Red Hat OpenStack Platform 13

High Availability Deployment and Usage

Planning, deploying, and managing high availability in Red Hat OpenStack Platform

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Abstract

To keep your OpenStack environment up and running efficiently, use the Red Hat OpenStack Platform director to create configurations that offer high availability and load-balancing across all major services in OpenStack.

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MAKING OPEN SOURCE MORE INCLUSIVE

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

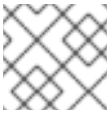
CHAPTER 1. HIGH AVAILABILITY SERVICES

Red Hat OpenStack Platform (RHOSP) employs several technologies to provide the services required to implement high availability (HA).

Service types

Core container

Core container services are *Galera*, *RabbitMQ*, *Redis*, and *HAProxy*. These services run on all Controller nodes and require specific management and constraints for the start, stop and restart actions. You use Pacemaker to launch, manage, and troubleshoot core container services.



NOTE

RHOSP uses the MariaDB Galera Cluster to manage database replication.

Active-passive

Active-passive services run on one Controller node at a time, and include services such as **openstack-cinder-volume**. To move an active-passive service, you must use Pacemaker to ensure that the correct stop-start sequence is followed.

Systemd and plain container

Systemd and plain container services are independent services that can withstand a service interruption. Therefore, if you restart a high availability service such as Galera, you do not need to manually restart any other service, such as **nova-api**. You can use systemd or Docker to directly manage systemd and plain container services.

When orchestrating your HA deployment with the director, the director uses templates and Puppet modules to ensure that all services are configured and launched correctly. In addition, when troubleshooting HA issues, you must interact with services in the HA framework using the **docker** command or the **systemctl** command.

Service modes

HA services can run in one of the following modes:

- **Active-active**: Pacemaker runs the same service on multiple Controller nodes, and uses HAProxy to distribute traffic across the nodes or to a specific Controller with a single IP address. In some cases, HAProxy distributes traffic to active-active services with Round Robin scheduling. You can add more Controller nodes to improve performance.

- **Active-passive**: Services that are unable to run in active-active mode must run in active-passive mode. In this mode, only one instance of the service is active at a time. For example, HAProxy uses stick-table options to direct incoming Galera database connection requests to a single back-end service. This helps prevent too many simultaneous connections to the same data from multiple Galera nodes.

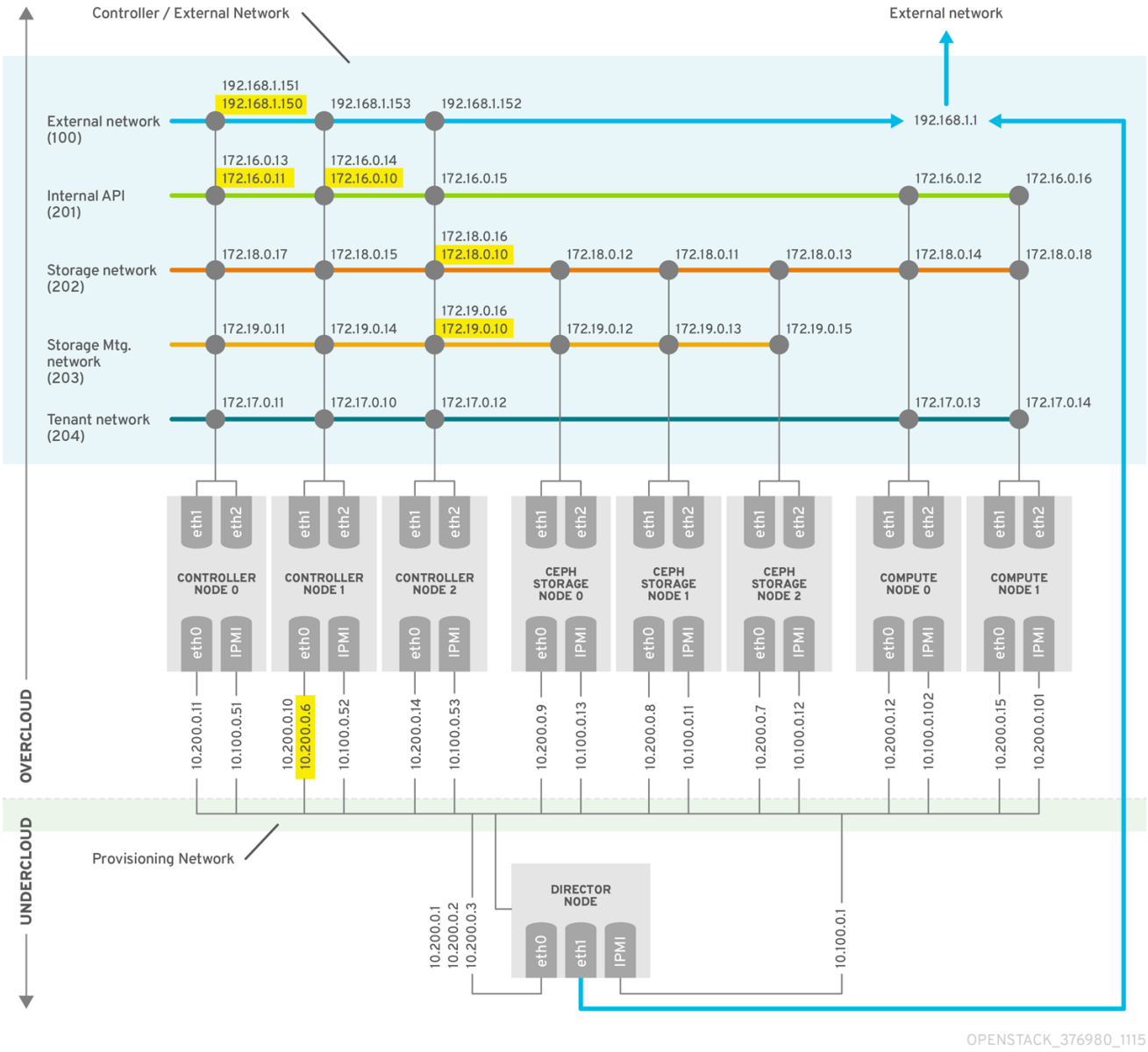
CHAPTER 2. EXAMPLE DEPLOYMENT: HIGH AVAILABILITY CLUSTER WITH COMPUTE AND CEPH

The following example scenario shows the architecture, hardware and network specifications, as well as the undercloud and overcloud configuration files for a high availability deployment with the OpenStack Compute service and Red Hat Ceph Storage.

IMPORTANT

This deployment is intended to use as a reference for test environments and is not supported for production environments.

Figure 2.1. Example high availability deployment architecture



For more information about deploying a Red Hat Ceph Storage cluster, see Deploying an Overcloud with Containerized Red Hat Ceph.

For more information about deploying Red Hat OpenStack Platform with director, see Director Installation and Usage.

2.1. HARDWARE SPECIFICATIONS

The following table shows the hardware used in the example deployment. You can adjust the CPU, memory, storage, or NICs as needed in your own test deployment.

Table 2.1. Physical computers

Number of Computers	Purpose	CPUs	Memory	Disk Space	Power Management	NICs
1	undercloud node	4	6144 MB	40 GB	IPMI	2 (1 external; 1 on provisioning) + 1 IPMI
3	Controller nodes	4	6144 MB	40 GB	IPMI	3 (2 bonded on overcloud; 1 on provisioning) + 1 IPMI
3	Ceph Storage nodes	4	6144 MB	40 GB	IPMI	3 (2 bonded on overcloud; 1 on provisioning) + 1 IPMI
2	Compute nodes (add more as needed)	4	6144 MB	40 GB	IPMI	3 (2 bonded on overcloud; 1 on provisioning) + 1 IPMI

Review the following guidelines when you plan hardware assignments:

Controller nodes

Most non-storage services run on Controller nodes. All services are replicated across the three nodes, and are configured as active-active or active-passive services. An HA environment requires a minimum of three nodes.

Red Hat Ceph Storage nodes

Storage services run on these nodes and provide pools of Red Hat Ceph Storage areas to the Compute nodes. A minimum of three nodes are required.

Compute nodes

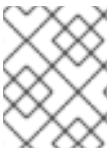
Virtual machine (VM) instances run on Compute nodes. You can deploy as many Compute nodes as you need to meet your capacity requirements, as well as migration and reboot operations. You must connect Compute nodes to the storage network and to the tenant network, to ensure that VMs can access the storage nodes, the VMs on other Compute nodes, and the public networks.

STONITH

You must configure a STONITH device for each node that is a part of the Pacemaker cluster in a highly available overcloud. Deploying a highly available overcloud without STONITH is not supported. For more information on STONITH and Pacemaker, see Fencing in a Red Hat High Availability Cluster and Support Policies for RHEL High Availability Clusters .

2.2. NETWORK SPECIFICATIONS

The following table shows the network configuration used in the example deployment.



NOTE

This example does not include hardware redundancy for the control plane and the provisioning network where the overcloud keystone admin endpoint is configured.

Table 2.2. Physical and virtual networks

Physical NICs	Purpose	VLANs	Description
eth0	Provisioning network (undercloud)	N/A	Manages all nodes from director (undercloud)
eth1 and eth2	Controller/External (overcloud)	N/A	Bonded NICs with VLANs
	External network	VLAN 100	Allows access from outside the environment to the tenant networks, internal API, and OpenStack Horizon Dashboard
	Internal API	VLAN 201	Provides access to the internal API between Compute nodes and Controller nodes
	Storage access	VLAN 202	Connects Compute nodes to storage media
	Storage management	VLAN 203	Manages storage media
	Tenant network	VLAN 204	Provides tenant network services to RHOSP

In addition to the network configuration, you must deploy the following components:

Provisioning network switch

- This switch must be able to connect the undercloud to all the physical computers in the overcloud.

- The NIC on each overcloud node that is connected to this switch must be able to PXE boot from the undercloud.
- The **portfast** parameter must be enabled.

Controller/External network switch

- This switch must be configured to perform VLAN tagging for the other VLANs in the deployment.
- Allow only VLAN 100 traffic to external networks.

Networking hardware and keystone endpoint

- To prevent a Controller node network card or network switch failure disrupting overcloud services availability, ensure that the keystone admin endpoint is located on a network that uses bonded network cards or networking hardware redundancy.
  If you move the keystone endpoint to a different network, such as **internal_api**, ensure that the undercloud can reach the VLAN or subnet. For more information, see the Red Hat Knowledgebase solution How to migrate Keystone Admin Endpoint to internal_api network .

2.3. UNDERCLOUD CONFIGURATION FILES

The example deployment uses the following undercloud configuration files.

instackenv.json

```
{
    "nodes": [
      {
        "pm_password": "testpass",
        "memory": "6144",
        "pm_addr": "10.100.0.11",
        "mac": [
          "2c:c2:60:3b:b3:94"
        ],
        "pm_type": "pxe_ipmitool",
        "disk": "40",
        "arch": "x86_64",
        "cpu": "1",
        "pm_user": "admin"
      },
      {
        "pm_password": "testpass",
        "memory": "6144",
        "pm_addr": "10.100.0.12",
        "mac": [
          "2c:c2:60:51:b7:fb"
        ],
        "pm_type": "pxe_ipmitool",
        "disk": "40",
        "arch": "x86_64",
        "cpu": "1",
        "pm_user": "admin"
```

```
},
{
  "pm_password": "testpass",
  "memory": "6144",
  "pm_addr": "10.100.0.13",
  "mac": [
    "2c:c2:60:76:ce:a5"
  ],
  "pm_type": "pxe_ipmitool",
  "disk": "40",
  "arch": "x86_64",
  "cpu": "1",
  "pm_user": "admin"
},
{
  "pm_password": "testpass",
  "memory": "6144",
  "pm_addr": "10.100.0.51",
  "mac": [
    "2c:c2:60:08:b1:e2"
  ],
  "pm_type": "pxe_ipmitool",
  "disk": "40",
  "arch": "x86_64",
  "cpu": "1",
  "pm_user": "admin"
},
{
  "pm_password": "testpass",
  "memory": "6144",
  "pm_addr": "10.100.0.52",
  "mac": [
    "2c:c2:60:20:a1:9e"
  ],
  "pm_type": "pxe_ipmitool",
  "disk": "40",
  "arch": "x86_64",
  "cpu": "1",
  "pm_user": "admin"
},
{
  "pm_password": "testpass",
  "memory": "6144",
  "pm_addr": "10.100.0.53",
  "mac": [
    "2c:c2:60:58:10:33"
  ],
  "pm_type": "pxe_ipmitool",
  "disk": "40",
  "arch": "x86_64",
  "cpu": "1",
  "pm_user": "admin"
},
{
  "pm_password": "testpass",
  "memory": "6144",
```

```
          "pm_addr": "10.100.0.101",
          "mac": [
            "2c:c2:60:31:a9:55"
          ],
          "pm_type": "pxe_ipmitool",
          "disk": "40",
          "arch": "x86_64",
          "cpu": "2",
          "pm_user": "admin"
        },
        {
          "pm_password": "testpass",
          "memory": "6144",
          "pm_addr": "10.100.0.102",
          "mac": [
            "2c:c2:60:0d:e7:d1"
          ],
          "pm_type": "pxe_ipmitool",
          "disk": "40",
          "arch": "x86_64",
          "cpu": "2",
          "pm_user": "admin"
        }
      ],
      "overcloud": {"password": "7adbbbeedc5b7a07ba1917e1b3b228334f9a2d4e",
      "endpoint": "http://192.168.1.150:5000/v2.0/"
                  }
}
```

undercloud.conf

```
[DEFAULT]
image_path = /home/stack/images
local_ip = 10.200.0.1/24
undercloud_public_vip = 10.200.0.2
undercloud_admin_vip = 10.200.0.3
undercloud_service_certificate = /etc/pki/instack-certs/undercloud.pem
local_interface = eth0
masquerade_network = 10.200.0.0/24
dhcp_start = 10.200.0.5
dhcp_end = 10.200.0.24
network_cidr = 10.200.0.0/24
network_gateway = 10.200.0.1
#discovery_interface = br-ctlplane
discovery_iprange = 10.200.0.150,10.200.0.200
discovery_runbench = 1
undercloud_admin_password = testpass
...
```

network-environment.yaml

```
resource_registry:
  OS::TripleO::BlockStorage::Net::SoftwareConfig: /home/stack/templates/nic-configs/cinder-
storage.yaml
  OS::TripleO::Compute::Net::SoftwareConfig: /home/stack/templates/nic-configs/compute.yaml
```

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

parameter_defaults:
  InternalApiNetCidr: 172.16.0.0/24
  TenantNetCidr: 172.17.0.0/24
  StorageNetCidr: 172.18.0.0/24
  StorageMgmtNetCidr: 172.19.0.0/24
  ExternalNetCidr: 192.168.1.0/24
  InternalApiAllocationPools: [{'start': '172.16.0.10', 'end': '172.16.0.200'}]
  TenantAllocationPools: [{'start': '172.17.0.10', 'end': '172.17.0.200'}]
  StorageAllocationPools: [{'start': '172.18.0.10', 'end': '172.18.0.200'}]
  StorageMgmtAllocationPools: [{'start': '172.19.0.10', 'end': '172.19.0.200'}]
  # Leave room for floating IPs in the External allocation pool
  ExternalAllocationPools: [{'start': '192.168.1.150', 'end': '192.168.1.199'}]
  InternalApiNetworkVlanID: 201
  StorageNetworkVlanID: 202
  StorageMgmtNetworkVlanID: 203
  TenantNetworkVlanID: 204
  ExternalNetworkVlanID: 100
  # Set to the router gateway on the external network
  ExternalInterfaceDefaultRoute: 192.168.1.1
  # Set to "br-ex" if using floating IPs on native VLAN on bridge br-ex
  NeutronExternalNetworkBridge: """"
  # Customize bonding options if required
  BondInterfaceOvsOptions:
    "bond_mode=active-backup lacp=off other_config:bond-miimon-interval=100"
```

2.4. OVERCLOUD CONFIGURATION FILES

The example deployment uses the following overcloud configuration files.

/var/lib/config-data/haproxy/etc/haproxy/haproxy.cfg (Controller nodes)

This file identifies the services that HAProxy manages. It contains the settings for the services that HAProxy monitors. This file is identical on all Controller nodes.

```
# This file is managed by Puppet
global
  daemon
  group  haproxy
  log  /dev/log local0
  maxconn  20480
  pidfile  /var/run/haproxy.pid
  ssl-default-bind-ciphers
!SSLv2:kEECDH:kRSA:kEDH:kPSK:+3DES:!aNULL:!eNULL:!MD5:!EXP:!RC4:!SEED:!IDEA:!DES
  ssl-default-bind-options  no-sslv3
  stats  socket /var/lib/haproxy/stats mode 600 level user
  stats  timeout 2m
  user  haproxy

defaults
```

```
  log  global
  maxconn  4096
  mode  tcp
  retries  3
  timeout  http-request 10s
  timeout  queue 2m
  timeout  connect 10s
  timeout  client 2m
  timeout  server 2m
  timeout  check 10s

listen aodh
  bind 192.168.1.150:8042 transparent
  bind 172.16.0.10:8042 transparent
  mode http
  http-request set-header X-Forwarded-Proto https if { ssl_fc }
  http-request set-header X-Forwarded-Proto http if !{ ssl_fc }
  option httpchk
  server overcloud-controller-0.internalapi.localdomain 172.16.0.13:8042 check fall 5 inter 2000 rise 2
  server overcloud-controller-1.internalapi.localdomain 172.16.0.14:8042 check fall 5 inter 2000 rise 2
  server overcloud-controller-2.internalapi.localdomain 172.16.0.15:8042 check fall 5 inter 2000 rise 2

listen cinder
  bind 192.168.1.150:8776 transparent
  bind 172.16.0.10:8776 transparent
  mode http
  http-request set-header X-Forwarded-Proto https if { ssl_fc }
  http-request set-header X-Forwarded-Proto http if !{ ssl_fc }
  option httpchk
  server overcloud-controller-0.internalapi.localdomain 172.16.0.13:8776 check fall 5 inter 2000 rise 2
  server overcloud-controller-1.internalapi.localdomain 172.16.0.14:8776 check fall 5 inter 2000 rise 2
  server overcloud-controller-2.internalapi.localdomain 172.16.0.15:8776 check fall 5 inter 2000 rise 2

listen glance_api
  bind 192.168.1.150:9292 transparent
  bind 172.18.0.10:9292 transparent
  mode http
  http-request set-header X-Forwarded-Proto https if { ssl_fc }
  http-request set-header X-Forwarded-Proto http if !{ ssl_fc }
  option httpchk GET /healthcheck
  server overcloud-controller-0.internalapi.localdomain 172.18.0.17:9292 check fall 5 inter 2000 rise 2
  server overcloud-controller-1.internalapi.localdomain 172.18.0.15:9292 check fall 5 inter 2000 rise 2
  server overcloud-controller-2.internalapi.localdomain 172.18.0.16:9292 check fall 5 inter 2000 rise 2

listen gnocchi
  bind 192.168.1.150:8041 transparent
  bind 172.16.0.10:8041 transparent
  mode http
  http-request set-header X-Forwarded-Proto https if { ssl_fc }
  http-request set-header X-Forwarded-Proto http if !{ ssl_fc }
  option httpchk
  server overcloud-controller-0.internalapi.localdomain 172.16.0.13:8041 check fall 5 inter 2000 rise 2
  server overcloud-controller-1.internalapi.localdomain 172.16.0.14:8041 check fall 5 inter 2000 rise 2
  server overcloud-controller-2.internalapi.localdomain 172.16.0.15:8041 check fall 5 inter 2000 rise 2

listen haproxy.stats
```

```
  bind 10.200.0.6:1993 transparent
  mode http
  stats enable
  stats uri /
  stats auth admin:PnDD32EzdVCf73CpjHhFGHZdV

listen heat_api
  bind 192.168.1.150:8004 transparent
  bind 172.16.0.10:8004 transparent
  mode http
  http-request set-header X-Forwarded-Proto https if { ssl_fc }
  http-request set-header X-Forwarded-Proto http if !{ ssl_fc }
  option httpchk
  timeout client 10m
  timeout server 10m
  server overcloud-controller-0.internalapi.localdomain 172.16.0.13:8004 check fall 5 inter 2000 rise 2
  server overcloud-controller-1.internalapi.localdomain 172.16.0.14:8004 check fall 5 inter 2000 rise 2
  server overcloud-controller-2.internalapi.localdomain 172.16.0.15:8004 check fall 5 inter 2000 rise 2

listen heat_cfn
  bind 192.168.1.150:8000 transparent
  bind 172.16.0.10:8000 transparent
  mode http
  http-request set-header X-Forwarded-Proto https if { ssl_fc }
  http-request set-header X-Forwarded-Proto http if !{ ssl_fc }
  option httpchk
  timeout client 10m
  timeout server 10m
  server overcloud-controller-0.internalapi.localdomain 172.16.0.13:8000 check fall 5 inter 2000 rise 2
  server overcloud-controller-1.internalapi.localdomain 172.16.0.14:8000 check fall 5 inter 2000 rise 2
  server overcloud-controller-2.internalapi.localdomain 172.16.0.15:8000 check fall 5 inter 2000 rise 2

listen horizon
  bind 192.168.1.150:80 transparent
  bind 172.16.0.10:80 transparent
  mode http
  cookie SERVERID insert indirect nocache
  option forwardfor
  option httpchk
  server overcloud-controller-0.internalapi.localdomain 172.16.0.13:80 check cookie overcloud-
controller-0 fall 5 inter 2000 rise 2
  server overcloud-controller-1.internalapi.localdomain 172.16.0.14:80 check cookie overcloud-
controller-0 fall 5 inter 2000 rise 2
  server overcloud-controller-2.internalapi.localdomain 172.16.0.15:80 check cookie overcloud-
controller-0 fall 5 inter 2000 rise 2

listen keystone_admin
  bind 192.168.24.15:35357 transparent
  mode http
  http-request set-header X-Forwarded-Proto https if { ssl_fc }
  http-request set-header X-Forwarded-Proto http if !{ ssl_fc }
  option httpchk GET /v3
  server overcloud-controller-0.ctlplane.localdomain 192.168.24.9:35357 check fall 5 inter 2000 rise 2
  server overcloud-controller-1.ctlplane.localdomain 192.168.24.8:35357 check fall 5 inter 2000 rise 2
  server overcloud-controller-2.ctlplane.localdomain 192.168.24.18:35357 check fall 5 inter 2000 rise
2
```

```
listen keystone_public
  bind 192.168.1.150:5000 transparent
  bind 172.16.0.10:5000 transparent
  mode http
  http-request set-header X-Forwarded-Proto https if { ssl_fc }
  http-request set-header X-Forwarded-Proto http if !{ ssl_fc }
  option httpchk GET /v3
  server overcloud-controller-0.internalapi.localdomain 172.16.0.13:5000 check fall 5 inter 2000 rise 2
  server overcloud-controller-1.internalapi.localdomain 172.16.0.14:5000 check fall 5 inter 2000 rise 2
  server overcloud-controller-2.internalapi.localdomain 172.16.0.15:5000 check fall 5 inter 2000 rise 2

listen mysql
  bind 172.16.0.10:3306 transparent
  option tcpka
  option httpchk
  stick on dst
  stick-table type ip size 1000
  timeout client 90m
  timeout server 90m
  server overcloud-controller-0.internalapi.localdomain 172.16.0.13:3306 backup check inter 1s on-
marked-down shutdown-sessions port 9200
  server overcloud-controller-1.internalapi.localdomain 172.16.0.14:3306 backup check inter 1s on-
marked-down shutdown-sessions port 9200
  server overcloud-controller-2.internalapi.localdomain 172.16.0.15:3306 backup check inter 1s on-
marked-down shutdown-sessions port 9200

listen neutron
  bind 192.168.1.150:9696 transparent
  bind 172.16.0.10:9696 transparent
  mode http
  http-request set-header X-Forwarded-Proto https if { ssl_fc }
  http-request set-header X-Forwarded-Proto http if !{ ssl_fc }
  option httpchk
  server overcloud-controller-0.internalapi.localdomain 172.16.0.13:9696 check fall 5 inter 2000 rise 2
  server overcloud-controller-1.internalapi.localdomain 172.16.0.14:9696 check fall 5 inter 2000 rise 2
  server overcloud-controller-2.internalapi.localdomain 172.16.0.15:9696 check fall 5 inter 2000 rise 2

listen nova_metadata
  bind 172.16.0.10:8775 transparent
  option httpchk
  server overcloud-controller-0.internalapi.localdomain 172.16.0.13:8775 check fall 5 inter 2000 rise 2
  server overcloud-controller-1.internalapi.localdomain 172.16.0.14:8775 check fall 5 inter 2000 rise 2
  server overcloud-controller-2.internalapi.localdomain 172.16.0.15:8775 check fall 5 inter 2000 rise 2

listen nova_novncproxy
  bind 192.168.1.150:6080 transparent
  bind 172.16.0.10:6080 transparent
  balance source
  http-request set-header X-Forwarded-Proto https if { ssl_fc }
  http-request set-header X-Forwarded-Proto http if !{ ssl_fc }
  option tcpka
  timeout tunnel 1h
  server overcloud-controller-0.internalapi.localdomain 172.16.0.13:6080 check fall 5 inter 2000 rise 2
  server overcloud-controller-1.internalapi.localdomain 172.16.0.14:6080 check fall 5 inter 2000 rise 2
  server overcloud-controller-2.internalapi.localdomain 172.16.0.15:6080 check fall 5 inter 2000 rise 2
```

```
listen nova_osapi
  bind 192.168.1.150:8774 transparent
  bind 172.16.0.10:8774 transparent
  mode http
  http-request set-header X-Forwarded-Proto https if { ssl_fc }
  http-request set-header X-Forwarded-Proto http if !{ ssl_fc }
  option httpchk
  server overcloud-controller-0.internalapi.localdomain 172.16.0.13:8774 check fall 5 inter 2000 rise 2
  server overcloud-controller-1.internalapi.localdomain 172.16.0.14:8774 check fall 5 inter 2000 rise 2
  server overcloud-controller-2.internalapi.localdomain 172.16.0.15:8774 check fall 5 inter 2000 rise 2

listen nova_placement
  bind 192.168.1.150:8778 transparent
  bind 172.16.0.10:8778 transparent
  mode http
  http-request set-header X-Forwarded-Proto https if { ssl_fc }
  http-request set-header X-Forwarded-Proto http if !{ ssl_fc }
  option httpchk
  server overcloud-controller-0.internalapi.localdomain 172.16.0.13:8778 check fall 5 inter 2000 rise 2
  server overcloud-controller-1.internalapi.localdomain 172.16.0.14:8778 check fall 5 inter 2000 rise 2
  server overcloud-controller-2.internalapi.localdomain 172.16.0.15:8778 check fall 5 inter 2000 rise 2

listen panko
  bind 192.168.1.150:8977 transparent
  bind 172.16.0.10:8977 transparent
  http-request set-header X-Forwarded-Proto https if { ssl_fc }
  http-request set-header X-Forwarded-Proto http if !{ ssl_fc }
  option httpchk
  server overcloud-controller-0.internalapi.localdomain 172.16.0.13:8977 check fall 5 inter 2000 rise 2
  server overcloud-controller-1.internalapi.localdomain 172.16.0.14:8977 check fall 5 inter 2000 rise 2
  server overcloud-controller-2.internalapi.localdomain 172.16.0.15:8977 check fall 5 inter 2000 rise 2

listen redis
  bind 172.16.0.13:6379 transparent
  balance first
  option tcp-check
  tcp-check send AUTH\ V2EgUh2pvkr8VzU6yuE4XHsr9\r\n
  tcp-check send PING\r\n
  tcp-check expect string +PONG
  tcp-check send info\ replication\r\n
  tcp-check expect string role:master
  tcp-check send QUIT\r\n
  tcp-check expect string +OK
  server overcloud-controller-0.internalapi.localdomain 172.16.0.13:6379 check fall 5 inter 2000 rise 2
  server overcloud-controller-1.internalapi.localdomain 172.16.0.14:6379 check fall 5 inter 2000 rise 2
  server overcloud-controller-2.internalapi.localdomain 172.16.0.15:6379 check fall 5 inter 2000 rise 2

listen swift_proxy_server
  bind 192.168.1.150:8080 transparent
  bind 172.18.0.10:8080 transparent
  option httpchk GET /healthcheck
  timeout client 2m
  timeout server 2m
```

```
  server overcloud-controller-0.storage.localdomain 172.18.0.17:8080 check fall 5 inter 2000 rise 2
  server overcloud-controller-1.storage.localdomain 172.18.0.15:8080 check fall 5 inter 2000 rise 2
  server overcloud-controller-2.storage.localdomain 172.18.0.16:8080 check fall 5 inter 2000 rise 2
```

/etc/corosync/corosync.conf file (Controller nodes)

This file defines the cluster infrastructure, and is available on all Controller nodes.

```
totem {
 version: 2
 cluster_name: tripleo_cluster
 transport: udpu
 token: 10000
}


nodelist {
   node {
      ring0_addr: overcloud-controller-0
      nodeid: 1
   }


   node {
      ring0_addr: overcloud-controller-1
      nodeid: 2
   }


   node {
      ring0_addr: overcloud-controller-2
      nodeid: 3
   }
}

quorum {
   provider: corosync_votequorum
}

logging {
    to_logfile: yes
   logfile: /var/log/cluster/corosync.log
   to_syslog: yes
}
```

/etc/ceph/ceph.conf (Ceph nodes)

This file contains Ceph high availability settings, including the hostnames and IP addresses of the monitoring hosts.

```
[global]
osd_pool_default_pgp_num = 128
osd_pool_default_min_size = 1
auth_service_required = cephx
mon_initial_members = overcloud-controller-0,overcloud-controller-1,overcloud-controller-2
fsid = 8c835acc-6838-11e5-bb96-2cc260178a92
```

```
cluster_network = 172.19.0.11/24
auth_supported = cephx
auth_cluster_required = cephx
mon_host = 172.18.0.17,172.18.0.15,172.18.0.16
auth_client_required = cephx
osd_pool_default_size = 3
osd_pool_default_pg_num = 128
public_network = 172.18.0.17/24
```

CHAPTER 3. ACCESSING THE HIGH AVAILABILITY ENVIRONMENT

You can access and investigate specific HA nodes from the undercloud.

Procedure

1. In a running HA environment, log in to the undercloud.
2. Change to the **stack** user:

```
# sudo su - stack
```

3. To access and investigate an undercloud node, get the IP address of the node from the undercloud:

```
(undercloud) $ source ~/stackrc
(undercloud) $ openstack server list
 +-------+-----------------------+---+---------------------+---+
 | ID    | Name                  |...| Networks            |...|
 +-------+-----------------------+---+---------------------+---+
 | d1... | overcloud-controller-0 |...| ctlplane=*10.200.0.11* |...|
 ...
```

4. To log in to one of the overcloud nodes, run the following commands:

```
(undercloud) $ source ~/overcloudrc
(overcloud) $ ssh [NODE_NAME]@[NODE_IP]
```

Replace the name and IP address with the actual values from your deployment.

CHAPTER 4. MANAGING HIGH AVAILABILITY SERVICES WITH PACEMAKER

The Pacemaker service manages core container and active-passive services, such as Galera, RabbitMQ, Redis, and HAProxy. You use Pacemaker to view and manage general information about the managed services, virtual IP addresses, power management, and fencing.

For more information about Pacemaker in Red Hat Enterprise Linux, see Configuring and Managing High Availability Clusters in the Red Hat Enterprise Linux documentation.

4.1. RESOURCE BUNDLES AND CONTAINERS

Pacemaker manages Red Hat OpenStack Platform (RHOSP) services as *Bundle Set resources*, or *bundles*. Most of these services are active-active services that start in the same way and always run on each Controller node.

Pacemaker manages the following resource types:

Bundle

A bundle resource configures and replicates the same container on all Controller nodes, maps the necessary storage paths to the container directories, and sets specific attributes related to the resource itself.

Container

A container can run different kinds of resources, from simple **systemd** services like HAProxy to complex services like Galera, which requires specific resource agents that control and set the state of the service on the different nodes.

IMPORTANT

- You cannot use **docker** or **systemctl** to manage bundles or containers. You can use the commands to check the status of the services, but you must use Pacemaker to perform actions on these services.
- Docker containers that Pacemaker controls have a **RestartPolicy** set to **no** by Docker. This is to ensure that Pacemaker, and not Docker, controls the container start and stop actions.

Simple Bundle Set resources (simple bundles)

A simple Bundle Set resource, or *simple bundle*, is a set of containers that each include the same Pacemaker services that you want to deploy across the Controller nodes.

The following example shows a list of simple bundles from the output of the **pcs status** command:

```
Docker container set: haproxy-bundle [192.168.24.1:8787/rhosp-rhel7/openstack-
haproxy:pcmklatest]
  haproxy-bundle-docker-0    (ocf::heartbeat:docker):    Started overcloud-controller-0
  haproxy-bundle-docker-1    (ocf::heartbeat:docker):    Started overcloud-controller-1
  haproxy-bundle-docker-2    (ocf::heartbeat:docker):    Started overcloud-controller-2
```

For each bundle, you can see the following details:

- The name that Pacemaker assigns to the service.

- The reference to the container that is associated with the bundle.
- The list and status of replicas that are running on the different Controller nodes.

The following example shows the settings for the **haproxy-bundle** simple bundle:

```
$ sudo pcs resource show haproxy-bundle
Bundle: haproxy-bundle
 Docker: image=192.168.24.1:8787/rhosp-rhel7/openstack-haproxy:pcmklatest network=host
options="--user=root --log-driver=journald -e KOLLA_CONFIG_STRATEGY=COPY_ALWAYS"
replicas=3 run-command="/bin/bash /usr/local/bin/kolla_start"
 Storage Mapping:
  options=ro source-dir=/var/lib/kolla/config_files/haproxy.json target-
dir=/var/lib/kolla/config_files/config.json (haproxy-cfg-files)
  options=ro source-dir=/var/lib/config-data/puppet-generated/haproxy/ target-
dir=/var/lib/kolla/config_files/src (haproxy-cfg-data)
  options=ro source-dir=/etc/hosts target-dir=/etc/hosts (haproxy-hosts)
  options=ro source-dir=/etc/localtime target-dir=/etc/localtime (haproxy-localtime)
  options=ro source-dir=/etc/pki/ca-trust/extracted target-dir=/etc/pki/ca-trust/extracted (haproxy-pki-
extracted)
  options=ro source-dir=/etc/pki/tls/certs/ca-bundle.crt target-dir=/etc/pki/tls/certs/ca-bundle.crt
(haproxy-pki-ca-bundle-crt)
  options=ro source-dir=/etc/pki/tls/certs/ca-bundle.trust.crt target-dir=/etc/pki/tls/certs/ca-
bundle.trust.crt (haproxy-pki-ca-bundle-trust-crt)
  options=ro source-dir=/etc/pki/tls/cert.pem target-dir=/etc/pki/tls/cert.pem (haproxy-pki-cert)
  options=rw source-dir=/dev/log target-dir=/dev/log (haproxy-dev-log)
```

The example shows the following information about the containers in the bundle:

- **image**: Image used by the container, which refers to the local registry of the undercloud.
- **network**: Container network type, which is **"host"** in the example.
- **options**: Specific options for the container.
- **replicas**: Indicates how many copies of the container must run in the cluster. Each bundle includes three containers, one for each Controller node.
- **run-command**: System command used to spawn the container.
- **Storage Mapping**: Mapping of the local path on each host to the container. To check the **haproxy** configuration from the host, open the **/var/lib/config-data/puppet-generated/haproxy/etc/haproxy/haproxy.cfg** file instead of the **/etc/haproxy/haproxy.cfg** file.

NOTE

Although HAProxy provides high availability services by load balancing traffic to selected services, you configure HAProxy as a highly available service by managing it as a Pacemaker bundle service.

Complex Bundle Set resources (complex bundles)

Complex Bundle Set resources, or *complex bundles*, are Pacemaker services that specify a resource configuration in addition to the basic container configuration that is included in simple bundles.

This configuration is needed to manage *Multi-State* resources, which are services that can have different states depending on the Controller node they run on.

This example shows a list of complex bundles from the output of the **pcs status** command:

```
Docker container set: rabbitmq-bundle [192.168.24.1:8787/rhosp-rhel7/openstack-
rabbitmq:pcmklatest]
  rabbitmq-bundle-0    (ocf::heartbeat:rabbitmq-cluster):      Started overcloud-controller-0
  rabbitmq-bundle-1    (ocf::heartbeat:rabbitmq-cluster):      Started overcloud-controller-1
  rabbitmq-bundle-2    (ocf::heartbeat:rabbitmq-cluster):      Started overcloud-controller-2
Docker container set: galera-bundle [192.168.24.1:8787/rhosp-rhel7/openstack-mariadb:pcmklatest]
  galera-bundle-0      (ocf::heartbeat:galera):        Master overcloud-controller-0
  galera-bundle-1      (ocf::heartbeat:galera):        Master overcloud-controller-1
  galera-bundle-2      (ocf::heartbeat:galera):        Master overcloud-controller-2
Docker container set: redis-bundle [192.168.24.1:8787/rhosp-rhel7/openstack-redis:pcmklatest]
  redis-bundle-0       (ocf::heartbeat:redis): Master overcloud-controller-0
  redis-bundle-1       (ocf::heartbeat:redis): Slave overcloud-controller-1
  redis-bundle-2       (ocf::heartbeat:redis): Slave overcloud-controller-2
```

This output shows the following information about each complex bundle:

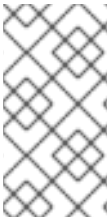
- RabbitMQ: All three Controller nodes run a standalone instance of the service, similar to a simple bundle.
- Galera: All three Controller nodes are running as Galera masters under the same constraints.
- Redis: The **overcloud-controller-0** container is running as the master, while the other two Controller nodes are running as slaves. Each container type might run under different constraints.

The following example shows the settings for the **galera-bundle** complex bundle:

```
[...]
Bundle: galera-bundle
 Docker: image=192.168.24.1:8787/rhosp-rhel7/openstack-mariadb:pcmklatest masters=3
network=host options="--user=root --log-driver=journald -e
KOLLA_CONFIG_STRATEGY=COPY_ALWAYS" replicas=3 run-command="/bin/bash
/usr/local/bin/kolla_start"
 Network: control-port=3123
 Storage Mapping:
  options=ro source-dir=/var/lib/kolla/config_files/mysql.json target-
dir=/var/lib/kolla/config_files/config.json (mysql-cfg-files)
  options=ro source-dir=/var/lib/config-data/puppet-generated/mysql/ target-
dir=/var/lib/kolla/config_files/src (mysql-cfg-data)
  options=ro source-dir=/etc/hosts target-dir=/etc/hosts (mysql-hosts)
  options=ro source-dir=/etc/localtime target-dir=/etc/localtime (mysql-localtime)
  options=rw source-dir=/var/lib/mysql target-dir=/var/lib/mysql (mysql-lib)
  options=rw source-dir=/var/log/mariadb target-dir=/var/log/mariadb (mysql-log-mariadb)
  options=rw source-dir=/dev/log target-dir=/dev/log (mysql-dev-log)
 Resource: galera (class=ocf provider=heartbeat type=galera)
  Attributes: additional_parameters=--open-files-limit=16384 cluster_host_map=overcloud-controller-
0:overcloud-controller-0.internalapi.localdomain;overcloud-controller-1:overcloud-controller-
1.internalapi.localdomain;overcloud-controller-2:overcloud-controller-2.internalapi.localdomain
enable_creation=true wsrep_cluster_address=gcomm://overcloud-controller-
0.internalapi.localdomain,overcloud-controller-1.internalapi.localdomain,overcloud-controller-
2.internalapi.localdomain
```

```
 Meta Attrs: container-attribute-target=host master-max=3 ordered=true
 Operations: demote interval=0s timeout=120 (galera-demote-interval-0s)
             monitor interval=20 timeout=30 (galera-monitor-interval-20)
             monitor interval=10 role=Master timeout=30 (galera-monitor-interval-10)
             monitor interval=30 role=Slave timeout=30 (galera-monitor-interval-30)
             promote interval=0s on-fail=block timeout=300s (galera-promote-interval-0s)
             start interval=0s timeout=120 (galera-start-interval-0s)
             stop interval=0s timeout=120 (galera-stop-interval-0s)
[...]
```

This output shows that, unlike in a simple bundle, the **galera-bundle** resource includes explicit resource configuration that determines all aspects of the multi-state resource.



NOTE

Although a service can run on multiple Controller nodes at the same time, the Controller node itself might not be listening at the IP address that is required to reach those services. For information about how to check the IP address of a service, see Section 4.4, "Viewing virtual IP addresses".

4.2. VIEWING GENERAL PACEMAKER INFORMATION

To view general Pacemaker information, use the **pcs status** command.

Procedure

1. Log in to any Controller node as the **heat-admin** user.

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

2. Run the **pcs status** command:

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

Example output:

```
Cluster name: tripleo_cluster
Stack: corosync
Current DC: overcloud-controller-1 (version 1.1.16-12.el7_4.5-94ff4df) - partition with quorum

Last updated: Thu Feb  8 14:29:21 2018
Last change: Sat Feb  3 11:37:17 2018 by root via cibadmin on overcloud-controller-2

12 nodes configured
37 resources configured

Online: [ overcloud-controller-0 overcloud-controller-1 overcloud-controller-2 ]
GuestOnline: [ galera-bundle-0@overcloud-controller-0 galera-bundle-1@overcloud-
controller-1 galera-bundle-2@overcloud-controller-2 rabbitmq-bundle-0@overcloud-
controller-0 rabbitmq-bundle-1@overcloud-controller-1 rabbitmq-bundle-2@overcloud-
controller-2 redis-bundle-0@overcloud-controller-0 redis-bundle-1@overcloud-controller-1
redis-bundle-2@overcloud-controller-2 ]
```

```
Full list of resources:
[...]
```

The main sections of the output show the following information about the cluster:

- **Cluster name**: Name of the cluster.
- **[NUM] nodes configured**: Number of nodes that are configured for the cluster.
- **[NUM] resources configured**: Number of resources that are configured for the cluster.
- **Online**: Names of the Controller nodes that are currently online.
- **GuestOnline**: Names of the guest nodes that are currently online. Each guest node consists of a complex Bundle Set resource. For more information about bundle sets, see Section 4.1, "Resource bundles and containers".

4.3. VIEWING BUNDLE STATUS

You can check the status of a bundle from an undercloud node or log in to one of the Controller nodes to check the bundle status directly.

Check bundle status from an undercloud node

Run the following command:

```
$ sudo docker exec -it haproxy-bundle-docker-0 ps -efww | grep haproxy*
```

Example output:

```
root           7       1  0 06:08 ?        00:00:00 /usr/sbin/haproxy -f /etc/haproxy/haproxy.cfg -Ws
haproxy       11       7  0 06:08 ?        00:00:17 /usr/sbin/haproxy -f /etc/haproxy/haproxy.cfg -Ws
```

The output shows that the **haproxy** process is running inside the container.

Check bundle status from a Controller node

Log in to a Controller node and run the following command:

```
$ ps -ef | grep haproxy*
```

Example output:

```
root       17774   17729  0 06:08 ?        00:00:00 /usr/sbin/haproxy -f /etc/haproxy/haproxy.cfg -Ws
42454      17819   17774  0 06:08 ?        00:00:21 /usr/sbin/haproxy -f /etc/haproxy/haproxy.cfg -Ws
root      288508  237714  0 07:04 pts/0    00:00:00 grep --color=auto haproxy*
[root@controller-0 ~]# ps -ef | grep -e 17774 -e 17819
root       17774   17729  0 06:08 ?        00:00:00 /usr/sbin/haproxy -f /etc/haproxy/haproxy.cfg -Ws
42454      17819   17774  0 06:08 ?        00:00:22 /usr/sbin/haproxy -f /etc/haproxy/haproxy.cfg -Ws
root      301950  237714  0 07:07 pts/0    00:00:00 grep --color=auto -e 17774 -e 17819
```

4.4. VIEWING VIRTUAL IP ADDRESSES

Each IPaddr2 resource sets a virtual IP address that clients use to request access to a service. If the Controller node with that IP address fails, the IPaddr2 resource reassigns the IP address to a different Controller node.

Show all virtual IP addresses

Run the **pcs resource show** command with the **--full** option to display all resources that use the **VirtualIP** type:

```
$ sudo pcs resource show --full
```

The following example output shows each Controller node that is currently set to listen to a particular virtual IP address:

```
ip-10.200.0.6 (ocf::heartbeat:IPaddr2): Started overcloud-controller-1
ip-192.168.1.150 (ocf::heartbeat:IPaddr2): Started overcloud-controller-0
ip-172.16.0.10 (ocf::heartbeat:IPaddr2): Started overcloud-controller-1
ip-172.16.0.11 (ocf::heartbeat:IPaddr2): Started overcloud-controller-0
ip-172.18.0.10 (ocf::heartbeat:IPaddr2): Started overcloud-controller-2
ip-172.19.0.10 (ocf::heartbeat:IPaddr2): Started overcloud-controller-2
```

Each IP address is initially attached to a specific Controller node. For example, **192.168.1.150** is started on **overcloud-controller-0**. However, if that Controller node fails, the IP address is reassigned to other Controller nodes in the cluster.

The following table describes the IP addresses in the example output and shows the original allocation of each IP address.

Table 4.1. IP address description and allocation source

IP Address	Description	Allocated From
192.168.1.150	Public IP address	**ExternalAllocationPools** attribute in the **network-environment.yaml** file
10.200.0.6	Controller virtual IP address	Part of the **dhcp_start** and **dhcp_end** range set to **10.200.0.5-10.200.0.24** in the **undercloud.conf** file
172.16.0.10	Provides access to OpenStack API services on a Controller node	**InternalApiAllocationPools** in the **network-environment.yaml** file
172.18.0.10	Storage virtual IP address that provides access to the Glance API and to Swift Proxy services	**StorageAllocationPools** attribute in the **network-environment.yaml** file
172.16.0.11	Provides access to Redis service on a Controller node	**InternalApiAllocationPools** in the **network-environment.yaml** file

IP Address	Description	Allocated From
172.19.0.10	Provides access to storage management	**StorageMgmtAlloctionPools** in the **network-environment.yaml** file

View a specific IP address

Run the **pcs resource show** command.

```
$ sudo pcs resource show ip-192.168.1.150
```

Example output:

```
Resource: ip-192.168.1.150 (class=ocf provider=heartbeat type=IPaddr2)
 Attributes: ip=192.168.1.150 cidr_netmask=32
 Operations: start interval=0s timeout=20s (ip-192.168.1.150-start-timeout-20s)
             stop interval=0s timeout=20s (ip-192.168.1.150-stop-timeout-20s)
             monitor interval=10s timeout=20s (ip-192.168.1.150-monitor-interval-10s)
```

View network information for a specific IP address

1. Log in to the Controller node that is assigned to the IP address you want to view.
2. Run the **ip addr show** command to view network interface information.

   ```
   $ ip addr show vlan100
   ```

   Example output:

   ```
    9: vlan100: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc noqueue state
   UNKNOWN
       link/ether be:ab:aa:37:34:e7 brd ff:ff:ff:ff:ff:ff
       inet *192.168.1.151/24* brd 192.168.1.255 scope global vlan100
          valid_lft forever preferred_lft forever
       inet *192.168.1.150/32* brd 192.168.1.255 scope global vlan100
          valid_lft forever preferred_lft forever
   ```

3. Run the **netstat** command to show all processes that listen to the IP address.

   ```
   $ sudo netstat -tupln | grep "192.168.1.150.haproxy"
   ```

   Example output:

   ```
   tcp        0      0 192.168.1.150:8778      0.0.0.0:*               LISTEN      61029/haproxy
   tcp        0      0 192.168.1.150:8042      0.0.0.0:*               LISTEN      61029/haproxy
   tcp        0      0 192.168.1.150:9292      0.0.0.0:*               LISTEN      61029/haproxy
   tcp        0      0 192.168.1.150:8080      0.0.0.0:*               LISTEN      61029/haproxy
   tcp        0      0 192.168.1.150:80        0.0.0.0:*               LISTEN      61029/haproxy
   tcp        0      0 192.168.1.150:8977      0.0.0.0:*               LISTEN      61029/haproxy
   tcp        0      0 192.168.1.150:6080      0.0.0.0:*               LISTEN      61029/haproxy
   ```

```
tcp    0    0 192.168.1.150:9696    0.0.0.0:*    LISTEN    61029/haproxy
tcp    0    0 192.168.1.150:8000    0.0.0.0:*    LISTEN    61029/haproxy
tcp    0    0 192.168.1.150:8004    0.0.0.0:*    LISTEN    61029/haproxy
tcp    0    0 192.168.1.150:8774    0.0.0.0:*    LISTEN    61029/haproxy
tcp    0    0 192.168.1.150:5000    0.0.0.0:*    LISTEN    61029/haproxy
tcp    0    0 192.168.1.150:8776    0.0.0.0:*    LISTEN    61029/haproxy
tcp    0    0 192.168.1.150:8041    0.0.0.0:*    LISTEN    61029/haproxy
```

NOTE

Processes that are listening to all local addresses, such as **0.0.0.0**, are also available through **192.168.1.150**. These processes include **sshd**, **mysqld**, **dhclient**, **ntpd**.

View port number assignments

Open the **/var/lib/config-data/puppet-generated/haproxy/etc/haproxy/haproxy.cfg** file to see default port number assignments.

The following example shows the port numbers and the services that they listen to:

- TCP port 6080: **nova_novncproxy**
- TCP port 9696: **neutron**
- TCP port 8000: **heat_cfn**
- TCP port 80: **horizon**
- TCP port 8776: **cinder**

In this example, most services that are defined in the **haproxy.cfg** file listen to the **192.168.1.150** IP address on all three Controller nodes. However, only the **controller-0** node is listening externally to the **192.168.1.150** IP address.

Therefore, if the **controller-0** node fails, HAProxy only needs to re-assign **192.168.1.150** to another Controller node and all other services will already be running on the fallback Controller node.

4.5. VIEWING PACEMAKER STATUS AND POWER MANAGEMENT INFORMATION

The last sections of the **pcs status** output show information about your power management fencing, such as IPMI, and the status of the Pacemaker service itself:

```
 my-ipmilan-for-controller-0 (stonith:fence_ipmilan): Started my-ipmilan-for-controller-0
 my-ipmilan-for-controller-1 (stonith:fence_ipmilan): Started my-ipmilan-for-controller-1
 my-ipmilan-for-controller-2 (stonith:fence_ipmilan): Started my-ipmilan-for-controller-2

PCSD Status:
  overcloud-controller-0: Online
  overcloud-controller-1: Online
  overcloud-controller-2: Online

Daemon Status:
  corosync: active/enabled
```

```
  pacemaker: active/enabled openstack-cinder-volume       (systemd:openstack-cinder-volume):
Started overcloud-controller-0

  pcsd: active/enabled
```

The **my-ipmilan-for-controller** settings show the type of fencing for each Controller node (**stonith:fence_ipmilan**) and whether or not the IPMI service is stopped or running. The PCSD Status shows that all three Controller nodes are currently online. The Pacemaker service consists of three daemons: **corosync**, **pacemaker**, and **pcsd**. In the example, all three services are active and enabled.

4.6. TROUBLESHOOTING FAILED PACEMAKER RESOURCES

If one the Pacemaker resources fails, you can view the **Failed Actions** section of the **pcs status** output. In the following example, the **openstack-cinder-volume** service stopped working on **controller-0**:

```
Failed Actions:
* openstack-cinder-volume_monitor_60000 on overcloud-controller-0 'not running' (7): call=74,
status=complete, exitreason='none',
 last-rc-change='Wed Dec 14 08:33:14 2016', queued=0ms, exec=0ms
```

In this case, you must enable the systemd service *openstack-cinder-volume*. In other cases, you might need to locate and fix the problem and then clean up the resources. For more information about troubleshooting resource problems, see Chapter 8, *Troubleshooting resource problems*.

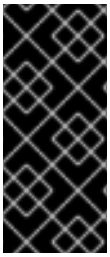
CHAPTER 5. FENCING CONTROLLER NODES WITH STONITH

Fencing is the process of isolating a failed node to protect the cluster and the cluster resources. Without fencing, a failed node might result in data corruption in a cluster.

Director uses Pacemaker to provide a highly available cluster of Controller nodes. Pacemaker uses a process called *STONITH* to fence failed nodes. STONITH is an acronym for "Shoot the other node in the head".

If a Controller node fails a health check, the Controller node that acts as the Pacemaker designated coordinator (DC) uses the Pacemaker **stonith** service to fence the impacted Controller node.

STONITH is disabled by default and requires manual configuration so that Pacemaker can control the power management of each node in the cluster.



IMPORTANT

Deploying a highly available overcloud without STONITH is not supported. You must configure a STONITH device for each node that is a part of the Pacemaker cluster in a highly available overcloud. For more information on STONITH and Pacemaker, see Fencing in a Red Hat High Availability Cluster and Support Policies for RHEL High Availability Clusters.

For more information on fencing with Pacemaker in Red Hat Enterprise Linux, see:

- High Availability Add-On Overview
- High Availability Add-On Administration
- High Availability Add-On Reference

5.1. SUPPORTED FENCING AGENTS

When you deploy a high availability environment with fencing, you can choose one of the following fencing agents based on your environment needs. To change the fencing agent, you must configure additional parameters in the **fencing.yaml** file, as described in Section 5.2, “Deploying and testing fencing on the overcloud”.

Intelligent Platform Management Interface (IPMI)

Default fencing mechanism that RHOSP uses to manage fencing.

Storage Block Device (SBD)

Use in deployments with Watchdog devices. The deployment must not use shared storage.

fence_kdump

Use in deployments with the **kdump** crash recovery service. If you choose this agent, make sure you have enough disk space to store the dump files.

You can configure this agent as a secondary mechanism in addition to the IPMI, **fence_rhevm**, or Redfish fencing agents. If you configure multiple fencing agents, make sure that you allocate enough time for the first agent to complete the task before the second agent starts the next task.

Redfish

Use in deployments with servers that support the DMTF Redfish APIs. To specify this agent, change the value of the **agent** parameter to **fence_redfish** in the **fencing.yaml** file. For more information about Redfish, see the DTMF Documentation.

fence_rhevm for Red Hat Virtualization (RHV)

Use to configure fencing for Controller nodes that run RHV environments. You can generate the **fencing.yaml** file in the same way as you do for IPMI fencing, but you must define the **pm_type** parameter in the **nodes.json** file to use RHV.
By default, the **ssl_insecure** parameter is set to accept self-signed certificates. You can change the parameter value based on your security requirements.

IMPORTANT

Make sure that you use a role with permissions to create and launch virtual machines in RHV, such as **UserVMManager**.

5.2. DEPLOYING AND TESTING FENCING ON THE OVERCLOUD

The fencing configuration process includes the following stages:

1. Reviewing the state of STONITH and Pacemaker.
2. Generating the **fencing.yaml** file.
3. Redeploying the overcloud and testing the configuration.

Prerequisites

Make sure that you can access the **nodes.json** file that you created when you registered your Controller nodes in director. This file is a required input for the **fencing.yaml** file that you generate during deployment.

Review the state of STONITH and Pacemaker

1. Log in to each Controller node as the **heat-admin** user.
2. Verify that the cluster is running:

```
$ sudo pcs status
```

Example output:

```
Cluster name: openstackHA
Last updated: Wed Jun 24 12:40:27 2015
Last change: Wed Jun 24 11:36:18 2015
Stack: corosync
Current DC: lb-c1a2 (2) - partition with quorum
Version: 1.1.12-a14efad
3 Nodes configured
141 Resources configured
```

3. Verify that STONITH is disabled:

```
$ sudo pcs property show
```

Example output:

```
Cluster Properties:
cluster-infrastructure: corosync
cluster-name: openstackHA
dc-version: 1.1.12-a14efad
have-watchdog: false
stonith-enabled: false
```

Generate the fencing.yaml environment file

Choose one of the following options:

- If you use the IPMI or Red Hat Virtualization (RHV) fencing agent, run the following command to generate the **fencing.yaml** environment file:

```
$ openstack overcloud generate fencing --output fencing.yaml nodes.json
```

NOTE

- This command converts **ilo** and **drac** power management details to IPMI equivalents.
- Make sure that the **nodes.json** file contains the MAC address of one of the network interfaces (NICs) on the node. For more information, see Registering Nodes for the Overcloud.
- If you use RHV, make sure that you use a role with permissions to create and launch virtual machine, such as **UserVMManager**.

- If you use a different fencing agent, such as Storage Block Device (SBD), **fence_kdump**, or Redfish, generate the **fencing.yaml** file manually.

NOTE

If you use pre-provisioned nodes, you also must create the **fencing.yaml** file manually.

For more information about supported fencing agents, see Section 5.1, “Supported fencing agents” .

Redeploy the overcloud and test the configuration

1. Run the **overcloud deploy** command and include the **fencing.yaml** file that you generated to configure fencing on the Controller nodes:

```
openstack overcloud deploy --templates \
-e /usr/share/openstack-tripleo-heat-templates/environments/network-isolation.yaml \
-e ~/templates/network-environment.yaml \
-e ~/templates/storage-environment.yaml --control-scale 3 --compute-scale 3 --ceph-storage-scale 3 --control-flavor control --compute-flavor Compute --ceph-storage-flavor ceph-storage --ntp-server pool.ntp.org --neutron-network-type vxlan --neutron-tunnel-types vxlan \
-e fencing.yaml
```

2. Log in to the overcloud and verify that fencing is configured for each of the Controller nodes:

   a. Check that Pacemaker is configured as the resource manager:

   ```
   $ source stackrc
   $ nova list | grep controller
   $ ssh heat-admin@<controller-x_ip>
   $ sudo pcs status |grep fence
   stonith-overcloud-controller-x (stonith:fence_ipmilan): Started overcloud-controller-y
   ```

   In this example, Pacemaker is configured to use a STONITH resource for each of the Controller nodes that are specified in the **fencing.yaml** file.

   NOTE

   You must not configure the **fence-resource** process on the same node that it controls.

   b. Run the **pcs stonith show** command to check the fencing resource attributes:

   ```
   $ sudo pcs stonith show <stonith-resource-controller-x>
   ```

   The STONITH attribute values must match the values in the **fencing.yaml** file.

Verify fencing on the Controller nodes

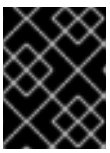
To test whether fencing works correctly, you trigger fencing by closing all ports on a Controller node and rebooting the server.

1. Log in to a Controller node:

   ```
   $ source stackrc
   $ nova list |grep controller
   $ ssh heat-admin@<controller-x_ip>
   ```

2. Change to the **root** user and run the **iptables** command on each port:

   ```
   $ sudo -i
   iptables -A INPUT -m state --state RELATED,ESTABLISHED -j ACCEPT &&
   iptables -A INPUT -p tcp -m state --state NEW -m tcp --dport 22 -j ACCEPT &&
   iptables -A INPUT -p tcp -m state --state NEW -m tcp --dport 5016 -j ACCEPT &&
   iptables -A INPUT -p udp -m state --state NEW -m udp --dport 5016 -j ACCEPT &&
   iptables -A INPUT ! -i lo -j REJECT --reject-with icmp-host-prohibited &&
   iptables -A OUTPUT -p tcp --sport 22 -j ACCEPT &&
   iptables -A OUTPUT -p tcp --sport 5016 -j ACCEPT &&
   iptables -A OUTPUT -p udp --sport 5016 -j ACCEPT &&
   iptables -A OUTPUT ! -o lo -j REJECT --reject-with icmp-host-prohibited
   ```

   IMPORTANT

   This step drops all connections to the Controller node, which causes the server to reboot.

3. From a different Controller node, locate the fencing event in the Pacemaker log file:

```
$ ssh heat-admin@<controller-x_ip>
$ less /var/log/cluster/corosync.log
(less): /fenc*
```

If the STONITH service performed the fencing action on the Controller, the log file will show a fencing event.

4. Wait a few minutes and then verify that the rebooted Controller node is running in the cluster again by running the **pcs status** command.

5.3. VIEWING STONITH INFORMATION

To see how STONITH configures your fencing devices, run the **pcs stonith show --full** command from the overcloud:

```
$ sudo pcs stonith show --full
 Resource: my-ipmilan-for-controller-0 (class=stonith type=fence_ipmilan) 1
  Attributes: pcmk_host_list=overcloud-controller-0 ipaddr=10.100.0.51 login=admin passwd=abc
lanplus=1 cipher=3
  Operations: monitor interval=60s (my-ipmilan-for-controller-0-monitor-interval-60s)
 Resource: my-ipmilan-for-controller-1 (class=stonith type=fence_ipmilan)
  Attributes: pcmk_host_list=overcloud-controller-1 ipaddr=10.100.0.52 login=admin passwd=abc
lanplus=1 cipher=3
  Operations: monitor interval=60s (my-ipmilan-for-controller-1-monitor-interval-60s)
 Resource: my-ipmilan-for-controller-2 (class=stonith type=fence_ipmilan)
  Attributes: pcmk_host_list=overcloud-controller-2 ipaddr=10.100.0.53 login=admin passwd=abc
lanplus=1 cipher=3
  Operations: monitor interval=60s (my-ipmilan-for-controller-2-monitor-interval-60s)
```

The **--full** option returns fencing details about the three Controller nodes.

This output shows the following information for each resource:

- IPMI power management service that the fencing device uses to turn the machines on and off as needed, such as **fence_ipmilan**.
- IP address of the IPMI interface, such as **10.100.0.51**.
- User name to log in with, such as **admin**.
- Password to use to log in to the node, such as **abc**.
- Interval in seconds at which each host is monitored, such as **60s**.

5.4. FENCING PARAMETERS

When you deploy fencing on the overcloud, you generate a **fencing.yaml** file with the required parameters to configure fencing. For more information about deploying and testing fencing, see Section 5.2, “Deploying and testing fencing on the overcloud”.

The following example shows the structure of the **fencing.yaml** environment file:

```
parameter_defaults:
  EnableFencing: true
```

```
FencingConfig:
  devices:
  - agent: fence_ipmilan
    host_mac: 11:11:11:11:11:11
    params:
      ipaddr: 10.0.0.101
      lanplus: true
      login: admin
      passwd: InsertComplexPasswordHere
      pcmk_host_list: host04
      privlvl: administrator
```

This file contains the following parameters:

EnableFencing

Enables the fencing functionality for Pacemaker-managed nodes.

FencingConfig

Lists the fencing devices and the parameters for each device:

- **agent**: Fencing agent name. Red Hat OpenStack Platform only supports **fence_ipmilan** for IPMI.
- **host_mac**: Unique identifier for the fencing device.
- **params**: List of fencing device parameters.

Fencing device parameters

- **auth**: IPMI authentication type (**md5**, **password**, or none).
- **ipaddr**: IPMI IP address.
- **ipport**: IPMI port.
- **login**: Username for the IPMI device.
- **passwd**: Password for the IPMI device.
- **lanplus**: Use lanplus to improve security of connection.
- **privlvl**: Privilege level on IPMI device
- **pcmk_host_list**: List of Pacemaker hosts.

CHAPTER 6. LOAD BALANCING TRAFFIC WITH HAPROXY

The HAProxy service provides load balancing of traffic to Controller nodes in the high availability cluster, as well as logging and sample configurations.

The **haproxy** package contains the **haproxy** daemon, which corresponds to the **systemd** service of the same name. Pacemaker manages the HAProxy service as a highly available service called **haproxy-bundle**.

For more information about HAProxy, see the HAProxy Configuration chapter in the Load Balancer Administration guide.

For information on verifying that HAProxy is configured correctly, see the KCS article How can I verify my haproxy.cfg is correctly configured to load balance openstack services?.

6.1. HOW HAPROXY WORKS

Director can configure most Red Hat OpenStack Platform services to use the HAProxy service. Director configures those services in the **/var/lib/config-data/haproxy/etc/haproxy/haproxy.cfg** file, which instructs HAProxy to run in a dedicated container on each overcloud node.

The following table shows the list of services that HAProxy manages:

Table 6.1. Services managed by HAProxy

aodh	cinder	glance_api	gnocchi
haproxy.stats	heat_api	heat_cfn	horizon
keystone_admin	keystone_public	mysql	neutron
nova_metadata	nova_novncproxy	nova_osapi	nova_placement

For each service in the **haproxy.cfg** file, you can see the following properties:

- **listen**: The name of the service that is listening for requests.
- **bind**: The IP address and TCP port number on which the service is listening.
- **server**: The name of each Controller node server that uses HAProxy, the IP address and listening port, and additional information about the server.

The following example shows the OpenStack Block Storage (cinder) service configuration in the **haproxy.cfg** file:

```
listen cinder
  bind 172.16.0.10:8776
  bind 192.168.1.150:8776
  mode http
  http-request set-header X-Forwarded-Proto https if { ssl_fc }
  http-request set-header X-Forwarded-Proto http if !{ ssl_fc }
  option httpchk
```

```
server overcloud-controller-0 172.16.0.13:8777 check fall 5 inter 2000 rise 2
server overcloud-controller-1 172.16.0.14:8777 check fall 5 inter 2000 rise 2
server overcloud-controller-2 172.16.0.15:8777 check fall 5 inter 2000 rise 2
```

This example output shows the following information about the OpenStack Block Storage (cinder) service:

- **172.16.0.10:8776**: Virtual IP address and port on the Internal API network (VLAN201) to use within the overcloud.
- **192.168.1.150:8776**: Virtual IP address and port on the External network (VLAN100) that provides access to the API network from outside the overcloud.
- **8776**: Port number on which the OpenStack Block Storage (cinder) service is listening.
- **server**: Controller node names and IP addresses. HAProxy can direct requests made to those IP addresses to one of the Controller nodes listed in the **server** output.
- **httpchk**: Enables health checks on the Controller node servers.
- **fall 5**: Number of failed health checks to determine that the service is offline.
- **inter 2000**: Interval between two consecutive health checks in milliseconds.
- **rise 2**: Number of successful health checks to determine that the service is running.

For more information about settings you can use in the **haproxy.cfg** file, see the **/usr/share/doc/haproxy-[VERSION]/configuration.txt** file on any node where the **haproxy** package is installed.

6.2. VIEWING HAPROXY STATS

By default, the director also enables HAProxy Stats, or statistics, on all HA deployments. With this feature, you can view detailed information about data transfer, connections, and server states on the HAProxy Stats page.

The director also sets the **IP:Port** address that you use to reach the HAProxy Stats page and stores the information in the **haproxy.cfg** file.

Procedure

1. Open the **/var/lib/config-data/haproxy/etc/haproxy/haproxy.cfg** file in any Controller node where HAProxy is installed.
2. Locate the **listen haproxy.stats** section:

```
listen haproxy.stats
  bind 10.200.0.6:1993
  mode http
  stats enable
  stats uri /
  stats auth admin:<haproxy-stats-password>
```

3. In a Web browser, navigate to **10.200.0.6:1993** and enter the credentials from the **stats auth** row to view the HAProxy Stats page.

CHAPTER 7. MANAGING DATABASE REPLICATION WITH GALERA

Red Hat OpenStack Platform uses the MariaDB Galera Cluster to manage database replication. Pacemaker runs the Galera service as a **bundle set** resource that manages the database master/slave status. You can use Galera to test and verify different aspects of the database cluster, such as hostname resolution, cluster integrity, node integrity, and database replication performance.

Similar to other Pacemaker services, you can use the **pcs status** command to check that the Galera service is running, and on which Controller nodes it is running. For more information about viewing Pacemaker bundle status, see Section 4.3, “Viewing bundle status”.

When you investigate database cluster integrity, each node must meet the following criteria:

- The node is a part of the correct cluster.
- The node can write to the cluster.
- The node can receive queries and write commands from the cluster.
- The node is connected to other nodes in the cluster.
- The node is replicating write-sets to tables in the local database.

7.1. VERIFYING HOSTNAME RESOLUTION

By default, director binds the Galera resource to a hostname instead of an IP address. Therefore, any problems that prevent hostname resolution, such as misconfigured or failed DNS, might cause Pacemaker to incorrectly manage the Galera resource.

To troubleshoot the MariaDB Galera cluster, you first eliminate any hostname resolution problems, and then you check the write-set replication status on the database of each Controller node. To access the MySQL database, you use the password set by director during the overcloud deployment.

Procedure

1. From a Controller node, get the MariaDB database root password by running the **hiera** command.

```
$ sudo hiera -c /etc/puppet/hiera.yaml "mysql::server::root_password"
*<MYSQL-HIERA-PASSWORD>*
```

2. Get the name of the MariaDB container that runs on the node.

```
$ sudo docker ps | grep -i galera
5fb195b0d9e8        192.168.24.1:8787/rh-osbs/rhosp13-openstack-mariadb:pcmklatest
"dumb-init -- /bin..."   7 hours ago         Up 7 hours  galera-bundle-docker-0
```

3. Get the write-set replication information from the MariaDB database on each node.

```
$ sudo docker exec galera-bundle-docker-0 sudo mysql -B --password="[MYSQL-HIERA-
PASSWORD]" -e "SHOW GLOBAL STATUS LIKE 'wsrep_%';"
    +----------------------------+----------+
    | Variable_name              | Value    |
```

```
+----------------------------+----------+
| wsrep_applier_thread_count | 1        |
| wsrep_apply_oooe           | 0.018672 |
| wsrep_apply_oool           | 0.000630 |
| wsrep_apply_window         | 1.021942 |
| ...                        | ...      |
+----------------------------+----------+
```

Each relevant variable uses the prefix **wsrep**.

4. Verify the health and integrity of the MariaDB Galera cluster by first checking that the cluster is reporting the correct number of nodes.

7.2. CHECKING DATABASE CLUSTER INTEGRITY

When you investigate problems with the MariaDB Galera Cluster, you can check the integrity of the whole cluster by checking specific **wsrep** database variables on each Controller node.

Procedure

Run the following command and replace ***VARIABLE*** with the **wsrep** database variable that you want to check:

```
$ sudo docker exec galera-bundle-docker-0 sudo mysql -B --password="[MYSQL-HIERA-PASSWORD]" -e "SHOW GLOBAL STATUS LIKE 'VARIABLE';"
```

The following example shows how to view the cluster state UUID of the node:

```
$ sudo docker exec galera-bundle-docker-0 sudo mysql -B --password="[MYSQL-HIERA-PASSWORD]" -e "SHOW GLOBAL STATUS LIKE 'wsrep_cluster_state_uuid';"

+--------------------------+--------------------------------------+
| Variable_name            | Value                                |
+--------------------------+--------------------------------------+
| wsrep_cluster_state_uuid | e2c9a15e-5485-11e0-0800-6bbb637e7211 |
+--------------------------+--------------------------------------+
```

The following table lists the **wsrep** database variables that you can use to check cluster integrity.

Table 7.1. Database variables to check for cluster integrity

Variable	Summary	Description
wsrep_cluster_state_uuid	Cluster state UUID	ID of the cluster to which the node belongs. All nodes must have an identical cluster ID. A node with a different ID is not connected to the cluster.
wsrep_cluster_size	Number of nodes in the cluster	You can check this on any node. If the value is less than the actual number of nodes, then some nodes either failed or lost connectivity.

Variable	Summary	Description
wsrep_cluster_conf_id	Total number of cluster changes	Determines whether the cluster was split to several components, also known as *partitions*. Partitioning is usually caused by a network failure. All nodes must have an identical value. In case some nodes report a different **wsrep_cluster_conf_id**, check the **wsrep_cluster_status** value to see if the nodes can still write to the cluster (**Primary**).
wsrep_cluster_status	Primary component status	Determines whether the node can write to the cluster. If the node can write to the cluster, the **wsrep_cluster_status** value is **Primary**. Any other value indicates that the node is part of a non-operational partition.

7.3. CHECKING DATABASE NODE INTEGRITY

If you can isolate a Galera cluster problem to a specific node, certain **wsrep** database variables can indicate the specific problem in the node.

Procedure

Run the following command and replace ***VARIABLE*** with the **wsrep** database variable that you want to check:

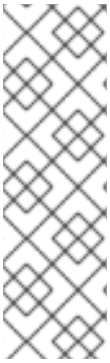
```
$ sudo docker exec galera-bundle-docker-0 sudo mysql -B --password="[MYSQL-HIERA-PASSWORD]" -e "SHOW GLOBAL STATUS LIKE 'VARIABLE';"
```

The following table lists the **wsrep** database variables that you can use to check node integrity.

Table 7.2. Database variables to check for node integrity

Variable	Summary	Description
wsrep_ready	Node ability to accept queries	States whether the node can accept write-sets from the cluster. If so, then **wsrep_ready** is **ON**.
wsrep_connected	Node network connectivity	States whether the node can connect to other nodes on the network. If so, then **wsrep_connected** is **ON**.

Variable	Summary	Description
wsrep_local_state_comment	Node state	Summarizes the node state. If the node can write to the cluster, then typical values for **wsrep_local_state_comment** can be **Joining**, **Waiting on SST**, **Joined**, **Synced**, or **Donor**. If the node is part of a non-operational component, then the value of **wsrep_local_state_comment** is **Initialized**.



NOTE

- The **wsrep_connected** value can be **ON** even if the node is connected only to a subset of nodes in the cluster. For example, in case of a cluster partition, the node might be part of a component that cannot write to the cluster. For more information about checking cluster integrity, see Section 7.2, "Checking database cluster integrity".
- If the **wsrep_connected** value is **OFF**, then the node is not connected to any cluster components.

7.4. TESTING DATABASE REPLICATION PERFORMANCE

If the cluster and the individual nodes are all healthy and stable, you can run performance benchmark tests on the replication throughput by querying specific database variables.

Every time you query one of these variables, a **FLUSH STATUS** command resets the variable value. To run benchmark tests, you must run multiple queries and analyze the variances. These variances can help you determine how much *Flow Control* is affecting the cluster's performance.

Flow Control is a mechanism that the cluster uses to manage replication. When the local *received queue* exceeds a certain threshold, Flow Control pauses the replication until the queue size goes down. For more information about Flow Control, see Flow Control on the Galera Cluster website.

Procedure

Run the following command and replace ***VARIABLE*** with the **wsrep** database variable that you want to check:

```
$ sudo docker exec galera-bundle-docker-0 sudo mysql -B --password="[MYSQL-HIERA-PASSWORD]" -e "SHOW STATUS LIKE 'VARIABLE';"
```

The following table lists the **wsrep** database variables that you can use to test database replication performance.

Table 7.3. Database variables to check for database replication performance

Variable	Summary	Usage
wsrep_local_recv_queue_avg	Average size of the local received write-set queue after the last query.	A value higher than **0.0** indicates that the node cannot apply write-sets as quickly as it receives write-sets, which triggers replication throttling. Check **wsrep_local_recv_queue_min** and **wsrep_local_recv_queue_max** for a detailed look at this benchmark.
wsrep_local_send_queue_avg	Average send queue length after the last query.	A value higher than **0.0** indicates a higher likelihood of replication throttling and network throughput problems.
wsrep_local_recv_queue_min and **wsrep_local_recv_queue_max**	Minimum and maximum size of the local receive queue after the last query.	If the value of **wsrep_local_recv_queue_avg** is higher than **0.0**, you can check these variables to determine the scope of the queue size.
wsrep_flow_control_paused	Fraction of the time that Flow Control paused the node after the last query.	A value higher than **0.0** indicates that Flow Control paused the node. To determine the duration of the pause, multiply the **wsrep_flow_control_paused** value with the number of seconds between the queries. The optimal value is as close to **0.0** as possible. For example: ● If the value of **wsrep_flow_control_paused** is **0.50** one minute after the last query, then Flow Control paused the node for 30 seconds. ● If the value of **wsrep_flow_control_paused** is **1.0** one minute after the last query, then Flow Control paused the node for the entire minute.

Variable	Summary	Usage
wsrep_cert_deps_distance	Average difference between the lowest and highest sequence number (**seqno**) value that can be applied in parallel	In case of throttling and pausing, this variable indicates how many write-sets on average can be applied in parallel. Compare the value with the **wsrep_slave_threads** variable to see how many write-sets can actually be applied simultaneously.
wsrep_slave_threads	Number of threads that can be applied simultaneously	You can increase the value of this variable to apply more threads simultaneously, which also increases the value of **wsrep_cert_deps_distance**. The value of **wsrep_slave_threads** must not be higher than the number of CPU cores in the node. For example, if the **wsrep_cert_deps_distance** value is **20**, you can increase the value of **wsrep_slave_threads** from **2** to **4** to increase the amount of write-sets that the node can apply. If a problematic node already has an optimal **wsrep_slave_threads** value, you can exclude the node from the cluster while you investigate possible connectivity issues.

CHAPTER 8. TROUBLESHOOTING RESOURCE PROBLEMS

In case of resource failure, you must investigate the cause and location of the problem, fix the failed resource, and optionally clean up the resource. There are many possible causes of resource failures depending on your deployment, and you must investigate the resource to determine how to fix the problem.

For example, you can check the resource constraints to ensure that the resources are not interrupting each other, and that the resources can connect to each other. You can also examine a Controller node that is fenced more often than other Controller nodes to identify possible communication problems.

8.1. VIEWING RESOURCE CONSTRAINTS

You can view constraints on how services are launched, including constraints related to where each resource is located, the order in which the resource starts, and whether the resource must be colocated with another resource.

View all resource constraints

On any Controller node, run the **pcs constraint show** command.

```
$ sudo pcs constraint show
```

The following example shows a truncated output from the **pcs constraint show** command on a Controller node:

```
Location Constraints:
  Resource: galera-bundle
    Constraint: location-galera-bundle (resource-discovery=exclusive)
      Rule: score=0
        Expression: galera-role eq true
  [...]
  Resource: ip-192.168.24.15
    Constraint: location-ip-192.168.24.15 (resource-discovery=exclusive)
      Rule: score=0
        Expression: haproxy-role eq true
  [...]
  Resource: my-ipmilan-for-controller-0
    Disabled on: overcloud-controller-0 (score:-INFINITY)
  Resource: my-ipmilan-for-controller-1
    Disabled on: overcloud-controller-1 (score:-INFINITY)
  Resource: my-ipmilan-for-controller-2
    Disabled on: overcloud-controller-2 (score:-INFINITY)
Ordering Constraints:
  start ip-172.16.0.10 then start haproxy-bundle (kind:Optional)
  start ip-10.200.0.6 then start haproxy-bundle (kind:Optional)
  start ip-172.19.0.10 then start haproxy-bundle (kind:Optional)
  start ip-192.168.1.150 then start haproxy-bundle (kind:Optional)
  start ip-172.16.0.11 then start haproxy-bundle (kind:Optional)
  start ip-172.18.0.10 then start haproxy-bundle (kind:Optional)
Colocation Constraints:
  ip-172.16.0.10 with haproxy-bundle (score:INFINITY)
  ip-172.18.0.10 with haproxy-bundle (score:INFINITY)
  ip-10.200.0.6 with haproxy-bundle (score:INFINITY)
```

```
  ip-172.19.0.10 with haproxy-bundle (score:INFINITY)
  ip-172.16.0.11 with haproxy-bundle (score:INFINITY)
  ip-192.168.1.150 with haproxy-bundle (score:INFINITY)
```

This output displays the following main constraint types:

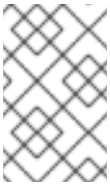
Location Constraints

Lists the locations to which resources can be assigned:

- The first constraint defines a rule that sets the **galera-bundle** resource to run on nodes with the **galera-role** attribute set to **true**.
- The second location constraint specifies that the IP resource **ip-192.168.24.15** runs only on nodes with the **haproxy-role** attribute set to **true**. This means that the cluster associates the IP address with the **haproxy** service, which is necessary to make the services reachable.
- The third location constraint shows that the **ipmilan** resource is disabled on each of the Controller nodes.

Ordering Constraints

Lists the order in which resources can launch. This example shows a constraint that sets the virtual IP address resources **IPaddr2** to start before the HAProxy service.



NOTE

Ordering constraints only apply to IP address resources and to HAproxy. Systemd manages all other resources, because services such as Compute are expected to withstand an interruption of a dependent service, such as Galera.

Colocation Constraints

Lists which resources must be located together. All virtual IP addresses are linked to the **haproxy-bundle** resource.

View Galera location constraints

On any Controller node, run the **pcs property show** command.

```
$ sudo pcs property show
```

Example output:

```
Cluster Properties:
 cluster-infrastructure: corosync
 cluster-name: tripleo_cluster
 dc-version: 1.1.16-12.el7_4.5-94ff4df
 have-watchdog: false
 redis_REPL_INFO: overcloud-controller-0
 stonith-enabled: false
Node Attributes:
 overcloud-controller-0: cinder-volume-role=true galera-role=true haproxy-role=true rabbitmq-
role=true redis-role=true rmq-node-attr-last-known-rabbitmq=rabbit@overcloud-controller-0
 overcloud-controller-1: cinder-volume-role=true galera-role=true haproxy-role=true rabbitmq-
```

```
role=true redis-role=true rmq-node-attr-last-known-rabbitmq=rabbit@overcloud-controller-1
 overcloud-controller-2: cinder-volume-role=true galera-role=true haproxy-role=true rabbitmq-
role=true redis-role=true rmq-node-attr-last-known-rabbitmq=rabbit@overcloud-controller-2
```

In this output, you can verify that the **galera-role** attribute is **true** for all Controller nodes. This means that the **galera-bundle** resource runs only on these nodes. The same concept applies to the other attributes associated with the other location constraints.

8.2. INVESTIGATING CONTROLLER NODE RESOURCE PROBLEMS

Depending on the type and location of the problem, there are different approaches you can take to investigate and fix the resource.

Investigating Controller node problems

If health checks to a Controller node are failing, this can indicate a communication problem between Controller nodes. To investigate, log in to the Controller node and check if the services can start correctly.

Investigating individual resource problems

If most services on a Controller are running correctly, you can run the **pcs status** command and check the output for information about a specific service failure. You can also log in to the Controller where the resource is failing and investigate the resource behavior on the Controller node.

Procedure

The following procedure shows how to investigate the **openstack-cinder-volume** resource.

1. Locate and log in to the Controller node on which the resource is failing.

2. Run the **systemctl status** command to show the resource status and recent log events:

```
[heat-admin@overcloud-controller-0 ~]$ sudo systemctl status openstack-cinder-volume
● openstack-cinder-volume.service - Cluster Controlled openstack-cinder-volume
   Loaded: loaded (/usr/lib/systemd/system/openstack-cinder-volume.service; disabled;
vendor preset: disabled)
  Drop-In: /run/systemd/system/openstack-cinder-volume.service.d
           └─50-pacemaker.conf
   Active: active (running) since Tue 2016-11-22 09:25:53 UTC; 2 weeks 6 days ago
 Main PID: 383912 (cinder-volume)
   CGroup: /system.slice/openstack-cinder-volume.service
           ├─383912 /usr/bin/python2 /usr/bin/cinder-volume --config-file /usr/share/cinder/cinder-
dist.conf --config-file /etc/cinder/cinder.conf --logfile /var/log/cinder/volume.log
           └─383985 /usr/bin/python2 /usr/bin/cinder-volume --config-file /usr/share/cinder/cinder-
dist.conf --config-file /etc/cinder/cinder.conf --logfile /var/log/cinder/volume.log


Nov 22 09:25:55 overcloud-controller-0.localdomain cinder-volume[383912]: 2016-11-22
09:25:55.798 383912 WARNING oslo_config.cfg [req-8f32db96-7ca2-4fc5-82ab-
271993b28174 - - - -...e future.
Nov 22 09:25:55 overcloud-controller-0.localdomain cinder-volume[383912]: 2016-11-22
09:25:55.799 383912 WARNING oslo_config.cfg [req-8f32db96-7ca2-4fc5-82ab-
271993b28174 - - - -...e future.
Nov 22 09:25:55 overcloud-controller-0.localdomain cinder-volume[383912]: 2016-11-22
09:25:55.926 383985 INFO cinder.coordination [-] Coordination backend started
successfully.
Nov 22 09:25:55 overcloud-controller-0.localdomain cinder-volume[383912]: 2016-11-22
```

```
09:25:55.926 383985 INFO cinder.volume.manager [req-cb07b35c-af01-4c45-96f1-
3d2bfc98ecb5 - - ...r (1.2.0)
Nov 22 09:25:56 overcloud-controller-0.localdomain cinder-volume[383912]: 2016-11-22
09:25:56.047 383985 WARNING oslo_config.cfg [req-cb07b35c-af01-4c45-96f1-
3d2bfc98ecb5 - - - -...e future.
Nov 22 09:25:56 overcloud-controller-0.localdomain cinder-volume[383912]: 2016-11-22
09:25:56.048 383985 WARNING oslo_config.cfg [req-cb07b35c-af01-4c45-96f1-
3d2bfc98ecb5 - - - -...e future.
Nov 22 09:25:56 overcloud-controller-0.localdomain cinder-volume[383912]: 2016-11-22
09:25:56.048 383985 WARNING oslo_config.cfg [req-cb07b35c-af01-4c45-96f1-
3d2bfc98ecb5 - - - -...e future.
Nov 22 09:25:56 overcloud-controller-0.localdomain cinder-volume[383912]: 2016-11-22
09:25:56.063 383985 INFO cinder.volume.manager [req-cb07b35c-af01-4c45-96f1-
3d2bfc98ecb5 - - ...essfully.
Nov 22 09:25:56 overcloud-controller-0.localdomain cinder-volume[383912]: 2016-11-22
09:25:56.111 383985 INFO cinder.volume.manager [req-cb07b35c-af01-4c45-96f1-
3d2bfc98ecb5 - - ...r (1.2.0)
Nov 22 09:25:56 overcloud-controller-0.localdomain cinder-volume[383912]: 2016-11-22
09:25:56.146 383985 INFO cinder.volume.manager [req-cb07b35c-af01-4c45-96f1-
3d2bfc98ecb5 - - ...essfully.
Hint: Some lines were ellipsized, use -l to show in full.
```

3. Correct the failed resource based on the information from the output.

4. Run the **pcs resource cleanup** command to reset the status and the fail count of the resource.

```
$ sudo pcs resource cleanup openstack-cinder-volume
  Resource: openstack-cinder-volume successfully cleaned up
```

CHAPTER 9. MONITORING A HIGH AVAILABILITY RED HAT CEPH STORAGE CLUSTER

When you deploy an overcloud with Red Hat Ceph Storage, Red Hat OpenStack Platform uses the **ceph-mon** monitor daemon to manage the Ceph cluster. Director deploys the daemon on all Controller nodes.

View the status of the Ceph Monitoring service

On a Controller node, run the **service ceph status** command to check that the Ceph Monitoring service is running:

```
$ sudo service ceph status
=== mon.overcloud-controller-0 ===
mon.overcloud-controller-0: running {"version":"0.94.1"}
```

View Ceph Monitoring configuration

On a Controller nodes or on a Ceph node, open the **/etc/ceph/ceph.conf** file to view the monitoring configuration parameters:

```
[global]
osd_pool_default_pgp_num = 128
osd_pool_default_min_size = 1
auth_service_required = cephx
mon_initial_members = overcloud-controller-0,overcloud-controller-1,overcloud-controller-2
fsid = 8c835acc-6838-11e5-bb96-2cc260178a92
cluster_network = 172.19.0.11/24
auth_supported = cephx
auth_cluster_required = cephx
mon_host = 172.18.0.17,172.18.0.15,172.18.0.16
auth_client_required = cephx
osd_pool_default_size = 3
osd_pool_default_pg_num = 128
public_network = 172.18.0.17/24
```

This example shows the following information:

- All three Controller nodes are configured to monitor the Red Hat Ceph Storage cluster with the **mon_initial_members** parameter.
- The **172.19.0.11/24** network is configured to provide a communication path between the Controller nodes and the Red Hat Ceph Storage nodes.
- The Red Hat Ceph Storage nodes are assigned to a separate network from the Controller nodes, and the IP addresses for the monitoring Controller nodes are **172.18.0.15**, **172.18.0.16**, and **172.18.0.17**.

View individual Ceph node status

Log in to the Ceph node and run the **ceph -s** command:

```
# ceph -s
    cluster 8c835acc-6838-11e5-bb96-2cc260178a92
     health HEALTH_OK
```

```
    monmap e1: 3 mons at {overcloud-controller-0=172.18.0.17:6789/0,overcloud-controller-
1=172.18.0.15:6789/0,overcloud-controller-2=172.18.0.16:6789/0}
           election epoch 152, quorum 0,1,2 overcloud-controller-1,overcloud-controller-2,overcloud-
controller-0
    osdmap e543: 6 osds: 6 up, 6 in
     pgmap v1736: 256 pgs, 4 pools, 0 bytes data, 0 objects
          267 MB used, 119 GB / 119 GB avail
               256 active+clean
```

This example output shows that the **health** parameter value is **HEALTH_OK**, which indicates that the Ceph node is active and healthy. The output also shows three Ceph monitor services that are running on the three **overcloud-controller** nodes and the IP addresses and ports of the services.

For more information about Red Hat Ceph Storage, see the Red Hat Ceph product page .