHE-ECDSA-
AES128-CCM:ECDHE-ECDSA-AES256-CCM:ECDHE-ECDSA-AES128-GCM-
SHA256:ECDHE-ECDSA-AES256-GCM-SHA384:ECDHE-ECDSA-CHACHA20-
POLY1305:ECDHE-ECDSA-CHACHA20-POLY1305:ECDHE-RSA-AES128-GCM-
SHA256:ECDHE-RSA-AES256-GCM-SHA384:ECDHE-RSA-CHACHA20-POLY1305'

    tripleo::haproxy::ssl_options: 'no-sslv3 no-tls-tickets'
```

NOTE

The cipher collection is one continuous line.

3. Include the **tls-ciphers.yaml** environment file with the overcloud deploy command when deploying the overcloud:

```
openstack overcloud deploy --templates \
...
-e /home/stack/templates/tls-ciphers.yaml
...
```

18.7. NETWORK POLICY

API endpoints will typically span multiple security zones, so you must pay particular attention to the separation of the API processes. For example, at the network design level, you can consider restricting access to specified systems only. See the guidance on security zones for more information.

With careful modeling, you can use network ACLs and IDS technologies to enforce explicit point-to-point communication between network services. As a critical cross domain service, this type of explicit enforcement works well for OpenStack's message queue service.

To enforce policies, you can configure services, host-based firewalls (such as iptables), local policy (SELinux), and optionally global network policy.

18.8. MANDATORY ACCESS CONTROLS

You should isolate API endpoint processes from each other and other processes on a machine. The configuration for those processes should be restricted to those processes by Discretionary Access

Controls (DAC) and Mandatory Access Controls (MAC). The goal of these enhanced access controls is to aid in the containment of API endpoint security breaches.

18.9. API ENDPOINT RATE-LIMITING

Rate Limiting is a means to control the frequency of events received by a network based application. When robust rate limiting is not present, it can result in an application being susceptible to various denial of service attacks. This is especially true for APIs, which by their nature are designed to accept a high frequency of similar request types and operations.

It is recommended that all endpoints (especially public) are give an extra layer of protection, for example, using physical network design, a rate-limiting proxy, or web application firewall.

It is key that the operator carefully plans and considers the individual performance needs of users and services within their OpenStack cloud when configuring and implementing any rate limiting functionality.

NOTE For Red Hat OpenStack Platform deployments, all services are placed behind load balancing proxies.

CHAPTER 19. IMPLEMENTING FEDERATION

WARNING

Red Hat does not support federation at this time. This feature should only be used for testing, and should not be deployed in a production environment.

19.1. FEDERATE WITH IDM USING RED HAT SINGLE SIGN-ON

You can use Red Hat Single Sign-On (RH-SSO) to federate your IdM users for OpenStack authentication (authN). Federation allows your IdM users to login to the OpenStack Dashboard without revealing their credentials to any OpenStack services. Instead, when Dashboard needs a user's credentials, it will forward the user to Red Hat Single Sign-On (RH-SSO) and allow them to enter their IdM credentials there. As a result, RH-SSO asserts back to Dashboard that the user has successfully authenticated, and Dashboard then allows the user to access the project.

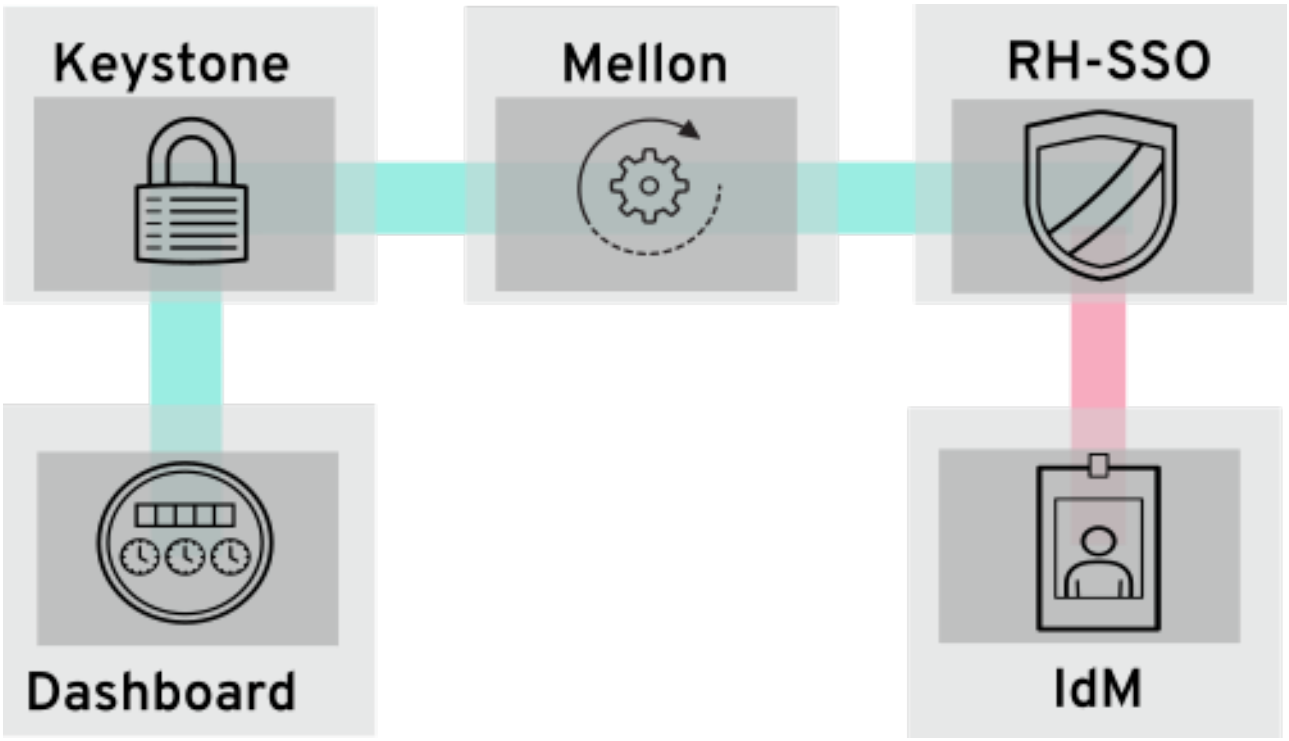
19.2. THE FEDERATION WORKFLOW

This section describes how the Identity service (keystone), RH-SSO and IdM interact with each other. Federation in OpenStack uses the concept of Identity Providers and Service Providers:

Identity Provider (IdP) - the service that stores the user accounts. In this case, the user accounts held in IdM, are presented to Keystone using RH-SSO.

Service Provider (SP) - the service that requires authentication from the users in the IdP. In this case, keystone is the service provider that grants Dashboard access to IdM users.

In the diagram below, keystone (the SP) communicates with RH-SSO (the IdP), which is also able to serve as a universal adapter for other IdPs. In this configuration, you can point keystone at RH-SSO, and RH-SSO will forward requests on to the Identity Providers that it supports (known as authentication modules), these currently include IdM and Active Directory. This is done by having the Service Provider (SP) and Identity Provider (IdP) exchange metadata, which each sysadmin then makes a decision to trust. The result is that the IdP can confidently make assertions, and the SP can then receive these assertions.



For more information, see the federation guide: https://access.redhat.com/documentation/en-us/red_hat_openstack_platform/16.1/html-single/federate_with_identity_service/