HP Helion OpenStack Carrier Grade 1.1: Administrator Guide

Chapter

1

HP Helion OpenStack Carrier Grade Overview

Topics:

HP Helion OpenStack Carrier Grade is a high-performance, high-availability, cloud operating system that enables telecommunications operators to use Commercial-off-the-shelf (COTS) hardware to manage Virtualized Network Functions (VNF) within a carrier grade Network Function Virtualization (NFV) architecture.

HP Helion OpenStack Carrier Grade brings together the flexibility and scalability of the IT cloud, and the high-availability and performance demanded by the Telecommunications industry, into a unique carrier grade, industry-leading solution to deliver a price-performance ratio well above alternative solutions. HP Helion OpenStack Carrier Grade is aligned with the ETSI-NFV architecture.

Core HP Helion OpenStack Carrier Grade Capabilities

HP Helion OpenStack Carrier Grade leverages core Wind River virtualization and carrier-grade technologies, Intel DPDK high-performance packet processing, open architectures, and the OpenStack software suite. It extends the OpenStack software suite to implement a unique carrier-grade, high-availability architecture, on which high-performance production systems can be deployed.

Core capabilities unique to HP Helion OpenStack Carrier Grade include:

High-Performance Networking

HP Helion OpenStack Carrier Grade provides significantly improved network performance over the default open source OpenStack solution, up to 20 Gbps throughput through a guest application on a virtual machine.

At the center of the HP Helion OpenStack Carrier Grade Networking is a DPDK-Accelerated Virtual L2 Switch (AVS), running on the compute node hosts. It provides connectivity between virtual machines on the same compute node, and between virtual machines and external networks. AVS supports a variety of network connectivity options with the hosted virtual machines, as follows:

- Unmodified guests can use Linux networking and virtio drivers. This provides a mechanism to bring existing applications into the production environment immediately.
- Guest applications can be modified to leverage the Accelerated Virtual Port (AVP) drivers provided with the HP Helion OpenStack Carrier Grade. AVP ports provide increased throughput over plain virtio drivers when connected to the AVS.
- For the highest performance, guest applications can also be modified to make use of the Intel DPDK libraries and the AVP poll-mode

drivers provided by the HP Helion OpenStack Carrier Grade to connect with the AVS Switch.

In addition to AVS, HP Helion OpenStack Carrier Grade incorporates DPDK-Accelerated Neutron Virtual Router L3 Forwarding (AVR). Accelerated forwarding is used between directly attached tenant networks and subnets, as well as for gateway, SNAT, and floating IP functionality.

High-Availability

HP Helion OpenStack Carrier Grade provides a number of extensions to OpenStack to deliver highly available hosting of virtual machines, including:

1:1 OpenStack controller services

Automatic configuration of the OpenStack controller services in 1:1 active/standby mode across two controller nodes.

Fast detection of compute host failures

Implemented by using a highly efficient and highly scalable heartbeat protocol between the controller and compute nodes.

Fast recovery of virtual machines instances upon detection of a compute node failure

Extensions to Nova services that automatically re-schedule impacted virtual machine instances to available alternative compute nodes in the cluster.

Fast recovery of tenant network services upon detection of a compute node failure

Extensions to Neutron that automatically re-schedule impacted network services such as DHCP, L3 Routing, and User/Meta data server, for all affected tenant networks. This covers tenant networks spanning multiple compute nodes.

Fast and enhanced detection of virtual machines failures

Failure of any KVM/QEMU instance is automatically reported by the death process notification.

Additionally, modified guests can make use of the HP Helion OpenStack Carrier Grade Guest Heartbeat Library to register application-specific health check callbacks with the virtual machine. This registration allows Nova compute extensions on the host compute node to monitor the health of the guest application. The frequency of the health checks is determined at registration time. The semantics of the health check, that is, determining when the application is in a good or a bad state, is under the control of the application itself.

Automatic recovery of failed virtual machine instances

Extensions to Nova that automatically re-start a failed virtual machine on the same compute node. If the re-start operation fails, the virtual machine is re-scheduled to use an alternative compute node.

Virtual machine server groups

Named groups of virtual machines instances to which a common set of attributes are applied, including:

- compute node affinity or anti-affinity

- maximum number of virtual machine instances
- best effort or strict affinity policy

Virtual machines in the same server group can use a server group messaging API for low-bandwidth communications.

In a typical use of a virtual machine server group, guest applications in active/standby pairs are deployed on different compute nodes to protect them from hardware failures.

Live migration support with DPDK-accelerated networking

Live migration support for virtual machines using the HP Helion OpenStack Carrier Grade high-performance networking options.

Graceful shutdown (and other operations) of virtual machines

Nova extensions that turn the default shutdown operation of virtual machines into an ACPI shutdown. Guest applications can therefore register shutdown scripts using standard ACPI mechanisms to execute operations such as closing files, updating persistent databases, or cleanly disconnecting from subscribed services.

Optionally, guest applications can use the HP Helion OpenStack Carrier Grade Guest Heartbeat Library to register to receive process management requests such as shutdown, live-migrate, pause, auto-scale, and others. The guest applications can then reject the requests based upon application-specific state directives, or prepare for a graceful execution.

Link Aggregation (LAG) support

Support for LAG, also known as Aggregate Ethernet, on controller and compute nodes for link protection.

Protected HA Middleware

HP Helion OpenStack Carrier Grade HA middleware is protected by a process monitor that uses death process notification to detect and respawn critical HA processes.

Virtual Machine Performance

HP Helion OpenStack Carrier Grade provides an improved execution environment for virtual machines that contributes to their overall performance when deployed on the compute nodes. Enhancements to the execution environment include:

- Low-latency, bounded delivery of virtual interrupts, and availability of low-latency high resolution timers.
- Option to allocate 2 MB or 1 GB huge memory pages to reduce swapping and TLB lookup misses.
- Improved resource tracking of VMs that use dedicated CPUs, to ensure successful migration and evacuation.
- Support for affining guest NUMA nodes to specific host NUMA nodes.
- Capability to specify specific CPU models to be used by a virtual machine in order to leverage advanced features of the CPU architecture.

Guest VLANs

HP Helion OpenStack Carrier Grade guests can make use of VLANs to encapsulate IP traffic from a single or multiple IP subnets on a virtual Ethernet interface. This capability facilitates the porting of current user applications running on dedicated physical servers using VLANs to a virtualized environment.

HP Helion OpenStack Carrier Grade tenants can define multiple IP subnets on a single tenant network, get their traffic encapsulated on VLAN IDs of their choice, and still benefit from the underlying functionality provided by the AVS and the overall virtualized network infrastructure.

Inventory Management

HP Helion OpenStack Carrier Grade provides complete inventory management of hosts in the OpenStack cloud, allowing the system administrator to install, configure, and maintain the individual servers. The inventory service gives the system administrator the following capabilities:

- Host management
    - discovery of new hosts in the cluster
    - installation of the appropriate load, controller, compute, or storage images
    - configuration of the management, OAM, infrastructure, and provider network interfaces on each host
    - creation and use of data interface and CPU profiles to simplify host configuration
    - configuration of the number of CPUs allocated to the Accelerated Virtual Switch (AVS) on each compute node
    - configuration of huge memory page allocations for VM use
- Administrative operations
    - lock/unlock
    - switch active controller host or service
    - reboot and reset host
    - power-on and power-off
    - software re-installation
- Status reporting
    - admin state
    - operational state
    - availability state
    - uptime
    - real-time command execution reports, such as booting and testing
- Host resources
    - processor, sockets, cores
    - memory
    - disk
    - network interfaces
    - additional hardware devices, such as cryptographic and compression devices

Performance Management Extensions

The Ceilometer service in the HP Helion OpenStack Carrier Grade features improved performance, scalability, and usability. It has been extended to support a CSV-formatted file backend that provides a more traditional Telco Northbound interface for performance management.

Improved Web Administration Interface

HP Helion OpenStack Carrier Grade web administration interface is an enhanced version of the Horizon web interface provided by OpenStack. The enhancements include:

- Automatic page refresh for immediate notification of status changes. This eliminates the need for manual reloading of web pages to access up-to-date information about the cloud
- Admin Overview page with charts and tables providing a high-level overview of cloud resources
    - avg/max/min compute vCPU usage
    - avg/max/min compute memory usage
    - avg/max/min compute disk usage
    - avg/max/min AVS CPU utilization
    - avg/max/min provider network port utilization
    - current host status (available, unavailable, locked, unlocked)
- Improved performance management resource usage web page
    - optimized performance management sample DB queries for improved usability
    - capability to filter on fields in the performance management sample's metadata
    - human-readable legends and chart labels using object names instead of long UUID text strings
    - performance management meters can be selected using their brief descriptions
    - meters for CPU, memory, and disk utilization

Heat Extensions

The OpenStack Heat orchestration service is enhanced to include:

- Support for several missing resource types in the public reference implementation
- Helpful example templates illustrating real reference scenarios

Backup and Restore

Tools and procedures to backup and restore system data and virtual machines.

Patching

Tools and procedures to patch system images to ensure they are always up to date with the latest release and security fixes.

Alarms Generation and Reporting

- alarms on performance management thresholds and cloud-level services and equipment
- SNMPv2c support

Supported OpenStack Services

HP Helion OpenStack Carrier Grade integrates the following OpenStack services into its cloud solution: Nova, Neutron, Keystone, Glance, Cinder, Horizon, Ceilometer, Heat and Swift.

REST API

HP Helion OpenStack Carrier Grade supports the following external REST APIs through its OAM floating IP address:

- OpenStack REST APIs
  - Object Storage API
  - Block Storage API (with HP Helion OpenStack Carrier Grade extensions)
  - Compute API (with HP Helion OpenStack Carrier Grade extensions)
  - Identity API
  - Image Service API
  - Networking API (with HP Helion OpenStack Carrier Grade extensions)
  - Orchestration API
  - Telemetry API (with HP Helion OpenStack Carrier Grade extensions)
- HP Helion OpenStack Carrier Grade REST APIs
  - SysInv API
  - Patching API

Note:

HP Helion OpenStack Carrier Grade extensions use the OpenStack Extension Mechanism to ensure compatibility with existing clients.

HTTP or HTTPS protocol can be supported for these external REST APIs.

HP Helion OpenStack Carrier Grade SDK

The HP Helion OpenStack Carrier Grade Software Development Kit (SDK) provides drivers, daemons, API libraries, and configuration files that you can include in a guest image to leverage the extended capabilities of HP Helion OpenStack Carrier Grade. Available components include:

- Accelerated Kernel Network Drivers—Drivers for improved performance of kernel-based networking VNFs
- Accelerated DPDK Network Drivers—Drivers for high-performance DPDK-based networking VNFs
- VM Resource Scaling—A service for scaling the capacity of a guest server on demand
- Guest Heartbeat—A service for health monitoring of guest applications
- Server Group Messaging—A service for low-bandwidth peer messaging between servers in the same group
- SNMP MIB—Resources for system alarms management
- Sample Heat Orchestration Templates—Resources for deploying and managing stacks of applications or application services

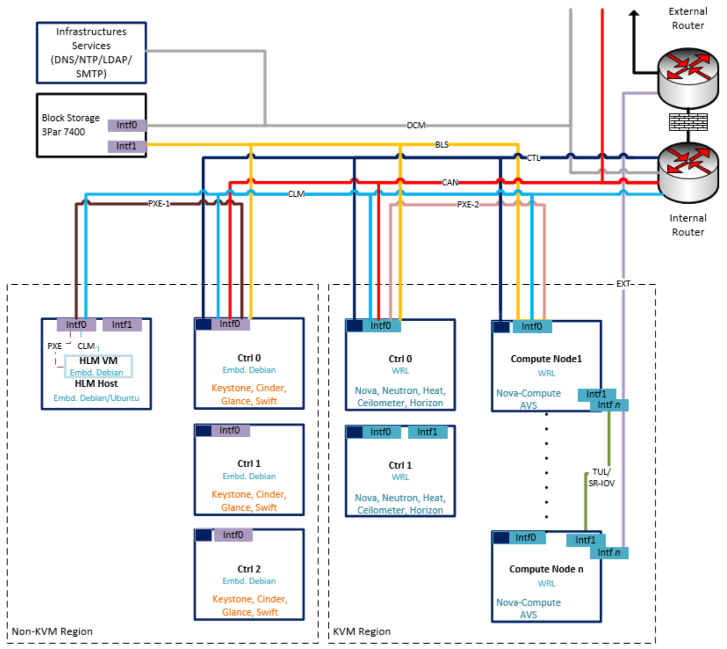
- OpenStack REST API Documentation—Documentation for HP Helion OpenStack Carrier Grade REST APIs and HP Helion OpenStack Carrier Grade extensions to OpenStack REST APIs
- Custom Branding—Resources for customizing the Horizon GUI

For more information, see the *HP Helion OpenStack Carrier Grade Software Development Kit*.

Reference Logical Architecture

The HP Helion OpenStack Carrier Grade architecture supports various types of host, networks, and networking hardware in different configurations. In this documentation, a reference configuration is used for discussion.

A logical view of the reference hardware platform is illustrated in the following figure.



Networks:-
PXE-1 - Boot/Initial Configuration Network for non-KVM region Controllers – Untagged
PXE-2 - Boot/Initial Configuration Network for KVM Region – Untagged
CLM or MGMT - Cloud Management Network (shared network between regions)
CAN or OAM - Consumer Access Network (shared network between regions)
CTL - IPMI/ILO Network (shared network between regions)
BLS or INFRA - Block Store Network (shared network between regions)*
DCM – Data Center Management Network (accessible to KVM region)*
TUL/SR-IOV– Tenant Underlay or VLAN Provider Network for KVM Region
EXT – One of the Provider VLANs as External Network (provides FIP pool for KVM Region)

Routing ACLs

From	To	Reason
CLM	DCM	Access NTP, DNS, LDAP, StoreVirtual APIs etc
CLM	CTL	Access iLO network for managing lifecyle of the node.

CLM, PXE-1/2, BLS, TUL – will use RFC 1918 non-routable IPs. Implement ACLs to ensure no connectivity from DCM or CTL or EXT to the CLM/PXE/BLS/TUL networks.

DCM, CAN, EXT – will use Routable IPs. DCM is very much restricted to corporate network

Intf0	Mapped to Port1/Bonded Pair
Intf1	Mapped to Port2/Bonded Pair
Intf*n*	Multiple Provider Network or SR-IOV Interfaces

Note: This is the minimal interface being used. If need be one can use more than 2 interfaces and dedicate specific logical network to physical networks.

Figure 1: HP Helion OpenStack Carrier Grade Reference Logical Architecture

Note:

For clarity, connections to the internal, infrastructure, and board management networks are illustrated for just one host of each type.

HLM

Helion Lifecycle Management deploys and manages the non-KVM Region controllers. HLM provides input files to deploy the KVM region of the cloud. HLM provisions the node on PXE-1 network and configures nodes on CLM network.

Non-KVM Region Controller

The Runs the HP Helion OpenStack Carrier Grade services needed to manage the cloud infrastructure: Keystone with LDAP backend, Glance with Swift backend, and Cinder with 3Par as storage backend. Some of these services are shared with KVM Region of the cloud. Controller nodes run the services in carrier grade mode, that is, as a high-availability cluster. The controller manages other hosts on CLM network, and provides API interfaces to clients over CAN (Consumer Access Network) or OAM (Operations, Administration and Management) network.

3PAR

HP 3PAR StoreServ storage is a storage array that is used as a backend for the HP Block Storage (Cinder) service. This array must connect to both the CLM (Cloud Management or internal management) and BLS (Block Store or Infrastructure) networks.

KVM Region Controller

The KVM region controller is a real-time control plane for the HP Compute (nova) service and HP Network Operation (Neutron) service. The controller nodes run the services in carrier grade mode, that is, as a high-availability cluster.

Compute

The real-time compute nodes are based on Wind River Linux(WR) with Accelerated Virtual Switch (AVS) networking components. The nodes run HP Helion OpenStack Carrier Grade compute services and host the virtual machines. A compute node connects to the controller nodes over CLM network, and to the provider networks using its data interfaces. Compute nodes also have connectivity to BLS enabling attaching a Cinder volume to the VM guest.

Infratructure Services

A block of servers provide NTP, SMTP, LDAP and other infrastructure services to the Cloud.

Provider Network

A Layer 2 virtual network used to provide the underlying network connectivity needed to instantiate the tenant networks. Multiple provider networks may be configured as required, and realized over the same or different physical networks. Access to external networks is typically granted to the compute nodes via the provider network. The extent of this connectivity, including access to the open Internet, is application dependent.

Provider networks are created by the HP Helion OpenStack Carrier Grade administrator to make use of an underlying set of resources on a physical network. They can be created as being of one of the following types:

flat

A provider network mapped entirely over the physical network. The physical network is used as a single Layer 2 broadcast domain. Each physical network can realize at most one flat provider network.

A provider network of this type supports at most one tenant network, even if its corresponding shared flag is enabled.

VLAN

A provider network implemented over a range of IEEE 802.1Q VLAN identifiers supported by the physical network. This allows for multiple provider networks to be defined over the same physical network, all operating over non-overlapping sets of VLAN IDs.

A set of consecutive VLAN IDs over which the provider network is defined is referred to as a network's **segmentation range**. A provider network can have more than one segmentation range. Each VLAN ID in a segmentation range is used to support the implementation of a single tenant network.

A segmentation range can be shared by multiple tenants if its **shared** flag is set. Otherwise, the segmentation range supports tenant networks belonging to a single specified tenant.

VXLAN

A provider network implemented over a range of VXLAN Network Identifiers (VNIs.) This is similar to the VLAN option, in that it allows multiple provider networks to be defined over the same physical network using unique VNIs defined in segmentation ranges. In addition, VXLAN provides a Layer 2 overlay scheme on Layer 3 networks, enabling connectivity between Layer 2 segments separated by one or more Layer 3 routers.

Tenant Network

A virtual network associated with a tenant. A tenant network is instantiated on a compute node, and makes use of a provider network, either directly over a flat network, or using technologies such as VLAN and VXLAN.

Tenant networks use the high-performance virtual L2 switching capabilities built into the HP Helion OpenStack Carrier Grade software stack of the compute node. They provide switching facilities to the virtual service instances, to communicate with external resources and with other virtual service instances running on the same or different compute nodes.

When instantiated over a provider network of the VLAN or VXLAN type, the VLAN ID or VNI for the tenant network is assigned automatically. The allocation algorithm selects the lowest available ID from any segmentation range owned by the tenant. If no such ID is available, it selects the lowest available ID from any shared segmentation range. The system reports an error when no available ID is found.

Tenant networks created by the administration can also be configured to use a pre-selected VLAN ID or VNI. This can be used to extend connectivity to external networks.

Controller Floating IP Address

A unique IP address shared by the cluster of controller nodes. Only the master controller node is active on this address at any time. The IP address is floating in the sense that it is automatically transferred from one controller node to the other, as dictated by the high-availability directives of the cluster.

The controller cluster has two floating IP addresses, one facing the OAM network, only seen by the web interface SSH administration clients and REST APIs, and another facing the internal management network, only seen by the compute nodes.

Link Aggregation (LAG) or Aggregated Ethernet (AE)

A mechanism that allows multiple parallel Ethernet network connections between two hosts to be used as a single logical connection. The HP Helion OpenStack Carrier Grade supports LAG connections on all its Ethernet connections for the purpose of protection (fault-tolerance) only. Different modes of operation are supported. For details, see the *Installing HP Helion OpenStack Carrier Grade*.

OAM Network L2 Switch(es)

One or more switches used to provide an entry point into the OAM network.

Note:

The OAM ports on the controller do not support VLAN tagging. If needed, port- or MAC-based VLANs defined on the L2 switch can be used to steer OAM traffic appropriately.

Provider Network L2 Switches

Provide the entry point into the provider networks. It is through these L2 switches that the compute nodes get integrated as active end points into each of the provider networks.

Edge Router

Provides connectivity to external networks as needed by controller and compute nodes.

Reachability to the open Internet is not mandatory, but strictly application-dependent. Guest applications running on the compute nodes may need to access, or be reachable from, the Internet. Additionally, access to the OAM Network from external networks might be desirable.

Web Administration Interface

Provides the HP Helion OpenStack Carrier Grade main management interface. It is available using any W3C standards-compliant web browser, from any point within the OAM Network where the OAM floating IP address is reachable.

About Tenants (Projects) and Users

Tenants and users are system resources managed by the OpenStack Keystone service.

Tenants are the core resource structure on which all end user services are managed. They are isolated resource containers consisting of networks, storage volumes, images, virtual machines, authentication keys, and users.

When the HP Helion OpenStack Carrier Grade is deployed, two default tenants are created: **admin** and **services**. They are used to group resources to be associated with the user **admin** and the cloud services, respectively.

Note:

Earlier versions of OpenStack used the term *project* instead of *tenant*. Because of this legacy terminology, the web administration interface uses both terms, and some command-line tools use **--project_id** when a tenant ID is expected.

Users are system resources that can operate on one or more tenants, within the constraints of a particular role. For each user, the Keystone service maintains a list of (tenant, role) tuples, which are used to determine the tenants the user can operate on, and the role the user should play on each of them.

In the default installation of the HP Helion OpenStack Carrier Grade, several users are already defined. Each of the OpenStack services, such as Nova and Neutron, exist as system users. They all operate on the default tenant **services**.

The Keystone **admin** user is associated with the **admin** tenant. This user has administrator privileges for creating, modifying, and deleting OpenStack resources, including creating other tenants and users.

Note: In this document, after this point, all references to contoller-0 and controller-1 are specific to the KVM region only.

Linux User Accounts

Linux user accounts are available on all hosts for administration, operation, and general hosting purposes. They have no relation with the cloud user tenant accounts created using the web management interface, the CLI commands, or the APIs.

You can log in remotely as a Linux user by using an SSH connection and specifying the OAM floating IP address as the target. This establishes a connection to the currently active controller. If the OAM floating IP address moves from one controller node to another, the SSH session is blocked. To ensure access to a particular controller regardless of its current role, specify the controller physical address instead.

The wrsroot Account

This is a local, per-host, account created automatically in the KVM region when a new host is provisioned. On controller nodes, this account is available even before the **region_config** script is executed during the installation.

The default initial password is **wrsroot**.

- The initial password must be changed immediately when you log in to **controller-0** for the first time. For details, see the *HP Helion OpenStack Carrier Grade Software Installation Guide*.
- After five consecutive unsuccessful login attempts, further attempts are blocked for about five minutes.

Subsequent password changes must be executed on the active controller to ensure that they propagate to all other hosts in the cluster. Otherwise, they remain local to the host where they were executed, and are overwritten on the next reboot to match the password on the active controller.

From the **wrsroot** account, you can execute commands requiring different privileges.

- You can execute non-root level commands as a regular Linux user directly.

  If you do not have sufficient privileges to execute a command as a regular Linux user, you may receive a permissions error, or in some cases, the command may be reported as not found.
- You can execute root-level commands as the **root** user.

  To become the root user, use the `sudo` command to elevate your privileges, followed by the command to be executed.

  If a password is requested, provide the password for the **wrsroot** account.
- You can execute OpenStack administrative commands as the Keystone **admin** user.

Source the script `/etc/nova/openrc` while working on the active controller to acquire Keystone administrative privileges.

```
$ source /etc/nova/openrc
[wrsroot@controller-0 ~(keystone_admin)]$
```

The system prompt changes to indicate the new acquired privileges.

Note:

The default Keystone prompt includes the host name and the current working path. For simplicity, this guide uses the following generic prompt instead:

```
~(keystone_admin)$
```

For more information on the active controller, see *Controller Nodes and High Availability* on page 110.

Local User Accounts

You can manage regular Linux user accounts on any host in the cluster using standard Linux commands. New accounts created on one host are not automatically propagated to other hosts.

Password changes are not enforced automatically on first login, and they are not propagated by the system (with the exception of the **wrsroot** account, for which passwords changed on the active controller are propagated to other hosts.) Any special considerations for these accounts, if any, must be configured manually.

Local user accounts can be added to the *sudoers* list using the `visudo` command. They can also source the script `/etc/nova/openrc` to become OpenStack administrators when working on the active controller.

Backup and restore operations of home directories and passwords must be done manually. They are ignored by the system backup and restore utilities. See *System Backups* on page 166 for further details.

LDAP User Accounts

You can create regular Linux user accounts using the HP Helion OpenStack Carrier Grade LDAP service. LDAP accounts are centrally managed; changes made on any host are propagated automatically to all hosts on the cluster.

In other respects, LDAP user accounts behave as any local user account. They can be added to the sudoers list, and can acquire OpenStack administration credentials when executing on the active controller.

LDAP user accounts share the following set of attributes:

- The initial password is the name of the account.
- The initial password must be changed immediately upon first login.
- Requirements for new passwords include:
  - to be at least eight characters long
  - to have at least one lowercase character
  - to differ in at least three characters from the previous password
  - not to be evidently trivial to guess, such as a2345678, or a reversed version of the old password
- Login sessions are logged out automatically after about 15 minutes of inactivity.
- The accounts block following five consecutive unsuccessful login attempts. They unblock automatically after a period of about five minutes.
- Home directories are created dynamically on first login. Note that home directories for local user accounts are created when the accounts are created.
- All authentication attempts are recorded on the file `/var/log/auth.log` of the target host.
- Home directories and passwords are backed up and restored by the system backup utilities.

The following LDAP user accounts are available by default on newly deployed hosts, regardless of their personality:

admin

A cloud administrative account, comparable in purpose to the default **admin** account used in the web management interface.

This user account operates on a restricted Linux shell, with very limited access to native Linux commands. However, the shell is preconfigured to have administrative access to OpenStack commands, including the available HP Helion OpenStack Carrier Grade CLI extensions.

operator

A host administrative account. It has access to all native Linux commands and is included in the sudoers list.

For increased security, the **admin** and **operator** accounts must be used from the console ports of the hosts; no SSH access is allowed.

Managing LDAP User Accounts

Although the scope of operations for the LDAP user accounts is local, that is, they operate on the target host exclusively, management of these accounts operates at the cluster level. This means that operations such as password change, and addition or removal of users, are applied to the entire cluster. For example, a password change executed while logged into controller-0, is effective immediately on all other hosts in the cluster.

Centralized management is implemented using two LDAP servers, one running on each controller node. LDAP server synchronization is automatic using the native LDAP content synchronization protocol.

A set of LDAP commands is available to operate on LDAP user accounts. The commands are installed in the directory `/usr/local/sbin`, and are available to any user account in the sudoers list. Included commands are `lsldap`, `ldapadduser`, `ldapdeleteuser`, and several others starting with the prefix `ldap`. Use the command option --help on any command to display a brief help message, as illustrated below.

```
$ ldapadduser --help
Usage : /usr/local/sbin/ldapadduser <username> <groupname | gid> [uid]
$ ldapdeleteuser --help
Usage : /usr/local/sbin/ldapdeleteuser <username | uid>
```

Network Requirements

The networking environment of the HP Helion OpenStack Carrier Grade incorporates up to five types of network: the internal management network, the OAM network, one or more provider networks, an optional infrastructure network, and an optional board management network. Operational requirements for each network are described in the following sections.

PXE Network

The PXE network must be implemented as a single, dedicated, Layer 2 broadcast domain for the exclusive use of each HP Helion OpenStack Carrier Grade cluster. Sharing of this network by more than one HP Helion OpenStack Carrier Grade cluster is not a supported configuration.

During the HP Helion OpenStack Carrier Grade software installation process, several network services such as BOOTP, DHCP, and PXE, are expected to run over the PXE network. These services are used to bring up the different hosts to an operational state. Therefore, it is mandatory that this network be operational and available in advance, to ensure a successful installation.

On each host, the PXE network can be implemented using a 1Gb or 10 Gb Ethernet port. In either case, requirements for this port are:

- it must be capable of PXE-booting
- can be used by the motherboard as a primary boot device

Cloud Management Network

This network must be implemented as a single, dedicated, Layer2 broadcase domain for the exclusive use of each HP Helion OpenStack Carrier Grade cluster. Sharing of this network by more than one HP Helion OpenStack Carrier Grade cluster is not a supported configuration. This is typically configured by installer as a VLAN sub interface on PXE network. Allows inter service communication, configuration on this network.

Infrastructure Network

The infrastructure network must be implemented as a single, dedicated, Layer 2 broadcast domain for the exclusive use of each HP Helion OpenStack Carrier Grade cluster. Sharing of this network by more than one HP Helion OpenStack Carrier Grade cluster is not a supported configuration.

The infrastructure network can be implemented as a 10 Gb Ethernet network. In its absence, all infrastructure traffic is carried over the internal management network.

DCM Network

You should ensure that the following services are available on the DCM (Data center management network) Network and available through the CLM Network:

DNS Service

Needed to facilitate the name resolution of servers reachable on the OAM Network.

The HP Helion OpenStack Carrier Grade can operate without a configured DNS service. However, a DNS service should be in place to ensure that links to external references in the current and future versions of the web administration interface work as expected.

NTP Service

The Network Time Protocol (NTP) can be optionally used by the HP Helion OpenStack Carrier Grade controller nodes to synchronize their local clocks with a reliable external time reference. However, it is strongly suggested that this service be available, among other things, to ensure that system-wide log reports present a unified view of the day-to-day operations.

The HP Helion OpenStack Carrier Grade compute nodes always use the controller nodes as the de-facto time server for the entire HP Helion OpenStack Carrier Grade cluster.

Provider Network

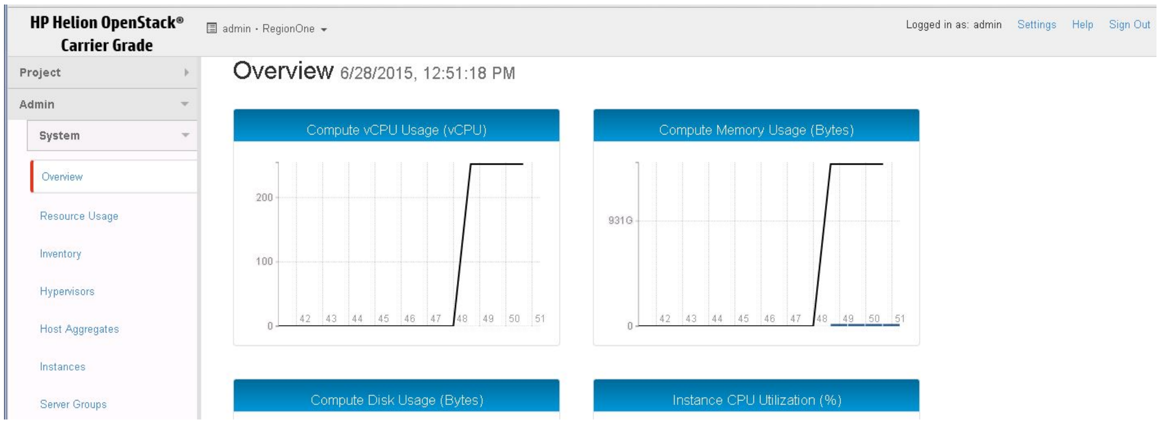
There are no specific requirements for network services to be available on the provider network. However, you must ensure that all network services required by the guests running in the compute nodes are available. For configuration purposes, the compute nodes themselves are entirely served by the services provided by the controller nodes over the internal management network.

Board Management CTL (IPMI Control) Network

External access to the board management network, the board management modules are assigned IP addresses accessible from the OAM network, and the controller uses the OAM network to connect to them.

Dashboard Controls

The HP Helion OpenStack Carrier Grade web administration interface provides a dashboard for managing all aspects of the system.


HP Helion OpenStack® Carrier Grade
admin • RegionOne
Logged in as: admin
Settings
Help
Sign Out
Project
Admin
System
Overview
Resource Usage
Inventory
Hypervisors
Host Aggregates
Instances
Server Groups
Overview 6/28/2015, 12:51:18 PM
Compute vCPU Usage (vCPU)
Compute Memory Usage (Bytes)
Compute Disk Usage (Bytes)
Instance CPU Utilization (%)

The dashboard consists of a left-hand pane containing menus, and a right-hand pane containing information for the currently selected menu item. It also shows the current user, the current tenant (project), the system ID, and the system time, and includes options for setting user preferences, viewing help, and signing out.

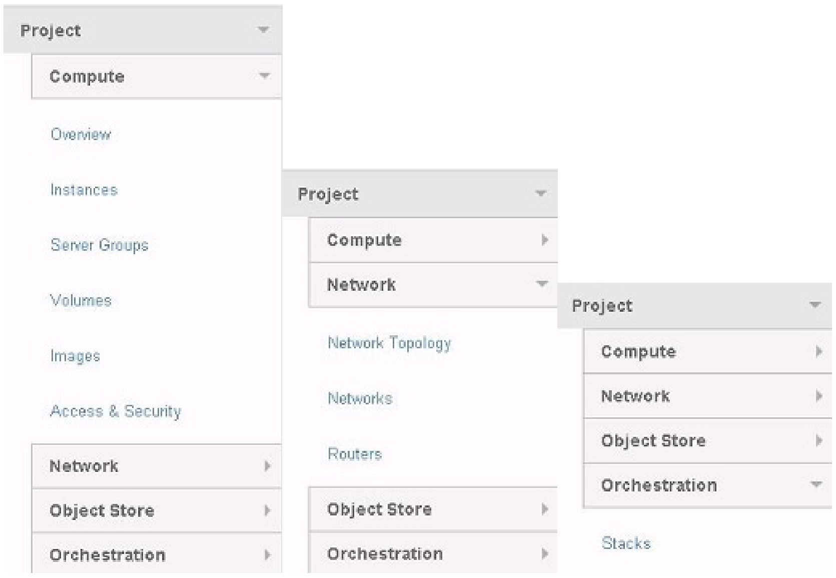
The menu pane contains tabs for different menus. The selection depends on the current user.

- The **Project** (tenant) tab is available for users assigned to one or more tenants as a **member**.
- The **Admin** tab is available for users assigned as **admin** for the HP Helion OpenStack Carrier Grade.

The Project Menu

The **Project** menu contains selections for managing the currently selected tenant (project).

The **Current Tenant** is identified at the top of the **Information Pane**. Users with membership in more than one tenant can select a different tenant using a drop-down list.



The menu is divided into three sections.

Compute

Menu item	**Description**	**Reference**
Overview	Charts and statistics for monitoring compute node resource usage for instances associated with the tenant (project).	
Instances	Controls for managing instances associated with the tenant, including controls for creating snapshots.	*Managing Virtual Machines* on page 113
Server Groups	Controls for managing server groups associated with the tenant.	*Server Groups* on page 125
Volumes	Controls for managing virtual disk volumes associated with the tenant's instances.	*Storage Planning* on page 46
Images	Controls for managing and launching images, and creating volumes for images.	
Access & Security	Controls for network protocol and port security, SSH-based access to virtual machines, API access to services, and floating IP address allocations.	

Network

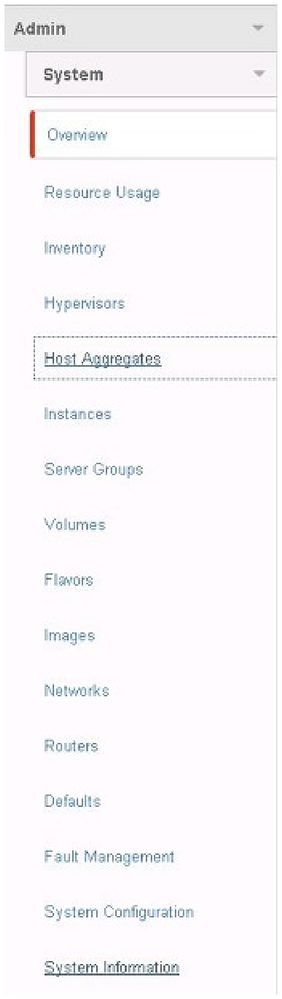
Menu item	**Description**	**Reference**
Network Topology	Configuration charts depicting system networks, instances, and network connections between instances.	
Networks	Controls for managing networks for the current tenant, and viewing QoS (Quality of Service) policies or weightings for tenants of which the user is a member.	*Network Planning* on page 34
Routers	Controls for managing virtual routers. Tenant members can create and delete virtual routers, view router details and delete interfaces, and clear gateways.	*Virtual Routers* on page 36

Orchestration

Menu item	**Description**	**Reference**
Stacks	Details for existing services (stacks), and controls for creating new services (launching stacks). Service details include topologies, resource allocations, and event histories.	*Managing Stacks* on page 171

The Admin Menu

The **Admin** menu contains selections for managing tenants (projects), tenant resources, and users. It is available when **admin** is selected as the **Current Tenant**.



The menu contains one section.

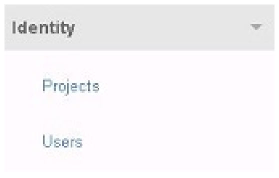
System

Menu item	Description	Reference
Overview	Performance charts for system health monitoring, including hosts status, provider-network port utilization, and compute node processing, memory, and disk usage.	*Cluster Overview* on page 74
Resource Usage	Tools for performing Ceilometer database queries using real-time or collected data, to support detailed performance analysis.	*Resource Usage* on page 76
Inventory	Controls for managing systems, hosts, and standardized CPU, port, or storage profiles that can be applied to hosts.	*Managing Hardware Inventory* on page 81
Host Aggregates	Controls for managing host aggregates and availability zones.	*Host Aggregates* on page 111

Menu item	Description	Reference
Hypervisors	Charts for monitoring hypervisor resource usage on compute nodes.	
Instances	Controls for managing virtual-machine instances.	*Managing Virtual Machines* on page 113
Server Groups	Controls for managing server groups across all tenants. Server groups are collections of instances sharing common attributes.	*Server Groups* on page 125
Volumes	Controls for managing virtual disk volumes available for use with instances. The virtual volumes are implemented using *storage volumes* defined in the system.	*Storage Planning* on page 46
Flavors	Controls for managing standardized processor, disk, and memory complements (flavors) that can be applied to virtual machines.	*Virtual Machine Flavors* on page 114
Images	Controls for managing disk images used to initialize and configure virtual machines.	
Networks	Controls for managing tenant networks, provider networks, and QoS (Quality of Service) policies or tenant weightings.	*Network Planning* on page 34
Routers	Controls for managing virtual routers. Administrators can list the virtual routers created for tenants, view router and interface details, and delete routers.	*Virtual Router Administration* on page 39
Defaults	Controls for viewing and setting the default quota values for new tenants.	
Fault Management	System alarms and customer logs	*Fault Management* on page 135
System Configuration	System configuration updates	*System Configuration Management* on page 57
System Information	Status information for services and network agent processes, availability zones, and host aggregates.	*Controller Nodes and High Availability* on page 110

The Identity Menu

The **Identity** menu contains selections for managing tenants (projects) and users. It is available when **admin** is selected as the **Current Tenant**.



The menu contains one section.

Identity

Menu item	Description	Reference
Projects	Controls for managing tenants.	
Users	Controls for managing user accounts.	

Chapter 2

Configuration Planning

Topics:

System configuration options are available when installing the HP Helion OpenStack Carrier Grade software. You should prepare a set of selected values and features ready to use which are applicable to a specific deployment scenario.

Ethernet Interfaces

Ethernet interfaces, both physical and virtual, play a key role in the overall performance of the virtualized network. Therefore, it is important to understand the available interface types, their configuration options, and their impact on network design.

On compute node data interfaces, the HP Helion OpenStack Carrier Grade supports Ethernet Network Interface Cards (NIC) based on the following chip sets:

- Intel 82599 (NIANTIC) 10 G
- Intel I350 (Powerville) 1G
- Mellanox Technologies MT27500 Family [ConnectX-3]

The following is the list of supported virtual network interfaces:

- Accelerated Virtual Port (AVP)
- Intel e1000 emulation (e1000)
- NE2000 emulation (ne2k_pci)
- AMD PCNet/PCI Emulation (pcnet)
- Realtek 8139 emulation (rtl8139)
- VirtIO Network (virtio)
- PCI Passthrough Device
- SR-IOV

About LAG/AE Interfaces

Ethernet interfaces in a LAG group should be attached to the same L2 switch to provide link protection. For more information about the different LAG modes see the *HP Helion OpenStack Carrier Grade Software Installation Guide*.

Ethernet Interface Configuration

You can review and modify the configuration for physical or virtual Ethernet interfaces using the web administration interface or the CLI.

Physical Ethernet Interfaces

The physical Ethernet interfaces on HP Helion OpenStack Carrier Grade nodes are configured to use the following networks:

- the internal management network
- the external OAM network
- the infrastructure network, if present
- one or more data networks

A single interface can optionally be configured to support more than one network using VLAN tagging (see *Shared (VLAN) Ethernet Interfaces* on page 23). In addition, the management or infrastructure interfaces, or both, can be configured with an additional data network (see the *Installing HP Helion OpenStack Carrier Grade*).

On the controller nodes, all Ethernet interfaces are configured automatically when the nodes are initialized, based on the information provided in the controller configuration script (see the *HP Helion OpenStack Carrier Grade Installation Guide: The Controller Configuration Script*). On compute nodes, the Ethernet interfaces for the management network are configured automatically. The remaining interfaces require manual configuration. Interface configurations are summarized in the following table.

Note:

If a network attachment uses LAG, the corresponding interfaces on the compute nodes must also be configured manually to specify the interface type.

Table 1: Interface Configuration by Network Type

	Controller	Compute
Mgmt	Configured automatically	Configured automatically
OAM	Configured automatically	Not used
Infra	Configured automatically	Configured manually
Data	Not used	Configured manually

You can review and modify physical interface configurations from the web administration interface or the CLI. For more information, see the *HP Helion OpenStack Carrier Grade Installation Guide: Editing Interface Settings*, the *HP Helion OpenStack Carrier Grade Installation Guide: Creating Data Interfaces*, and the *HP Helion OpenStack Carrier Grade Installation Guide: Command-line Installation*.

You can also save the interface configurations for a particular node to use as a *profile* or template when setting up other nodes. For more information, see *Interfaces* on page 107.

Virtual Ethernet Interfaces

The virtual Ethernet interfaces for guest VMs running on HP Helion OpenStack Carrier Grade are defined when an instance is launched. They connect the VM to *tenant networks*, which are virtual networks defined over *provider networks*, which in turn are abstractions associated with physical interfaces assigned to data networks on the compute nodes. Several virtual interface driver options are available. For more information about launching instances and connecting their virtual Ethernet interfaces, see the *HP Helion OpenStack Carrier Grade Reference Deployment Scenarios*. The chapters on *Deploying the Bridging Scenario* and *Deploying the Routing Scenario* contain detailed examples for defining virtual Ethernet interfaces.

You can also connect a VM directly to a physical interface using PCI passthrough (see *PCI Passthrough Ethernet Interfaces* on page 28) or SR-IOV (see *SR-IOV Ethernet Interfaces* on page 31).

Shared (VLAN) Ethernet Interfaces

The management, OAM, infrastructure, and data networks can share Ethernet or aggregated Ethernet interfaces using VLAN tagging.

As explained in *Network Planning* on page 34, the internal management network cannot use VLAN tagging. However, the OAM, infrastructure, and data networks can use VLAN tagging, allowing them to share an Ethernet or aggregated Ethernet interface with other networks.

Note:

You cannot configure a data VLAN or add a data network on an aggregated Ethernet interface.

For a system using all four networks, the following arrangements are possible:

- One interface for the management network, another interface for the OAM network, a third for the infrastructure network, and one or more additional interfaces for data networks.
- One interface for the management network, and a second interface for either the OAM or infrastructure network, with the remaining networks implemented using VLAN tagging on either interface.
- One interface for the management network, and a second carrying the OAM and infrastructure networks, both implemented using VLAN tagging, with data networks implemented on either or both interfaces using VLAN tagging.
- One interface for the management network, with the OAM, infrastructure, and data networks also implemented on it using VLAN tagging.

Note:

Data networks implemented using VLAN tagging are not compatible with VLAN-based provider networks. (Stacked VLANs are not supported.). To support VLAN provider networks, you can configure a data network on a management or infrastructure interface by editing the interface and selecting both types of network, ane then selecting the VLAN provider network. For more information, see the Network Type discussion in the *HP Helion OpenStack Carrier Grade Installation Guide: Interface Settings*.

Options to share an interface using VLAN tagging are presented during the configuration controller script (see the *HP Helion OpenStack Carrier Grade Installation Guide: The Controller Configuration Script*). To attach an interface to other networks after configuration, you can edit the interface; for details, see the *HP Helion OpenStack Carrier Grade Installation Guide: Attaching to Networks Using a VLAN Interface*.

You can also use the command line by logging into the active controller and becoming the Keystone **admin** user, and then using a command such as the following for each node:

```
~(keystone_admin)$ system host-if-add infra0 -V 22 -nt infra vlan eth1
+-------------------+--------------------------------------+
| Property          | Value                                |
+-------------------+--------------------------------------+
| ifname            | infra0                               |
| networktype       | infra                                |
| iftype            | vlan                                 |
| ports             | []                                   |
| providernetworks  | None                                 |
| imac              | 08:00:27:f2:0d:68                    |
| imtu              | 1500                                 |
| aemode            | None                                 |
| schedpolicy       | None                                 |
| txhashpolicy      | None                                 |
| uuid              | 8ca9854e-a18e-4a3c-8afe-f050da702fdf |
| ihost_uuid        | 3d207384-7d30-4bc0-affe-d68ab6a00a5b |
| vlan_id           | 22                                   |
| uses              | [u'eth1']                            |
| used_by           | []                                   |
| created_at        | 2015-02-04T16:23:28.917084+00:00     |
| updated_at        | None                                 |
+-------------------+--------------------------------------+
```

This example configures the **eth1** interface on **compute-0** to connect to the infrastructure network using VLAN ID 22.

To display VLAN information as well as dependencies, use a command such as the following:

```
~(keystone_admin)$ system host-if-list controller-0
...+--------+------...+----------+---------+-----------+------------
+-------------+...
...| name   | netwo...| type     | vlan id | ports     | uses i/f   | used
 by i/f |...
...+--------+------...+----------+---------+-----------+------------
+-------------+...
...| infra0 | infra...| vlan     | 22      | []        | [u'mgmt0'] | []
      |...
...| oam0   | oam  ...| ethernet | None    | [u'eth0'] | []         | []
      |...
...| mgmt0  | mgmt ...| ethernet | None    | [u'eth1'] | []         |
 [u'infra0'] |...
...+--------+------...+----------+---------+-----------+------------
+-------------+...
```

The output lists all interfaces and associated networks. For each network that uses VLAN tagging, the **vlan id** is shown, as well as the shared interface used (in the **uses i/f** column). For shared interfaces, the names of the networks that use VLAN tagging on the interface are shown (in the **used by i/f** column).

For a LAG interface, the dependencies are shown as follows.

```
...+--------+------...+----------+--------+----------+-----------
+-------------+...
...| name   | netwo...| type     | vlan id | ports    | uses i/f   | used
 by i/f |...
...+--------+------...+----------+--------+----------+-----------
+-------------+...
...| oam0   | oam  ...| ethernet | None    | [u'eth0'] | []         | []
      |...
...| bond0  | mgmt ...| ae       | None    | []        | [u'eth1']  | []
      |...
...| eth1   | None ...| ethernet | None    | [u'eth1'] | []         |
 [u'bond0']  |...
...| infra0 | infra...| ethernet | None    | [u'eth3'] | []         | []
      |...
...+--------+------...+----------+--------+----------+-----------
+-------------+...
```

To see all available interfaces, add the -a flag.

```
~(keystone_admin)$ system host-if-list -a controller-0
...+--------+------...+----------+--------+----------+-----------
+-------------+...
...| name   | netwo...| type     | vlan id | ports    | uses i/f   | used
 by i/f |...
...+--------+------...+----------+--------+----------+-----------
+-------------+...
...| eth3   | None ...| ethernet | None    | [u'eth3'] | []         | []
      |...
...| infra0 | infra...| vlan     | 22      | []        | [u'mgmt0'] | []
      |...
...| eth2   | None ...| ethernet | None    | [u'eth2'] | []         | []
      |...
...| oam0   | oam  ...| ethernet | None    | [u'eth0'] | []         | []
      |...
...| mgmt0  | mgmt ...| ethernet | None    | [u'eth1'] | []         |
 [u'infra0'] |...
...+--------+------...+----------+--------+----------+-----------
+-------------+...
```

The Ethernet MTU

The Maximum Transmission Unit (MTU) of an Ethernet frame is a configurable attribute in the HP Helion OpenStack Carrier Grade. Changing its default size must be done in coordination with other network elements on the Ethernet link.

In HP Helion OpenStack Carrier Grade, the Maximum Transmission Unit (MTU) refers to the largest possible payload on the Ethernet frame on a particular network link. The payload is enclosed by the Ethernet header (14 bytes) and the CRC (4 bytes), resulting in an Ethernet frame that is 18 bytes longer than the MTU size.

The original IEEE 802.3 specification defines a valid standard Ethernet frame size to be from 64 to 1518 bytes, accommodating payloads ranging in size from 46 to 1500 bytes. Ethernet frames with a payload larger than 1500 bytes are considered to be jumbo frames.

For a VLAN network, the frame also includes a 4-byte VLAN ID header, resulting in a frame size 22 bytes longer than the MTU size.

For a VXLAN network, the frame is either 54 or 74 bytes longer, depending on whether IPv4 or IPv6 protocol is used. This is because, in addition to the Ethernet header and CRC, the payload is enclosed by an IP header (20 bytes for Ipv4 or 40 bytes for IPv6), a UDP header (8 bytes), and a VXLAN header (8 bytes).

In the HP Helion OpenStack Carrier Grade, you can configure the MTU size for the following interfaces and networks:

- The management, OAM, and infrastructure network interfaces on the controller. The MTU size for these interfaces is set during initial installation. You can update the infrastructure interface MTU for the controller from the web administration interface or the CLI.
- Data interfaces on compute nodes. For more information, see the *Compute Node* entry in *Reference Logical Architecture* on page 9.
- Provider networks. For more information, see the *Provider Networks* entry in *Reference Logical Architecture* on page 9.

In all cases, the default MTU size is 1500. The minimum value is 576, and the maximum is 9216.

Since data interfaces are defined over physical interfaces connecting to provider networks, it is important to consider the implications of modifying the default MTU size:

- The MTU sizes for a data interface and the corresponding Ethernet interface on the edge router or switch must be compatible. You must ensure that each side of the link is configured to accept the maximum frame size that can be delivered from the other side. For example, if the data interface is configured with a MTU size of 9216 bytes, the corresponding switch interface must be configured to accept a maximum frame size of 9238 bytes, assuming a VLAN tag is present.

  The way switch interfaces are configured varies from one switch manufacturer to another. In some cases you configure the MTU size directly, while in some others you configure the maximum Ethernet frame size instead. In the latter case, it is often unclear whether the frame size includes VLAN headers or not. In any case, you must ensure that both sides are configured to accept the expected maximum frame sizes.
- For a VXLAN network, the additional IP, UDP, and VXLAN headers are invisible to the data interface, which expects a frame only 18 bytes larger than the MTU. To accommodate the larger frames on a VXLAN network, you must specify a larger nominal MTU on the data interface. For simplicity, and to avoid issues with stacked VLAN tagging, some third party vendors recommend rounding up by an additional 100 bytes for calculation purposes. For example, to attach to a VXLAN provider network with an MTU of 1500, a data interface with an MTU of 1600 is recommended.
- A provider network can only be associated with a compute node data interface with an MTU of equal or greater value.
- The MTU size of a compute node data interface cannot be modified to be less than the MTU size of any of its associated provider networks.
- The MTU size of a provider network can be modified only when there are no tenant networks that depend on the provider network.
- The MTU size of a provider network is automatically propagated up to any derived tenant networks.
- The Neutron L3 and DHCP agents automatically propagate the MTU size of their networks to their Linux network interfaces.
- The Neutron DHCP agent makes the option interface-mtu available to any DHCP client request from a virtual machine. The request response from the server is the current interface's MTU size, which can then be used by the client to adjust its own interface MTU size.
- The AVS prevents any AVP-Kernel or AVP-DPDK instances from setting a link MTU size that exceeds the maximum allowed on the corresponding tenant network. No such verification is available for virtio VM instances.

You can configure the MTU size from the web management interface when creating or modifying data interfaces and provider networks. On the CLI, use the option --mtu to modify the MTU size. For example:

```
~(keystone_admin)$ neutron providernet-create common-net --type vlan --mtu
 9216
```

This command creates a provider network named **common-net** with an MTU size of 9216 bytes.

Address Filtering on Virtual Interfaces

The AVS on compute nodes can be configured to filter out packets based on source MAC address.

MAC addresses for virtual network interfaces on virtual machines are dynamically allocated by the system. For most scenarios, the assigned MAC addresses are expected to be used on all outgoing packets from the virtual machine instances. However, there are scenarios where the source MAC address is not expected to match the original assignment, such as when a L2 switch is implemented internally on the virtual machine.

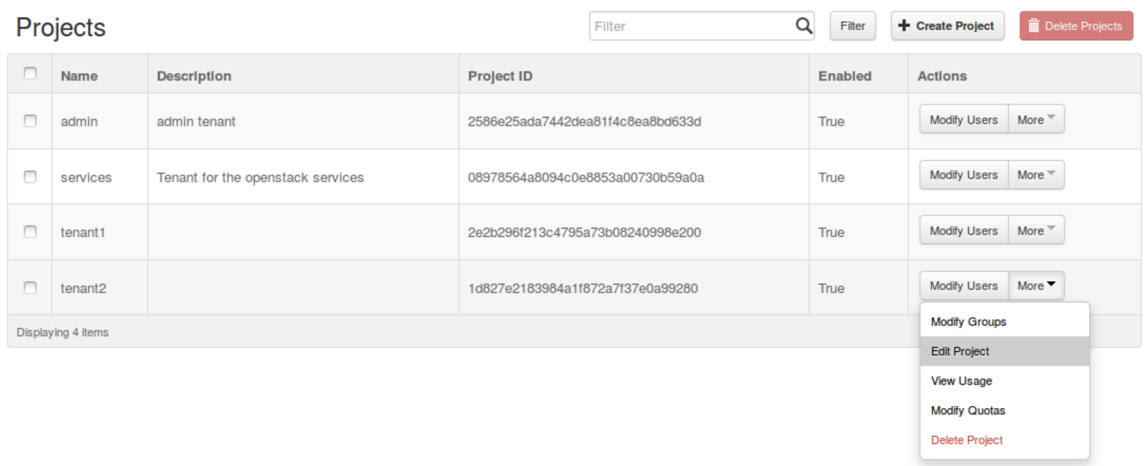
By default, the AVS on compute nodes accepts any source MAC address on the attached virtual network interfaces. However, it can be configured to filter out all incoming packets with non-system-generated source MAC address, if required. When evaluating the use of the filtering capability, you must consider the following:

- Source MAC address filtering can be enabled and disabled by the administrator user only, not by tenants.
- Filtering is enabled on a per-tenant basis only. Higher granularity, such as per-instance filtering, is not supported.
- When enabled, source MAC address filtering applies to all new virtual interfaces created by the Neutron service. Address filtering is not active on virtual interfaces created before filtering is enabled.

Use the following command to enable source MAC address filtering:

```
~(keystone_admin)$ neutron setting-update --tenant-id=<TENANTID> \
--mac-filtering={True|False}
```

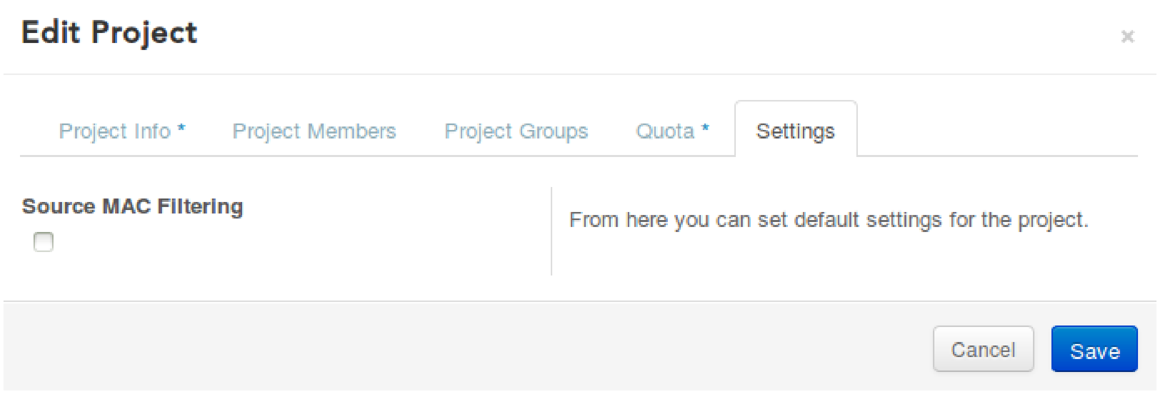
Filtering can be enabled or disabled from the web management interface. As the administrator, select **Projects** on the **Admin** tab to display the **Projects** window. Then select the option Edit Project from the More drop-down menu of the desired tenant, as illustrated below.


Projects

	Name	Description	Project ID	Enabled	Actions
☐	admin	admin tenant	2586e25ada7442dea81f4c8ea8bd633d	True	Modify Users More
☐	services	Tenant for the openstack services	08978564a8094c0e8853a00730b59a0a	True	Modify Users More
☐	tenant1		2e2b296f213c4795a73b08240998e200	True	Modify Users More
☐	tenant2		1d827e2183984a1f872a7f37e0a99280	True	Modify Users More

Displaying 4 items

The **Edit Project** window is displayed. The filtering option is available from the tab **Settings**, as illustrated below.


Edit Project

Source MAC Filtering ☐

From here you can set default settings for the project.

PCI Passthrough Ethernet Interfaces

A *passthrough* Ethernet interface is a physical PCI Ethernet NIC on a compute node to which a virtual machine is granted direct access. This minimizes packet processing delays but at the same time demands special operational considerations.

For all purposes, a PCI passthrough interface behaves as if it were physically attached to the virtual machine. Therefore any potential throughput limitations coming from the virtualized environment, such as the ones introduced by internal copying of data buffers, are eliminated. However, by bypassing the virtualized environment, the use of PCI passthrough Ethernet devices introduces several restrictions that must be taken into consideration. They include:

- no support for LAG, QoS, ACL, or host interface monitoring
- no support for live migration
- no access the compute node's AVS switch

A passthrough interface bypasses the compute node's AVS switch completely, and is attached instead directly to the provider network's access switch. Therefore, proper routing of traffic to connect the passthrough interface to a particular tenant network depends entirely on the VLAN tagging options configured on both the passthrough interface and the access port on the switch.

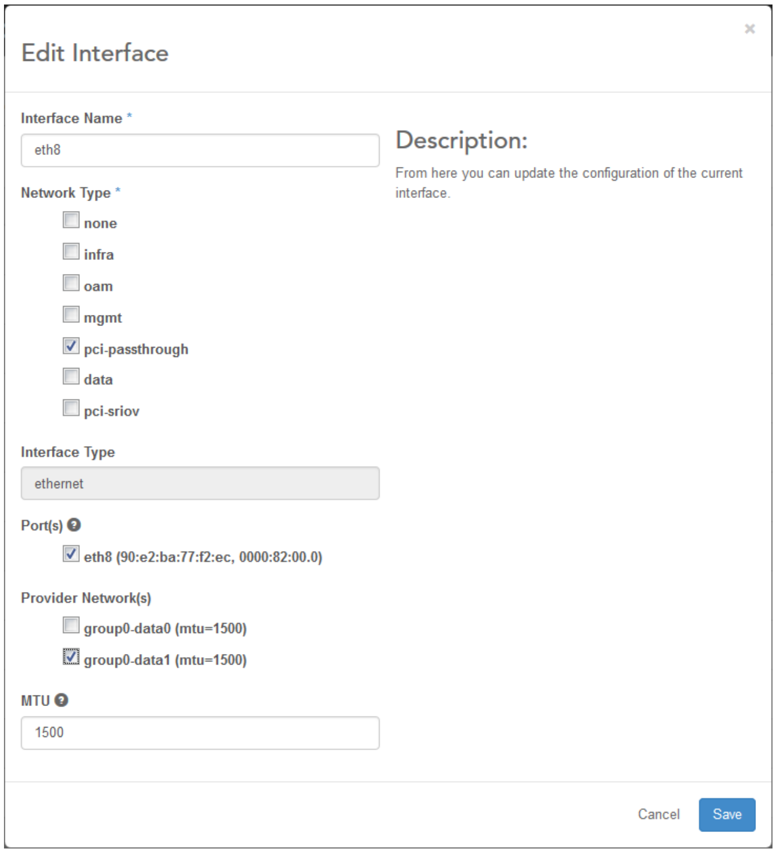
The access switch routes incoming traffic based on a VLAN ID, which ultimately determines the tenant network to which the traffic belongs. The VLAN ID is either explicit, as found in incoming tagged packets, or implicit, as defined by the access port's default VLAN ID when the incoming packets are untagged. In both cases the access switch must be configured to process the proper VLAN ID, which therefore has to be known in advance.

In the following example a new virtual machine is launched by user **user1** on tenant **tenant1**, with a passthrough interface connected to the tenant network **net0** identified with VLAN ID 10.

The exercise assumes that the underlying provider network **group0-data0** exists already, and that VLAN ID 10 is a valid segmentation ID assigned to **tenant1**.

1. Log in as the **admin** user to the web management interface.
2. Lock the compute node you want to configure.
3. Configure the Ethernet interface to be used as a PCI passthrough interface.

   Select the **System Inventory** window from the **Admin** panel, click the **Hosts** tab, click the name of the compute node where the PCI interface is available, click the **Interfaces** tab, and finally click the **Edit Interface** button associated with the interface you want to configure. Fill in the window as illustrated below:



Edit Interface

Interface Name *

eth8

Network Type *

- [ ] none
- [ ] infra
- [ ] oam
- [ ] mgmt
- [✓] pci-passthrough
- [ ] data
- [ ] pci-sriov

Interface Type

ethernet

Port(s)

- [✓] eth8 (90:e2:ba:77:f2:ec, 0000:82:00.0)

Provider Network(s)

- [ ] group0-data0 (mtu=1500)
- [✓] group0-data1 (mtu=1500)

MTU

1500

Description:

From here you can update the configuration of the current interface.

In this example, Ethernet interface **eth8** is assigned the network type *pci-passthrough*, and configured as connected to provider network **group0-data0**. Click the **Save** button to proceed.

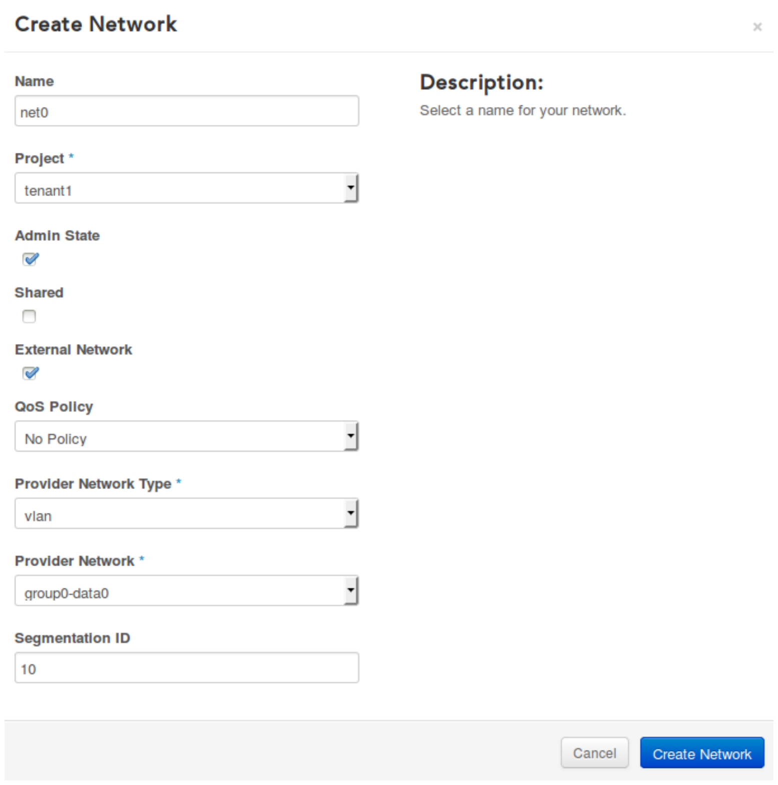
The interface can also be configured from the CLI as illustrated below:

```
~(keystone_admin)$ system host-if-modify \
-nt pci-passthrough -p group0-data0 compute-0 eth8
```

4. Create the **net0** tenant network

Select the **Networks** window from the **Admin** panel, click the **Networks** tab, and then click the **Create Network** button. Fill in the **Create Network** window as illustrated below. You must ensure that:

- The **tenant1** tenant has access to the tenant network, either assigning it as the owner, as in the illustration (using **Project**), or by enabling the shared flag.
- The segmentation ID is set to 10.



Create Network

Name: net0

Description: Select a name for your network.

Project *: tenant1

Admin State: ✓

Shared: ☐

External Network: ✓

QoS Policy: No Policy

Provider Network Type *: vlan

Provider Network *: group0-data0

Segmentation ID: 10

Click the **Create Network** button to proceed.

5. Configure the access switch.

   Configure the physical port on the access switch used to connect to Ethernet interface **eth8** as an access port with default VLAN ID of 10. Traffic across the connection is therefore untagged, and effectively integrated into the targeted tenant network.

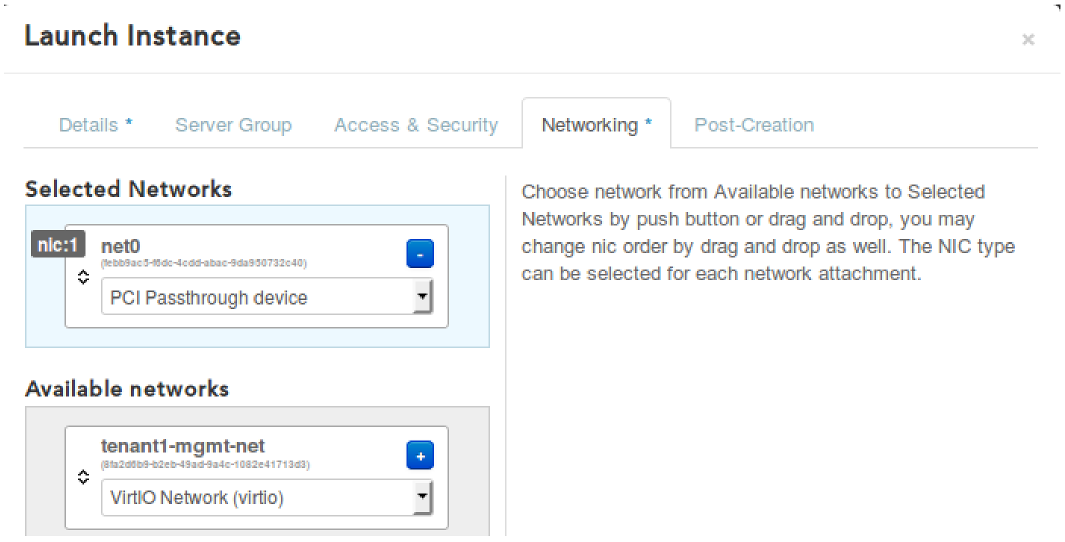
   You can also use a trunk port on the access switch so that it handles tagged packets as well. However, this opens the possibility for guest applications to join other tenant networks using tagged packets with different VLAN IDs, which might compromise the security of the system. See *L2 Access Switches* on page 43 for other details regarding the configuration of the access switch.

6. Unlock the compute node.
7. Launch the virtual machine.

   a) Log in as user **user1** to the web management interface.

   b) Configure the network interfaces for the new virtual machine.

      Open the **Launch Instance** dialog by clicking the **Launch Interface** button on the **Instances** window. Configure the necessary options for the new virtual machine. In particular, click the **Networking** tab and add a PCI passthrough interface on the tenant network **net0**, as illustrated below. Add other network interfaces as needed.



net0
(febb9ac5-f6dc-4cdd-abac-9da950732c40)
PCI Passthrough device

tenant1-mgmt-net
(8fa2d6b9-b2eb-49ad-9a4c-1082e41713d3)
VirtIO Network (virtio)

Choose network from Available networks to Selected Networks by push button or drag and drop, you may change nic order by drag and drop as well. The NIC type can be selected for each network attachment.

Click the **Launch** button to proceed.

Passthrough interfaces can be attached from the CLI when booting a new virtual machine, as illustrated below:

```
~(keystone_admin)$ nova boot \
--nic net-id=704e9f3b,vif-model=pci-passthrough my-new-vm
```

The new virtual machine instance is up now. It has a PCI passthrough connection to the **net0** tenant network identified with VLAN ID 10.

Access switches must be properly configured to ensure that virtual machines using PCI-passthrough or SR-IOV Ethernet interfaces (the latter discussed in *SR-IOV Ethernet Interfaces* on page 31) have the expected connectivity. In a common scenario, the virtual machine using these interfaces connects to external end points only, that is, it does not connect to other virtual machines in the same cluster. In this case:

- Traffic between the virtual machine and the access switch can be tagged or untagged.
- The connecting port on the access switch is part of a port-based VLAN.
- If the port is tagged, the allowed VLAN ID range must not overlap with VLAN ID ranges used by the AVS ports.
- The port-based VLAN provides the required connectivity to external switching and routing equipment needed by guest applications to establish connections to the intended end points.

For connectivity to other virtual machines in the cluster the following configuration is also required:

- The VLAN ID used for the tenant network, 10 in this example, and the default port VLAN ID of the access port on the switch are the same. This ensures that incoming traffic from the virtual machine is tagged internally by the switch as belonging to VLAN ID 10, and switched to the appropriate exit ports.
- The target virtual machines are reachable through another port on the compute node, which is managed by the AVS.
- That other port is configured as usual, as a VLAN trunk port, and the tenant network's VLAN ID (10) is included in the tagged range. This ensures that VLAN 10 is common to both the passthrough/SR-IOV interface and the AVS port.

SR-IOV Ethernet Interfaces

A SR-IOV Ethernet interface is a physical PCI Ethernet NIC that implements hardware-based virtualization mechanisms to expose multiple virtual network interfaces that can be used by one or more virtual machines simultaneously.

The PCI-SIG Single Root I/O Virtualization and Sharing (SR-IOV) specification defines a standardized mechanism to create individual virtual Ethernet devices from a single physical Ethernet interface. For each exposed virtual Ethernet device, formally referred to as a *Virtual Function* (VF), the SR-IOV interface provides separate management memory space, work queues, interrupts resources, and DMA streams, while utilizing common resources behind the host interface. Each VF therefore has direct access to the hardware and can be considered to be an independent Ethernet interface.

When compared with a PCI Passthtrough Ethernet interface, a SR-IOV Ethernet interface:

- Provides benefits similar to those of a PCI Passthtrough Ethernet interface, including lower latency packet processing.
- Scales up more easily in a virtualized environment by providing multiple VFs that can be attached to multiple virtual machine interfaces.
- Shares the same limitations, including the lack of support for LAG, QoS, ACS, and live migration.
- Has the same requirements regarding the VLAN configuration of the access switches.
- Provides a similar configuration workflow when used on HP Helion OpenStack Carrier Grade.

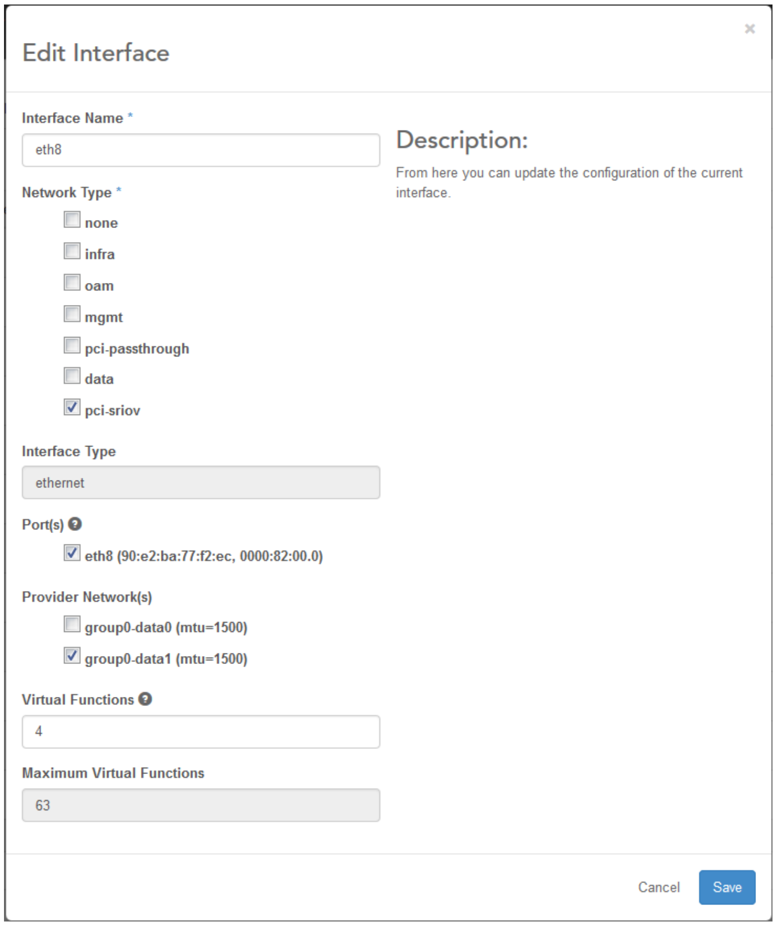
It is suggested that you read *PCI Passthrough Ethernet Interfaces* on page 28 first. Most configuration steps are similar, with the difference that you use **pci-sriov** instead of **pci-passthrough** when defining the network type of an interface.

In the following example a new virtual machine is launched by user **user1** on tenant **tenant1**, with a VF interface connected to the tenant network **tenant1-net1** identified with VLAN ID 20.

The exercise assumes that the underlying provider network **group0-data0** exists already, and that VLAN ID 20 is a valid segmentation ID assigned to **tenant1**.

1. Log in as the **admin** user to the web management interface.
2. Lock the compute node you want to configure.
3. Configure the Ethernet interface to be used as a SR-IOV interface.

   Select the **System Inventory** window from the **Admin** panel, click the **Hosts** tab, click the name of the compute node where the PCI interface is available, click the **Interfaces** tab, and finally click the **Edit Interface** button associated with the interface you want to configure. Fill in the window as illustrated below:


Edit Interface

Interface Name *

eth8

Network Type *

- [ ] none
- [ ] infra
- [ ] oam
- [ ] mgmt
- [ ] pci-passthrough
- [ ] data
- [✓] pci-sriov

Interface Type

ethernet

Port(s)

- [✓] eth8 (90:e2:ba:77:f2:ec, 0000:82:00.0)

Provider Network(s)

- [ ] group0-data0 (mtu=1500)
- [✓] group0-data1 (mtu=1500)

Virtual Functions

4

Maximum Virtual Functions

63

Description:

From here you can update the configuration of the current interface.

In this example, Ethernet interface **eth8** is assigned the network type *pci-sriov*, enabled to use 4 VFs, and configured as connected to provider network **group0-data0**. Click the **Save** button to proceed.

The Maximum number of VFs displayed in this form is a read-only item which is auto-discovered by the system by inspecting the specific NIC model. This value is reported as 0 when the selected interface does not support SR-IOV.

The interface can also be configured from the CLI as illustrated below:

```
~(keystone_admin)$ system host-if-modify \
-nt pci-sriov -N 4 -p group0-data0 compute-0 eth8
```

4. Create the **tenant1-net1** tenant network.

   You must ensure that:

   - The **tenant1** tenant has access to the tenant network, either assigning it as the owner, or by enabling the tenant network's shared flag.
   - The segmentation ID is set to 20.

5. Configure the access switch.

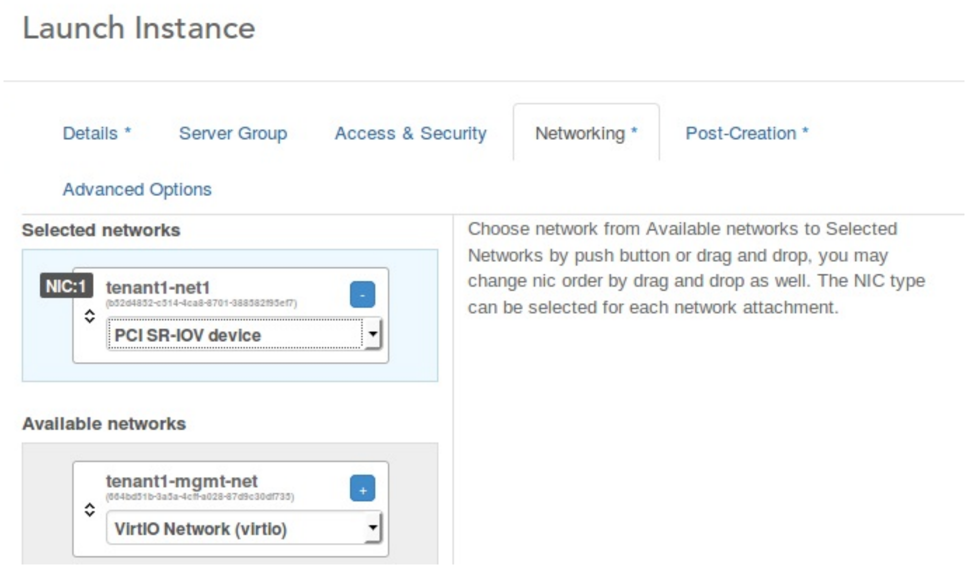
   Configure the physical port on the access switch used to connect to Ethernet interface **eth8** as an access port with default VLAN ID of 20.

6. Unlock the compute node.
7. Launch the virtual machine.

   a) Log in as user **user1** to the web management interface.

   b) Configure the network interfaces for the new virtual machine.

Open the **Launch Instance** dialog by clicking the **Launch Interface** button on the **Instances** window. Configure the necessary options for the new virtual machine. In particular, click the **Networking** tab and add a SR-IOV interface on the tenant network **tenant1-net1**, as illustrated below. Add other network interfaces as needed, there are as many SR-IOV ports available as VFs have been enabled.



Choose network from Available networks to Selected Networks by push button or drag and drop, you may change nic order by drag and drop as well. The NIC type can be selected for each network attachment.

Click the **Launch** button to proceed.

SR-IOV interfaces can be attached from the CLI when booting a new virtual machine, as illustrated below:

```
~(keystone_admin)$ nova boot \
--nic net-id=704e9f3b,vif-model=pci-sriov my-new-vm
```

The new virtual machine instance is up now. It has a SR-IOV VF connection to the **tenant1-net1** tenant network identified with VLAN ID 20.

Network Planning

When planning the deployment of the HP Helion OpenStack Carrier Grade, it is important to understand the available networking options and how to take advantage of them for the benefit of the end users. The sections that follow provide useful networking guidelines.

Provider Networks

Provider networks are the payload-carrying networks used implicitly by end users when they move traffic over their tenant networks.

You must consider the following guidelines:

- From the point of view of the tenants, all networking happens over the tenant networks created by them, or by the **admin** user on their behalf. Tenants are not necessarily aware of the available provider networks. In fact, they cannot create tenant networks over provider networks not already accessible to them. For this reason, the system administrator must ensure that proper communication mechanisms are in place for tenants to request access to specific provider networks when required.

  For example, a tenant may be interested in creating a new tenant network with access to a specific network access device in the data center, such as an access point for a wireless transport. In this case, the system administrator must create a new tenant network on behalf of the tenant, using a VLAN ID in the provider network's segmentation range that provides connectivity to the said network access point.

- Consider how different offerings of bandwidth, throughput commitments, and class-of-service, can be used by your users. Having different provider network offerings available to your tenants enables end users to diversify their own portfolio of services. This in turn gives the HP Helion OpenStack Carrier Grade administration an opportunity to put different revenue models in place.
- For the IPv4 address plan, consider the following:
  - Tenant networks attached to a public network, such as the Internet, have to have external addresses assigned to them. Therefore you must plan for valid definitions of their IPv4 subnets and default gateways.
  - As with the OAM network, you must ensure that suitable firewall services are in place on any tenant network with a public address.
- Segmentation ranges defined on a provider network may be owned by the administrator, a specific tenant, or may be shared by all tenants. With this ownership model:
  - A base deployment scenario has each compute node using a single data interface defined over a single provider network. In this scenario, all required tenant networks can be instantiated making use of the available VLANs or VNIs in each corresponding segmentation range. You may need more than one provider network when the underlying physical networks demand different MTU sizes, or when boundaries between provider networks are dictated by policy or other non-technical considerations.
  - Segmentation ranges can be reserved and assigned on-demand without having to lock and unlock the compute nodes. This facilitates day-to-day operations which can be performed without any disruption to the running environment.

Tenant Networks

Tenant networks are logical networking entities visible to tenant users, and around which working network topologies are built.

Tenant networks need support from the physical layers to work as intended. This means that the access L2 switches, providers' networks, and data interface definitions on the compute nodes, must all be properly configured. In particular, when using provider networks of the VLAN or VXLAN type, getting the proper configuration in place requires additional planning.

For provider networks of the VLAN type, consider the following guidelines:

- All ports on the access L2 switches must be statically configured to support all the VLANs defined on the provider networks they provide access to. The dynamic nature of the cloud might force the set of VLANs in use by a particular L2 switch to change at any moment.
- The set of VLANs used by each compute node is not fixed; it changes over time. The current VLAN set in use is determined by the configuration details of the tenant networks, and the scheduling on the compute nodes of the virtual machines that use them. This information is provided to the Neutron's AVS plugin, which then uses it to configure the AVS as required.

  When a tenant creates a new network, the Neutron segmentation allocation strategy is to look first for an available segmentation identifier owned by the tenant. If none is available, the search continues over the available shared segmentation identifiers. The allocation process returns an error if no segmentation identifiers are available.

  The VLAN ID assigned to a tenant network is fixed for as long as the tenant network is defined in the system. If for some reason the VLAN ID has to change, the tenant network must be deleted and recreated again.
- Configuring a tenant network to have access to external networks (not just providing local networking) requires the following elements:
  - A physical router, and the provider network's access L2 switch, must be part of the same Layer-2 network. Because this Layer 2 network uses a unique VLAN ID, this means also that the router's port used in the connection must be statically configured to support the corresponding VLAN ID.
  - The router must be configured to be part of the same IP subnet that the tenant network is intending to use.
  - When configuring the IP subnet, the tenant must use the router's port IP address as its external gateway.
  - The tenant network must have the **external** flag set. Only the **admin** user can set this flag when the tenant network is created.

For provider networks of the VXLAN type, consider the following guidelines:

- Layer 3 routers used to interconnect compute nodes must be multicast-enabled, as required by the VXLAN protocol.
- To minimize flooding of multicast packets, IGMP and MLD snooping is recommended on all Layer 2 switches. The AVS switch supports IGMP V1, V2 and V3, and MLD V1 and V2.
- To support IGMP and MDL snooping, Layer 3 routers must be configured for IGMP and MDL querying.
- To accommodate VXLAN encapsulation, the MTU values for Layer 2 switches and compute node data interfaces must allow for additional headers. For more information, see *The Ethernet MTU* on page 25.
- To participate in a VXLAN network, the data interfaces on the compute nodes must be configured with IP addresses, and with route table entries for the destination subnets or the local gateway. For more information, see *Configuring Endpoint IP Addresses* on page 55, and *Adding and Maintaining Routes for a VXLAN Network* on page 56.

Virtual Routers

Virtual routers provide internal and external network connectivity for tenants.

The user associated with a tenant can add a designated number of virtual routers (Neutron routers) to the tenant. The maximum number is specified in the quotas for the tenant.

The virtual router automatically provides a connection to system services required by the tenant, such as the metadata service that supplies instances with user data. You can configure the virtual routers with interfaces to tenant networks to provide internal and external connectivity.

A virtual router can be implemented as a centralized router, or a distributed virtual router (DVR).

Note:

Only the **admin** user can specify a distributed router. For other tenants, this choice is not available, and a centralized router is implemented by default. The **admin** user can change a centralized router to a distributed router on behalf of other tenants (see *Virtual Router Administration* on page 39).

A distributed router cannot be converted to a centralized router.

Centralized

A centralized virtual router is instantiated on a single compute node. All traffic using the router must pass through the compute node.

Distributed

A distributed virtual router is instantiated in a distributed manner across multiple hosts. Distributed virtual routers provide more efficient routing than standard virtual routers for east-west (tenant-to-tenant) or floating IP address traffic. Local traffic is routed within the local host, while external L3 traffic is routed directly between the local host and the gateway router.

To implement the distributed model, a centralized-portion of the router is still deployed on one host. The centralized portion manages north-south (external network) traffic and source network address translation (SNAT) traffic, as well as agents deployed on other hosts. The agents offload the centralized router for east-west (tenant-to-tenant) routing and floating IP network address translation.

To add a virtual router, see *Adding Virtual Routers* on page 36. To create interfaces, see *Configuring Virtual Routers* on page 37.

Adding Virtual Routers

You can add virtual routers to a tenant using the web administration interface or the CLI.

To add a router to a tenant, you must be logged in as the user associated with the tenant.

As an alternative to the web administration interface, you can use CLI commands to add a router. First, become the appropriate keystone user (this example sources the **admin** user):

```
$ source etc/nova/openrc
```

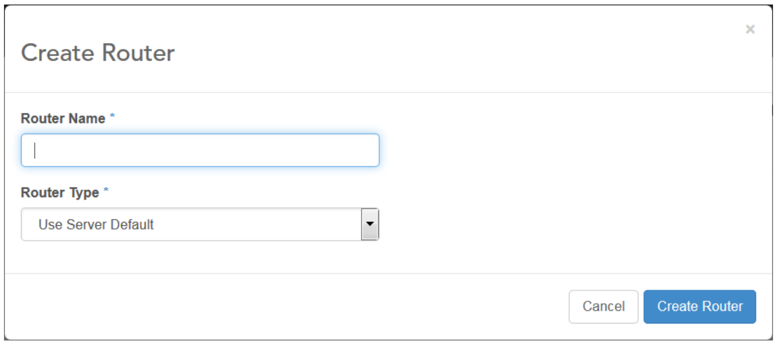
To create a router from the CLI, use the `neutron router-create` command. For example:

```
~(keystone_admin)$ neutron router-create router_name --distributed=True
```

where *router_name* is a name assigned to the router. This example creates a distributed virtual router. If the --distributed option is omitted, the default setting (centralized) is used.

1. Log in as the user associated with the tenant.
2. Select **Project** > **Network** > **Routers**.
3. On the **Routers** page, click **Create Router**.

   The Create Router dialog box appears.



Router Name *

Router Type *
Use Server Default

4. Provide a **Router Name**.
5. Select the **Router Type**.

   Note:

   The **Router Type** field is shown only for the **admin** user. For other tenants, a centralized router is added. The **admin** user can change this setting on behalf of another tenant after the router has been added (see *Virtual Router Administration* on page 39).

   Use Server Default

   Use the default setting specified on the controller (for a standard HP Helion OpenStack Carrier Grade installation, centralized).

   Centralized

   Add a centralized virtual router.

   Distributed

   Add a distributed virtual router (DVR).

   For more information about these choices, see *Virtual Routers* on page 36.
6. To save your settings and close the dialog box, click **Create Router**.

To attach router interfaces to tenant networks, see *Configuring Virtual Routers* on page 37.

Configuring Virtual Routers

You can create router interfaces to tenant networks using the web administration interface or the CLI.

For more information about virtual routers, see *Virtual Routers* on page 36.

Before you can create interfaces to tenant networks, you must create the tenant networks and associated subnets. For examples, see the *HP Helion OpenStack Carrier Grade Reference Deployment Scenarios*. For more information about tenant networks and subnets, see *Tenant Networks* on page 35 and *Managed and Unmanaged Subnets* on page 40.

As an alternative to the web administration interface, you can use CLI commands to add router interfaces. First, become the appropriate keystone user (this example sources the **admin** user):

```
$ source etc/nova/openrc
```

Then use the `neutron router-interface-add` command to add interfaces. For example:

```
~(keystone_admin)$ neutron router-interface-add router_id subnet-id
```

where *router_id* is the name or UUID of the router, and *subnet_id* is the name or UUID of the subnet to which you want to attach an interface. By default, the interface is assigned the gateway address on the subnet.

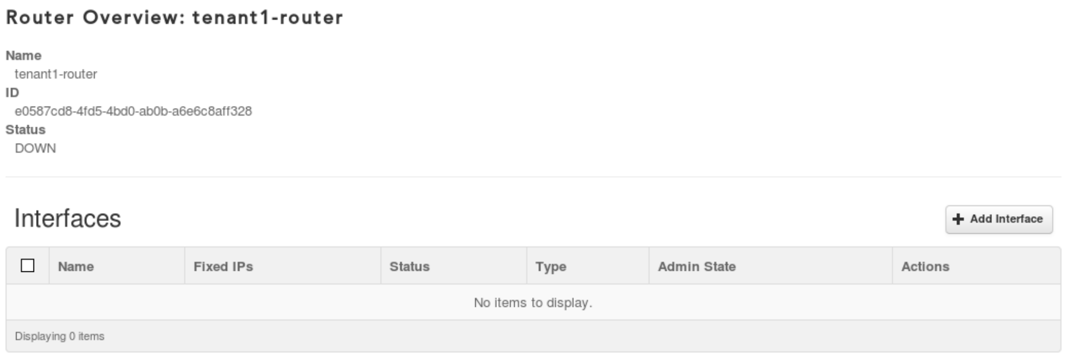
To add an interface to an external network:

```
~(keystone_admin)$ neutron router-gateway-set router_id externalnet-id
```

where *router_id* is the name or UUID of the router, and *externalnet_id* is the name or UUID of a tenant network configured to provide external connections.

1. Log in as the user associated with the tenant.
2. Select **Project** > **Network** > **Routers**.
3. In the list of existing routers, click the name of the router to be configured.

   The **Router Overview** page appears.



Router Overview: tenant1-router

Name
tenant1-router
ID
e0587cd8-4fd5-4bd0-ab0b-a6e6c8aff328
Status
DOWN

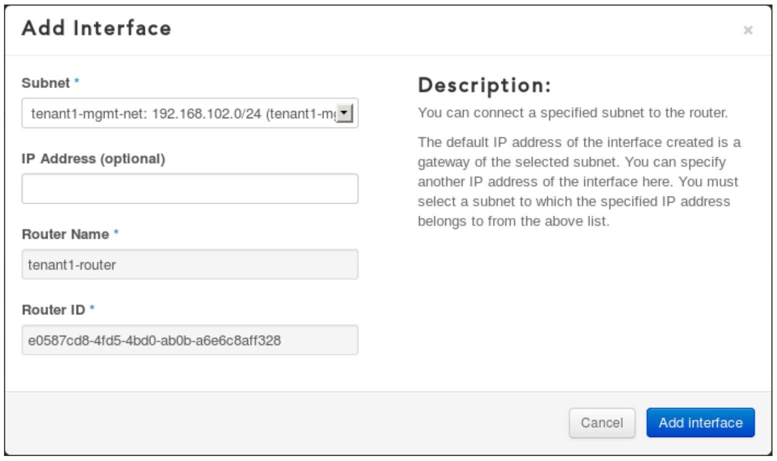
Interfaces

☐	Name	Fixed IPs	Status	Type	Admin State	Actions
No items to display.						

Displaying 0 items

4. Click **Add Interface**.

   The **Add Interface** dialog box appears.



Add Interface

Subnet *
tenant1-mgmt-net: 192.168.102.0/24 (tenant1-m

IP Address (optional)

Router Name *
tenant1-router

Router ID *
e0587cd8-4fd5-4bd0-ab0b-a6e6c8aff328

Description:
You can connect a specified subnet to the router.

The default IP address of the interface created is a gateway of the selected subnet. You can specify another IP address of the interface here. You must select a subnet to which the specified IP address belongs to from the above list.

Subnet

Use the drop-down list to select from existing subnets defined for the tenant. Each subnet is identified by a tenant network name, followed by a subnet address and mask created for the tenant network.

IP Address (optional)

You can optionally specify an IP address for the interface. By default, the gateway address for the subnet is used (for example, 192.168.102.1).

Router Name

This field is shown for information only.

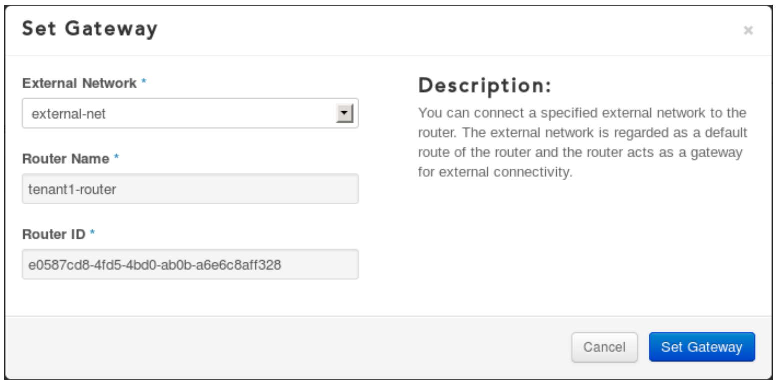
Router ID

This field is shown for information only.

The new interface is shown in the **Router Overview**.

5. Optional: To create an interface to a tenant network configured for external access, click **Set Gateway** for the new interface.

   The **Set Gateway** dialog box appears.



Set Gateway

External Network *: external-net

Router Name *: tenant1-router

Router ID *: e0587cd8-4fd5-4bd0-ab0b-a6e6c8aff328

Description:

You can connect a specified external network to the router. The external network is regarded as a default route of the router and the router acts as a gateway for external connectivity.

   From the **External Network** drop-down menu, select a tenant network configured to provide external access.

6. To save your settings and close the dialog box, click **Add Interface**.

Virtual Router Administration

Users with administrative privileges can review and edit router information for all tenants.

The **Routers** page accessed from **Admin** > **System** > **Routers** provides central control of all virtual routers. From this page, you can edit router names, change router types, change the status of routers (**Up** or **Down**), and delete routers.

Only users with administrative privileges can convert a centralized router to a distributed router.

Note:

A distributed router cannot be converted to a centralized router.

An administrative user can delete routers on any tenant. A non-administrative user can delete routers on the tenant associated with the user.

As an alternative to the web administration interface, you can use the CLI. The following examples assume you have become the **admin** user.

- To list routers:

```
~(keystone_admin)$ neutron router-list
```

- To show details for a router:

  ```
  ~(keystone_admin)$ neutron router-show router_id
  ```

  where *router_id* is the name or UUID of the router.
- To update a router:

  ```
  ~(keystone_admin)$ neutron router-update router_id --distributed=True
  ```

  where *router_id* is the name or UUID of the router. This example updates a router to make it a distributed virtual router.
- To delete a router:

  ```
  ~(keystone_admin)$ neutron router-delete router_id
  ```

Managed and Unmanaged Subnets

Use the *System Managed Subnet* and *Enable DHCP* subnet attributes to determine how IP addresses are allocated and offered on an IP subnet.

With the proper configuration in place, DHCP services can be provided by the built-in Neutron DHCP server, by a standalone server available from an external network infrastructure, or by both.

When creating a new IP subnet for a tenant network you can specify the following attributes:

System Managed Subnet

When this attribute is enabled, the subnet is *system managed*. the Neutron service automatically allocates an IP address from the address allocation pools defined for the subnet to any new virtual machine instance with a virtual Ethernet interface attached to the tenant network. Once allocated, the pair (MAC address, IP address) is registered in the Neutron database as part of the overall registration process for the new virtual machine.

When the system managed subnet attribute is disabled, the subnet is *unmanaged*. No automatic allocation of IP addresses takes place, and the Neutron DHCP service for the subnet is disabled. Allocation of IP addresses for new virtual machines must be done at boot time using the CLI or the API interfaces.

Enable DHCP

When this attribute is enabled, a virtual DHCP server becomes available when the subnet is created. It uses the (MAC address, IP address) pairs registered in the Neutron database to offer IP addresses in response to DHCP discovery requests broadcast on the subnet. DHCP discovery requests from unknown MAC addresses are ignored.

The Neutron DHCP server can only be enabled on system managed subnets. DHCP services for unmanaged subnets, if required, must be provisioned by external, non-Neutron, DHCP servers.

When the DHCP attribute is disabled, all DHCP and DNS services, and all static routes, if any, must be provisioned externally.

Allocation Pools

This a list attribute where each element in the list specifies an IP address range, or address pool, in the subnet address space that can be used for dynamic offering of IP addresses. By default there is a single allocation pool comprised of the entire subnet's IP address space, with the exception of the default gateway's IP address.

An external, non-Neutron, DHCP server can be attached to a system managed subnet to support specific deployment needs as required. For example, it can be configured to offer IP addresses on ranges outside the Neutron allocation pools to service physical devices attached to the tenant network, such as testing equipment and servers.

Allocation pools can only be specified on system managed subnets.

On the web administration interface you set these attributes in the **Subnet Detail** tab of the **Create Subnet** window. On the CLI you set these attributes as illustrated in the following examples.

Create a new system managed subnet, DHCP-enabled, and a custom allocation pool:

```
$ neutron subnet-create --name my-subnet \
--allocation-pool start=172.18.0.100,end=172.18.0.150 \
my-tenant-net 172.18.0.0/24
```

Create a new system managed subnet with DHCP service disabled:

```
$ neutron subnet-create --name my-subnet \
--disable-dhcp \
my-tenant-net 172.18.0.0/24
```

Create a new unmanaged subnet:

```
$ neutron subnet-create --name my-subnet \
--unmanaged --disable-dhcp \
my-tenant-net 172.18.0.0/24
```

Accessing the Metadata Server

Access to the system's metadata server is available using the well known URL http://169.254.169.254. In the HP Helion OpenStack Carrier Grade implementation, access to this address is provided by a virtual router attached to the tenant on which the access request is made. Virtual routers are automatically configured as proxies to the metadata service.

The following requirements must be satisfied in order for a guest application to access the metadata service:

1. There is a route table entry to route traffic destined to the 169.254.169.254 address via a Neutron router, or via a suitable static route to the 169.254.169.254 address.
2. The metadata server knows about the virtual machine instance associated with the MAC and IP addresses of the virtual Ethernet interface issuing the metadata service request. This is necessary for the metadata server to be able to validate the request, and to identify the virtual machine's specific data to be returned.

   On system managed subnets, the Neutron service has all address information associated with the virtual machines in its database.

   On unmanaged subnets, you must tell the Neutron service the IP address of the network interface issuing the metadata service requests. This can only be done using the command line or API interfaces when instantiating the virtual machine, as illustrated below:

   ```
   $ nova boot \
   --nic net-id=net-uuid,vif-model=avp,v4-fixed-ip=172.18.0.1 \
   my-new-vm
   ```

   In this simplified example, the option v4-fixed-ip tells Neutron what the IP address for this interface should be. The interface's MAC address is automatically generated by Nova.

Guest VLANs

Use guest VLANs to segregate IP traffic from a single virtual Ethernet interface on a virtual machine into dedicated VLANs. Together with the capability to define multiple IP subnets on a single tenant network, guest VLANs facilitate the transitioning of existing guest applications to run on the HP Helion OpenStack Carrier Grade virtualized network environment.

Guest VLANs are useful when guest applications rely on the capability to configure a single virtual Ethernet interface with multiple, probably overlapping, IP addresses. From the point of view of the guest, this is done by defining

VLAN Ethernet interfaces, and associating one or more IP addresses to them. If implementing overlapping IP addresses, typically in support of VPN applications, the guest must use different VLAN IDs to separate traffic from different VPNs.

For example. on a Linux guest, the virtual interfaces eth0.10:1, eth0.10:2, and eth0.20 refer to the same eth0 physical interface with two virtual interfaces on VLAN ID 10, and a single virtual interface on VLAN ID 20. A common scenario in a VLAN application is to allocate distinct IP addresses from the same IP subnet to virtual interfaces on the same VLAN. In this example, eth0.10:1 and eth0.10:2 could be assigned distinct IP addresses from the subnet 192.168.1.0/24, and eth0.20 an address from the subnet 192.168.2.0/24. In the case of a VPN application, overlapping IP addresses are allowed to exist on eth0.20 and either eth0.10:1 or eth0.10:2.

HP Helion OpenStack Carrier Grade supports these deployment scenarios with the help of guest VLANs which enable the transport of IP subnets traffic over VLAN-tagged Ethernet frames. To support the example above, a tenant user would define the following two IP subnets, both on the same tenant network, using guest VLAN IDs as follows:

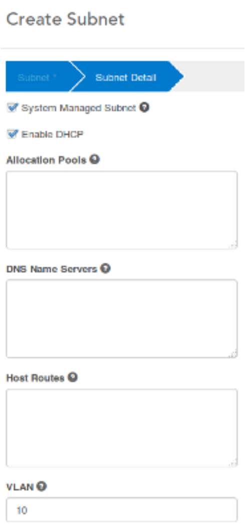
- Subnet 192.168.1.0/24 with guest VLAN ID set to 10
- Subnet 192.168.2.0/24 with guest VLAN ID set to 20

The subnet-to-VLAN_ID mapping can be one-to-one, as in this example, or many-to-one. This means that tenant users can use a single VLAN ID of their choice to encapsulate traffic from one or more IP subnets.

Creating Guest VLANs

Tenant users can define a guest VLAN when they add a new IP subnet to a tenant network they are creating, or to an existing one. See *Reference Deployment Scenarios* for examples of how to create tenant networks.

From the web management interface you add the VLAN ID of the guest VLAN to the **Subnet Detail** tab of the **Create Subnet** window. In the following example a guest VLAN with ID of 10 will be created when the subnet is added.


Create Subnet

Subnet * | Subnet Detail

☑ System Managed Subnet

☑ Enable DHCP

Allocation Pools

DNS Name Servers

Host Routes

VLAN

10

Figure 2: Creating a guest VLAN

From the command line interface, a guest VLAN can be defined using the --vlan-id option when creating a new subnet, as illustrated below:

```
~(keystone_admin)$ neutron subnet-create --tenant-id ${tenant_UUID} \
--name my-new-subnet --vlan-id 10
```

Guest VLAN Implementation

Guest VLANs are implemented using available segmentation ranges from suitable provider networks, just as it is done when new tenant networks are created. Therefore all network design considerations regarding the configuration of L2 switches and the Neutron allocation strategy, described in *Tenant Networks* on page 35, must be taken into consideration.

Additionally, note that the AVS will silently discard incoming VLAN-tagged VM traffic with unknown VLAN IDs, that is, with VLAN IDs not defined as guest VLANs on the particular tenant network.

L2 Access Switches

L2 access switches connect the HP Helion OpenStack Carrier Grade hosts to the different networks. Proper configuration of the access ports is necessary to ensure proper traffic flow.

One or more L2 switches can be used to connect the HP Helion OpenStack Carrier Grade hosts to the different networks. When sharing a single L2 switch you must ensure proper isolation of the network traffic. Here is an example of how to configure a shared L2 switch:

- one port- or MAC-based VLAN for the internal management network
- one port- or MAC-based VLAN for the OAM network
- one port-based VLAN for an optional board management network, if the network is configured for internal access
- one or more sets of VLANs for provider networks. For example:
  - one set of VLANs with good QoS for bronze tenants
  - one set of VLANs with better QoS for silver tenants
  - one set of VLANs with the best QoS for gold tenants

When using multiple L2 switches, there are several deployment possibilities. Here is an example:

- A single L2 switch for the internal management and OAM networks. Port- or MAC-based network isolation is mandatory.
- One or more L2 switches, not necessarily inter-connected, with one L2 switch per provider network.

Switch ports that send tagged traffic are referred to as *trunk* ports. They usually participate in the Spanning Tree Protocol (STP) from the moment the link goes up, which usually translates into several seconds of delay before the trunk port moves to the forwarding state. This delay is likely to impact services such as DHCP and PXE which are used during regular operations of HP Helion OpenStack Carrier Grade.

Therefore, you must consider configuring the switch ports to which the management interfaces are attached to transition to the forwarding state immediately after the link goes up. This option is usually referred to as a *PortFast*.

You should also consider configuring these ports to prevent them from participating on any STP exchanges. This is usually done by configuring them to avoid processing inbound and outbound BDPU STP packets completely. Consult your switch's manual for details.

DiffServ-Based Priority Queuing and Scheduling

Differentiated Services, or DiffServ, is a packet-based traffic management mechanism that allows end devices to specify an expected per-hop behavior (PHB) from upstream switches and routers when handling their traffic during overload conditions.

DiffServ marking and architecture are IEEE specifications, IEEE RFC 2474 and RFC 2475.

Support for DiffServ is implemented on the AVS for all input and output ports, on all attached tenant networks. On each port, it uses eight queues associated with the CS0 to CS7 DiffServ class selectors, which are processed by a round-robin scheduler with weights of 1, 1, 2, 2, 4, 8, 16, and 32. Overflow traffic is tail-drop discarded on each queue. Guest applications in the HP Helion OpenStack Carrier Grade cluster can set a Differentiated Services Code Point (DSCP) value in the Differentiated Service (DS) field of the IP header to mark the desired upstream PHB.

On ingress, a packet being processed to be sent to the VM is directed to the appropriate DiffServ output queue. On overflow, that is, if the virtual machine cannot keep up with the incoming traffic rate, lower priority packets are discarded first.

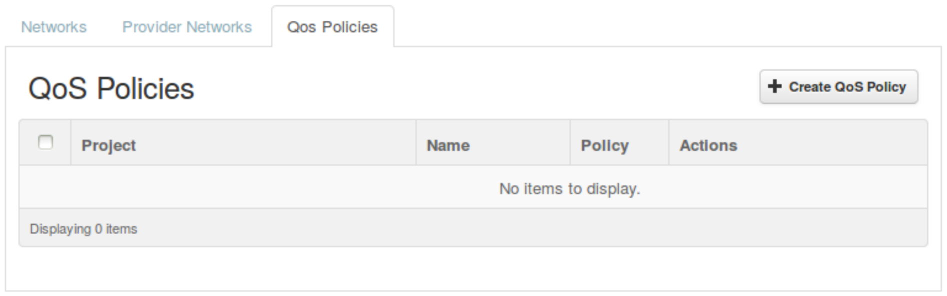
On egress, a packet sent from the VM to the AVS is first enqueued into the appropriate DiffServ input queue according to the specified DSCP value, the CS0 queue being the default. On overload, that is, if the AVS cannot keep up with the incoming traffic, lower priority packets are discarded first; in this case, you should consider reengineering the AVS, possibly assigning it more processing cores. Once serviced by the DiffServ class scheduler, the packet is processed according to the QoS policy in place for the tenant network, as described in *Quality of Service Policies* on page 44.

Quality of Service Policies

Quality of Service (QoS) policies specify relative packet processing priorities applied by the AVS switch on each compute node to incoming tenant network's traffic during overload conditions.

The QoS polices play no role under normal traffic loads, when no input traffic queues in the AVS are close to their overflow limits.

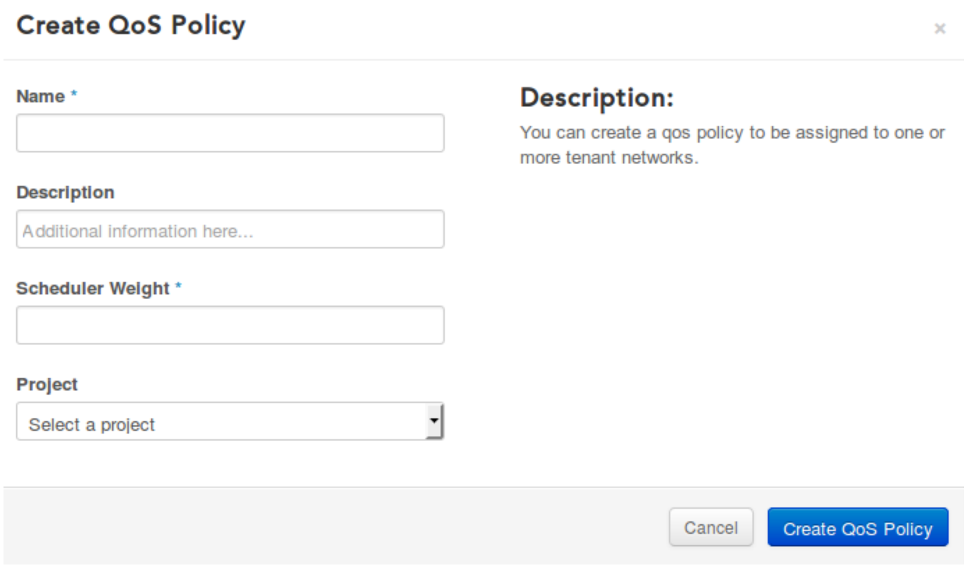
QoS policies are created by the cluster administrator, and selected by the tenant users to apply on a per-tenant network basis. To create a new QoS policy, log in as administrator, select the option Networks from the **Admin** menu, and visit the **QoS Policies** tab on the **Networks** page, as illustrated below.



	Project	Name	Policy	Actions
	No items to display.			

Displaying 0 items

Click the button **Create QoS Policy** to display the **Create QoS Policy** window.



Description:
You can create a qos policy to be assigned to one or more tenant networks.

The following fields are available:

Name

The name of the new QoS policy. This is the name that the tenant user sees as available for use.

This field is mandatory.

Description

A free form text for your reference.

Scheduler Weight

The relative weight the AVS traffic scheduler uses on overload conditions, as compared with the scheduler weight of all other QoS policies.

The scheduler weight is a positive integer number associated with each QoS policy. On overload, the AVS schedules traffic processing for each tenant network according to its assigned QoS policy. By default, with no specific QoS policies defined, traffic from all tenant networks is processed in round-robin mode, one tenant network after another. Effectively, the default behavior is similar to assigning a scheduler weight of 1 to all tenant networks.

When a specific QoS policy with a scheduler weight greater than 1 is applied to a tenant network, its traffic is scheduled with a relative higher frequency. For example, if the scheduler weight for tenant network A is 10, and the one for tenant network B is 100, then on overload, tenant network B will see its queued traffic processed 10 times as often as tenant network A.

The handling of the scheduler weight is implemented as a per-packet token bucket for each tenant network. This means that each unit in the scheduler weight counts as one packet to be processed in sequence. In the previous example, the AVS processes 10 consecutive packets from tenant network A, followed by 100 packets from tenant network B. This implementation ensures a fair-share behavior that prevents any tenant network from running into total bandwidth starvation, even if its scheduler weight is relatively low.

The range of values for the scheduler weight is arbitrary. You must however ensure that the values assigned to the different policies make sense for the intended applications.

This field is mandatory.

Project

A drop-down menu displaying the currently defined tenants (projects). The new QoS policy is available to only the selected tenant. If no tenant is selected, it is available to all tenants in the cluster.

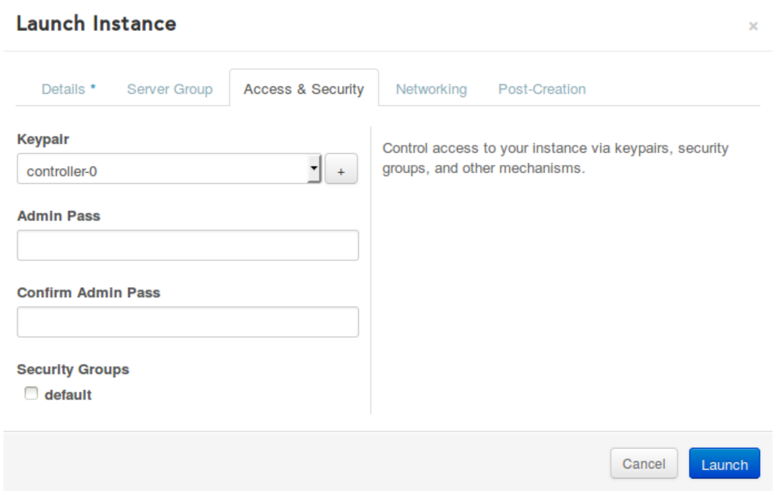
Tenant users can select available QoS policies when the tenant networks are created from the **Create Network** window. They can also apply a QoS policy to an already existing tenant network from the **Edit Network** window.

Security Groups

Security groups are tenant-specific sets of IP filter rules that are applied to the networking stack of a virtual machine.

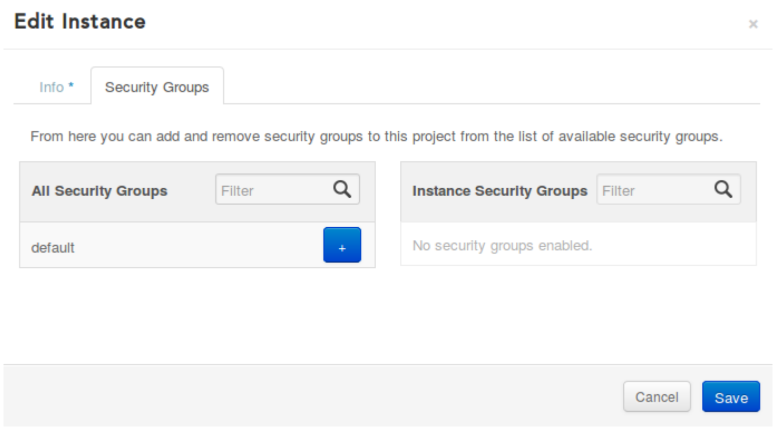
The HP Helion OpenStack Carrier Grade does not enforce a default security group when launching a new virtual machine. Instead, the security groups are optional, and only enforced when explicitly assigned to a virtual machine, either at launch time, or while it is executing.

At launch time, select the desired security groups from the tab **Access & Security** on the **Launch Instance** window, as illustrated below.



Control access to your instance via keypairs, security groups, and other mechanisms.

To assign security groups to a running instance, display the **Instances** page, click the **More** button associated with the instance, and select the option Edit Security Groups. The **Edit Instance** window displays with the tab **Security Groups** showing the available security instance groups, as illustrated below.



From here you can add and remove security groups to this project from the list of available security groups.

default

No security groups enabled.

You can then drag and drop security groups from the section **All Security Groups** to the section **Instance Security Groups**. The selected security groups are applied immediately once the configuration is saved.

In the HP Helion OpenStack Carrier Grade implementation, the following limitations apply:

- the maximum number of security groups that can be applied to a single tenant network is 10
- the maximum number of rules that can be configured on a single tenant network is 100

These two limitations work always together, whichever is first reached.

REST API Secure Access Planning

For secure REST API access, you must obtain and install a signed digital certificate before software installation.

HP Helion OpenStack Carrier Grade supports programming access using REST APIs. By default, access using the HTTP protocol is supported. For increased security, you can enable HTTPS access during system installation.

To enable HTTPS access, you must obtain a digital certificate and copy it to the first controller before starting the controller configuration script. For more information, see the *HP Helion OpenStack Carrier Grade Software Installation Guide*.

Storage Planning

Storage resources on the controller are used to maintain internal databases, and to provide storage for virtual machines. For VMs, it is highly recommended to use storage provided through volumes (Cinder service backed by 3PAR). There might not be enough storage on compute nodes (especially blades).

During HP Helion OpenStack Carrier Grade software installation, the controller configuration script gives you the options to allocate space on the controller for the internal database, and for general storage volumes (images and disk space for the virtual machines).

The size of the database grows with the number system resources created by the system administrator and the tenants. This includes objects of all kinds such as compute nodes, provider networks, images, flavors, tenant networks, subnets, virtual machine instances and NICs. As a reference point, consider the following deployment scenario:

- two controllers
- four compute nodes with dual Intel(R) Xeon(R) CPU E5-2670 v2 @ 2.50GHz each.
- 40 virtual machine instances
- 120 tenant networks
- steady collection of power management statistics

The size of the database in this case is approximately 9 GB. With a suggested default of 20 GB, there is still plenty of room to grow. However, you should periodically monitor the size of the database to ensure that it does not become a bottleneck when delivering new services.

For general storage, the default settings suggested during the controller configuration script are recommended to utilize the maximum available space on the storage media.

Storage for Virtual Machines

For VMs, you can use remote Cinder storage or local storage.

Persistent block storage for virtual machines is allocated by the Cinder service using 3PAR.

LVM/iSCSI

This backend provides block storage managed by the Linux Logical Volume Manager (LVM) exposed as iSCSI targets. In the HP Helion OpenStack Carrier Grade implementation:

- Storage space is allocated on the active controller and automatically mounted over iSCSI by the virtual machines running on the compute nodes. No storage space is allocated on the compute nodes.
- The two controllers always maintain their storage partitions in sync for carrier-grade reliability.

As an alternative to persistent storage provided by the Cinder service, you can implement ephemeral local storage on the compute nodes where the VMs are instantiated. This is useful for VMs requiring local disk access for performance optimization. You can use a pre-allocated partition on the root disk, as well as additional disks optionally installed in the compute nodes. For more information, see *Configuring a Compute Host to Provide Local Storage* on page 47.

Caution:

Local storage is ephemeral.

- Live migration is not currently supported for an instance using local storage. Locking the host initiates a cold migration. The local storage for the instance is rebuilt.
- Resizing of local storage is partly supported. If the reconfigured instance is instantiated on the same host, then any root or ephemeral disks that use local storage are resized with their data preserved. Swap disks that use local storage are rebuilt. If the instance is migrated to another host, only cold migration is supported. All local storage for the instance is rebuilt.

To instantiate VMs on compute nodes configured for local storage, see *Specifying Local Storage for a VM* on page 124.

Configuring a Compute Host to Provide Local Storage

You can configure a compute host to provide local storage for use by VMs.

Local storage can be used to provide improved disk access performance for VMs instantiated on the host.

Caution:

Local storage is ephemeral.

- Live migration is not currently supported for an instance using local storage. Locking the host initiates a cold migration. The local storage for the instance is rebuilt.
- Resizing of local storage is partly supported. If the reconfigured instance is instantiated on the same host, then any root or ephemeral disks that use local storage are resized with their data preserved. Swap disks that use local storage are rebuilt. If the instance is migrated to another host, only cold migration is supported. All local storage for the instance is rebuilt.

To provide local storage on a compute host, add a local volume group called **nova-local** to the host. This automatically includes the host in the **local_storage_hosts** host aggregate. The Nova scheduler draws from this host aggregate to instantiate VMs that require local storage.

To populate the **nova-local** group with storage resources, you must also add physical volumes created on local disks.

As an alternative to the web administration interface, you can use the CLI to configure the host for local storage. For more information, see *Managing Local Volume Groups* on page 105 and *Managing Physical Volumes* on page 105.

1. Lock the host to make changes.
   a) On the **Admin** pane of the web administration interface, in the **System Panel** section, select **Inventory**.
   b) Select the **Hosts** tab.
   c) Open the **More** drop-down list for the host, and then select **Lock Host**.
   d) Wait for the host to be reported as **Locked**.
2. Open the **Inventory Detail** page for the locked host.

   In the **Host Name** column, click the name of the host.
3. Select the **Storage** tab.

   For a compute node, the storage tab displays three lists:

   Disks

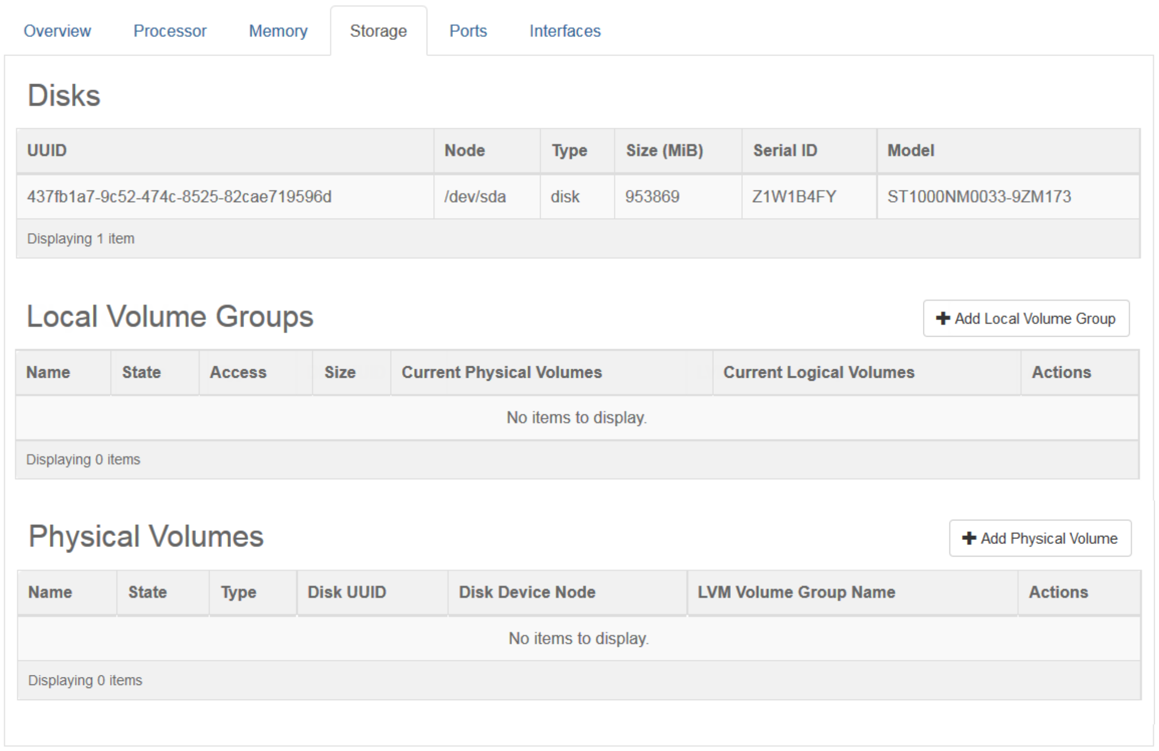
   Physical disks installed in the compute node.

   Local Volume Groups

   Groups of physical volumes available for VM storage.

   Physical Volumes

   Partitions that have been initialized for logical volume management (LVM) and assigned to a local volume group.



Disks

UUID	Node	Type	Size (MiB)	Serial ID	Model
437fb1a7-9c52-474c-8525-82cae719596d	/dev/sda	disk	953869	Z1W1B4FY	ST1000NM0033-9ZM173

Displaying 1 item

Local Volume Groups

Name	State	Access	Size	Current Physical Volumes	Current Logical Volumes	Actions
No items to display.						

Displaying 0 items

Physical Volumes

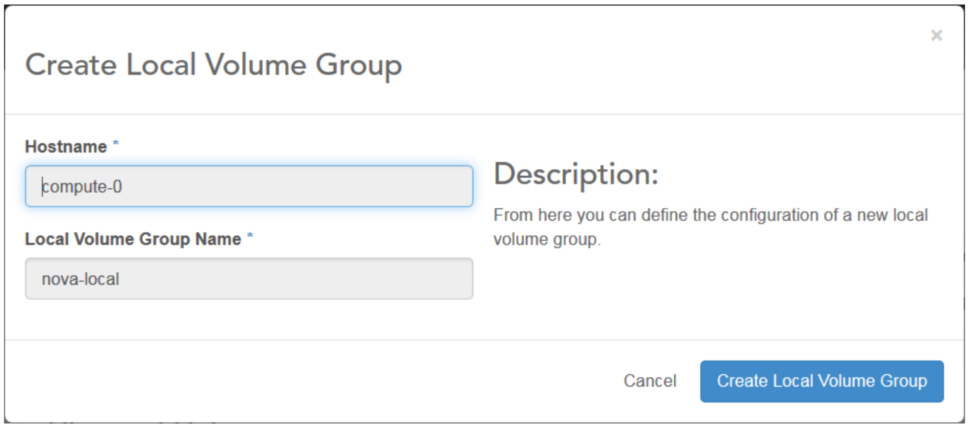
Name	State	Type	Disk UUID	Disk Device Node	LVM Volume Group Name	Actions
No items to display.						

Displaying 0 items

4. If required, add the **nova-local** group to the **Local Volume Groups** list.

   The **Local Volume Groups** list displays groups of physical volumes designated for use as local storage.

   The default group for use by VMs is called **nova-local**. If this group is not listed, you can create it by clicking **Add Local Volume Group**, and then accepting the defaults in the dialog box that appears.

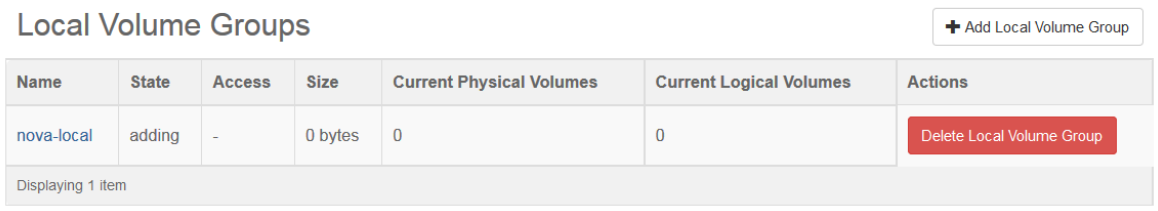

Create Local Volume Group

Hostname *
compute-0

Local Volume Group Name *
nova-local

Description:
From here you can define the configuration of a new local volume group.

The **nova-local** group is shown in the list.

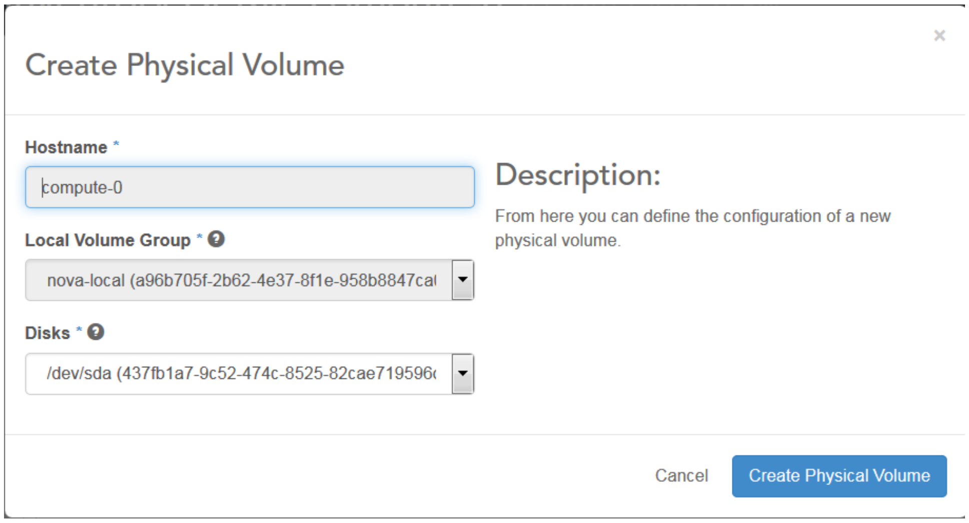

Local Volume Groups

Name	State	Access	Size	Current Physical Volumes	Current Logical Volumes	Actions
nova-local	adding	-	0 bytes	0	0	Delete Local Volume Group

Displaying 1 item

5. Add a physical volume to the **nova-local** group.

The **Physical Volumes** list displays LVM volumes that have been created and added to a Local Volume Group. To add a new one, click **Add Physical Volume** and complete the dialog box that appears.


Create Physical Volume

Hostname *
compute-0

Local Volume Group *
nova-local (a96b705f-2b62-4e37-8f1e-958b8847cal

Disks *
/dev/sda (437fb1a7-9c52-474c-8525-82cae719596

Description:
From here you can define the configuration of a new physical volume.

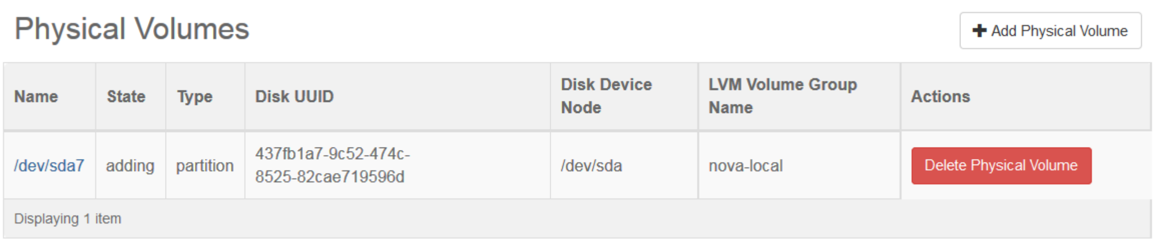
Note:

The **Local Volume Group** drop-down selection is automatically set to **nova-local**, and cannot be changed.

Use the **Disks** drop-down menu to select a disk to provide storage. For the root disk, a designated partition (**local_pv**) is used.

You can add any number of physical volumes to the **nova-local** group, limited only by the number of available disks.

A physical volume is created and added to the **nova-local** group.


Physical Volumes

Name	State	Type	Disk UUID	Disk Device Node	LVM Volume Group Name	Actions
/dev/sda7	adding	partition	437fb1a7-9c52-474c-8525-82cae719596d	/dev/sda	nova-local	Delete Physical Volume

Displaying 1 item

6. Unlock the host to make the changes take effect.

The compute host is ready to provide local storage for use by VMs. Because a **nova-local** local volume group has been added, the host is automatically included in the **local_storage_hosts** host aggregate.

To return a host to the **remote_storage_hosts** host aggregate, so that it is used to instantiate VMs configured for remote Cinder-based storage, delete the **nova-local** local volume group.

Caution:

VMs instantiated on the compute node must be migrated or terminated before the host is reconfigured for remote storage.

To configure a VM to use local storage or remote Cinder-based storage, or to be instantiated on any compute host regardless of storage type, see *Specifying Local Storage for a VM* on page 124.

To add disks to a compute node for extra local storage, see *Adjusting Resources on a Compute Node* on page 93

Using VXLANs

You can use Virtual eXtensible Local Area Networks (VXLANs) to connect VM instances across non-contiguous Layer 2 segments (that is, Layer 2 segments connected by one or more Layer 3 routers).

Note: This is a beta feature.

A VXLAN is a Layer 2 overlay network scheme on a Layer 3 network infrastructure. Packets originating from VMs and destined for other VMs are encapsulated with IP, UDP, and VXLAN headers and sent as Layer 3 packets. The IP addresses of the source and destination compute nodes are included in the headers.

You can configure VXLANs on HP Helion OpenStack Carrier Grade using the following workflow.

1. Set up a provider network of the VXLAN type.

   For details, see *Setting Up a VXLAN Provider Network* on page 50.
2. Configure the endpoint IP addresses of the compute nodes.

   For details, see *Configuring Endpoint IP Addresses* on page 55.
3. Establish routes between the hosts.

   For details, see *Adding and Maintaining Routes for a VXLAN Network* on page 56

You must also ensure that the networking environment meets certain minimum requirements. For more information, see *Tenant Networks* on page 35.

Setting Up a VXLAN Provider Network

You can use the CLI or the web administration interface to set up a VXLAN provider network and add segmentation ranges.

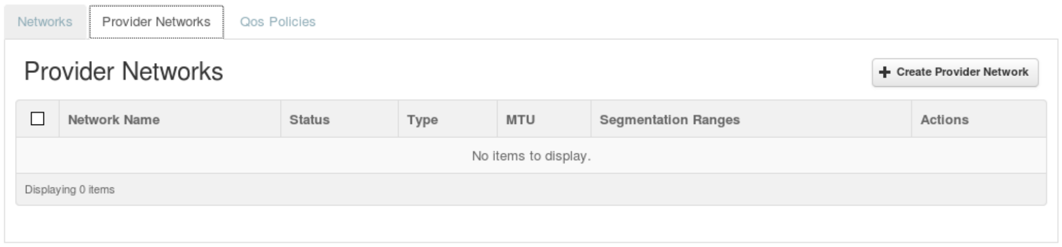
VXLAN provider networks are an alternative to VLAN provider networks when VM L2 connectivity is required across separate Layer 2 network segments separated by one or more Layer 3 routers.

The steps in this section describe how to set up a VXLAN provider network and add segmentation ranges using the web administration interface. For information about using CLI commands, see *Setting Up a VXLAN Provider Network Using the CLI* on page 53.

1. Open the HP Helion OpenStack Carrier Grade web administration interface.

   Using a browser, navigate to the OAM floating IP address, and log in as **admin**.
2. In the left-hand pane, on the **Admin** tab, click **Networks**, and then select the **Provider Networks** tab.

   The Provider Networks list is displayed.



Provider Networks

☐	Network Name	Status	Type	MTU	Segmentation Ranges	Actions
No items to display.						

Displaying 0 items

3. Create a provider network.

   Click **Create Provider Network**.

   In the **Create Provider Network** window, complete the fields as required.

   Name

   The name of the provider network.

   Description

   A free-text field for reference.

   Type

   The type of provider network to be created.

   flat

   mapped directly to the physical network

   vlan

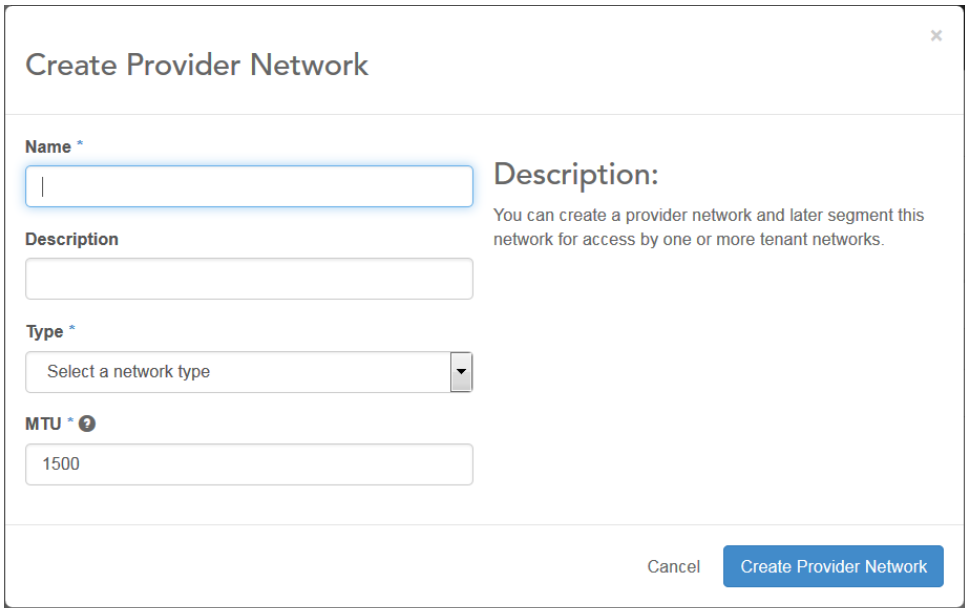
   supports multiple tenant networks using VLAN IDs.

   vxlan

   supports multiple tenant networks using VXLAN VNIs.

   MTU

   The maximum transmission unit for the Ethernet segment used to access the network.



Create Provider Network

Name *

Description

Type *

Select a network type

MTU *

1500

Description:

You can create a provider network and later segment this network for access by one or more tenant networks.

For the **Type**, select **VXLAN**.

For the MTU, set a maximum transmission unit that allows for the overhead required by VXLAN encapsulation. For more information, see *The Ethernet MTU* on page 25.

4. Commit the changes.

   Click **Create Provider Network**.

   The new provider network is added to the **Provider Networks** list.

5. Add one or more segmentation ranges.

   Segmentation ranges are sets of contiguous identifiers defined on a provider network. Each ID is used to implement a tenant network.

   On the **Provider Network Overview** page, click **Create Range** to open the **Create Segmentation Range** page. Complete the form as required.

   Name

   The name of the segmentation range.

   Description

   A free-text field for reference.

   Shared

   If selected, shares the range for use by all tenants.

   Project

   The tenant associated with the segmentation range.

   Minimum

   The lowest value of a range of IDs.

   Maximum

   The highest value of a range of IDs.

   Caution:

   The range must not overlap other segmentation ranges on the same provider network.

Multicast Group Address

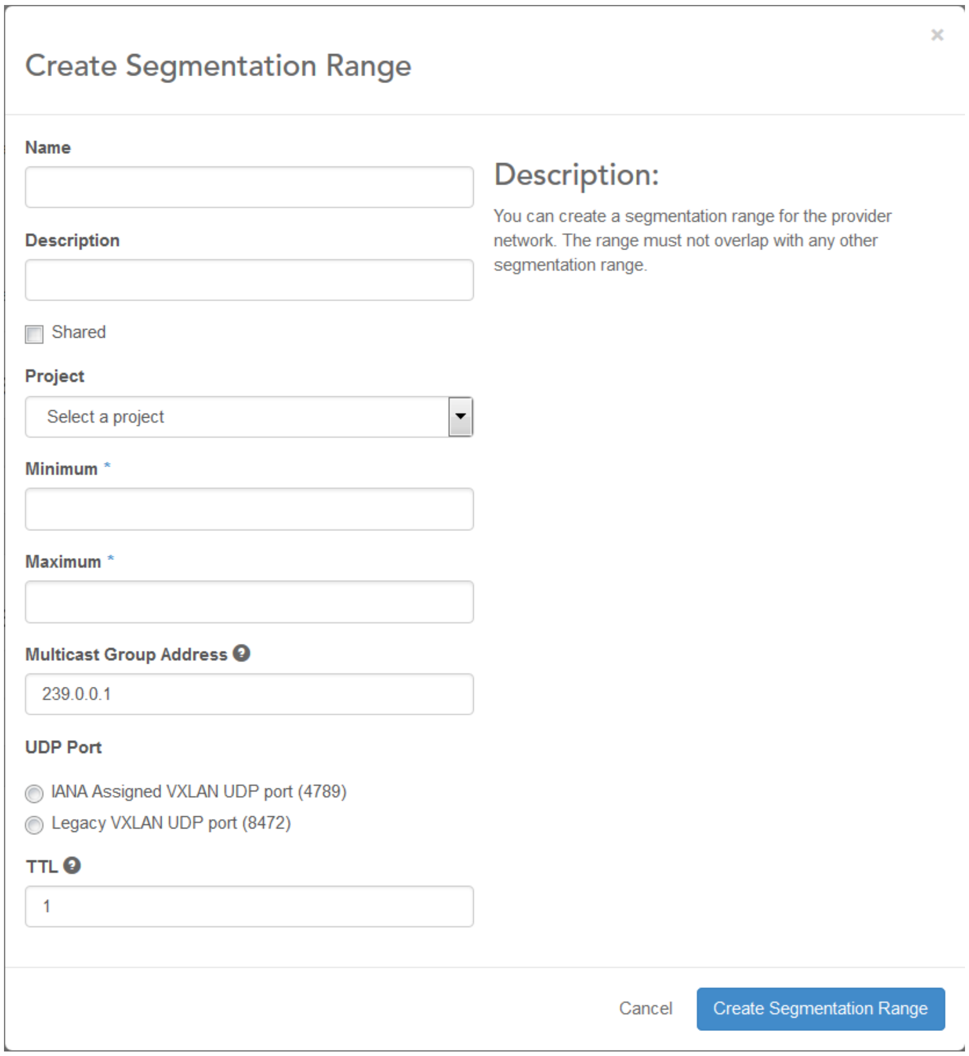
The IPv4 or IPv6 address for participation in a multicast group used to discover MAC addresses for destination VMs. You can use a different multicast group for each segmentation range to help organize and partition network traffic.

UDP Port

The destination UDP port for packets sent on the VXLAN. You can select either the IANA standard 4789 to use this range with the OpenStack Neutron service, or the legacy standard 8472 for use with some commercial switch equipment.

TTL

The time-to-live, measured in hops, for packets sent on the VXLAN. The value is decremented at each hop; when it reaches zero, the packet expires. You can use this to limit the scope of the VXLAN. For example, to limit the packet to no more than three router hops, use a time-to-live value of 4.


Create Segmentation Range

Name

Description

Shared

Project

Select a project

Minimum *

Maximum *

Multicast Group Address

239.0.0.1

UDP Port

IANA Assigned VXLAN UDP port (4789)

Legacy VXLAN UDP port (8472)

TTL

1

Description:

You can create a segmentation range for the provider network. The range must not overlap with any other segmentation range.

6. Click **Create Segmentation Range** to commit the changes.

Setting Up a VXLAN Provider Network Using the CLI

You can use the command line interface to set up a VXLAN provider network and add segmentation ranges.

VXLAN provider networks are an alternative to VLAN provider networks when VM L2 connectivity is required across separate Layer 2 network segments separated by one or more Layer 3 routers.

The steps in this section describe how to set up a VXLAN provider network and add segmentation ranges using the command line interface. For information about using the web administration interface, see *Setting Up a VXLAN Provider Network* on page 50.

To create a provider network using the CLI, use the following command:

```
~(keystone_admin)$ neutron providernet-create name \
--type=type --description=description mtu mtu_size
```

where

name

is a name for the provider network

type

is the type of provider network (**flat**, **vlan**, or **vxlan**)

description

is a brief description for reference purposes

mtu_size

is the maximum transmission unit size

To add a segmentation range using the CLI, use the following command:

```
~(keystone_admin)$ neutron providernet-range-create provider_network \
--name=range_name --tenant_id=tenant \
--description=description --range min-max \
--group multicast_address --port=udp_port \
--ttl=time_to_live
```

where

provider_network

is the name of the associated provider network

name

is a name for the segmentation range

tenant

is the name or UUID of the tenant associated with the range

description

is a brief description for reference purposes

min

is the lowest value in the range

max

is the highest value in the range

The following additional values are used for segmentation ranges on VxLAN provider networks:

multicast_address

The IPv4 or IPv6 address for participation in a multicast group used to discover MAC addresses for destination VMs. You can use a different multicast group for each segmentation range to help organize and partition network traffic.

udp_port

The destination UDP port for packets sent on the VXLAN. You can select either the IANA standard 4789 to use this range with the OpenStack Neutron service, or the legacy standard 8472 for use with some commercial switch equipment.

time_to_live

The time-to-live, measured in hops, for packets sent on the VXLAN. The value is decremented at each hop; when it reaches zero, the packet expires. You can use this to limit the scope of the VXLAN. For example, to limit the packet to no more than three router hops, use a time-to-live value of 4.

For more about these parameters, refer to the steps for using the web administration interface.

You can obtain information about provider networks and segmentation ranges using the following commands.

```
~(keystone_admin)$ neutron net-list-on-providernet providernet
```

```
~(keystone_admin)$ neutron providernet-range-show providernet-range
```

Configuring Endpoint IP Addresses

You can configure a data interface on a compute node with an endpoint address using CLI commands.

For VXLAN connectivity between VMs, the compute nodes that host the VMs must be configured with endpoint IP addresses.

To make interface changes, you must lock the compute node first.

1. Lock the compute node.
2. Set the interface to support an IPv4 or IPv6 address, or both.

   ```
   ~(keystone_admin)$ system host-if-modify node ifname --ipv4-mode=ipv4mode
    --ipv6-mode=ipv6mode
   ```

   where

   node

   is the name or UUID of the compute node

   ifname

   is the name of the interface

   ipv4mode

   is either **disabled** or **static**

   ipv6mode

   is either **disabled** or **static**

3. Add an IPv4 or IPv6 address to the interface.

   ```
   ~(keystone_admin)$ system host-addr-add node ifname ip_address prefix
   ```

   where

   node

   is the name or UUID of the compute node

   ifname

   is the name of the interface

ip_address

is an IPv4 or IPv6 address

prefix

is the netmask length for the address

To delete an address, use the following commands:

```
~(keystone_admin)$ system host-addr-list
```

This displays the UUIDs of existing addresses.

```
~(keystone_admin)$ system host-addr-delete uuid
```

where **uuid** is the UUID of the address.

4. Unlock the compute node and wait for it to become available.

Adding and Maintaining Routes for a VXLAN Network

You can add or delete routing table entries for hosts on a VXLAN network using the CLI.

The compute node must be locked.

To add routes, use the following command.

```
~(keystone_admin)$ system host-route-
add node ifname network prefix gateway metric
```

where

node

is the name or UUID of the compute node

ifname

is the name of the interface

network

is an IPv4 or IPv6 network address

prefix

is the netmask length for the network address

gateway

is the default gateway

metric

is the cost of the route (the number of hops)

To delete routes, use the following command.

```
~(keystone_admin)$ system host-route-
delete uuid ifname network prefix gateway metric
```

where **uuid** is the UUID of the route to be deleted.

To list existing routes, including their UUIDs, use the following command.

```
~(keystone_admin)$ system host-route-list compute-0
```

Chapter 3

System Configuration Management

Topics:

You can make changes to the HP Helion OpenStack Carrier Grade's initial configuration at any time after installation.

The HP Helion OpenStack Carrier Grade's initial configuration is defined during software installation, using the **region_config** script (see the *HP Helion OpenStack Carrier Grade Software Installation Guide: Configuring Controller-0).* After installation, you can make changes using the web administration interface or the CLI. For most types of changes, you can do this without interrupting system operations.

You can change the initial configuration as follows:

- Reconfigure aspects of the External OAM network, including the subnet, controller IP addresses, gateway IP address, and floating IP address.
- Change the DNS server IP addresses.
- Change the NTP server IP addresses.
- Change the disk allocations for database storage, image storage, backup storage, and Cinder volume storage.
- Add an infrastructure network if one is not already configured.

Note:

A service interruption is required to add an infrastructure network; all nodes except the active controller must be locked. In addition, you must use the CLI to make this change.

Immediately before making a change, ensure the following:

- All hosts are unlocked.
- No **Major** or **Critical** alarms are shown for the system on the Fault Management page.
- No **250.001 Configuration out-of-date** alarms are shown for the system on the Fault Management page.

During these changes, the HP Helion OpenStack Carrier Grade can remain online and operational. For some types of changes, alarms are raised while the settings are in transition. To make the changes take effect and to clear the alarms, individual hosts must be locked and then unlocked one at a time. For more information, see *Host Status and Alarms During System Configuration Changes* on page 59.

Only hosts with **250.001 Configuration out-of-date** alarms need to be locked and then unlocked. When locking and unlocking the hosts to clear the alarms, use the following order:

1. controller nodes
2. compute nodes

Note:

To keep the system operational during an OAM network change, sufficient resources must be available to migrate the virtual machines on a compute node while it is locked for changes.

To make changes using the web administration interface, you must be logged in as the **admin** user. Use the **System Configuration** pane, is available from the **System Panel** section of the **Admin** menu.

To make changes using the CLI, you must be logged in as the **wrsroot** user on the active controller, and sourced as the Keystone **admin** user. For more information, see *System Configuration Management Using the CLI* on page 65.

Host Status and Alarms During System Configuration Changes

For all types of configuration changes, alarms and status messages appear while the system is in transition. You can use the information provided by these messages to help guide the transition successfully.

Configuration changes require multiple hosts to be reconfigured, during which the settings across the cluster are not consistent. This causes alarms to be raised for the system.

- Changes to the DNS server configuration cause transitory alarms. These alarms are cleared automatically when the configuration change is applied.
- Changes to the External OAM network IP addresses or NTP server addresses, and in particular to the controller storage allotments, cause persistent alarms. These alarms must be cleared manually, by locking and unlocking the affected hosts or performing other administrative actions.

Alarms appear on the **Fault Management** pane, and related status messages appear on the **Hosts** tab on the **Inventory** pane. A variety of alarms may be reported on the Fault Management page, depending on the configuration change.

Caution:

To help identify alarms raised during a configuration change, ensure that any existing system alarms are cleared before you begin.

On the **Hosts** tab of the **System Inventory** pane, the status **Config out-of-date** is shown for hosts affected by the change. Each host with this status must be locked and then unlocked to update its configuration and clear the alarm.

Changing the OAM IP Configuration

You can change the External OAM subnet, floating IP address, controller addresses, and default gateway at any time after installation.

During software installation, the HP Helion OpenStack Carrier Grade is configured with an OAM network subnet and related IP addresses. You can change these addresses using the web administration interface or the CLI.

Caution:

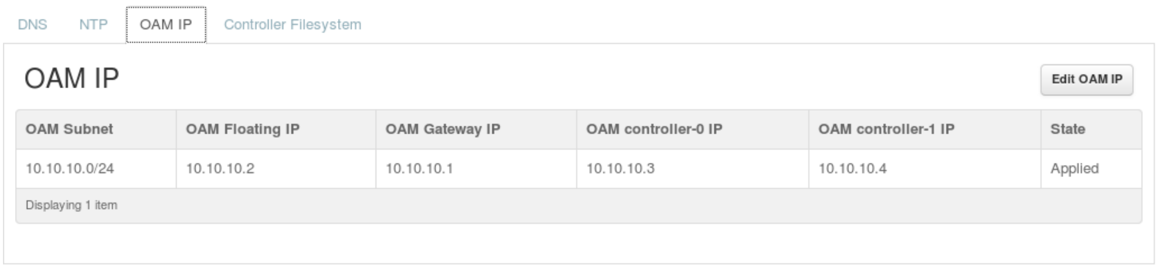
Access to the OAM network is interrupted during this procedure. When a swact is performed on the controllers, the newly active controller uses the changed OAM IP addresses. The existing OAM IP addresses are no longer valid, and you must use the new OAM IP addresses to reconnect to the controller. Changes to external OAM access routing settings may also be required. In addition, VNC console access to compute-node hosts is interrupted until the hosts are locked and unlocked.

Before changing the OAM IP configuration, review the Fault Management page and ensure that any existing system alarms are cleared.

1. In the HP Helion OpenStack Carrier Grade web administration interface, open the **System Configuration** pane.

   The **System Configuration** pane is available from the **System Panel** section of the **Admin** menu.
2. Select the **OAM IP** tab.

   The **OAM IP** page appears, showing the currently defined OAM network configuration.

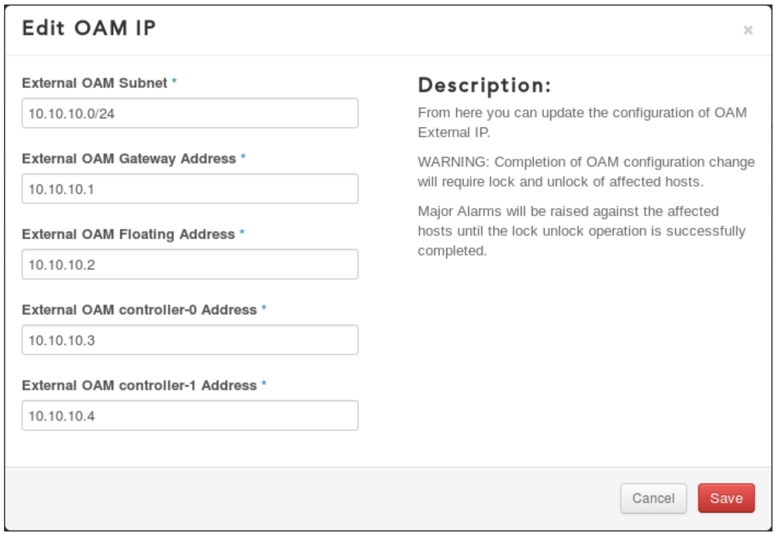


OAM Subnet	OAM Floating IP	OAM Gateway IP	OAM controller-0 IP	OAM controller-1 IP	State
10.10.10.0/24	10.10.10.2	10.10.10.1	10.10.10.3	10.10.10.4	Applied

Displaying 1 item

3. Click **Edit OAM IP**.

   The **Edit OAM IP** dialog box appears.



Edit OAM IP

External OAM Subnet *
10.10.10.0/24

External OAM Gateway Address *
10.10.10.1

External OAM Floating Address *
10.10.10.2

External OAM controller-0 Address *
10.10.10.3

External OAM controller-1 Address *
10.10.10.4

Description:

From here you can update the configuration of OAM External IP.

WARNING: Completion of OAM configuration change will require lock and unlock of affected hosts.

Major Alarms will be raised against the affected hosts until the lock unlock operation is successfully completed.

4. Replace the IP addresses with different ones as required.
5. Click **Save**.

   This raises major alarms against the controllers and services. You can view the alarms on the Fault Management page.
6. Lock and unlock the controllers to clear the alarms.

   Open the **Hosts** list by clicking **Inventory** on the **System Panel** section of the **Admin** menu, and then selecting the **Hosts** tab. Hosts requiring attention are shown with the status **Config out-of-date**.

   To lock or unlock a host, click **More** for the host and then use the menu selections.

   a) Lock the standby controller.

      Wait for the lock operation to be completed.
   b) Unlock the standby controller.

      Wait for the host to become available. It is updated with the new OAM configuration, and its error message is cleared.
   c) Perform a swact on the active controller.

      Click **More** > **Swact Host** >   for the active controller.

      Note:

      After the swact, the HP Helion OpenStack Carrier Grade begins using the new OAM network configuration. If you have changed the OAM subnet or the OAM floating IP address, the current web session is terminated. To continue using the web administration interface, you must start a new session and log in using the new IP address. You may also need to update router tables to establish a connection.
   d) Lock the original controller (now in standby mode).

      Wait for the lock operation to be completed.
   e) Unlock the original controller.

      Wait for it to become available. It is updated with the new OAM configuration, and its error message is cleared.
7. Lock and unlock each compute node.

   Caution:

Before locking a compute node, ensure that sufficient resources are available on other hosts to migrate any running instances.

8. Ensure that the **250.001 Configuration out-of-date** alarms are cleared for all hosts.

   If any alarms are present, clear them by locking and unlocking the affected host. In most cases, the alarms are cleared within one minute. If other system configuration operations are pending for the host, allow more time for the alarms to be cleared.

Changing the DNS Server Configuration

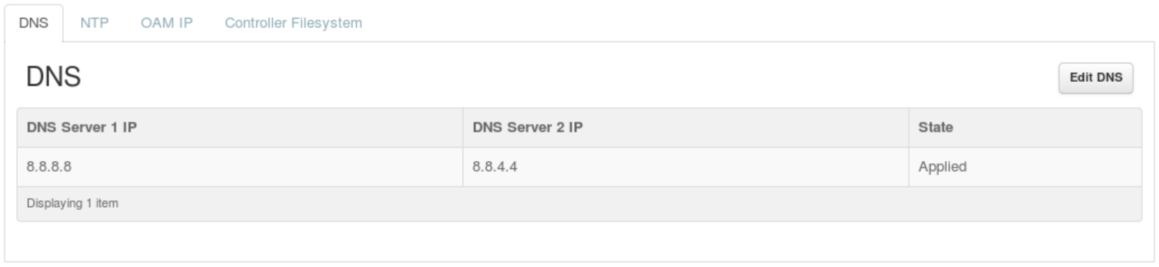
You can change the DNS servers defined for the HP Helion OpenStack Carrier Grade at any time after installation.

During software installation, the HP Helion OpenStack Carrier Grade is configured with up to two DNS server IP addresses. You change these addresses using the web administration interface or the CLI.

1. In the HP Helion OpenStack Carrier Grade web administration interface, open the **System Configuration** pane.

   The **System Configuration** pane is available from the **System Panel** section of the **Admin** menu.
2. Select the **DNS** tab.

   The **DNS** page appears, showing the currently defined DNS servers and their IP addresses.

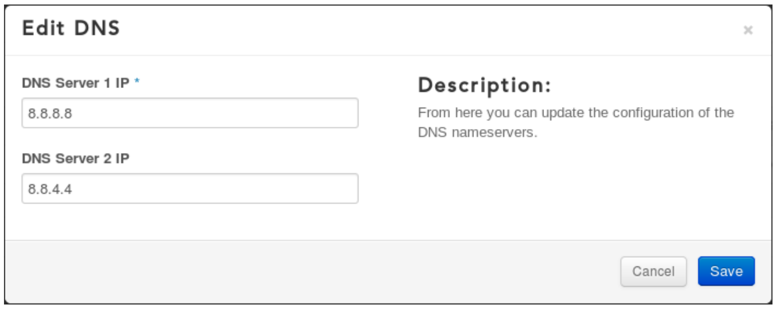


DNS Server 1 IP	DNS Server 2 IP	State
8.8.8.8	8.8.4.4	Applied

Displaying 1 item

3. Click **Edit DNS**.

   The **Edit DNS** dialog box appears.



DNS Server 1 IP *: 8.8.8.8

DNS Server 2 IP: 8.8.4.4

Description:

From here you can update the configuration of the DNS nameservers.

4. Replace the DNS Server IP addresses with different ones as required.

Upon completion of the DNS configuration change, a **250.001 Configuration out-of-date** alarm is raised temporarily, and then cleared automatically by the system.

Changing the NTP Server Configuration

You can change the NTP server addresses defined for the HP Helion OpenStack Carrier Grade at any time after installation.

During software installation, the HP Helion OpenStack Carrier Grade is configured with up to three NTP server IP addresses. You change these addresses using the web administration interface or the CLI.

Before changing NTP server addresses, review the Fault Management page and ensure that any existing system alarms are cleared.

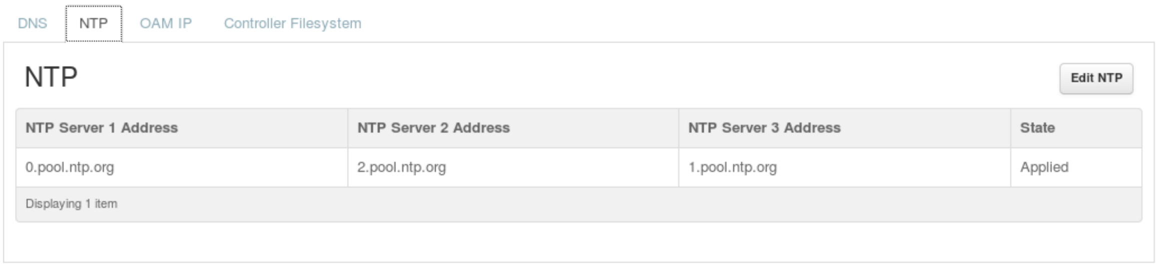
Caution:

For the HP Helion OpenStack Carrier Grade system to use FQDN servers instead of IPv4 servers, at least one valid DNS server must be specified.

1. In the HP Helion OpenStack Carrier Grade web administration interface, open the **System Configuration** pane.

   The **System Configuration** pane is available from the **System Panel** section of the **Admin** menu.
2. Select the **NTP** tab.

   The **NTP** page appears, showing the currently defined NTP servers and their IP addresses.

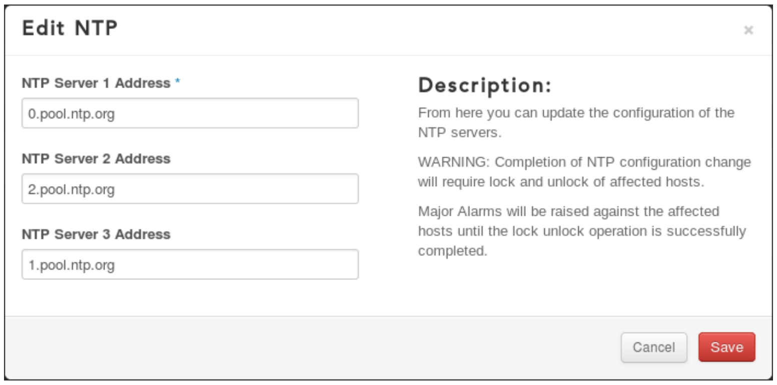


NTP Server 1 Address	NTP Server 2 Address	NTP Server 3 Address	State
0.pool.ntp.org	2.pool.ntp.org	1.pool.ntp.org	Applied

Displaying 1 item

3. Click **Edit NTP**.

   The **Edit NTP** dialog box appears.



NTP Server 1 Address *: 0.pool.ntp.org

NTP Server 2 Address: 2.pool.ntp.org

NTP Server 3 Address: 1.pool.ntp.org

Description:

From here you can update the configuration of the NTP servers.

WARNING: Completion of NTP configuration change will require lock and unlock of affected hosts.

Major Alarms will be raised against the affected hosts until the lock unlock operation is successfully completed.

4. Replace the NTP Server IP addresses or names with different ones as required.

   If you specify the NTP servers using FQDNs you must have at least one valid DNS server defined on your system. You must use IP addresses otherwise.
5. Click **Save**.

   This raises major alarms against the controllers and services. You can view the alarms on the Fault Management page.
6. Lock and unlock the controllers to clear the alarms.

   Open the **Hosts** list by clicking **Inventory** on the **System Panel** section of the **Admin** menu, and then selecting the **Hosts** tab. Hosts requiring attention are shown with the status **Config out-of-date**.

   To lock or unlock a host, click **More** for the host and then use the menu selections.

   a) Lock the standby controller.

      Wait for the lock operation to be completed.

   b) Unlock the standby controller.

      Wait for the host to become available. It is updated with the new NTP server addresses, and its error message is cleared.

c) Perform a swact on the active controller.

   Click **More** > **Swact Host** > for the active controller.

d) Lock the original controller (now in standby mode).

   Wait for the lock operation to be completed.

e) Unlock the original controller.

   Wait for it to become available. It is updated with the new NTP server addresses, and its error message is cleared.

7. Ensure that the **250.001 Configuration out-of-date** alarms are cleared for both controllers.

Changing Storage Space Allotments on the Controller

You can change the allotments for controller-based storage at any time after installation. This includes the space allotted for database, image, and backup storage, and for clusters using an LVM backend, the space allotted for Cinder volume storage.

Note:

Cinder volume storage is allotted using 3PAR, not on the controller node.

During software installation, the HP Helion OpenStack Carrier Grade is configured with the following storage allotments.

Database storage

The storage allotment for the OpenStack database.

Image storage

The size of the partition to use for image storage.

Backup storage

The storage allotment for backup operations.

Volume storage

For a system using LVM storage, the storage allotment for all Cinder volumes used by guest instances.

You can change these allotments using the **System Configuration** controls in the web administration interface, or using the CLI. For CLI instructions, see *System Configuration Management Using the CLI* on page 65.

To accommodate the changes, there must be enough disk space on the controller, including headroom needed to complete the operation. The headroom required is 45 GiB on the primary disk for a cluster using an LVM backend. This is in addition to the space required for the new allotments. The requested changes are checked against available space on the affected disks; if there is not enough, the changes are disallowed.

To provide more space, you can replace the affected disk or disks. Database, image, and backup storage use space on the primary disk. Cinder volume storage (on a cluster with an LVM backend) uses space on a disk selected by device node number during controller configuration. The replacement disk must occupy the same device node number. Changes to the Cinder volume storage may also affect the primary disk because of the headroom requirement.

To pass the disk-space checks, any replacement disks must be installed before the allotments are changed.

Caution:

The configurations for **controller-0** and **controller-1** must be identical. If you make changes to one, you must make the same changes to the other.

Changes to the storage allotments require a reinstallation of the HP Helion OpenStack Carrier Grade host software on the controllers, even if the primary disk is not replaced.

Note:

Performing a host reinstall successfully is dependent on your BIOS boot order. Observe the following tips.

- Prior to installation, the BIOS should be configured to allow booting from disk and the network.
- During the host re-installation, it is advisable to have a console serial cable attached to the host to observe the boot progress.
- BIOS boot order should be:
  1. The boot partition.

     Typically, this is the disk associated with `/dev/sda` and is as defined in `/proc/cmdline` when the load is booted.
  2. The NIC on the boot interface (e.g. management or pxe network).
- Set BIOS boot options to ensure failsafe boot if available, e.g. rotating through available boot interfaces, watchdog timer on boot, retry boot interfaces etc.

If the BIOS boot still fails to progress, it may be necessary to force boot via the network interfaces via the BIOS boot option.

Before changing storage allotments, prepare as follows:

- Calculate your system storage requirements using the *HP Helion OpenStack Carrier Grade System Engineering Guidelines*. Include the headroom required for changes to the storage space allotments.
- Record the current configuration settings in case they need to be restored (for example, because of an unexpected interruption during changes to the system configuration). Consult the configuration plan for your system.

1. If necessary, install replacement disks in the controllers.

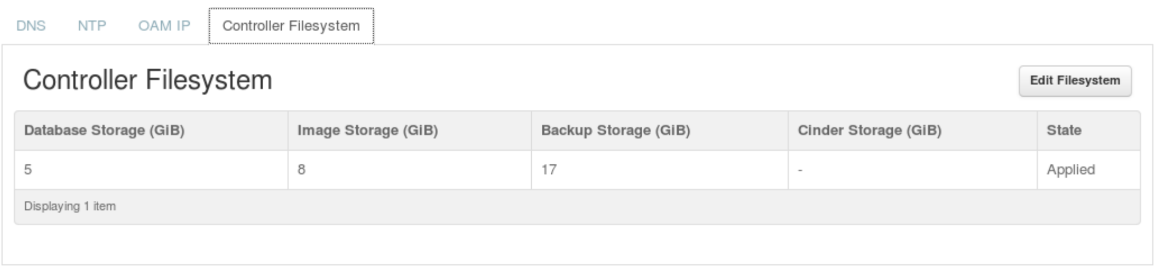
   If you do not need to replace disks, you can skip this step. To determine whether you need to replace disks, calculate your storage requirements using the *HP Helion OpenStack Carrier Grade System Engineering Guidelines*. Be sure to include the headroom required on the primary disk.

   To replace disks in the controllers, follow these steps. For more details, see *Managing Controller Nodes* on page 91.

   a) Lock the standby controller.
   b) Power down the standby controller.
   c) Make any required hardware changes.
   d) Power up the standby controller.
   e) Reinstall the HP Helion OpenStack Carrier Grade software on the standby controller.
   f) Unlock the standby controller.
   g) Swact the controllers.
   h) Repeat these steps for the new standby controller.
2. Edit the disk storage allotments.
   a) In the HP Helion OpenStack Carrier Grade web administration interface, open the **System Configuration** pane.

      The **System Configuration** pane is available from the **System Panel** section of the **Admin** menu.
   b) Select the **Controller Filesystem** tab.

      The **Controller Filesystem** page appears, showing the currently defined storage allotments.



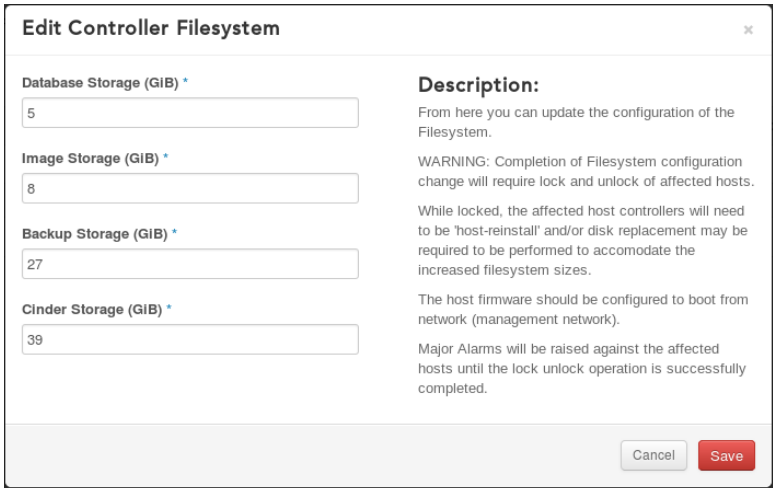
Controller Filesystem

Database Storage (GiB)	Image Storage (GiB)	Backup Storage (GiB)	Cinder Storage (GiB)	State
5	8	17	-	Applied

Displaying 1 item

   c) Click **Edit Filesystem**.

The **Edit Controller Filesystem** dialog box appears.


Edit Controller Filesystem

Database Storage (GiB) *
5

Image Storage (GiB) *
8

Backup Storage (GiB) *
27

Cinder Storage (GiB) *
39

Description:

From here you can update the configuration of the Filesystem.

WARNING: Completion of Filesystem configuration change will require lock and unlock of affected hosts.

While locked, the affected host controllers will need to be 'host-reinstall' and/or disk replacement may be required to be performed to accomodate the increased filesystem sizes.

The host firmware should be configured to boot from network (management network).

Major Alarms will be raised against the affected hosts until the lock unlock operation is successfully completed.

Note:

The **Cinder storage (GiB)** field is present only for clusters using the LVM backend.

d) Replace the storage allotments as required.
e) Click **Save**.

This raises major alarms against the controllers (**250.001 Configuration out-of-date**). You can view the alarms on the Fault Management page. In addition, the status **Config out-of-date** is shown for the controllers in the **Hosts** list.

3. Lock the standby controller.
4. Reinstall the HP Helion OpenStack Carrier Grade software on the standby controller.

   This step is required to update the system configuration, even if you have already reinstalled the HP Helion OpenStack Carrier Grade software as part of the disk replacement procedure.
5. Unlock the standby controller.

   When the controller is unlocked, the **250.001 Configuration out-of-date** alarms against the controller are cleared.
6. Swact the controllers.
7. Lock the new standby controller.
8. Reinstall the HP Helion OpenStack Carrier Grade software on the controller.
9. Unlock the controller.
10. Confirm that the **250.001 Configuration out-of-date** alarms are cleared for both controllers.

After making these changes, ensure that the configuration plan for your system is updated with the new storage allotments and disk sizes.

System Configuration Management Using the CLI

You can use the CLI to make changes to the system configuration after installation.

For information about the types of configuration changes you can make, and guidelines for implementing them on an operational system, see *System Configuration Management* on page 57. During some configuration changes, system alarms are raised; for help viewing them from the CLI, see *System Alarms CLI Commands* on page 141.

To make configuration changes using the CLI, you must log in as user **wrsroot** to the active controller and source the script `/etc/nova/openrc` to obtain Keystone administrative privileges. See *Linux User Accounts* on page 12 for details.

With the exception of the DNS Server Configuration, the configuration changes described in this section require that you lock and unlock the indicated hosts after the configuration change is made. For more information about locking and unlocking hosts, see *Host Inventory* on page 82.

OAM IP Configuration

To view the existing OAM IP configuration, use the following command.

```
~(keystone_admin)$ system oam-show
+-----------------+--------------------------------------+
| Property        | Value                                |
+-----------------+--------------------------------------+
| uuid            | bacf5c9d-47a1-43df-845a-f38a88e1dcd4 |
| istate          | applied                              |
| oam_lag_ifc     | False                                |
| oam_ifcs        | eth0                                 |
| oam_mtu         | 1500                                 |
| oam_subnet      | 10.10.10.0/24                        |
| oam_gateway_ip  | 10.10.10.1                           |
| oam_floating_ip | 10.10.10.2                           |
| oam_c0_ip       | 10.10.10.3                           |
| oam_c1_ip       | 10.10.10.4                           |
| isystem_uuid    | 1bbd29be-c6a2-4e9b-93ce-a8dac3ce8e5c |
| recordtype      | reconfig                             |
| created_at      | 2014-12-23T21:15:34.097509+00:00     |
| updated_at      | 2014-12-31T19:41:43.787097+00:00     |
+-----------------+--------------------------------------+
```

To change the OAM IP subnet, floating IP address, gateway IP address, or controller IP addresses, use the following command syntax.

```
~(keystone_admin)$ system oam-modify oam_subnet=subnet/netmask \
oam_gateway_ip=gateway_ip_address \
oam_floating_ip=floating_IP_address \
oam_c0_ip=controller-0_IP_address \
oam_c1_ip=controller-1_ip_address \
action=apply
```

For example:

```
~(keystone_admin)$ system oam-modify oam_subnet=10.10.10.0/24 \
oam_gateway_ip=10.10.10.1 \
oam_floating_ip=10.10.10.2 \
oam_c0_ip=10.10.10.3 \
oam_c1_ip=10.10.10.4 \
action=apply
```

After changing the OAM server configuration, you must lock and unlock the controllers. This process requires a swact on the controllers. Then you must lock and unlock the compute nodes one at a time, ensuring that sufficient resources are available to migrate any running instances.

DNS Server Configuration

To view the existing DNS server configuration, use the following command.

```
~(keystone_admin)$ system dns-show
+--------------+--------------------------------------+
| Property     | Value                                |
+--------------+--------------------------------------+
| uuid         | cd2d645f-d8ca-4344-995b-aab480b1951d |
| recordtype   | reconfig                             |
| istate       | applied                              |
| nameservers  | 8.8.8.8,8.8.4.4                      |
| isystem_uuid | 1bbd29be-c6a2-4e9b-93ce-a8dac3ce8e5c |
| created_at   | 2014-12-23T21:15:34.127239+00:00     |
| updated_at   | 2014-12-31T19:41:43.806842+00:00     |
+--------------+--------------------------------------+
```

To change the DNS server IP addresses, use the following command syntax. The nameservers option takes a comma-delimited list of DNS server IP addresses.

```
~(keystone_admin)$ system dns-modify \
nameservers=IP_address_1[,IP_address_2][,IP_address_3] action=apply
```

For example:

```
~(keystone_admin)$ system dns-modify \
nameservers=8.8.8.8,8.8.4.4 action=apply
```

NTP Server Configuration

To view the existing NTP server configuration, use the following command.

```
~(keystone_admin)$ system ntp-show
+--------------+----------------------------------------------+
| Property     | Value                                        |
+--------------+----------------------------------------------+
| uuid         | 33bf8ad6-9426-4e10-b5b2-0be1b23a22c9         |
| recordtype   | reconfig                                     |
| istate       | applied                                      |
| ntpservers   | 0.pool.ntp.org,2.pool.ntp.org,1.pool.ntp.org |
| isystem_uuid | 1bbd29be-c6a2-4e9b-93ce-a8dac3ce8e5c         |
| created_at   | 2014-12-23T21:15:34.145488+00:00             |
| updated_at   | 2014-12-31T19:53:44.343981+00:00             |
+--------------+----------------------------------------------+
```

To change the NTP server IP addresses, use the following command syntax. The ntpservers option takes a comma-delimited list of NTP server names.

```
~(keystone_admin)$ system ntp-modify \
ntpservers=server_1[,server_2][,server_3] action=apply
```

For example:

```
~(keystone_admin)$ system ntp-modify \
ntpservers=0.north-america.pool.ntp.org,\
0.north-america.pool.ntp.org,0.north-america.pool.ntp.org \
action=apply
```

After changing the NTP server configuration, you must lock and unlock both controllers. This process requires a swact on the controllers.

Controller Storage Configuration

To view the existing storage configuration, use the following command.

```
~(keystone_admin)$ system controllerfs-show
+--------------+--------------------------------------+
| Property     | Value                                |
+--------------+--------------------------------------+
| uuid         | b1242c7f-7cb1-4878-a088-aac02c3f424b |
| recordtype   | reconfig                             |
| istate       | applied                              |
| database_gib | 5                                    |
| image_gib    | 8                                    |
| backup_gib   | 27                                   |
| cinder_gib   | 39                                   |
| isystem_uuid | 1bbd29be-c6a2-4e9b-93ce-a8dac3ce8e5c |
| created_at   | 2014-12-23T21:15:33.970585+00:00     |
| updated_at   | 2014-12-31T19:54:44.321612+00:00     |
+--------------+--------------------------------------+
```

Before you can change storage allotments, you must have enough disk space, including additional headroom required to complete the operation. If there is not enough disk space, changes to the storage allotment are disallowed. For more information, see *Changing Storage Space Allotments on the Controller* on page 63.

You can replace the disks in the controllers to provide more space. For more information, see *Managing Controller Nodes* on page 91. To support storage changes, you must reinstall the HP Helion OpenStack Carrier Grade software on each controller during the disk replacement procedure. This is required even if the primary disk is not directly affected by the change. To reinstall the software, you can use the following command:

```
~(keystone_admin)$ system host-reinstall controller_name
```

Note:

Performing a host reinstall successfully is dependent on your BIOS boot order. Observe the following tips.

- Prior to installation, the BIOS should be configured to allow booting from disk and the network.
- During the host re-installation, it is advisable to have a console serial cable attached to the host to observe the boot progress.
- BIOS boot order should be:

  1. The boot partition.

     Typically, this is the disk associated with `/dev/sda` and is as defined in `/proc/cmdline` when the load is booted.

  2. The NIC on the boot interface (e.g. management or pxe network).
- Set BIOS boot options to ensure failsafe boot if available, e.g. rotating through available boot interfaces, watchdog timer on boot, retry boot interfaces etc.

If the BIOS boot still fails to progress, it may be necessary to force boot via the network interfaces via the BIOS boot option.

To change the database, image, or backup storage allotment, or the Cinder volume storage allotment on a system with an LVM storage backend, use the following command syntax, where the allotments are in GiB.

```
~(keystone_admin)$ system controllerfs-modify \
database_gib=database_allotment \
image_gib=image_allotment \
backup_gib=backup_allotment \
cinder_gib=cinder_volume_allotment \
action=apply
```

For example:

```
~(keystone_admin)$ system controllerfs-modify \
database_gib=10 image_gib=13 backup_gib=22 action=apply
```

After changing the controller storage configuration, you must lock each controller and reinstall the HP Helion OpenStack Carrier Grade software, even if you have already done so as part of changing the controller disks. You can use the following command:

```
~(keystone_admin)]$ system host-reinstall controller_name
```

Then you can unlock the controller to clear any **Configuration out-of-date** alarms. A controller swact is required to update both controllers.

Adding an Infrastructure Network Using the CLI

If an infrastructure network is not installed during initial configuration, you can add one later using the CLI.

Note:

On a cluster with an infrastructure network, each host must have an infrastructure interface before it can be unlocked. Ensure that all hosts have the required hardware.

For a system with an LVM storage backend, the infrastructure network is optional. It can be used to offload the internal management network on clusters with many compute nodes. For more information, see *Network Planning* on page 34.

You can view the existing infrastructure network configuration using the following command on the active controller (assumed to be **controller-0** for this discussion).

```
~(keystone_admin)$ system infra-show
```

```
+--------------+--------------------------------------+
| Property     | Value                                |
+--------------+--------------------------------------+
| uuid         | cc549ef3-5c81-4fbf-8c50-5163c89e5039 |
| istate       | applied                              |
| infra_subnet | None                                 |
| isystem_uuid | 1bbd29be-c6a2-4e9b-93ce-a8dac3ce8e5c |
| recordtype   | reconfig                             |
| created_at   | 2014-12-23T21:15:34.074881+00:00     |
| updated_at   | 2014-12-31T19:38:43.603320+00:00     |
+--------------+--------------------------------------+
```

You can add an infrastructure network after initial installation. For this operation, all nodes except the active controller must be locked. During the change, the nodes cannot be unlocked until the new configuration is applied to both controllers. In addition, before a node can be unlocked, an infrastructure interface must be configured on the host.

1. Lock all hosts except the active controller.

   For each host, use the following command.

   ```
   ~(keystone_admin)$ system host-lock hostname
   ```

2. Add an infrastructure interface on the standby controller.

   To add an infrastructure network to a dedicated interface, use the following command, specifying a name for the network and the port to use for the network connection. To identify the port to use for an infrastructure network, consult your configuration plan.

   Note:

   You can also add an infrastructure network to a shared interface as a VLAN-tagged network. For more information, see *Shared (VLAN) Ethernet Interfaces* on page 23.

   ```
   ~(keystone_admin)$ system host-if-add -nt infra \
   ```

```
hostname interfacename port
```

For example:

```
~(keystone_admin)$ system host-if-add -nt infra \
controller-1 infra0 eth3
+------------------+--------------------------------------+
| Property         | Value                                |
+------------------+--------------------------------------+
| ifname           | infra0                               |
| networktype      | infra                                |
| iftype           | ethernet                             |
| ports            | [u'eth3']                            |
| providernetworks | None                                 |
| imac             | 08:00:27:7a:fa:a5                    |
| imtu             | 1500                                 |
| aemode           | active_standby                       |
| schedpolicy      | None                                 |
| txhashpolicy     | layer2                               |
| uuid             | d3efde57-c475-402e-acad-34f5029f3988 |
| ihost_uuid       | 62657285-cc9c-45a2-962e-ecb01647916f |
| vlan_id          | None                                 |
| uses             | []                                   |
| used_by          | []                                   |
| created_at       | 2014-12-31T20:13:16.326992+00:00     |
| updated_at       | None                                 |
+------------------+--------------------------------------+
```

3. Add the same infrastructure network on the active controller.

   For example:

```
~(keystone_admin)$ system host-if-add -nt infra \
controller-0 infra0 eth3
+------------------+--------------------------------------+
| Property         | Value                                |
+------------------+--------------------------------------+
| ifname           | infra0                               |
| networktype      | infra                                |
| iftype           | ethernet                             |
| ports            | [u'eth3']                            |
| providernetworks | None                                 |
| imac             | 08:00:27:51:58:6b                    |
| imtu             | 1500                                 |
| aemode           | active_standby                       |
| schedpolicy      | None                                 |
| txhashpolicy     | layer2                               |
| uuid             | 66c4543e-6bfd-4ede-9b8a-4d091cf290a9 |
| ihost_uuid       | 3c11607b-1550-4e99-a46f-2580c18683da |
| vlan_id          | None                                 |
| uses             | []                                   |
| used_by          | []                                   |
| created_at       | 2014-12-31T20:29:51.759507+00:00     |
| updated_at       | None                                 |
+------------------+--------------------------------------+
```

4. Specify the infrastructure subnet.

```
~(keystone_admin)$ system infra-modify \
infra_subnet=subnet/mask action=apply
```

For example:

```
~(keystone_admin)$ system infra-modify \
infra_subnet=192.168.205.0/24 action=apply

+--------------+--------------------------------------+
| Property     | Value                                |
+--------------+--------------------------------------+
| uuid         | cc549ef3-5c81-4fbf-8c50-5163c89e5039 |
| istate       | applying                             |
| infra_subnet | 192.168.205.0/24                     |
| isystem_uuid | 1bbd29be-c6a2-4e9b-93ce-a8dac3ce8e5c |
| recordtype   | reconfig                             |
| created_at   | 2014-12-23T21:15:34.074881+00:00     |
| updated_at   | 2015-01-02T16:06:39.275800+00:00     |
+--------------+--------------------------------------+
```

5. Reboot the standby controller.

```
~(keystone_admin)$ system host-reboot controller-1
```

This updates its configuration.

Wait for the standby controller to reboot. To monitor its status, use the following command.

```
~(keystone_admin)$ watch -n 5 system host-list
```

This displays a refreshed host list every five seconds. Monitor the output until the standby controller is shown as **locked** and **online**. To stop monitoring, enter `CTRL-C`.

Caution:

To prevent potential service conflicts due to inconsistent controller network configurations, do not unlock the standby controller until the active controller is also rebooted.

6. Reboot the active controller.

```
~(keystone_admin)$ sudo reboot
The system is going down for reboot NOW!
```

Wait for the controller to reboot.

7. Log in to the active controller and become the Keystone **admin** user.

```
$ source /etc/nova/openrc
```

8. Unlock the standby controller.

```
~(keystone_admin)$ system host-unlock controller-1
+-----------------+--------------------------------------+
| Property        | Value                                |
+-----------------+--------------------------------------+
| action          | none                                 |
| administrative  | locked                               |
| availability    | online                               |
| bm_ip           |                                      |
| bm_mac          |                                      |
| bm_type         | None                                 |
| bm_username     |                                      |
| capabilities    | {}                                   |
| created_at      | 2014-12-24T16:44:08.749540+00:00     |
| cstatus         |                                      |
| hostname        | controller-1                         |
| iconfig_applied | 76aa6a81-620a-4ba2-85c3-113d1c42f5ec |
| iconfig_fini    | 76aa6a81-620a-4ba2-85c3-113d1c42f5ec |
| iconfig_target  | 76aa6a81-620a-4ba2-85c3-113d1c42f5ec |
| id              | 5                                    |
| invprovision    | unprovisioned                        |
| location        | {u'locn': u'Rack 1 Pos 2'}           |
| mgmt_ip         | 192.168.204.4                        |
| mgmt_mac        | 08:00:27:ba:e8:52                    |
| operational     | disabled                             |
| personality     | controller                           |
| reserved        | False                                |
| serialid        | None                                 |
| task            | Unlocking                            |
| updated_at      | 2015-01-02T17:12:56.464592+00:00     |
| uptime          | 1955                                 |
| uuid            | 62657285-cc9c-45a2-962e-ecb01647916f |
+-----------------+--------------------------------------+
```

9. Add infrastructure interfaces to each compute node.

For each node, use the following command.

```
~(keystone_admin)$ system host-if-add -nt infra \
hostname networkname port
+------------------+--------------------------------------+
| Property         | Value                                |
+------------------+--------------------------------------+
| ifname           | infra0                               |
| networktype      | infra                                |
| iftype           | ethernet                             |
| ports            | [u'eth0']                            |
| providernetworks | None                                 |
| imac             | 08:00:27:20:d2:d1                    |
| imtu             | 1500                                 |
| aemode           | active_standby                       |
| schedpolicy      | None                                 |
| txhashpolicy     | layer2                               |
| uuid             | d664ad66-58fa-4378-b906-ae417d58dbf0 |
| ihost_uuid       | 43b462ac-05fc-43dd-82de-160c7ab0923f |
| vlan_id          | None                                 |
| uses             | []                                   |
| used_by          | []                                   |
| created_at       | 2015-01-02T17:33:37.138694+00:00     |
| updated_at       | None                                 |
+------------------+--------------------------------------+
```

You can now unlock the compute nodes. This clears any **Configuration out-of-date** errors.

Chapter 4

Managing Hardware Resources

Topics:

The HP Helion OpenStack Carrier Grade reports status information about the hosts in the cluster, and provides a set of tools to operate on them to execute commands, configure parameters, and monitor status.

Cluster Overview

The **Overview** page appears when you log into the HP Helion OpenStack Carrier Grade web management interface as the administrator. It presents a dashboard providing a quick health-check overview of the cluster.

The **Overview** page is an enhanced version of its OpenStack counterpart. It includes the following features:

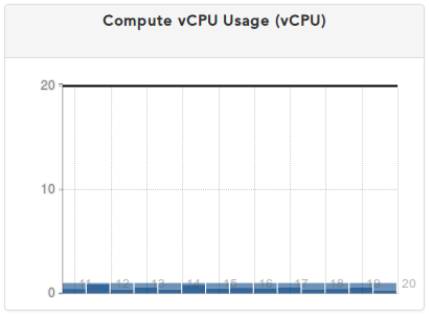
- dynamically updated, relocatable resource charts. Click the top of any chart, and drag it to the desired location to customize the presentation as desired. The layout changes are persistent across logins.
- dynamically updated, relocatable Host Server Status summary table. Presents the total number of hosts currently in one of the following states:
  - locked
  - unlocked
  - available
  - unavailable
  - degraded
- dynamically updated, relocatable Alarms summary table. Lists the current count of critical, major, minor, and warning alarms.

Common attributes of the resource pages are:

- All resource charts display resource information in real-time, spanning over a time-window of ten minutes.
- Labels along the X-axis present the number of minutes elapsed since the last full-time hour of the system clock.
- Hovering the mouse over the charts overlays information windows with detailed values.
- History information is lost when the **Overview** page is no longer displayed.

The following charts are available:

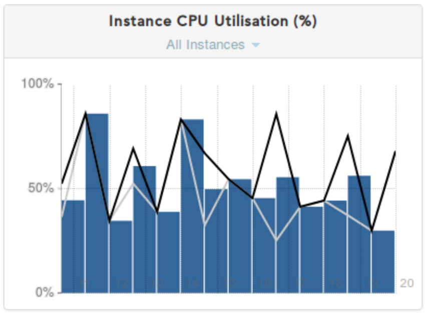
Compute vCPU Usage



Presents information about the number of virtual CPUs across the entire cluster, available and allocated to virtual machines, and their average level of utilization. Elements in this chart are as follows:

- Y-axis is in units vCPUs.
- A solid black line tracking the number of available vCPUs. This line settles at a constant value at the top of the chart, unless the number of compute nodes changes over time.
- Light blue bars indicating the number of allocated vCPUs, that is, the number of vCPUs in use by virtual machines (one in the example).
- Dark blue bars indicating the average level of utilization of the allocated vCPUs (varies from 30 to 83% in the example), presented as a relative height with respect to the light blue bars.

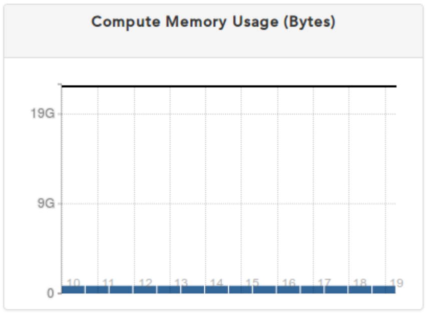
Instance CPU Utilization



Presents information about virtual CPU utilization levels on virtual machines, across the entire cluster or for individual instances. Elements in this chart are as follows:

- Y-axis displays the virtual CPU utilization level, from 0 to 100%.
- A solid black line tracking the maximum utilization level.
- Dark blue bars indicating the average utilization level.
- A gray line tracking the minimum utilization level.
- A filter drop-down menu to select the virtual machines on which to report utilization levels. The default value for this filter is "All Instances," and therefore it reports the same utilization levels indicated by the dark blue bars in the Compute vCPU Usage chart.

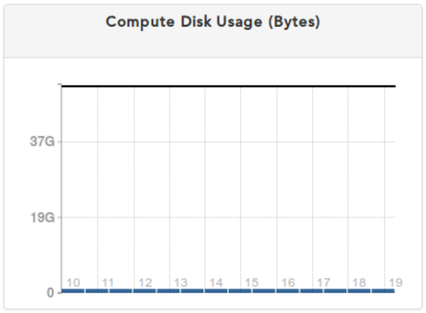
Compute Memory Usage



Presents information about memory usage levels on the compute nodes across the entire cluster. Elements in this chart are as follows:

- Y-axis is in units of bytes.
- A solid black line tracking the available aggregated compute memory. This line usually settles as a constant value at the top of the chart, unless the number of compute nodes changes over time.
- Dark blue bars indicating the amount of memory allocated to virtual machines (less than 1 GB in the example).

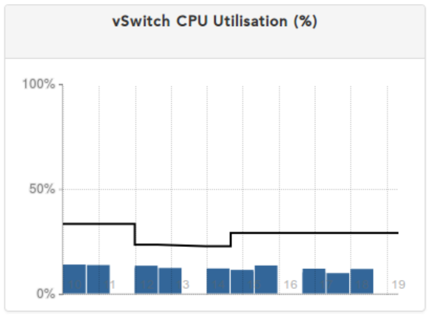
Compute Disk Usage



Presents information about disk usage levels on the compute nodes across the entire cluster. Elements in this chart are as follows:

- Y-axis is in units of bytes.
- A solid black line tracking the available aggregated storage capacity. This line usually settles as a constant value at the top of the chart.
- Dark blue bars indicating the amount of disk space allocated to virtual machines (about 1 GB in the example).

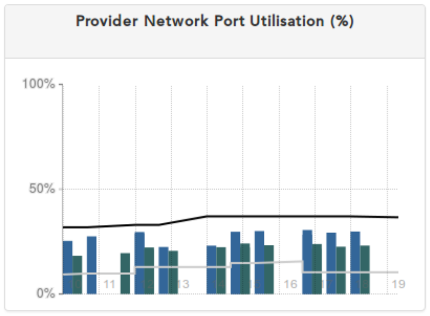
AVS CPU Utilization



Presents information about AVS CPU utilization levels on the compute nodes across the entire cluster. Elements in this chart are as follows:

- Y-axis displays the AVS CPU utilization level, from 0 to 100%.
- A solid black line tracking the maximum utilization level.
- Dark blue bars indicating the average utilization level.

Provider Network Port Utilization



Presents information about network traffic levels on provider networks across the entire cluster. Elements in this chart are as follows:

- Y-axis displays the port utilization level, from 0 to 100%.
- A solid black line tracking the maximum utilization level.
- Pairs of dark blue and dark green bars indicating the average utilization level, egress and ingress (Tx and Rx) traffic respectively.
- A gray line tracking the minimum utilization level.

Resource Usage

Usage of system resources is monitored by Ceilometer, the standard OpenStack mechanism for collecting and distributing performance monitoring samples from the cluster. The HP Helion OpenStack Carrier Grade cluster extends Ceilometer with improved reports and new tools to facilitate offline analysis of the collected data.

Performance Monitor (PM) samples are periodically collected from different resources such as hosts, virtual machine instances, AVS, and others. They include CPU and memory utilization, network traffic counters, storage space, and several more. By default the samples are stored in a database which is used for reporting activities such as:

- command line queries and graphical charts
- triggering of threshold alarms
- triggering of threshold actions. The most common example is Heat actions to scale up and down a resource.

The Ceilometer database is periodically cleaned in order to contain its size and prevent the overuse of storage resources on the controller nodes.

The Ceilometer implementation in HP Helion OpenStack Carrier Grade improves on several aspects. They are described in the following sections.

Optimized Ceilometer Filters

The Ceilometer implementation in HP Helion OpenStack Carrier Grade is specially tuned to allow time-sensitive actions, such as Heat autoscaling, to take place in response to relatively high-frequency sample rates of system events. The size of both the Ceilometer database and the CSV files are maintained under control at all times, while still enabling the required system actions to take place in real-time.

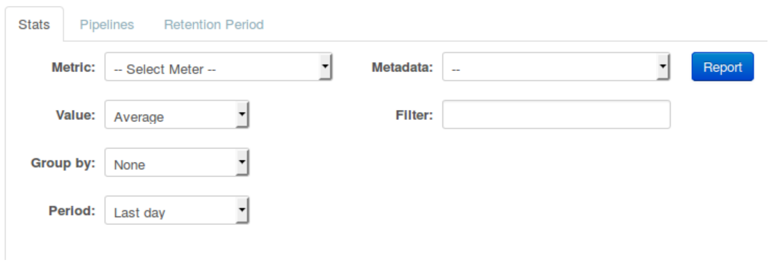
On-Line Ceilometer Reports

On-line, on-demand, Ceilometer reports in HP Helion OpenStack Carrier Grade benefit from several improvements over the stock OpenStack reporting tool, including:

- optimized Ceilometer database queries
- improved naming of menu entries on pull-down menus
- use of brief meter descriptions and human-readable legends on the charts

Additionally, all database queries are user-initiated, as opposed to event-initiated. This provides a different user workflow, whereby all required report parameters and filters are configured first, before the database query is executed

Access to Ceilometer reports is available from the **Stats** tab on the **Resource Usage Overview** page. This page can be accessed from the web management interface by selecting the option Resource Usage on the **Admin** tab of the system panel. The **Stats** tab is presented as follows:



Metric: -- Select Meter --
Metadata: --
Value: Average
Filter:
Group by: None
Period: Last day

The following fields are available:

Metric

The Ceilometer metric you want to query. Metrics are grouped by service, as follows:

- Compute (Nova)
- Network (Neutron)
- Image (Glance)
- Volume (Cinder)
- Switching (AVS)

On the CLI, use the following command to list the available metrics, and find their resource IDs:

```
~(keystone_admin)$ ceilometer meter-list
```

Value

The particular statistic you want to visualize. Select among Average, Minimum, Maximum, and Summation.

Group by

How to group the displayed charts, as follows:

None

The selected statistic is presented as a single line chart reporting the aggregate over all resources and projects (tenants).

Projects (Tenants)

The selected statistic is presented as a multiple line charts over all resources, one line per tenant.

Resource

The selected statistic is presented as a multiple line charts over all resources, one line per resource (hosts, instances, and so on).

Period

The period of time to be covered by the report. They include last 15 minutes, last 30 minutes, last hour, last day, last week, last 15 days, last 30 days, last year, and other. When selecting other, two new fields become available, Date From and Date To, allowing you to specify a specific time period.

Metadata

Metadata represents additional attributes collected with a metric. In this menu, you can select the specific attribute you want the report on.

The pull-down menu is auto-populated with the corresponding attributes for the selected metric. On the CLI, use the following command to list the metadata associated with a metric identified with its resource ID:

```
~(keystone_admin)$ ceilometer resource-show –r <resource_id>
```

Filter

Use this field to limit the report to show metric samples whose metadata attribute equals the specified value. The filter field is applied only when a specific metadata attribute is selected.

Once the selections are in place, click the Report button to display the report.

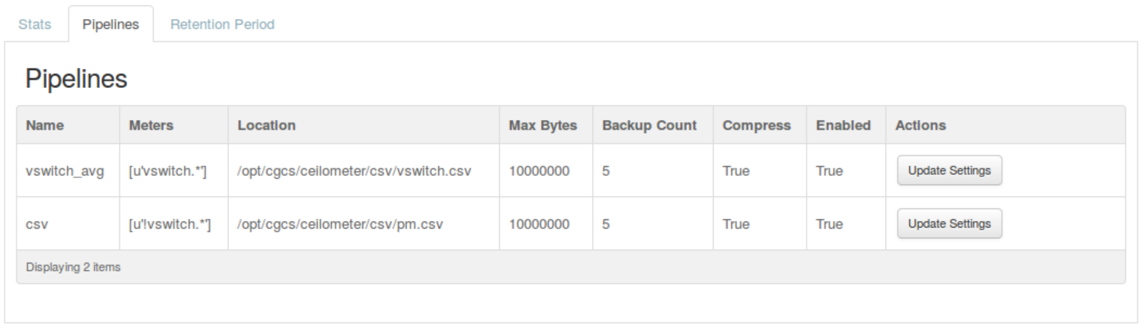
CSV Performance Monitoring Backend

HP Helion OpenStack Carrier Grade provides access to performance measurement samples in the form of comma-separated values (CSV) files. They provide the following benefits:

- off-line permanent storage of large samples history
- enables the use of off-line tools for data analysis, accounting, and archiving

The CSV files are expected to be retrieved from the controllers using any suitable file transfer client application such as SFTP or SCP. This can be done manually by the system administrator, or automatically by an operations and support server (OSS/BSS) configured with the appropriate login credentials.

Recording of samples and management of CSV files is done through special Ceilometer pipelines available from the **Pipelines** tab, as illustrated below:



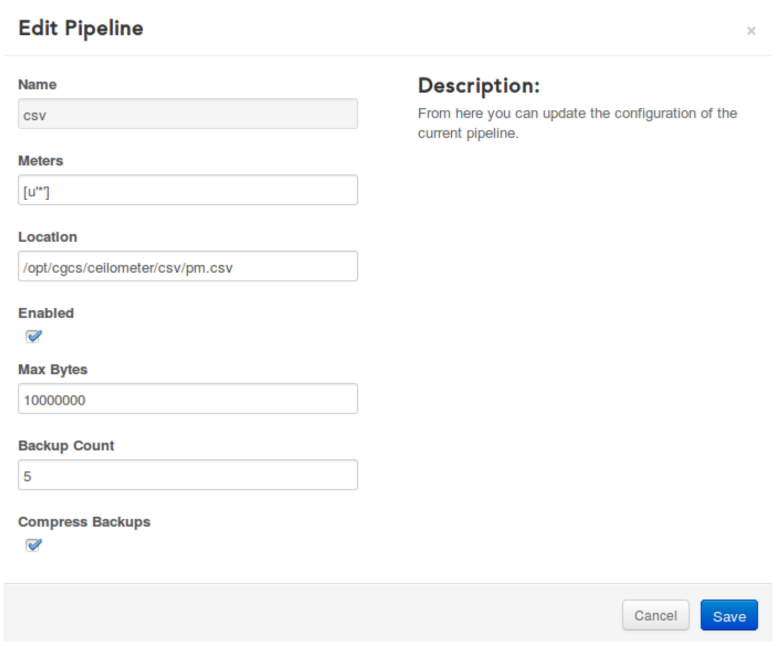
Pipelines

Name	Meters	Location	Max Bytes	Backup Count	Compress	Enabled	Actions
vswitch_avg	[u'vswitch.*']	/opt/cgcs/ceilometer/csv/vswitch.csv	10000000	5	True	True	Update Settings
csv	[u'!vswitch.*']	/opt/cgcs/ceilometer/csv/pm.csv	10000000	5	True	True	Update Settings

Displaying 2 items

The **csv** pipeline collects system information with the exception of AVS switching meters. The latter are collected by the **vswitch_avg** pipeline.

Click the button **Update Settings** to configure the behavior of a pipeline. The **Edit Pipeline** window is presented as follows:



Edit Pipeline

Name: csv

Meters: [u'*']

Location: /opt/cgcs/ceilometer/csv/pm.csv

Enabled: ✓

Max Bytes: 10000000

Backup Count: 5

Compress Backups: ✓

Description:

From here you can update the configuration of the current pipeline.

The following fields are available:

Name

A read-only field displaying the name of the pipeline

Meters

An editable field displaying the list of comma-separated meters included in the pipeline. The list must be enclosed in square brackets, as follows:

```
[meter1,meter2,...]
```

The following syntax rules apply to the specified meters:

- A meter specification is a text string of the form *metergroup.metersubgroup.meter*, for example, `disk.read.bytes`
- A meter specification supports a trailing wild-card to include all *meters* within a *metergroup*. For example, the text `disk.*` matches the meters `disk.read.bytes` and `disk.write.bytes`.
- A meter specification supports a trailing wild-card to include all *metersubgroups* within a *metergroup*. For example, the text `disk.read.*` matches the meter `disk.read.bytes`.

- Meter specifications support a leading exclamation mark to exclude the specified meter, as follows:

  ```
  [!meter1,!meter2,...]
  ```

  Such a pipeline includes all meters but the ones in the list.

  Exclamation marks cannot be applied selectively in a list of meters. Either all meters use them or none at all. The following list is therefore invalid:

  ```
  [meter1,!meter2,meter3]
  ```

Location

The absolute path to the CSV file on the controller.

Enabled

A check box used to enable or disable the pipeline.

Max Bytes

The maximum size, in bytes, of a CSV file. The default value is 10 MB.

Backup Count

The number of concurrent backup CSV files to maintain in a rotation ring, including the currently active file. When a CSV file reaches its maximum size, it is renamed as a backup file, and a new CSV file is opened for writing. Backup files older than the size of the rotation ring are automatically removed.

Compress Backups

A check box used to select whether or not to compress backup files in the rotation ring.

Retention Period

Performance samples are kept in the database for a limited period of time known as the *retention period*. Its default value is 86400 seconds, or 24 hours.

Click the **Edit Retention Period** button in the **Retention Period** tab to modify the current value. You must ensure that the configured value is equal or higher than the period over which you intend to gather statistics.

You can also control the retention period from the CLI. To view the current settings, use the following command.

```
~(keystone_admin)$ system pm-show
```

To change the retention period from the CLI, use the following command syntax.

```
~(keystone_admin)$ system pm-modify retention_secs=retention_period
```

For example:

```
~(keystone_admin)$ system pm-modify retention_secs=172800
```

Note:

Changes to the retention period cause **250.001 Configuration out-of-date** alarms to be raised briefly for the controller nodes. During this period, the status **Config out-of-date** is displayed for the controller nodes on the **Host** tab of the **Inventory** pane. These alarms are resolved and cleared automatically after a few seconds.

Managing Hardware Inventory

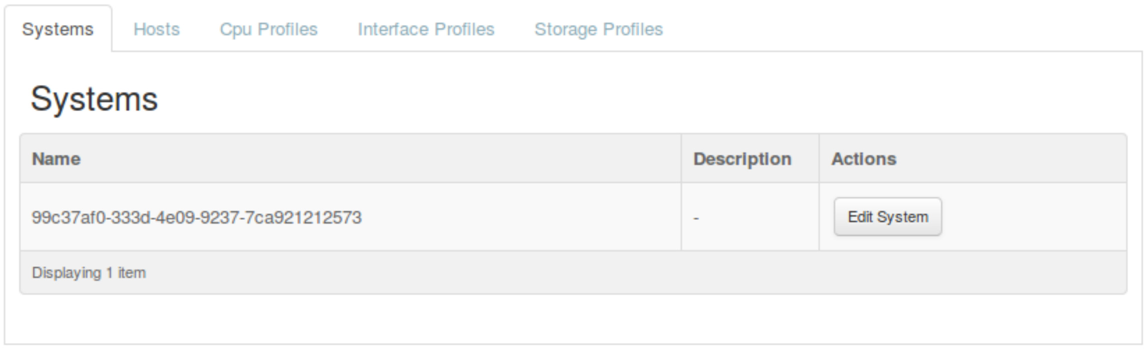
The maintenance and inventory component of HP Helion OpenStack Carrier Grade allows the administrator to install, configure, and manage the hosts of the HP Helion OpenStack Carrier Grade cluster.

To access the **System Inventory** page on the web management interface, click the Inventory option of the **Admin** tab on the side panel.

The Cluster System

The HP Helion OpenStack Carrier Grade cluster is represented internally by a unique object referred to as the **system**.

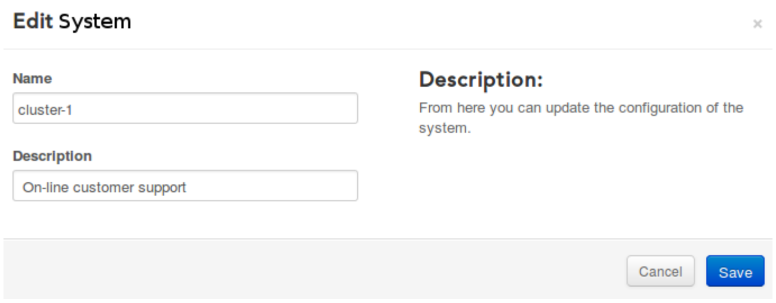
Information about this object is available from the **Systems** tab on the **System Inventory** page, as illustrated below.



Name	Description	Actions
99c37af0-333d-4e09-9237-7ca921212573	-	Edit System

Displaying 1 item

By default, the name of the system object is its internal UUID, and it has no description. This can be changed from the **Edit Host** window, accessible by clicking **Edit System**, as follows:

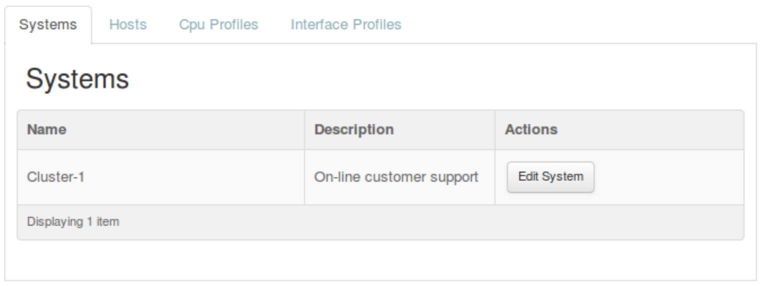


Name: cluster-1

Description: On-line customer support

Description:
From here you can update the configuration of the system.

After committing the changes, the **Systems** tab is displayed with the updated information:



Name	Description	Actions
Cluster-1	On-line customer support	Edit System

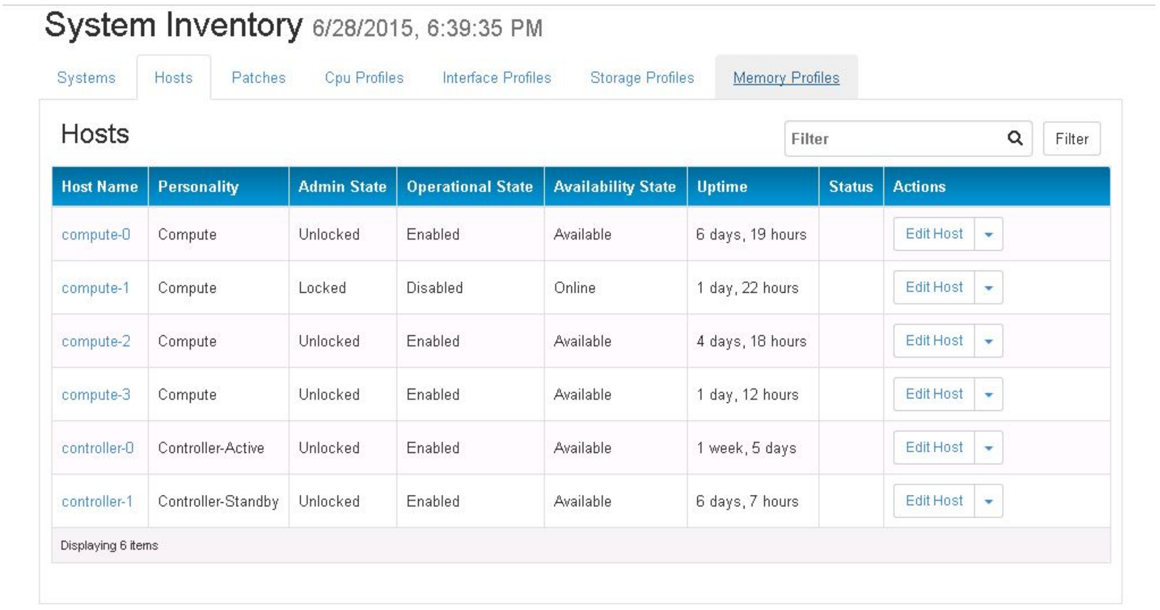
Displaying 1 item

The new name displays on the top left corner of the web management interface, and on the welcome message when logging in to the nodes using an SSH client.

Host Inventory

The **Hosts** tab on the **System Inventory** page provides an overview of the current state of all hosts in the HP Helion OpenStack Carrier Grade cluster. From this tab, you can obtain detailed information about the hosts, and execute maintenance operations.

A sample hosts tab is illustrated below:



Host Name	Personality	Admin State	Operational State	Availability State	Uptime	Status	Actions
compute-0	Compute	Unlocked	Enabled	Available	6 days, 19 hours		Edit Host
compute-1	Compute	Locked	Disabled	Online	1 day, 22 hours		Edit Host
compute-2	Compute	Unlocked	Enabled	Available	4 days, 18 hours		Edit Host
compute-3	Compute	Unlocked	Enabled	Available	1 day, 12 hours		Edit Host
controller-0	Controller-Active	Unlocked	Enabled	Available	1 week, 5 days		Edit Host
controller-1	Controller-Standby	Unlocked	Enabled	Available	6 days, 7 hours		Edit Host

Displaying 6 items

The information is refreshed periodically to reflect the ongoing changes on the cluster. It consists of the following columns:

Host Name

The name assigned to the host. This is an active link pointing to the detailed inventory page for the host. See *Inventory Detail* on page 93 for details.

Personality

The personality of the host (controller, compute, or storage).

Admin State

The administrative state of the host. It can be in one of two states:

Locked

The host is administratively prohibited from performing services. This is the initial state for hosts auto-discovered in the cluster.

A controller node in this state is not functioning in HA mode, and it is not running any active controller services.

Compute nodes in this state do not provide any service. In particular, a locked compute node is not running any virtual machine instances, and no new ones will be scheduled to run on it.

Unlocked

The host is administratively in service.

A controller node in this state, and not in the failed state, is active in its HA role, and is running the assigned controller services.

A compute node in this state, and not in the failed state, is eligible for regular scheduling and maintenance operations on virtual machines.

A storage node in this state, and not in the failed state, provides storage services.

Operational State

The operational state of the host. It can be in one of two states:

Disabled

Indicates that the host is not providing the expected services. This may be due to the fact that it is in the process of being unlocked, a failure has occurred, or it is being automatically recovered due to a failure.

Enabled

Indicates that the host is providing the expected services, even if its operational environment is compromised. In the latter case, the host is reported to be in the *degraded* availability state, in which case, state maintenance is constantly trying to recover the host to fully *available* state through in-service testing.

Availability State

The availability state of the host. It can be in one of the following states:

Offline

The host is known to the HP Helion OpenStack Carrier Grade, but is not reachable for maintenance purposes.

Online

The host is reachable and ready to be unlocked.

InTest

A transient state that occurs when transitioning from locked, or from a *failed* operational state, to unlocked states. While in this state, the host is executing a series of tests to validate its hardware and software integrity.

Available

The host is fully operational and providing services.

Degraded

The host is experiencing compromised operational conditions, such as low memory, but is still providing the expected services. Details about the compromised conditions are available through the alarms subsystem. See *System Alarms* on page 136 for details.

Failed

A major fault has occurred and the host is no longer providing any services. The HP Helion OpenStack Carrier Grade maintenance system automatically tries to recover hosts in this state.

In the case of a compute node, any virtual machines that were running before are immediately evacuated to another enabled compute node with sufficient available resources.

Power-off

The host is known to have been powered off by a previous maintenance action.

Uptime

The uptime of the host, as reported by the system maintenance service.

Status

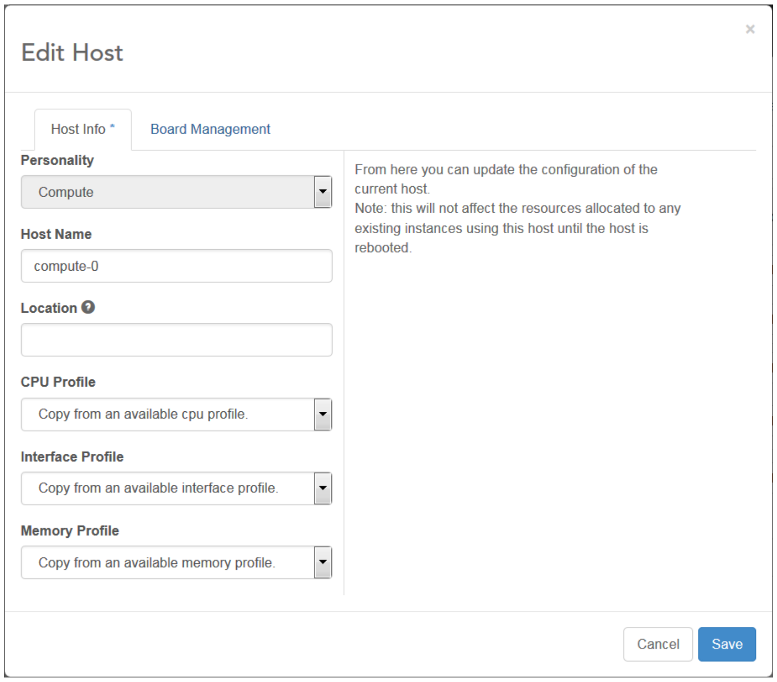
An indicator of the immediate activity occurring on the host. It reports transitory steps such as booting, initializing, configuration out of date, and in-test, which a host goes through as it transitions from one administrative or availability state to another.

Actions

The actions columns presents two buttons, as follows:

Edit Host

Clicking this button displays the **Edit Host** window as illustrated below for a compute node:



Personality: Compute

Host Name: compute-0

Location

CPU Profile: Copy from an available cpu profile.

Interface Profile: Copy from an available interface profile.

Memory Profile: Copy from an available memory profile.

From here you can update the configuration of the current host.
Note: this will not affect the resources allocated to any existing instances using this host until the host is rebooted.

From this window you can modify the host name (compute nodes only), and apply profiles as needed. For more about profiles, see *Hardware Profiles* on page 88.

The **Board Management** tab gives you access to the configuration of the management board, if available on the host. See *The Board Management Network* for details.

Note that this is the same window you use to assign the host's personality when installing HP Helion OpenStack on the host.

More (when host is locked)

This button gives you access to the list of maintenance operations that can be initiated on the host. The list is context sensitive whereby only permissible command operations are displayed.

Unlock Host

Used to bring a host into service. The first step is to reset the target host to ensure that it starts from a well-known state. The host is automatically configured, and any required software patches are applied.

The state transition only succeeds if all the necessary configuration components for the host are already in place. For example, the state transition is rejected on a compute node for which no data interfaces are defined.

You can unlock a host from the controller's command line, as follows:

```
~(keystone_admin)$  system host-unlock hostname
```

Power Off Host

Gracefully powers off the host, ensuring that all system processes are properly shut off first. This selection is available if board management is configured on the system, the host is equipped with an iLO module, and the host is in a powered-on state.

You can power off a host from the controller's command line, as follows:

```
~(keystone_admin)$  system host-power-off hostname
```

Power On Host

Powers on the host. This selection is available if board management is configured on the system, the host is equipped with an iLO module, and the host is in a powered-off state.

You can power on a host from the controller's command line, as follows:

```
~(keystone_admin)$  system host-power-on hostname
```

Reboot Host

Gracefully shuts down the host, ensuring that all system processes are properly shut off first. The host then reboots automatically.

You can reboot a host from the controller's command line, as follows:

```
~(keystone_admin)$  system host-reboot hostname
```

Reset Host

Use this selection only if **Reboot Host** fails. It performs an out-of-band reset, stopping and restarting the host without ensuring that all system processes are shut off first.

This selection is available if board management is configured on the system, the host is equipped with an iLO module, and the host is in a powered-on state.

You can reset a host from the controller's command line, as follows:

```
~(keystone_admin)$  system host-reset hostname
```

Reinstall Host

Forces a full re-installation of the HP Helion OpenStack Carrier Grade software on the host. The host's hard drive is erased, and the installation process is started afresh.

Note:

Performing a host reinstall successfully is dependent on your BIOS boot order. Observe the following tips.

- Prior to installation, the BIOS should be configured to allow booting from disk and the network.
- During the host re-installation, it is advisable to have a console serial cable attached to the host to observe the boot progress.
- BIOS boot order should be:
  1. The boot partition.

     Typically, this is the disk associated with `/dev/sda` and is as defined in `/proc/cmdline` when the load is booted.
  2. The NIC on the boot interface (e.g. management or pxe network).
- Set BIOS boot options to ensure failsafe boot if available, e.g. rotating through available boot interfaces, watchdog timer on boot, retry boot interfaces etc.

If the BIOS boot still fails to progress, it may be necessary to force boot via the network interfaces via the BIOS boot option.

Delete Host

Removes the host from the inventory database, and its hard drive is erased.

You can delete a host from the controller's command line, as follows:

```
~(keystone_admin)$  system host-delete hostname
```

Install Patches

Initiates any pending patching operations. Once successfully executed, the host returns back to the locked state. See *Managing Software Patches* on page 154 for details.

This option is only available if there are patching operations pending for the host.

More (when host is unlocked)

This button gives you access to the list of maintenance operations that can be initiated on the host. The list is context sensitive whereby only permissible command operations are displayed.

Lock Host

Attempts to bring the host out of service.

On a controller node, the state transition only succeeds if there are no services running in active mode on the host.

On a compute node, the state transition only succeeds if all currently running instances on the host can be migrated to alternative compute nodes. Migration of the virtual machine instances is initiated automatically as soon as the state transition is requested.

Note:

Live migration is not currently supported for an instance using local storage. Locking the host initiates a cold migration. The local storage for the instance is rebuilt.

You can lock a host from the controller's command line, as follows:

```
~(keystone_admin)$  system host-lock hostname
```

Forced Lock Host

Forces the host to be out of service. Use this option only if for some reason you cannot bring the host out of service using the Lock Host option. When selected, the system displays a warning message appropriate to the personality of the host. Use this option with caution.

You can force lock a host from the controller's command line, as follows:

```
~(keystone_admin)$  system host-lock --force hostname
```

Note that a force lock operation on a compute node causes an immediate service outage on all hosted virtual machines.

Swact Host

This operation is available on controller nodes only, and should be run on the active controller to initiate a switch of the active/standby roles.

Swact is an abbreviated form of the term **Switch Active** (host). When selected, this option forces the other controller to become the active one in the HA cluster. This means that all active system services on this controller move to standby operation, and that the corresponding services on the other controller become active.

Use this option when you need to lock the currently active controller, or do any kind of maintenance procedures, for example, when updating hardware or replacing faulty components.

You can swact a host from the controller's command line, as follows:

```
~(keystone_admin)$  system host-swact --force hostname
```

Install Patches

Initiates any pending patching operations. Once successfully executed, the host returns back to the unlocked state. See *Managing Software Patches* on page 154 for details.

This option is only available if there are patching operations pending for the host.

The Life Cycle of a host

The life cycle of a host is the set of state transitions the host goes through as its current state changes. The host states in the HP Helion OpenStack Carrier Grade are based on the *ITU X.731 State Management Function Specification for Open Systems*.

The current state of a host is determined by the allowed combinations of the administrative, operational, and availability states at any given time. The following figure illustrates the life cycle of a host.

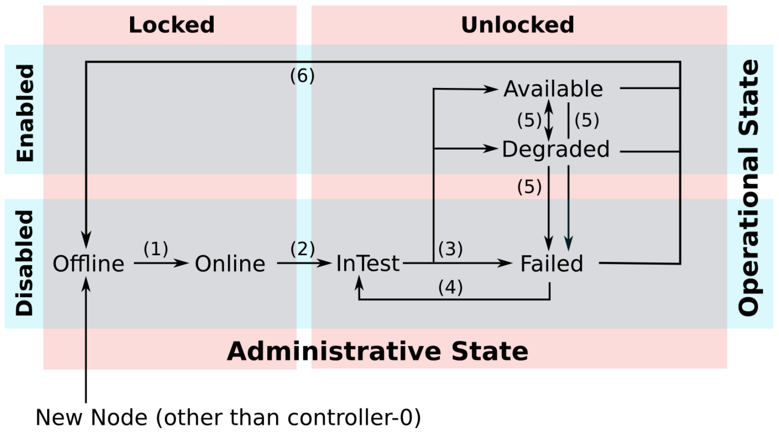


Figure 3: The Life Cycle of a Host

In this figure:

- the administrative states, locked and unlocked, are presented in two columns
- the operational states, disabled and enabled, are presented in two rows
- the availability states are presented as elements inside the administrative/operational matrix

The description that follows uses the availability states only, since for each state the corresponding administrative and operational states can be read directly from the figure.

The life cycle of a new host starts when it is discovered by the active controller on the internal management network. A new host is initially reported as *Offline*. As an exception, the first controller, **controller-0**, is automatically set to *available* during initial commissioning. The following are the available transitions. Numbers are attached to them for easier reference:

(1) *Offline* to *Online*

This transition takes place once the administrator configures the host name and personality of the host. During the transition, the HP Helion OpenStack Carrier Grade software is installed and the host reboots. The transition concludes when the controller establishes maintenance and inventory connectivity with the new host.

(2) *Online* to *InTest*

This transition takes place when the administrator requests to move the host from the locked to the unlocked administrative states. The host reboots first. After it finishes booting, it establishes maintenance communication and enters the transient **InTest** state. While in this state, the configuration is applied, and a set of hardware and software tests are executed to ensure the integrity of the host.

(3) *InTest* to *Available*, *Degraded*, or *Failed*

The transition is initiated automatically after the activities in the transient state **inTest** are complete. Depending on the outcome, the host goes into one the three states.

(4) *Failed* to *InTest*

This is a value-added maintenance transition that the HA framework executes automatically to recover failed hosts.

(5) *Available* to/from *Degraded*, *Available* to *Failed*, and *Degraded* to *Failed*

These are transitions that may occur at any time due to changes on the operational state and faults on unlocked hosts.

(6) *Available*, *Degraded*, or *Failed*, to *Offline*

These are maintenance transitions that take place automatically to reflect the operational state of a host.

On a compute node in *Available* or *Degraded* state, the transition triggers the migration of the active instances to another available compute node.

Hardware Profiles

A hardware profile is a named object that captures a particular host configuration. The profile can be applied to any other host with a similar hardware configuration.

The following types of hardware profiles are available from the **Systems Inventory** page, each presented on a separate tab:

- CPU profiles
- interface profiles
- storage profiles
- memory profiles

Once a hardware profile is defined, it can be applied to any host where it makes sense to be applied to change its configuration.

CPU Profiles

A CPU profile is a named assignment of processors and cores to one or more of the following types of processing threads:

Platform

System threads handling the core hosting functionality of the host. Platform threads are always present on all types of hosts in the cluster.

vSwitch

AVS threads dedicated to handling network traffic and packet processing tasks. They exists on the compute nodes only.

Shared

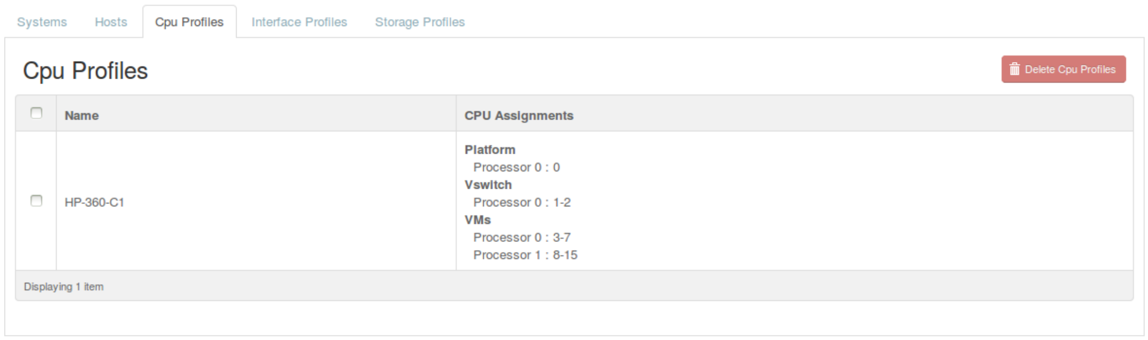
Threads handling low-load or non-real-time virtual machine tasks, implemented on a shared physical CPU in a compute node.

Virtual Machines

Threads handling virtual machines. They exists on the compute nodes only.

On controller nodes, all processors and cores are automatically assigned to platform threads, as they are the only ones available. On compute nodes, which always run a number of threads of all types, a default CPU allocation is done automatically when the system software is initially installed.

A list of the currently defined CPU profiles is available from the **CPU Profiles** tab on the **System Inventory** page, as illustrated below.



	Name	CPU Assignments
	HP-360-C1	**Platform** Processor 0 : 0 **Vswitch** Processor 0 : 1-2 **VMs** Processor 0 : 3-7 Processor 1 : 8-15

Displaying 1 item

This example lists one CPU profile, named **HP-360-C1**, with the following processor and core allocation:

Table 2: CPU Allocation Example

Thread Type	CPU Allocation
Platform	Processor 0, core 0
vSwitch	Processor 0, cores 1 and 2
Virtual Machines	Processor 0, cores 3 to 7 Processor 1, cores 8 to 15

CPU profiles can be deleted using the button **Delete CPU Profiles** on this page. When clicked, it deletes all check-marked profiles in the list. The delete operation does not affect CPU profiles already applied.

See *Processor* on page 95 for more information of how to change the CPU allocation for a compute node, and on how to define CPU profiles.

Interface Profiles

An interface profile is a named configuration of Ethernet ports and interfaces on a host, as follows:

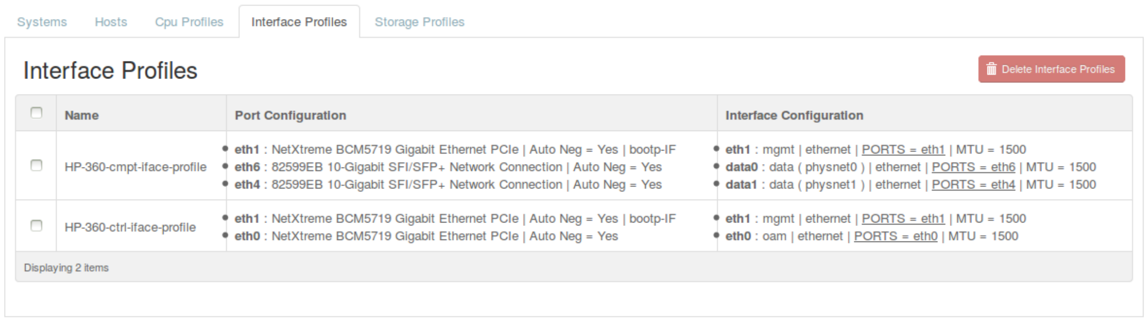
Ethernet Ports

The list of physical Ethernet ports that have been allocated to connect to a network.

Interfaces

Logical L2 interfaces defined on top of physical Ethernet ports.

A list of the currently defined interface profiles is available from the **Interface Profiles** tab on the **System Inventory** page, as illustrated below.



	Name	Port Configuration	Interface Configuration
	HP-360-cmpt-iface-profile	• **eth1** : NetXtreme BCM5719 Gigabit Ethernet PCIe | Auto Neg = Yes | bootp-IF • **eth6** : 82599EB 10-Gigabit SFI/SFP+ Network Connection | Auto Neg = Yes • **eth4** : 82599EB 10-Gigabit SFI/SFP+ Network Connection | Auto Neg = Yes	• **eth1** : mgmt | ethernet | PORTS = eth1 | MTU = 1500 • **data0** : data (physnet0) | ethernet | PORTS = eth6 | MTU = 1500 • **data1** : data (physnet1) | ethernet | PORTS = eth4 | MTU = 1500
	HP-360-ctrl-iface-profile	• **eth1** : NetXtreme BCM5719 Gigabit Ethernet PCIe | Auto Neg = Yes | bootp-IF • **eth0** : NetXtreme BCM5719 Gigabit Ethernet PCIe | Auto Neg = Yes	• **eth1** : mgmt | ethernet | PORTS = eth1 | MTU = 1500 • **eth0** : oam | ethernet | PORTS = eth0 | MTU = 1500

Displaying 2 items

This example lists two interface profiles, as follows:

Table 3: Interface Profiles

Profile Name	Ports	Interfaces
HP-360-cmpt-iface-profile	eth1, eth4, eth6	eth1 on internal management network data0 (eth6 on physnet0) data1 (eth4 on physnet1)
HP-360-ctrl-iface-profile	eth0, eth1	eth0 on OAM network eth1 on internal management network

The interface profile **HP-360-cmpt-iface-profile** belongs to a compute node. It lists three physical ports, eth1, eth4, and eth6, allocated to connect to a network. It also lists three logical L2 interfaces:

- eth1, allocated to connect to the internal management network
- data0, a data interface associating physical port eth6 with the provider network physnet0.
- data1, a data interface associating physical port eth4 with the provider network physnet1.

The interface profile **HP-360-ctrl-iface-profile** belongs to a controller node. It lists two physical ports, eth0, and eth1, and two logical L2 interfaces connecting these ports to the OAM and internal management networks.

Interface profiles can be deleted using the button **Delete Interface Profiles** on this page. When clicked, it deletes all check-marked profiles in the list. The delete operation does not affect interface profiles already applied.

See *Interfaces* on page 107 for more information on how to create interface profiles.

Storage Profiles

A storage profile is a named configuration for a list of storage resources on a computing node. Each storage resource consists of the following elements:

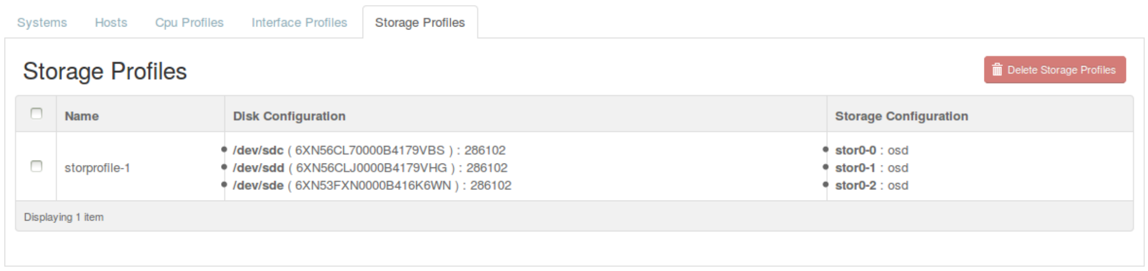
Disks

A Linux block storage device, such as `/dev/sdd`, identifying an entire hard drive.

Storage Volumes

A storage volume consisting of a name and a storage function. The name is used as a human-readable version of the native storage device UUID. The storage function indicates the type of storage backend, such as **OSD** for a storage system.

A list of the currently defined storage profiles is available from the **Storage Profiles** tab on the **System Inventory** page, as illustrated below.



Storage Profiles

☐	Name	Disk Configuration	Storage Configuration
☐	storprofile-1	• **/dev/sdc** (6XN56CL70000B4179VBS) : 286102 • **/dev/sdd** (6XN56CLJ0000B4179VHG) : 286102 • **/dev/sde** (6XN53FXN0000B416K6WN) : 286102	• **stor0-0** : osd • **stor0-1** : osd • **stor0-2** : osd

Displaying 1 item

This example lists one storage profile named **storprofile-1** with three storage resources on the hard drives `/dev/sdc`, `/dev/sdd`, and `/dev/sde`. All storage resources are of the **OSD** type.

See *Storage* on page 103 for more information on how to create storage profiles.

Memory Profiles

A memory profile is a named assignment of huge pages for use as VM memory. For more information, see *Creating and Using Memory Profiles* on page 101.

Host Management on an Active System

You can add or remove hosts and change disks without interrupting the HP Helion OpenStack Carrier Grade.

To make changes to a host, you must lock it. Locking a host automatically and seamlessly redirects activity to other available hosts. While the host is locked, you can safely power it down and make disk changes, or remove the host and insert a new one.

After making the required configuration changes, you can unlock the host and begin using it.

Managing Controller Nodes

You can replace controller nodes or disks while the system is running.

The HP Helion OpenStack Carrier Grade system uses exactly two controllers; you cannot add or remove a controller. However, you can replace the primary or secondary disks, and you can replace faulty controller nodes.

Note:

If you are replacing disks in order to increase the controller storage capacity, follow the instructions for *Changing Storage Space Allotments on the Controller* on page 63.

1. Lock the standby controller.

   Open the **Hosts** list by clicking **Inventory** on the **System Panel** section of the **Admin** menu, and then selecting the **Hosts** tab.

   Click **More** > **Lock Host** for the controller.

   Wait for the procedure to be completed.
2. Power down the standby controller and make any required hardware changes.

   This may involve replacing disks, or replacing the host completely.
3. Place the new or modified controller into service.

   a) Power up the controller.

      Wait until the controller is reported as **Locked**, **Enabled**, and **Available**.

   b) If required, reinstall the HP Helion OpenStack Carrier Grade software on the controller.

      If you are making disk changes to increase storage capacity, you must re-install the HP Helion OpenStack Carrier Grade software. For more information, see *Changing Storage Space Allotments on the Controller* on page 63.

      To reinstall the software on a host , click **More** > **Reinstall**.

      Note:

      Performing a host reinstall successfully is dependent on your BIOS boot order. Observe the following tips.

      - Prior to installation, the BIOS should be configured to allow booting from disk and the network.
      - During the host re-installation, it is advisable to have a console serial cable attached to the host to observe the boot progress.

- BIOS boot order should be:
    1. The boot partition.

       Typically, this is the disk associated with `/dev/sda` and is as defined in `/proc/cmdline` when the load is booted.
    2. The NIC on the boot interface (e.g. management or pxe network).
- Set BIOS boot options to ensure failsafe boot if available, e.g. rotating through available boot interfaces, watchdog timer on boot, retry boot interfaces etc.

If the BIOS boot still fails to progress, it may be necessary to force boot via the network interfaces via the BIOS boot option.

Wait for the host to be reported as **Locked**, **Disabled**, and **Online**.

c) Perform a swact.

Click **More** > **Swact Host** for the active controller.

The standby controller becomes the active controller, and the original active controller is placed into standby.

4. Lock the original active controller (now in standby).

   Open the **Hosts** list by clicking **Inventory** on the **System Panel** section of the **Admin** menu, and then selecting the **Hosts** tab.

   Click **More** > **Lock Host** for the controller.

   Wait for the procedure to be completed.
5. Power down the controller and make the same hardware changes.

   Caution:

   The configurations for controller-0 and controller-1, including disk types and sizes, must be identical.
6. Power up the new or modified controller.
7. If required, reinstall the HP Helion OpenStack Carrier Grade software on the controller.

The updated controllers are now in service. The controller that was formerly active is now the standby controller.

Compute Node Management

The compute nodes in HP Helion OpenStack Carrier Grade form a resource pool for hosting guest instances. You can manage this pool by managing the hosts.

You can change the resource pool in several ways:

- You can add or remove hosts to increase or decrease the size of the pool.
- You can replace a host with another that has different resources (for example, memory, or number of CPU cores).
- You can adjust the resources on an existing host.
- You can replace a failed compute node host with an equivalent.

Caution:

When replacing or adjusting a host, ensure that the overall resource pool still meets the requirements for your system.

Complete instructions for adding a compute node are provided in the *HP Helion OpenStack Carrier Grade Software Installation Guide: Initializing and Configuring Compute Nodes*.

Removing Compute Nodes

You can remove a compute node from the pool of available resources.

You may need to remove a compute node in order to replace a failed host, or to change the configuration of a host. If the host is active, you can migrate instances on it by locking the host.

Caution:

Before locking a host, ensure that sufficient resources are available on other hosts to migrate any running instances.

1. Lock the host to be removed.

   Open the **Hosts** list by clicking **Inventory** on the **System Panel** section of the **Admin** menu, and then selecting the **Hosts** tab.

   Click **More** > **Lock Host** for the host.

   Wait for the procedure to be completed.
2. Delete the host from the HP Helion OpenStack Carrier Grade system.

   Click **More** > **Delete Host** for the host.
3. Power down the host and remove the hardware from the cluster.

Adjusting Resources on a Compute Node

You can adjust the resources of a compute node while it is offline.

1. Lock the host to make changes.
   a) On the **Admin** pane of the web administration interface, in the **System Panel** section, select **Inventory**.
   b) Select the **Hosts** tab.
   c) Open the **More** drop-down list for the host, and then select **Lock Host**.
   d) Wait for the host to be reported as **Locked**.
2. Power off the host.
3. Make any required resource changes (for example, BIOS changes required for proper operation).

   If you are adding a disk to provide additional local storage for VMs, you can install an unpartitioned disk. New disks are detected by the compute node operating system and automatically configured with a single partition.
4. Power on the host, and wait for it to reboot fully.

   When the host is fully rebooted, it is shown as **Locked**, **Enabled**, and **Available** in the **Hosts** list.

   Note:

   Do not unlock the host until it is fully rebooted.
5. Unlock the host.

   The host is rebooted a second time.

When the host is reported as **Unlocked**, **Enabled**, and **Available**, it is ready for use with the adjusted resources.

Inventory Detail

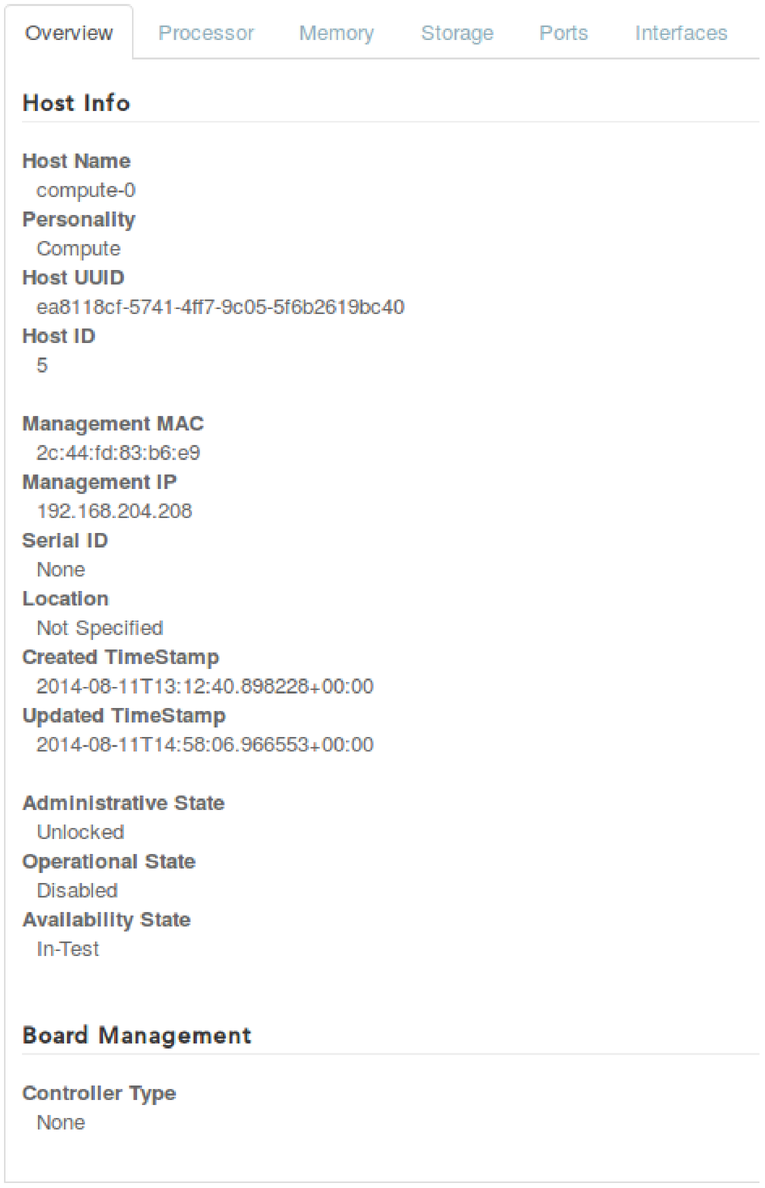
From the **Inventory Detail** page you can see detailed information about a host, and use it to define hardware profiles that can be used across the cluster.

You access the **Inventory Detail** page by clicking the host name on the **Hosts** tab of the **Systems Inventory** page, as described in *Managing Hardware Inventory* on page 81. The inventory detail for a host consists of multiple tabs, each addressing a different aspect of the host. They include:

- overview
- processor
- memory
- storage
- ports
- interfaces

Overview

The **Overview** tab on the **Inventory Detail** page summarizes core details about a host object.



Host Info

Host Name
compute-0
Personality
Compute
Host UUID
ea8118cf-5741-4ff7-9c05-5f6b2619bc40
Host ID
5

Management MAC
2c:44:fd:83:b6:e9
Management IP
192.168.204.208
Serial ID
None
Location
Not Specified
Created TimeStamp
2014-08-11T13:12:40.898228+00:00
Updated TimeStamp
2014-08-11T14:58:06.966553+00:00

Administrative State
Unlocked
Operational State
Disabled
Availability State
In-Test

Board Management

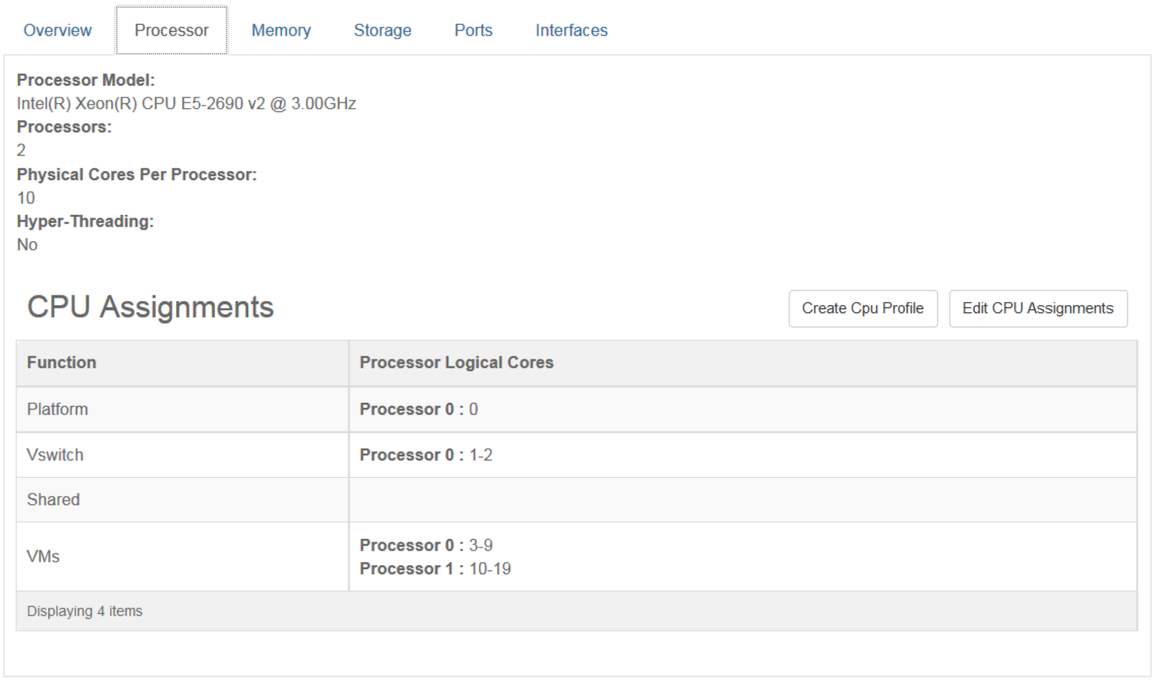
Controller Type
None

The following items are included in the summary:

- host name, personality, and the internal UUID and host ID reference numbers
- MAC and IP addresses on the internal management network
- serial ID, if known. Use the command `system host-modify <hostname> serialid=xxx` to update it.
- location, as entered by the operator using the **Edit Host** window (see *Host Inventory* on page 82)
- time stamps of when the host was created and last updated
- the host's state
- board management (iLO) information, if available, including controller type, MAC address, and IP address.

Processor

The **Processor** tab on the **Inventory Detail** page presents processor details for a host, as illustrated below.



Processor Model:
Intel(R) Xeon(R) CPU E5-2690 v2 @ 3.00GHz
Processors:
2
Physical Cores Per Processor:
10
Hyper-Threading:
No

CPU Assignments

Function	Processor Logical Cores
Platform	**Processor 0 :** 0
Vswitch	**Processor 0 :** 1-2
Shared	
VMs	**Processor 0 :** 3-9 **Processor 1 :** 10-19

Displaying 4 items

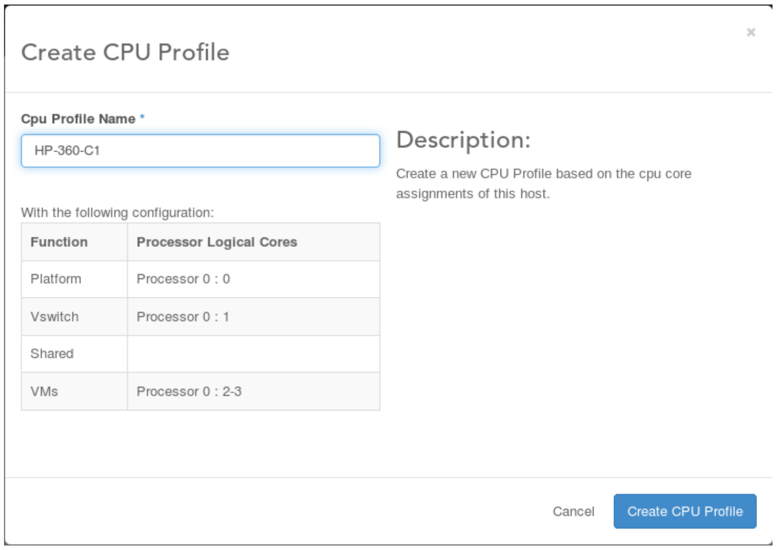
The **Processor** tab includes the following items:

- processor model, number of processors, number of cores per processor, and Hyper-Threading status (enabled or disabled).
- the CPU assignments. See section *CPU Profiles* on page 88 for more details.

Two buttons are also available as follows:

Create CPU Profile

Clicking this button displays the **Create CPU Profile** window, where the current CPU assignment can be given a name, as illustrated below.



Create CPU Profile

Cpu Profile Name *
HP-360-C1

Description:
Create a new CPU Profile based on the cpu core assignments of this host.

With the following configuration:

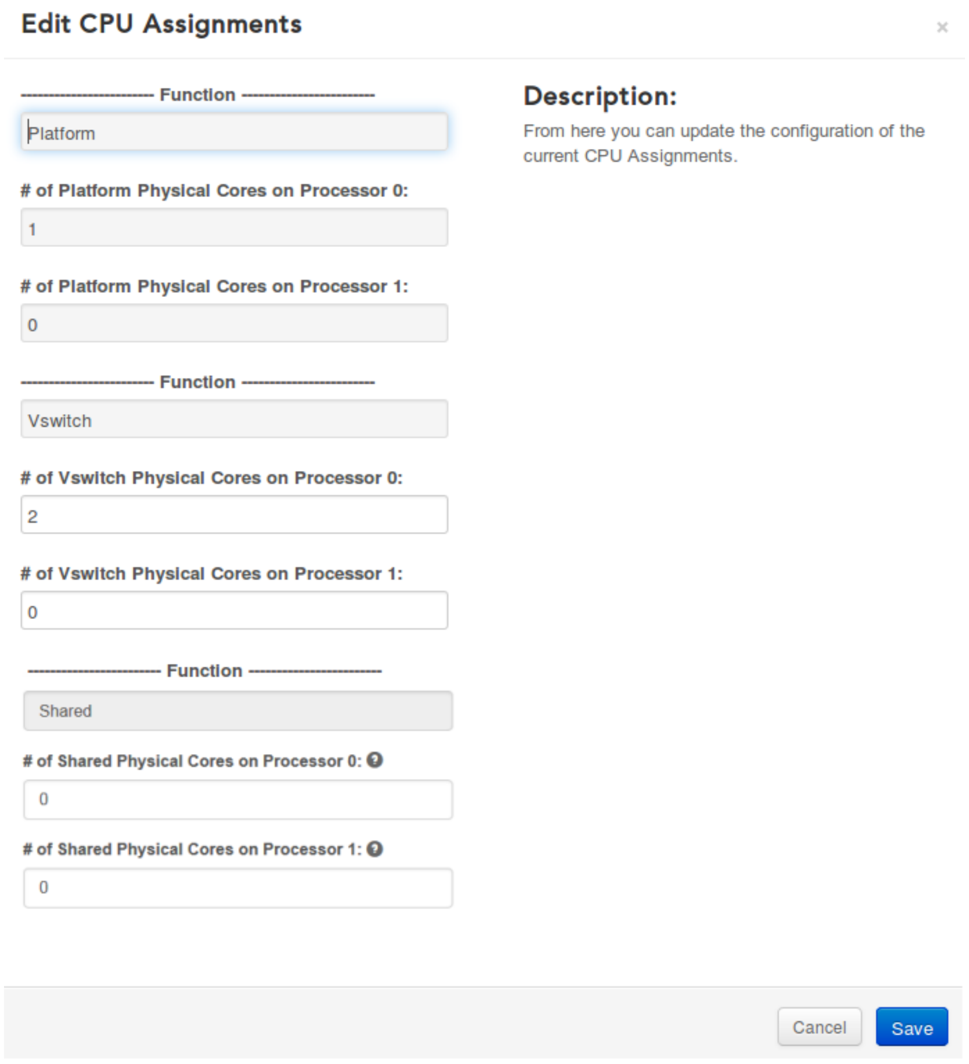
Function	Processor Logical Cores
Platform	Processor 0 : 0
Vswitch	Processor 0 : 1
Shared	
VMs	Processor 0 : 2-3

In this example, you are about to create a CPU Profile named **HP-360-C1** out of the current CPU assignments found in a compute node.

Edit CPU Assignments

This button is available only when the host is in the locked state.

Clicking this button displays the **Edit CPU Assignments** window, where the current CPU assignment can be changed, as illustrated below for a compute node.


Edit CPU Assignments

---------------------- Function ----------------------

Platform

# of Platform Physical Cores on Processor 0:

1

# of Platform Physical Cores on Processor 1:

0

---------------------- Function ----------------------

Vswitch

# of Vswitch Physical Cores on Processor 0:

2

# of Vswitch Physical Cores on Processor 1:

0

---------------------- Function ----------------------

Shared

# of Shared Physical Cores on Processor 0:

0

# of Shared Physical Cores on Processor 1:

0

Description:

From here you can update the configuration of the current CPU Assignments.

Currently, the number of platform cores is limited to one for each host. In the example above, this is indicated by the read-only platform fields that allocate one core from processor 0.

AVS cores can be configured for each processor independently. This means that the single logical vSwitch running on a compute node can make use of cores in multiple processors, or NUMA nodes. Optimal data path performance is achieved however, when all AVS cores, the physical ports, and the virtual machines that use them, are all running on the same processor. However, having AVS cores on all processors ensures that all virtual machines, regardless of the core they run on, are efficiently serviced. The example allocates two cores from processor 0 to the AVS threads.

One physical core per processor can be configured as a shared CPU, which can be used by multiple VMs for low-load tasks. To use the shared physical CPU, each VM must be configured with a shared vCPU ID. For more information, see *Pinning a vCPU to a Shared Physical CPU* on page 121.

All other cores are automatically available for allocation to virtual machine threads.

Viewing NUMA Node Resources on a Host

You can use the CLI to display the NUMA node resources for a host.

Host NUMA nodes can be *pinned*, or assigned for use by VMs. For example, a VM can be configured to use NUMA node 0, so that when the VM is launched or migrated, the virtual machine scheduler locates a host node with an available NUMA node 0, and dedicates that NUMA node for use by the VM. For more about pinning NUMA nodes, see *Pinning a Guest NUMA Node to a Host NUMA Node* on page 120.

The resources of the pinned NUMA node, including the number of available CPUS and the available memory, must be sufficient to meet the requirements of the VM, which can be specified independently. (For more about specifying NUMA node requirements for a VM, see *Configuring the NUMA Node Allocations for a VM* on page 118.) To ensure that a given host NUMA node can support the VM requirements, you can review the CPU and memory complements for host NUMA nodes.

To view the CPU complement for a NUMA Node (that is, for a socketed physical processor), use the vm-topology command. For details, see *Processor* on page 95.

Designating Shared Physical CPUs on a Compute Host

You can designate one shared physical CPU per physical processor on a compute host to run low-load or non-real-time tasks for multiple VMs, freeing other cores on the host for dedicated high-load tasks.

You can use the web administration interface or the CLI to set up shared physical CPUs.

To add or remove a shared physical CPU from the CLI, use a command of the following form:

```
~(keystone_admin)$ system host-cpu-modify -f shared -
pprocessor use_shared hostname
```

where

processor

is the number of the physical processor (0 or 1)

use_shared

specifies whether to use a shared physical CPU (0 for no, 1 for yes)

hostname

is the name of the compute host

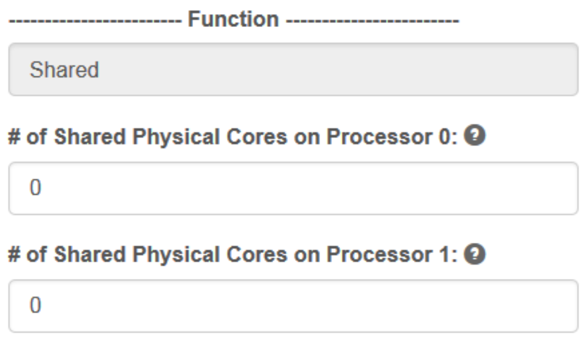
For example, to set up a shared physical CPU on processor **0** of **compute-0**:

```
~(keystone_admin)$ system host-cpu-modify -f shared -p0 1 compute-0
```

1. Lock the host to make changes.
   a) On the **Admin** pane of the web administration interface, in the **System Panel** section, select **Inventory**.
   b) Select the **Hosts** tab.
   c) Open the **More** drop-down list for the host, and then select **Lock Host**.
   d) Wait for the host to be reported as **Locked**.
2. Open the **Inventory Detail** page for the locked host.

   In the **Host Name** column, click the name of the host.
3. Select the **Processor** tab.
4. Click **Edit CPU Assignments**.

   This control is available only if the host is locked.
5. In the **Edit CPU Assignments** dialog box, use the **Shared** Function section to enable shared physical CPUs.



----------------------- Function -----------------------

Shared

# of Shared Physical Cores on Processor 0:

0

# of Shared Physical Cores on Processor 1:

0

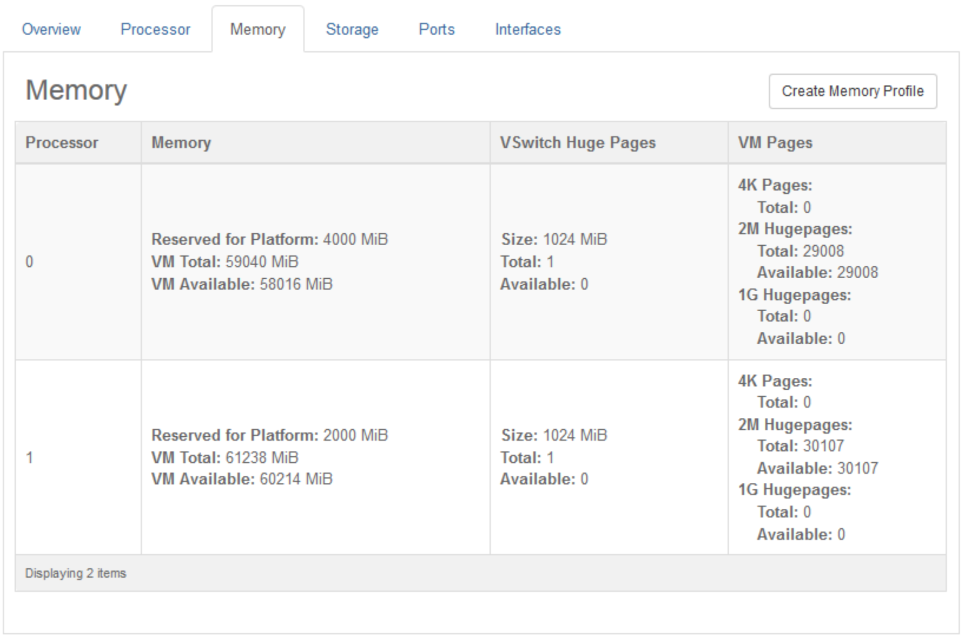
You can designate one core on each physical processor for use as a shared physical CPU. The actual core is assigned from the pool of available cores for the processor.

For example, to use a core on processor 0 as a shared physical CPU, set the **# of Shared Physical Cores on Processor 0** to 1. Valid values are **1** (to assign a core as a shared physical CPU) or **0** (if a shared physical CPU is not required on the processor.)

To configure a VM to use a shared physical CPU, see *Pinning a vCPU to a Shared Physical CPU* on page 121.

Memory

The tab **Memory** on the **Inventory Detail** page presents memory details for a host, as illustrated below.



Memory

Processor	Memory	VSwitch Huge Pages	VM Pages
0	**Reserved for Platform:** 4000 MiB **VM Total:** 59040 MiB **VM Available:** 58016 MiB	**Size:** 1024 MiB **Total:** 1 **Available:** 0	**4K Pages:** **Total:** 0 **2M Hugepages:** **Total:** 29008 **Available:** 29008 **1G Hugepages:** **Total:** 0 **Available:** 0
1	**Reserved for Platform:** 2000 MiB **VM Total:** 61238 MiB **VM Available:** 60214 MiB	**Size:** 1024 MiB **Total:** 1 **Available:** 0	**4K Pages:** **Total:** 0 **2M Hugepages:** **Total:** 30107 **Available:** 30107 **1G Hugepages:** **Total:** 0 **Available:** 0

Displaying 2 items

The information is presented in three columns, as follows:

Memory

Overall memory on the host.

For a controller node it displays the total and available memory figures.

For a compute node, as in the example above, it displays the amount reserved for the platform (system software), and the total and available figures for use by virtual machines.

VSwitch Huge Pages

This column is relevant on compute nodes only.

The size of the huge pages, and the total and available huge page figures.

VM Pages

This column is relevant on compute nodes only.

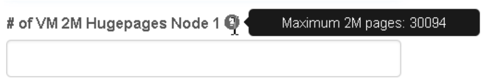
The size of the pages, and the total and available page figures. If changes to the huge page allocations have been requested for a locked host, they are shown as **Pending**.

Huge Page Provisioning

You can adjust the number and size of pages to allocate on a host for use as VM memory. For individual VMs, you can specify the page size to use.

In each NUMA node on a host, a fixed amount of memory is reserved for use by VMs. By default, this memory is managed using 2 MiB huge pages. You can change this for individual NUMA nodes to use a combination of 2 MiB and 1 GiB huge pages. Using larger pages can reduce page management overhead and improve system performance for systems with large amounts of virtual memory and many running processes.

You can use the `system host-memory-list` and `system host-memory-show` commands to see how much memory is available for VMs. This information is also shown on the **Memory** tab of the **Host Inventory** page (see *Memory* on page 98). To see how many pages of a given size you can successfully request on a node (assuming that pages of another size are not also requested), click the Information icon next to each field on the **Update Hugepage Memory** dialog box.



If the huge page request cannot be allocated from the available memory, an informative message is displayed. If the available memory is greater than the amount required by the huge page request, unallocated memory is automatically assigned as 4K pages.

After setting the memory allocations for a compute node, you can save them as a *memory profile*, and then apply the profile to other compute nodes. For more information, see *Creating and Using Memory Profiles* on page 101.

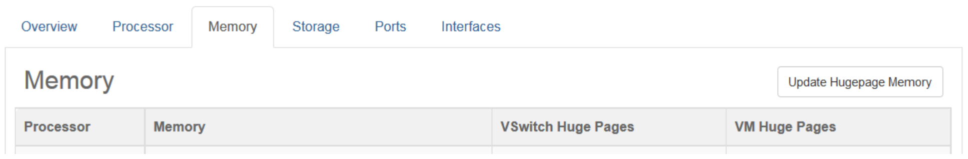
To specify the page size to use for a VM, see *Specifying a Page Size for a VM* on page 121.

Provisioning Huge Pages

You can edit the huge page attributes for a NUMA node from the web admin interface using the **Memory** tab on the **Inventory** pane.

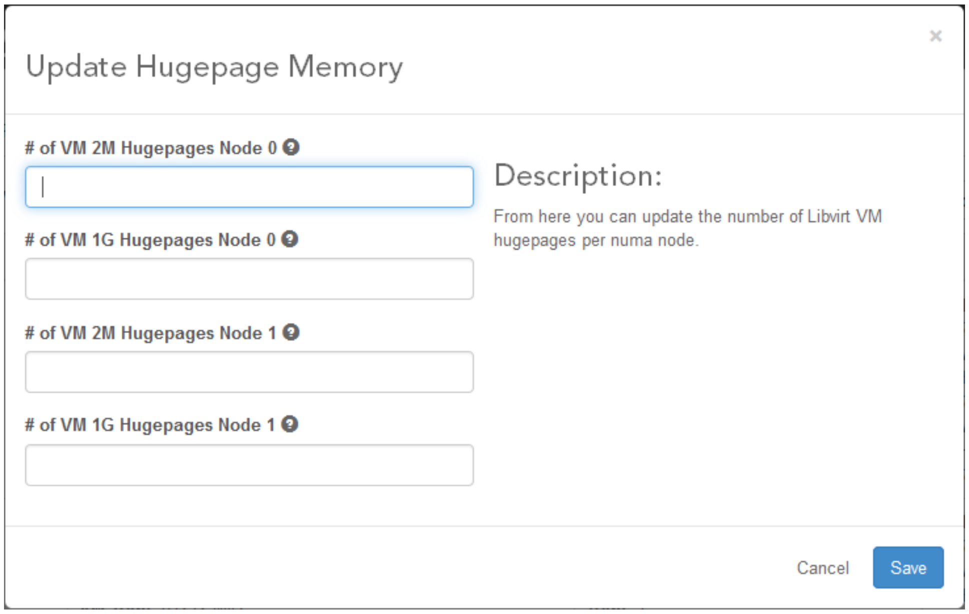
Before requesting huge pages on a host, ensure that the host has enough available memory. For details, see *Huge Page Provisioning* on page 99.

1. On the **Inventory** pane, lock the host you want to edit.
2. Click the **Host Name** to open the settings for the host.
3. On the **Memory** tab, click **Update Hugepage Memory**.



4. Use the **Update Hugepage Memory** dialog box to set the desired huge pages for each NUMA node.

   For each available NUMA node, two fields are supplied, as illustrated in the following example screen for two NUMA nodes.


Update Hugepage Memory

# of VM 2M Hugepages Node 0

# of VM 1G Hugepages Node 0

# of VM 2M Hugepages Node 1

# of VM 1G Hugepages Node 1

Description:

From here you can update the number of Libvirt VM hugepages per numa node.

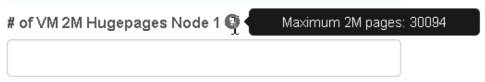
# of VM 2M Hugepages Node *n*

The number of 2MiB pages to reserve for VM use on the NUMA Node. If no 2MiB pages are required, type 0.

# of VM 1G Hugepages Node *n*

The number of 1GiB pages to reserve for VM use on the NUMA Node. If no 1GiB pages are required, type 0.

To see how many pages of a given size you can successfully request on a node (assuming that pages of another size are not also requested), hover over the Information icon next to the field.


# of VM 2M Hugepages Node 1

Maximum 2M pages: 30094

Any unused memory is automatically allocated as 4K pages.

5. Click **Save**.
6. Unlock the host and wait for it to be reported as **Available**.

Provisioning Huge Pages Using the CLI

You can edit the huge page attributes for a NUMA node from the CLI.

1. Lock the affected host.

```
(keystone_admin)$ system host-lock hostname
```

2. Use the following command to set the huge page attributes.

```
(keystone_admin)$ system host-hugepage-update hostname processor
 -2M 2Mpages -1G 1Gpages
```

where

hostname

is the hostname or id of the compute node

processor

is the NUMA node of the compute node (0 or 1)

2Mpages

(if the optional -2M argument is included) the number of 2MiB huge pages to make available (if none, use 0).

1Gpages

(if the optional -1G argument is included) number of 1GiB huge pages to make available (if none, use 0)

For example, to allocate four 2 MiB huge pages for use by VMs on NUMA node 1 of compute node **compute-0** :

```
(keystone_admin)$ system host-hugepage-update compute-0 1 -2M 4
```

3. Unlock the host.

```
(keystone_admin)$ system host-unlock hostname
```

4. Wait for the host to be reported as **available**.

```
(keystone_admin)$ system host-list hostname
+----+--------------+------------+---------------+------------
+--------------+
| id | hostname     | personality | administrative | operational |
 availability |
+----+--------------+------------+---------------+------------
+--------------+
| 1  | controller-0 | controller  | unlocked       | enabled     |
 available    |
| 2  | controller-1 | controller  | unlocked       | enabled     |
 available    |
| 3  | compute-0    | compute     | unlocked       | enabledd    |
 available      |
+----+--------------+------------+---------------+------------
+--------------+
```

Creating and Using Memory Profiles

You can optionally save the huge pages configuration for a host as a profile, and apply the profile to other hosts.

For more information about huge page configurations, see *Huge Page Provisioning* on page 99.

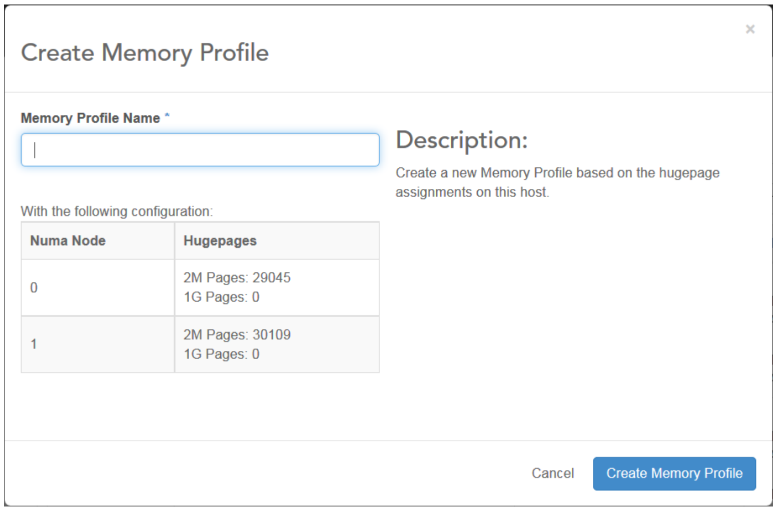
As an alternative to the web administration interface, you can use the following CLI command to create a memory profile:

```
~(keystone-admin)$ system memprofile-add memoryprofile hostid
```

where *memoryprofile* is the name or UUID of the memory profile, and *hostid* is the name or UUID of the host from which to create the profile.

1. Open the **Inventory Detail** page for the host.
   a) On the **Admin** pane of the web administration interface, in the **System Panel** section, select **Inventory**.
   b) Select the **Hosts** tab, and then in the **Host Name** column, click the name of the host.
2. On the Memory tab, click **Create Memory Profile**.

   The **Create Memory Profile** dialog box appears.



Create a new Memory Profile based on the hugepage assignments on this host.

With the following configuration:

Numa Node	Hugepages
0	2M Pages: 29045 1G Pages: 0
1	2M Pages: 30109 1G Pages: 0

3. Type a name for the memory profile.
4. Click **Create Memory Profile** to save the profile and close the dialog box.

You can apply this profile to other hosts by editing the host settings in the web administration interface. For information about editing a host, see *Host Inventory* on page 82. You can also use the following CLI command to apply a memory profile to a host:

```
~(keystone-admin)$ system host-apply-memprofile memoryprofile hostid
```

where *memoryprofile* is the name or UUID of the memory profile, and *hostid* is the name or UUID of the host.

To manage memory profiles, you can use the **Memory Profiles** tab on the **System Inventory** page, or you can use the following CLI commands:

- To list memory profiles:

  ```
  ~(keystone-admin)$ system memprofile-list
  ```

- To show details for a memory profile:

  ```
  ~(keystone-admin)$ system memprofile-show memoryprofile
  ```

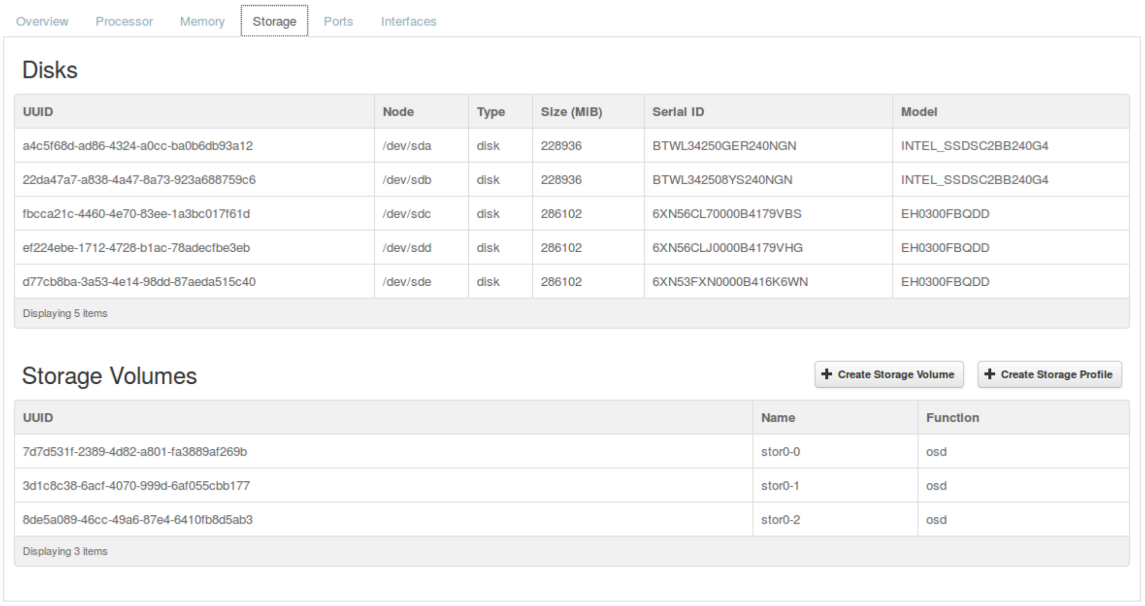
  where *memoryprofile* is the name or UUID of the memory profile.
- To delete a memory profile:

  ```
  ~(keystone-admin)$ system memprofile-delete memoryprofile
  ```

  where *memoryprofile* is the name or UUID of the memory profile.

Storage

The **Storage** tab on the **Inventory Detail** page presents storage details for a host.



Disks

UUID	Node	Type	Size (MiB)	Serial ID	Model
a4c5f68d-ad86-4324-a0cc-ba0b6db93a12	/dev/sda	disk	228936	BTWL34250GER240NGN	INTEL_SSDSC2BB240G4
22da47a7-a838-4a47-8a73-923a688759c6	/dev/sdb	disk	228936	BTWL342508YS240NGN	INTEL_SSDSC2BB240G4
fbcca21c-4460-4e70-83ee-1a3bc017f61d	/dev/sdc	disk	286102	6XN56CL70000B4179VBS	EH0300FBQDD
ef224ebe-1712-4728-b1ac-78adecfbe3eb	/dev/sdd	disk	286102	6XN56CLJ0000B4179VHG	EH0300FBQDD
d77cb8ba-3a53-4e14-98dd-87aeda515c40	/dev/sde	disk	286102	6XN53FXN0000B416K6WN	EH0300FBQDD

Displaying 5 items

Storage Volumes

UUID	Name	Function
7d7d531f-2389-4d82-a801-fa3889af269b	stor0-0	osd
3d1c8c38-6acf-4070-999d-6af055cbb177	stor0-1	osd
8de5a089-46cc-49a6-87e4-6410fb8d5ab3	stor0-2	osd

Displaying 3 items

The information is presented in one or more lists, as determined by the host type.

Disks

This list is presented for all host types. It lists all available hardware devices used for storage. For each device, the following information is included:

UUID

The unique identifier for the device.

Node

The Linux device name.

Type

The type of storage device, typically a hard drive (disk).

Size

The capacity of the device in MiB.

Serial ID

The device's serial ID number.

Model

The manufacturer's model for the device.

Storage Volumes

This list is presented for storage hosts. It shows a list of logical storage volumes defined on available disks. For each volume, the following information is included:

UUID

The unique identifier for the storage volume.

Name

The name assigned to the volume, if any.

Function

The type of storage backend handling the storage volume.

For information about creating storage volumes or adding storage profiles, see the *HP Helion OpenStack Carrier Grade Software Installation Guide: Creating Storage Volumes*.

Local Volume Groups

This list is presented for compute nodes. It shows groups that provide local storage for use by VMs. For more information, see *Managing Local Volume Groups* on page 105.

For each group, the following information is provided:

Name

The name assigned to the local volume group.

State

The availability of the local volume group.

Access

The access status of the volume group (**w**riteable, **r**eadonly, resi**z**eable, e**x**ported, **p**artial, or **c**lustered).

Size

The capacity of the device in bytes.

Current Physical Volumes

The number of physical volumes that define the local volume group.

Current Logical Volumes

the number of logical volumes contained by the local volume group.

Actions

Available actions that can be performed on the local volume group.

Physical Volumes

This list is presented for compute nodes. It shows physical volumes that provide local storage for use by VMs. For more information, see *Managing Physical Volumes* on page 105.

For each group, the following information is provided:

Name

The device name associated with the physical volume.

State

The availability of the physical volume.

Type

The device type used for the physical volume.

Disk UUID

the unique identifier of the disk used to implement the physical volume.

Disk Device Node

The device used to implement the physical volume.

LVM Logical Group Name

The name of the local volume group to which the physical volume belongs.

Actions

Available actions that can be performed on the physical volume.

Managing Local Volume Groups

You can add, delete, and review local volume groups on a compute host.

Local volume groups are used to designate physical volumes on a compute host as local storage for use by VMs. You can use the web administration or the CLI to manage them. For web administration interface instructions, see *Configuring a Compute Host to Provide Local Storage* on page 47.

Before you can modify the settings for a host, you must lock the host:

```
~(keystone_admin)$ host-lock hostname
```

To configure a compute host to provide local storage for use by VMs, add a local volume group with the name **nova-local**.

The following CLI commands are available for managing local volume groups.

```
~(keystone_admin)$ host-lvg-add hostname groupname
```

Note:

The only valid **groupname** is **nova-local**.

```
~(keystone_admin)$ host-lvg-delete hostname nova-local
```

```
~(keystone_admin)$ host-lvg-list hostname
```

```
~(keystone_admin)$ host-lvg-show hostname
```

To complete the configuration of a compute host for local storage, you must also add physical volumes to the **nova-local** local volume group. For more information, see *Managing Physical Volumes* on page 105.

Managing Physical Volumes

You can add, delete, and review physical volumes on a compute host.

Physical volumes provide storage using local disks. You can use the web administration or the CLI to manage them. For web administration interface instructions, see *Configuring a Compute Host to Provide Local Storage* on page 47.

As each physical volume is created, it is added to an existing local volume group.

Before you can modify the settings for a host, you must lock the host:

```
~(keystone_admin)$ host-lock hostname
```

Before you can add a physical volume, a local volume group must exist on the host. To create one, see *Managing Local Volume Groups* on page 105

The following CLI commands are available for managing physical volumes.

```
~(keystone_admin)$ host-pv-add hostname groupname disk_uuid
```

where **groupname** is the name of the local volume group to which the physical volume is added.

Note:

The only valid **groupname** is **nova-local**.

When **disk_uuid** indicates the root disk, the physical volume uses a system-designated partition on the root disk. For any other disk, the physical volume uses the entire disk.

```
~(keystone_admin)$ host-pv-delete hostname nova-local disk_uuid
```

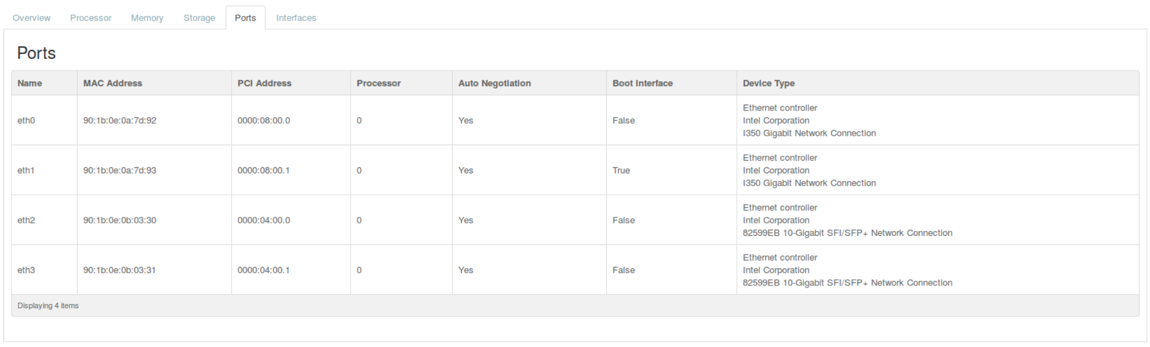
```
~(keystone_admin)$ host-pv-list hostname
```

```
~(keystone_admin)$ host-pv-show hostname
```

To configure VMs to use local storage, see *Specifying Local Storage for a VM* on page 124.

Ports

The tab **Ports** on the **Inventory Detail** page presents information about the physical ports on a host, as illustrated below.



Ports

Name	MAC Address	PCI Address	Processor	Auto Negotiation	Boot Interface	Device Type
eth0	90:1b:0e:0a:7d:92	0000:08:00.0	0	Yes	False	Ethernet controller Intel Corporation I350 Gigabit Network Connection
eth1	90:1b:0e:0a:7d:93	0000:08:00.1	0	Yes	True	Ethernet controller Intel Corporation I350 Gigabit Network Connection
eth2	90:1b:0e:0b:03:30	0000:04:00.0	0	Yes	False	Ethernet controller Intel Corporation 82599EB 10-Gigabit SFI/SFP+ Network Connection
eth3	90:1b:0e:0b:03:31	0000:04:00.1	0	Yes	False	Ethernet controller Intel Corporation 82599EB 10-Gigabit SFI/SFP+ Network Connection

Displaying 4 items

Currently none of the port attributes is configurable; they are all read directly from the hardware. Port information is presented in several columns, as follows:

Name

The name of the physical port, as identified by the host's Linux kernel.

MAC Address

The port's unique MAC address.

PCI Address

The port's unique address on the PCI bus. Together with the MAC address, this field can be used to uniquely identify a port on the host's hardware platform.

Processor

The processor node that the port's IO controller is connected to.

Auto Negotiation

The status of the Ethernet auto-negotiation flag. Currently, auto-negotiation is always enabled.

Boot Interface

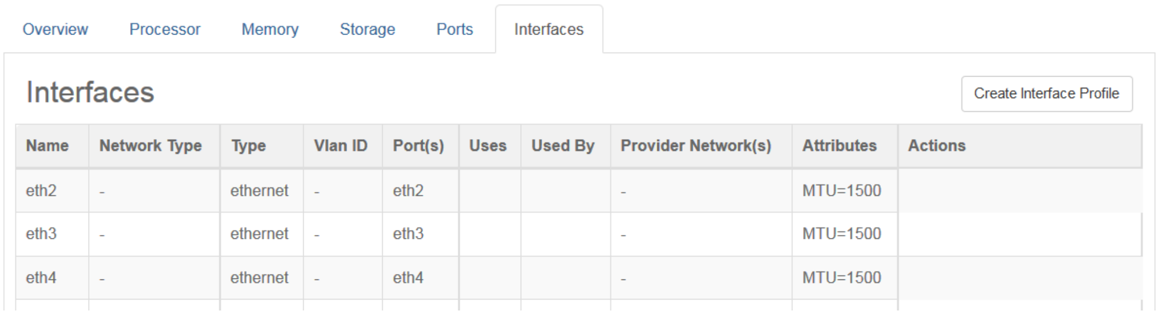
The boot flag, whether or not PXE booting is enabled.

Device Type

Hardware information about the port type, manufacturer, and model.

Interfaces

The **Interfaces** tab on the **Inventory Detail** page presents details about the logical L2 network interfaces on a node, as illustrated below for an unlocked controller node.

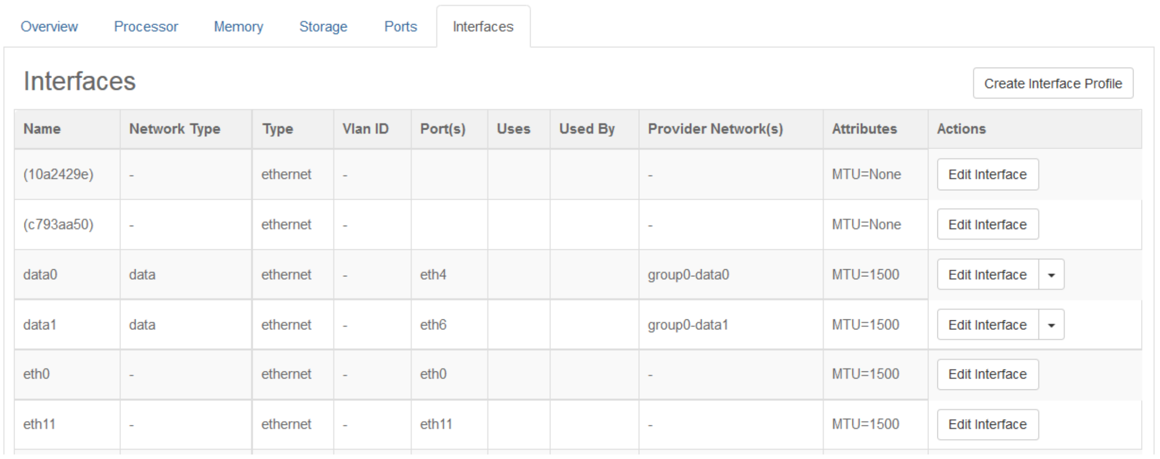


Interfaces

Name	Network Type	Type	Vlan ID	Port(s)	Uses	Used By	Provider Network(s)	Attributes	Actions
eth2	-	ethernet	-	eth2			-	MTU=1500	
eth3	-	ethernet	-	eth3			-	MTU=1500	
eth4	-	ethernet	-	eth4			-	MTU=1500	

In this example the node has two allocated interfaces, **eth0** connecting to the OAM network, and **eth1** connecting to the internal management network. These interfaces are mandatory and therefore cannot be deleted. They reflect the allocation given when the node was provisioned. See the *HP Helion OpenStack Carrier Grade Software Installation Guide* for details.

On a properly configured compute node, the **Interfaces** tab presents additional logical interfaces, as illustrated below for a locked node:



Interfaces

Name	Network Type	Type	Vlan ID	Port(s)	Uses	Used By	Provider Network(s)	Attributes	Actions
(10a2429e)	-	ethernet	-				-	MTU=None	Edit Interface
(c793aa50)	-	ethernet	-				-	MTU=None	Edit Interface
data0	data	ethernet	-	eth4			group0-data0	MTU=1500	Edit Interface
data1	data	ethernet	-	eth6			group0-data1	MTU=1500	Edit Interface
eth0	-	ethernet	-	eth0			-	MTU=1500	Edit Interface
eth11	-	ethernet	-	eth11			-	MTU=1500	Edit Interface

In this example the node has three allocated interfaces, **eth1** connecting to the internal management network, and **data0** and **data1** connecting to the provider networks **group0-data0** and **group0-data1** respectively. The interface **eth1** is auto-provisioned as part of the automated software installation process on the compute node. It can be modified but not deleted.

Information about interfaces is presented in several columns, as follows:

Name

The name given to the logical L2 interface.

Network Type

The type of network the logical network interface is connected to. The options are:

- **data**, for a compute node data interface
- **infra**, for the optional infrastructure network
- **mgmt**, for the internal management network
- **oam**, for the OAM network
- **pci-passthrough**, for a PCI passthrough interface

Type

Ethernet, or aggregated Ethernet (LAG).

Vlan ID

The VLAN ID of the network listed in the **Network Type** column, if the network uses a shared interface. For more information about shared interfaces, see *Shared (VLAN) Ethernet Interfaces* on page 23.

Port(s)

The physical ports on top of which the logical interface is built. Multiple ports are displayed when the logical interface uses LAG.

Uses

The interface used by the network listed in the **Network Type** column, if the network uses a shared interface. The VLAN ID of the network is shown in the **Vlan ID** field.

Used By

The networks that share the interface using VLAN tagging, if the interface is shared. For more information about shared interfaces, see *Shared (VLAN) Ethernet Interfaces* on page 23.

Provider Networks

This option is relevant for compute nodes only, and for interfaces of the **data** network type. It lists the provider networks associated with the data interface.

Attributes

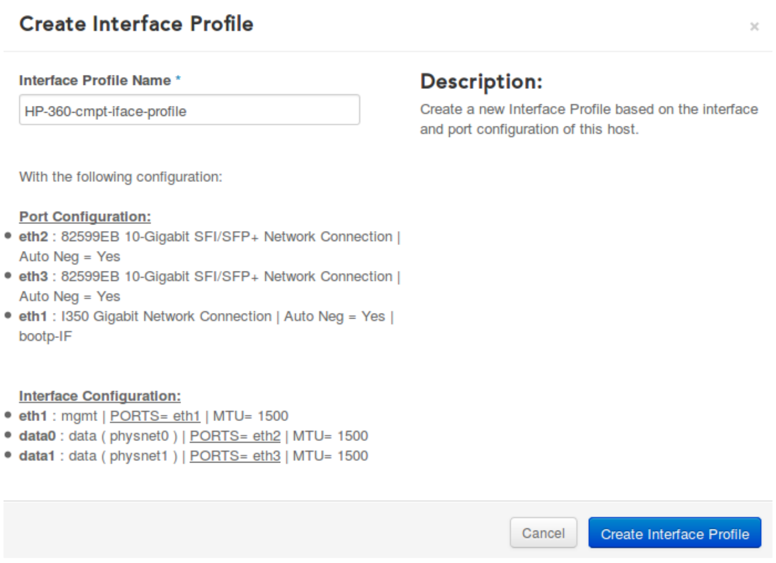
The current MTU size for the interface.

Actions

On a locked node, you can modify a logical interface, and execute management operations on it. This is implemented using the buttons **Edit Interface** and **More**. These buttons are not available when the node is unlocked.

Creating an Interface Profile

Use the **Create Interface Profile** button on the **Interfaces** tab to display the **Create Interface Profile** window. From there you can create a new interface profile out of the currently defined node interfaces. An example for a compute node is illustrated below.



Interface Profile Name *

HP-360-cmpt-iface-profile

Description:

Create a new Interface Profile based on the interface and port configuration of this host.

With the following configuration:

Port Configuration:

- **eth2** : 82599EB 10-Gigabit SFI/SFP+ Network Connection | Auto Neg = Yes
- **eth3** : 82599EB 10-Gigabit SFI/SFP+ Network Connection | Auto Neg = Yes
- **eth1** : I350 Gigabit Network Connection | Auto Neg = Yes | bootp-IF

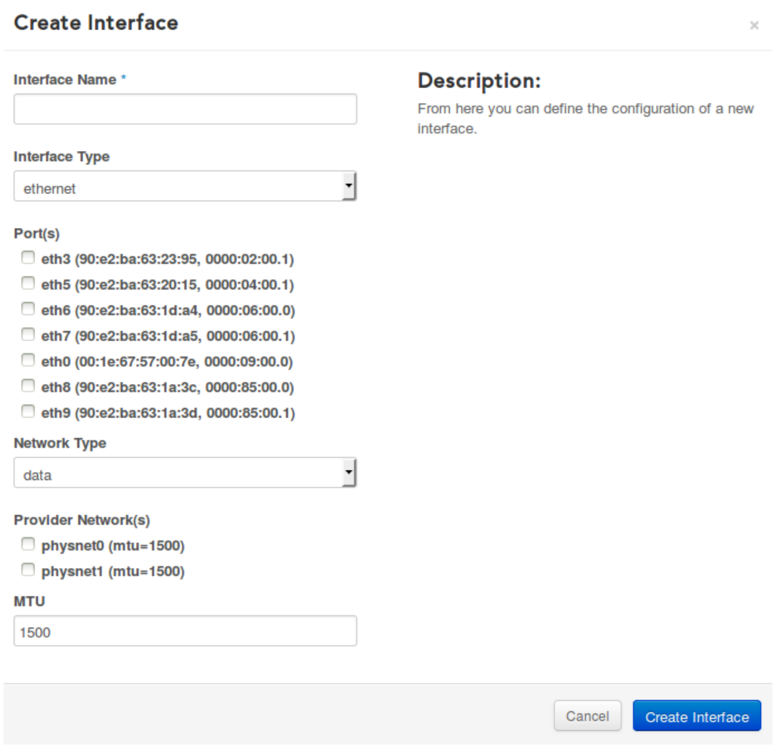
Interface Configuration:

- **eth1** : mgmt | PORTS= eth1 | MTU= 1500
- **data0** : data (physnet0) | PORTS= eth2 | MTU= 1500
- **data1** : data (physnet1) | PORTS= eth3 | MTU= 1500

In this window you enter the name of the new profile, **HP-360-cmpt-iface-profile** in this case, and then click the button **Create Interface Profile** to execute. Available interface profiles are listed, and can be removed, from the **System Inventory** page, as described in *Hardware Profiles* on page 88.

Managing Interfaces

New logical interfaces can be created using the **Create Interface** button on the **Interfaces** tab. This button is available only on nodes in the locked state. When the button is clicked, the window **Create Interface** is displayed, as illustrated below.


Create Interface

Interface Name *

Description:

From here you can define the configuration of a new interface.

Interface Type: ethernet

Port(s)
- eth3 (90:e2:ba:63:23:95, 0000:02:00.1)
- eth5 (90:e2:ba:63:20:15, 0000:04:00.1)
- eth6 (90:e2:ba:63:1d:a4, 0000:06:00.0)
- eth7 (90:e2:ba:63:1d:a5, 0000:06:00.1)
- eth0 (00:1e:67:57:00:7e, 0000:09:00.0)
- eth8 (90:e2:ba:63:1a:3c, 0000:85:00.0)
- eth9 (90:e2:ba:63:1a:3d, 0000:85:00.1)

Network Type: data

Provider Network(s)
- physnet0 (mtu=1500)
- physnet1 (mtu=1500)

MTU: 1500

The following fields are available:

Interface Name

The name to be assigned to the new logical interface.

Interface Type

The type of network interface, Ethernet or aggregated Ethernet (LAG).

Ports

A list of physical ports available to the new logical interface, with corresponding check-mark boxes. Physical ports already allocated to other interfaces are not listed.

Network Type

The type of network to attach the new logical interface to (**data** or **infra**, for compute node data interfaces and infrastructure network connections respectively). Note that connections to the OAM and internal management networks are auto-provisioned during the software installation process.

Provider Network(s)

A list of provider networks available to the new logical interface, with corresponding check-mark boxes. They can be selected for networks of type **data**, to which multiple provider networks can be attached. Provider networks already allocated to other data interfaces are not listed, since no provider network can be associated with more than a single data interface.

MTU

The MTU size in bytes for the interface. For compute nodes, values between 1500 and 9000 are supported. For controller nodes, the MTU size cannot exceed 1500.

To edit or remove a logical interface of network type **data** or **infra** you must first lock the target node. You can then use the **Edit Interface** and **More** buttons to perform these maintenance actions.

Logical interfaces of network types **oam** and **mgmt** cannot be deleted. They can only be modified to use different physical ports when required.

Controller Nodes and High Availability

Services in the controller nodes run constantly in active/standby mode to provide continuity in the event of a controller failure.

Controller services are organized internally into the following groups:

Table 4: Controller Service Groups

Group	Description
Cloud Services	The enhanced OpenStack components, including Nova, Neutron, Cinder, Ceilometer, and Heat
Controller Services	Core HP Helion OpenStack Carrier Grade services such as maintenance and inventory
Directory Services	LDAP services
OAM Services	OAM access services
Patching Services	Patching alarm services
Storage Monitoring Services	Storage alarm services
Storage Services	Storage REST API services
Web Services	The HP Helion OpenStack Carrier Grade OpenStack Horizon service and web server

Each of these groups is run in 1:1 HA mode by the controllers. This means that while some service groups can be active on controller-0, and in standby on controller-1, others are active on controller-1, and in standby on controller-0.

The high-availability framework constantly monitors and reports on the health of the individual services within each of the service groups on both controllers. When a service fails, a decision is made on whether to restart it on the same controller, or to switch the corresponding service group to the other controller. This decision depends on the criticality and the dependencies of the affected service.

For maintenance purposes, when one of the controller nodes needs to be powered down for service, it is necessary to force all currently active service groups in one controller to switch to the other. This can be done from the **Hosts** tab on the **Inventory** page, by selecting the option swact (switch active) in the **More** menu of the controller you want to take out of service.

The Active Controller

Services in the **Controller Services** group drive core functionality in the HP Helion OpenStack Carrier Grade. The controller where they are running is referred to as the *active* controller. The **Hosts** tab in the **System Inventory** page of the **Admin** panel lists the status of all hosts in the cluster; it reports the active controller as having the *Controller-Active* personality.

When working from the CLI on a controller node it is often important to ensure that you are working on the active controller, for example, to execute OpenStack **admin** operations, or to change the password of the **wrsroot** user account. See *Linux User Accounts* on page 12 for further details on the **wrsroot** account.

You can ensure you are working on the active controller by using the OAM floating IP address as the destination address in the SSH command.

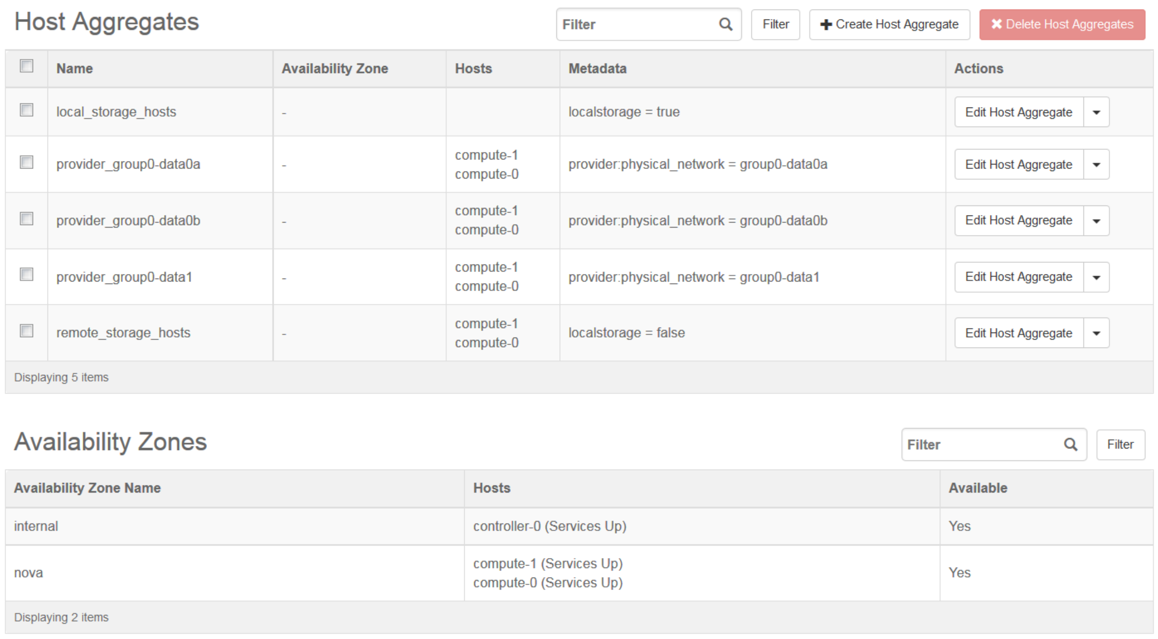
Host Aggregates

Host aggregates are collections of hosts that share common attributes for the purposes of VM scheduling.

Note:

The information in this topic is preliminary and subject to change.

To view host aggregates, open the **Host Aggregates** page from the **Admin** menu.



Name	Availability Zone	Hosts	Metadata	Actions
local_storage_hosts	-		localstorage = true	Edit Host Aggregate
provider_group0-data0a	-	compute-1 compute-0	provider:physical_network = group0-data0a	Edit Host Aggregate
provider_group0-data0b	-	compute-1 compute-0	provider:physical_network = group0-data0b	Edit Host Aggregate
provider_group0-data1	-	compute-1 compute-0	provider:physical_network = group0-data1	Edit Host Aggregate
remote_storage_hosts	-	compute-1 compute-0	localstorage = false	Edit Host Aggregate

Displaying 5 items

Availability Zone Name	Hosts	Available
internal	controller-0 (Services Up)	Yes
nova	compute-1 (Services Up) compute-0 (Services Up)	Yes

Displaying 2 items

When the Nova Scheduler selects a compute node to instantiate a VM, it can use host aggregates to narrow the selection. For example, if the VM requires local storage, the Nova scheduler selects a host from the **local_storage_hosts** host aggregate. Alternatively, if the VM requires remote storage, the scheduler selects from the **remote_storage_hosts** host aggregate. This ensures that the instance is instantiated on a host that meets the requirements of the VM.

The Nova scheduler does not always use host aggregates. For example, if a VM does not specify either local or remote storage, the Nova scheduler can instantiate it on any resource.

Some host aggregates are managed automatically by HP Helion OpenStack Carrier Grade.

Caution:

Do not make manual changes to host aggregates that are managed automatically.

- The **local_storage_hosts** and **remote_storage_hosts** memberships are updated automatically whenever a local volume group is added or removed on a compute host. For more information, see *Configuring a Compute Host to Provide Local Storage* on page 47.

You can use host aggregates to meet special requirements. For example, you can create a pool of compute hosts to offer dedicated resources such as pinned NUMA nodes or specific huge page sizes, while grouping the remaining compute hosts to offer shared resources.

Chapter

5

Managing Virtual Machines

Topics:

Virtual machines and the applications that run on them are at the core of cloud-based communications solutions. Understanding how to manage them is of paramount importance.

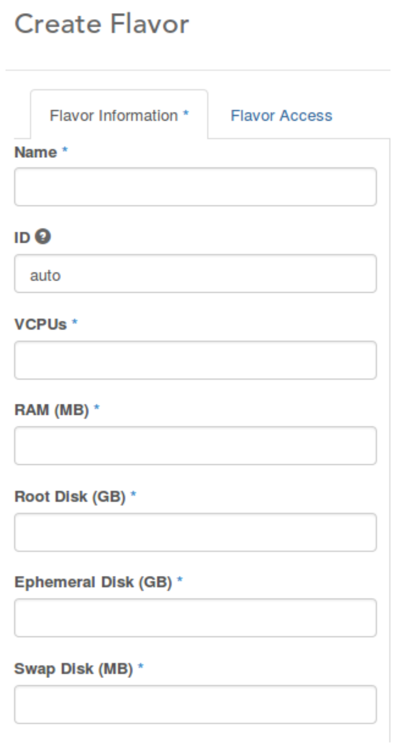
This chapter elaborates on software features available exclusively on the HP Helion OpenStack Carrier Grade, which add to the already powerful set of management tools available from OpenStack. The exclusive features include virtual machine settings to optimize the use of virtual CPUs, improvements to the scheduling algorithms, better integration of NUMA architectures, and others.

Virtual Machine Flavors

A flavor is a list of attributes applied to a virtual machine when a new instance is created. It specifies resources to be allocated by the system, such as size of RAM, number of cores, storage resources, and so on.

You can create and edit flavors using the **Flavors** page of the web administration interface. To access this page, open the **Admin** menu, expand the **System** section, and then select **Flavors**.

- To create a flavor, click the **Create Flavor** button. The **Create Flavor** window appears, as illustrated below:


Create Flavor

Flavor Information * | Flavor Access

Name *

ID

auto

VCPUs *

RAM (MB) *

Root Disk (GB) *

Ephemeral Disk (GB) *

Swap Disk (MB) *

The **Create Flavor** window has two tabs.

Flavor Information

Defines basic information for the flavor.

Name

The name to be associated with the flavor.

ID

The object ID to associate with the flavor. In most situations you should leave the default value of **auto** for the system to auto-generate a unique ID.

VCPUs

Number of virtual CPUs to be allocated to the virtual machine.

RAM MB

Memory, in megabytes, to be allocated to the virtual machine.

Root Disk GB

Specifies the virtual root disk size in gigabytes. This is an ephemeral disk to which the base image is copied. Use the value **0** to set the ephemeral disk size equal to the base image size.

Note:

Booting the VM from the ephemeral root disk is not recommended. Always boot from persistent storage by launching the instance from a Cinder volume.

Ephemeral Disk GB

Specifies the size, in gigabytes, of a secondary ephemeral data disk. This is an empty, unformatted disk that exists only for the life time of the instance.

Swap Disk MB

Ephemeral swap space, in megabytes, to be allocated to the instance.

Flavor Access

Controls which projects can see and use the flavor.

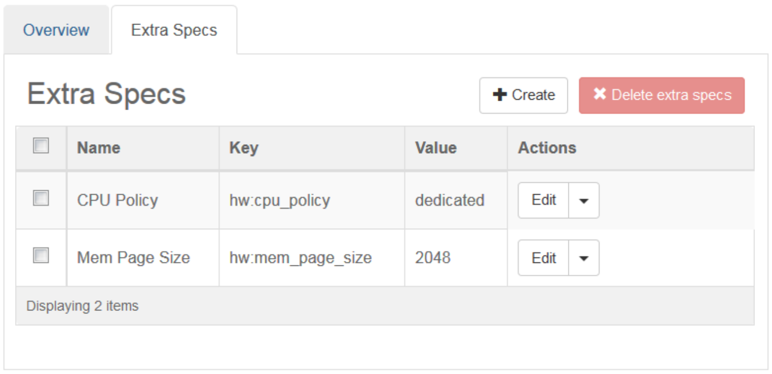
- To edit an existing flavor, click its name in the **Flavor Name** column. For more information about editing flavors, see *Flavor Extra Specifications* on page 115.

Flavor Extra Specifications

You can edit an existing flavor to include additional attributes using *extra specifications*.

Extra specifications are key-value pairs you can add to an existing flavor to be included when the flavor is used with a new virtual machine. The HP Helion OpenStack Carrier Grade **Extra Specs** tab for a flavor includes extensions specific to HP Helion OpenStack Carrier Grade.

To access the extra specifications settings for a flavor, open the **Flavors** window and click the flavor name. For help accessing the Flavors window, see *Virtual Machine Flavors* on page 114.



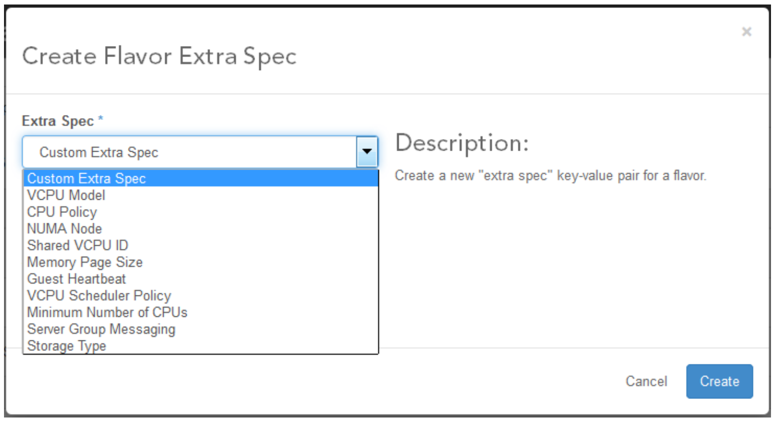
Name	Key	Value	Actions
CPU Policy	hw:cpu_policy	dedicated	Edit
Mem Page Size	hw:mem_page_size	2048	Edit

Displaying 2 items

Figure 4: Flavor extra specs

The **Extra Specs** tab lists extra specifications that have been added for the flavor. To modify an existing entry, use the **Edit** button. To remove a single entry, open the drop-down menu associated with the extra spec, and select **Delete extra spec** from the menu. You can also remove all extra specs at once using the **Delete extra specs** button.

To add a new extra specification, click **Create**. This opens the **Create Flavor Extra Spec** window, as illustrated below:



Description:

Create a new "extra spec" key-value pair for a flavor.

Figure 5: Creating a flavor extra specification

Use the **Extra Spec** drop-down list to add specifications. The following options are available:

Custom Extra Spec

Available for internal use only.

VCPU Model

The CPU model to use with the virtual machine. For more information, see *Specifying the VCPU Model for a VM* on page 117.

CPU Policy

The policy for assigning dedicated physical or logical CPU resources to the VM. For more information, see *Specifying Dedicated CPUs for a VM* on page 117.

NUMA node

The NUMA node to use when launching a virtual machine. For more information, see *Pinning a Guest NUMA Node to a Host NUMA Node* on page 120.

Shared VCPU ID

The ID of a virtual CPU scheduled to run on a shared physical CPU in the compute host. For more information, see *Designating Shared Physical CPUs on a Compute Host* on page 97 and *Pinning a vCPU to a Shared Physical CPU* on page 121.

Note:

To use this extra specification, you must also set the **CPU Policy** extra specification for the flavor to Dedicated. This enables the VM to run a single house-keeping virtual CPU on a shared physical core, while keeping all its high-performance virtual CPUs on dedicated physical cores.

Memory Page Size

Sets the page size for VM memory. For more information, see *Specifying a Page Size for a VM* on page 121.

Guest Heartbeat

Enables the Heartbeat API for use by guests on the VM. For more information, see *Enabling the Heartbeat API for a VM* on page 122.

VCPU Scheduler Policy

Sets the scheduling priority for non-boot virtual CPUs. For more information, see *Configuring vCPU Scheduling and Priority* on page 122.

Minimum Number of CPUs

Sets the minimum number of virtual CPUs for the flavor. For more information, see *Setting the CPU Scaling Range* on page 130.

Server Group Messaging

Enables the VM to communicate with other VMs in the same server group using a messaging API. For more information, see *Enabling Server Group Messaging for a VM* on page 123.

Local Storage

Specifies whether to use local or remote ephemeral storage resources. For more information, see *Specifying Local Storage for a VM* on page 124.

Note:

Some extra specifications are available using the command line only. For more information, see:

- *Configuring the NUMA Node Allocations for a VM* on page 118

Specifying the VCPU Model for a VM

You can select a particular VCPU model for a VM in order to leverage advanced CPU features such as SSE4.2, AES, or AVX on the compute nodes.

When a virtual machine is launched, a Nova scheduler filter restricts the target compute nodes to those with available cores of the requested model, or better. If no such compute node is available, the error *No valid host was found* is reported.

If no VCPU model is specified, the default QEMU virtual processor is used.

The following selections are available:

- Intel Core i7 9xx (Nehalem Class Core i7)
- Intel Westmere E56xx/L56xx/X56xx (Nehalem-C)
- Intel Xeon E312xx (Sandy Bridge)
- Intel Core Processor (Haswell)

Note:

The Haswell model does not currently support transactional synchronization extensions (TSX).

To add this extra spec to a flavor using the web administration interface, use the **VCPU Model** selection in the **Create Flavor Extra Spec** drop-down menu. To access this menu, see *Flavor Extra Specifications* on page 115.

You can also specify the extra spec from the CLI using the following command:

```
~(keystone_admin)$ nova flavor-key flavor_name set hw:cpu_model=cpu_model
```

where *cpu_model* is one of Nehalem, Westmere, SandyBridge, or Haswell. If the hw:cpu_model parameter is not supplied with the `nova flavor-key` command, then the default QEMU model is used.

Specifying Dedicated CPUs for a VM

You can specify the use of dedicated CPUs for a VM using an extra specification.

When a virtual machine is launched, its virtual CPUs use resources from a shared pool of cores on the target compute node. Each virtual CPU is scheduled for processing as an independent thread. The CPU Policy extra specification affects two aspects of the scheduling process: the CPU affinity mask, and the CPU over-commit limit.

If the CPU Policy is set to **Dedicated**, each virtual CPU thread is scheduled to run on a single core exclusively. The cores are removed from the shared resource pool, and each virtual CPU is scheduled to run as a dedicated thread on its corresponding target core. The cores are returned to the shared pool upon termination of the virtual machine.

Selecting **Dedicated** effectively affines each virtual CPU thread to a dedicated core, and ensures that the core is not shared with other virtual CPU threads.

The **Dedicated** setting is recommended for Carrier-Grade requirements to prevent over-commitment of host resources, and to minimize the impact that scheduling events may have on the latency and throughput responses of the guest kernel.

If the CPU Policy is set to **Shared**, the virtual CPU threads are scheduled to run on any available core on the compute node. Also, they can be moved within the compute node from one core to another at any time. In a sense, the virtual CPU threads can be considered to be floating threads. This is the CPU affinity mask portion of the scheduling action.

Additionally, when **Shared** is selected, the virtual CPU threads can share the core with other threads from the same virtual machine or other virtual machines. The default OpenStack virtual CPU over-commit ratio is 16:1, which means that up to 16 virtual CPU threads can share a single core. Over-committing of virtual CPUs is highly discouraged in Carrier-Grade operations.

To add this extra spec to a flavor using the web administration interface, use the **CPU Policy** selection in the **Create Flavor Extra Spec** drop-down menu. To access this menu, see *Flavor Extra Specifications* on page 115.

To add the extra spec using the CLI, use the following command:

```
~(keystone_admin)$ nova flavor-key flavor_name set hw:cpu_policy=policy
```

where *policy* is either dedicated or shared.

Note:

Using a single compute node for both shared and dedicated threads is not recommended. For clusters that must support threads of both types, use a host aggregate for each type. For more information, see *Host Aggregates* on page 111.

Configuring the NUMA Node Allocations for a VM

You can use flavor extra specs or image properties to allocate virtual memory and vCPU resources to virtual NUMA nodes.

By default, the memory and CPU resources defined for a flavor are assigned to a single virtual NUMA node, which is mapped to an available host NUMA node when an instance is launched or migrated. You can specify the use of multiple NUMA nodes using either flavor extra specifications (which take the general form **hw:specification**), or image properties (which take the general form **hw_specification**).

By default, the available CPU and memory resources for the flavor are distributed equally among the NUMA nodes. You can customize the distribution of resources. For example, given a flavor with two NUMA nodes, three vCPUs, and 1024 MB of RAM, you can assign one vCPU and 512 MB to virtual NUMA node 0, and two VCPUs and 512 MB to virtual NUMA node 1. The ability to allocate resources is useful when pinning virtual NUMA nodes to host NUMA nodes to optimize VM performance.

By default, the memory required for a virtual NUMA node is pinned to a single host NUMA node to ensure high performance. For applications where this is not a concern, you can relax the memory allocation requirements so that the memory for a virtual NUMA node can be drawn from more than one host NUMA node if necessary.

When deploying network guest images operating on the data path, it is advisable to co-locate the virtual machines, the AVS switch, physical ports, and all other networking elements on the same node.

Use of this option should be limited to cases where fine-tuning of the data path on guest applications is important.

Caution:

If the virtual CPUs cannot be allocated to run on the specified node on any compute node, the virtual machine may fail to launch

1. Declare the number of NUMA nodes to expose to the guest.

The following extra specification sets the number of NUMA nodes:

```
hw:numa_nodes=n
```

where *n* is the number of NUMA nodes to expose (1 or more).

For example, given the flavor **numa.pinned.asym**, use the following command to expose two NUMA nodes.

```
~(keystone_admin)$ nova flavor-key numa.pinned.asym set hw:numa_nodes=2
```

To set an image property instead, you can use the following command:

```
~(keystone_admin)$ nova image-meta image hw_numa_nodes=2
```

2. Optional: For each NUMA node, assign a list of CPUs.

   This step is optional. By default, available CPUs for the flavor are distributed evenly across the available NUMA nodes.

   The following extra specification assigns CPUs to a NUMA node:

   ```
   hw:numa_cpus.vnode_id=cpu_list
   ```

   where

   vnode_id

   is the number used to identify the virtual NUMA node (0 for the first node, 1 for the second, and so on).

   cpu_list

   is a comma-separated list of vCPUs to assign to the node. The vCPUs for the flavor are enumerated beginning with 0.

   For example, given flavor **numa.pinned.asym**, use the following command to assign vCPU 0 to the first NUMA node, and vCPUs 1 and 2 to the second NUMA node:

   ```
   ~(keystone_admin)$ nova flavor-key numa.pinned.asym set hw:numa_cpus.0=0 \
   hw:numa_cpus.1=1,2
   ```

3. Optional: For each NUMA node, assign an amount of memory.

   This step is optional. By default, available memory for the flavor is distributed evenly across the available NUMA nodes.

   The following extra specification assigns memory to a NUMA node:

   ```
   hw:numa_mem.vnode_id=ram_size
   ```

   where

   vnode_id

   is the number used to identify the virtual NUMA node (0 for the first node, 1 for the second, and so on).

   ram_size

   is the amount of RAM in MB.

   For example, given flavor **numa.pinned.asym**, use the following command to assign 512 MB of RAM to each of two NUMA nodes:

   ```
   ~(keystone_admin)$ nova flavor-key numa.pinned.asym set hw:numa_mem.0=512
    \
   ```

```
hw:numa_mem.1=512
```

4. Optional: Specify whether memory for the flavor can be drawn from more than one NUMA node if necessary.

   This step is optional. By default, memory is allocated from the designated host NUMA node only.

   To control whether memory for the flavor can be drawn from more than one host NUMA node, use the following extra specification:

   ```
   hw:numa_mempolicy=policy
   ```

   where policy is either **strict** (to use only memory from the designated host NUMA node) or **preferred** (to permit memory from other host NUMA nodes to be used if necessary).

To pin the virtual NUMA nodes to host NUMA nodes, see *Pinning a Guest NUMA Node to a Host NUMA Node* on page 120.

Viewing the NUMA Node Configuration for a VM

You can use the CLI to display the NUMA node configuration for a VM.

Use the following command:

```
~(keystone_admin)$ nova show instance
```

where **instance** is the name or UUID of the instance.

Pinning a Guest NUMA Node to a Host NUMA Node

You can use flavor extra specs or image properties to pin a guest NUMA node to a host NUMA node.

By default, when instances are launched or migrated, the virtual NUMA nodes defined for the VMs are mapped to available host NUMA nodes. You can optionally designate a specific host NUMA node for a virtual NUMA node, using either a flavor extra specification (which takes the general form **hw:specification**), or an image property (which takes the general form **hw_specification**). This enables you to co-locate VM processes with AVS vSwitch processes for high-performance networking.

For information about assigning vSwitch processes to host NUMA nodes, see *Processor* on page 95.

For a VM with only one virtual NUMA node, you can use an extra specification to specify the host NUMA node. To add this extra spec to a flavor using the web administration interface, use the **NUMA Node** selection in the **Create Flavor Extra Spec** drop-down menu. This provides fields to associate a **Guest NUMA Node** with a **Host NUMA Node**. To access this menu, see *Flavor Extra Specifications* on page 115.

You can also pin NUMA nodes using the CLI. The following extra specification assigns a specific host NUMA node to a virtual NUMA node:

```
hw:numa_node.vnode_id=pnode_id
```

where

vnode_id

is the number used to identify the virtual NUMA node (0 for the first node, 1 for the second, and so on).

pnode_id

is the number used to identify the host NUMA node (0 for the first node, 1 for the second, and so on).

For example, given flavor **numa.pinned.asym**, use the following command to assign virtual NUMA node 0 to host NUMA node 1:

```
~(keystone_admin)$ nova flavor-key numa.pinned.asym set hw:numa_node.0=1
```

Pinning a vCPU to a Shared Physical CPU

You can pin a vCPU to a shared physical CPU by using a flavor with the required extra specification.

You can set up a shared physical CPU on the host to run low-load or non-real-time tasks for multiple VMs, freeing other cores on the host for dedicated high-load tasks. You can then use an extra spec to pin a specified vCPU to the shared physical CPU.

To use this extra spec, you must define a shared physical CPU on at least one host. For more information, see *Designating Shared Physical CPUs on a Compute Host* on page 97. To support migration, shared physical CPUs on multiple hosts are recommended.

You must also set the **CPU Policy** extra specification for the flavor to **Dedicated**. This enables the high-load vCPUs for the instance to be pinned.

To add the required extra specification to a flavor using the web administration interface, use the **Shared VCPU ID** selection in the **Create Flavor Extra Spec** drop-down menu. To access this menu, see *Flavor Extra Specifications* on page 115.

To set the Shared VCPU ID from the CLI, use a command of the following form:

```
~(keystone_admin)$ nova flavor-key flavor_name set
 hw:wrs:shared_vcpu=vcpu_id
```

where **vcpu_id** is an integer that identifies the vcpu (starting from 0).

Specifying a Page Size for a VM

You can request a specific page size for a VM by using a flavor with the required extra spec when you launch the VM, or by defining an image with the required metadata property.

Before you can request huge pages for a VM, you must define the available page sizes on the hosts in the cluster. For details, see *Huge Page Provisioning* on page 99.

Memory required by a guest is allocated as one or more pages of the requested size. Once allocated, the memory is unavailable for use by other guests until the instance is terminated.

To add this extra spec to a flavor using the web administration interface, use the **Memory Page Size** selection in the **Create Flavor Extra Spec** drop-down menu. To access this menu, see *Flavor Extra Specifications* on page 115.

You can also specify the extra spec from the CLI by setting the following parameter for a flavor:

```
hw:mem_page_size=pagesize
```

where *pagesize* is one of the following:

small

Requests the smallest available size on the compute node.

large

Requests the largest available huge page size (1GiB, then 2MiB). *This setting is not recommended* (see note).

any

Requests any available size, including smaller pages. The actual size used depends on the compute driver implementation. For HP Helion OpenStack Carrier Grade, the largest available size is used (1 GiB, then 2MiB, then 4KiB). *This setting is not recommended* (see note).

2048

Requests a 2MiB page.

1048576

requests a 1GiB page.

If no page size is specified, small pages are used by default.

Note:

The use of **large** or **any** is not recommended. These settings can cause migration issues if the largest available size varies from host to host. For reliable results, use **small** or a specific page size.

For example, to set a 2MiB page size on a flavor that has already been created, use the following command:

```
~(keystone)admin)$ nova flavor-key hw:mem_page_size=2048
```

You can also define an image with the required property by including the hw_mem_page_size parameter, as in the following example:

```
~(keystone)admin)$ nova image-meta image hw_mem_page_size=pagesize
```

Note that if you use image metadata to request a page size, the image is unable to access a **large** page unless the setting for the flavor is also **large** or **any**.

Enabling the Heartbeat API for a VM

You can accommodate the use of guest heartbeats on a VM using an extra specification.

Select this option when you expect one or more of the guest applications running on the virtual machine to make use of the HP Helion OpenStack Carrier Grade Heartbeat client API. For more information about the Heartbeat API, refer to the *HP Helion OpenStack Carrier Grade Software Development Kit*. The controller node starts heartbeat application-level polling cycles on virtual machines launched using a flavor with this option selected.

A guest application modified to use the HP Helion OpenStack Carrier Grade Heartbeat client API can be more accurately monitored by internal messaging within the virtual machine. For more about application monitoring, see *Virtual Machines and Carrier-Grade Availability* on page 132.

To add this extra spec to a flavor using the web administration interface, use the **Guest Heartbeat** selection in the **Create Flavor Extra Spec** drop-down menu. To access this menu, see *Flavor Extra Specifications* on page 115.

To enable the heartbeat API using the CLI, use the following command:

```
~(keystone_admin)$ nova flavor-key flavor_name set
 sw:wrs:guest:heartbeat=integer_value
```

where *integer_value* is either 0 or 1.

Configuring vCPU Scheduling and Priority

You can assign the Linux scheduler and priority for non-boot virtual CPUs using an extra specification.

This extra specification applies to non-boot virtual CPUs, and is available only for flavors that define more than one virtual CPU. For the boot CPU, the Linux scheduler and priority are fixed to non-real-time, with a *nice* priority of 0.

For each additional virtual CPU, the available options are:

Default Policy

Assigns a non-real-time scheduling policy with *nice* priority of 0.

Real-Time FIFO

Assigns a real-time, first-in-first-out policy with *nice* priority of 1–99, specified in the associated **VCPU Priority** field.

Real-Time Round Robin

Assigns a real-time, round-robin policy with *nice* priority of 1–99, specified in the associated **VCPU Priority** field.

To add this extra spec to a flavor using the web administration interface, use the **VCPU Scheduler Policy** selection in the **Create Flavor Extra Spec** drop-down menu. To access this menu, see *Flavor Extra Specifications* on page 115.

You can specify the scheduler policy and priority for non-boot virtual CPUs from the CLI using the hw:wrs:vcpu:scheduler parameter on the `nova flavor-key` command. This parameter accepts a semicolon-separated list of *scheduler:priority:vcpus* values as follows.

scheduler

The scheduler policy. One of *other*, *fifo*, or *rr* to indicate non real-time, FIFO, and Round Robin policies respectively.

priority

The real-time scheduler priority. A value between 1 and 99.

vcpus

A list of virtual CPUs as a comma-separated list (1,2,3) or a range specification (1-3). Virtual CPU number 0 refers to the boot virtual CPU and therefore cannot be used.

To set real-time schedulers and priorities on virtual CPU 1 (FIFO, 50) and virtual CPU 2 (Round Robin, 80):

```
~(keystone_admin)$ nova flavor-key flavor_name set
 hw:wrs:vcpu:scheduler fifo:50:1;rr:80:2
```

To set real-time Round Robin schedulers for three virtual CPU (Round Robin, 80):

```
~(keystone_admin)$ nova flavor-key flavor_name set
 hw:wrs:vcpu:scheduler rr:80:1-3
```

To set the FIFO scheduler with priority 50 on all virtual CPUs:

```
~(keystone_admin)$ nova flavor-key flavor_name set
 hw:wrs:vcpu:scheduler=fifo:50
```

To reset all scheduler settings to default values (non real-time scheduler with priority 0):

```
~(keystone_admin)$ nova flavor-key flavor_name unset
 hw:wrs:vcpu:scheduler
```

Enabling Server Group Messaging for a VM

You can enable a messaging API for a VM, for use with other VMs in the same server group.

Server Group Messaging is a service that provides simple low-bandwidth datagram messaging and notifications for virtual machines that belong to the same server group. This message channel is available regardless of whether IP networking is functional within the server, and requires no knowledge about the other members in the group.

Guest applications can access this service if the Server Group Messaging API is enabled for the VM. To enable the API, select this option. For more information about the Server Group Messaging API, refer to the *HP Helion OpenStack Carrier Grade Software Development Kit*.

The service provides three types of messaging:

- **Broadcast**—allows the server to send a datagram of up to 3050 bytes to all other servers in the server group.
- **Notification**—provides servers with information about changes to the state of other servers in the server group.
- **Status**—allows the server to query the current state of all servers in the group (including the originating server).

Caution:

This service is not intended for high-bandwidth or low-latency operations. If reliability is an important consideration, use acknowledgements and retries.

To add this extra spec to a flavor using the web administration interface, use the **Server Group Messaging** selection in the **Create Flavor Extra Spec** drop-down menu. To access this menu, see *Flavor Extra Specifications* on page 115.

To enable the Server Group Messaging API using the CLI, use the following command:

```
~(keystone_admin)$ nova flavor-key flavor_name set
 sw:wrs:srv_grp_messaging=value
```

where *value* is either False or True.

Specifying Local Storage for a VM

You can specify instantiation on a host with local storage by using a flavor with the required extra specification.

When this extra spec is used, ephemeral disks defined for the flavor use local storage, allocated from the Local Volume Group on the host. Note that the default is to use remote storage, but you can change the extra spec to use local storage.

If the instance is booted from an image, then the root disk also uses local storage. If the instance is booted from a volume, the root disk uses Cinder-based storage allocated from the controller (for a system using LVM) or from storage hosts (for a system using 3PAR).

Before you can use local storage for a VM, you must configure at least one compute node to provide local storage. For more information, see *Configuring a Compute Host to Provide Local Storage* on page 47.

Caution:

Local storage is ephemeral.

- Live migration is not currently supported for an instance using local storage. Locking the host initiates a cold migration. The local storage for the instance is rebuilt.
- Resizing of local storage is partly supported. If the reconfigured instance is instantiated on the same host, then any root or ephemeral disks that use local storage are resized with their data preserved. Swap disks that use local storage are rebuilt. If the instance is migrated to another host, only cold migration is supported. All local storage for the instance is rebuilt.

To add the required extra specification to a flavor using the web administration interface, click **Storage Type** in the **Create Flavor Extra Spec** drop-down menu, and then select the **Local Storage** check box. To access this menu, see *Flavor Extra Specifications* on page 115.

You can also specify the extra spec from the CLI by setting the following parameter for a flavor:

```
aggregate_instance_extra_specs:local_storage=loc_storage
```

where *loc_storage* is one of the following:

true

Specifies ephemeral local storage for use by the VM.

false

Specifies persistent Cinder-based storage for use by the VM.

For example:

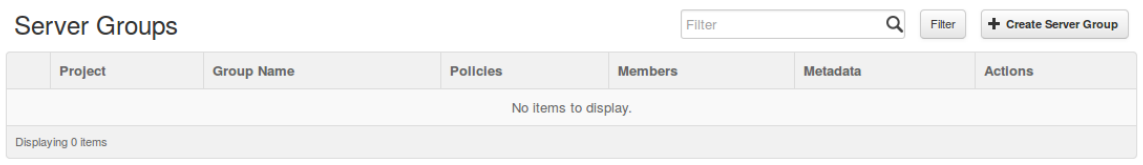
```
~(keystone_admin)$ nova flavor-key flavor_name \
set aggregate_instance_extra_specs=integer_value
```

The local storage key is added by default on flavor creation and set to false (remote storage).

Server Groups

Server Groups is a mechanism to group virtual machines to which a common set of attributes is applied.

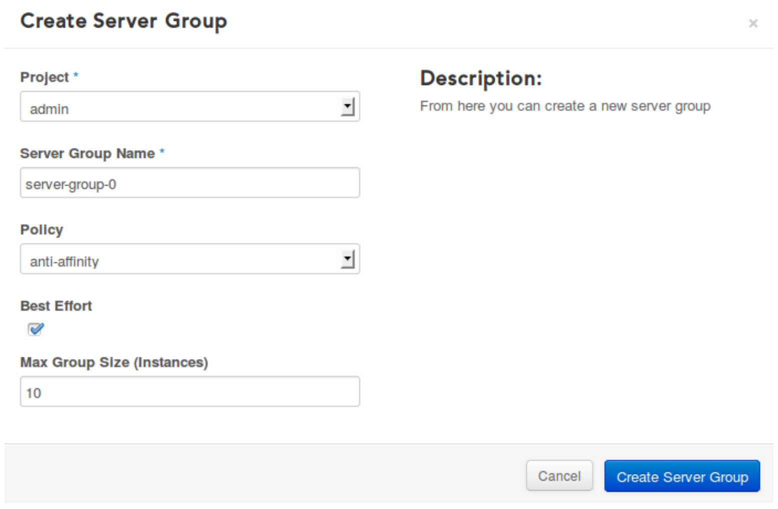
Select the option Server Groups from either the **Project** or the **Admin** tabs on the web administration interface to display the **Server Groups** window illustrated in the following figure:



	Project	Group Name	Policies	Members	Metadata	Actions
No items to display.						

Displaying 0 items

Click the button **Create Server Group** to create a new server group, as illustrated below:



Project *: admin

Server Group Name *: server-group-0

Policy: anti-affinity

Best Effort: ✓

Max Group Size (Instances): 10

Description:
From here you can create a new server group

The following parameters can be defined for the new server group:

Project

Identifies the tenant the new service group should be associated with. This field is only available as part of the **Admin** operations; the project identity is implicit within the context of a specific tenant.

Server Group Name

The name for the new server group.

Policy

The following scheduling policy options are available:

affinity

When this option is selected, new instances launched as part of this server group are scheduled to run on the same compute node.

anti-affinity

When this option is selected, new instances launched as part of this server group are scheduled to run on different compute nodes. For example, you can use the anti-affinity option when you have two virtual machines that run in 1:1 HA protection mode, and you want them to be protected against hardware failures.

See *The Virtual Machine Scheduler* on page 126 and *Live Migration of Virtual Machines* on page 127 for additional considerations on scheduling and live migration for each of these policies.

Best Effort

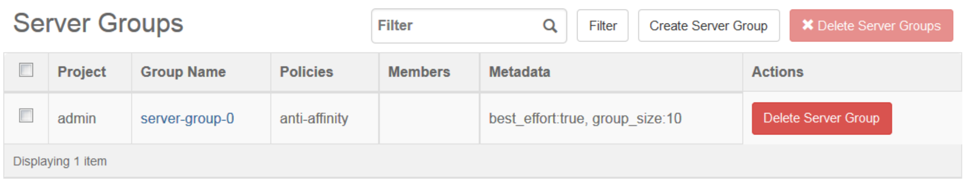
When selected, the policy in place, affinity, or anti-affinity, is enforced whenever possible, on a best-effort basis. If for any reason the policy cannot be enforced, then the deployment of the new instance proceeds using the regular scheduling.

When cleared, the policy in place must be executable for the new instance to be scheduled. Launching of a new virtual machine fails if there are no resources to comply with the selected policy.

Max Group Size (Instances)

Determines the maximum number of instances that can co-exist as part of this server group.

The new service group is displayed as follows:



☐	Project	Group Name	Policies	Members	Metadata	Actions
☐	admin	server-group-0	anti-affinity		best_effort:true, group_size:10	Delete Server Group

Displaying 1 item

Once a server group is defined, you can add virtual machines to it at launch time. This is done by selecting the desired server group from the tab **Server Group** on the launch window.

Server Groups and the CLI

Server groups can be created and deleted using the CLI as illustrated in the following examples:

```
~(keystone_admin)$ nova server-group-create --policy affinity \
--metadata best_effort=true --metadata group_size=2 ht-group-test
+--------------+--------------+---------------+---------+------------+
| Id           | Name         | Policies      | Members | Metadata   |
+--------------+--------------+---------------+---------+------------+
| 63752c24-... | ht-group-test | [u'affinity... | []      | {u'best... |
+--------------+--------------+---------------+---------+------------+
~(keystone_admin)$ nova server-group-delete 63752c24-...
Server group 63752c24-... has been successfully deleted.
```

The Virtual Machine Scheduler

The virtual machine scheduler in the HP Helion OpenStack Carrier Grade is a modified version of the OpenStack Nova scheduler. It allows for better placement of virtual machines in order to exploit hardware and network resources, and for a better distribution of the system workload overall.

In addition to the scheduler actions taken based upon the virtual machine flavor in use, as discussed in *Virtual Machine Flavors* on page 114, the following are enhancements integrated into the HP Helion OpenStack Carrier Grade Nova scheduler:

Memory over-commit policy

There is no support for memory over-commit when scheduling virtual machines. When launching a virtual machine, the Nova scheduler reserves the requested memory block from the system in its entirety. The launch operation fails if not enough memory can be allocated from the compute cluster.

Network load balancing across processor nodes

When scheduling threads for new virtual CPUs, the Nova scheduler selects the target core taking into account the load average of the running AVS cores on each processor node. In a common scenario, the AVS is deployed on two cores, not necessarily part of the same processor. When a new virtual machine is launched, the Nova scheduler looks at the average load incurred by AVS cores on each processor, and then selects the processor with the lighter load as the target for the new virtual CPUs.

This scheduling approach aims at balancing the switching load on the AVS across virtual machines as they are deployed, and minimizing the cross-NUMA inefficiencies for AVS switching.

Provider networks access verification

When scheduling a virtual machine, the Nova scheduler verifies that the target compute node has data interfaces on all needed provider networks, as determined by the list of tenant networks the virtual NICs are attached to. This verification helps prevent unnecessary debugging steps incurred when the networking services on a guest application fail to operate due to the lack of proper network access.

NUMA node pinning

When scheduling a virtual machine, the Nova scheduler selects a host on which the virtual NUMA nodes can be affined to specific host NUMA nodes according to the flavor extra specifications or image properties.

The Nova Scheduler and Server Group Policies

Virtual machines launched as part of a Server Group are subject to scheduling actions determined by the selection of scheduling policy. See *Server Groups* on page 125 for details.

Affinity policy

The goal of this policy is to schedule all virtual machines in the Server Group to execute on the same host. The target compute node is selected by the Nova scheduler when the first instance in the Server Group is launched, in compliance with its corresponding flavor, network, and system requirements.

If the **Best Effort** flag of the Server Group is clear, then the scheduling policy is strictly enforced. Any new instance in the Server Group will fail to launch if any run-time requirements cannot be satisfied by the selected compute node.

If the **Best Effort** flag of the Server Group is set, then the scheduling policy is relaxed. New instances are scheduled to run on the selected compute node whenever possible, but are scheduled on a different host if otherwise necessary.

Anti-affinity policy

The goal of this policy is to schedule each virtual machine in the Server Group to execute on a different host. The target compute node for each instance is selected by the Nova scheduler in compliance with the corresponding flavor, network, and system requirements. As with the affinity policy, the Nova scheduler takes no special considerations regarding the nature of the target host, HT-enabled or not.

If the **Best Effort** flag of the Server Group is clear, then the scheduling policy is strictly enforced. Any new instance in the Server Group will fail to launch if its run-time requirements can not be satisfied by any newly selected compute node.

If the **Best Effort** flag of the Server Group is set, then the scheduling policy is relaxed. New instances are scheduled to run on a different compute node whenever possible, but are scheduled on any already selected host if otherwise necessary.

Live Migration of Virtual Machines

Live migration occurs when a virtual machine is transferred to execute on a different compute node with minimal disruption of the guest applications. This can happen automatically, or upon request by the system administrator.

Note:

Live migration is not currently supported for instances using the following:

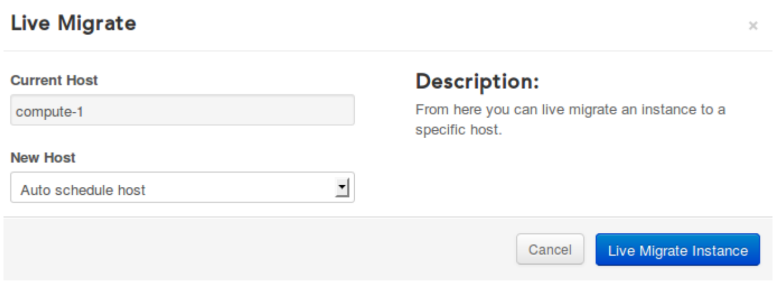
- PCI passthrough
- SR-IOV
- Local storage

While executing a live migration operation, the HP Helion OpenStack Carrier Grade manages the virtual machine's state in such a way that it appears unmodified on the migrated instance. This includes:

- system memory, both kernel and user space
- access to all non-local storage resources, including LVM/iSCSI and Cinder
- all the virtual machine networking options (unmodified/virtio, AVP kernel driver, AVP DPDK Poll Mode Driver), and AVS

Automatic migration of virtual machines occurs whenever the administrator initiates a locking operation on a compute node. In this case, the HP Helion OpenStack Carrier Grade first live-migrates all virtual machine instances off of the compute node before administratively locking it.

The **admin** user can also initiate live migrations manually from the **Instances** page available by clicking the option Instances on the **Admin** side pane of the web management interface. The More button of the selected instance provides the option Live Migrate Instance. When selected, the **Live Migrate** window is displayed as illustrated below:



Description:

From here you can live migrate an instance to a specific host.

The following fields are available:

Current Host

A read-only field displaying the compute node the selected instance is currently running on.

New Host

The target compute node for the migration. The default value is to let the HP Helion OpenStack Carrier Grade auto-schedule the virtual machine following the current scheduling guidelines and constraints. Optionally, you can manually select the target compute node.

Note that the set of available target compute nodes for the migration is still subject to the scheduler constraints from the virtual machine flavor and other systems options that might be in place.

Live Migration and Server Group Policies

Virtual machines launched as part of a Server Group are subject to additional live migration restrictions determined by the selection of scheduling policy. See *Server Groups* on page 125 for details.

Affinity policy

The goal of this policy is to schedule all virtual machines in the Server Group to execute on the same host.

If the **Best Effort** flag of the Server Group is clear, then the individual instances cannot be migrated since this would break the affinity policy.

Note that this means that a compute node running instances in a Server Group with affinity policy in strict mode cannot be locked. An alternative mode of operation is to always set the **Best Effort** flag and then manually migrate the instances to a common host.

If the **Best Effort** flag of the Server Group is set, then any individual instances can migrate to any other available host.

Anti-affinity policy

The goal of this policy is to schedule each virtual machine in the Server Group to execute on a different host.

If the **Best Effort** flag of the Server Group is clear, then the individual instances can migrate provided that there are suitable hosts where no other Server Group instance is running.

If the **Best Effort** flag of the Server Group is set, then any individual instances can migrate to any other available host.

Scaling Virtual Machine Resources

You can scale the resources of individual instances up or down.

Currently, the CPU resources for an instance are scalable.

For an instance to be scalable, the following requirements must be satisfied:

- The image used to launch the instance must support scaling.

  The example image provided with HP Helion OpenStack Carrier Grade supports scaling. You can also build your own image, incorporating the required libraries and services. For more about building your own images, or about the technical requirements for scaling support, refer to the documentation included with the HP Helion OpenStack Carrier Grade Software Development Kit.
- The flavor used to launch the instance must be configured with maximum and minimum scaling limits (the *scaling range*) for the resource.

When scaling a VM, use the credentials of the user that launched the VM. This ensures that quotas are correctly managed.

Depending on the resource being scaled, the scaling behavior applied by HP Helion OpenStack Carrier Grade may be adjustable. For example, you can control which CPUs are released when the CPU resources for an instance are scaled down. To adjust scaling behavior, use the App Scale Helper script.

Normally, scaling is performed under the direction of Heat orchestration. For more about Heat autoscaling, see *Resource Scaling (Autoscaling)* on page 181. If required, you can scale resources manually from the command line using the `nova scale` command, with the following syntax:

```
~(keystone_admin)$ nova scale instance_id resource {up | down}
```

For example, to reduce the number of CPUs allotted to an instance, you can use this command:

```
~(keystone_admin)$ nova scale instance_id cpu down
```

Note:

To scale up the resources for an instance, sufficient resources are required on the host. If all available resources are already allocated to other instances, you may need to free up resources manually.

The App Scale Helper Script

The App Scale Helper script supports resource scaling customizations.

This is an optional script running on the guest. If present, it can modify aspects of scaling behavior. For example, it can control which CPU is taken offline during a scale-down operation, overriding the default selection.

It can also call other scripts or programs. You can use this to coordinate or manage processing work for the vCPUs as you scale them.

For more about the App Scale Helper script, refer to the documentation for the HP Helion OpenStack Carrier Grade Software Development Kit.

CPU Scaling

HP Helion OpenStack Carrier Grade supports CPU up/down scaling for instances.

When an instance is first started, all available vCPUs are brought online. If the instance is restarted, the number of online vCPUs is set to match the number when the instance was stopped. This is controlled by a helper script that automatically takes the required number of vCPUs offline.

When CPU resources are scaled up, a vCPU is brought online from the pool of available vCPUs for the instance, subject to the maximum allowed by the flavor. The lowest-numbered offline vCPU is selected.

When CPU resources are scaled down, a vCPU is taken offline, subject to the minimum allowed by the flavor. By default, the highest-numbered online vCPU is selected. This can be overridden using the App Scale Helper script.

For more about CPU scaling, refer to the documentation for the HP Helion OpenStack Carrier Grade Software Development Kit.

Note:

If there are insufficient resources to launch a scalable VM with the expected allotment when the VM is started or restarted, the launch fails. The VM is *not* automatically scaled down to compensate.

Setting the CPU Scaling Range

You can define the maximum and minimum CPU resources available to an instance by using a flavor.

- To set the maximum number of VCPUs for an instance, define a flavor with the required number of vCPUs.
- To set the minimum number of vCPUs, edit the flavor to include an Extra Spec. The minimum cannot be less than one.

You can use the web administration interface or the CLI to edit the flavor. The CLI parameter for setting the minimum number of CPUs is as follows:

```
hw:wrs:min_vcpus=min
```

where **min** is the minimum number of CPUs.

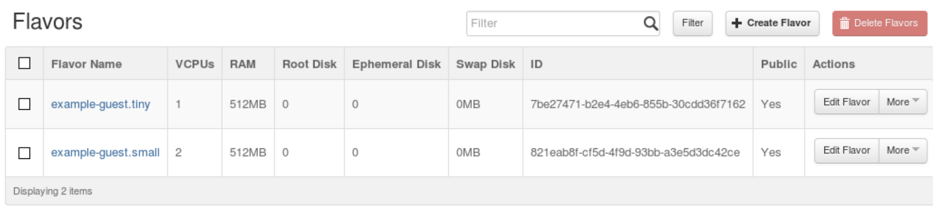
For example:

```
~(keystone_admin)$ nova flavor-key flavor_name set
 hw:wrs:min_vcpus=integer_value
```

For complete information about working with flavors, see *Virtual Machine Flavors* on page 114.

1. Display the **Flavors** list.

   Select the **Admin** menu in the web administration interface, and then in the **System Panel** section of the menu, click **Flavors**.



Flavors

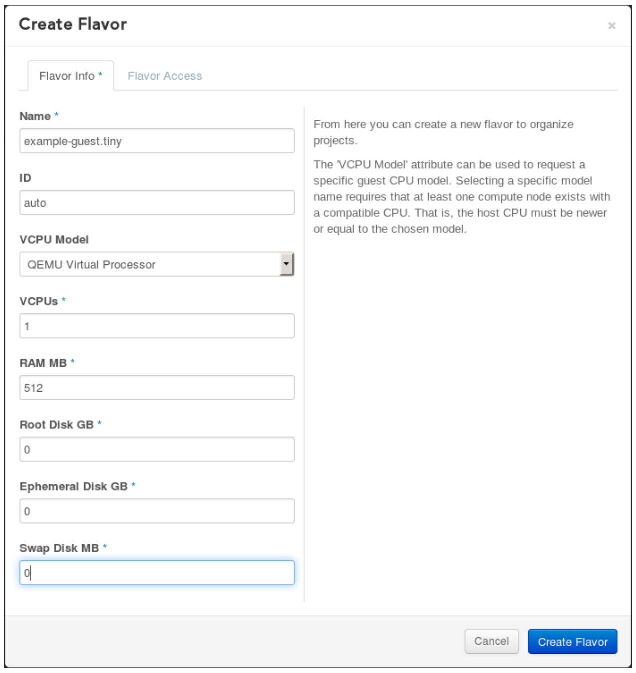
☐	Flavor Name	VCPUs	RAM	Root Disk	Ephemeral Disk	Swap Disk	ID	Public	Actions
☐	example-guest.tiny	1	512MB	0	0	0MB	7be27471-b2e4-4eb6-855b-30cdd36f7162	Yes	Edit Flavor More
☐	example-guest.small	2	512MB	0	0	0MB	821eab8f-cf5d-4f9d-93bb-a3e5d3dc42ce	Yes	Edit Flavor More

Displaying 2 items

2. Optional: If necessary, create a new flavor.

   If a suitable flavor already exists, you can edit it to specify the maximum and minimum vCPUs.

   If no suitable flavor exists, you can create a new flavor by clicking **Create Flavor** in the list to open the **Create Flavor** dialog box.



Create Flavor

Flavor Info * | Flavor Access

Name *: example-guest.tiny

ID: auto

VCPU Model: QEMU Virtual Processor

VCPUs *: 1

RAM MB *: 512

Root Disk GB *: 0

Ephemeral Disk GB *: 0

Swap Disk MB *: 0

From here you can create a new flavor to organize projects.

The 'VCPU Model' attribute can be used to request a specific guest CPU model. Selecting a specific model name requires that at least one compute node exists with a compatible CPU. That is, the host CPU must be newer or equal to the chosen model.

Assign a **Name** for the flavor, and then save the flavor by clicking **Create Flavor** in the dialog box.

3. Specify the maximum number of vCPUs for the instance.

In the **Flavors** list, locate the flavor, and then click **Edit** to open the **Edit Flavor** dialog box.

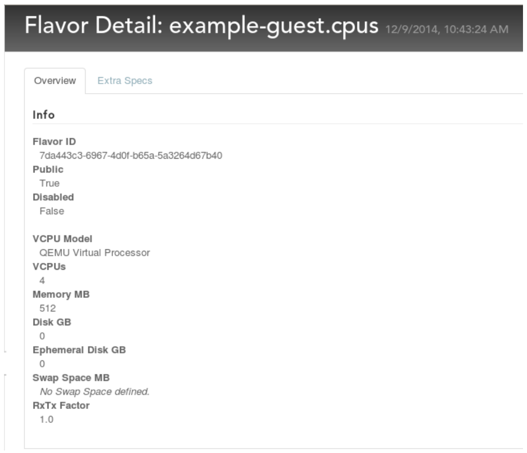
In the **vCPU** field, enter the maximum number of vCPUs.

When you are finished editing, click **Save** to return to the **Flavors** list.

4. Specify the minimum number of vCPUs for the instance.

You can specify the minimum number of vCPUs by adding an Extra Spec for the flavor.

a) In the **Flavors** list, click the **Flavor Name** for the flavor to open the **Flavor Details** dialog box.



Flavor Detail: example-guest.cpus 12/9/2014, 10:43:24 AM

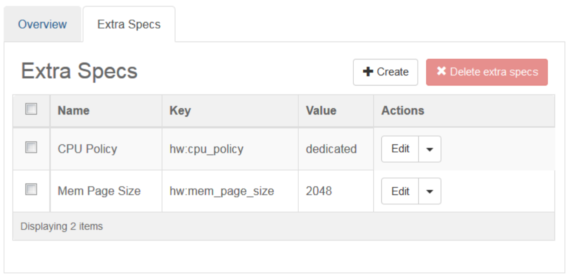
Overview | Extra Specs

Info

Flavor ID
7da443c3-6967-4d0f-b65a-5a3264d67b40
Public
True
Disabled
False

VCPU Model
QEMU Virtual Processor
VCPUs
4
Memory MB
512
Disk GB
0
Ephemeral Disk GB
0
Swap Space MB
No Swap Space defined.
RxTx Factor
1.0

b) On the **Extra Specs** tab, click **Create**.

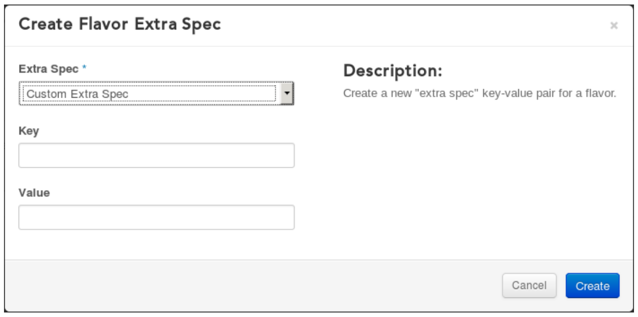


Extra Specs

Name	Key	Value	Actions
CPU Policy	hw:cpu_policy	dedicated	Edit
Mem Page Size	hw:mem_page_size	2048	Edit

Displaying 2 items

c) In the **Create Flavor Extra Spec** dialog, select **Minimum Number of CPUs** from the **Extra Spec** drop-down menu.


Create Flavor Extra Spec

Extra Spec *: Custom Extra Spec

Key:

Value:

Description:

Create a new "extra spec" key-value pair for a flavor.

d) In the **Key** field, enter wrs:min_vcpus.

e) In the **Value** field, enter the minimum allowed number of vCPUs for the flavor.

f) Click **Create**.

Virtual Machines and Carrier-Grade Availability

The HP Helion OpenStack Carrier Grade virtualized environment provides a health monitoring mechanism that can be used to implement and support the deployment of guest applications in Carrier-Grade High Availability (HA) mode.

A simplified view of the health monitoring system is illustrated in the following figure:

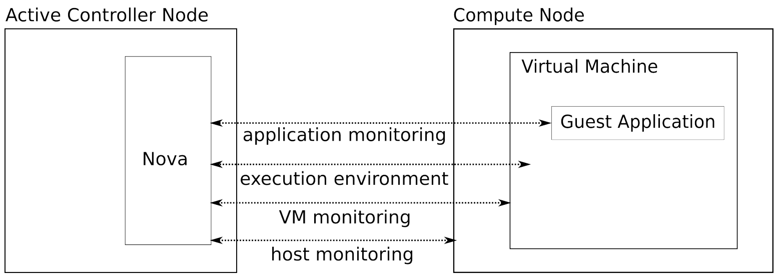


Figure 6: Hardware and software health monitoring

Host monitoring

A host failure occurs when the compute node hardware that hosts the application fails, or when its kernel becomes unresponsive. Host failures are detected by the active controller node through an efficient and scalable monitoring process that runs continuously during normal operation of the HP Helion OpenStack Carrier Grade cluster.

When such a failure is detected, the HP Helion OpenStack Carrier Grade automatically re-schedules all affected virtual machines for deployment on alternative compute nodes.

Host monitoring, and its recovery mechanisms, are always available for every deployed virtual machine in the HP Helion OpenStack Carrier Grade Cluster.

Virtual machine monitoring

From the point of view of a guest application, a hardware failure occurs when the hosting virtual machine fails to execute. From the compute node, this means that the virtual machine process itself is experiencing execution problems, or that it is no longer running.

When such a failure is detected, the HP Helion OpenStack Carrier Grade automatically tries to restart the affected virtual machine on the same compute node. If the restart operation fails, the virtual machine is automatically scheduled to deploy on an alternative compute node.

Virtual machine monitoring, and its recovery mechanisms, are always available for every deployed virtual machine in the HP Helion OpenStack Carrier Grade Cluster.

Execution environment

The HP Helion OpenStack Carrier Grade Heartbeat daemon, built into the guest image, verifies the execution environment. If the guest kernel becomes unresponsive, the lack of heartbeat messages from the daemon triggers an alarm on the active controller.

For all purposes, the virtual machine is considered then to be at fault, and is therefore re-scheduled for execution, first on the same compute node, and then on a different host if necessary.

Application monitoring

Software failures at the application level can be addressed within the context of the following failure scenarios:

Sudden death of the application process

The application process ends abruptly, likely because of a software bug in its code.

The application becomes unresponsive

Several conditions can lead the application process to stall, that is, to be unscheduled for additional work. This may happen because the application is waiting for some resource that is not available, or because of a bug in the application's logic.

The application declares itself to have failed

Logic built into the application determines conditions under which it must declare itself to be in an unrecoverable error state.

Handling of these cases is optional, and subject to the proper API integration into the guest application itself.

Application monitoring happens when the HP Helion OpenStack Carrier Grade Heartbeat daemon in the virtual machine registers the application for monitoring. What happens after an application failure occurs is determined when the application is registered. By default, an application failure results in the Nova service triggering a hard reboot of the virtual machine instance.

If the application makes use of the HP Helion OpenStack Carrier Grade Heartbeat API, it can instruct the active controller on how to proceed when the application declares itself in a state of error. This could include a restart of the virtual machine, which in the case of 1:1 HA application/VM pair, would trigger a VM switchover. The application can also use the *VM Peer Notification API* to receive notifications when virtual machines in the same server group go up or down.

Refer to the *HP Helion OpenStack Carrier Grade SDK* for more information on how to configure the health-monitoring daemon and the use of the HP Helion OpenStack Carrier Grade Heartbeat API.

Data persistence is another aspect that impacts the high-availability of a running application. This is addressed by providing storage persistence across applications restarts for Cinder remote HA block storage using distributed storage backends, such as 3PAR, for configuration databases.

By instrumenting the level of interaction between the guest application and the health-monitoring system, and by using the appropriate Cinder storage backends, guest applications can be deployed to run in different HA scenarios. Note that in all cases, monitoring of hardware and virtual machines, and their corresponding failure recovery mechanisms, are always active.

HA-unaware Guest Applications

These are applications designed with no consideration for special behavior needed when a failure occurs. Typical scenarios include:

- Stateless applications such as web servers serving static data, and data query systems. The requirement in these cases is for the application to be running continuously.

  This requirement is fulfilled when the application is deployed on the HP Helion OpenStack Carrier Grade by the automatic monitoring at the hardware and virtual machine levels. Optionally, the application can benefit from all other monitoring levels when the proper instrumentation is in place.
- Stateful applications such as an enterprise-level call center, where the application's state is maintained in a database or some form of journaling system. An additional requirement in these cases is for storage persistence across restart operations, that is, for the state to be recoverable when the application restarts.

  This additional requirement is fulfilled when the application is deployed on the HP Helion OpenStack Carrier Grade by the Cinder services, when configured to use distributed storage backends.

HA-aware Guest Applications

Typically, these are legacy applications supporting their own HA framework. They are expected to run unmodified, or with minimal changes, when deployed on the HP Helion OpenStack Carrier Grade.

As with any other application, HA-aware applications benefit from the hardware and virtual machine monitoring processes, which provide them with automatic restart upon failures. When coupled with server groups (see *Server Groups* on page 125), they also benefit from the anti-affinity options to ensure that hot/standby running applications are protected against hardware failures.

HA-aware applications also benefit from internal tenant networks on top of which the application's HA framework, and any journaling framework it may use, can be deployed.

Chapter 6

Fault Management

Topics:

- *System Alarms*
- *Customer Logs*

You can examine and filter the alarms and logs generated by HP Helion OpenStack Carrier Grade in order to monitor and respond to fault conditions.

Using the **Fault Management** page on the **Admin** menu, you can access the following system records:

- **Active Alarms**—Alarms that are currently set, and require user action to clear them.
- **Historical Alarms**—Alarms that have been raised in the past, including those that have been cleared.
- **Customer Logs**—Events that do not require user action, but may provide useful information for fault management.

For more about active and historical alarms, see *System Alarms* on page 136. For more about customer logs, see *Customer Logs* on page 151.

System Alarms

HP Helion OpenStack Carrier Grade can generate system alarms when operational conditions change on any of the hosts in the cluster.

The supported interfaces to the alarms subsystem are the command line interface (see *System Alarms CLI Commands* on page 141), the web interface (click the **Fault Management** menu on the **Admin** tab), SNMP, and the system REST API.

About SNMP Support

Support for SNMP is implemented as follows:

- access is disabled by default, must be enabled manually from the command line interface
- available using the controller's node floating OAM IP address, over the standard UDP port 161
- supported version is SNMPv2c
- access is read-only for all SNMP communities
- all SNMP communities have access to the entire OID tree, there is not support for *VIEWS*
- supported SNMP operations are *GET*, *GETNEXT*, *GETBULK*, and *SNMPv2C-TRAP2*
- the SNMP *SET* operation is not supported

SNMPv2-MIB (RFC 3418)

Support for the basic standard MIB for SNMP entities is limited to the System and SNMP groups, as follows:

- System Group, **.iso.org.dod.internet.mgmt.mib-2.system**
- SNMP Group, **.iso.org.dod.internet.mgmt.mib-2.snmp**
- coldStart and warmStart Traps

The following system attributes are used in support of the SNMP implementation. They can be displayed using the `system show` command.

contact

A read-write system attribute used to populate the **sysContact** attribute of the SNMP System group. The contact value can be set with the following command:

```
~(keystone_admin)$ system modify contact="the-site-contact"
```

location

A read-write system attribute used to populate the **sysLocation** attribute of the SNMP System group. The location value can be set with the following command:

```
~(keystone_admin)$ system modify location="some-location"
```

name

A read-write system attribute used to populate the **sysName** attribute of the SNMP System group. The name value can be set with the following command:

```
~(keystone_admin)$ system modify name="the-system-name"
```

software_version

A read-only system attribute set automatically by the system. Its value is used to populate the **sysDescr** attribute of the SNMP System group.

The following SNMP attributes are used as follows:

sysObjectId

Set to **iso.org.dod.internet.private.enterprise.wrs.titanium** (1.3.6.1.4.1.1.2).

sysUpTime

Set to the up time of the active controller.

sysServices

Set to the nominal value of 72 to indicate that the host provides services at layers 1 to 7.

Enterprise MIBs

The HP Helion OpenStack Carrier Grade supports the following *Enterprise Registration* and *Alarm* MIBs.

Enterprise Registration MIB, wrsEnterpriseReg.mib

Defines the hierarchy underneath the **iso(1).org(3).dod(6).internet(1).private(4).enterprise(1)**. This hierarchy is administered as follows:

- **.wrs(731)**, the IANA-registered enterprise code for HP Helion OpenStack Carrier Grade
- **.wrs(731).wrsCommon(1).wrs<Module>(1-...)**, defined in `wrsCommon<Module>.mib`.
- **.wrs(731).wrsProduct(2-...)**, defined in `wrs<Product>.mib`.

Alarm MIB, wrsAlarmMib.mib

Defines the common TRAP and ALARM MIBs. The definition includes *textual conventions*, an *active alarm table*, a *historical alarm table*, and *traps*.

Textual Conventions

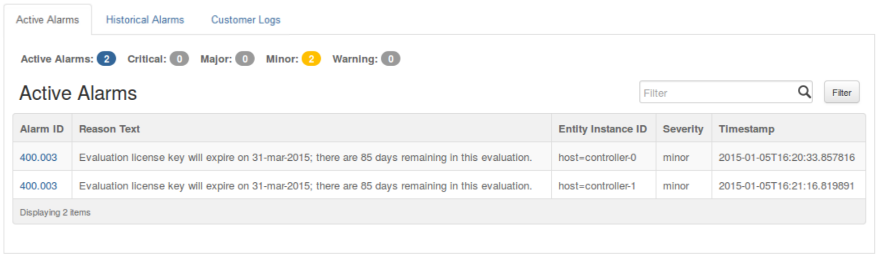
Semantic statements used to simplify definitions in the active alarm table and traps components of the MIB.

Active Alarm Table

A list of all *active* or *set* alarms in the system. Each entry in the table includes the following variables:

- *UUID*
- *AlarmID*
- *EntityInstanceID*
- *DateAndTime*
- *AlarmSeverity*
- *ReasonText*
- *EventType*
- *ProbableCause*
- *ProposedRepairAction*
- *ServiceAffecting*
- *SuppressionAllowed*

On the web interface, click the **Fault Management** menu on the **Admin** tab, and then select the **Active Alarms** tab. Active alarms are displayed as illustrated below:



Active Alarms

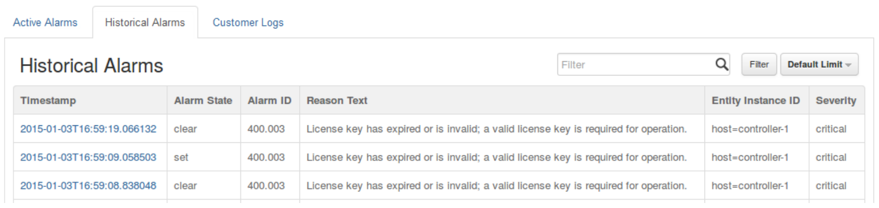
Alarm ID	Reason Text	Entity Instance ID	Severity	Timestamp
400.003	Evaluation license key will expire on 31-mar-2015; there are 85 days remaining in this evaluation.	host=controller-0	minor	2015-01-05T16:20:33.857816
400.003	Evaluation license key will expire on 31-mar-2015; there are 85 days remaining in this evaluation.	host=controller-1	minor	2015-01-05T16:21:16.819891

Displaying 2 items

Historical Alarm Table

A history of set and clear alarm operations in the system. The table includes the same variables as the active alarm table, plus the variable *AlarmState* used to indicate whether the table entry is a SET or a CLEAR operation.

On the web interface, click the **Fault Management** menu on the **Admin** tab, and then select the **Historical Alarms** tab. The alarm history is displayed as illustrated below:



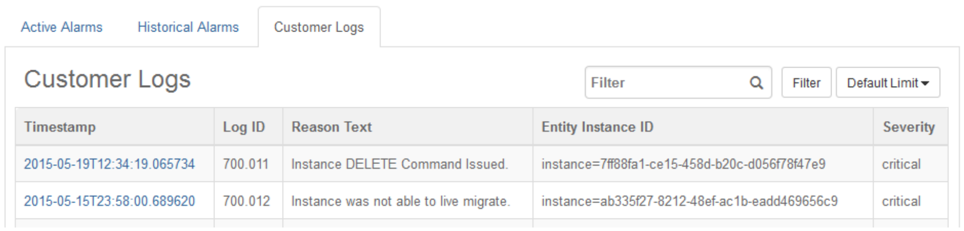
Historical Alarms

Timestamp	Alarm State	Alarm ID	Reason Text	Entity Instance ID	Severity
2015-01-03T16:59:19.066132	clear	400.003	License key has expired or is invalid; a valid license key is required for operation.	host=controller-1	critical
2015-01-03T16:59:09.058503	set	400.003	License key has expired or is invalid; a valid license key is required for operation.	host=controller-1	critical
2015-01-03T16:59:08.838048	clear	400.003	License key has expired or is invalid; a valid license key is required for operation.	host=controller-1	critical

Customer Log Table

A list of all customer logs in the system. The table includes the same variables as the Active Alarm Table, with the exception that *ProposedRepairAction* and *SuppressionAllowed* are excluded.

On the web interface, click the **Fault Management** menu on the **Admin** tab, and then select the **Customer Logs** tab. Logs are displayed as illustrated below:



Customer Logs

Timestamp	Log ID	Reason Text	Entity Instance ID	Severity
2015-05-19T12:34:19.065734	700.011	Instance DELETE Command Issued.	instance=7ff88fa1-ce15-458d-b20c-d056f78f47e9	critical
2015-05-15T23:58:00.689620	700.012	Instance was not able to live migrate.	instance=ab335f27-8212-48ef-ac1b-eadd469656c9	critical

Traps

Defines the following generic traps:

- **wrsAlarmCritical**
- **wrsAlarmMajor**
- **wrsAlarmMinor**
- **wrsAlarmWarning**
- **wrsAlarmMessage**
- **wrsAlarmClear**
- **wrsAlarmHierarchicalClear**

For all alarms, the Notification Type is based on the severity of the trap or alarm. This is done to facilitate the interaction with most SNMP trap viewers which typically use the Notification Type to drive the coloring of traps, that is, red for critical, yellow for minor, and so on.

Customer Logs always result in **wrsAlarmMessage** traps.

For Critical, Major, Minor, Warning, and Message traps, all variables in the active alarm table are included as *varbinds*.

For the Clear trap, *varbinds* include only the *AlarmID*, *EntityInstanceID*, *DateAndTime*, and *ReasonText* variables.

For the HierarchicalClear trap, *varbinds* include only the *EntityInstanceID*, *DateAndTime*, and *ReasonText* variables.

Enabling SNMP Support

In order to have a workable SNMP configuration you must use the command line interface on the active controller to:

1. Define at least one SNMP community string. See *Adding an SNMP Community String* on page 139 for details.
2. Configure at least one SNMP trap destination so that alarms can be reported as they happen. See *Configuring SNMP Trap Destinations* on page 140 for details.

Adding an SNMP Community String

To enable SNMP services you need to define one or more SNMP community strings using the command line interface.

No default community strings are defined on HP Helion OpenStack Carrier Grade after the initial commissioning of the cluster. This means that no SNMP operations are enabled by default.

The following exercise illustrates the system commands available to manage and query SNMP community strings. It uses the string *commstr1* as an example.

All commands must be executed on the active controller's console, which can be accessed using the OAM floating IP address. You must acquire Keystone **admin** credentials in order to execute the commands.

1. Add the SNMP community string *commstr1* to the system.

```
~(keystone_admin)$ system snmp-comm-add -c commstr1
+-----------+--------------------------------------+
| Property  | Value                                |
+-----------+--------------------------------------+
| access    | ro                                   |
| uuid      | eccf5729-e400-4305-82e2-bdf344eb868d |
| community | commstr1                             |
| view      | .1                                   |
+-----------+--------------------------------------+
```

   The following are attributes associated with the new community string:

   access

   The SNMP access type. In HP Helion OpenStack Carrier Grade all community strings provide read-only access.

   uuid

   The UUID associated with the community string.

   community

   The community string value.

   view

   The is always the full MIB tree.

2. List available community strings.

```
~(keystone_admin)$ system snmp-comm-list
+----------------+---------------------+--------+
| SNMP community | View                | Access |
+----------------+---------------------+--------+
| commstr1       | .1                  | ro     |
+----------------+---------------------+--------+
```

3. Query details of a specific community string.

```
~(keystone_admin)$ system snmp-comm-show commstr1
+------------+--------------------------------------+
| Property   | Value                                |
+------------+--------------------------------------+
| access     | ro                                   |
| created_at | 2014-08-14T21:12:10.037637+00:00     |
| uuid       | eccf5729-e400-4305-82e2-bdf344eb868d |
| community  | commstr1                             |
| view       | .1                                   |
+------------+--------------------------------------+
```

4. Delete a community string.

```
~(keystone_admin)$ system snmp-comm-delete commstr1
Deleted community commstr1
```

Community strings in HP Helion OpenStack Carrier Grade provide query access to any SNMP monitor workstation that can reach the controller's OAM address on UDP port 161.

You can verify SNMP access using any monitor tool. For example, the freely available command `snmpwalk` can be issued from any host to list the state of all SNMP Object Identifiers (OID):

```
$ snmpwalk -v 2c -c commstr1 10.10.10.100 > oids.txt
```

In this example, 10.10.10.100 is the HP Helion OpenStack Carrier Grade's OAM floating IP address. The output, which is a large file, is redirected to the file `oids.txt`.

Configuring SNMP Trap Destinations

SNMP trap destinations are hosts configured in HP Helion OpenStack Carrier Grade to receive unsolicited SNMP notifications.

Destination hosts are specified by IP address, or by host name if it can be properly resolved by HP Helion OpenStack Carrier Grade. Notifications are sent to the hosts using a designated community string so that they can be validated.

1. Configure IP address 10.10.10.1 to receive SNMP notifications using the community string *commstr1*.

```
~(keystone_admin)$ system snmp-trapdest-add -c commstr1 --ip_address
 10.10.10.1
+------------+--------------------------------------+
| Property   | Value                                |
+------------+--------------------------------------+
| uuid       | c7b6774e-7f45-40f5-bcca-3668de2a186f |
| ip_address | 10.10.10.1                           |
| community  | commstr1                             |
| type       | snmpv2c_trap                         |
| port       | 162                                  |
| transport  | udp                                  |
+------------+--------------------------------------+
```

The following are attributes associated with the new community string:

uuid

The UUID associated with the trap destination object.

ip_address

The trap destination IP address.

community

The community string value to be associated with the notifications.

type

snmpv2c_trap, the only supported message type for SNMP traps.

port

The destination UDP port that SNMP notifications are sent to.

transport

The transport protocol used to send notifications.

2. List defined trap destinations.

```
~(keystone_admin)$ system snmp-trapdest-list
+------------+---------------+------+-------------+-----------+
| IP Address  | SNMP Community | Port | Type         | Transport |
+-------------+----------------+------+--------------+-----------+
| 10.10.10.1  | commstr1       | 162  | snmpv2c_trap | udp       |
+-------------+----------------+------+--------------+-----------+
```

3. Query access details of a specific trap destination.

```
~(keystone_admin)$ system snmp-trapdest-show 10.10.10.1
+------------+--------------------------------------+
| Property   | Value                                |
+------------+--------------------------------------+
| uuid       | c7b6774e-7f45-40f5-bcca-3668de2a186f |
| ip_address | 10.10.10.1                           |
| community  | commstr1                             |
| type       | snmpv2c_trap                         |
| port       | 162                                  |
| transport  | udp                                  |
+------------+--------------------------------------+
```

4. Disable the sending of SNMP notifications to a specific IP address.

```
~(keystone_admin)$ system snmp-trapdest-delete 10.10.10.1
Deleted ip 10.10.10.1
```

System Alarms CLI Commands

You can use the CLI to find information about currently active and previously triggered system alarms.

The following commands are used to interact with the alarms subsystem: `system alarm-list`, `system alarm-show`, `system alarm-delete`, and `system alarm-history-list`. Before using the commands you must log in to the active controller as the Keystone **admin** user. See *Linux User Accounts* on page 12 for details.

system alarm-list

The command `system alarm-list` lists currently active alarms, as illustrated below (the output is split in two pieces for presentation purposes only):

```
~(keystone_admin)$ system alarm-list

+--------------+----------+-------------------+----------+---------------
| UUID         | Alarm ID | Entity Instance ID | Severity |  Time Stamp
+--------------+----------+-------------------+----------+---------------
| 4ab5698a-... | 100.104  | host=controller-0  | critical |  2014-06-25...
+--------------+----------+-------------------+----------+---------------

--+-------------------------------------------------------+
  | Reason Text                                           |
--+-------------------------------------------------------+
  | /dev/sda3 severity critical threshold set (0.00 MB left) |
--+-------------------------------------------------------+
```

This example lists a single critical alarm on host **controller-0** regarding running out of space on disk unit `/dev/sda3`. Each alarm object is listed with a unique UUID which you can use to obtain additional information.

Specific subsets of alarms, or a particular alarm, can be listed using one of the following --query command filters:

Query Filter	Comment
`uuid=<uuid>`	Query alarm by UUID, for example: `$ system alarm-list --query uuid=4ab5698a-19cb...`
`alarm_id=<alarm id>`	Query alarms by alarm ID, for example: `$ system alarm-list --query alarm_id=100.104`
`alarm_type=<type>`	Query alarms by type, for example: `$ system alarm-list --query \ alarm_type=operational-violation`
`entity_type_id=<type id>`	Query alarms by entity type ID, for example: `$ system alarm-list --query \ entity_type_id=system.host`
`entity_instance_id=<instance id>`	Query alarms by entity instance id, for example: `$ system alarm-list --query \ entity_instance_id=host=compute-0`
`severity=<severity>`	Query alarms by severity type, for example: `$ system alarm-list --query severity=warning` The valid severity types are *critical*, *major*, *minor*, and *warning*.

Query command filters can be combined into a single expression separated by semicolons, as illustrated in the following example:

```
$ system alarm-list -q
 'alarm_id=400.002;entity_instance_id=service_domain=controller.service_group=directory-
services'
```

system alarm-show

The command `system alarm-show` presents additional information about a currently active alarm, as illustrated below:

```
~(keystone_admin)$ system alarm-show 4ab5698a-19cb-4c17-bd63-302173fef62c

+------------------------+--------------------------------------------------+
| Property               | Value                                            |
+------------------------+--------------------------------------------------+
| alarm_id               | 100.104                                          |
| alarm_state            | set                                              |
| alarm_type             | operational-violation                            |
| entity_instance_id     | system=hp380-1_4.host=controller-0               |
| entity_type_id         | system.host                                      |
| probable_cause         | threshold-crossed                                |
| proposed_repair_action | /dev/sda3 check usage                            |
| reason_text            | /dev/sda3 critical threshold set (0.00 MB left) |
| service_affecting      | False                                            |
| severity               | critical                                         |
| suppression            | True                                             |
| timestamp              | 2014-06-25T16:58:57.324613                       |
| uuid                   | 4ab5698a-19cb-4c17-bd63-302173fef62c             |
+------------------------+--------------------------------------------------+
```

The pair of attributes **(alarm_id, entity_instance_id)** uniquely identifies an active alarm:

alarm_id

An ID identifying the particular alarm condition. Note that there are some alarm conditions, such as *administratively locked* , that can be raised by more than one entity-instance-id.

entity_instance_id

Type and instance information of the object raising the alarm. A period-separated list of (key, value) pairs, representing the containment structure of the overall entity instance. This structure is used for processing hierarchical clearing of alarms.

system alarm-delete

The command `system alarm-delete` is used to manually delete an alarm that remains active for no apparent reason, which may happen in rare conditions. Alarms usually clear automatically when the trigger condition is corrected. Use this command as illustrated below:

```
~(keystone_admin)$ system alarm-delete 4ab5698a-19cb-4c17-bd63-302173fef62c
```

Manually deleting an alarm should not be done unless it is absolutely clear that there is no reason for the alarm to be active.

system alarm-history-list

The command `system alarm-history-list` is used to query the historical alarm table. It operates on an alarm ring buffer of up to 2000 entries used by the alarms subsystem to sequentially store active alarm change events. In its simplest form, without any parameters, the command returns a list of the 20 most recent change events in reverse chronological order, the most recent event first. Use the -l option to specify the size of the list. The following command lists the 30 more recent change events:

```
~(keystone_admin)$ system alarm-history-list -l 30
```

The console output is automatically paginated when the list size is greater than 20. Press the `Enter` key to go the next page, or press `q` to quit.

Specific alarms, or alarm subsets, in the ring buffer can be listed using the --query command filters accepted by the `system alarms-list` command. For example, use the following command to query alarm events in the ring buffer by type ID:

```
~(keystone_admin)$ system alarm-history-list --query alarm_id=100.104
```

Two additional command filters are available to restrict the command output to change events in a particular time slot, as follows:

Query Filter	Comment
`start=<time_stamp>`	Query change events that occurred at or after a particular time, for example: `$ system alarm-history-list --query \ start=2014-11-26T18:58:53`
`end=<time_stamp>`	Query change events that occurred at or before a particular time, for example: `$ system alarm-history-list --query \ end=2014-11-26T18:59:53`

Time stamps must be entered in a suitable ISO 8601 date and time format. Some examples are: `2014`, `2014-11-26`, `2014-11-28T16:39`, and `2014-11-28T16:42:35.647157`.

Query command filters can be combined into a single expression separated by semicolons, as illustrated in the following example:

```
~(keystone_admin)$ system alarm-history-list -l 10 \
-q 'start=2014-11-26T18:58:53;end=2014-11-26T18:59:53'
```

Alarms Reference Table

The system inventory and maintenance service reports system changes with different degrees of severity. Use the reported alarms to monitor the overall health of the system.

In the following tables the severity of the alarms is represented by one or more letters, as follows:

- C: Critical
- M: Major
- m: Minor
- W: Warning

A comma-separated list of letters is used when the alarm can be triggered with one of several severity levels.

Resource Alarms

Alarm ID	Reason Text	Entity Instance ID	Severity	Proposed Repair Action
100.101	Platform CPU threshold exceeded; threshold x%, actual y%	host=<*hostname*>	C, M, m	Monitor, and if condition persists, contact next level of support.
100.102	AVS CPU threshold exceeded; threshold x%, actual y%	host=<*hostname*>	C, M, m	Monitor, and if condition persists, contact next level of support.
100.103	Memory threshold exceeded; threshold x%, actual y%	host=<*hostname*>	C, M, m	Monitor, and if condition persists, contact next level of support; may require additional memory on host.

Alarm ID	**Reason Text**	**Entity Instance ID**	**Severity**	**Proposed Repair Action**

100.104	File System threshold exceeded; threshold x%, actual y%	host=<*hostname*>.filesystem=<*mount-dir*>
		or
		filesystem=<*mount-dir*>
		or
		host=<*hostname*>.volumegroup=<*volumegroup-name*>
			C, M	(for filesystem) Monitor, and if condition persists, contact next level of support.
				(for volumegroup) Monitor, and if condition persists, consider adding additional physical volumes to the volume group

Maintenance Alarms

Alarm ID	**Reason Text**	**Entity Instance ID**	**Severity**	**Proposed Repair Action**
100.105	No access to remote VM volumes.	host=<*hostname*>	M	Check management and infrastructure networks. Check controller nodes.
100.106	OAM Port failed	host=<*hostname*>.port=<*port-name*>	M	Check cabling, far-end port configuration, and status on adjacent equipment.
100.107	OAM Interface failed or OAM Interface degraded	host=<*hostname*>.interface=<*if-name*>	C, M	Check cabling, far-end port configuration, and status on adjacent equipment.
100.108	MGMT Port failed	host=<*hostname*>.port=<*port-name*>	M	Check cabling, far-end port configuration, and status on adjacent equipment.
100.109	MGMT Interface failed or MGMT Interface degraded	host=<*hostname*>.interface=<*if-name*>	C, M	Check cabling, far-end port configuration, and status on adjacent equipment.
100.110	INFRA Port failed	host=<*hostname*>.port=<*port-name*>	M	Check cabling, far-end port configuration, and status on adjacent equipment.
100.111	INFRA Interface failed or INFRA Interface degraded	host=<*hostname*>.interface=<*if-name*>	C, M	Check cabling, far-end port configuration, and status on adjacent equipment.

Alarm ID	**Reason Text**	**Entity Instance ID**	**Severity**	**Proposed Repair Action**
200.001	Host was administratively locked to take it out-of-service	host=<*hostname*>	W	Administratively unlock host to bring it back in-service.
200.004	Host experienced a service-affecting failure.	host=<*hostname*>	C	If problem consistently occurs after host is reset, contact next level of support, or lock and replace failing host.
200.005	Degrade: Host is experiencing an intermittent infrastructure network communication failure that has exceeded its lower alarming threshold. Failure: Host is experiencing a persistent critical infrastructure Network communication failure. Resetting Host.	host=<*hostname*>	C, M	If problem consistently occurs after host is reset, contact next level of support, or lock and replace failing host.
200.006	One or more critical processes on host have failed and can not be recovered. Resetting host	host=<*hostname*>	C, M	If problem consistently occurs after host is reset, contact next level of support or lock and replace failing host.
200.007	Degrade: Host is degraded due to out-of-tolerance readings from sensors: '<*sensor list*>' Critical: One or more sensors: '<*sensor list*>' on Host are reporting persistent critical failure	host=<*hostname*>	C, M	If problem consistently occurs after Host is power cycled and or reset, contact next level of support or lock and replace failing host.
200.008	*ntpd* process has failed on host	host=<*hostname*>	m	*ntpd* is a process that can not be auto recovered. The host must be re-enabled (locked and then unlocked) to clear this alarm. If the alarm persists then contact next level of support to investigate and recover.
200.009	Degrade: Host is experiencing an intermittent infrastructure network communication failure	host=<*hostname*>	C, M	If problem consistently occurs after host is reset, contact next level of support, or lock and replace failing host.

Alarm ID	Reason Text	Entity Instance ID	Severity	Proposed Repair Action
	that has exceeded its lower alarming threshold. Failure: Host is experiencing a persistent critical infrastructure Network communication failure. Resetting Host.			
200.010	Access to board management module has failed	host=<*hostname*>	W	Check host's board management configuration and connectivity.
200.011	Host encountered a critical configuration failure during initialization. Resetting Host.	host=<*hostname*>	M	If problem consistently occurs after Host is reset, contact next level of support or lock and replace failing host.
200.012	In-Service failure of host's controller function while compute services remain healthy.	host=<*hostname*>	M	Lock and then Unlock host to recover. Avoid using 'Force Lock' action as that will impact compute services running on this host. If lock action fails then contact next level of support to investigate and recover.
200.013	In-Service failure of host's compute function on host with only available and healthy controller service.	host=<*hostname*>	M	Enable second controller as soon as possible and then optionally Lock and Unlock host to recover local compute services on this host.

Storage Alarms

Alarm ID	Reason Text	Entity Instance ID	Severity	Proposed Repair Action
800.001	Storage alarm condition: <*failure reason*>	cluster=<*dist-fs-uuid*>	C, M	If problem persists, contact next level of support.

Data Networking Alarms

Alarm ID	Reason Text	Entity Instance ID	Severity	Proposed Repair Action
300.001	Data port failed	host=<*hostname*>.port=<*port-uuid*>	M	Check cabling, far-end port configuration, and status on adjacent equipment.

Alarm ID	**Reason Text**	**Entity Instance ID**	**Severity**	**Proposed Repair Action**
300.002	Data interface failed or Data interface degraded	host=<*hostname*>.interface=<*if-uuid*>	C/M	Check cabling, far-end port configuration, and status on adjacent equipment.
300.003	Networking agent not responding	host=<*hostname*>.agent=<*agent-uuid*>	M	If condition persists, attempt to clear issue by administratively locking and unlocking the host.
300.004	No enabled compute node with connectivity to provider network	host=<*hostname*>.providernet=<*pnet-uuid*>	M	Enable compute nodes with required provider network connectivity.

Controller HA Alarms

Alarm ID	**Reason Text**	**Entity Instance ID**	**Severity**	**Proposed Repair Action**
400.001	Service group failure; <*list of affected services*> or Service group degraded; <*list of affected services*> or Service group warning; <*list of affected services*>	service_domain=<*domain_name*>.service_group=<*group_name*>.host=<*hostname*>	C, M, m	Contact next level of support.
400.002	Service group loss of redundancy; expected <*num*> standby member<*s*> but only <*num*> standby member<*s*> available or Service group loss of redundancy; expected <*num*> standby member<*s*> but only <*num*> standby member<*s*> available or Service group loss of redundancy; expected <*num*> active member<*s*> but no active members available or Service group loss of redundancy; expected <*num*>	service_domain=<*domain_name*>.service_group=<*group_name*>	M	Bring a controller node back into service, otherwise contact next level of support.

Alarm ID	**Reason Text**	**Entity Instance ID**	**Severity**	**Proposed Repair Action**
	active member<*s*> but only <*num*> active member<*s*> available			
400.003	License key has expired or is invalid; a valid license key is required for operation or Evaluation license key will expire on <*date*>; there are only 7 or less days remaining in this evaluation or Evaluation license key will expire on <*date*>; there are <*num_days*> days remaining in this evaluation	host=<*hostname*>	C, M, m	Contact next level of support to obtain a new license key.
400.004	Service group software modification detected; <*list of affected files*>	host=<<*hostname*>>	M	Contact next level of support.
400.005	Communication failure detected with peer over interface <*linux-ifname*> or Communication failure detected with peer over interface <*linux-ifname*> within the last 30 seconds	host=<*hostname*>.network=<*mgmt | oam | infra*>	M	Check cabling, far-end port configuration, and status on adjacent equipment.

Backup and Restore Alarms

Alarm ID	**Reason Text**	**Entity Instance ID**	**Severity**	**Proposed Repair Action**
210.001	System Backup in progress	host=controller	m	No action required.

System Configuration

Alarm ID	**Reason Text**	**Entity Instance ID**	**Severity**	**Proposed Repair Action**
250.001	Configuration is out of date	host=<hostname>	M	Administratively lock and unlock <hostname> to update config.

Alarm ID	Reason Text	Entity Instance ID	Severity	Proposed Repair Action
250.010	<hostname> Provisioning compute required. (This alarm only applies in the 2-Server/Combined load).	host=<hostname>	M	Administratively lock and unlock <hostname> to update provisioning of Compute functionality.

Software Management Alarms

Alarm ID	Reason Text	Entity Instance ID	Severity	Proposed Repair Action
900.001	Patching operation in progress	host=controller	m	Complete reboots of affected hosts.
900.002	Obsolete patch in system	host=controller	W	Remove and delete obsolete patches.
900.003	Patch host install failure	host=<*hostname*>	M	Undo patching operation.

Virtual Machine Instance Alarms

Alarm ID	Reason Text	Entity Instance ID	Severity	Proposed Repair Action
700.001	Instance has encountered a non-recoverable error	instance=<*instance_uuid*>	C	The system will automatically attempt to re-start the instance at regular intervals. No repair action required.
700.002	Instance is stopped or shutoff	instance=<*instance_uuid*>	C	Restart the instance (`nova start <instance>`)
700.003	Instance is rebooting	instance=<*instance_uuid*>	C	Wait for reboot completion. If problem persists contact next level of support.
700.004	Instance is paused	instance=<*instance_uuid*>	C	Unpause the instance (`nova unpause <instance>`)
700.005	Instance is suspended	instance=<*instance_uuid*>	C	Resume the instance (`nova resume <instance>`)
700.006	Instance is evacuating or rebuilding	instance=<*instance_uuid*>	C	Wait for evacuate completion. Check health of compute nodes and network. If problem persists contact next level of support.
700.007	Instance is live migrating	instance=<*instance_uuid*>	W	Wait for live migration completion. If problem persists contact next level of support.

Alarm ID	Reason Text	Entity Instance ID	Severity	Proposed Repair Action
700.008	Instance is cold migrating or resizing	instance=<*instance_uuid*>	C	Wait for cold migration or resize completion. If (`nova show <instance>`) reports a STATUS of VERIFY_RESIZE, then a resize confirmation is required (`nova resize-confirm <instance>`). If problem persists contact next level of support.

Customer Logs

You can obtain information about transient events using Customer Logs.

Certain system events that do not result in node state changes and typically do not require immediate customer action, such as instance deletions or failed migration attempts, are recorded in Customer Logs. Each log describes a single event. The logs are held in a buffer, with older logs discarded as needed to release logging space.

The logs are displayed in a list, along with summary information. For each individual log, you can view detailed information. For more information, see *Viewing Customer Logs* on page 151.

Viewing Customer Logs

You can use the web administration interface or the CLI to examine customer logs.

To view customer logs, you must be logged in with administrative privileges.

You can use the command-line interface to view customer logs by acquiring Keystone credentials and using the `system log-list` and `system log-show` commands. Alternatively, you can use the web administration interface using the steps given later in this section.

- To acquire Keystone **admin** credentials, type the following command:

```
$ source /etc/nova/openrc
```

- To list logs, use the following command:

```
~(keystone_admin)$ system log-list [-q query] [-l limit]
```

where

query

is a list of one or more key-value pairs with comparison operators, separated by semicolons.

limit

is the maximum number of logs to return, beginning with the most recent.

For example:

```
~(keystone_admin)$ system log-list -q severity=critical -l 20
```

returns the 20 most recent logs with **critical** severity.

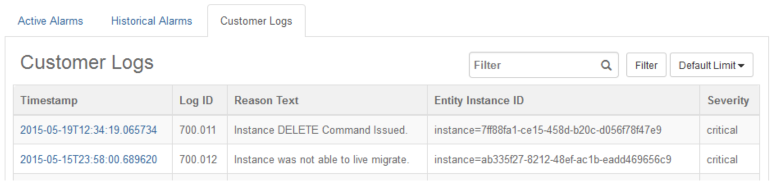
- To view details for an individual log, use the following command:

```
~(keystone_admin)$ system log-show uuid
```

where *uuid* is the unique identifier for the log (obtained using the `system log-list` command).

1. In the main menu, select **Admin** > **System** > **Fault Management**.
2. On the Fault Management page, select the **Customer Logs** tab.

   The logs are displayed in chronological order, beginning with the most recent.

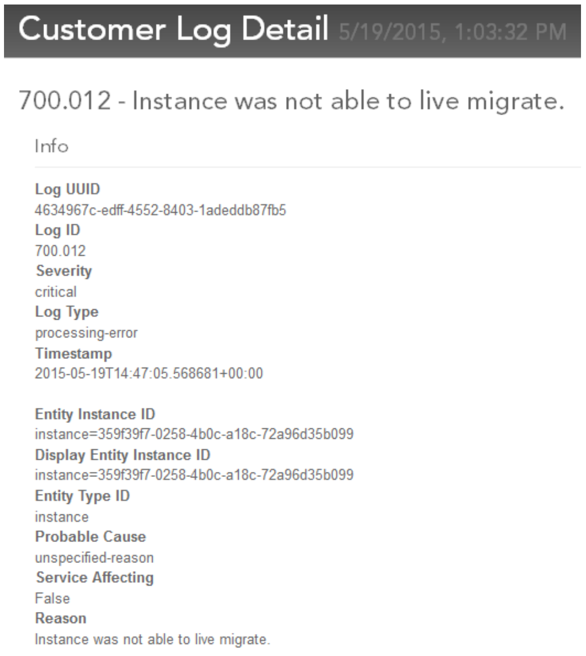
   

   Customer Logs

Timestamp	Log ID	Reason Text	Entity Instance ID	Severity
2015-05-19T12:34:19.065734	700.011	Instance DELETE Command Issued.	instance=7ff88fa1-ce15-458d-b20c-d056f78f47e9	critical
2015-05-15T23:58:00.689620	700.012	Instance was not able to live migrate.	instance=ab335f27-8212-48ef-ac1b-eadd469656c9	critical

   By default, 20 items are shown per page. To see older items, scroll to the bottom of the list and click **Next**. You can change the number of items displayed per page using the **Default Limit** drop-down list.

   You can also filter the items using the **Filter** text box. Type the filter string, and then click the magnifying-glass icon. The results include only those logs that contain the string in the Customer Log Detail.
3. To see the Customer Log Detail, click the **Timestamp** identifier for the log.

   Customer Log Detail 5/19/2015, 1:03:32 PM

   700.012 - Instance was not able to live migrate.

   Info

   Log UUID
   4634967c-edff-4552-8403-1adeddb87fb5
   Log ID
   700.012
   Severity
   critical
   Log Type
   processing-error
   Timestamp
   2015-05-19T14:47:05.568681+00:00

   Entity Instance ID
   instance=359f39f7-0258-4b0c-a18c-72a96d35b099
   Display Entity Instance ID
   instance=359f39f7-0258-4b0c-a18c-72a96d35b099
   Entity Type ID
   instance
   Probable Cause
   unspecified-reason
   Service Affecting
   False
   Reason
   Instance was not able to live migrate.

Customer Logs Reference Table

The Customer Logs include events that do not require immediate user action.

The following types of events are included in the Customer Logs. The severity of the events is represented in the table by one or more letters, as follows:

- C: Critical
- M: Major
- m: Minor
- W: Warning

Log ID	**Reason**	**Entity Instance ID**	**Severity**
700.002	Instance STOP command issued	instance=<*instance_uuid*>	
700.004	Instance PAUSE command issued	instance=<*instance_uuid*>	
700.005	Instance SUSPEND command issued	instance=<*instance_uuid*>	
700.011	Instance DELETE command issued	instance=<*instance_uuid*>	
700.012	Instance was not able to cold or live migrate	instance=<*instance_uuid*>	

Chapter 7

Managing Software Patches

Topics:

Patches to the system software become available as needed to address issues associated with a current HP Helion OpenStack Carrier Grade software release. They must be uploaded to the active controller and applied to all required hosts in the cluster.

The patching system is implemented using the following components:

Patch Controller

This is a daemon running on the active controller. The daemon queries the patch agents to collect information about the state of patches on every host in the cluster. It also communicates with the patch agents to command patch operations to take place.

Patch Agent

These are daemons running on the cluster hosts, one agent per host. Each patch agent maintains up-to-date information about the status of patches on the host, and responds to queries and commands from the patch controller.

Patching Commands

The `wrs-patch` command is available on the active controller. It provides the user interface to process the patches, including querying the state of a patch, listing affected hosts, and applying, installing, and removing patches.

The `system host-patch-reboot` command provides a convenient way to lock a host, install all pending patches, reboot, and bring the host back to the unlock-available state.

Patch Storage Area

A central storage area maintained by the patch controller. Patches are initially uploaded to the patch storage area and remain there until they are deleted.

Software Updates Repository

A central repository of software updates associated with patches applied to the system. This repository is used by all hosts in the cluster to identify the software updates and rollbacks required on each host.

The overall flow for installing a patch from the command line interface on a working HP Helion OpenStack Carrier Grade cluster is the following:

1. Download the patch to a workstation that can reach the active controller through the OAM network.
2. Copy the patch to the active controller using the cluster's OAM floating IP address as the destination point. You can use a command such as `scp`

to copy the patch. The patching workflows presented in this document assume that this step is complete already, that is, they assume that the patch is already available from the file system of the active controller.

3. Upload the new patch to the patching storage area. This step makes the new patch available within the patching system, but does not install it to the cluster yet. For all purposes, the patch is dormant.
4. Apply the patch, and install it on each of the affected hosts in the cluster.

Patching the system can be done using the web administration interface or the command line interface on the active controller. When using the web administration interface you upload the patch directly from your workstation using a file browser window provided by the patch upload facility.

A special case occurs during the initial provisioning of a cluster, when you want to patch **controller-0** before the system software is configured. This can only be done from the command line interface. See *Installing Patches Locally* on page 160 for details.

The following sections introduce the core patching concepts using the command line interface. It is therefore advised that you read this content before reading the section *Patching Using the Web Administration Interface* on page 162, which assumes you are already familiar with the patching workflow.

Populating the Patch Storage Area

Patches have to be uploaded to the HP Helion OpenStack Carrier Grade patch storage area before they can be applied.

1. Log in as Keystone user **admin** to the active controller.

   Log in as user **wrsroot** to the active controller and source the script `/etc/nova/openrc` to obtain administrative privileges as described in *Linux User Accounts* on page 12.
2. Upload the patch file to the patch storage area.

   ```
   ~(keystone_admin)$ sudo wrs-patch upload /tmp/patches/
   ```

   This example uploads a single patch to the storage area. You can specify multiple patch files on the same command separating their names with spaces.

   Alternatively, you can upload all patch files stored in a directory using a single command, as illustrated in the following example:

   ```
   ~(keystone_admin)$ sudo wrs-patch upload-dir /tmp/patches
   ```

   The patch files are available now in the patch storage area, but they have not yet been applied to the cluster.
3. Verify the status of the patch.

   ```
   ~(keystone_admin)$ sudo wrs-patch query
          Patch ID              Patch State
   =========================   ===========
   PATCH_0001   Available
   ```

   The patch state is *Available* now, indicating that it is included in the patch storage area. Further details about the patch can be retrieved as follows:

   ```
   ~(keystone_admin)$ sudo wrs-patch show PATCH_0001
   PATCH_0001:
       Patch State:    Available
       Release Status: Released
       Summary:        Add logs to hbsClient and libalarm-clock
       Description:    Modified log in hbsClient. Expect to see this log on
                       all blade types  'hbsClient patches by
                       PATCH_0001' when hbsClient
                       restarts. Also added a log to ac_init() function
                       that reads "PATCH_0001 patched
                       libalarm-clock".  Should be seen when heartbeat
                       process is restarted on controller and compute.
       Install Instructions:
                       install text here
       Requires:
                       PATCH_0001
       Contents:
                       mtce-common-1.0-r23.x86_64.rpm
                       mtce-common-dev-1.0-r23.x86_64.rpm
                       mtce-common-pmon-1.0-r23.x86_64.rpm
                       mtce-common-rmon-1.0-r23.x86_64.rpm
                       libalarm-clock-1.0-r1.x86_64.rpm
   ```
4. Delete a patch from the patch storage area.

   Patches in the *Available* state can be deleted as illustrated in the following command:

   ```
   ~(keystone_admin)$ sudo wrs-patch delete PATCH_0001
   ```

The patch to delete from the patch storage area is identified by the patch ID reported by the `wrs-patch query` command. You can provide multiple patch IDs to the delete command separated by spaces.

Installing Patches

Patches in the patch storage area can be selected to be installed to the cluster, one, several, or all patches at a time. When selected, they are moved into the software updates repository from where they must be subsequently installed on each impacted host in the cluster.

Installing a patch to the cluster means installing it to each and every host of the type where the patch is relevant. For example, one patch can be installed on the controller nodes only, while another can be installed on all host types. Since a patch is not necessarily installed on all applicable hosts simultaneously, patching the entire cluster can take some time.

As a patch is installed to the cluster, it goes through the following state transitions:

Available* to *Partial-Apply

A patch in the *Partial-Apply* state indicates that it has been installed on zero or more, but not all, the applicable hosts.

Use the command `wrs-patch apply` to trigger this transition. The patch moves from the patch storage area to the software updates repository and becomes ready to be installed on the applicable hosts.

Partial-Apply* to *Applied

A patch in the *Applied* state indicates that it has been installed on all applicable hosts.

Use the command `wrs-patch host-install` repeatedly targeting each time one of the applicable hosts in the cluster. The transition to the *Applied* state is complete when the patch is installed on all target hosts.

The following example illustrates the process of installing a single patch on the cluster. It assumes that the patch is in the *Available* state already, as described in *Populating the Patch Storage Area* on page 156, and that only the controller nodes must be patched.

1. Log in as Keystone user **admin** to the active controller.

   Log in as user **wrsroot** to the active controller and source the script `/etc/nova/openrc` to obtain administrative privileges as described in *Linux User Accounts* on page 12.
2. Verify that the patches are available using the command `wrs-patch query`.

```
~(keystone_admin)$ sudo wrs-patch query
       Patch ID              Patch State
=========================    ===========
PATCH_0001   Available
PATCH_0002   Available
PATCH_0003   Available
```

3. Apply the patch.

```
~(keystone_admin)$ sudo wrs-patch apply PATCH_0001
PATCH_0001 is now in the repo
```

   The patch is now in the *Partial-Apply* state, ready for installation from the software updates repository on the impacted hosts.
4. Optional: Apply all available patches in a single operation.

```
~(keystone_admin)$ sudo wrs-patch apply --all
PATCH_0001 is now in the repo
PATCH_0002 is now in the repo
PATCH_0003 is now in the repo
```

In this example there are three patches ready now for installation from the software updates repository.

5. Query the patching status of all hosts in the cluster.

   You can query the patching status of all hosts at any time as illustrated below. Note that the reported status is the accumulated result of all applied and removed patches in the software updates repository, and not just the status due to a particular patch.

   ```
   ~(keystone_admin)$ sudo wrs-patch query-hosts
     Hostname       IP Address    Patch Current  Reboot Required
   ============  ==============  =============  ===============
   compute-0     192.168.204.15       Yes            No
   controller-0  192.168.204.3        No             Yes
   controller-1  192.168.204.4        No             Yes
   ```

   For each host in the cluster, the following patch status fields are displayed:

   Patch Current

   Indicates whether there are patches pending for installation or removal on the host or not. If *Yes*, then all relevant patches in the software updates repository have been installed on, or removed from, the host already. If *No*, then there is at least one patch in either the *Partial-Apply* or *Partial-Remove* states that has not been applied to the host.

   Reboot Required

   Indicates whether the host has to be rebooted or not as a result of one or more patches that have been either applied or removed, or because it is not patch current.

   In this example, **compute-0** is up to date, no patches need to be installed and no reboot is required. By contrast, the controllers are not patch current, and therefore a reboot is required to install the patch.

6. Install all pending patches on **controller-0**.

   a) Swact controller services.

   ```
   ~(keystone_admin)$ system host-swact controller-0
   ```

   Before patching a controller node, you must transfer any active services running on the host to the other controller. Only then it is safe to lock the host.

   b) Run the patching sequence.

   The patching sequence locks the host, installs the patches, and forces a host reboot.

   ```
   ~(keystone_admin)$ system host-patch-reboot controller-0
   host-patch-reboot controller-0 may take several minutes to complete.

   2014-10-17-20-39-59_host-patch-reboot start.
   ...

   2014-10-17-20-39-59_host-patch-reboot host-lock.
   waiting for host controller-0 to transition to locked-disabled-
   online ...
   waiting for host controller-0 to transition to locked-disabled-
   online ...
   2014-10-17-20-40-14_Host controller-0 is locked-disabled-online.

   2014-10-17-20-40-14_Patch install request
   Installing patch for host controller-0 ...

   2014-10-17-20-40-16_Patch install response
   Patch response Info: Patch installation was successful on controller-0.

   2014-10-17-20-40-16_host-patch-reboot host-unlock
   ```

```
Restoring initial administrative state: unlocked. Unlocking host
 controller-0 to return to initial administrative state.
```

All patches are now installed on **controller-0**. Querying the current patch status displays the following information:

```
~(keystone_admin)$ sudo wrs-patch query-hosts
  Hostname      IP Address    Patch Current  Reboot Required
============  ==============  =============  ===============
compute-0     192.168.204.15       Yes             No
controller-0  192.168.204.3        Yes             No
controller-1  192.168.204.4        No              Yes
```

7. Optional: Manually install all pending patches on **controller-0**.

You may want to have finer control of the patching steps executed by the `system host-patch-reboot` command to determine when to install the patches and unlock the host.

a) Swact controller services.

```
~(keystone_admin)$ system host-swact controller-0
```

Before patching a controller node, you must transfer any active services running on the host to the other controller. Only then it is safe to lock the host.

b) Lock the host.

```
~(keystone_admin)$ system host-lock controller-0
```

You must lock the target host, controller, compute, or storage, before installing patches.

c) Install the pending patches.

```
~(keystone_admin)$ sudo wrs-patch host-install controller-0
Patch installation was successful on controller-0
```

All patches are now installed on **controller-0**. Querying the current patching status displays the following information:

```
~(keystone_admin)$ sudo wrs-patch query-hosts
  Hostname      IP Address    Patch Current  Reboot Required
============  ==============  =============  ===============
compute-0     192.168.204.15       Yes             No
controller-0  192.168.204.3        Yes             Yes
controller-1  192.168.204.4        No              Yes
```

For illustration purposes in this section, the command `wrs-patch host-install` is presented as the tool to *install* patches. But in fact, this command also *removes* patches as well, as described in *Removing Patches* on page 161. The command is better described then as the tool to install and remove all patches in the *Partial-Apply* and *Partial-Remove* states on a host.

d) Unlock the target host.

```
~(keystone_admin)$ system host-unlock controller-0
```

Unlocking the host forces a reset of the host followed by a reboot. This ensures that the host is restarted in a known state.

All patches are now installed on **controller-0**.

8. Install all pending patches on **controller-1**.

Repeat the previous step targeting **controller-1** this time.

All patches are now installed on **controller-1** as well. Querying the current patching status displays the following information:

```
~(keystone_admin)$ sudo wrs-patch query-hosts
  Hostname      IP Address    Patch Current  Reboot Required
============  ==============  =============  ===============
compute-0     192.168.204.15       Yes             No
controller-0  192.168.204.3        Yes             No
controller-1  192.168.204.4        Yes             No
```

The cluster is up to date now. All patches are installed.

Installing Patches Locally

When installing the HP Helion OpenStack Carrier Grade software on new hardware, it is recommended that you install the latest available patches on **controller-0** before running the `region_config` script, and before installing the software on other hosts. This ensures that:

- The software on **controller-0**, and all other hosts, is up to date when the cluster comes alive.
- You reduce installation time by avoiding patching the system right after an out-of-date software installation is complete.

This exercise assumes that the patches to install are available on a USB flash drive, or from a server reachable by **controller-0**.

1. Initialize **controller-0**.

   Use the HP Helion OpenStack Carrier Grade bootable ISO image to initialize **controller-0**. See the *HP Helion OpenStack Carrier Grade Software Installation Guide* for details.

   This step takes you to the point where you use the console port to log in to **controller-0** as user **wrsroot**.
2. Copy the patches to the local file system.

   If the patches are on a USB flash drive, copy them from the appropriate mount point to some directory in the local file system. For example:

   ```
   $ mkdir /tmp/patches
   $ cp /media/wrsroot/data/PATCH_0001.patch /tmp/patches
   ```

   If the patches are available from a remote server, you need to manually initialize a suitable Ethernet interface first, and then transfer them to the local file system. For example:

   ```
   $ mkdir /tmp/patches
   $ sudo ifconfig eth3 192.168.1.100 netmask 255.255.255.0 up
   $ scp \
   me@192.168.1.150:/usr/local/patches/PATCH_0001.patch \
   /tmp/patches
   ```

   All patches are now in the directory `/tmp/patches`.
3. Populate the patch storage area.

   Upload the patches using the command `wrs-patch upload` or `wrs-patch upload-dir` as described in *Populating the Patch Storage Area* on page 156.
4. Apply the patches.

   Apply the patches using the command `wrs-patch apply --all`.

   The patches are now in the software updates repository, ready to be installed.

5. Install the patches locally.

   ```
   $ sudo wrs-patch install-local
   Patch installation is complete.
   Please reboot before continuing with configuration.
   ```

   This command installs all applied patches on **controller-0**.

6. Reboot **controller-0**.

   You must reboot the controller to ensure that it is running with the software fully patched.

7. Continue with the HP Helion OpenStack Carrier Grade software installation.

   Log in again as **wrsroot** and continue with the software installation by running the `region_config` script. See the *HP Helion OpenStack Carrier Grade Software Installation Guide* for further details and directions.

Once all hosts in the cluster are initialized, they are all running fully patched software. The HP Helion OpenStack Carrier Grade cluster is up to date.

Removing Patches

Patches in the *Applied* or *Partial-Apply* states can be removed if necessary, for example, when they trigger undesired or unplanned effects on the cluster.

Rolling back patches is conceptually identical to installing patches. A roll-back operation can be commanded for a patch in either the *Applied* or the *Partial-Apply* states. As the patch is removed, it goes through the following state transitions:

Applied* or *Partial-Apply* to *Partial-Remove

A patch in the *Partial-Remove* state indicates that it has been removed from zero or more, but not from all, the applicable hosts.

Use the command `wrs-patch remove` to trigger this transition.

Partial-Remove* to *Available

Use the command `wrs-patch host-install` repeatedly targeting each time one of the applicable hosts in the cluster. The transition to the *Available* state is complete when the patch is removed from all target hosts. The patch remains in the patch storage area as if it had just been uploaded.

The following example is basically a copy of the workflow used in *Installing Patches* on page 157, but this time removing instead of installing the patch. The steps are therefore presented in simplified form.

1. Log in as Keystone user **admin** to the active controller.
2. Verify the state of the patch.

   ```
   ~(keystone_admin)$ sudo wrs-patch query
          Patch ID             Patch State
   =========================   ===========
   PATCH_0001   Applied
   ```

   In this example the patch is listed in the *Applied* state, but it could be in the *Partial-Apply* state as well.

3. Remove the patch.

   ```
   ~(keystone_admin)$ sudo wrs-patch remove PATCH_0001
   PATCH_0001 has been removed from the repo
   ```

   The patch is now in the *Partial-Remove* state, ready to be removed from the impacted hosts where it was already installed.

4. Query the patching status of all hosts in the cluster.

   ```
   ~(keystone_admin)$ sudo wrs-patch query-hosts
     Hostname       IP Address     Patch Current  Reboot Required
   ============  ==============  =============  ================
   compute-0     192.168.204.15       Yes             No
   controller-0  192.168.204.3        No              Yes
   controller-1  192.168.204.4        No              Yes
   ```

   In this example, the controllers have patches ready to be removed, and therefore must be rebooted.
5. Remove all pending-for-removal patches from **controller-0**.
   a) Swact controller services.
   b) Run the patching sequence.

      ```
      ~(keystone_admin)$ system host-patch-reboot controller-0
      ```
6. Remove all pending patches from **controller-1**.

The cluster is up to date now. All patches have been removed, and the patch PATCH_0001 can be deleted from the patch storage area if necessary.

It is important to note the role of the command `wrs-path host-install` as a tool that both installs and removes patches as necessary.

Patching Using the Web Administration Interface

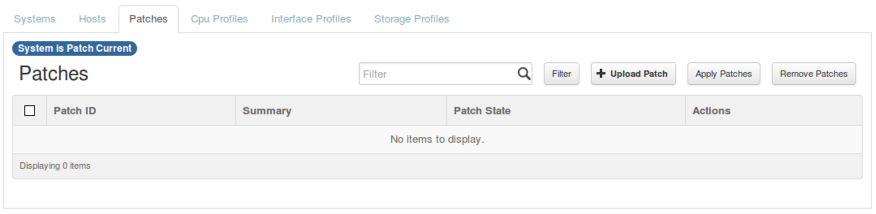
Use the web management interface to upload, delete, apply, and remove patches.

This section presents a example patching workflow using the single patch PATCH_0001.

1. Log in to the web administration interface as the **admin** user.
2. Visit the **Patches** page to see the current patch status.

   Click the **Admin** tab on the System Panel, select **Inventory** to display the **System Inventory** page, and then click the **Patches** tab.

   The **Patches** page is displayed presenting the current status of all patches uploaded to the system. If there are no patches, an empty page is displayed as illustrated below.



Patches

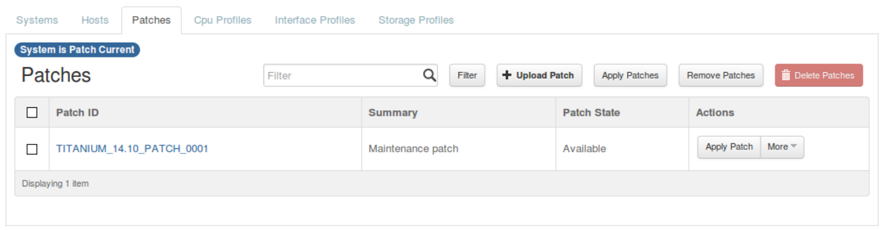
	Patch ID	Summary	Patch State	Actions
No items to display.				

Displaying 0 items

3. Upload the patch file to the patch storage area.

   Click the **Upload Patch** button to display an upload window from which you can browse your workstation's file system to select the patch file. Press the **Upload Patch** button once the selection is done.

   The patch file is available now in the patch storage area, but it has yet to be applied to the cluster. This is reflected in the **Patches** page as illustrated below.



Patches

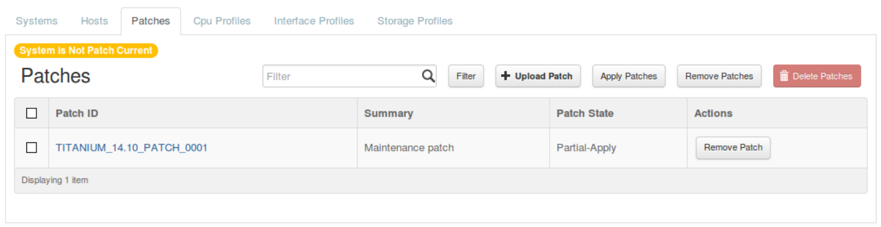
Patch ID	Summary	Patch State	Actions
TITANIUM_14.10_PATCH_0001	Maintenance patch	Available	Apply Patch More

Displaying 1 item

4. Apply the patch.

Click the **Apply Patch** button associated with the patch. Alternatively, select the patch first using the selection boxes on the left, and then click the **Apply Patches** button at the top. You can use this selection process to apply all patches, or a selected subset, in a single operation.

The **Patches** page is updated to report the patch to be in the *Partial-Apply* state.

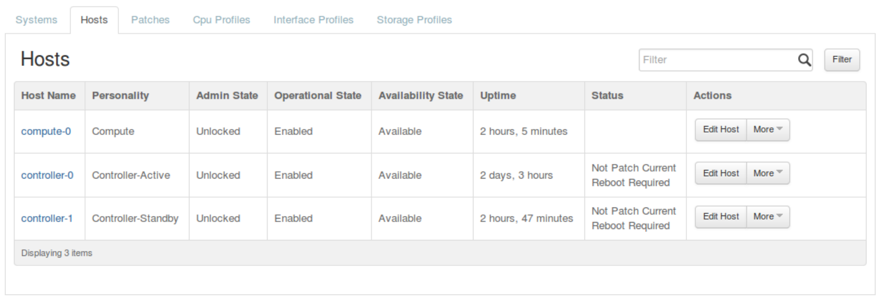


Patches

Patch ID	Summary	Patch State	Actions
TITANIUM_14.10_PATCH_0001	Maintenance patch	Partial-Apply	Remove Patch

Displaying 1 item

The **Hosts** tab on the **System Inventory** page is also updated to reflect the new status of the hosts with respect to the new patch state. As illustrated in the following image, both controllers are now reported as not patch current and requiring reboot.



Hosts

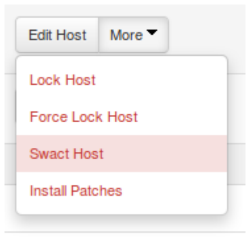
Host Name	Personality	Admin State	Operational State	Availability State	Uptime	Status	Actions
compute-0	Compute	Unlocked	Enabled	Available	2 hours, 5 minutes		Edit Host More
controller-0	Controller-Active	Unlocked	Enabled	Available	2 days, 3 hours	Not Patch Current Reboot Required	Edit Host More
controller-1	Controller-Standby	Unlocked	Enabled	Available	2 hours, 47 minutes	Not Patch Current Reboot Required	Edit Host More

Displaying 3 items

5. Install the patch on **controller-0**.

a) Transfer active services to the standby controller.

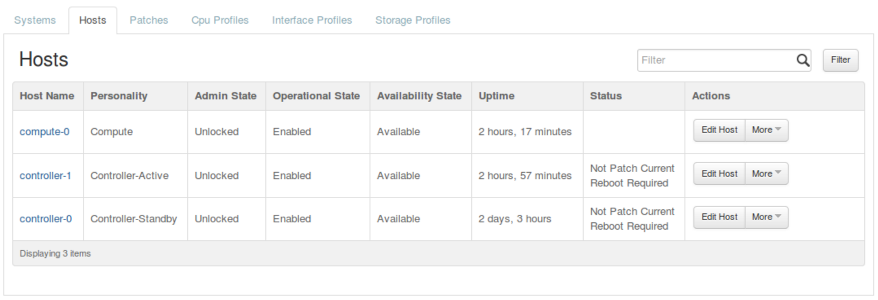
Swact **controller-0** using the Swact Host option from the **More** button associated with the host.



Note:

Access to the web administration interface may be lost briefly during the active controller transition. You may have to log in as user **admin** again.

After a suitable delay, **controller-1** becomes the active controller and **controller-0** is the standby controller. It is safe then to install the patch.



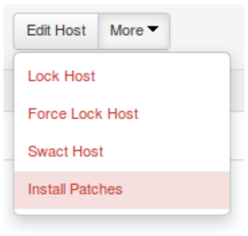
Hosts

Host Name	Personality	Admin State	Operational State	Availability State	Uptime	Status	Actions
compute-0	Compute	Unlocked	Enabled	Available	2 hours, 17 minutes		Edit Host More
controller-1	Controller-Active	Unlocked	Enabled	Available	2 hours, 57 minutes	Not Patch Current Reboot Required	Edit Host More
controller-0	Controller-Standby	Unlocked	Enabled	Available	2 days, 3 hours	Not Patch Current Reboot Required	Edit Host More

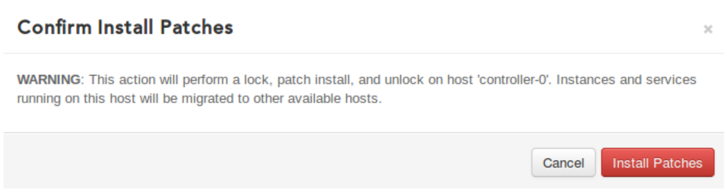
Displaying 3 items

b) Install the patch.

Select the Install Patches option from the **More** button associated with **controller-0**.



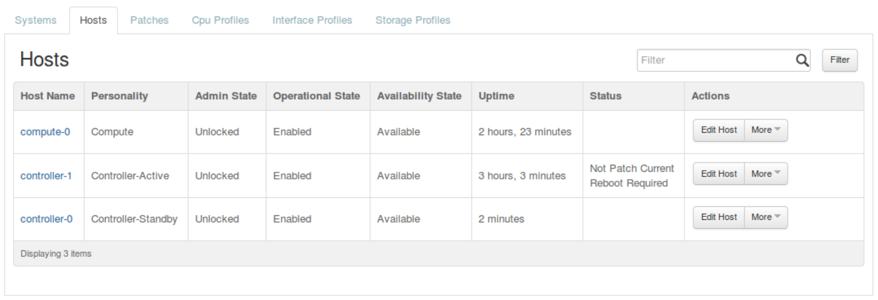
A confirmation window is presented giving you a last opportunity to cancel the operation before proceeding. Note that the patching sequence reboots the host in order to install the patches.



Confirm Install Patches

WARNING: This action will perform a lock, patch install, and unlock on host 'controller-0'. Instances and services running on this host will be migrated to other available hosts.

The patch is now installed on **controller-0** which resumes operation as the standby controller.



Hosts

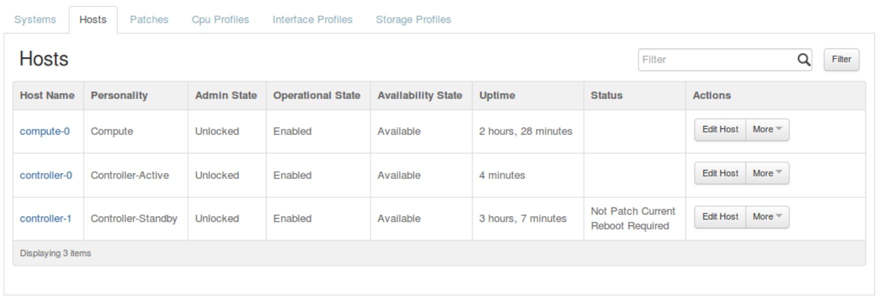
Host Name	Personality	Admin State	Operational State	Availability State	Uptime	Status	Actions
compute-0	Compute	Unlocked	Enabled	Available	2 hours, 23 minutes		Edit Host More
controller-1	Controller-Active	Unlocked	Enabled	Available	3 hours, 3 minutes	Not Patch Current Reboot Required	Edit Host More
controller-0	Controller-Standby	Unlocked	Enabled	Available	2 minutes		Edit Host More

Displaying 3 items

c) Let **controller-0** resume the active controller role.

Select the Swact Host option again on either controller to transition **controller-0** to the active controller role.

The updated host list looks then as follows:



Hosts

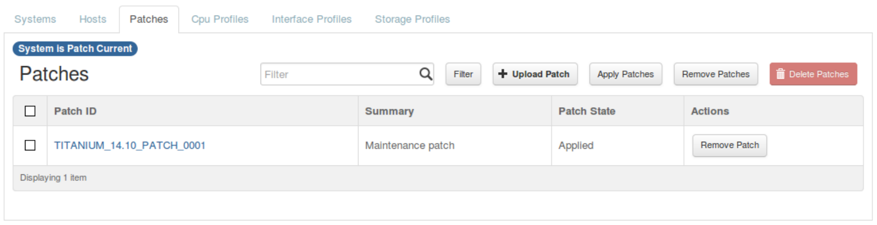
Host Name	Personality	Admin State	Operational State	Availability State	Uptime	Status	Actions
compute-0	Compute	Unlocked	Enabled	Available	2 hours, 28 minutes		Edit Host More
controller-0	Controller-Active	Unlocked	Enabled	Available	4 minutes		Edit Host More
controller-1	Controller-Standby	Unlocked	Enabled	Available	3 hours, 7 minutes	Not Patch Current Reboot Required	Edit Host More

Displaying 3 items

6. Install the patch on **controller-1**.

   Select the Install Patches option from the **More** button associated with **controller-1** in the **Hosts** window, and wait for the host to resume its standby controller role.
7. Verify the state of the patch.

   Visit the **Patches** page again. The patch is now in the *Applied* state as illustrated below.



	Patch ID	Summary	Patch State	Actions
☐	TITANIUM_14.10_PATCH_0001	Maintenance patch	Applied	Remove Patch

Displaying 1 item

The patch is applied now, all affected hosts have been updated.

Patches can be removed using the **Remove Patches** button from the **Patches** page. The workflow is similar to the one presented in this section, with the exception that patches are being removed from each host instead of being applied.

Chapter 8

System Backups

Topics:

The HP Helion OpenStack Carrier Grade provides tools to back up *system data* so that they can be stored in external storage resources and used to restore a full cluster.

The backup and restore procedures can be summarized as follows:

- Log in as user **wrsroot** to the console of the active controller.
- Execute the backup procedures from the CLI. The backup files are stored in the directory `/opt/backups` on the current controller node.
- Copy the backup files to an external storage resource.
- Shut down the cluster, and proceed with any maintenance operations that might be required. Ensure that all hosts are powered down.
- Restore the cluster one host at a time. Start with the first controller, then the second controller, then compute nodes.

It is important to note that a restore operation must be executed on the same cluster hardware where the backups were created, otherwise, the operation fails. Hardware differences affect the restore operation in multiple ways. For example, differences in Ethernet MAC addresses impact the networking metadata stored in the system data backup files.

The backup and restore tools are designed to operate on an entire cluster. They are not suitable as a tool to back up and restore individual hosts.

Performing a System Data Backup

A system data backup captures core system information needed to restore a fully operational HP Helion OpenStack Carrier Grade cluster.

System data backups include:

- platform configuration details
- system databases
- patching and package repositories
- home directory for the **wrsroot** user and all LDAP user accounts. See *Linux User Accounts* on page 12 for additional information.

System data backups do not include:

- Modifications manually made to the file systems, such as configuration changes on the `/etc` directory. After a restore operation has been completed, these modification have to be reapplied.
- Home directories and passwords of local user accounts. They must be backed up manually by the system administrator.
- The `/root` directory. Use the **wrsroot** account instead when root access is needed.

1. Log in as user **wrsroot** to the active controller.

   You can log in directly on the console or remotely using **ssh**.
2. Execute the system backup.

   ```
   $ sudo config_controller --backup backup_20140918
   Performing backup (this will take several minutes):
   Step 13 of 13 [#############################################] [100%]
   System backup file created: /opt/backups/backup_20140918_system.tgz
   Images backup file created: /opt/backups/backup_20140918_images.tgz

   Backup complete
   ```

   In this example, the argument *backup_20140918* to the --backup option is an arbitrary identifier you want to use for the backup.

   Upon successful execution of the command, the following two files are available on the controller's file system:

   - `/opt/backups/backup_20140918_system.tgz`
   - `/opt/backups/backup_20140918_images.tgz`

   Together, these two files represent the entire system data.
3. Transfer the backup files to an external storage resource.

   You can use a command such as `scp` to transfer the backup files to a server reachable over the OAM network. You can also copy them to a locally attached storage device, such as an external USB drive.
4. Optional: Delete the backup files.

The system data backup is now complete. The backup files must be kept in a secured location, probably holding multiple copies of them for redundancy purposes.

Restore Procedure

You can restore a HP Helion OpenStack Carrier Grade cluster from available system data backup files to bring it back to the operational state it was when the backup procedure took place.

Restoring a HP Helion OpenStack Carrier Grade cluster from a set of backup files is done by restoring one host at a time, starting with the controllers, then the compute nodes.

Before you start the restore procedure you must ensure the following conditions are in place:

- All cluster hosts must be powered down, just as if they were going to be initialized anew.
- All backup files are accessible from a USB flash drive locally attached to the controller where the restore operation takes place (**controller-0**).
- You have the HP Helion OpenStack Carrier Grade installation image available on a USB flash drive, just as when the software was installed the first time. It is mandatory that you use the exact same version of the software used during the original installation, otherwise the restore procedure will fail.
- The restore procedure requires all hosts but **controller-0** to boot over the internal management network using the PXE protocol, just as it was done during the initial software installation. Ideally, you cleaned up all hard drives in the cluster, and the old boot images are no longer present; the hosts then default to boot from the network when powered on. If this is not the case, you must configure each host manually for network booting right after this exercise asks you to power them on.

1. Install the HP Helion OpenStack Carrier Grade software on **controller-0** from the USB flash drive.

   Refer to the *HP Helion OpenStack Carrier Grade Software Installation Guide* for details.

   When the software installation is complete, you should be able to log in using the host's console and the web administration interface.
2. Log in to the console as user **wrsroot** with password **wrsroot**.
3. Ensure the backup files are available to the controller.

   Plug the USB flash drive containing the backup files into the system. The USB flash drive is mounted automatically. Use the command `df` to list the mount points.

   The following steps assume that the backup files are available from a USB flash drive mounted in `/media/wrsroot` in the directory `backups`.
4. Update the controller's software to the previous patching level.

   When restoring the system configuration, the current software version on the controller, at this time, the original software version from the ISO image, is compared against the version available in the backup files. They differ if the latter includes patches applied to the controller's software at the time the backup files were created. If different, the restore process automatically applies the patches and forces an additional reboot of the controller to make them effective.

   The following is the command output if patching is necessary:

   ```
   $ sudo config_controller --restore-system \
   /media/wrsroot/backups/backup_20140918_system.tgz
   Restoring system (this will take several minutes):
   Step  4 of 19 [#########                                    ] [21%]
   This controller has been patched. A reboot is required.
   After the reboot is complete, re-execute the restore command.
   Enter 'reboot' to reboot controller:
   ```

   You must enter **reboot** at the prompt as requested. Once the controller is back, log in as user **wrsroot** as before to continue.

   After the reboot, you can verify that the patches were applied, as illustrated in the following example:

   ```
   $ sudo wrs-patch query
           Patch ID          Repo State  Patch State
   ========================  ==========  ===========
   COMPUTECONFIG             Available       n/a
   LIBCUNIT_CONTROLLER_ONLY   Applied        n/a
   ```
5. Restore the system configuration.

The controller's software is up to date now, at the same stage it was when the backup operation was executed. The restore procedure can be invoked again, and should run without interruptions.

```
$ sudo config_controller --restore-system \
/media/wrsroot/backups/backup_20140918_system.tgz
Restoring system (this will take several minutes):
Step 19 of 19 [#########################] [100%]
Restoring node states (this will take several minutes):

Locking nodes:Step 10 of 10
 [#############################################] [100%]
Powering-off nodes:
Step 10 of 10 [###############################################] [100%]

System restore complete
```

6. Authenticate to the system as Keystone user **admin**.

   Source the **admin** user environment as follows:

   ```
   $ cd; source /etc/nova/openrc
   ```

7. Restore the system images.

   ```
   ~(keystone_admin)$ sudo config_controller --restore-images \
   /media/wrsroot/backups/backup_20140918_images.tgz
   Step 2 of 2 [#############################################] [100%]

   Images restore complete
   ```

   This step assumes that the backup file resides on the attached USB drive. If instead you copied the image backup file to the `/opt/backups` directory, for example using the `scp` command, you can remove it now.

8. Restore **controller-1**.

   a) List the current state of the hosts.

   ```
   ~(keystone_admin)$ system host-list
   +----+--------------+-------------+----------------+-------------
   +--------------+
   | id | hostname     | personality | administrative | operational |
    availability |
   +----+--------------+-------------+----------------+-------------
   +--------------+
   | 1  | controller-0 | controller  | unlocked       | enabled     |
    available    |
   | 2  | controller-1 | controller  | locked         | disabled    |
    offline      |
   | 3  | compute-0    | compute     | locked         | disabled    |
    offline      |
   +----+--------------+-------------+----------------+-------------
   +--------------+
   ```

   b) Power on the host.

   Remember to ensure that the host boots from the network and not from an old disk image that might still be present on its hard drive.

   c) Unlock the host.

   ```
   ~(keystone_admin)$ system host-unlock 2
   +-----------------+--------------------------------------+
   | Property        | Value                                |
   +-----------------+--------------------------------------+
   ```

```
| action           | none                                 |
| administrative   | locked                               |
| availability     | online                               |
| ...              | ...                                  |
| uuid             | 5fc4904a-d7f0-42f0-991d-0c00b4b74ed0 |
+------------------+--------------------------------------+
```

d) Verify the new state of the hosts.

```
~(keystone_admin)$ system host-list
+----+--------------+-------------+----------------+-------------
+--------------+
| id | hostname     | personality | administrative | operational |
 availability |
+----+--------------+-------------+----------------+-------------
+--------------+
| 1  | controller-0 | controller  | unlocked       | enabled     |
 available    |
| 2  | controller-1 | controller  | unlocked       | enabled     |
 available    |
| 3  | compute-0    | compute     | locked         | disabled    |
 offline      |
+----+--------------+-------------+----------------+-------------
+--------------+
```

The unlocking operation forces a reboot of the host, which is then initialized with the corresponding image available from the system backup.

You must wait for the host to become enabled and available before proceeding to the next step.

9. Restore the compute nodes, one at a time.

You restore these hosts following the same procedure used to restore **controller-1**.

The state of the hosts when the restore operation is complete is as follows:

```
~(keystone_admin)$ system host-list
+----+--------------+-------------+----------------+-------------
+--------------+
| id | hostname     | personality | administrative | operational |
 availability |
+----+--------------+-------------+----------------+-------------
+--------------+
| 1  | controller-0 | controller  | unlocked       | enabled     |
 available    |
| 2  | controller-1 | controller  | unlocked       | enabled     |
 available    |
| 3  | compute-0    | compute     | unlocked       | enabledd    |
 available    |
+----+--------------+-------------+----------------+-------------
+--------------+
```

As each compute node is restored, the original instances at the time the backups were done are started automatically.

The system is fully restored. The state of the system, including virtual machines, is identical to the state the cluster was in when the backup procedure took place.

Remember however, that passwords for local user accounts must be restored manually since they are not included as part of the backup and restore procedures. See *Linux User Accounts* on page 12 for additional information.

Chapter 9

Managing Stacks

Topics:

You can create and manage collections of resources, or *services* (also known as *stacks*), using Heat, the OpenStack orchestration service. HP Helion OpenStack Carrier Grade extensions are included for enhanced scope and reliability.

With Heat, you can define a service configuration in a *template* file, and then apply the template to create or modify the service resources and connections. The Heat orchestration layer includes life-cycle management features to simplify the addition, modification, and deletion of services.

Services (Stacks)

A collection of resources created and managed using the Heat orchestration service is called a *service* (also known as a *stack*).

Service resources can be flavors, images, instances, tenant networks, volumes, security groups, users, floating IP addresses, or any other entities defined and configured in Heat templates. Most types of resources offered by OpenStack can be defined in Heat templates and included in services.

Using the CLI, you can obtain information on existing stacks in several ways:

- `heat stack-list` shows the names of stacks
- `heat stack-show`*name* shows details about the named stack
- `heat stack-create` *name* creates the named stack with given parameters
- `heat stack-modify` *name* modifies the named stack according to given parameters
- `heat stack-delete` *name* deletes the named stack

Services can include *static* and *autoscaling* resources.

Static resource

A resource that is defined when the cloud is launched, and does not change unless a `heat stack-modify` command is issued.

Autoscaling resource

A resource that can be created, modified, or removed in response to performance metrics collected by Ceilometer. These can include metrics generated by the HP Helion OpenStack Carrier Grade or OpenStack platform, and metrics generated by VM instances using CloudWatch.

Templates

A template is a formal set of instructions for defining and configuring a service.

Templates specify the resources to include in a service, and relationships between them.

A template contains several sections, including:

Description

You can use this section to provide comments about the service, such as its purpose or any special considerations when using it.

Parameters

This section defines the parameters that you can pass to the service template. You can pass parameters using the command line, a web form, or an environment file.

You can include a default value for a parameter, and optionally pass a different value when the template is deployed. If no default value is included, you must provide a value when the template is deployed. Parameters without default values are called *mandatory parameters*.

Resources

This section defines the resources to be created. They can be specified in any order.

There are two official formats for templates: CloudFormation (CFN) and Heat Orchestration Template (HOT).

CFN

This format is associated with Amazon Web Services (AWS) technology. A CFN template is indicated by the first line:

```
HeatTemplateFormatVersion: '2012-12-12'
```

HOT

This format is associated specifically with the OpenStack project. A HOT template is indicated by the first line:

```
heat_template_version: 2013-05-23
```

In HOT, some of the built-in functions are different, and lowercase is used for attribute names.

Both formats support Amazon Web Services (AWS) resources and OpenStack resources, in any combination.

The HP Helion OpenStack Carrier Grade includes sample service templates for demonstration purposes (see *Sample Templates for HP Helion OpenStack Carrier Grade* on page 184). Both CFN and HOT formats are represented in the samples. The templates are expressed using YAML, which is the recommended notation for HOT. Heat templates may also be expressed using JSON, which is the usual notation for CFN.

For more information on the content and syntax of Heat templates, see the online *OpenStack Template Guide*.

Parameters

You can specify parameters for a service, such as authentication, networking, and so on, when you invoke a template.

You can supply parameter values by:

- including them in the template as defaults
- specifying each one using a form in the web administration interface, or using the -parameters option on the `heat create-stack` command line
- saving them in an environment file, which you can specify using the -e option on the `heat create-stack` command line

This enables you to customize the behavior of a common service template when the service is created or modified.

You can use environment files or command-line entries to supplement parameters in the template, or to override them if they already exist. Environment-file values override existing values in the template. Command-line values override existing values in the environment file or the template.

The syntax for specifying parameters is as follows:

- on the command line, using the -P option. Multiple -P arguments are supported.

```
~(keystone_admin)$ heat stack-create -P key1=val1 -P key2=val2
```

- in an environment file:

```
parameters:
    key:value
    key:value
```

HP Helion OpenStack Carrier Grade Extensions to Heat

Several extensions to Heat are included with HP Helion OpenStack Carrier Grade.

The HP Helion OpenStack Carrier Grade Extensions are compatible with both HOT format and CFN format.

Multiple NIC Support

When launching a VM instance initially or in an autoscaling stack, you can specify multiple network interfaces. The open-source version of Heat allows only a single network interface to be specified at launch.

The syntax for the extension is as follows:

```
...
LaunchConfig:
    Type: AWS::AutoScaling::LaunchConfiguration
    Properties
        ...
        NetworkInterfaces: [
            {DeviceIndex: "0", vif-model: "virtio", NetworkId: { Ref:
 PublicNetId } },
            {DeviceIndex: "1", vif-model: "avp", NetworkId: { Ref:
 InternalNetId } }
```

As the example shows, this extension also adds the ability to specify a different vif-model for each interface. In addition, a new avp option is introduced, supporting the use of optimized AVP device drivers.

The valid vif-model values are as follows:

avp	Accelerated Virtual Port
e1000	Intel e1000 Emulation
ne2k_pci	NE2000 Emulation
pcnet	AMD PCnet/PCI Emulation
rtl8139	Realtek 8139 Emulation
virtio	VirtIO Network
pci-passthrough	PCI Passthrough Device

Simplified Network Interface Configuration

You can specify a network interface for a server or instance resource directly, without the need to define and then reference an **AWS::EC2::NetworkInterface** resource. In addition, you can specify the network using NetworkName, NetworkId, SubNetName, or SubNetId.

```
  PDN_Gateway-1:
    Type: AWS::EC2::Instance
    Properties:
      ImageId: 'cirros'
      InstanceType: 'm1.tiny'
      NetworkInterfaces: [
          { DeviceIndex: "0", NetworkName: 'public-net0' }

  PDN_Gateway-2:
    Type: AWS::EC2::Instance
    Properties:
      ImageId: 'cirros'
      InstanceType: 'm1.tiny'
      NetworkInterfaces: [
          { DeviceIndex: "0", NetworkId: '1d9a8765-a7e7-46b6-
abd0-0e2f7985778a' }
```

```
   PDN_Gateway-3:
     Type: AWS::EC2::Instance
     Properties:
       ImageId: 'cirros'
       InstanceType: 'm1.tiny'
       NetworkInterfaces: [
           { DeviceIndex: "0", SubNetName: 'public-subnet0' }

   PDN_Gateway-4:
     Type: AWS::EC2::Instance
     Properties:
       ImageId: 'cirros'
       InstanceType: 'm1.tiny'
       NetworkInterfaces: [
           { DeviceIndex: "0", SubNetId:
  'dfa64673-6a75-4f8a-9c74-1a7578113c31' }
```

Simplified VM Instance Naming

The HP Helion OpenStack Carrier Grade introduces minor changes to the OpenStack VM naming convention to make Heat-generated names more user-friendly.

- For a static resource, launched VM instances are named using the name attribute of the OS::Nova::Server structure (without including the `<StackTemplateName>`).

```
Serving_Gateway:
    Type: OS::Nova::Server
    Properties:
      name  : ‘Serving_Gateway’
      image : 'cirros'
      flavor: 'm1.tiny'


~(keystone_admin)$ heat stack-create –f <file> EPC
~(keystone_admin)$ nova list
+--------------------------------------+-----------------+--------+-…
| ID                                   | Name            | Status | …
+--------------------------------------+-----------------+--------+-…
| 581b3495-3cf1-4410-9587-5cf04fccfed2 | Serving_Gateway | ACTIVE | …
+--------------------------------------+-----------------+--------+-…
```

- For an autoscaling resource, launched VM instances are named using the pattern `<StackTemplateName>-<AutoScalingGroupName>-<LaunchConfigName>-<ScalingInstanceNum>`.

```


  Scalable_GW:
    Type: AWS::AutoScaling::AutoScalingGroup
    Properties:
      AvailabilityZones: {'Fn::GetAZs': ''}
      Name: 'Scaling_GW'
      LaunchConfigurationName: {Ref: LaunchConfig}
      MinSize: {Ref: VRC-MinClusterSize}
      MaxSize: {Ref: VRC-MaxClusterSize}
  ServerScaleOutPolicy:
     …
  ServerScaleInPolicy:
     …
  ComputeAlarmHigh:
     …
  ComputeAlarmLow:
     …
  LaunchConfig:
    Type: AWS::AutoScaling::LaunchConfiguration
    Name: 'DP_Engine'
    Properties:
      ImageId: 'cirros'
      InstanceType: 'm1.tiny'
      …

~(keystone_admin)$ heat stack-create –f <file> EPC
~(keystone_admin)$ nova list
+--------------------------------------+----------------------------
+--------+-…
| ID                                   | Name                       |
 Status | …
+--------------------------------------+----------------------------
+--------+-…
| 581b3495-3cf1-4410-9587-5cf04fccfed2 | EPC-Scaling_GW-DP_Engine-0 |
 ACTIVE | …
| 67df4321-ac22-498a-bff2-b376f2aa6d2b | EPC-Scaling_GW-DP_Engine-1 |
 ACTIVE | …
+--------------------------------------+----------------------------
+--------+-…
```

Support for Server Groups

You can create Server Groups and add VM Instances to them.

The syntax for adding a Server Group Resource is as follows:

```
...
resources:
    ...
    my_server_group:
        type: OS::Nova::ServerGroup
        properties:
            policy: 'anti-affinity'
            group_size: 4
            best_effort: False...
```

For a static resource, the syntax for specifying a **Server Group** in a OS::Nova::Server definition is as follows:

```
cirros_server1:
    type: OS::Nova::Server
    properties:
        name: cirros1
        image: 'cirros'
        flavor: 'm1.tiny'
        scheduler_hints:
            group: {get_resource: my_server_group }
```

For a static resource, the syntax for specifying a **Server Group** in an AWS::EC2::LaunchConfiguration definition is as follows:

```
Cirros_Server1:
    Type: AWS::AutoScaling::AutoScalingGroup
    Properties:
        AvailabilityZones: {'Fn::GetAZs': ''}
        LaunchConfigurationName: {Ref: LaunchConfig}
        MinSize: {Ref: VRC-MinClusterSize}
        MaxSize: {Ref: VRC-MaxClusterSize}
```

```
   ServerScaleOutPolicy:
      …
   ServerScaleInPolicy:
      …
   ComputeAlarmHigh:
      …
   ComputeAlarmLow:
      …
   LaunchConfig:
     Type: AWS::AutoScaling::LaunchConfiguration
     Properties:
         ImageId: 'cirros'
         InstanceType: 'm1.tiny'
         NovaSchedulerHints: [{Key: 'group', Value: {Ref: my_server_group }}]
         …
```

Note:

This example uses AWS autoscaling resources and CFN format, but autoscaling is not limited to CFN templates. You can use AWS resources and OS (OpenStack) resources in any combination in either CFN or HOT templates.

Improved Metrics Communication

HP Helion OpenStack Carrier Grade addresses reliability issues with the OpenStack Havana implementation of **cfn-push-stats**, ensuring that guest instances can successfully pass Ceilometer metrics to the Controller.

Relaxed Requirements for Passing User Data

The property UserDataType is a HP Helion OpenStack template extension that you can use to pass user data to an instance even if the instance does not have **cloud-init** installed. For more information, see *Customizing Guest Images with User Data* on page 180.

Improved User Access to Stacks

Stacks can be created, modified, or deleted by admin or non-admin users.

Greater Control over Resource Allocations

When creating a network resource using OS::Neutron::Net, you can use a **depends_on** attribute to ensure that the requirements of other resources are given priority before the resource is created. The attribute takes another resource as an argument. In the following example, it is used to specify that the resource **external_network** must be created before **internal_network** is created.

```
internal_network:
      type: OS::Neutron::Net
      properties:
        name: { get_param: INTERNALNET }
        depends_on: { get_resource: external_network }
        shared: false
        tenant_id: {get_param: TENANT_ID}
```

Additional Heat Resources

In addition to the standard OpenStack resources available for Heat templates, you can use the following resources:

OS::SysInv::HostInterface

Defines a host L2 interface (ethernet or LAG), including the physical ports, network type (oam, mgmt, data, or infra), and connectivity to provider networks.

OS::Glance::Image

Defines a virtual machine image registered with the Glance image service.

OS::Nova::Flavor

Defines a set of resources (memory, vCPUs, and so on) for use when defining virtual machines.

OS::Nova::ServerGroup

Defines a set of instances that share the same attributes (such as compute-node-affinity). For additional information, see *Support for Server Groups* on page 176.

OS::Neutron::ProviderNet

Defines a provider network.

OS::Neutron::ProviderNetRange

Defines a segmentation range for a provider network.

OS::Neutron::QoSPolicy

Defines a packet scheduling weight that can be referenced by a tenant network (OS::Neutron::Net).

Creating a Service

You can create a service (or *launch* a *stack*) using the web administration interface, or you can use the command-line interface.

These instructions assume you are using the web administration interface. For CLI assistance, use the following command.

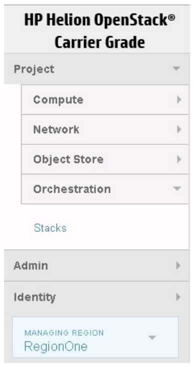
```
~(keystone_admin)$ heat help stack-create
```

Ensure that you have a template for the stack.

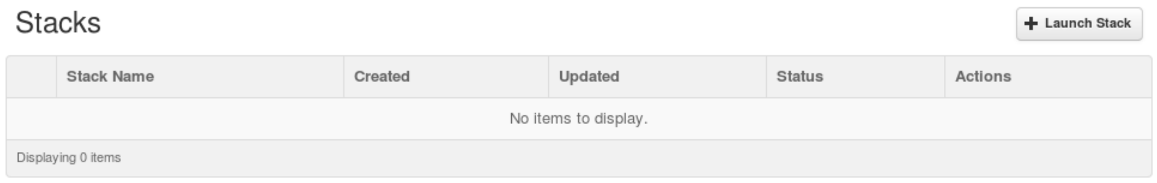
Depending on the template, you may need to collect some parameters in advance. For details, see the documentation for the specific template, or refer to the Parameters section of the template.

1. Open the list of existing services.

   On the **Project** tab of the web administration interface, in the **Orchestration** section, select **Stacks**.

   The Stacks list appears.

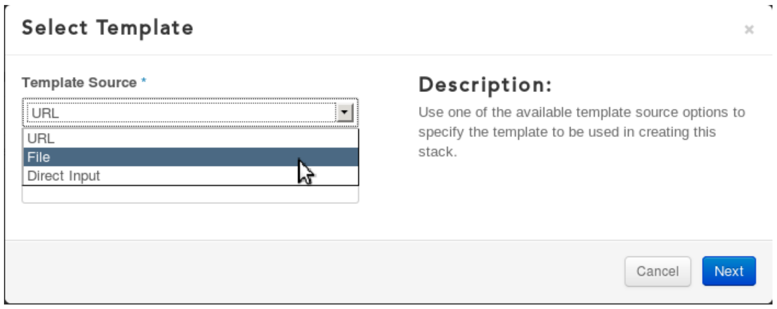


	Stack Name	Created	Updated	Status	Actions
No items to display.					

Displaying 0 items

2. Launch a new stack and specify a template.

   Click **Launch Stack**, and then complete the **Select Template** dialog box.



Description:

Use one of the available template source options to specify the template to be used in creating this stack.

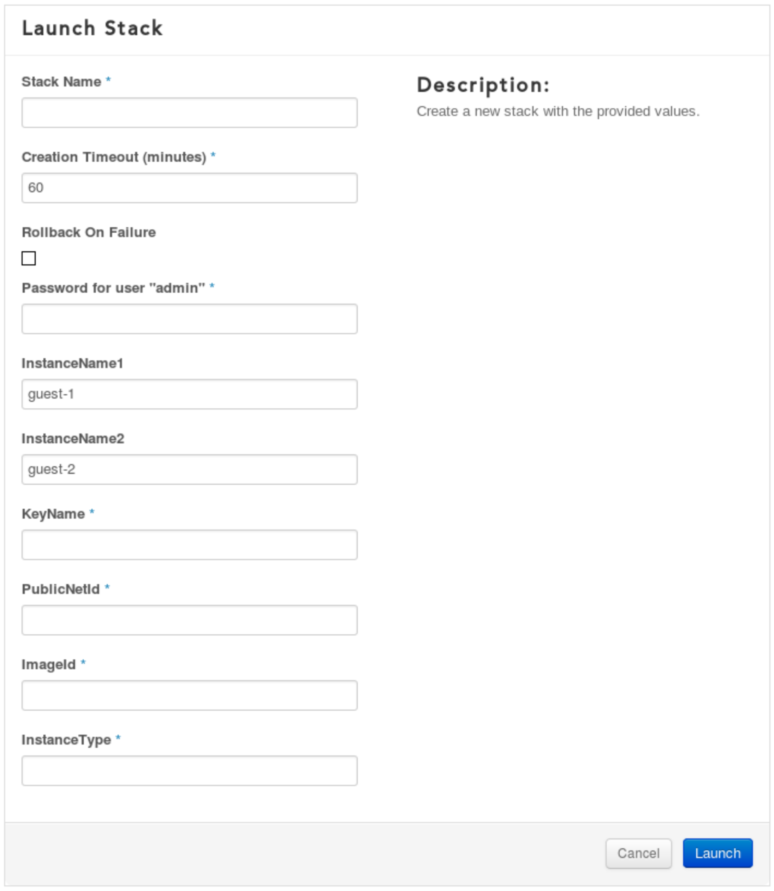
The **Template Source** drop-down list offers several ways to specify a template.

Option	Description
URL	Provides a text field for URL access to a template file.
File	Provides a **Browse** button for access to locally stored template files.
Direct Input	Provides a text window for direct entry of template content.

3. Complete the **Launch Stack** form to provide any parameter values required by the template.

   Note:

   The form is created dynamically based on the Parameters section of the template, and varies depending on the template. The form shown here is an example only.


Launch Stack

Stack Name *

Creation Timeout (minutes) *
60

Rollback On Failure
☐

Password for user "admin" *

InstanceName1
guest-1

InstanceName2
guest-2

KeyName *

PublicNetId *

ImageId *

InstanceType *

Description:
Create a new stack with the provided values.

Customizing Guest Images with User Data

You can provide bootstrap configuration for an instance at launch by including user data in the template.

You can include user data by defining a **UserData** property for an instance. This sends configuration instructions to the instance at launch. For an example of user data, see the `CPUScale.yaml` template included with the HP Helion OpenStack Carrier Grade.

Normally, this requires **cloud-init** to be installed in the guest, because the user data is converted to MIME format and then interpreted by **cloud-init**. For instances that do not include **cloud-init**, you can bypass the MIME conversion of user data by invoking a HP Helion OpenStack Carrier Grade extension property and assigning the value **'RAW'**. This allows the VM to retrieve the specified user data in unaltered format through a simple REST API call to the metadata server. The name of the property follows the convention for the associated resource type. For an AWS resource (for example, **AWS::EC2::Instance**), use UserDataType. For an OpenStack resource (for example, **OS::Nova::Server**), use user_data_type. The following code fragment shows the property used with an AWS resource.

```
type : AWS::EC2::Instance
. . .
UserDataType: 'RAW'
UserData:
        Fn::Base64:
          Fn::Replace:
          - 'AWS::StackName': {Ref: 'AWS::StackName'}
            'AWS::Region': {Ref: 'AWS::Region'}
            'AWS::AccessKey': {Ref: 'WebServerKeys'}
            'AWS::SecretKey': {"Fn::GetAtt": [WebServerKeys,
 SecretAccessKey]}
          - |
. . .
```

Note:

For a VM to access user data, it must have a DHCP-enabled interface on a tenant network that has a Neutron router. Typically, this is the interface to the VM's OAM network or an internal network. The Neutron router provides a route to the metadata server, which provides instances with access to user data.

Resource Scaling (Autoscaling)

You can use Heat to reassign stack resources automatically to meet changing conditions.

You can define and monitor performance thresholds for metrics such as memory usage or CPU activity, and then add or remove resources when the thresholds are crossed. This allows you to make efficient use of the hardware in the cluster, by allocating resources only when they are needed, and assigning them where they are most required.

HP Helion OpenStack Carrier Grade supports two types of scaling:

In/Out

This type of scaling (also known as *horizontal scaling*) adds or removes instances as needed.

Up/Down

This type of scaling (also known as *vertical scaling*) increases or decreases resources (for example, vCPUs) for individual instances as needed. For more about up/down scaling, see *Scaling Virtual Machine Resources* on page 129.

Performance metrics can be collected and reported by the HP Helion OpenStack Carrier Grade platform, or by the guests using guest metrics. For more information about guest metrics, see *Reporting a Guest Metric* on page 181.

Reporting a Guest Metric

You can collect and report performance metrics from individual guest instances.

To enable the guest to push information to Ceilometer, **heat-cfntools** must be installed on the guest.

To send data to Ceilometer on the controller, the guest must have the correct controller IP address specified in the file `/etc/heat/heat.conf`.

Caution:

If the controller IP address changes after an instance is launched (because the HP Helion OpenStack Carrier Grade's external OAM network address has been manually reconfigured), the instance will be unable to send metrics. To update the controller IP address, restart the instance.

Ceilometer can accept data from meters that run directly on guest instances, integrating it with data from meters that run on the server and periodically query the instances. The data is pushed to the controller using CloudWatch and **heat-cfntools**.

Guest-based metrics can offload platform processors and improve real-time monitoring for services such as thresholding, alarms, CSV file generation, and heat triggers. This example draws on the sample file `CPUScale.yaml` to develop a guest-based metric that scales a service based on CPU usage.

To launch an example of guest-based performance monitoring from the web administration interface, see *Creating an In/Out Autoscaling Resource* on page 190. For more information about Ceilometer, see *Resource Usage* on page 76.

1. In the Parameters section, define any parameters to be used in the template.

The use of parameters is optional. You can use them as required to improve readability and modularity. This example shows the parameters used in the remaining steps.

```
Parameters
...
    CustomMeterName:
        Description: Ceilometer meter to store
        Type: String
        Default: 'guest_cpu_avg'
    CustomMeterUnit:
        Description: Ceilometer meter unit
        Type: String
        Default: '%'
    MetricHighWaterMark:
        Description: Metric value that will trigger a scale out if
 exceeded
        Type: String
        Default: '60'
    MetricLowWaterMark:
        Description: Metric value that will trigger a scale in if below
        Type: String
        Default: '5'
```

2. Initialize the service with a script that takes a measurement and returns a result.

   In this example, drawn from the sample file `CPUScale.yaml`, the file /etc/cfn/get_cpu_load is created to retrieve the current CPU load average and perform an averaging calculation.

```
AWS::CloudFormation::Init :
    config:
        files:
. . .
            /etc/cfn/get_cpu_load:
              content:
                Fn::Base64:
                  Fn::Replace:
                  - 'AWS::StackName': {Ref: 'AWS::StackName'}
                  - |
                    #!/usr/bin/python
                    # Get the 1 minute CPU load average and divide by num
 cores
                    import os
                    num_cores = 1
                    ncpus = os.sysconf("SC_NPROCESSORS_ONLN")
                    if isinstance(ncpus, int) and ncpus > 0:
                        num_cores = ncpus
                    loadavg = os.getloadavg()[0]
                    # convert to a percentage
                    percent = (100 * float(loadavg)) / float(num_cores)
                    print percent
              mode: '000700'
              owner: root
              group: root
```

3. Add a script that pushes the result to the Ceilometer service.

```
/etc/cfn/send_guest_metrics:
              content:
                Fn::Base64:
                  Fn::Replace:
                  - 'METRIC_NAME': {Ref: 'CustomMeterName'}
                    'METRIC_UNIT': {Ref: 'CustomMeterUnit'}
                  - |
                     #!/bin/sh
                     METRIC=`/etc/cfn/get_cpu_load`
                     /opt/aws/bin/cfn-push-stats --metric METRIC_NAME --
value ${METRIC} --units METRIC_UNIT
              mode: '000700'
              owner: root
              group: root
```

4. Add a cron job to push the result at regular intervals.

```
/etc/cron.d/cfn_cron:
              content:
                Fn::Base64:
                  Fn::Replace:
                  - 'AWS::StackName': {Ref: 'AWS::StackName'}
                  - |
                    * * * * * root /etc/cfn/send_guest_metrics
              mode: '000600'
              owner: root
              group: root
```

5. Define an alarm to take action if the pushed measurements meet specified criteria.

   In this example, two alarms (**OS::Ceilometer::Alarm**) are defined. One is triggered if the average measurement over a given evaluation period exceeds a threshold. The other is triggered if the average measurement falls below a threshold. In each case, an action is defined to execute a scaling policy, defined separately in the template.

```
CPUGuestAlarmHigh:
    Type: OS::Ceilometer::Alarm
    Properties:
      description: Scale-out if the 1 minute avg for the meter is above
 the threshold
      meter_name: {Ref: CustomMeterName}
      statistic: avg
      period: '60'
      evaluation_periods: '1'
      threshold: {Ref: MetricHighWaterMark}
      alarm_actions:
      - {"Fn::GetAtt": [ServerScaleOutPolicy, AlarmUrl]}
      #matching_metadata: {'metadata.user_metadata.groupname': {Ref:
 'WebServerGroup'}}
      comparison_operator: gt
CPUGuestAlarmLow:
    Type: OS::Ceilometer::Alarm
    Properties:
      description: Scale-in if the 1 minute avg for the meter is below the
 threshold
      meter_name: {Ref: CustomMeterName}
      statistic: avg
      period: '60'
      evaluation_periods: '1'
      threshold: {Ref: MetricLowWaterMark}
      repeat_actions: True
      alarm_actions:
      - {"Fn::GetAtt": [ServerScaleInPolicy, AlarmUrl]}
      #matching_metadata: {'metadata.user_metadata.groupname': {Ref:
 'WebServerGroup'}}
      comparison_operator: lt
```

6. Define the scaling policies.

```
ServerScaleOutPolicy:
    Type: AWS::AutoScaling::ScalingPolicy
```

```
     Properties:
       AdjustmentType: ChangeInCapacity
       AutoScalingGroupName: {Ref: WebServerGroup}
       Cooldown: '60'
       ScalingAdjustment: '1'
   ServerScaleInPolicy:
     Type: AWS::AutoScaling::ScalingPolicy
     Properties:
       AdjustmentType: ChangeInCapacity
       AutoScalingGroupName: {Ref: WebServerGroup}
       Cooldown: '60'
       ScalingAdjustment: '-1'
```

Sample Templates for HP Helion OpenStack Carrier Grade

You can evaluate selected features of Heat using sample templates included with HP Helion OpenStack Carrier Grade. The samples also demonstrate some HP Helion OpenStack Carrier Grade extensions.

HOT Templates—Simple

The templates in the `hot/simple` directory use the OpenStack HOT Template File Format. Each template in this directory provides a simple example for an OpenStack Resource type, indicated by the filename.

Template file	Description
`AWS_CloudFormation_Stack.yaml`	Specifies the URL of another Heat template that describes additional resources. This allows Heat templates to be nested.
`OS_Ceilometer_Alarm.yaml`	Creates a Ceilometer threshold alarm. This example illustrates how to specify the name of an alarm meter, and how to set parameters such as the threshold for triggering an alarm, the comparison operator to use, the evaluation period for the comparison, and so on.
`OS_Cinder_Volume.yaml`	Creates a Cinder volume of a particular size (in gigabytes).
`OS_Cinder_VolumeAttachment.yaml`	Creates an attachment, or mount point, for a Cinder volume within a VM instance.
`OS_Glance_Image.yaml`	Creates a Glance image, specifying the image file, container format, disk format, and so on.
`OS_Heat_AccessPolicy.yaml`	Specifies which types of resource to include in the results for `heat stack-show` *`stackname`* and `heat resource-show` *`stackname resourcename`*.
`OS_Heat_CWLiteAlarm.yaml`	Creates a threshold alarm using OS::Heat::CWLiteAlarm. This is an older and less capable alarm resource than OS::Ceilometer::Alarm. If possible, use OS::Ceilometer::Alarm instead.
`OS_Heat_InstanceGroup.yaml`	Creates a specified number of instances using a specified launch configuration. The number of instances is controlled by the size property. This

Template file	Description
	invokes AWS::AutoScaling::LaunchConfiguration, which effectively restricts the launched instances to AWS::EC2::Instance resources.
`OS_Neutron_FloatingIP.yaml`	Creates a floating IP address for an external tenant network, in order to represent an internal port IP address using NAT.
`OS_Neutron_Net.yaml`	Creates a tenant network, to which other resources such as OS::Neutron::Port, OS::Neutron::Subnet, and OS::Nova::Server can refer.
`OS_Neutron_Port.yaml`	Creates a port for a VM instance on a tenant network. The VM instance can use this to attach to the tenant network.
`OS_Neutron_ProviderNet.yaml`	Creates a provider network, specifying the name and type (flat or vlan).
`OS_Neutron_ProviderNetRange.yaml`	Creates a segmentation range for a provider network, specifying the provider network, and the minimum and maximum values of the range.
`OS_Neutron_QoSPolicy.yaml`	Creates a Neutron QoS policy, which specifies a packet scheduling weight. The policy can be referenced by a tenant network to modify the scheduling weight of AVS ingress traffic from VMs for the tenant network.
`OS_Neutron_Router.yaml`	Creates an IP router for tenant networks. The router's IP interfaces to tenant network subnets are established as shown in OS_Neutron_RouterInterface.yaml.
`OS_Neutron_RouterGateway.yaml`	Creates a router gateway interface for the specified router on the specified external network. The IP address for the interface is allocated from the external network’s subnet, and a default IP route is created using the gateway_ip of the subnet.
`OS_Neutron_RouterInterface.yaml`	Creates an IP interface on an existing router for an existing IP subnet.
`OS_Neutron_SecurityGroup.yaml`	Creates a Security Group that defines a stateless IP Filter. This Security Group can be referenced by a Server (VM) resource that requires a stateless IP Filter for ingress and egress traffic to or from the VM.
`OS_Neutron_Subnet.yaml`	Creates an IP subnet on a specified tenant network. The IP subnet and mask are required, and the DHCP support status (enabled or disabled) must be specified . DNS nameservers can optionally be specified.

Template file	**Description**
`OS_Nova_Flavor.yaml`	Creates a Nova flavor that describes the resource requirements for a VM, such as the required RAM, number of vCPUs, disk size, and so on.
`OS_Nova_KeyPair.yaml`	Creates a secure shell (SSH) key pair to enable secure login to a launched VM. The created key pair is referenced in OS::Nova::Server.
`OS_Nova_Server.yaml`	Creates a VM Instance, specifying flavor, image and network attachments.
`OS_Nova_ServerGroup.yaml`	Creates a *server group*, which is a set of VM instances (OS::Nova::Server) that can be assigned group attributes such as compute-node-affinity or anti-affinity. To assign a VM instance to a server group, use NovaSchedulerHints within the OS::Nova::Server resource; for example, `NovaSchedulerHints: [{Key: 'group', Value: {Ref: *server_group_name*}}]`.
`OS_SysInv_HostInterface.yaml`	Creates a Layer 2 interface on a compute node, specifying the compute node, the interface type (eth or lag), the port or ports, the network type (mgmt, oam, infra, or data), and for a data network, the provider networks.

HOT Templates—Scenarios

The templates in the `hot/scenarios` directory use the OpenStack HOT Template File Format. Each template in this directory provides an example scenario involving several Resource types.

Template file	**Description**
`BootFromCinder.yaml`	Creates a bootable Cinder volume, and uses it to launch a VM instance. The Cinder volume is used as the VM's virtual boot disk.
`DPDK_Flavors.yaml`	Creates four different flavors for DPDK-type guest applications.
`Launch2NamedVMs.yaml`	Creates a static service containing two virtual machines attached to the same network. This template illustrates the HP Helion OpenStack Carrier Grade extension for simplified VM instance naming, as described in *HP Helion OpenStack Carrier Grade Extensions to Heat* on page 173. The template is used as an example in *Creating a Static Resource* on page 188.
`LabSetup.yaml`	Similar to `Provisioning.yaml`, but also creates IP subnets on the tenant networks, routers on the tenant networks, and router gateways.

Template file	Description
`NetworkSetup.yaml`	Creates three tenant networks, five subnets, and two routers, each with an external gateway interface and an internal interface.
`Provisioning.yaml`	Provisions a variety of resources, including provider networks, segmentation ranges, tenant networks, key pairs, Glance images, and flavors, some of which are implemented as a nested stack (by referencing another Heat template).
`SimpleServer.yaml`	Creates a single VM instance. This template illustrates several HP Helion OpenStack Carrier Grade extensions, incuding support for multiple network attachments, the use of 'name' or subnet_name' to refer to the network, and the ability to specify the vif-model per network attachment (or NIC).
`DemoAutoScaling.yaml`	Creates a single Load Balancer VM, and an AutoScalingGroup of server VMs that scales based on link utilization. This demonstrates a typical in/out autoscaling use case. The template also illustrates the use of the RAW UserDataType to pass user data that does not require **cf_init** for parsing.
`VMAutoScaling.yaml`	Creates an up/down autoscaling service that responds to CPU load by adding or removing vCPUs for a VM instance.
`NestedStack.yaml`	Creates an OS::Cinder::Volume, and an OS::Nova::Server resource that uses the volume. This stack is used as a nested stack within the `NestedAutoScale.yaml` template.
`NestedAutoScale.yaml`	Creates an autoscaling stack, using a nested stack. The stack NestedStack.yaml, which contains a VM and its Cinder Volume, is scaled in and out.

CFN Templates

The templates in the `cfn` directory use the AWS Cloud Formation Template File Format.

Template file	Description
`AutoScaleWithNamePattern.yaml`	Creates an in/out autoscaling service with simplified names for VM instances, using a HP Helion OpenStack Carrier Grade extension. The service responds to CPU load as reported by a platform-generated metric.
`ComputeScale.yaml`	Creates an in/out autoscaling service that responds to CPU load as reported by the compute node hosting the VM.

Template file	**Description**
`CPUScale.yaml`	Creates an in/out autoscaling service that responds to CPU load as reported by the guest VM, using a custom metric generated within the guest. For more about this template, see *Creating an In/Out Autoscaling Resource* on page 190.
`MemScale.yaml`	Creates an in/out autoscaling service that responds to memory usage as reported by the guest VM, using a custom metric generated within the guest. To push the metric to the HP Helion OpenStack Carrier Grade platform, the guest must contain **cloud-init** and **heat-cfntools**.
`TenantScale.yaml`	Demonstrates the use of a parameter to supply user credentials. This template can be run by a tenant user. It creates an in/out autoscaling service that responds to CPU load as reported by the guest VM. To push the metric to the HP Helion OpenStack Carrier Grade platform, the guest must contain **cloud-init** and **heat-cfntools**.

Creating a Static Resource

The `Launch2NamedVMs.yaml` template illustrates the use of templates to create static resources.

This HOT template creates two VM instances named **guest-1** and **guest-2**. These names are specified as parameters in the template, illustrating the use of HP Helion OpenStack Carrier Grade extensions to simplify VM instance naming. They are used by the **OS::Nova::Server** resources, which define the construction of the VMs.

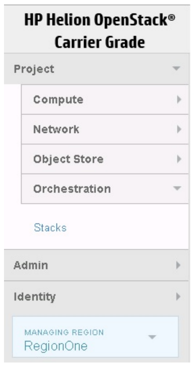
The template also defines networking ports for the VMs. Each VM has a single network port (**OS::Neutron::Port**). Both ports are attached to the same existing tenant network.

1. Collect the required parameter values for this template.

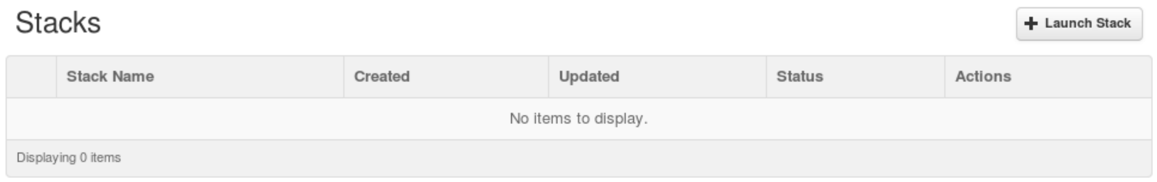
   For information about flavors, keypairs, images, or tenant networks, see the *HP Helion OpenStack Carrier Grade Reference Deployment Scenarios: User Tasks*.

   a) On the **Admin** > **System Panel** > **Flavors** page, locate a **Flavor Name** (a resource profile).
   b) On the **Project** > **Manage Compute** > **Access & Security** page, locate a **Keypair Name** to provide secure access to the stack.
   c) On the **Admin** > **System Panel** > **Images** page, locate an **Image Name** to specify the VM image used by the stack.
   d) On the **Admin** > **System Panel** > **Networks** page, click the appropriate network **Name** to open the Network Overview page, and then obtain the network **ID**.
   e) On the same page, locate and record an internal network to provide connectivity for the stack.
2. Open the list of existing services.

   On the **Project** tab of the web administration interface, in the **Orchestration** section, select **Stacks**.



The Stacks list appears.

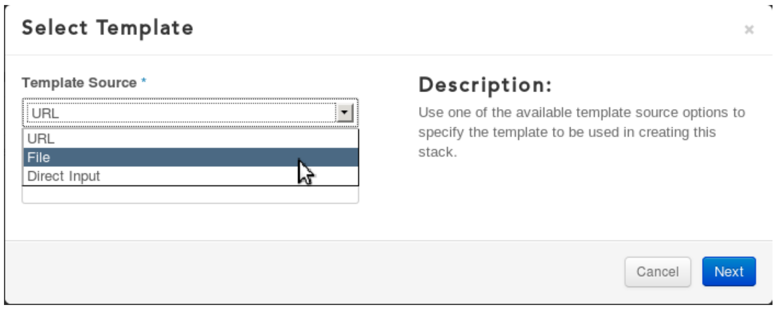


	Stack Name	Created	Updated	Status	Actions
No items to display.					

Displaying 0 items

3. Launch a new stack and specify a template.

Click **Launch Stack**, and then complete the **Select Template** dialog box.



Description:

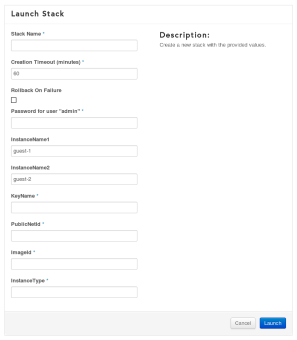
Use one of the available template source options to specify the template to be used in creating this stack.

The **Template Source** drop-down list offers several ways to specify a template.

Option	Description
URL	Provides a text field for URL access to a template file.
File	Provides a **Browse** button for access to locally stored template files.
Direct Input	Provides a text window for direct entry of template content.

4. Select the template, then click **Browse** and select `Launch2NamedVMs.yaml` from the local disk.

5. Use the **Launch Stack** form to provide the required parameter values for the template.



Launch Stack

Stack Name *

Creation Timeout (minutes) *
60

Rollback On Failure
☐

Password for user "admin" *

InstanceName1
guest-1

InstanceName2
guest-2

KeyName *

PublicNetId *

ImageId *

InstanceType *

Description:
Create a new stack with the provided values.

Creating an In/Out Autoscaling Resource

The `CPUScale.yaml` template illustrates the use of a template to create an in/out autoscaling resource. It also shows how to customize VM instance images at startup, and how to use custom performance monitoring on the guest.

This CFN template creates a server group based on a standard instance type, specified as a parameter. The template includes a **UserData** section that customizes each instance at launch by defining a CPU meter and setting it to push information to the controller at regular intervals. Instances are added or removed based on this information.

For in/out scaling, the CPU measurement uses a **cpu_util** meter, which takes into account the total number of available vCPUS for the instance when measuring usage.

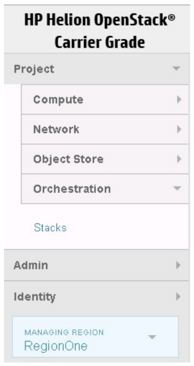
Use an **admin** account to run this template.

To use the autoscaling resource in this example, the following requirements must be satisfied:

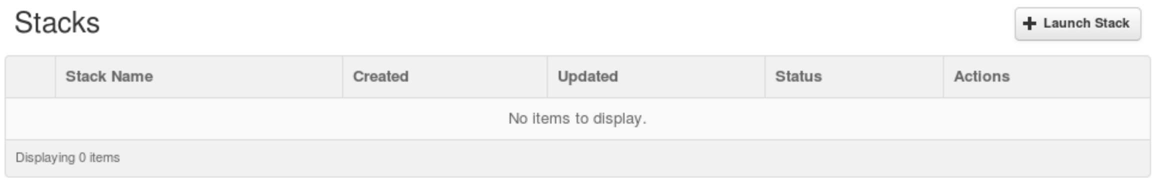
- **cloud-init** must be available on the guest image. This is required so that the guest can process the **UserData** configuration supplied at launch. The example image provided with HP Helion OpenStack Carrier Grade includes **cloud-init**.
- **heat-cfntools** must be available on the guest image. This is required so that the guest can push information to Ceilometer on the controller. The example image provided with HP Helion OpenStack Carrier Grade includes **heat-cfntools**.
- the guest can send data to the controller using the IP address specified in `/etc/heat/heat.conf`.

1. Collect the required parameter values for this template.
   a) On the **Admin** > **System Panel** > **Flavors** page, locate a **Flavor Name** (a resource profile).
   b) On the **Project** > **Manage Compute** > **Access & Security** page, locate a **Keypair Name** to provide secure access to the stack.
   c) On the **Admin** > **System Panel** > **Images** page, locate an **Image Name** to specify the VM image used by the stack.
   d) On the **Admin** > **System Panel** > **Networks** page, click the **Name** of each required network in turn, in order to open the Network Overview page and obtain the network **ID**. For this template, a public network ID and an internal network ID are required.
2. Open the list of existing services.

   On the **Project** tab of the web administration interface, in the **Orchestration** section, select **Stacks**.



The Stacks list appears.

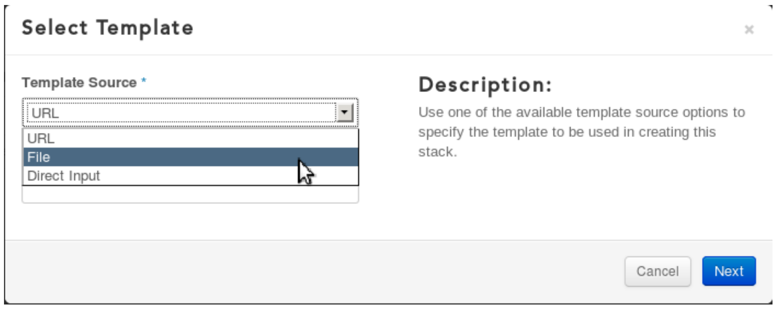


	Stack Name	Created	Updated	Status	Actions
No items to display.					

Displaying 0 items

3. Launch a new stack and specify a template.

   Click **Launch Stack**, and then complete the **Select Template** dialog box.



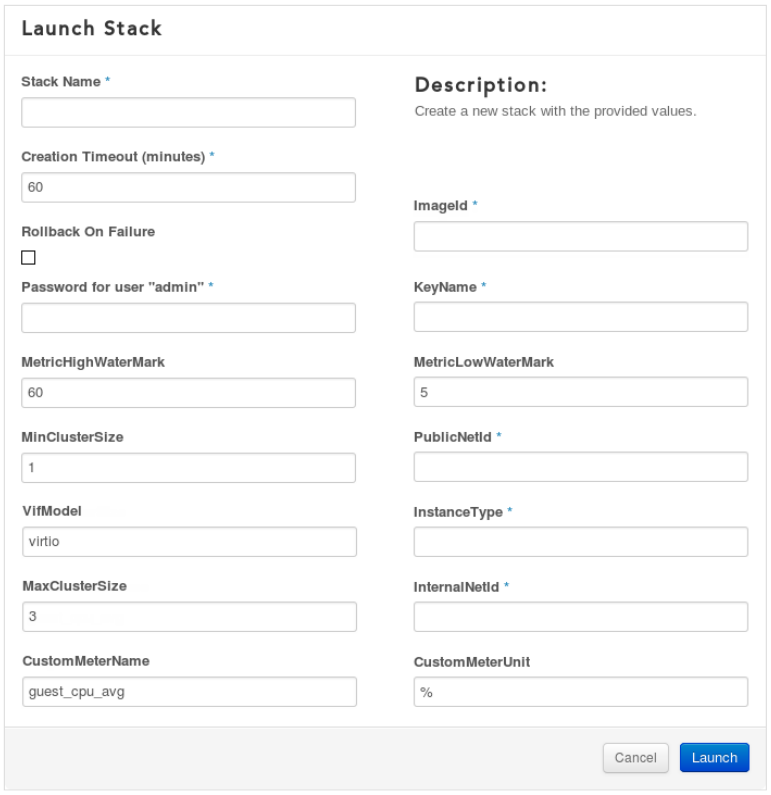
Description:

Use one of the available template source options to specify the template to be used in creating this stack.

The **Template Source** drop-down list offers several ways to specify a template.

Option	**Description**
URL	Provides a text field for URL access to a template file.
File	Provides a **Browse** button for access to locally stored template files.
Direct Input	Provides a text window for direct entry of template content.

4. Select **File**, then click **Browse** and select `CPUScale.yaml` from the local disk.
5. Use the **Launch Stack** form to provide the required parameter values for the template.


Launch Stack

Stack Name *	Description:
	Create a new stack with the provided values.
Creation Timeout (minutes) * 60	ImageId *
Rollback On Failure ☐	KeyName *
Password for user "admin" *	
MetricHighWaterMark 60	MetricLowWaterMark 5
MinClusterSize 1	PublicNetId *
VifModel virtio	InstanceType *
MaxClusterSize 3	InternalNetId *
CustomMeterName guest_cpu_avg	CustomMeterUnit %

Note:

The parameters are presented in a single column. This image has been edited to present them in two columns.

6. Optional: Adjust existing values to meet your requirements.

Option	Description
KeyName	The **KeyPair** name from the **Access & Security** page.
ViFModel	The virtual interface model to use. For valid choices, see *Multiple NIC Support* in *HP Helion OpenStack Carrier Grade Extensions to Heat* on page 173.
InstanceType	The **Flavor Name** from the **Flavors** page.
ImageId	The **Image Name** from the **Images** page.
PublicNetId	The **ID** from the **Network Overview** page.
InternalNetId	The **ID** from the **Network Overview** page.
MinClusterSize	The minimum number of VMs to launch. The stack cannot autoscale below this value.
MaxClusterSize	The maximum number of VMs that can be launched.
CustomMeterName	The name of a custom Ceilometer metric to store. For information about custom metrics, see *Reporting a Guest Metric* on page 181.

Option	Description
CustomMeterUnit	The unit of measurement to display for the custom metric; for example, 'Percent'.
MetricHighWaterMark	The value that triggers autoscaling to add resources.
MetricLowWaterMark	The value that triggers autoscaling to remove resources.

Creating an Up/Down Autoscaling Resource

The `VMAutoscaling.yaml` template illustrates the use of a template to create an up/down autoscaling resource.

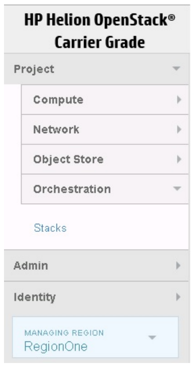
This HOT template creates a VM instance with vCPU autoscaling. The number of online vCPUS for the instance is scaled up or down depending on vCPU utilization. The scaling range (minimum and maximum number of vCPUs) is determined by the launch flavor.

For up/down scaling, the CPU measurement uses a **vcpu_util** meter, which takes into account the current number of online vCPUs when measuring usage. This is in contrast to the **cpu_util** meter, which always uses the maximum number of vCPUs. Using **cpu_util** for up/down scaling would produce an inaccurate usage/availability ratio if any vCPUs were offline, since it assumes all VCPUs are available.

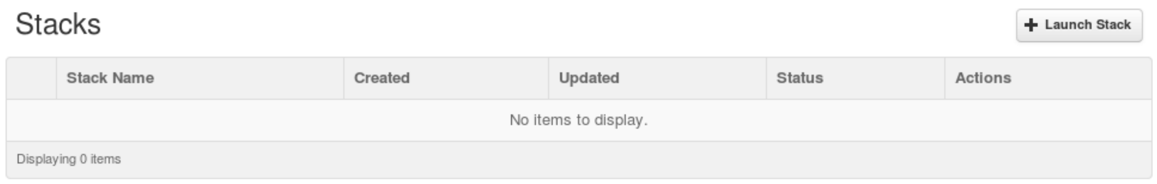
The VM image selected for launch must be capable of scaling. For more information about VM scaling, see *Scaling Virtual Machine Resources* on page 129.

1. Collect the required parameters.
   a) On the **Admin** > **System Panel** > **Flavors** page, locate a **Flavor Name** (a resource profile).
   b) On the **Project** > **Manage Compute** > **Access & Security** page, locate a **Keypair Name** to provide secure access to the stack.
   c) On the **Admin** > **System Panel** > **Images** page, locate an **Image Name** to specify the VM image used by the stack.
   d) On the **Admin** > **System Panel** > **Networks** page, obtain the **Name** of the private network.
   e) On the **Admin** > **Identity Panel** > **Users** page, locate the **User Name** for the tenant where the VM will be launched.
2. Open the list of existing services.

   On the **Project** tab of the web administration interface, in the **Orchestration** section, select **Stacks**.



   The Stacks list appears.



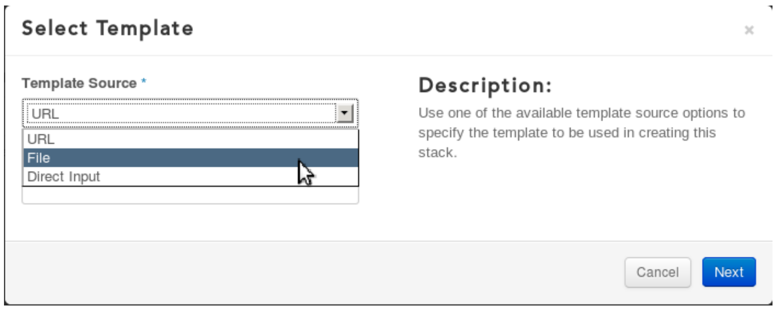
Stacks

	Stack Name	Created	Updated	Status	Actions
No items to display.					

Displaying 0 items

3. Launch a new stack and specify a template.

   Click **Launch Stack**, and then complete the **Select Template** dialog box.



Select Template

Template Source *

URL

Description:

Use one of the available template source options to specify the template to be used in creating this stack.

The **Template Source** drop-down list offers several ways to specify a template.

Option	Description
URL	Provides a text field for URL access to a template file.
File	Provides a **Browse** button for access to locally stored template files.
Direct Input	Provides a text window for direct entry of template content.

4. Select **File**, then click **Browse** and select `VMAutoScaling.yaml` from the local disk.
5. Adjust the parameters in the **Launch Stack** form to meet your requirements.

Option	Description
KeyName	The **KeyPair** name from the **Access & Security** page.
TenantUserID	The tenant user ID associated with the instance launch. Scaling of the instance resources can only be performed by the tenant associated with the launch.
FlavorName	The **Flavor Name** from the **Flavors** page.
ImageName	The **Image Name** from the **Images** page.
PrivateNetName	The **Name** from the **Network Overview** page.
InstanceName	The name of the instance to create.
CustomMeterName	The name of a custom Ceilometer metric to store. For information about custom metrics, see *Reporting a Guest Metric* on page 181.
CustomMeterUnit	The unit of measurement to display for the custom metric; for example, 'Percent'.
MetricHighWaterMark	The value that triggers autoscaling to add resources.
MetricLowWaterMark	The value that triggers autoscaling to remove resources.

Supported Heat Resource Types

The HP Helion OpenStack Carrier Grade implementation of Heat has been tested with most commonly-used resource types.

The following resource types have been tested for use with HP Helion OpenStack Carrier Grade.

- AWS::AutoScaling::AutoScalingGroup
- AWS::AutoScaling::LaunchConfiguration
- AWS::AutoScaling::ScalingPolicy
- AWS::CloudFormation::Stack
- AWS::EC2::Instance
- AWS::EC2::NetworkInterface
- AWS::IAM::AccessKey
- AWS::IAM::User
- OS::Ceilometer::Alarm
- OS::Cinder::Volume
- OS::Cinder::VolumeAttachment
- OS::Glance::Image
- OS::Heat::AccessPolicy
- OS::Heat::InstanceGroup
- OS::Neutron::FloatingIP
- OS::Neutron::FloatingIPAssociation
- OS::Neutron::Net
- OS::Neutron::Port
- OS::Neutron::ProviderNet
- OS::Neutron::ProviderNetRange
- OS::Neutron::QoSPolicy
- OS::Neutron::Router
- OS::Neutron::RouterGateway
- OS::Neutron::RouterInterface
- OS::Neutron::SecurityGroup
- OS::Neutron::Subnet
- OS::Nova::Flavor
- OS::Nova::KeyPair
- OS::Nova::Server
- OS::Nova::ServerGroup
- OS::SysInv::HostInterface

Further Reading

Additional resources are available for understanding and working with OpenStack Heat Orchestration and templates.

The following online resources are suggested.

- *Create and manage stacks* (from the *OpenStack End User Guide*)
- *Heat* (from the OpenStack wiki)
- *Heat commands* (from the *OpenStack End User Guide*)
- *Heat Orchestration Template (HOT) Guide*
- *An Introduction to OpenStack Heat* (slide show from Mirantis)
- *AWS::CloudFromation::Init* (from Amazon's *AWS Documentation*; discusses metadata options for an EC2 instance)