Planning

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1 Registering SUSE Linux

To get technical support and product updates, you need to register and activate your SUSE product with the SUSE Customer Center. It is recommended to register during the installation, since this will enable you to install the system with the latest updates and patches available. However, if you are offline or want to skip the registration step, you can register at any time later from the installed system.

> **Note**
>
> In case your organization does not provide a local registration server, registering SUSE Linux requires a SUSE account. In case you do not have a SUSE account yet, go to the SUSE Customer Center home page (https://scc.suse.com/) to create one.

1.1 Registering SUSE Linux during the Installation

To register your system, provide the E-mail address associated with the SUSE account you or your organization uses to manage subscriptions. In case you do not have a SUSE account yet, go to the SUSE Customer Center home page (https://scc.suse.com/) to create one.

Enter the Registration Code you received with your copy of SUSE Linux Enterprise Server. Proceed with Next to start the registration process.

By default the system is registered with the SUSE Customer Center. However, if your organization provides local regsitration servers you can either choose one form the list of auto-detected servers or provide the URL at "Register System via local SMT Server". Proceed with *Next*.

During the registration, the online update repositories will be added to your installation setup. When finished, you can choose whether to install the latest available package versions from the update repositories. This ensures that SUSE Linux Enterprise Server is installed with the latest security updates available. If you choose No, all packages will be installed from the installation media. Proceed with Next.

If the system was successfully registered during installation, YaST will disable repositories from local installation media such as CD/DVD or flash disks when the installation has been completed. This prevents problems if the installation source is no longer available and ensures that you always get the latest updates from the online repositories.

1.2 Registering SUSE Linux from the Installed System

1.2.1 Registering from the Installed System

If you have skipped the registration during the installation or want to re-register your system, you can register the system at any time using the YaST module *Product Registration* or the command line tool `SUSEConnect`.

Registering with YaST

To register the system start *YaST* › *Software* › *Product Registation*. Provide the E-mail address associated with the SUSE account you or your organization uses to manage subscriptions. In case you do not have a SUSE account yet, go to the SUSE Customer Center home page (https://scc.suse.com/) to create one.

Enter the Registration Code you received with your copy of SUSE Linux Enterprise Server. Proceed with Next to start the registration process.

By default the system is registered with the SUSE Customer Center. However, if your organization provides local regsitration servers you can either choose one form the list of auto-detected servers or provide the URl at *Register System via local SMT Server*. Proceed with *Next*.

Registering with SUSEConnect

To register from the command line, use the command

```
sudo SUSEConnect -r <REGISTRATION_CODE> -e <EMAIL_ADDRESS>
```

Replace <REGISTRATION_CODE> with the Registration Code you received with your copy of SUSE Linux Enterprise Server. Replace <EMAIL_ADDRESS> with the E-mail address associated with the SUSE account you or your organization uses to manage subscriptions. To register with a local registration server, also provide the URL to the server:

```
sudo SUSEConnect -r <REGISTRATION_CODE> -e <EMAIL_ADDRESS> --url "https://
suse_register.example.com/"
```

1.3 Registering SUSE Linux during Automated Deployment

If you deploy your instances automatically using AutoYaST, you can regsiter the system during the installation by providing the respective information in the AutoYaST control file. Refer to https://www.suse.com/documentation/sles-12/book_autoyast/data/createprofile_register.html for details.

2 Hardware and Software Support Matrix

This document lists the details about the supported hardware and software for HPE Helion OpenStack 5.0

Firmware Requirements

Before performing any installation or upgrade of a HPE Helion OpenStack release on HPE (ProLiant) servers, the Service Pack for ProLiant (SPP) should be applied to be compatible with latest releases in firmware. The Service Pack for ProLiant (SPP) can be downloaded from http://www.hpe.com/info/spp

2.1 OpenStack Version Information

HPE Helion OpenStack 5.0 services have been updated to the OpenStack Newton (http://www.openstack.org/software/mitaka) release.

2.2 Supported Hardware

For information about hardware supported in HPE Helion OpenStack 5.0, see HPE Helion Ready Solution Catalog (http://docs.hpcloud.com/#hrc/helionReady.html).

2.3 Supported Hardware Configurations

HPE Helion OpenStack 5.0 supports the following hardware configurations for a deployment.

Storage Interconnects/Protocols

- 10Gb Ethernet.
- Software iSCSI
- FibreChannel (FC)

Multipath

HPE Helion OpenStack 5.0 supports Fibre Channel and FCoE boot from SAN in multipath environments. The following list outlines the current limitations based on testing:

- Emulex based LPE1605 Native Fibre Channel - Up to 1024 paths during boot
- Qlogic based SN100Q Native Fibre Channel - Up to 1024 paths during boot
- Emulex Flex Fabric 650 series - Up to 1024 paths during boot
- Emulex Flex Fabric 554FLB - Up to 1024 paths during boot
- Qlogic Flex Fabric 536 and 630 series - Up to 1024 paths during boot

2.4 Cloud Scaling

In HPE Helion OpenStack 5.0 a total of 200 total compute nodes in a single region across any of the following hypervisors is supported:

- VMware ESX
- Linux for HPE Helion/KVM
- Red Hat Enterprise Linux/KVM

You can distribute the compute nodes in any number of deployments as long as the total is no more than 200. Example: 100 ESX + 100 RHEL/KVM or 75 ESX + 25 HPE Linux/KVM + 100 RHEL/KVM.

HPE Helion OpenStack 5.0 supports a total of 8000 virtual machines across a total of 200 compute nodes.

HPE Helion OpenStack 5.0 supports 100 baremetal Ironic nodes in a single region.

2.5 Supported Software

Supported ESXi versions

HPE Helion OpenStack 5.0 currently supports the following ESXi versions:

- ESXi version 5.5 (Update 3)
- ESXi version 6.0
- ESXi version 6.0 (Update 1b)

The following are the requirements for your vCenter server:

- Software
  - vCenter 5.5 Update 3 and above (It is recommended to run the same server version as the ESXi hosts)
- License Requirements
  - vSphere Enterprise Plus license

2.6 Notes about Performance

We have the following recommendations to ensure good performance of your cloud environment:

- On the control plane nodes, you will want good I/O performance. Your array controllers must have cache controllers and we advise against the use of RAID-5.
- On compute nodes, the I/O performance will influence the virtual machine start-up performance. We also recommend the use of cache controllers in your storage arrays.
- If you are using dedicated object storage (Swift) nodes, in particular the account, container, and object servers, we recommend that your storage arrays have cache controllers.
- For best performance, set the the servers power management setting in the iLO to OS Control Mode. This power mode setting is only available on servers that include the HP Power Regulator.

2.7 Disk Calculator

2.7.1 Disk Calculator for Compute-Centric Deployments

This topic provides guidance on how to estimate the amount of disk space required for a compute-centric HPE Helion OpenStack deployment. To accurately estimate the disk space needed, it is important to understand how Helion utilizes resources. Although there are a variety of factors, including the number of compute nodes, a large portion of the utilization is driven by operational tools, such as monitoring, metering, and logging.

> **Important**
>
> The disk calculator does not accurately estimate a Swift-centric deployment at this time. For more information on Swift, see *Section 3.6, "Recommended Hardware Minimums for an Entry-scale Swift Model"*.

The usage of disk space by operational tools can be estimated from the following parameters:

- **Number of compute nodes + Number of VM's running on each compute node**
- **Number of services being monitored or metered + Amount of logs created**
- **Retention periods for operational data** (for Elastic Search, Vertica/InfluxDB, and Kafka)

> **Important**
>
> If you also enable auditing, follow the steps in the *Section 2.7.3, " Audit Logging Adjustment "* section to enter additional input parameters.

Disk Estimation Process

HPE Helion OpenStack provides entry scale and scale-out models for deployment. This disk estimation tool, currently in a spreadsheet form, helps you decide which disk model to start from as well as what customizations you need to meet your deployment requirements. The disk estimation process also provides default settings and minimum values for the parameters that drive disk size.

> **Important**
>
> Kafka is the queuing system used to process metering monitoring and logging (MML) data. Kakfa stores the queued data on disk, so the disk space available will have a large impact on the amount of data the MML systems can process. Providing less than the minimum disk space for Kakfa will result in loss of MML data and can affect other components on the control plane. The default for Kafka is 1 hour which is 17 GB.

To estimate the disk sizes required for your deployment:

1. *Section 2.7.2, " Enter Input Parameters "*
2. If you also enable auditing, follow the steps in the *Section 2.7.3, " Audit Logging Adjustment "* section to enter additional input parameters.
3. *Section 2.7.4, "Select the Deployment Model"*
4. *Section 2.7.5, "Match to a Disk Model"*Match the selected deployment to a disk model example.

2.7.2 Enter Input Parameters

The Disk Calculator spreadsheet automatically displays the minimum requirements for the components that define disk size. You can replace the default values with either the number you have to work with or the number that you want to support.

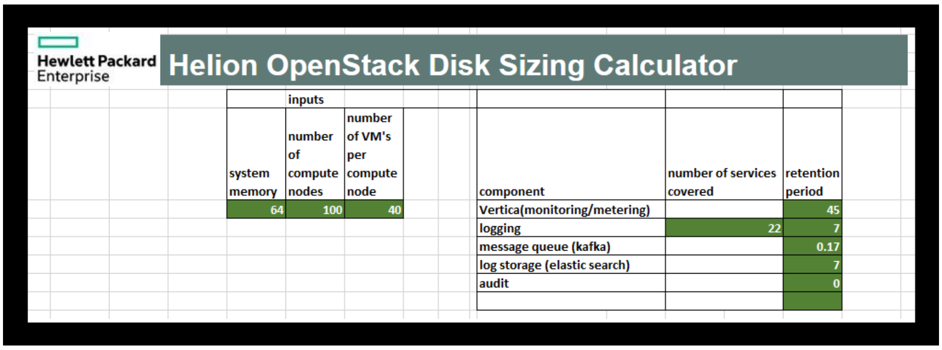
Important

If you want to enable audit logging, follow the steps in the *Section 2.7.3, " Audit Logging Adjustment "* section to enter additional input parameters.

Input Parameter	Default	Minimum
System Memory	64 GB	64 GB
Compute Nodes	100	100
VMs per Compute Node	40	40
Component: Vertica	45 days retention period	30 days
Component: Logging	22 services covered 7 days retention period	7 days retention period
Component: Kafka (message queue)	0.17 of an hour retention period	0.042 of an hour retention period
Component: Elastic Search (log storage)	7 days retention period	7 days retention period

Input Parameter	Default	Minimum
Component: Audit	0 days retention period	0 days retention period

The following diagram shows the input parameters in the spreadsheet.



To provide the parameters required to estimate disk size:

1. Open the disk calculator spreadsheet.
2. At the bottom of the spreadsheet, click on the **Draft Sizing Tool4** tab.
3. To set the server RAM size, replace the default value in the **System Memory** field.
4. To set the number of compute nodes, replace the default in the **Compute Nodes** field.
5. To set the average number of virtual machines per compute node, replace the default in the **VM's per Compute Node** field.
6. To set the number of days you want the metering and logging files retained, replace the default in the **Vertica Retention Period** field.
7. To set logging values, replace the default in **Number of Services Covered** and **Retention Period**.

> **Important**
>
> If you enable additional logging of services than those set by default, then you must increase the number in the **Logging Number of Services** Field.

8. To set a value for Kafka messages to be retained, replace the default in the **Kafka Retention Period** field.

9. To set a value for Elastic Search log file retention, replace the default in the **Elastic Search Retention Period** field.

10. To set a value for Audit logging file retention, replace the default in the **Audit Retention Period** field.

2.7.3 Audit Logging Adjustment

If you want to enable audit logging, you must enter additional input parameters to ensure there is enough room to retain the audit logs. The following diagram shows the parameters you need to specify in the Disk Calculator spreadsheet.

			API/Core Services	Networking	Swift - Images	MMLB	MySQL/RabbitMQ
	number of services on cluster		13	10	5	9	6
	number Audit Enabled services on cluster		9	1	1	2	
Filesystem	used by	subcomponents					
/			60				
/var/crash			64				
/var/log	logging		175	134	67	121	81
/var/lib/mysql	monitoring, core services		0	0	0	0	60
/var/lib/rabbitmq	logging, core services		0	0	0	0	26
/var/vertica	MM		0	0	0	362	0
/var/kafka	MML		0	0	0	141	0
/var/lib/elasticsearch	LB		0	0	0	246	0
		logging					
		BURA					
/var/lib/zookeeper	monitoring, logging, metering		0	0	0	1	0
/var/audit	logging		7	0	3	1	
/var/lib/glance/work_dir	glance		0	0	0	0	0

To add audit logging to disk size calculations:

1. Determine which services you have enabled to collect audit logging information. This is part of HLM configuration.

2. Enter the number of Audit Enabled services on cluster. Auditing is disabled by default, so these values will initially be 0. If audit logging is enabled, initial suggested values would be 9 for API/Core Services, 1 for Networking, 1 for Swift, and 2 for MMLB.

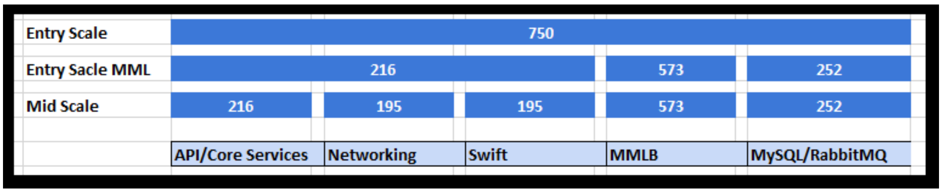
> **Important**
>
> If you enable logging for services beyond the defaults, you must change the **Number of Services on a Cluster** field in the spreadsheet. It is recommended that you increase the total services covered as well as increment the number on the appropriate cluster. For example, if you enable Apache logs on the core services, then the total would increase to 23 and the api/core services entry would change from 13 to 14.

3. To include Glance image space in your estimation, determine the size of the images that will be cached.

4. Enter the total size needed to store Glance images in the **/var/lib/glance/work_dir** field.

2.7.4 Select the Deployment Model

To decide which architecture will meet all of your requirements, use the values given in the Disk Calculator spreadsheet. Keeping in mind the rough scale you expect to target as well as any need to separate services, choose an Entry Scale, Entry Scale MML, or Mid Scale deployment. Once you have chosen a deployment you can match it to the sample disk models in the *Section 2.7.5, "Match to a Disk Model"* section. The following diagram shows the deployment options that are recommended if you use the default values in the Disk Calculator spreadsheet.



For example, in the above diagram, if you wanted to choose an Entry Scale MML deployment, the calculator recommends the following disk sizes:

- 216GB for API/Core Service
- 216GB for Neutron (networking)
- 216GB for Swift (storage)
- 573GB for MMLB
- 252GB for MySQL/RabbitMQ

2.7.5 Match to a Disk Model

For each of the entry-scale and scale-out cloud models, there is a set of associated disk models that can be used as the basis for your deployment. These models provide examples of pontetial parameters for operational tools and are expected to be used as the starting point for actual deployments. Since each deployment can vary greatly, the disk calculator spreadsheet provides a way to create the basic disk model and customize it to fit the specific parameters your deployment. Once you have estimated disk sizes and chosen a deployment architecture, you can choose which example disk partitioning file to use from the tables below. Keep in mind if you are enabling more options than are listed in the Disk Calculator, or if you want to plan for growth, you will need to manually adjust parameters as necessary.

Disk models are provided for each deployment option based on the expected size of the disk available to the control plane nodes. The available space is then partitioned by percentage to be allocated to each of the required volumes on the control plane. Each of the disk models is targeted at a specific set of parameters which can be found in the following tables:

- Entry Scale: 600 GB, 1 TB
- Mid Scale/ Entry Scale MML Servers: 600 GB, 2 TB, 4.5 TB

2.7.6 Entry Scale Disk Models

These models include a single cluster of control plane nodes and all services.

600GB Entry Scale

Component	Parameters
compute nodes	100 This model provides lower than recommended retention and should only be used for POC deployments.

1TB Entry Scale

Component	Parameters
compute nodes	100
local logging var/log	7 day retention
metering/monitoring /var/vertica	45 day retention
centralized logging /var/lib/elasticsearch	7 day retention

Component	Parameters
Kafka Message Queue /var/kafka	4 hour retention

2.7.7 MML Disk Models

These mid-scale and entry-scale MML models include seperate control plane nodes for core services, metering/monitoring/logging, and MySQL/RabbitMQ. Optionally you can also seperate out Swift (storage) and Neutron (networking). MML servers are the ones that will need modification based on the scale and operational parameters.

600GB MML Server

Component	Parameters
compute nodes	100
local logging var/log	7 day retention
metering/monitoring /var/vertica	30 day retention **Caution** 45 days is the default minimum.
centralized logging /var/lib/elasticsearch	7 day retention
Kafka Message Queue /var/kafka	4 hour retention

2TB MML Server

Component	Parameters
compute nodes	200

Component	Parameters
local logging var/log	7 day retention
metering/monitoring /var/vertica	45 day retention
centralized logging /var/lib/elasticsearch	7 day retention
Kafka Message Queue /var/kafka	12 hour retention

4.5TB MML Server

Component	Parameters
compute nodes	200
local logging var/log	7 day retention
metering/monitoring /var/vertica	45 day retention
centralized logging /var/lib/elasticsearch	45 day retention
Kafka Message Queue /var/kafka	12 hour retention

2.7.8 Notes about disk sizing for Cinder bootable volumes

When creating your disk model for nodes that will have the cinder volume role make sure that there is sufficient disk space allocated for a temporary space for image conversion if you will be creating bootable volumes.

By default, Cinder uses `/var/lib/cinder` for image conversion and this will be on the root filesystem unless it is explicitly separated. You can ensure there is enough space by ensuring that the root file system is sufficiently large, or by creating a logical volume mounted at `/var/lib/cinder` in the disk model when installing the system.

If you have post-installation issues with creating bootable volumes, see the *FIXME: broken external xref* documentation for steps to resolve these issues.

2.8 KVM Guest OS Support

A **Verified** Guest OS has been tested by HPE and appears to function properly as a Nova compute virtual machine on HPE Helion OpenStack 5.0.

A **Certified** Guest OS has been officially tested by the operating system vendor, or by HPE under the vendor's authorized program, and will be supported by the operating system vendor as a Nova compute virtual machine on HPE Helion OpenStack 5.0.

KVM Guest Operating System	Verified	Certified
Windows Server 2008		Yes
Windows Server 2008 R2		Yes
Windows Server 2012		Yes
Windows Server 2012 R2		Yes
CentOS 6.7	Yes	
CentOS 7.1	Yes	
CoreOS - Stable	Yes	
Debian 7.9	Yes	
Debian 8.2	Yes	
RHEL 6.7	Yes	
RHEL 7.1	Yes	
RHEL Atomic	Yes	

KVM Guest Operating System	Verified	Certified
SLES 11 SP4	Yes	
SLES 12	Yes	
Ubuntu 14.04	Yes	

2.9 ESX Guest OS Support

For ESX, refer to the VMware Compatibility Guide (http://www.vmware.com/resources/compatibility/search.php?action=search&deviceCategory=software&advancedORbasic=advanced&maxDisplayRows=50&key=&productId=4&gos_vmw_product_release%5B%5D=90&datePosted=-1&partnerId%5B%5D=-1&os_bits=-1&os_use%5B%5D=-1&os_family%5B%5D=-1&os_type%5B%5D=-1&rorre=0).

2.10 Ironic Guest OS Support

A **Verified** Guest OS has been tested by HPE and appears to function properly as a bare metal instance on HPE Helion OpenStack 5.0.

A **Certified** Guest OS has been officially tested by the operating system vendor, or by HPE under the vendor's authorized program, and will be supported by the operating system vendor as a bare metal instance on HPE Helion OpenStack 5.0.

Ironic Guest Operating System	Verified	Certified
RHEL 6.7	Yes	
RHEL 7.1	Yes	
Ubuntu 14.04	Yes	

3 Recommended Hardware Minimums for the Example Configurations

Firmware Requirements

Before performing any installation or upgrade of a HPE Helion OpenStack release on HPE (ProLiant) servers, the Service Pack for ProLiant (SPP) should be applied to be compatible with latest releases in firmware. The Service Pack for ProLiant (SPP) can be downloaded from http://www.hpe.com/info/spp

3.1 Recommended Hardware Minimums for an Entry-scale KVM with VSA Model

These recommended minimums are based on the included *Chapter 10, Example Configurations* included with the base installation and are suitable only for demo environments. For production systems you will want to consider your capacity and performance requirements when making decisions about your hardware.

> **Note**
>
> The disk requirements detailed below can be met with logical drives, logical volumes, or external storage such as a 3PAR array.

Node Type	Role Name	Required Number	Server Hardware - Minimum Requirements and Recommendations			
			Disk	**Memory**	**Network**	**CPU**
Dedicated lifecycle manager (optional)	Lifecycle-manager	1	300 GB	8 GB	1 x 10 Gbit/s with PXE Support	8 CPU (64-bit) cores total (Intel x86_64)
Control Plane	Controller	3	• 1 x 600 GB	64 GB	2 x 10 Gbit/s with	8 CPU (64-bit) cores

Node Type	Role Name	Required Number	Server Hardware - Minimum Requirements and Recommendations			
			Disk	Memory	Network	CPU
			(minimum) - operating system drive • 2 x 600 GB (minimum) - Data drive		one PXE enabled port	total (Intel x86_64)
Compute	Compute	1-3	2 X 600 GB (minimum)	32 GB (memory must be sized based on the virtual machine instances hosted on the Compute node)	2 x 10 Gbit/s with one PXE enabled port	8 CPU (64-bit) cores total (Intel x86_64) with hardware virtualization support. The CPU cores must be sized based on the VM instances hosted by

Node Type	Role Name	Required Number	Server Hardware - Minimum Requirements and Recommendations			
			Disk	Memory	Network	CPU
						the Compute node.
Block Storage (Optional)	VSA or OSD (Ceph)	0 or 3 (which will provide the recommended redundancy)	3 X 600 GB (minimum) See *Book "Installation Guide", Chapter 2 "Pre-Installation Checklist"* for more details.	32 GB	2 x 10 Gbit/s with one PXE enabled port	8 CPU (64-bit) cores total (Intel x86_64)

For more details about the supported network requirements, see *Chapter 10, Example Configurations*.

3.2 Recommended Hardware Minimums for an Entry-scale KVM with Ceph Model

The table below lists out the key characteristics needed per server role for this configuration.

Node Type	Role Name	Required Number	Server Hardware - Minimum Requirements and Recommendations			
			Disk	Memory	Network	CPU
Dedicated lifecycle manager (optional)	Lifecycle-manager	1	300 GB	8 GB	1 x 10 Gbit/s with PXE Support	8 CPU (64-bit) cores total (Intel x86_64)

Node Type	Role Name	Required Number	Server Hardware - Minimum Requirements and Recommendations			
			Disk	Memory	Network	CPU
Control Plane	Controller	3	• 1 x 600 GB (minimum) - operating system drive • 2 x 600 GB (minimum) - Data drive	64 GB	2 x 10 Gbit/s with one PXE enabled port	8 CPU (64-bit) cores total (Intel x86_64)
Compute (KVM hypervisor)	Compute	1-3	2 X 600 GB (minimum)	32 GB (memory must be sized based on the virtual machine instances hosted on the Compute node)	2 x 10 Gbit/s with one PXE enabled port	8 CPU (64-bit) cores total (Intel x86_64) with hardware virtualization support. The CPU cores must be sized based on the VM in-

Node Type	Role Name	Required Number	Server Hardware - Minimum Requirements and Recommendations			
			Disk	Memory	Network	CPU
						stances hosted by the Compute node.
CEPH-OSD	ceph-osd	0 or 3 (which will provide the recommended redundancy)	3 X 600 GB (minimum)	32 GB	2 x 10 Gbit/s with one PXE enabled port	8 CPU (64-bit) cores total (Intel x86_64)
RADOS Gateway	radosgw	2	2 x 600 GB (minimum)	32 GB	2 x 10 Gbit/s with one PXE enabled port	8 CPU (64-bit) cores total (Intel x86_64)

3.3 Recommended Hardware Minimums for an Entry-scale ESX, KVM with VSA Model

These recommended minimums are based on the included included with the base installation and are suitable only for demo environments. For production systems you will want to consider your capacity and performance requirements when making decisions about your hardware.

HPE Helion OpenStack 5.0 currently supports the following ESXi versions:

- ESXi version 5.5 (Update 3)
- ESXi version 6.0
- ESXi version 6.0 (Update 1b)

The following are the requirements for your vCenter server:

- Software

- vCenter 5.5 Update 3 and above (It is recommended to run the same server version as the ESXi hosts)

- License Requirements

  - vSphere Enterprise Plus license

Node Type	Role Name	Required Number	Server Hardware - Minimum Requirements and Recommendations			
			Disk	**Memory**	**Network**	**CPU**
Dedicated lifecycle manager (optional)	Lifecycle-manager	1	300 GB	8 GB	1 x 10 Gbit/s with PXE Support	8 CPU (64-bit) cores total (Intel x86_64)
Control Plane	Controller	3	• 1 x 600 GB (minimum) - operating system drive • 2 x 600 GB (minimum) - Data drive	64 GB	2 x 10 Gbit/s with one PXE enabled port	8 CPU (64-bit) cores total (Intel x86_64)

Node Type	Role Name	Required Number	Server Hardware - Minimum Requirements and Recommendations			
			Disk	Memory	Network	CPU
Compute (ESXi hypervisor)		2	2 X 1 TB (minimum, shared across all nodes)	128 GB (minimum)	2 x 10 Gbit/s +1 NIC (for DC access)	16 CPU (64-bit) cores total (Intel x86_64)
Compute (KVM hypervisor)	kvm-compute	1-3	2 X 600 GB (minimum)	32 GB (memory must be sized based on the virtual machine instances hosted on the Compute node)	2 x 10 Gbit/s with one PXE enabled port	8 CPU (64-bit) cores total (Intel x86_64) with hardware virtualization support. The CPU cores must be sized based on the VM instances hosted by the Compute node.
Block Storage (Optional)	VSA	0 or 3 (which will provide the recommended redundancy)	3 X 600 GB (minimum) See *Book "Installation Guide", Chapter 2 "Pre-*	32 GB	2 x 10 Gbit/s with one PXE enabled port	8 CPU (64-bit) cores total (Intel x86_64)

Node Type	Role Name	Required Number	Server Hardware - Minimum Requirements and Recommendations			
			Disk	Memory	Network	CPU
			Installation Checklist" for more details.			

3.4 Recommended Hardware Minimums for an Entry-scale ESX, KVM with VSA model with Dedicated Cluster for Metering, Monitoring, and Logging

These recommended minimums are based on the included included with the base installation and are suitable only for demo environments. For production systems you will want to consider your capacity and performance requirements when making decisions about your hardware.

HPE Helion OpenStack 5.0 currently supports the following ESXi versions:

- ESXi version 5.5 (Update 3)
- ESXi version 6.0
- ESXi version 6.0 (Update 1b)

The following are the requirements for your vCenter server:

- Software
  - vCenter 5.5 Update 3 and above (It is recommended to run the same server version as the ESXi hosts)
- License Requirements

- vSphere Enterprise Plus license

Node Type	Role Name	Required Number	Server Hardware - Minimum Requirements and Recommendations			
			Disk	Memory	Network	CPU
Dedicated lifecycle manager (optional)	Lifecycle-manager	1	300 GB	8 GB	1 x 10 Gbit/s with PXE Support	8 CPU (64-bit) cores total (Intel x86_64)
Control Plane	Core-API Controller	2	• 1 x 600 GB (minimum) - operating system drive • 2 x 300 GB (minimum) - Swift drive	128 GB	2 x 10 Gbit/s with PXE Support	24 CPU (64-bit) cores total (Intel x86_64)
	DBMQ Cluster	3	• 1 x 600 GB (minimum)	96 GB	2 x 10 Gbit/s with PXE Support	24 CPU (64-bit) cores total (Intel x86_64)

Node Type	Role Name	Required Number	Server Hardware - Minimum Requirements and Recommendations			
			Disk	Memory	Network	CPU
			- operating system drive • 1 x 300 GB (minimum) - MySQL drive			
	Metering Mon/Log Cluster	3	• 1 x 600 GB (minimum) - operating system drive	128 GB	2 x 10 Gbit/s with one PXE enabled port	24 CPU (64-bit) cores total (Intel x86_64)
Compute (ESXi hypervisor)		2 (minimum)	2 X 1 TB (minimum, shared	64 GB (memory must be sized based on the vir-	2 x 10 Gbit/s +1 NIC (for Data Center access)	16 CPU (64-bit) cores total (Intel x86_64)

Node Type	Role Name	Required Number	Server Hardware - Minimum Requirements and Recommendations			
			Disk	Memory	Network	CPU
			across all nodes)	tual machine instances hosted on the Compute node)		
Compute (KVM hypervisor)	kvm-compute	1-3	2 X 600 GB (minimum)	32 GB (memory must be sized based on the virtual machine instances hosted on the Compute node)	2 x 10 Gbit/s with one PXE enabled port	8 CPU (64-bit) cores total (Intel x86_64) with hardware virtualization support. The CPU cores must be sized based on the VM instances hosted by the Compute node.
Block Storage (Optional)	VSA	0 or 3 (which will provide the recommended redundancy)	3 X 600 GB (minimum) See *Book "Installation Guide", Chapter 2 "Pre-*	32 GB	2 x 10 Gbit/s with one PXE enabled port	8 CPU (64-bit) cores total (Intel x86_64)

Node Type	Role Name	Required Number	Server Hardware - Minimum Requirements and Recommendations			
			Disk	Memory	Network	CPU
			Installation Checklist" for more details.			

3.5 Recommended Hardware Minimums for an Ironic Flat Network Model

When using the `agent_ilo` driver, you should ensure that the most recent iLO controller firmware is installed. A recommended minimum for the iLO4 controller is version 2.30.

The recommended minimum hardware requirements are based on the *Chapter 10, Example Configurations* included with the base installation and are suitable only for demo environments. For production systems you will want to consider your capacity and performance requirements when making decisions about your hardware.

Node Type	Role Name	Required Number	Server Hardware - Minimum Requirements and Recommendations			
			Disk	Memory	Network	CPU
Dedicated lifecycle manager (optional)	Lifecycle-manager	1	300 GB	8 GB	1 x 10 Gbit/s with PXE Support	8 CPU (64-bit) cores total (Intel x86_64)
Control Plane	Controller	3	• 1 x 600 GB (minimum) - operat-	64 GB	2 x 10 Gbit/s with one PXE enabled port	8 CPU (64-bit) cores total (Intel x86_64)

Node Type	Role Name	Required Number	Server Hardware - Minimum Requirements and Recommendations			
			Disk	Memory	Network	CPU
			ing system drive • 2 x 600 GB (minimum) - Data drive			
Compute	Compute	1	1 X 600 GB (minimum)	16 GB	2 x 10 Gbit/s with one PXE enabled port	16 CPU (64-bit) cores total (Intel x86_64)

For more details about the supported network requirements, see *Chapter 10, Example Configurations*.

3.6 Recommended Hardware Minimums for an Entry-scale Swift Model

These recommended minimums are based on the included *Chapter 10, Example Configurations* included with the base installation and are suitable only for demo environments. For production systems you will want to consider your capacity and performance requirements when making decisions about your hardware.

The `entry-scale-swift` example runs the Swift proxy, account and container services on the three controller servers. However, it is possible to extend the model to include the Swift proxy, account and container services on dedicated servers (typically referred to as the Swift proxy servers). If you are using this model, we have included the recommended Swift proxy servers specs in the table below.

Node Type	Role Name	Required Number	Server Hardware - Minimum Requirements and Recommendations			
			Disk	Memory	Network	CPU
Dedicated lifecycle manager (optional)	Lifecycle-manager	1	300 GB	8 GB	1 x 10 Gbit/s with PXE Support	8 CPU (64-bit) cores total (Intel x86_64)
Control Plane	Controller	3	• 1 x 600 GB (minimum) - operating system drive • 2 x 600 GB (minimum) - Swift account/con-	64 GB	2 x 10 Gbit/s with one PXE enabled port	8 CPU (64-bit) cores total (Intel x86_64)

Node Type	Role Name	Required Number	Server Hardware - Minimum Requirements and Recommendations			
			Disk	**Memory**	**Network**	**CPU**
			tainer data drive			
Swift Object	swobj	3	If using x3 replication only: • 1 x 600 GB (minimum, see considerations at bottom of page for more details) If using Erasure Codes only or a mix of x3 repli-	32 GB (see considerations at bottom of page for more details)	2 x 10 Gbit/s with one PXE enabled port	8 CPU (64-bit) cores total (Intel x86_64)

Node Type	Role Name	Required Number	Server Hardware - Minimum Requirements and Recommendations			
			Disk	Memory	Network	CPU
			cation and Erasure Codes: • 6 x 600 GB (minimum, see considerations at bottom of page for			

Node Type	Role Name	Required Number	Server Hardware - Minimum Requirements and Recommendations			
			Disk	Memory	Network	CPU
			more details) **Note** The disk speeds (RPM) chosen should be consistent within the same ring or storage policy. It's best to not use			

Node Type	Role Name	Required Number	Server Hardware - Minimum Requirements and Recommendations			
			Disk	Memory	Network	CPU
			disks with mixed disk speeds within the same Swift ring.			
Swift Proxy, Account, and Container	swpac	3	2 x 600 GB (minimum, see considerations at bottom of page for more details)	64 GB (see considerations at bottom of page for more details)	2 x 10 Gbit/s with one PXE enabled port	8 CPU (64-bit) cores total (Intel x86_64)

Considerations for your Swift object and proxy, account, container servers RAM and disk capacity needs

Swift can have a diverse number of hardware configurations. For example, a Swift object server may have just a few disks (minimum of 6 for erasure codes) or up to 70 and beyond. The memory requirement needs to be increased as more disks are added. The general rule of thumb for memory needed is 0.5 GB per TB of storage. For example, a system with 24 hard drives at 8TB each, giving a total capacity of 192TB, should use 96GB of RAM. However, this does not work well for a system with a small number of small hard drives or a very large number of very large drives. So, if after calculating the memory given this guideline, if the answer is less than 32GB then go with 32GB of memory minimum and if the answer is over 256GB then use 256GB maximum, no need to use more memory than that.

When considering the capacity needs for the Swift proxy, account, and container (PAC) servers, you should calculate 2% of the total raw storage size of your object servers to specify the storage required for the PAC servers. So, for example, if you were using the example we provided earlier and you had an object server setup of 24 hard drives with 8TB each for a total of 192TB and you had a total of 6 object servers, that would give a raw total of 1152TB. So you would take 2% of that, which is 23TB, and ensure that much storage capacity was available on your Swift proxy, account, and container (PAC) server cluster. If you had a cluster of three Swift PAC servers, that would be ~8TB each.

Another general rule of thumb is that if you are expecting to have more than a million objects in a container then you should consider using SSDs on the Swift PAC servers rather than HDDs.

4 High Availability

4.1 High Availability Concepts Overview

A highly available (HA) cloud ensures that a minimum level of cloud resources are always available on request, which results in uninterrupted operations for users.

In order to achieve this high availability of infrastructure and workloads, we define the scope of HA to be limited to protecting these only against single points of failure (SPOF). Single points of failure include:

- **Hardware SPOFs**: Hardware failures can take the form of server failures, memory going bad, power failures, hypervisors crashing, hard disks dying, NIC cards breaking, switch ports failing, network cables loosening, and so forth.
- **Software SPOFs**: Server processes can crash due to software defects, out-of-memory conditions, operating system kernel panic, and so forth.

By design, HPE Helion OpenStack strives to create a system architecture resilient to SPOFs, and does not attempt to automatically protect the system against multiple cascading levels of failures; such cascading failures will result in an unpredictable state. Hence, the cloud operator is encouraged to recover and restore any failed component, as soon as the first level of failure occurs.

4.2 Highly Available Cloud Infrastructure

The highly available cloud infrastructure consists of the following:

- High Availability of Controllers
- Availability Zones
- Compute with KVM
- Nova Availability Zones
- Compute with ESX
- Block Storage with StoreVirtual VSA
- Object Storage with Swift

4.3 High Availability of Controllers

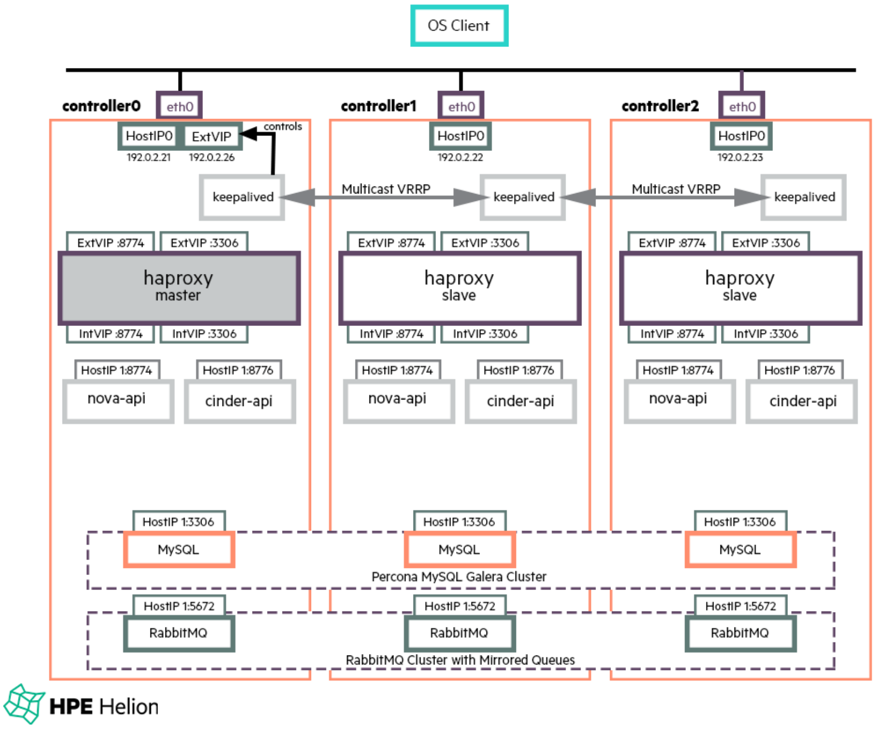
The HPE Helion OpenStack installer deploys highly available configurations of OpenStack cloud services, resilient against single points of failure.

The high availability of the controller components comes in two main forms.

- Many services are stateless and multiple instances are run across the control plane in active-active mode. The API services (nova-api, cinder-api, etc.) are accessed through the HA proxy load balancer whereas the internal services (nova-scheduler, cinder-scheduler, etc.), are accessed through the message broker. These services use the database cluster to persist any data.

  > **Note**
  >
  > The HA proxy load balancer is also run in active-active mode and keepalived (used for Virtual IP (VIP) Management) is run in active-active mode, with only one keepalived instance holding the VIP at any one point in time.

- The high availability of the message queue service and the database service is achieved by running these in a clustered mode across the three nodes of the control plane: RabbitMQ cluster with Mirrored Queues and Percona MySQL Galera cluster.



The above diagram illustrates the HA architecture with the focus on VIP management and load balancing. It only shows a subset of active-active API instances and does not show examples of other services such as nova-scheduler, cinder-scheduler, etc.

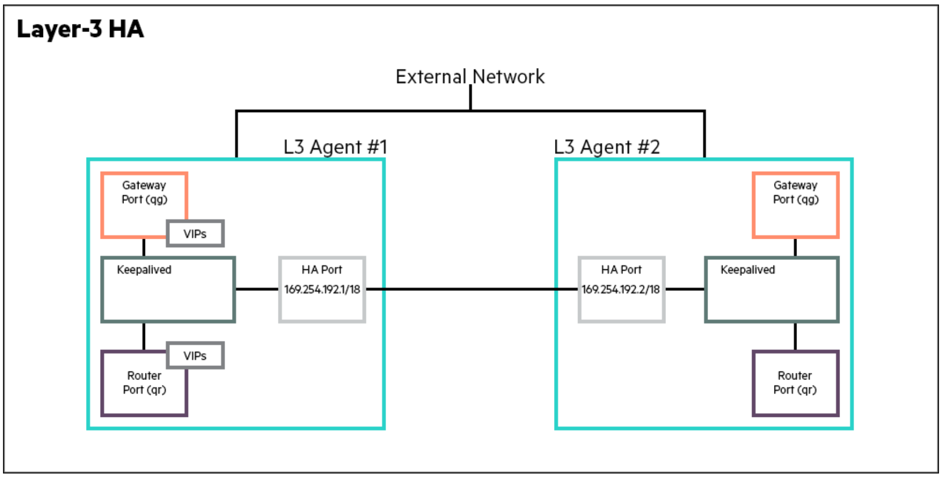
In the above diagram, requests from an OpenStack client to the API services are sent to VIP and port combination; for example, 192.0.2.26:8774 for a Nova request. The load balancer listens for requests on that VIP and port. When it receives a request, it selects one of the controller nodes configured for handling Nova requests, in this particular case, and then forwards the request to the IP of the selected controller node on the same port.

The nova-api service, which is listening for requests on the IP of its host machine, then receives the request and deals with it accordingly. The database service is also accessed through the load balancer. RabbitMQ, on the other hand, is not currently accessed through VIP/HA proxy as the clients are configured with the set of nodes in the RabbitMQ cluster and failover between cluster nodes is automatically handled by the clients.

4.4 High Availability Routing - Centralized

Incorporating High Availability into a system involves implementing redundancies in the component that is being made highly available. In Centralized Virtual Router (CVR), that element is the Layer 3 agent a.k.a L3 agent. By making L3 agent highly available, upon failure all HA routers are migrated from the primary L3 agent to a secondary L3 agent. The implementation efficiency of an HA subsystem is measured by the number of packets that are lost when the secondary L3 agent is made the master.

In HPE Helion OpenStack, the primary and secondary L3 agents run continuously, and failover involves a rapid switchover of mastership to the secondary agent (IEFT RFC 5798). The failover essentially involves a switchover from a already running master to already running slave. This substantially reduces the latency of the HA. The mechanism used by the master and the slave to implement a failover is implemented using Linux's pacemaker HA resource manager. This CRM (Cluster resource manager) uses VRRP (Virtual Router Redundancy Protocol) to implement the HA mechanism. VRRP is a industry standard protocol and defined in RFC 5798.



L3 HA uses of VRRP comes with several benefits.

The primary benefit is the failover mechanism does not involve interprocess communication overhead (order of 10s of seconds). By not using an RPC mechanism to invoke the secondary agent to assume the primary agents role enables VRRP to achieve failover within 1-2 seconds.

In VRRP, the primary and secondary routers are all active. As the routers are running, it is a matter of making the router aware of its primary/master status. This switchover takes less than 2 seconds instead of 60+ seconds it would have taken to start a backup router and failover.

The failover depends upon a heartbeat link between the primary and secondary. That link in HPE Helion OpenStack 3.0 uses keepalived package of the pacemaker resource manager. The heartbeats are sent at a 2 second intervals between the primary and secondary. As per the VRRP protocol, if the secondary does not hear from the master after 3 intervals, it assumes the function of the primary.

Further, all the routable IP addresses i.e. the VIPs (virtual IPs) are assigned to the primary agent.

For information on more creating HA routers, see:

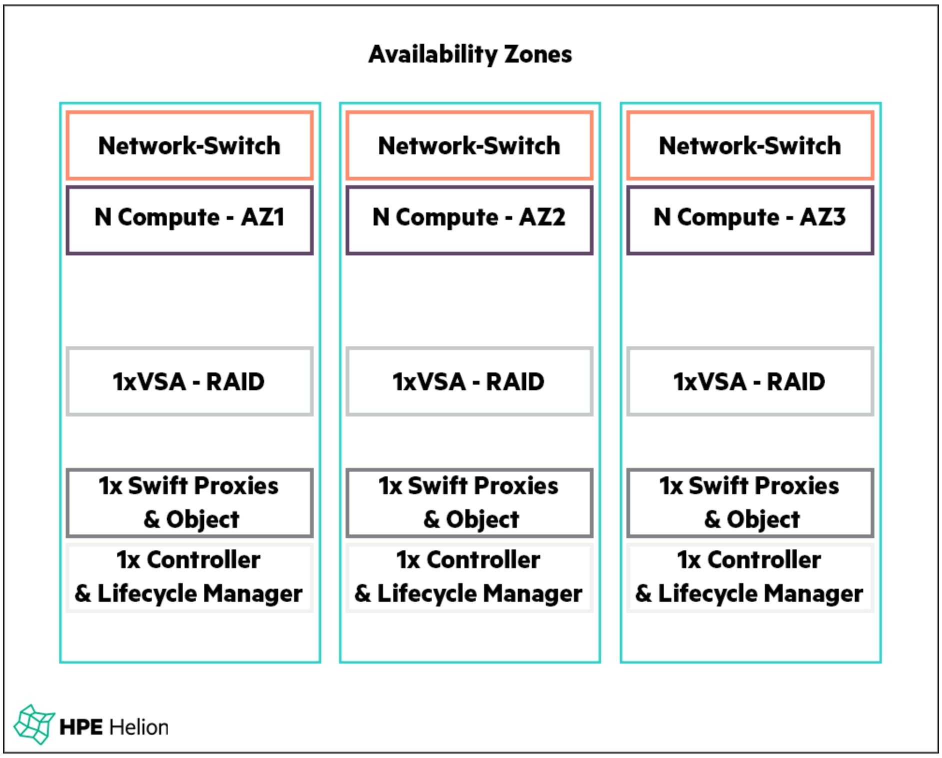
4.5 High Availability Routing - Distributed

The OpenStack Distributed Virtual Router (DVR) function delivers HA through its distributed architecture. The one centralized function remaining is source network address translation (SNAT), where high availability is provided by DVR SNAT HA.

DVR SNAT HA is enabled on a per router basis and requires that two or more L3 agents capable of providing SNAT services be running on the system. If a minimum number of L3 agents is configured to 1 or lower, the neutron server will fail to start and a log message will be created. The L3 Agents must be running on a control-plane node, L3 agents running on a compute node do not provide SNAT services.

For more information on creating HA routers, see: .

4.6 Availability Zones



While planning your OpenStack deployment, you should decide on how to zone various types of nodes - such as compute, block storage, and object storage. For example, you may decide to place all servers in the same rack in the same zone. For larger deployments, you may plan more elaborate redundancy schemes for redundant power, network ISP connection, and even physical firewalling between zones (*this aspect is outside the scope of this document*).

HPE Helion OpenStack offers APIs, CLIs and Horizon UIs for the administrator to define and user to consume, availability zones for Nova, Cinder and Swift services. This section outlines the process to deploy specific types of nodes to specific physical servers, and makes a statement of available support for these types of availability zones in the current release.

Note

By default, HPE Helion OpenStack is deployed in a single availability zone upon installation. Multiple availability zones can be configured by an administrator post-install, if required. Refer to the Chapter 5: Scaling (http://docs.openstack.org/openstack-ops/content/scaling.html) (in the OpenStack Operations Guide for more information).

4.7 Compute with KVM

You can deploy your KVM nova-compute nodes either during initial installation, or by adding compute nodes post initial installation.

While adding compute nodes post initial installation, you can specify the target physical servers for deploying the compute nodes.

Learn more about .

4.8 Nova Availability Zones

Nova host aggregates and Nova availability zones can be used to segregate Nova compute nodes across different failure zones.

4.9 Compute with ESX Hypervisor

Compute nodes deployed on ESX Hypervisor can be made highly available using the HA feature of VMware ESX Clusters. For more information on VMware HA, please refer to your VMware ESX documentation.

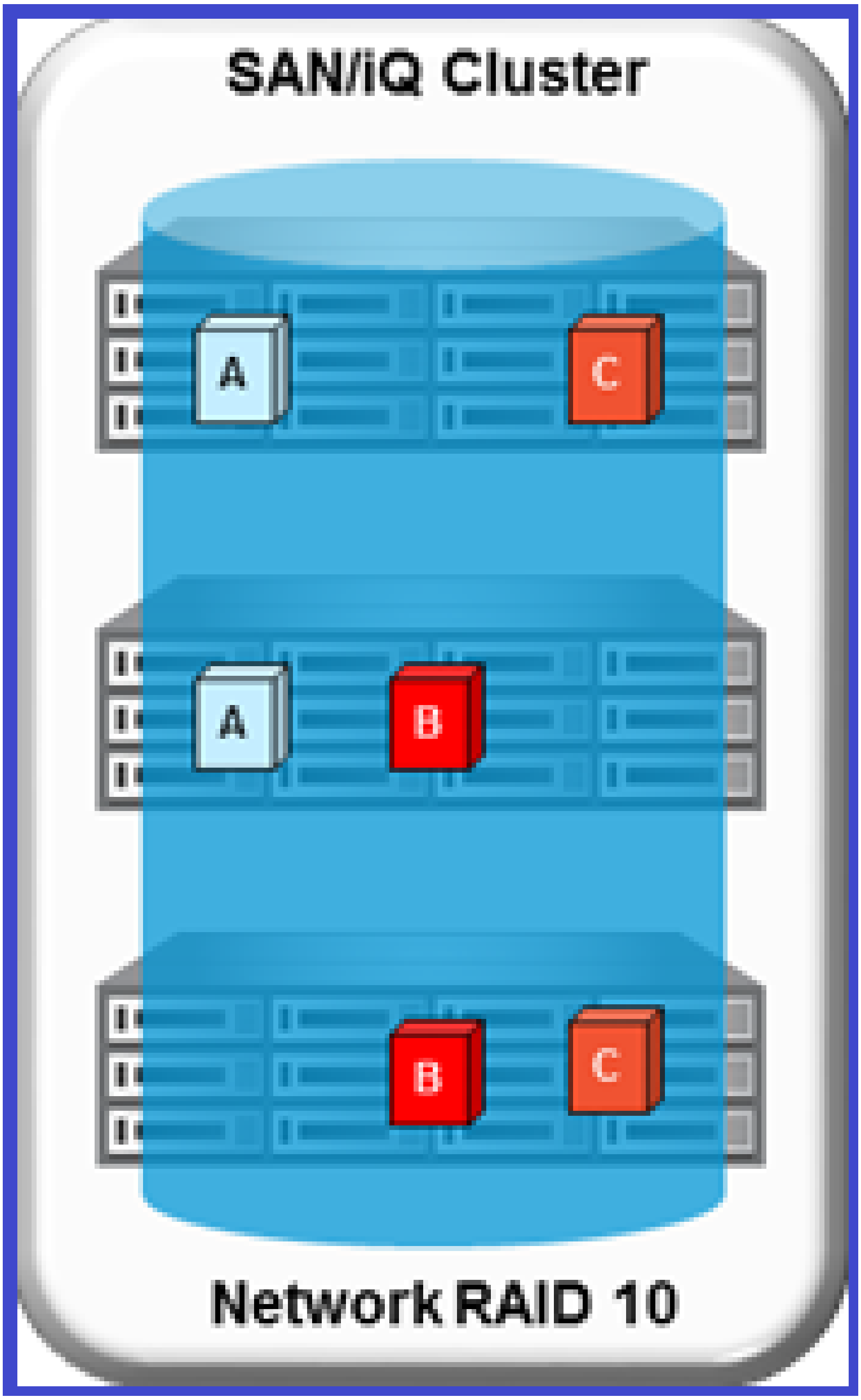
4.10 Block Storage with StoreVirtual VSA

Highly available Cinder block storage volumes are provided by the network RAID 10 implementation in the HPE StoreVirtual VSA software. You can deploy the VSA nodes in three node cluster and specify Network RAID 10 protection for Cinder volumes.

The underlying SAN/iQ operating system of the StoreVirtual VSA ensures that the two-way replication maintains two mirrored copies of data for each volume.

This Network RAID 10 capability ensures that failure of any single server does not cause data loss, and maintains data access to the clients.

Furthermore, each of the VSA nodes of the cluster can be strategically deployed in different zones of your data center for maximum redundancy and resiliency. For more information on how to deploy VSA nodes on desired target servers, refer to the document.


SAN/iQ Cluster
A
C
A
B
B
C
Network RAID 10

4.11 Deploy VSA cluster across Availability Zones/ Racks

In the Availablity Zone image above, the input model example has 3 VSA servers in three different server-groups (Racks) (server-groups are are logical separations). You can configure these server-groups in different physical Racks to provide the required hardware isolation. See input model examples for *Section 10.4.1, "Entry-scale KVM with VSA Model"*, *Section 10.5.2, "Entry-scale ESX, KVM with VSA Model with Dedicated Cluster for Metering, Monitoring, and Logging"*, and FIXME: *Section 10.4.4, "Mid-scale KVM with VSA Model"*

The recommended configuration for a VSA Cluster is to use RAID 10 with 3 mirrors to guarantee that data is replicated across 3 VSA nodes spreading across AZs/Racks. Using one of the two options below, you can expand storage capacity by adding 3 more nodes.

1. Add new three VSA nodes to the existing cluster and ensure that each new VSA node is on different AZ/Rack.

   > **Note**
   >
   > There is a 1500 volumes limit per VSA cluster.

2. Create a new VSA cluster with the 3 new nodes.

4.12 Cinder Availability Zones

Cinder availability zones are not supported for general consumption in the current release.

4.13 Object Storage with Swift

High availability in Swift is achieved at two levels.

Control Plane

The Swift API is served by multiple Swift proxy nodes. Client requests are directed to all Swift proxy nodes by the HA Proxy load balancer in round-robin fashion. The HA Proxy load balancer regularly checks the node is responding, so that if it fails, traffic is directed to the remaining nodes. The Swift service will continue to operate and respond to client requests as long as at least one Swift proxy server is running.

If a Swift proxy node fails in the middle of a transaction, the transaction fails. However it is standard practice for Swift clients to retry operations. This is transparent to applications that use the python-swiftclient library.

The entry-scale example cloud models contain three Swift proxy nodes. However, it is possible to add additional clusters with additional Swift proxy nodes to handle a larger workload or to provide additional resiliency.

Data

Multiple replicas of all data is stored. This happens for account, container and object data. The example cloud models recommend a replica count of three. However, you may change this to a higher value if needed.

When Swift stores different replicas of the same item on disk, it ensures that as far as possible, each replica is stored in a different zone, server or drive. This means that if a single server of disk drives fails, there should be two copies of the item on other servers or disk drives.

If a disk drive is failed, Swift will continue to store three replicas. The replicas that would normally be stored on the failed drive are “handed off” to another drive on the system. When the failed drive is replaced, the data on that drive is reconstructed by the replication process. The replication process re-creates the “missing” replicas by copying them to the drive using one of the other remaining replicas. While this is happening, Swift can continue to store and retrieve data.

4.14 Highly Available Cloud Applications and Workloads

Projects writing applications to be deployed in the cloud must be aware of the cloud architecture and potential points of failure and architect their applications accordingly for high availability.

Some guidelines for consideration:

1. Assume intermittent failures and plan for retries

    - **OpenStack Service APIs**: invocations can fail - you should carefully evaluate the response of each invocation, and retry in case of failures.

    - **Compute**: VMs can die - monitor and restart them

- **Network**: Network calls can fail - retry should be successful
- **Storage**: Storage connection can hiccup - retry should be successful

2. Build redundancy into your application tiers

   - - Replicate VMs containing stateless services such as Web application tier or Web service API tier and put them behind load balancers (you must implement your own HA Proxy type load balancer in your application VMs until HPE Helion OpenStack delivers the LBaaS service).
     - Boot the replicated VMs into different Nova availability zones.
     - If your VM stores state information on its local disk (Ephemeral Storage), and you cannot afford to lose it, then boot the VM off a Cinder volume.
     - Take periodic snapshots of the VM which will back it up to Swift through Glance.
     - Your data on ephemeral may get corrupted (but not your backup data in Swift and not your data on Cinder volumes).
     - Take regular snapshots of Cinder volumes and also back up Cinder volumes or your data exports into Swift.

3. Instead of rolling your own highly available stateful services, use readily available HPE Helion OpenStack platform services such as Designate, the DNS service.

4.15 What is not Highly Available?

Lifecycle Manager

The lifecycle manager in HPE Helion OpenStack is not highly-available. The lifecycle manager state/data are all maintained in a filesystem and are backed up by the Freezer service. In case of lifecycle manager failure, the state/data can be recovered from the backup.

Control Plane

High availability is not supported for Network Services (LBaaS, VPNaaS, FWaaS)

Nova-consoleauth

Nova-consoleauth is a singleton service, it can only run on a single node at a time. While nova-consoleauth is not high availability, some work has been done to provide the ability to switch nova-consoleauth to another controller node in case of a failure. More Information on troubleshooting Nova-consoleauth can be found in the .

Cinder Volume and Backup Services

Cinder Volume and Backup Services are not high availability and started on one controller node at a time. More information on Cinder Volume and Backup Services can be found in

Keystone Cron Jobs

The Keystone cron job is a singleton service, which can only run on a single node at a time. A manual setup process for this job will be required in case of a node failure. More information on enabling the cron job for Keystone on the other nodes can be found in .

4.16 More Information

- OpenStack High-availability Guide (http://docs.openstack.org/high-availability-guide/content/ch-intro.html)
- 12-Factor Apps (http://12factor.net/)

5 Third Party Integrations

We have the following documentation showing how to integrate HPE Helion OpenStack 5.0 with third party solutions.

General Integrations

- HPE Helion OpenStack 5.0 supports the integration of 3rd-party components with a HPE Helion OpenStack platform deployment, whether that is a completely separate service or a plugin/driver to an existing service in the HPE Helion OpenStack stack. The 3rd-party mechanism supports the integration of a range of different types of content.

Logging Service

- This documentation demonstrates the possible integration between the HPE Helion OpenStack 5.0 centralized logging solution and Splunk including the steps to setup and forward logs.

II Helion Lifecycle Manager Overview

6 Input Model

6.1 Introduction to the Input Model

This document describes how the HPE Helion OpenStack input model can be used to define and configure the cloud.

HPE Helion OpenStack ships with a set of example input models that can be used as starting points for defining a custom cloud.

The input model allows you, the cloud administrator, to describe the cloud configuration in terms of:

- Which OpenStack services run on which server nodes
- How individual servers are configured in terms of disk and network adapters
- The overall network configuration of the cloud
- Network traffic separation
- CIDR and VLAN assignments

The input model is consumed by the configuration processor which parses and validates the input model and outputs the effective configuration that will be deployed to each server that makes up your cloud.

The document is structured as follows:

- *Concepts* - This explains the ideas behind the declarative model approach used in HPE Helion OpenStack 5.0 and the core concepts used in describing that model
- *Input Model* - This section provides a description of each of the configuration entities in the input model
- *Core Examples* - In this section we provide samples and definitions of some of the more important configuration entities

6.1.1 New in HPE Helion OpenStack 5.0

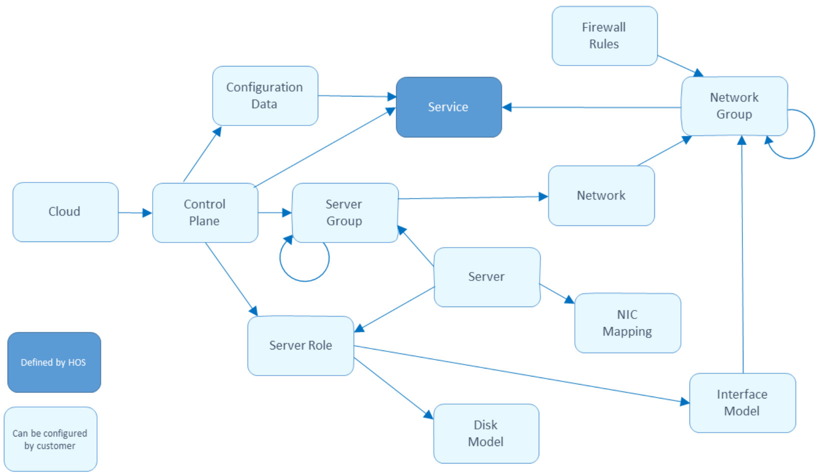
HPE Helion OpenStack 5.0 introduces the following additions to the cloud model:

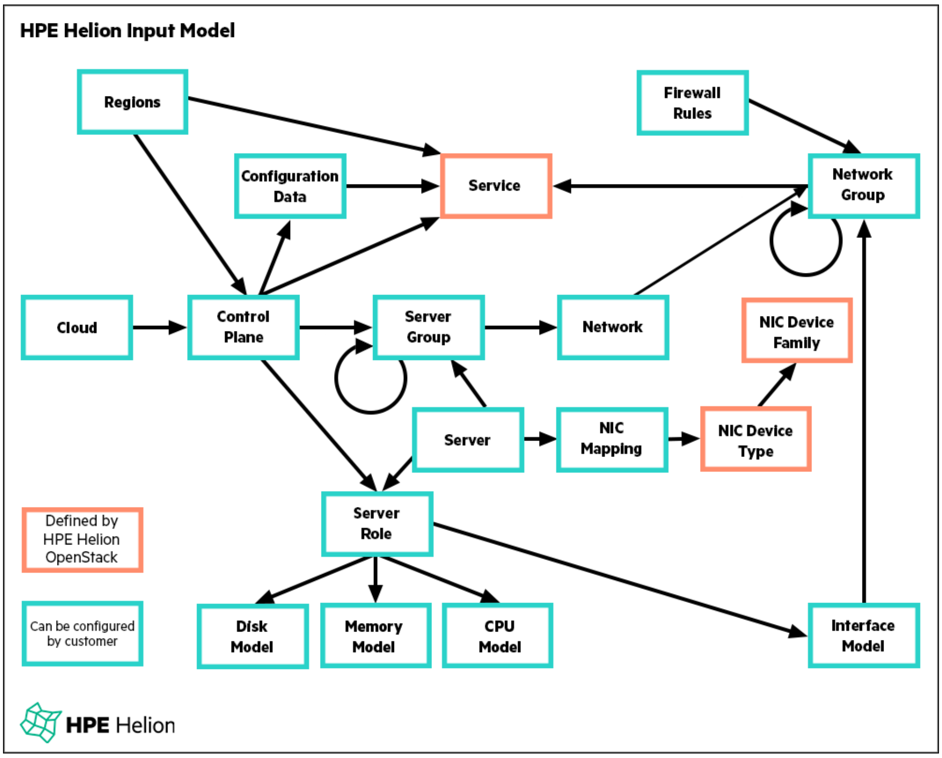
- Container as a Service (Magnum) Support has been included.
- neutron-ml2-qos service addition.

6.2 Concepts

An HPE Helion OpenStack 5.0 cloud is defined by a declarative model that is described in a series of configuration objects. These configuration objects are represented in YAML files which together constitute the various example configurations provided as templates with this release. These examples can be used nearly unchanged, with the exception of necessary changes to IP addresses and other site and hardware-specific identifiers. Alternatively, the examples may be customized to meet site requirements.

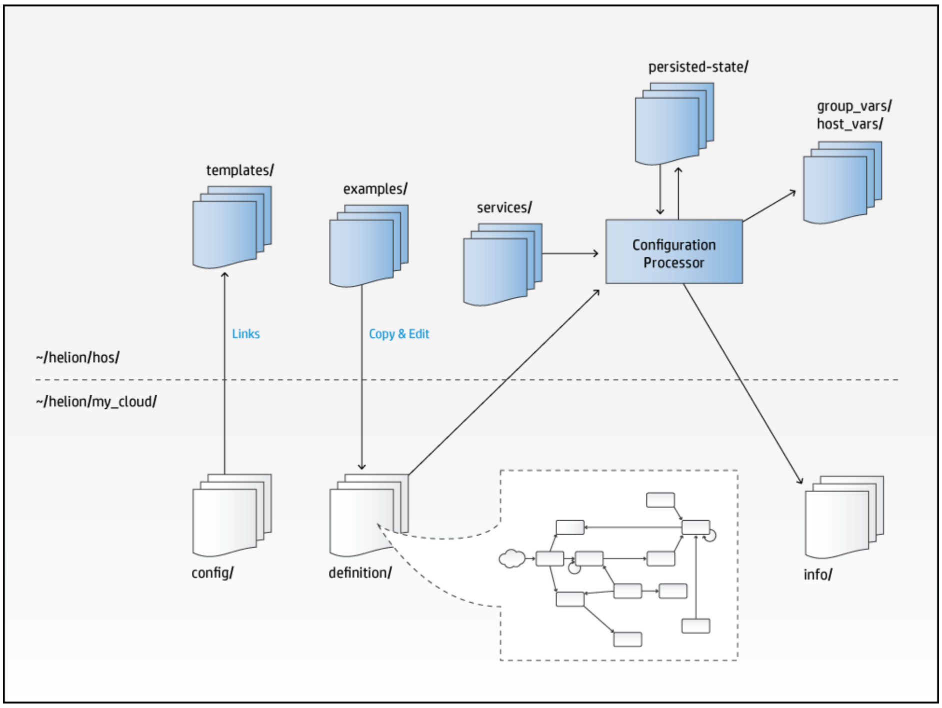
The following diagram shows the set of configuration objects and their relationships. All objects have a name that you may set to be something meaningful for your context. In the examples these names are provided in capital letters as a convention. These names have no significance to HPE Helion OpenStack, rather it is the relationships between them that define the configuration.





The configuration processor reads and validates the input model described in the YAML files discussed above, combines it with the service definitions provided by HPE Helion OpenStack and any persisted state information about the current deployment to produce a set of Ansible variables that can be used to deploy the cloud. It also produces a set of information files that provide details about the configuration.

The relationship between the file systems on the HPE Helion OpenStack deployment server and the configuration processor is shown in the following diagram. Below the line are the directories that you, the cloud administrator, interact with. Above the line are the directories that are maintained by HPE Helion OpenStack.



Download a high-res version (../../../../media/inputmodel/hphelionopenstack_directories_lg.png)

The input model is read from the `~/helion/my_cloud/definition` directory. Although the supplied examples use separate files for each type of object in the model, the names and layout of the files have no significance to the configuration processor, it simply reads all of the .yml files in this directory. Cloud administrators are therefore free to use whatever structure is best for their context. For example, you may decide to maintain separate files or sub-directories for each physical rack of servers.

As mentioned, the examples use the conventional upper casing for object names, but these strings are used only to define the relationship between objects. They have no specific significance to the configuration processor.

6.2.1 Cloud

The Cloud definition includes a few top-level configuration values such as the name of the cloud, the host prefix, details of external services (NTP, DNS, SMTP) and the firewall settings.

The location of the cloud configuration file also tells the configuration processor where to look for the files that define all of the other objects in the input model.

6.2.2 Control Planes

A control-plane runs one or more services distributed across clusters and resource groups.

A control-plane uses servers with a particular server-role.

A *control-plane* provides the operating environment for a set of *services*; normally consisting of a set of shared services (MySQL, RabbitMQ, HA Proxy, Apache, etc), OpenStack control services (API, schedulers, etc) and the *resources* they are managing (compute, storage, etc).

A simple cloud may have a single *control-plane* which runs all of the *services*. A more complex cloud may have multiple *control-planes* to allow for more than one instance of some services. (Note that support for multiple control-planes is a non-core feature in HPE Helion OpenStack 5.0 and not covered by the examples). Services that need to consume (use) another service (such as Neutron consuming MySQL, Nova consuming Neutron) always use the service within the same *control-plane*. In addition a control-plane can describe which services can be consumed from other control-planes. It is one of the functions of the configuration processor to resolve these relationships and make sure that each consumer/service is provided with the configuration details to connect to the appropriate provider/service.

Each *control-plane* is structured as *clusters* and *resources*. The *clusters* are typically used to host the OpenStack services that manage the cloud such as API servers, database servers, Neutron agents, and Swift proxies, while the *resources* are used to host the scale-out OpenStack services such as Nova-Compute or Swift-Object services. This is a representation convenience rather than a strict rule, for example it is possible to run the Swift-Object service in the management cluster in a smaller-scale cloud that is not designed for scale-out object serving.

A cluster can contain one or more *servers* and you can have one or more *clusters* depending on the capacity and scalability needs of the cloud that you are building. Spreading services across multiple *clusters* provides greater scalability, but it requires a greater number of physical servers. A common pattern for a large cloud is to run high data volume services such as monitoring and logging in a separate cluster. A cloud with a high object storage requirement will typically also run the Swift service in its own cluster.

Clusters in this context are a mechanism for grouping service components in physical servers, but all instances of a component in a *control-plane* work collectively. For example, if HA Proxy is configured to run on multiple clusters within the same *control-plane* then all of those instances will work as a single instance of the ha-proxy service.

Both *clusters* and *resources* define the type (via a list of *server-roles*) and number of servers (min and max or count) they require.

The *control-plane* can also define a list of failure-zones (*server-groups*) from which to allocate servers.

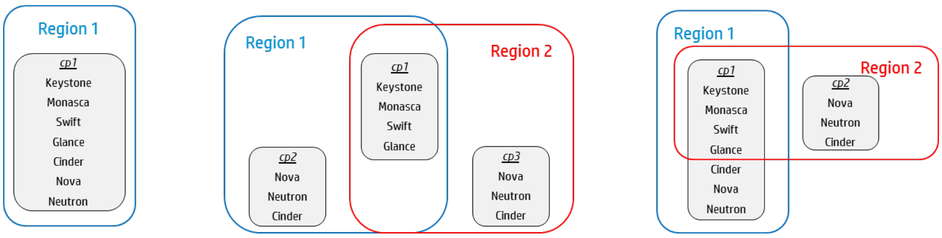
6.2.2.1 Control Planes and Regions

A region in OpenStack terms is a collection of URLs that together provide a consistent set of services (Nova, Neutron, Swift, etc). Regions are represented in the Keystone identity service catalog and clients can decide which region they want to use.

For the owner of a cloud, regions provide a way of segmenting resources for scale, resilience, and isolation.

Regions don't have to be disjointed; for example, you can have a Swift service shared across more than one region, in which case the Swift URL for both regions will be the same and any region-specific services will use the same Swift instance. However, not all services can be shared in this way. For example, a Neutron service cannot be used by more than one Nova and so these will generally be deployed as region specific services, provided from separate control-planes. Equally in HPE Helion OpenStack, Mysql and RabbitMQ cannot be shared by more than one instance of the same service (for example a single mysql cluster cannot be used by two different instances of Nova, and so these are also deployed on a per-control basis.

In the input model, each region is defined as a set of services drawn from one or more control-planes. All of the following are valid mappings of control-planes to regions:



In a simple single control-plane cloud, there is no need for a separate region definition and the control-plane itself can define the region name.

6.2.3 Services

A control-plane runs one or more services.

A service is the collection of *service-components* that provide a particular feature; for example, Nova provides the compute service and consists of the following service-components: nova-api, nova-scheduler, nova-conductor, nova-novncproxy, and nova-compute. Some services, like the authentication/identity service Keystone, only consist of a single service-component.

To define your cloud, all you need to know about a service are the names of the *service-components*. The details of the services themselves and how they interact with each other is captured in service definition files provided by HPE Helion OpenStack.

When specifying your HPE Helion OpenStack cloud you have to decide where components will run and how they connect to the networks. For example, should they all run in one *control-plane* sharing common services or be distributed across multiple *control-planes* to provide separate instances of some services? The HPE Helion OpenStack supplied examples provide solutions for some typical configurations.

Where services run is defined in the *control-plane*. How they connect to networks is defined in the *network-groups*.

6.2.4 Server Roles

Clusters and resources use servers with a particular set of server-roles.

You're going to be running the services on physical *servers*, and you're going to need a way to specify which type of servers you want to use where. This is defined via the *server-role*. Each *server-role* describes how to configure the physical aspects of a server to fulfill the needs of a particular role. You'll generally use a different role whenever the servers are physically different (have different disks or network interfaces) or if you want to use some specific servers in a particular role (for example to choose which of a set of identical servers are to be used in the control plane).

Each *server-role* has a relationship to four other entities - the disk-model, the interface-model, the memory-model and the cpu-model:

- The ***disk-model*** specifies how to configure and use a server's local storage and it specifies disk sizing information for virtual machine servers. The disk model is described in the next section.
- The ***interface-model*** describes how a server's network interfaces are to be configured and used. This is covered in more details in the networking section.

- An optional `memory-model` specifies how to configure and use huge pages. The memory-model specifies memory sizing information for virtual machine servers.

- An optional `cpu-model` specifies how the CPUs will be used by Nova and by DPDK. The cpu-model specifies CPU sizing information for virtual machine servers.

6.2.5 Disk Model

Each physical disk device is associated with a device-group or a volume-group.

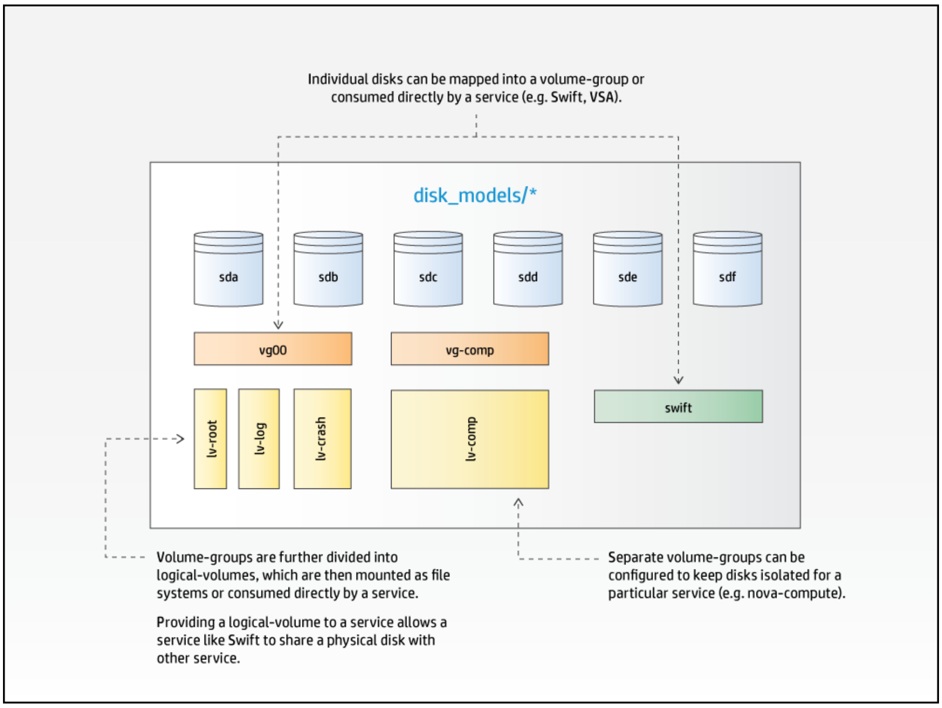
Device-groups are consumed by services.

Volume-groups are divided into logical-volumes.

Logical-volumes are mounted as file systems or consumed by services.

Disk-models define how local storage is to be configured and presented to *services*. Disk-models are identified by a name, which you will specify. The HPE Helion OpenStack examples provide some typical configurations. As this is an area that varies with respect to the services that are hosted on a server and the number of disks available, it is impossible to cover all possible permutations you may need to express via modifications to the examples.

Within a *disk-model*, disk devices are assigned to either a *device-group* or a *volume-group*.



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A *device-group* is a set of one or more disks that are to be consumed directly by a service. For example, a set of disks to be used by Swift. The device-group identifies the list of disk devices, the service, and a few service-specific attributes that tell the service about the intended use (for example, in the case of Swift this is the ring names). When a device is assigned to a device-group, the associated service is responsible for the management of the disks. This management includes the creation and mounting of file systems. (Swift can provide additional data integrity when it has full control over the file systems and mount points.)

A *volume-group* is used to present disk devices in a LVM volume group. It also contains details of the logical volumes to be created including the file system type and mount point. Logical volume sizes are expressed as a percentage of the total capacity of the volume group. A *logical-volume* can also be consumed by a service in the same way as a *device-group*. This allows services to manage their own devices on configurations that have limited numbers of disk drives.

Disk models also provide disk sizing information for virtual machine servers.

6.2.6 Memory Model

Memory models define how the memory of a server should be configured to meet the needs of a particular role. It allows a number of HugePages to be defined at both the server and numa-node level.

Memory models also provide memory sizing information for virtual machine servers.

Memory models are optional - it is valid to have a server role without a memory model.

6.2.7 CPU Model

CPU models define how CPUs of a server will be used. The model allows CPUs to be assigned for use by components such as Nova (for VMs) and Open vSwitch (for DPDK). It also allows those CPUs to be isolated from the general kernel SMP balancing and scheduling algorithms.

CPU models also provide CPU sizing information for virtual machine servers.

CPU models are optional - it is valid to have a server role without a cpu model.

6.2.8 Servers

Servers have a server-role which determines how they will be used in the cloud.

Servers (in the input model) enumerate the resources available for your cloud. In addition, in this definition file you can either provide HPE Helion OpenStack with all of the details it needs to PXE boot and install an operating system onto the server, or, if you prefer to use your own operating system installation tooling you can simply provide the details needed to be able to SSH into the servers and start the deployment.

The address specified for the server will be the one used by HPE Helion OpenStack for lifecycle management and must be part of a network which is in the input model. If you are using HPE Helion OpenStack to install the operating system this network must be an untagged VLAN. The first server must be installed manually from the HPE Helion OpenStack ISO and this server must be included in the input model as well.

In addition to the network details used to install or connect to the server, each server defines what its *server-role* is and to which *server-group* it belongs.

6.2.8.1 Virtual Machines as Servers

Starting in HPE Helion OpenStack 5.0, servers can be configured as hypervisors which host virtual machines that are can be defined, instantiated and configured as servers for hosting HPE Helion OpenStack services. Both the hypervisors and the VMs are treated as “servers” within the input model with additional attributes to define the relationship.

To define a hypervisor in the input model:

- Set the attribute `hlm-hypervisor: true` for the server.
- Define how network groups that are needed by the VMs will be mapped to the hypervisor's interfaces by adding `passthrough-network-groups` to the interface model of the hypervisor.

To define a virtual machine server in the input model:

- Create a server object that includes the `hypervisor-id` attribute. This indicates that the server is a virtual machine, and also identifies the physical server that will host the VM.
- Specify virtual machine CPU sizing information in the server's CPU model.
- Specify virtual machine memory sizing information in the server's memory model.
- Specify virtual machine disk sizing information in the server's disk model.
- Specify the virtual machine's network devices in the server's nic-mappings object.

Given the above information, HPE Helion OpenStack will configure the hypervisors and create thea virtual machines running the HPE Linux operating system. Subsequent configuration of the virtual machine's operating system, and installation and configuration of HPE Helion OpenStack services on that virtual machine server, use the same lifecycle management mechanisms as physical servers.

Note that a hypervisor can still be used to run HPE Helion OpenStack services, so for example a server can be both running VMs (that in turn are running API services, MySQL, etc) and also be running services that are better not virtualized such as Swift, VSA, etc.

6.2.9 Server Groups

A server is associated with a server-group.

A control-plane can use server-groups as failure zones for server allocation.

A server-group may be associated with a list of networks.

A server-group can contain other server-groups.

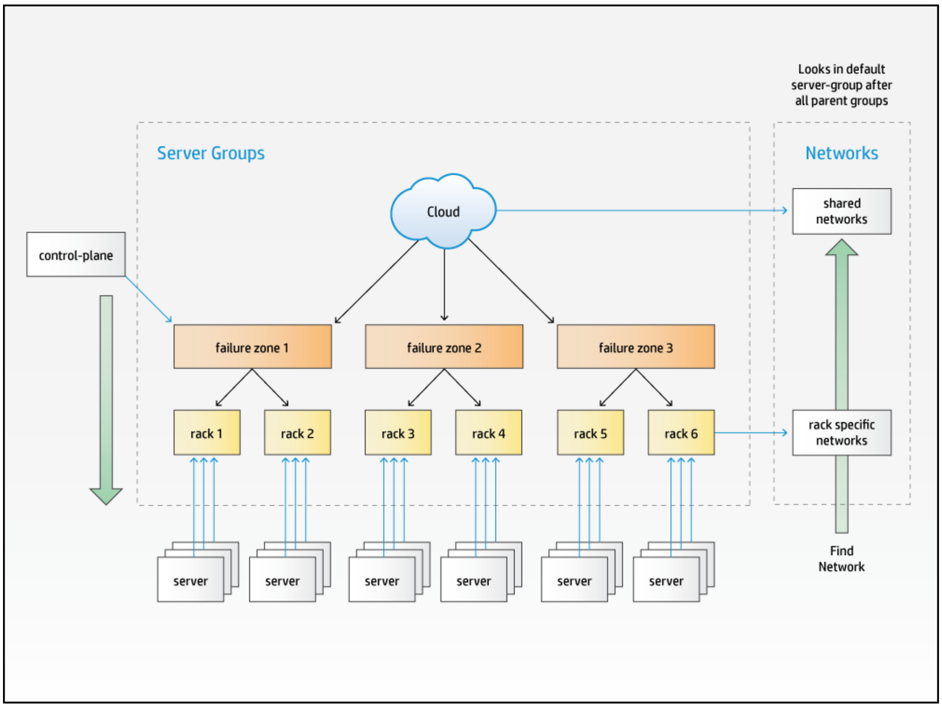
The practice of locating physical servers in a number of racks or enclosures in a data center is common. Such racks generally provide a degree of physical isolation that allows for separate power and/or network connectivity.

In the HPE Helion OpenStack model we support this configuration by allowing you to define a hierarchy of *server-groups*. Each *server* is associated with one *server-group*, normally at the bottom of the hierarchy.

Server-groups are an optional part of the input model - if you don't define any then all *servers* and *networks* will be allocated as if they are part of the same *server-group*.

6.2.9.1 Server Groups and Failure Zones

A *control-plane* defines a list of *server-groups* as the failure zones from which it wants to use servers. All servers in a *server-group* listed as a failure zone in the *control-plane* and any *server-groups* they contain are considered part of that failure zone for allocation purposes. The following example shows how three levels of *server-groups* can be used to model a failure zone consisting of multiple racks, each of which in turn contains a number of *servers*.



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When allocating *servers*, the configuration processor will traverse down the hierarchy of *server-groups* listed as failure zones until it can find an available server with the required *server-role*. If the allocation policy is defined to be strict, it will allocate *servers* equally across each of the failure zones. A *cluster* or *resource-group* can also independently specify the failure zones it wants to use if needed.

6.2.9.2 Server Groups and Networks

Each L3 *network* in a cloud must be associated with all or some of the *servers*, typically following a physical pattern (such as having separate networks for each rack or set of racks). This is also represented in the HPE Helion OpenStack model via *server-groups*, each group lists zero or more networks to which *servers* associated with *server-groups* at or below this point in the hierarchy are connected.

When the configuration processor needs to resolve the specific *network* a *server* should be configured to use, it traverses up the hierarchy of *server-groups*, starting with the group the server is directly associated with, until it finds a server-group that lists a network in the required network group.

The level in the *server-group* hierarchy at which a *network* is associated will depend on the span of connectivity it must provide. In the above example there might be networks in some *network-groups* which are per rack (i.e. Rack 1 and Rack 2 list different networks from the same *network-group*) and *networks* in a different *network-group* that span failure zones (the network used to provide floating IP addresses to virtual machines for example).

6.2.10 Networking

In addition to the mapping of *services* to specific *clusters* and *resources* we must also be able to define how the *services* connect to one or more *networks*.

In a simple cloud there may be a single L3 network but more typically there are functional and physical layers of network separation that need to be expressed.

Functional network separation provides different networks for different types of traffic; for example, it is common practice in even small clouds to separate the External APIs that users will use to access the cloud and the external IP addresses that users will use to access their virtual machines. In more complex clouds it's common to also separate out virtual networking between virtual machines, block storage traffic, and volume traffic onto their own sets of networks. In the input model, this level of separation is represented by *network-groups*.

Physical separation is required when there are separate L3 network segments providing the same type of traffic; for example, where each rack uses a different subnet. This level of separation is represented in the input model by the *networks* within each *network-group*.

6.2.10.1 Network Groups

Service endpoints attach to networks in a specific network-group.

Network-groups can define routes to other networks.

Network-groups encapsulate the configuration for services via network-tags

A *network-group* defines the traffic separation model and all of the properties that are common to the set of L3 networks that carry each type of traffic. They define where services are attached to the network model and the routing within that model.

In terms of *service* connectivity, all that has to be captured in the *network-groups* definition is the same service-component names that are used when defining *control-planes*. HPE Helion OpenStack also allows a default attachment to be used to specify "all service-components" that aren't explicitly connected to another *network-group*. So, for example, to isolate Swift traffic, the swift-account, swift-container, and swift-object service components are attached to an "Object" *network-group* and all other services are connected to "Management" *network-group* via the default relationship.

The details of how each service connects, such as what port it uses, if it should be behind a load balancer, if and how it should be registered in Keystone, and so forth, are defined in the service definition files provided by HPE Helion OpenStack.

In any configuration with multiple networks, controlling the routing is a major consideration. In HPE Helion OpenStack, routing is controlled at the *network-group* level. First, all *networks* are configured to provide the route to any other *networks* in the same *network-group*. In addition, a *network-group* may be configured to provide the route any other *networks* in the same *network-group*; for example, if the internal APIs are in a dedicated *network-group* (a common configuration in a complex network because a network group with load balancers cannot be segmented) then other *network-groups* may need to include a route to the internal API *network-group* so that services can access the internal API endpoints. Routes may also be required to define how to access an external storage network or to define a general default route.

As part of the HPE Helion OpenStack deployment, networks are configured to act as the default route for all traffic that was received via that network (so that response packets always return via the network the request came from).

Note that HPE Helion OpenStack will configure the routing rules on the servers it deploys and will validate that the routes between services exist in the model, but ensuring that gateways can provide the required routes is the responsibility of your network configuration. The configuration processor provides information about the routes it is expecting to be configured.

For a detailed description of how the configuration processor validates routes, refer to *Section 8.6, "Network Route Validation"*.

6.2.10.1.1 Load Balancers

Load-balancers provide a specific type of routing and are defined as a relationship between the virtual IP address (VIP) on a network in one *network group* and a set of service endpoints (which may be on *networks* in the same or a different *network-group*).

As each *load-balancer* is defined providing a virtual IP on a *network-group*, it follows that those *network-group*s can each only have one *network* associated to them.

The *load-balancer* definition includes a list of *service-components* and endpoint roles it will provide a virtual IP for. This model allows service-specific *load-balancers* to be defined on different *network-groups*. A "default" value is used to express "all service-components" which require a virtual IP address and are not explicitly configured in another *load-balancer* configuration. The details of how the *load-balancer* should be configured for each service, such as which ports to use, how to check for service liveness, etc, are provided in the HPE Helion OpenStack supplied service definition files.

Where there are multiple instances of a service (i.e in a cloud with multiple control-planes), each control-plane needs its own set of virtual IP address and different values for some properties such as the external name and security certificate. To accommodate this in HPE Helion OpenStack 5.0, load-balancers are defined as part of the control-plane, with the network groups defining just which load-balancers are attached to them.

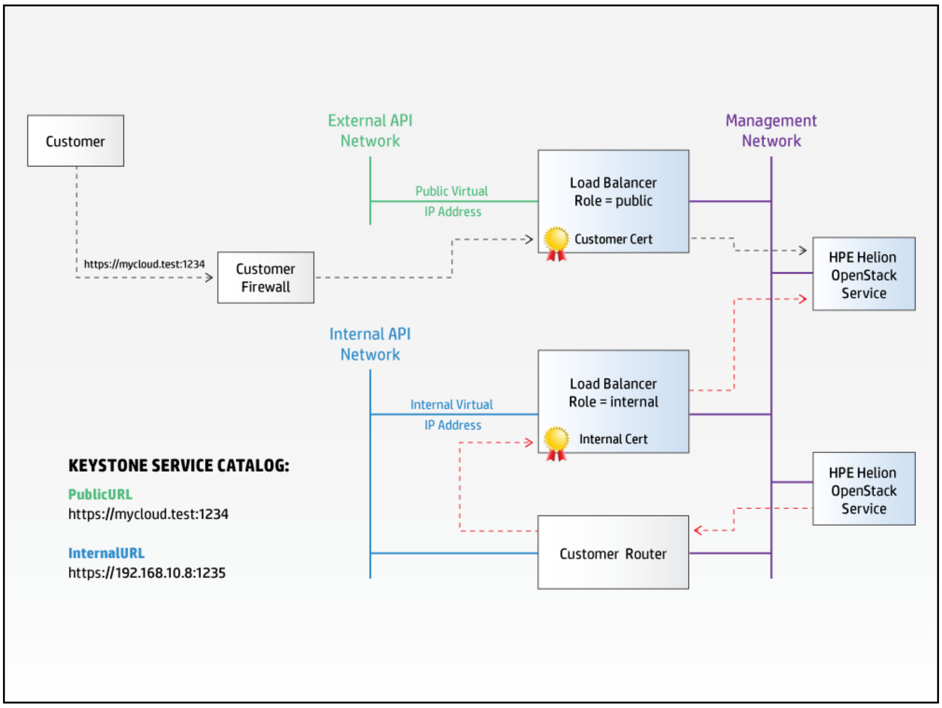
Load balancers are always implemented by an ha-proxy service in the same control-plane as the services.

6.2.10.1.2 Separation of Public, Admin, and Internal Endpoints

The list of endpoint roles for a *load-balancer* make it possible to configure separate *load-balancers* for public and internal access to services, and the configuration processor uses this information to both ensure the correct registrations in Keystone and to make sure the internal traffic is routed to the correct endpoint. HPE Helion OpenStack services are configured to only connect to other services via internal virtual IP addresses and endpoints, allowing the name and security certificate of public endpoints to be controlled by the customer and set to values that may not be resolvable/accessible from the servers making up the cloud.

Note that each *load-balancer* defined in the input model will be allocated a separate virtual IP address even when the load-balancers are part of the same *network-group*. Because of the need to be able to separate both public and internal access, HPE Helion OpenStack will not allow a single *load-balancer* to provide both public and internal access. *Load-balancers* in this context are logical entities (sets of rules to transfer traffic from a virtual IP address to one or more endpoints).

The following diagram shows a possible configuration in which the hostname associated with the public URL has been configured to resolve to a firewall controlling external access to the cloud. Within the cloud, HPE Helion OpenStack services are configured to use the internal URL to access a separate virtual IP address.



Download a high-res version (../../../../media/inputmodel/hphelionopenstack_loadbalancers_lg.p-ng)

6.2.10.1.3 Network Tags

Network tags are defined by some HPE Helion OpenStack *service-components* and are used to convey information between the network model and the service, allowing the dependent aspects of the service to be automatically configured.

Network tags also convey requirements a service may have for aspects of the server network configuration, for example, that a bridge is required on the corresponding network device on a server where that service-component is installed.

See for more information on specific tags and their usage.

6.2.10.2 Networks

A network is part of a network-group.

Networks are fairly simple definitions. Each *network* defines the details of its VLAN, optional address details (CIDR, start and end address, gateway address), and which *network-group* it is a member of.

6.2.10.3 Interface Model

A server-role identifies an interface-model that describes how its network interfaces are to be configured and used.

Network groups are mapped onto specific network interfaces via an *interface-model*, which describes the network devices that need to be created (bonds, ovs-bridges, etc) and their properties.

An *interface-model* acts like a template; it can define how some or all of the *network-groups* are to be mapped for a particular combination of physical NICs. However, it is the *service-components* on each server that determine which *network-groups* are required and hence which interfaces and *networks* will be configured. This means that *interface-models* can be shared between different *server-roles*. For example, an API role and a database role may share an interface model even though they may have different disk models and they will require a different subset of the *network-groups*.

Within an *interface-model*, physical ports are identified by a device name, which in turn is resolved to a physical port on a server basis via a *nic-mapping*. To allow different physical servers to share an *interface-model*, the *nic-mapping* is defined as a property of each *server*.

The `interface-model` can also used to describe how network devices are to be configured for use with DPDK, SR-IOV, and PCI Passthrough.

6.2.10.4 NIC Mapping

When a *server* has more than a single physical network port, a *nic-mapping* is required to unambiguously identify each port. Standard Linux mapping of ports to interface names at the time of initial discovery (e.g. eth0, eth1, eth2, ...) is not uniformly consistent from server to server, so a mapping of PCI bus address to interface name is instead.

NIC mappings are also used to specify the device type for interfaces that are to be used for SR-IOV or PCI Passthrough. Each HPE Helion OpenStack release includes the data for the supported device types.

6.2.10.5 Firewall Configuration

The configuration processor uses the details it has about which networks and ports *service-components* use to create a set of firewall rules for each server. The model allows additional user-defined rules on a per *network-group* basis.

6.2.11 Configuration Data

Configuration Data is used to provide settings which have to be applied in a specific context, or where the data needs to be verified against or merged with other values in the input model.

For example, when defining a Neutron provider network to be used by Octavia, the network needs to be included in the routing configuration generated by the Configuration Processor.

7 Configuration Objects

7.1 Cloud Configuration

The top-level cloud configuration file, *cloudConfig.yml*, defines some global values for the HPE Helion OpenStack Cloud, as described in the table below.

The snippet below shows the start of the control plane definition file.

```
---
  product:
    version: 2

  cloud:
    name: entry-scale-kvm-vsa

    hostname-data:
        host-prefix: helion
        member-prefix: -m

    ntp-servers:
        - "ntp-server1"

    # dns resolving configuration for your site
    dns-settings:
      nameservers:
        - name-server1

    firewall-settings:
        enable: true
        # log dropped packets
        logging: true

    audit-settings:
       audit-dir: /var/audit
       default: disabled
       enabled-services:
         - keystone
```

Key	Value Description
name	An administrator-defined name for the cloud

Key	Value Description
hostname-data (optional)	Provides control over some parts of the generated names (see) Consists of two values: • host-prefix - default is to use the cloud name (above) • member-prefix - default is "-m"
ntp-servers (optional)	A list of external NTP servers your cloud has access to. If specified by name then the names need to be resolvable via the external DNS nameservers you specify in the next section. All servers running the "ntp-server" component will be configured to use these external NTP servers.
dns-settings (optional)	DNS configuration data that will be applied to all servers. See example configuration for a full list of values.
smtp-settings (optional)	SMTP client configuration data that will be applied to all servers. See example configurations for a full list of values.
firewall-settings (optional)	Used to enable/disable the firewall feature and to enable/disable logging of dropped packets. The default is to have the firewall enabled.
audit-settings (optional)	Used to enable/disable the production of audit data from services. The default is to have audit disabled for all services.

7.2 Control Plane

The snippet below shows the start of the control plane definition file.

```
---
  product:
     version: 2

  control-planes:
     - name: control-plane-1
       control-plane-prefix: cp1
       region-name: region1
       failure-zones:
```

```
        - AZ1
        - AZ2
        - AZ3
      configuration-data:
        - NEUTRON-CONFIG-CP1
        - OCTAVIA-CONFIG-CP1
      common-service-components:
        - logging-producer
        - monasca-agent
        - freezer-agent
        - stunnel
        - lifecycle-manager-target
      clusters:
        - name: cluster1
          cluster-prefix: c1
          server-role: CONTROLLER-ROLE
          member-count: 3
          allocation-policy: strict
          service-components:
            - lifecycle-manager
            - ntp-server
            - swift-ring-builder
            - mysql
            - ip-cluster
            ...

      resources:
        - name: compute
          resource-prefix: comp
          server-role: COMPUTE-ROLE
          allocation-policy: any
          min-count: 0
          service-components:
             - ntp-client
             - nova-compute
             - nova-compute-kvm
             - neutron-l3-agent
             ...
```

Key	Value Description
name	This name identifies the control plane. This value is used to persist server allocations (see) and cannot be changed once servers have been allocated.

Key	Value Description
control-plane-prefix (optional)	The control-plane-prefix is used as part of the hostname (see). If not specified, the control plane name is used.
region-name	This name identifies the Keystone region within which services in the control plane will be registered. For clouds consisting of multiple control planes, this attribute should be omitted and the regions object should be used to set the region name (see Regions).
uses (optional)	Identifies the services this control will consume from other control planes (see Multiple control planes).
load-balancers (optional)	A list of load balancer definitions for this control plane (see Load balancer definitions in control planes). For a multi control-plane cloud load balancers must be defined in each control-plane. For a single control-plane cloud they may be defined either in the control plane or as part of a network group (compatibility with HPE Helion OpenStack 3.0)
common-service-components (optional)	This lists a set of service components that run on all servers in the control plane (clusters and resource pools)
failure-zones (optional)	A list of *server-group* names that servers for this control plane will be allocated from. If no failure-zones are specified, only servers not associated with a *server-group* will be used. (see *Section 6.2.9.1, "Server Groups and Failure Zones"*

Key	Value Description
	for a description of server-groups as failure zones.)
configuration-data (optional)	A list of configuration data settings to be used for services in this control plane (see *Section 6.2.11, "Configuration Data"*)
clusters	A list of clusters for this control plane (see *Section 7.2.1, "Clusters"*).
resources	A list of resource groups for this control plane (see *Section 7.2.2, "Resources"*).

7.2.1 Clusters

Key	Value Description
name	Cluster and resource names must be unique within a control plane. This value is used to persist server allocations (see *Section 8.3, "Persisted Data"*) and cannot be changed once servers have been allocated.
cluster-prefix (optional)	The cluster prefix is used in the hostname (see *Section 8.2, "Name Generation"*). If not supplied then the cluster name is used.
server-role	This can either be a string (for a single role) or a list of roles. Only servers matching one of the specified *server-roles* will be allocated to this cluster. (see *Section 6.2.4, "Server Roles"* for a description of server roles)
service-components	The list of *service-components* to be deployed on the servers allocated for the cluster. (The common-service-components for the control plane are also deployed.)

Key	Value Description
member-count min-count max-count (all optional)	Defines the number of servers to add to the cluster. The number of servers that can be supported in a cluster depends on the services it is running. For example MySQL and RabbitMQ can only be deployed on clusters on 1 (non-HA) or 3 (HA) servers. Other services may support different sizes of cluster. If min-count is specified, then at least that number of servers will be allocated to the cluster. If min-count is not specified it defaults to a value of 1. If max-count is specified, then the cluster will be limited to that number of servers. If max-count is not specified then all servers matching the required role and failure-zones will be allocated to the cluster. Specifying member-count is equivalent to specifying min-count and max-count with the same value.
failure-zones (optional)	A list of *server-groups* that servers will be allocated from. If specified, it overrides the list of values specified for the control-plane. If not specified, the control-plane value is used. (see *Section 6.2.9.1, "Server Groups and Failure Zones"* for a description of server groups as failure zones).
allocation-policy (optional)	Defines how failure zones will be used when allocating servers. **strict**: Server allocations will be distributed across all specified failure zones. (if max-count is not a whole number, an exact multi-

Key	Value Description
	ple of the number of zones, then some zones may provide one more server than other zones) **any**: Server allocations will be made from any combination of failure zones. The default allocation-policy for a cluster is *strict*.
configuration-data (optional)	A list of configuration-data settings that will be applied to the services in this cluster. The values for each service will be combined with any values defined as part of the configuration-data list for the control-plane. If a value is specified by settings in both lists, the value defined here takes precedence.

7.2.2 Resources

Key	Value Description
name	The name of this group of resources. Cluster names and resource-node names must be unique within a control plane. Additionally, clusters and resources cannot share names within a control-plane. This value is used to persist server allocations (see *Section 8.3, "Persisted Data"*) and cannot be changed once servers have been allocated.
resource-prefix	The resource-prefix is used in the name generation. (see *Section 8.2, "Name Generation"*)
server-role	This can either be a string (for a single role) or a list of roles. Only servers matching one

Key	Value Description
	of the specified *server-roles* will be allocated to this resource group. (see *Section 6.2.4, "Server Roles"* for a description of server roles).
service-components	The list of *service-components* to be deployed on the servers in this resource group. (The common-service-components for the control plane are also deployed.)
member-count min-count max-count (all optional)	Defines the number of servers to add to the cluster. The number of servers that can be supported in a cluster depends on the services it is running. For example MySQL and RabbitMQ can only be deployed on clusters on 1 (non-HA) or 3 (HA) servers. Other services may support different sizes of cluster. If min-count is specified, then at least that number of servers will be allocated to the cluster. If min-count is not specified it defaults to a value of 1. If max-count is specified, then the cluster will be limited to that number of servers. If max-count is not specified then all servers matching the required role and failure-zones will be allocated to the cluster. Specifying member-count is equivalent to specifying min-count and max-count with the same value.
failure-zones (optional)	A list of *server-groups* that servers will be allocated from. If specified, it overrides the list of values specified for the control-plane. If not specified, the control-plane value is used. (see *Section 6.2.9.1, "Server Groups and Failure Zones"*

Key	Value Description
	for a description of server groups as failure zones).
allocation-policy (optional)	Defines how failure zones will be used when allocating servers. **strict**: Server allocations will be distributed across all specified failure zones. (if max-count is not a whole number, an exact multiple of the number of zones, then some zones may provide one more server than other zones) **any**: Server allocations will be made from any combination of failure zones. The default allocation-policy for resources is *any*.
configuration-data (optional)	A list of configuration-data settings that will be applied to the services in this cluster. The values for each service will be combined with any values defined as part of the configuration-data list for the control-plane. If a value is specified by settings in both lists, the value defined here takes precedence.

7.2.3 Multiple Control Planes

The dependencies between service components (e.g. Nova needs MySql and Keystone API) is defined as part of the service definitions provide by HPE Helion OpenStack, the control-planes define how those dependencies will be met. For clouds consisting of multiple control-planes, the relationship between services in different control planes is defined by a `uses` attribute in its control-plane object. Services will always use other services in the same control-plane before looking to see if the required service can be provided from another control- plane. For example, a service component in control-plane `cp-2` (e.g. nova-api) might use service components from control-plane `cp-shared` (e.g. keystone-api).

```
control-planes:
  - name: cp-2
    uses:
      - from: cp-shared
        service-components:
          - any
```

Key	Value Description
from	The name of the control-plane providing services which may be consumed by this control-plane.
service-components	A list of service components from the specified control-plane which may be consumed by services in this control-plane. The reserved keyword `any` indicates that any service component from the specified control-plane may be consumed by services in this control-plane.

7.2.4 Load Balancer Definitions in Control Planes

Starting in HPE Helion OpenStack 5.0, a load-balancer may be defined within a control-plane object, and referenced by name from a network-groups object. The following example shows load balancer `extlb` defined in control-plane `cp1` and referenced from the EXTERNAL-API network group. See section Load balancers for a complete description of load balance attributes.

```
network-groups:
  - name: EXTERNAL-API
    load-balancers:
      - extlb

control-planes:
  - name: cp1
    load-balancers:
      - provider: ip-cluster
        name: extlb
        external-name:
        tls-components:
          - default
        roles:
```

```
      - public
    cert-file: cp1-extlb-cert
```

7.3 Load Balancers

Load balancers may be defined as part of a network-group object, or as part of a control-plane object. When a load-balancer is defined in a control-plane, it must be referenced by name only from the associated network-group object.

For clouds consisting of multiple control planes, load balancers must be defined as part of a control-plane object. This allows different load balancer configurations for each control plane.

In either case, a load-balancer definition has the following attributes:

```
load-balancers:
  - provider: ip-cluster
    name: extlb
    external-name:

    tls-components:
      - default
    roles:
      - public
    cert-file: cp1-extlb-cert
```

Key	Value Description
name	An administrator defined name for the load balancer. This name is used to make the association from a network-group.
provider	The service component that implements the load balancer. Currently only `ip-cluster` (ha-proxy) is supported. Future releases will provide support for external load balancers.
roles	The list of endpoint roles that this load balancer provides (see below). Valid roles are `public`, `internal`, and `admin`. To ensure separation of concerns, the role `public` cannot be combined with any other role. See Load

Key	Value Description
	Balancers for an example of how the role provides endpoint separation.
components (optional)	The list of service-components for which the load balancer provides a non-encrypted virtual IP address for.
tls-components (optional)	The list of service-components for which the load balancer provides TLS-terminated virtual IP addresses for.
external-name (optional)	The name to be registered in Keystone for the publicURL. If not specified, the virtual IP address will be registered. Note that this value cannot be changed after the initial deployment.
cert-file (optional)	The name of the certificate file to be used for tls endpoints. If not specified, a file name will be constructed using the format `<cp-name>-<lb-name>-cert`, where `cp-name` is the control-plane name and `lb-name` is the load-balancer name.

7.4 Regions

The regions configuration object is used to define how a set of services from one or more control-planes are mapped into Openstack regions (entries within the Keystone catalog).

Within each region a given service is provided by one control plane, but the set of services in the region may be provided by multiple control planes.

A service in a given control plane may be included in more than one region.

```
---
  product:
    version: 2

  regions:
```

```
  - name: region1
    includes:
      - control-plane: control-plane-1
        services:
          - all

  - name: region2
    includes:
      - control-plane: control-plane-1
        services:
          - keystone
          - glance
          - swift
          - designate
          - ceilometer
          - barbican
          - horizon
          - monasca
          - freezer
          - logging
          - operations
      - control-plane: control-plane-2
        services:
          - cinder
          - nova
          - neutron
          - octavia
          - heat
```

Key	Value Description
name	The name of the region in the Keystone service catalog.
includes	A list of services to include in this region, broken down by the control planes providing the services.

Key	Value Description
control-plane	A control-plane name.
services	A list of service names. This list specifies the services from this control-plane to be includ-

Key	Value Description
	ed in this region. The reserved keyword `all` may be used when all services from the control-plane are to be included.

7.5 Servers

The *servers* configuration object is used to list the available servers for deploying the cloud.

Optionally, it can be used as an input file to the operating system installation process, in which case some additional fields (identified below) will be necessary.

```
---
  product:
    version: 2

  baremetal:
    subnet: 192.168.10.0
    netmask: 255.255.255.0

  servers:
    - id: controller1
      ip-addr: 192.168.10.3
      role: CONTROLLER-ROLE
      server-group: RACK1
      nic-mapping: HP-DL360-4PORT
      mac-addr: b2:72:8d:ac:7c:6f
      ilo-ip: 192.168.9.3
      ilo-password: password
      ilo-user: admin

    - id: controller2
      ip-addr: 192.168.10.4
      role: CONTROLLER-ROLE
      server-group: RACK2
      nic-mapping: HP-DL360-4PORT
      mac-addr: 8a:8e:64:55:43:76
      ilo-ip: 192.168.9.4
      ilo-password: password
      ilo-user: admin
```

Key	Value Description
id	An administrator-defined identifier for the server. IDs must be unique and are used to track server allocations. (see *Section 8.3, "Persisted Data"*).
ip-addr	The IP address is used by the configuration processor to install and configure the service components on this server. This IP address must be within the range of a *network* defined in this model. When the servers file is being used for operating system installation, this IP address will be assigned to the node by the installation process, and the associated *network* must be an untagged VLAN.
hostname (optional)	The value to use for the hostname of the server. If specified this will be used to set the hostname value of the server which will in turn be reflected in systems such as Nova, Monasca, etc. If not specified the hostname will be derived based on where the server is used and the network defined to provide hostnames.
role	Identifies the *server-role* of the server. (see for a description of server roles)
nic-mapping	Name of the *nic-mappings* entry to apply to this server. (See *Section 7.12, "NIC Mappings"*.)
server-group (optional)	Identifies the *server-groups* entry that this server belongs to. (see *Section 6.2.9, "Server Groups"*)
boot-from-san (optional)	Must be set to true is the server needs to be configured to boot from SAN storage. Default is False

Key	Value Description
fcoe-interfaces (optional)	A list of network devices that will be used for accessing FCoE storage. This is only needed for devices that present as native FCoE, not devices such as Emulex which present as a FC device.
ansible-options (optional)	A string of additional variables to be set when defining the server as a host in Ansible. For example, `ansible_ssh_port=5986`
mac-addr (optional)	Needed when the servers file is being used for operating system installation. This identifies the MAC address on the server that will be used to network install the operating system.
distro-id (optional)	The name of the cobbler server profile to be used when the servers file is used for operating system installation. Supported values are: • hlinux-x86_64 (default) • rhel72-x86_64 • rhel72-x86_64-multipath **Important** RHEL is only supported for KVM compute hosts. Note that you need to add a -multipath suffix to the distro-id value when using multipath with RHEL.
kopt-extras (optional)	Provides additional command line arguments to be passed to the booting network kernel. For example, `vga=769` sets the video mode for the install to low resolution which can be useful for remote console users.

Key	Value Description
ilo-ip (optional)	Needed when the servers file is being used for operating system installation. This provides the IP address of the power management (e.g. IPMI, iLO) subsystem.
ilo-user (optional)	Needed when the servers file is being used for operating system installation. This provides the user name of the power management (e.g. ipmi-ip, iLO) subsystem.
ilo-password (optional)	Needed when the servers file is being used for operating system installation. This provides the user password of the power management (e.g. ipmi-ip, iLO) subsystem.
ilo-extras (optional)	Needed when the servers file is being used for operating system installation. Additional options to pass to ipmitool. For example, this may be required if the servers require additional IPMI addressing parameters.
moonshot (optional)	Provides the node identifier for HPE Moonshot servers, e.g. `c4n1` where c4 is the cartridge and n1 is node 1.
hypervisor-id (optional)	This attribute serves two purposes: it indicates that this server is a virtual machine (VM), and it specifies the server id of the HLM hypervisor that will host the VM.
hlm-hypervisor (optional)	When set to True, this attribute identifies a server as a HLM hypervisor. A HLM hypervisor is a server that may be used to host other servers that are themselves virtual machines. Default value is False.

7.6 Server Groups

The server-groups configuration object provides a mechanism for organizing servers and networks into a hierarchy that can be used for allocation and network resolution (see).

```
---
  product:
     version: 2

     - name: CLOUD
        server-groups:
         - AZ1
         - AZ2
         - AZ3
        networks:
         - EXTERNAL-API-NET
         - EXTERNAL-VM-NET
         - GUEST-NET
         - MANAGEMENT-NET

     #
     # Create a group for each failure zone
     #
     - name: AZ1
       server-groups:
         - RACK1

     - name: AZ2
       server-groups:
         - RACK2

     - name: AZ3
       server-groups:
         - RACK3

     #
     # Create a group for each rack
     #
     - name: RACK1
     - name: RACK2
     - name: RACK3
```

Key	Value Description
name	An administrator-defined name for the server group. The name is used to link server-groups

Key	Value Description
	together and to identify server-groups to be used as failure zones in a *control-plane*. (see *Section 7.2, "Control Plane"*)
server-groups (optional)	A list of server-group names that are nested below this group in the hierarchy. Each server group can only be listed in one other server group (i.e. in a strict tree topology).
networks (optional)	A list of network names (see *Section 6.2.10.2, "Networks"*). See *Section 6.2.9.2, "Server Groups and Networks"* for a description of how networks are matched to servers via server groups.

7.7 Server Roles

The server-roles configuration object is a list of the various server roles that you can use in your cloud. Each server role is linked to other configuration objects:

- Disk model (see)
- Interface model (see)
- Memory model (see)
- CPU model (see)

Server roles are referenced in the servers (see) configuration object above.

```
---
  product:
     version: 2

  server-roles:

     - name: CONTROLLER-ROLE
       interface-model: CONTROLLER-INTERFACES
       disk-model: CONTROLLER-DISKS
```

```
- name: COMPUTE-ROLE
  interface-model: COMPUTE-INTERFACES
  disk-model: COMPUTE-DISKS
  memory-model: COMPUTE-MEMORY
  cpu-model: COMPUTE-CPU


- name: VSA-ROLE
  interface-model: VSA-INTERFACES
  disk-model: VSA-DISKS
```

Key	Value Description
name	An administrator-defined name for the role.
interface-model	The name of the *interface-model* to be used for this server-role. Different server-roles can use the same interface-model.
disk-model	The name of the *disk-model* to use for this server-role. Different server-roles can use the same disk-model.
memory-model (optional)	The name of the *memory-model* to use for this server-role. Different server-roles can use the same memory-model.
cpu-model (optional)	The name of the *cpu-model* to use for this server-role. Different server-roles can use the same cpu-model.

7.8 Disk Models

The disk-models configuration object is used to specify how the directly attached disks on the server should be configured. It can also identify which service or service component consumes the disk, e.g. Swift object server, and provide service-specific information associated with the disk. It is also used to specify disk sizing information for virtual machine servers.

Disks can be used as raw devices or as logical volumes and the disk model provides a configuration item for each.

If the operating system has been installed by the HPE Helion OpenStack installation process then the root disk will already have been set up as a volume-group with a single logical-volume. This logical-volume will have been created on a partition identified, symbolically, in the configuration files as `/dev/sda_root`. This is due to the fact that different BIOS systems (UEFI, Legacy) will result in different partition numbers on the root disk.

```
---
  product:
     version: 2

  disk-models:
  - name: VSA-DISKS

    volume-groups:
       - ...
    device-groups:
       - ...
    vm-size:
       ...
```

Key	Value Description
name	The name of the disk-model that is referenced from one or more server-roles.
volume-groups	A list of volume-groups to be configured (see below). There must be at least one volume-group describing the root file system.
device-groups (optional)	A list of device-groups (see below)
vm-size (optional)	Disk sizing information for virtual machine servers (see below).

7.8.1 Volume Groups

The *volume-groups* configuration object is used to define volume groups and their constituent logical volumes.

Note that volume-groups are not exact analogs of device-groups. A volume-group specifies a set of physical volumes used to make up a volume-group that is then subdivided into multiple logical volumes.

The HPE Helion OpenStack operating system installation automatically creates a volume-group name "hlm-vg" on the first drive in the system. It creates a "root" logical volume there. The volume-group can be expanded by adding more physical-volumes (see examples). In addition, it is possible to create more logical-volumes on this volume-group to provide dedicated capacity for different services or file system mounts.

```
volume-groups:
  - name: hlm-vg
    physical-volumes:
      - /dev/sda_root

    logical-volumes:
      - name: root
        size: 35%
        fstype: ext4
        mount: /

      - name: log
        size: 50%
        mount: /var/log
        fstype: ext4
        mkfs-opts: -O large_file

      - ...

  - name: vg-comp
    physical-volumes:
      - /dev/sdb
    logical-volumes:
      - name: compute
        size: 95%
        mount: /var/lib/nova
        fstype: ext4
        mkfs-opts: -O large_file
```

Key	Value Descriptions
name	The name that will be assigned to the volume-group
physical-volumes	A list of physical disks that make up the volume group. As installed by the HPE Helion OpenStack operating system install process, the volume group "hlm-vg" will use a large partition (sda_root) on the first disk. This can be expanded by adding additional disk(s). **Important** Multipath storage should be listed as the corresponding `/dev/mapper/mpath<x>`
logical-volumes	A list of logical volume devices to create from the above named volume group.
name	The name to assign to the logical volume.
size	The size, expressed as a percentage of the entire volume group capacity, to assign to the logical volume.
fstype (optional)	The file system type to create on the logical volume. If nonE specified, the volume is not formatted.
mkfs-opts (optional)	Options, e.g. `-O large_file` to pass to the mkfs command.
mode (optional)	The `mode` changes the root file system mode bits, which can be either a symbolic representation or an octal number representing the bit patten for the new mode bits.

Key	Value Descriptions
mount (optional)	Mount point for the file system.
consumer attributes (optional, consumer dependent)	These will vary according to the service consuming the device group. The examples section provides sample content for the different services. Note, not all services support the use of logical volumes. VSA requires raw devices.

7.8.2 Device Groups

The device-groups configuration object provides the mechanism to make the whole of a physical disk available to a service.

```
device-groups:
    - name: vsa-data
      consumer:
        name: vsa
        usage: data
      devices:
        - name: /dev/sdc
    - name: vsa-cache
      consumer:
        name: vsa
        usage: adaptive-optimization
      devices:
        - name: /dev/sdb
```

Key	Value Descriptions
name	An administrator-defined name for the device group.
devices	A list of named devices to be assigned to this group. There must be at least one device in the group. Multipath storage should be listed as the corresponding /dev/mapper/mpath<x>

Key	Value Descriptions
consumer	Identifies the name of one of the storage services (e.g. one of the following: Swift, Cinder, Ceph, VSA, etc) that will consume the disks in this device group.
consumer attributes	These will vary according to the service consuming the device group. The examples section provides sample content for the different services.

7.8.3 Disk Sizing for Virtual Machine Servers

The vm-size configuration object specifies the names and sizes of disks to be created for a virtual machine server.

```
  vm-size:
    disks:
      - name: /dev/vda_root
        size: 1T
      - name: /dev/vdb
        size: 1T
      - name: /dev/vdc
        size: 1T
```

Key	Value Descriptions
disks	A list of disk names and sizes
name	Disk device name
size	The disk size in kilobytes, megabytes, gigabytes or terabytes specified as nX where: ***n*** is an integer greater than zero X is one of "K", "M" or "G"

7.9 Memory Models

The memory-models configuration object describes details of the optional configuration of Huge Pages. It also describes the amount of memory to be allocated for virtual machine servers.

The memory-model allows the number of pages of a particular size to be configured at the server level or at the numa-node level.

The following example would configure :

- five 2MB pages in each of numa nodes 0 and 1
- three 1GB pages (distributed across all numa nodes)
- six 2MB pages (distributed across all numa nodes)

```
memory-models:
  - name: COMPUTE-MEMORY-NUMA
    default-huge-page-size: 2M
    huge-pages:
      - size: 2M
        count: 5
        numa-node: 0
      - size: 2M
        count: 5
        numa-node: 1
      - size: 1G
        count: 3
      - size: 2M
        count: 6
  - name: VIRTUAL-CONTROLLER-MEMORY
    vm-size:
      ram: 6G
```

Key	Value Description
name	The name of the memory-model that is referenced from one or more server-roles.
default-huge-page-size (optional)	The default page size that will be used is specified when allocating huge pages. If not specified, the default is set by the operating system.
huge-pages	A list of huge page definitions (see below).

Key	Value Description
vm-size (optional)	Memory sizing information for virtual machine servers.

7.9.1 Huge Pages

Key	Value Description
size	The page size in kilobytes, megabytes, or gigabytes specified as *n*X where: ***n*** is an integer greater than zero **X** is one of "K", "M" or "G"
count	The number of pages of this size to create (must be greater than zero).
numa-node (optional)	If specified the pages will be created in the memory associated with this numa node. If not specified the pages are distributed across numa nodes by the operating system.

7.9.2 Memory Sizing for Virtual Machine Servers

Key	Value Description
ram	The amount of memory to be allocated for a virtual machine server in kilobytes, megabytes, or gigabytes specified as nX where: ***n*** is an integer greater than zero

Key	Value Description
	X is one of "K", "M" or "G"

7.10 CPU Models

The `cpu-models` configuration object describes how CPUs are assigned for use by service components such as Nova (for VMs) and Open vSwitch (for DPDK), and whether or not those CPUs are isolated from the general kernel SMP balancing and scheduling algorithms. It also describes the number of vCPUs for virtual machine servers.

```
---
  product:
     version: 2

  cpu-models:
    - name: COMPUTE-CPU
      assignments:
        - components:
            - nova-compute-kvm
          cpu:
            - processor-ids: 0-1,3,5-7
              role: vm
        - components:
            - openvswitch
          cpu:
            - processor-ids: 4,12
              isolate: False
              role: eal
            - processor-ids: 2,10
              role: pmd
    - name: VIRTUAL-CONTROLLER-CPU
      vm-size:
         vcpus: 4
```

cpu-models

Key	Value Description
name	An administrator-defined name for the cpu model.

Key	Value Description
assignments	A list of CPU assignments (see).
vm-size (optional)	CPU sizing information for virtual machine servers.

7.10.1 CPU Assignments

assignments

Key	Value Description
components	A list of components to which the CPUs will be assigned.
cpu	A list of CPU usage objects (see *Section 7.10.2, "CPU Usage"* below).

7.10.2 CPU Usage

cpu

Key	Value Description
processor-ids	A list of CPU IDs as seen by the operating system.
isolate (optional)	A boolean value which indicates if the CPUs are to be isolated from the general kernel SMP balancing and scheduling algorithms. The specified processor IDs will be configured in the Linux kernel isolcpus parameter. The default value is True.
role	A role within the component for which the CPUs will be used.

7.10.3 Components and Roles in the CPU Model

Component	Role	Description
nova-compute-kvm	vm	The specified processor IDs will be configured in the Nova vcpu_pin_set option.
openvswitch	eal	The specified processor IDs will be configured in the Open vSwitch DPDK EAL -c (coremask) option. Refer to the DPDK documentation for details.
	pmd	The specified processor IDs will be configured in the Open vSwitch pmd-cpu-mask option. Refer to the Open vSwitch documentation and the ovs-vswitchd.conf.db man page for details.

7.10.4 CPU sizing for virtual machine servers

Key	Value Description
vcpus	The number of vCPUs for a virtual machine server.

7.11 Interface Models

The interface-models configuration object describes how network interfaces are bonded and the mapping of network groups onto interfaces. Interface devices are identified by name and mapped to a particular physical port by the *nic-mapping* (see).

```
---
  product:
     version: 2

  interface-models:
     - name: INTERFACE_SET_CONTROLLER
       network-interfaces:
          - name: BONDED_INTERFACE
            device:
              name: bond0
            bond-data:
```

```
          provider: linux
          devices:
            - name: hed3
            - name: hed4
          options:
            mode: active-backup
            miimon: 200
            primary: hed3
        network-groups:
           - EXTERNAL_API
           - EXTERNAL_VM
           - GUEST

      - name: UNBONDED_INTERFACE
        device:
           name: hed0
        network-groups:
           - MGMT


    fcoe-interfaces:
      - name: FCOE_DEVICES
        devices:
          - eth7
          - eth8


  - name: INTERFACE_SET_DPDK
    network-interfaces:
      - name: BONDED_DPDK_INTERFACE
        device:
          name: bond0
        bond-data:
          provider: openvswitch
          devices:
            - name: dpdk0
            - name: dpdk1
          options:
            mode: active-backup
        network-groups:
           - GUEST
      - name: UNBONDED_DPDK_INTERFACE
        device:
           name: dpdk2
        network-groups:
           - PHYSNET2
    dpdk-devices:
```

```
      - devices:
          - name: dpdk0
          - name: dpdk1
          - name: dpdk2
            driver: igb_uio
        components:
          - openvswitch
        eal-options:
          - name: socket-mem
            value: 1024,0
          - name: n
            value: 2
        component-options:
          - name: n-dpdk-rxqs
            value: 64
```

Key	Value Description
name	An administrator-defined name for the interface model.
network-interfaces	A list of network interface definitions.
fcoe-interfaces (optional)	A list of network interfaces that will be used for Fibre Channel over Ethernet (FCoE). This is only needed for devices that present as a native FCoE device, not cards such as Emulex which present FCoE as a FC device. **Important** The devices must be "raw" device names, not names controlled via a nic-mapping.
dpdk-devices (optional)	A list of DPDK device definitions.

7.11.1 network-interfaces

The network-interfaces configuration object has the following attributes:

Key	Value Description
name	An administrator-defined name for the interface
device	A dictionary containing the network device name (as seen on the associated server) and associated properties (see *Section 7.11.1.1, "network-interfaces device"*F for details).
bond-data (optional)	See *Section 7.11.2, "Bonding"* for details.
network-groups (optional if forced-network-groups is defined)	A list of one or more ***network-groups*** (see *Section 7.13, "Network Groups"*) containing ***networks*** (see *Section 7.14, "Networks"*) that can be accessed via this interface. Networks in these groups will only be configured if there is at least one ***service-component*** on the server which matches the list of component-endpoints defined in the ***network-group***.
forced-network-groups (optional if network-groups is defined)	A list of one or more ***network-groups*** (see *Section 7.13, "Network Groups"*) containing ***networks*** (see *Section 7.14, "Networks"*) that can be accessed via this interface. Networks in these groups are always configured on the server.
passthrough-network-groups (optional)	A list of one or more network-groups (see *Section 7.13, "Network Groups"*) containing networks (see *Section 7.14, "Networks"*) that can be accessed by servers running as virtual machines on an HLM hypervisor server. Networks in these groups are not configured on the HLM hypervisor server unless they also are

Key	Value Description
	specified in the `network-groups` or `forced-network-groups` attributes.

7.11.1.1 network-interfaces device

network-interfaces device

The network-interfaces device configuration object has the following attributes:

Key	Value Description
name	When configuring a bond, this is used as the bond device name - the names of the devices to be bonded are specified in the bond-data section. If the interface is not bonded, this must be the name of the device specified by the nic-mapping (see NIC Mapping).
vf-count (optional)	Indicates that the interface is to be used for SR-IOV. The value is the number of virtual functions to be created. The associated device specified by the nic-mapping must have a valid nice-device-type. vf-count cannot be specified on bonded interfaces Interfaces used for SR-IOV must be associated with a network with `tagged-vlan: false`.
sriov-only (optional)	Only valid when vf-count is specified. If set to true then the interface is to be used for virtual functions only and the physical function will not be used. The default value is False.

Key	Value Description
pci-pt (optional)	If set to true then the interface is used for PCI passthrough. The default value is False.

7.11.2 Bonding

A *bond-data* definition is used to configure a bond device, and consists of the following attributes:

Key	Value Descriptions
provider	Identifies the software used to instantiate the bond device. The supported values are • **linux** to use the Linux bonding driver. • **windows** (for Windows hyperV servers) • **openvswitch** to use Open vSwitch bonding.
devices	A dictionary containing network device names used to form the bond. The device names must be the logical-name specified by the *nic-mapping* (see *Section 6.2.10.4, "NIC Mapping"*).
options	A dictionary containing bond configuration options. The *linux* provider options are described in the *Section 7.11.2.1, "Bond configuration options for the "linux" provider"* section. The *openvswitch* provider options are described in the *Section 7.11.2.2, "Bond Data Options for the "openvswitch" Provider"* section.

7.11.2.1 Bond configuration options for the "linux" provider

The Linux bonding driver supports a large number of parameters that control the operation of the bond, as described in the Linux Ethernet Bonding Driver HOWTO (https://www.kernel.org/doc/Documentation/networking/bonding.txt) document. The parameter names and values may be specified as key-value pairs in the `options` section of `bond-data`.

Options used in the HPE Helion OpenStack examples are:

Key	Value Descriptions
mode	Specifies the bonding policy. Possible values are: • balance-rr - Transmit packets in sequential order from the first available slave through the last. • active-backup - Only one slave in the bond is active. A different slave becomes active if, and only if, the active slave fails. • balance-xor - Transmit based on the selected transmit hash policy. • broadcast - Transmits everything on all slave interfaces. • 802.3ad - IEEE 802.3ad Dynamic link aggregation. • balance-tlb - Adaptive transmit load balancing: channel bonding that does not require any special switch support. • balance-alb - Adaptive load balancing: includes balance-tlb plus receive load balancing (rlb) for IPV4 traffic and does not require any special switch support.

Key	Value Descriptions
miimon	Specifies the MII link monitoring frequency in milliseconds. This determines how often the link state of each slave is inspected for link failures. Accepts values in milliseconds.
primary	The device to use as the primary when the mode is one of the possible values below: • active-backup • balance-tlb • balance-alb

7.11.2.2 Bond Data Options for the "openvswitch" Provider

The bond configuration options for Open vSwitch bonds are:

Key	Value Descriptions
mode	Specifies the bonding mode. Possible values include: • active-backup • balance – tcp • balance – slb Refer to the Open vSwitch `ovs-vswitchd.conf.db` man page for details.

7.11.2.3 Bond configuration options for the "windows" provider

Bond configuration options for windows bonds are:

Key	Value Descriptions
mode	Specifies the bonding mode. Possible values are: • SwitchIndependent • Static • LACP Refer to the Windows HyperV documentation for details.

7.11.3 fcoe-interfaces

The fcoe-interfaces configuration object has the following attributes:

Key	Value Description
name	An administrator-defined name for the group of FCOE interfaces
devices	A list of network devices that will be configured for FCOE Entries in this must be the name of a device specified by the nic-mapping (see *Section 7.12, “NIC Mappings”*).

7.11.4 dpdk-devices

The dpdk-devices configuration object has the following attributes:

Key	Value Descriptions
devices	A list of network devices to be configured for DPDK. See *Section 7.11.4.1, "dpdk-devices devices"*.
eal-options	A list of key-value pairs that may be used to set DPDK Environmental Abstraction Layer (EAL) options. Refer to the DPDK documentation for details. Note that the cpu-model should be used to specify the processor IDs to be used by EAL for this component. The EAL coremask (`-c`) option will be set automatically based on the information in the cpu-model, and so should not be specified here. See *Section 7.10, "CPU Models"*.
component-options	A list of key-value pairs that may be used to set component-specific configuration options.

7.11.4.1 dpdk-devices devices

The devices configuration object within dpdk-devices has the following attributes:

Key	Value Descriptions
name	The name of a network device to be used with DPDK. The device names must be the logical-name specified by the nic-mapping (see *Section 7.12, "NIC Mappings"*).

Key	Value Descriptions
driver (optional)	Defines the userspace I/O driver to be used for network devices where the native device driver does not provide userspace I/O capabilities. The default value is `igb_uio`.

7.11.4.2 DPDK component-options for the openvswitch component

The following options are supported for use with the openvswitch component:

Name	Value Descriptions
n-dpdk-rxqs	Number of rx queues for each DPDK interface. Refer to the Open vSwitch documentation and the `ovs-vswitchd.conf.db` man page for details.

Note that the cpu-model should be used to define the cpu affinity of the Open vSwitch PMD (Poll Mode Driver) threads. The Open vSwitch `pmd-cpu-mask` option will be set automatically based on the information in the cpu-model. See *Section 7.10, "CPU Models"*

7.12 NIC Mappings

The *nic-mappings* configuration object is used to ensure that the network device name used by the operating system always maps to the same physical device. A *nic-mapping* is associated to a *server* in the server definition file. (see). Devices should be named `hedN` to avoid name clashes with any other devices configured during the operating system install as well as any interfaces that are not being managed by HPE Helion OpenStack, ensuring that all devices on a baremetal machine are specified in the file. An excerpt from `nic_mappings.yml` illustrates:

```
---
  product:
    version: 2

  nic-mappings:
```

```
  - name: HP-DL360-4PORT
    physical-ports:
      - logical-name: hed1
        type: simple-port
        bus-address: "0000:07:00.0"

      - logical-name: hed2
        type: simple-port
        bus-address: "0000:08:00.0"
        nic-device-type: '8086:10fb'

      - logical-name: hed3
        type: multi-port
        bus-address: "0000:09:00.0"
        port-attributes:
            port-num: 0

      - logical-name: hed4
        type: multi-port
        bus-address: "0000:09:00.0"
        port-attributes:
            port-num: 1
```

Each entry in the *nic-mappings* list has the following attributes:

Key	Value Description
name	An administrator-defined name for the mapping. This name may be used in a server definition (see *Section 7.5, "Servers"*) to apply the mapping to that server.
physical-ports	A list containing device name to address mapping information.

Each entry in the *physical-ports* list has the following attributes:

Key	Value Description
logical-name	The network device name that will be associated with the device at the specified *bus-address*. The logical-name specified here can be used as a device name in network interface

Key	Value Description
	model definitions. (see *Section 7.11, "Interface Models"*)
type	The type of port. HPE Helion OpenStack 5.0 supports "simple-port" and "multi-port". Use "simple-port" if your device has a unique bus-address. Use "multi-port" if your hardware requires a "port-num" attribute to identify a single port on a multi-port device. An examples of such a device is: • Mellanox Technologies MT26438 [ConnectX VPI PCIe 2.0 5GT/s - IB QDR / 10GigE Virtualization+]
bus-address	PCI bus address of the port. Enclose the bus address in quotation marks so yaml does not misinterpret the embedded colon (:) characters. See *Book "Installation Guide", Chapter 2 "Pre-Installation Checklist"* for details on how to determine this value.
port-attributes (required if type is `multi-port`)	Provides a list of attributes for the physical port. The current implementation supports only one attribute, "port-num". Multi-port devices share a bus-address. Use the "port-num" attribute to identify which physical port on the multi-port device to map. See *Book "Installation Guide", Chapter 2 "Pre-Installation Checklist"* for details on how to determine this value.
nic-device-type (optional)	Specifies the PCI vendor ID and device ID of the port in the format of `<vendor_id>:<device_id>`, for example, `8086:10fb`.

7.12.1 NIC Mappings for Virtual Machine Servers

Virtual machine servers use the standard nic-mappings format described above, subject to the following constraints:

- logical name with unit number 0 (e.g. `hed0`) is not supported
- port type must be `simple-port`
- bus addresses must use the following sequence of values: 0000:01:01.0, 0000:01:02.0, 0000:01:03.0, etc.
- `port-attributes` is not supported
- `nic-device-type` is not supported
- in the interface model for the virtual machine server, the device at bus address `0000:01:01.0` (e.g. `hed1`) must host the network group associated with `ip-addr` attribute defined in the virtual machine server's server object

Here are example nic-mappings for virtual machine servers with one vNIC and four vNICs:

```
  - name: VIRTUAL-1PORT
    physical-ports:
      - logical-name: hed1
        type: simple-port
        bus-address: "0000:01:01.0"

  - name: VIRTUAL-4PORT
    physical-ports:
      - logical-name: hed1
        type: simple-port
        bus-address: "0000:01:01.0"
    physical-ports:
      - logical-name: hed2
        type: simple-port
        bus-address: "0000:01:02.0"
    physical-ports:
      - logical-name: hed3
        type: simple-port
        bus-address: "0000:01:03.0"
    physical-ports:
      - logical-name: hed4
        type: simple-port
        bus-address: "0000:01:04.0"
```

7.13 Network Groups

Network-groups define the overall network topology, including where service-components connect, what load balancers are to be deployed, which connections use TLS, and network routing. They also provide the data needed to map Neutron's network configuration to the physical networking.

```
---
  product:
     version: 2

  network-groups:

     - name: EXTERNAL-API
       hostname-suffix: extapi

       load-balancers:
         - provider: ip-cluster
           name: extlb
           external-name:

           tls-components:
             - default
           roles:
            - public
           cert-file: my-public-helion-cert

      - name: EXTERNAL-VM
        tags:
          - neutron.l3_agent.external_network_bridge

      - name: GUEST
        hostname-suffix: guest
        tags:
          - neutron.networks.vxlan

      - name: MANAGEMENT
        hostname-suffix: mgmt
        hostname: true

        component-endpoints:
          - default

        routes:
          - default
```

```
        load-balancers:
          - provider: ip-cluster
            name: lb
            components:
              - default
            roles:
              - internal
              - admin

        tags:
          - neutron.networks.vlan:
              provider-physical-network: physnet1
```

Key	Value Description
name	An administrator-defined name for the network group. The name is used to make references from other parts of the input model.
component-endpoints (optional)	The list of *service-components* that will bind to or need direct access to networks in this network-group.
hostname (optional)	If set to true, the name of the address associated with a network in this group will be used to set the hostname of the server. **Important** `hostname` **must** be set to `true` for one, and only one, of your network groups.
hostname-suffix (optional)	If supplied, this string will be used in the name generation (see *Section 8.2, "Name Generation"*). If not specified, the name of the network-group will be used.
load-balancers (optional)	A list of load balancers to be configured on networks in this network-group. Because load balances need a virtual IP address, any

Key	Value Description
	network group that contains a load balancer can only have one network associated with it. For clouds consisting of a single control plane, a load balancer may be fully defined within a `network-group` object. See Load balancer definitions in network groups. Starting in HPE Helion OpenStack 5.0, a load balancer may be defined within a `control-plane` object and referenced by name from a `network-group` object. See in control planes.
routes (optional)	A list of *network-groups* that networks in this group provide access to via their gateway. This can include the value `default` to define the default route. A network group with no services attached to it can be used to define routes to external networks. The name of a Neutron provide network defined via configuration-data (see *Section 7.16.2.1, "neutron-provider-networks"*) can also be included in this list.
tags (optional)	A list of network tags. Tags provide the linkage between the physical network configuration and the Neutron network configuration. Starting in HPE Helion OpenStack 5.0, network tags may be defined as part of a Neutron `configuration-data` object rather than as part of a `network-group` object (see *Section 7.16.2, "Neutron Configuration Data "*).

Key	Value Description
mtu (optional)	Specifies the MTU value required for networks in this network group If not specified a default value of 1500 is used. See on how MTU settings are applied to interfaces when there are multiple tagged networks on the same interface.

A load balancer definition has the following attributes:

Key	Value Description
name	An administrator-defined name for the load balancer.
provider	The service component that implements the load balancer. Currently only "ip-cluster" (haproxy) is supported. Future releases will provide support for external load balancers.
roles	The list of endpoint roles that this load balancer provides (see below). Valid roles are "public", "internal", and "admin'. To ensure separation of concerns, the role "public" cannot be combined with any other role. See *Section 6.2.10.1.1, "Load Balancers"* for an example of how the role provides endpoint separation.
components (optional)	The list of *service-components* for which the load balancer provides a non-encrypted virtual IP address for.
tls-components (optional)	The list of *service-components* for which the load balancer provides TLS-terminated virtual IP addresses for. In HPE Helion OpenStack 3.0, TLS is now supported for internal as well as public endpoints.

Key	Value Description
external-name (optional)	The name to be registered in Keystone for the publicURL. If not specified, the virtual IP address will be registered. Note that this value cannot be changed after the initial deployment.
cert-file (optional)	The name of the certificate file to be used for TLS endpoints.

7.14 Networks

A network definition represents a physical L3 network used by the cloud infrastructure. Note that these are different from the network definitions that are created/configured in Neutron, although some of the networks may be used by Neutron.

```
---
   product:
     version: 2

   networks:
     - name: NET_EXTERNAL_VM
       vlanid: 102
       tagged-vlan: true
       network-group: EXTERNAL_VM

     - name: NET_GUEST
       vlanid: 103
       tagged-vlan: true
       cidr: 10.1.1.0/24
       gateway-ip: 10.1.1.1
       network-group: GUEST

     - name: NET_MGMT
       vlanid: 100
       tagged-vlan: false
       cidr: 10.2.1.0/24
       addresses:
       - 10.2.1.10-10.2.1.20
       - 10.2.1.24
       - 10.2.1.30-10.2.1.36
```

```
      gateway-ip: 10.2.1.1
      network-group: MGMT
```

Key	Value Description
name	The name of this network. The network *name* may be used in a server-group definition (see *Section 7.6, "Server Groups"*) to specify a particular network from within a network-group to be associated with a set of servers.
network-group	The name of the associated network group.
vlanid (optional)	The IEEE 802.1Q VLAN Identifier, a value in the range 1 through 4094. A *vlanid* must be specified when *tagged-vlan* is true.
tagged-vlan (optional)	May be set to `true` or `false`. If true, packets for this network carry the *vlanid* in the packet header; such packets are referred to as VLAN-tagged frames in IEEE 802.1Q.
cidr (optional)	The IP subnet associated with this network.
addresses (optional)	A list of IP addresses or IP address ranges (specified as <start addr>-<end addr> from which server addresses may be allocated. The default value is the first host address within the CIDR (e.g. the .1 address). The `addresses` parameter provides more flexibility than the `start-address` and `end-address` parameters and so is the preferred means of specifying this data.
start-address (optional) (deprecated)	An IP address within the *CIDR* which will be used as the start of the range of IP addresses from which server addresses may be allocated. The default value is the first host address within the *CIDR* (e.g. the .1 address).

Key	Value Description
	Important This parameter is deprecated in favor of the new `addresses` parameter. This parameter may be removed in a future release.
end-address (optional) (deprecated)	An IP address within the *CIDR* which will be used as the end of the range of IP addresses from which server addresses may be allocated. The default value is the last host address within the *CIDR* (e.g. the .254 address of a /24). **Important** This parameter is deprecated in favor of the new `addresses` parameter. This parameter may be removed in a future release.
gateway-ip (optional)	The IP address of the gateway for this network. Gateway addresses must be specified if the associated *network-group* provides routes.

7.15 Firewall Rules

The configuration processor will automatically generate "allow" firewall rules for each server based on the services deployed and block all other ports. The firewall rules in the input model allow the customer to define additional rules for each network group.

Administrator-defined rules are applied after all rules generated by the Configuration Processor.

```
---
  product:
     version: 2
```

```
firewall-rules:

   - name: PING
     network-groups:
     - MANAGEMENT
     - GUEST
     - EXTERNAL-API
     rules:
     # open ICMP echo request (ping)
     - type: allow
       remote-ip-prefix:  0.0.0.0/0
       # icmp type
       port-range-min: 8
       # icmp code
       port-range-max: 0
       protocol: icmp
```

Key	Value Description
name	An administrator-defined name for the group of rules.
network-groups	A list of *network-group* names that the rules apply to. A value of "all" matches all network-groups.
rules	A list of rules. Rules are applied in the order in which they appear in the list, apart from the control provided by the "final" option (see above). The order between sets of rules is indeterminate.

7.15.1 Rule

Each rule in the list takes the following parameters (which match the parameters of a Neutron security group rule):

Key	Value Description
type	Must `allow`

Key	Value Description
remote-ip-prefix	Range of remote addresses in CIDR format that this rule applies to.
port-range-min port-range-max	Defines the range of ports covered by the rule. Note that if the protocol is `icmp` then port-range-min is the ICMP type and port-range-max is the ICMP code.
protocol	Must be one of `tcp`, `udp`, or `icmp`.

7.16 Configuration Data

Configuration data allows values to be passed into the model to be used in the context of a specific control plane or cluster. The content and format of the data is service specific.

```
---
  product:
    version: 2

  configuration-data:
    - name:  NEUTRON-CONFIG-CP1
      services:
        - neutron
      data:
        neutron_provider_networks:
        - name: OCTAVIA-MGMT-NET
          provider:
            - network_type: vlan
              physical_network: physnet1
              segmentation_id: 106
          cidr: 172.30.1.0/24
          no_gateway:  True
          enable_dhcp: True
          allocation_pools:
            - start: 172.30.1.10
              end: 172.30.1.250
          host_routes:
            # route to MANAGEMENT-NET-1
            - destination: 192.168.245.0/24
              nexthop:  172.30.1.1
```

```
    neutron_external_networks:
    - name: ext-net
      cidr: 172.31.0.0/24
      gateway: 172.31.0.1
      provider:
        - network_type: vlan
          physical_network: physnet1
          segmentation_id: 107
      allocation_pools:
        - start: 172.31.0.2
          end: 172.31.0.254

  network-tags:
    - network-group: MANAGEMENT
      tags:
        - neutron.networks.vxlan
        - neutron.networks.vlan:
            provider-physical-network: physnet1
    - network-group: EXTERNAL-VM
      tags:
        - neutron.l3_agent.external_network_bridge
```

Key	Value Description
name	An administrator-defined name for the set of configuration data.
services	A list of services that the data applies to. Note that these are service names (e.g. `neutron`, `octavia`, etc) not service-component names (`neutron-server`, `octavia-api`, etc).
data	A service specific data structure (see below).
network-tags (optional, Neutron-only)	A list of network tags. Tags provide the linkage between the physical network configuration and the Neutron network configuration. Starting in HPE Helion OpenStack 5.0, network tags may be defined as part of a Neutron `configuration-data` object rather than as part of a `network-group` object.

7.16.1 Neutron network-tags

Key	Value Description
network-group	The name of the network-group with which the tags are associated.
tags	A list of network tags. Tags provide the linkage between the physical network configuration and the Neutron network configuration. See section Network Tags.

7.16.2 Neutron Configuration Data

Key	Value Description
neutron-provider-networks	A list of provider networks that will be created in Neutron.
neutron-external-networks	A list of external networks that will be created in Neutron. These networks will have the “router:external” attribute set to True.

7.16.2.1 neutron-provider-networks

Key	Value Description
name	The name for this network in Neutron. This name must be distinct from the names of any Network Groups in the model to enable it to be included in the “routes” value of a network group.
provider	Details of network to be created

Key	Value Description
	• network_type • physical_network • segmentation_id These values are passed as `--provider:` options to the Neutron `net-create` command
cidr	The CIDR to use for the network. This is passed to the Neutron `subnet-create` command.
shared (optional)	A boolean value that specifies if the network can be shared. This value is passed to the Neutron `net-create` command.
allocation_pools (optional)	A list of start and end address pairs that limit the set of IP addresses that can be allocated for this network. These values are passed to the Neutron `subnet-create` command.
host_routes (optional)	A list of routes to be defined for the network. Each route consists of a `destination` in cidr format and a `nexthop` address. These values are passed to the Neutron `subnet-create` command.
gateway_ip (optional)	A gateway address for the network. This value is passed to the Neutron `subnet-create` command.
no_gateway (optional)	A Boolean value indicating that the gateway should not be distributed on this network.

Key	Value Description
	This is translated into the `no-gateway` option to the Neutron `subnet-create` command
enable_dhcp (optional)	A Boolean value indicating that DHCP should be enabled. The default if not specified is to not enable DHCP. This value is passed to the Neutron `subnet-create` command.

7.16.2.2 neutron-external-networks

Key	Value Description
name	The name for this network in Neutron. This name must be distinct from the names of any Network Groups in the model to enable it to be included in the “routes” value of a network group.
provider (optional)	The provider attributes are specified when using Neutron provider networks as external networks. Provider attributes should not be specified when the external network is configured with the `neutron.l3_agent.external_network_bridge`. Standard provider network attributes may be specified: • network_type • physical_network • segmentation_id

Key	Value Description
	These values are passed as `--provider:` options to the Neutron `net-create` command
cidr	The CIDR to use for the network. This is passed to the Neutron `subnet-create` command.
allocation_pools (optional)	A list of start and end address pairs that limit the set of IP addresses that can be allocated for this network. These values are passed to the Neutron `subnet-create` command.
gateway (optional)	A gateway address for the network. This value is passed to the Neutron `subnet-create` command.

7.16.3 Octavia Configuration Data

```
---
  product:
    version: 2

  configuration-data:
    - name: OCTAVIA-CONFIG-CP1
      services:
        - octavia
      data:
        amp_network_name: OCTAVIA-MGMT-NET
```

Key	Value Description
amp_network_name	The name of the Neutron provider network that Octavia will use for management access to load balancers.

7.16.4 Ironic Configuration Data

```
---
  product:
    version: 2

  configuration-data:
    - name:  IRONIC-CONFIG-CP1
      services:
        - ironic
      data:
        cleaning_network: guest-network
        enable_node_cleaning: true
        enable_oneview: false

        oneview_manager_url:
        oneview_username:
        oneview_encrypted_password:
        oneview_allow_insecure_connections:
        tls_cacert_file:
        enable_agent_drivers: true
```

Refer to the documentation on configuring Ironic for details of the above attributes.

7.16.5 Swift Configuration Data

```
---
  product:
    version: 2

  configuration-data:
  - name: SWIFT-CONFIG-CP1
    services:
      - swift
    data:
      control_plane_rings:
        swift-zones:
          - id: 1
            server-groups:
              - AZ1
          - id: 2
            server-groups:
              - AZ2
          - id: 3
            server-groups:
```

```
            - AZ3
        rings:
          - name: account
            display-name: Account Ring
            min-part-hours: 16
            partition-power: 12
            replication-policy:
              replica-count: 3

          - name: container
            display-name: Container Ring
            min-part-hours: 16
            partition-power: 12
            replication-policy:
              replica-count: 3

          - name: object-0
            display-name: General
            default: yes
            min-part-hours: 16
            partition-power: 12
            replication-policy:
              replica-count: 3
```

Refer to the documentation on *Section 12.10, "Understanding Swift Ring Specifications"* for details of the above attributes.

7.17 Pass Through

Through pass_through definitions, certain configuration values can be assigned and used.

```
product:
  version: 2

pass-through:
  global:
    esx_cloud: true
  servers:

      data:
        vmware:
          cert_check: false
          vcenter_cluster: Cluster1
          vcenter_id: BC9DED4E-1639-481D-B190-2B54A2BF5674
          vcenter_ip: 10.1.200.41
```

```
        vcenter_port: 443
        vcenter_username: administrator@vsphere.local
        id: 7d8c415b541ca9ecf9608b35b32261e6c0bf275a
```

Key	Value Description
global	These values will be used at the cloud level.
servers	These values will be assigned to a specific server(s) using the server-id.

8 Other Topics

8.1 Services and Service Components

		Service	Service Components

Compute	Virtual Machine Provisioning	nova	`nova-api`
			`nova-compute`
			`nova-compute-hyperv`
			`nova-compute-ironic`
			`nova-compute-kvm`
			`nova-conductor`
			`nova-console-auth`
			`nova-esx-compute-proxy`
			`nova-metadata`
			`nova-novncproxy`
			`nova-scheduler`
			`nova-scheduler-ironic`

	Bare Metal Provisioning	ironic	`ironic-api` `ironic-conductor`
	ESX Integration	eon	`eon-api` `eon-conductor`

Networking	Networking	neutron	`infoblox-ipam-agent`
			`neutron-dhcp-agent`
			`neutron-l2gateway-agent`
			`neutron-l3-agent`
			`neutron-lbaas-agent`
			`neutron-lbaasv2-agent`
			`neutron-metadata-agent`
			`neutron-ml2-plugin`
			`neutron-openvswitch-agent`
			`neutron-ovsvapp-agent`
			`neutron-server`

		Service	Service Components
			neutron-sriov-nic-agent neutron-vpn-agent
	Network Load Balancer	octavia	octavia-api octavia-health-manager
	Domain Name Service (DNS)	designate	designate-api designate-central designate-mdns designate-mdns-external designate-pool-manager designate-zone-manager
Storage	Ceph Storage	ceph	ceph-monitor ceph-osd ceph-osd-internal ceph-radosgw
	Block Storage	cinder	cinder-api cinder-backup cinder-scheduler cinder-volume
	Object Storage	swift	swift-account swift-common swift-container swift-object swift-proxy swift-ring-builder swift-rsync
	HPE Virtual Storage Array	vsa-storage	cmc-service vsa
Image	Image Management	glance	glance-api glance-registry

		Service	Service Components
Security	Key Management	barbican	`barbican-api` `barbican-worker`
	Identity and Authentication	keystone	`keystone-api`
Orchestration	Orchestration	heat	`heat-api` `heat-api-cfn` `heat-api-cloudwatch` `heat-engine`
Operations	Telemetry	ceilometer	`ceilometer-agent-notification` `ceilometer-api` `ceilometer-common` `ceilometer-polling`
	Backup and Recovery	freezer	`freezer-agent` `freezer-api`
	Helion Lifecycle Management	hlm	`hlm-ux-services` `lifecycle-manager` `lifecycle-manager-target`
	Dashboard	horizon	`horizon`
	Centralized Logging	logging	`logging-api` `logging-producer` `logging-rotate` `logging-server`
	Monitoring	monasca	`monasca-agent` `monasca-api` `monasca-dashboard` `monasca-liveness-check` `monasca-notifier` `monasca-persister` `monasca-threshold` `monasca-transform`

		Service	Service Components
	Operations Console	operations	`ops-console-web`
	Openstack Functional Test Suite	tempest	`tempest`

Foundation	Openstack Clients	clients	`barbican-client`
			`ceilometer-client`
			`cinder-client`
			`designate-client`
			`eon-client`
			`glance-client`
			`heat-client`
			`ironic-client`
			`keystone-client`
			`monasca-client`
			`neutron-client`
			`nova-client`
			`openstack-client`
			`swift-client`

	Supporting Services	foundation	`apache2`
			`bind`
			`bind-ext`
			`helion-ca`
			`influxdb`
			`ip-cluster`
			`kafka`
			`memcached`
			`mysql`
			`ntp-client`
			`ntp-server`
			`openvswitch`
			`powerdns`
			`powerdns-ext`
			`rabbitmq`
			`spark`
			`storm`
			`vertica`
			`zookeeper`

8.2 Name Generation

Names are generated by the configuration processor for all allocated IP addresses. A server connected to multiple networks will have multiple names associated with it. One of these may be assigned as the hostname for a server via the network-group configuration (see *Section 7.12, "NIC Mappings"*). Names are generated from data taken from various parts of the input model as described in the following sections.

Clusters

Names generated for servers in a cluster have the following form:

```
<cloud>-<control-plane>-<cluster><member-prefix><member_id>-<network>
```

Example: `helion-cp1-core-m1-mgmt`

Name	Description
<cloud>	Comes from the hostname-data section of the *cloud* object (see *Section 7.1, "Cloud Configuration"*)
<control-plane>	is the *control-plane* prefix or name (see *Section 7.2, "Control Plane"*)
<cluster>	is the *cluster-prefix* name (see *Section 7.2.1, "Clusters"*)
<member-prefix>	comes from the hostname-data section of the *cloud* object (see *Section 7.1, "Cloud Configuration"*)
<member_id>	is the ordinal within the cluster, generated by the configuration processor as servers are allocated to the cluster
<network>	comes from the *hostname-suffix* of the network group to which the network belongs (see *Section 7.12, "NIC Mappings"*).

Resource Nodes

Names generated for servers in a resource group have the following form:

```
<cloud>-<control-plane>-<resource-prefix><member_id>-<network>
```

Example: `helion-cp1-comp0001-mgmt`

Name	Description
<cloud>	Comes from the hostname-data section of the *cloud* object (see *Section 7.1, "Cloud Configuration"*).
<control-plane>	is the *control-plane* prefix or name (see *Section 7.2, "Control Plane"*).
<resource-prefix>	is the *resource-prefix* value name (see *Section 7.2.2, "Resources"*).
<member_id>	is the ordinal within the cluster, generated by the configuration processor as servers are allocated to the cluster, padded with leading zeroes to four digits.
<network>	comes from the *hostname-suffix* of the network group to which the network belongs to (see *Section 7.12, "NIC Mappings"*)

8.3 Persisted Data

The configuration processor makes allocation decisions on servers and IP addresses which it needs to remember between successive runs so that if new servers are added to the input model they don't disrupt the previously deployed allocations.

To allow users to make multiple iterations of the input model before deployment HPE Helion OpenStack will only persist data when the administrator confirms that they are about to deploy the results via the "ready-deployment" operation. To understand this better, consider the following example:

Imagine you have completed your HPE Helion OpenStack deployment with servers A, B, and C and you want to add two new compute nodes by adding servers D and E to the input model.

When you add these to the input model and re-run the configuration processor it will read the persisted data for A, B, and C and allocate D and E as new servers. The configuration processor now has allocation data for A, B, C, D, and E -- which it keeps in a staging area (actually a special branch in git) until we get confirmation that the configuration processor has done what you intended and you are ready to deploy the revised configuration.

If you notice that the role of E is wrong and it became a Swift node instead of a Nova node you need to be able to change the input model and re-run the configuration processor. This is fine because the allocations of D and E have not been confirmed, and so the configuration processor will re-read the data about A, B, C and re-allocate D and E now to the correct clusters, updating the persisted data in the staging area.

You can loop though this as many times as needed. Each time, the configuration processor is processing the deltas to what is deployed, not the results of the previous run. When you are ready to use the results of the configuration processor, you run `ready-deployment.yml` which commits the data in the staging area into the persisted data. The next run of the configuration processor will then start from the persisted data for A, B, C, D, and E.

8.3.1 Persisted Server Allocations

Server allocations are persisted by the administrator-defined server ID (see *Section 7.5, "Servers"*), and include the control plane, cluster/resource name, and ordinal within the cluster or resource group.

To guard against data loss, the configuration processor persists server allocations even when the server ID no longer exists in the input model -- for example, if a server was removed accidentally and the configuration processor allocated a new server to the same ordinal, then it would be very difficult to recover from that situation.

The following example illustrates the behavior:

A cloud is deployed with four servers with IDs of A, B, C, and D that can all be used in a resource group with `min-size=0` and `max-size=3`. At the end of this deployment they persisted state is as follows:

ID	Control Plane	Resource Group	Ordinal	State	Deployed As
A	ccp	compute	1	Allocated	mycloud-ccp-comp0001

ID	Control Plane	Resource Group	Ordinal	State	Deployed As
B	ccp	compute	2	Allocated	mycloud-ccp-comp0002
C	ccp	compute	3	Allocated	mycloud-ccp-comp0003
D				Available	

(In this example server D has not been allocated because the group is at its max size, and there are no other groups that required this server)

If server B is removed from the input model and the configuration processor is re-run, the state is changed to:

ID	Control Plane	Resource Group	Ordinal	State	Deployed As
A	ccp	compute	1	Allocated	mycloud-ccp-comp0001
B	ccp	compute	2	Deleted	
C	ccp	compute	3	Allocated	mycloud-ccp-comp0003
D	ccp	compute	4	Allocated	mycloud-ccp-comp0004

The details associated with server B are still retained, but the configuration processor will not generate any deployment data for this server. Server D has been added to the group to meet the minimum size requirement but has been given a different ordinal and hence will get different names and IP addresses than were given to server B.

If server B is added back into the input model the resulting state will be:

ID	Control Plane	Resource Group	Ordinal	State	Deployed As
A	ccp	compute	1	Allocated	mycloud-ccp-comp0001

ID	Control Plane	Resource Group	Ordinal	State	Deployed As
B	ccp	compute	2	Deleted	
C	ccp	compute	3	Allocated	mycloud-ccp-comp0003
D	ccp	compute	4	Allocated	mycloud-ccp-comp0004

The configuration processor will issue a warning that server B cannot be returned to the compute group because it would exceed the max-size constraint. However, because the configuration processor knows that server B is associated with this group it won't allocate it to any other group that could use it, since that might lead to data loss on that server.

If the max-size value of the group was increased, then server B would be allocated back to the group, with its previous name and addresses (`mycloud-cp1-compute0002`).

Note that the configuration processor relies on the server ID to identify a physical server. If the ID value of a server is changed the configuration processor will treat it as a new server. Conversely, if a different physical server is added with the same ID as a deleted server the configuration processor will assume that it is the original server being returned to the model.

You can force the removal of persisted data for servers that are no longer in the input model by running the configuration processor with the `remove_deleted_servers` option, like below:

```
cd ~/helion/hos/ansible
ansible-playbook -i hosts/localhost config-processor-run.yml -e
 remove_deleted_servers="y"
```

8.3.2 Persisted Address Allocations

The configuration processor persists IP address allocations by the generated name (see *Section 8.2, "Name Generation"* for how names are generated). As with servers. once an address has been allocated that address will remain allocated until the configuration processor is explicitly told that it is no longer required. The configuration processor will generate warnings for addresses that are persisted but no longer used.

You can remove persisted address allocations that are no longer used in the input model by running the configuration processor with the `free_unused_addresses` option, like below:

```
cd ~/helion/hos/ansible
ansible-playbook -i hosts/localhost config-processor-run.yml -e free_unused_addresses="y"
```

8.4 Server Allocation

The configuration processor allocates servers to a cluster or resource group in the following sequence:

1. Any *servers* that are persisted with a state of "allocated" are first returned to the *cluster* or *resource group*. Such servers are always allocated even if this contradicts the cluster size, failure-zones, or list of server roles since it is assumed that these servers are actively deployed.

2. If the *cluster* or *resource group* is still below its minimum size, then any *servers* that are persisted with a state of "deleted", but where the server is now listed in the input model (i.e. the server was removed but is now back), are added to the group providing they meet the *failure-zone* and *server-role* criteria. If they do not meet the criteria then a warning is given and the *server* remains in a deleted state (i.e. it is still not allocated to any other cluster or group). These *servers* are not part of the current deployment, and so you must resolve any conflicts before they can be redeployed.

3. If the *cluster* or *resource group* is still below its minimum size, the configuration processor will allocate additional *servers* that meet the *failure-zone* and *server-role* criteria. If the allocation policy is set to "strict" then the failure zones of servers already in the cluster or resource group are not considered until an equal number of servers has been allocated from each zone.

8.5 Server Network Selection

Once the configuration processor has allocated a *server* to a *cluster* or *resource group* it uses the information in the associated *interface-model* to determine which *networks* need to be configured. It does this by:

1. Looking at the *service-components* that are to run on the server (from the *control-plane* definition)
2. Looking to see which *network-group* each of those components is attached to (from the *network-groups* definition)
3. Looking to see if there are any *network-tags* related to a *service-component* running on this server, and if so, adding those *network-groups* to the list (also from the *network-groups* definition)
4. Looking to see if there are any *network-groups* that the *interface-model* says should be forced onto the server
5. It then searches the *server-group* hierarchy (as described in *Section 6.2.9.2, "Server Groups and Networks"*) to find a *network* in each of the *network-groups* it needs to attach to

If there is no *network* available to a server, either because the *interface-model* doesn't include the required *network-group*, or there is no *network* from that group in the appropriate part of the *server-groups* hierarchy, then the configuration processor will generate an error.

The configuration processor will also generate an error if the *server* address does not match any of the networks it will be connected to.

8.6 Network Route Validation

Once the configuration processor has allocated all of the required *servers* and matched them to the appropriate *networks*, it validates that all *service-components* have the required network routes to other *service-components*.

It does this by using the data in the services section of the input model which provides details of which *service-components* need to connect to each other. This data is not configurable by the administrator; however, it is provided as part of the HPE Helion OpenStack release.

For each *server*, the configuration processor looks at the list of *service-components* it runs and determines the network addresses of every other *service-component* it needs to connect to (depending on the service, this might be a virtual IP address on a load balancer or a set of addresses for the service).

If the target address is on a *network* that this *server* is connected to, then there is no routing required. If the target address is on a different *network*, then the Configuration Processor looks at each *network* the server is connected to and looks at the routes defined in the corresponding *network-group*. If the *network-group* provides a route to the *network-group* of the target address, then that route is considered valid.

Networks within the same *network-group* are always considered as routed to each other; *networks* from different *network-groups* must have an explicit entry in the `routes` stanza of the *network-group* definition. Routes to a named *network-group* are always considered before a "default" route.

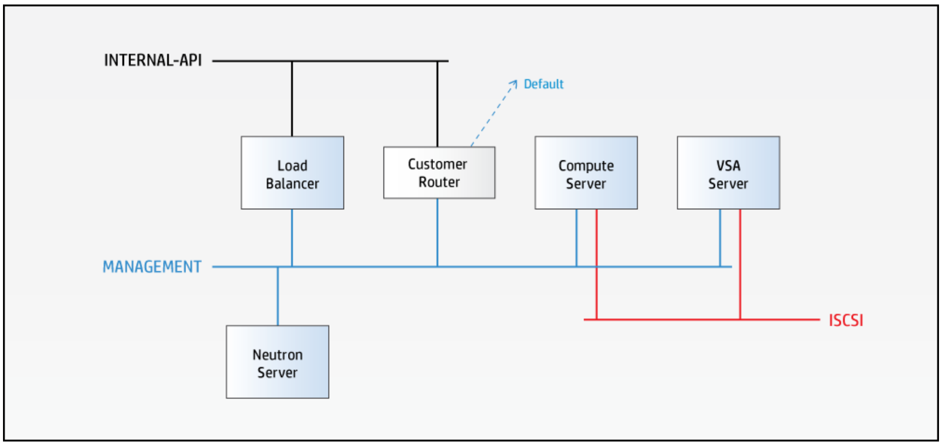
A warning is given for any routes which are using the "default" route since it is possible that the user did not intend to route this traffic. Such warning can be removed by adding the appropriate *network-group* to the list of routes.

The configuration processor provides details of all routes between networks that it is expecting to be configured in the `info/route_info.yml` file.

To illustrate how network routing is defined in the input model, consider the following example:

A compute server is configured to run nova-compute which requires access to the Neutron API servers and the VSA block storage service. The Neutron API servers have a virtual IP address provided by a load balancer in the INTERNAL-API network-group and the VSA service is connected to the ISCSI network-group. Nova-compute itself is part of the set of components attached by default to the MANAGEMENT network-group. The intention is to have virtual machines on the compute server connect to the VSA storage via the ISCSI network.

The physical network is shown below:



Download a high-res version (../../../../media/inputmodel/hphelionopenstack_networkroutevalidation_lg.png)

The corresponding entries in the *network-groups* are:

```
- name: INTERNAL-API
  hostname-suffix: intapi

  load-balancers:
     - provider: ip-cluster
       name: lb
       components:
         - default
       roles:
         - internal
         - admin

     - name: MANAGEMENT
       hostname-suffix: mgmt
       hostname: true

       component-endpoints:
         - default

       routes:
         - INTERNAL-API
         - default

     - name: ISCSI
       hostname-suffix: iscsi

       component-endpoints:
```

```
          - vsa
```

And the *interface-model* for the compute server looks like this:

```
 - name: INTERFACE_SET_COMPUTE
   network-interfaces:
     - name: BOND0
       device:
          name: bond0
       bond-data:
          options:
             mode: active-backup
             miimon: 200
             primary: hed5
          provider: linux
          devices:
             - name: hed4
             - name: hed5
       network-groups:
         - MANAGEMENT
         - ISCSI
```

When validating the route from nova-compute to the Neutron API, the configuration processor will detect that the target address is on a network in the INTERNAL-API network group, and that the MANAGEMENT network (which is connected to the compute server) provides a route to this network, and thus considers this route valid.

When validating the route from nova-compute to VSA, the configuration processor will detect that the target address is on a network in the ISCSI network group. However, because there is no service component on the compute server connected to the ISCSI network (according to the network-group definition) the ISCSI network will not have been configured on the compute server (see *Section 8.5, "Server Network Selection"*. The configuration processor will detect that the MANAGEMENT network-group provides a "default" route and thus considers the route as valid (it is, of course, valid to route ISCSI traffic); however, because this is using the default route, a warning will be issued:

```
#   route-generator-2.0       WRN: Default routing used between networks
The following networks are using a 'default' route rule. To remove this warning
either add an explicit route in the source network group or force the network to
attach in the interface model used by the servers.
  MANAGEMENT-NET-RACK1 to ISCSI-NET
    helion-ccp-comp0001
  MANAGEMENT-NET-RACK 2 to ISCSI-NET
    helion-ccp-comp0002
  MANAGEMENT-NET-RACK 3 to SCSI-NET
```

```
    helion-ccp-comp0003
```

To remove this warning, you can either add ISCSI to the list of routes in the MANAGEMENT network group (routed ISCSI traffic is still a valid configuration) or force the compute server to attach to the ISCSI network-group by adding it as a forced-network-group in the interface-model, like this:

```
  - name: INTERFACE_SET_COMPUTE
      network-interfaces:
        - name: BOND0
          device:
            name: bond0
          bond-data:
            options:
               mode: active-backup
               miimon: 200
               primary: hed5
            provider: linux
            devices:
               - name: hed4
               - name: hed5
          network-groups:
             - MANAGEMENT
          forced-network-groups:
             - ISCSI
```

With the attachment to the ISCSI network group forced, the configuration processor will attach the compute server to a network in that group and validate the route as either being direct or between networks in the same network-group.

The generated `route_info.yml` file will include entries such as the following, showing the routes that are still expected to be configured between networks in the MANAGEMENT network group and the INTERNAL-API network group.

```
  MANAGEMENT-NET-RACK1:
     INTERNAL-API-NET:
        default: false
        used_by:
           nova-compute:
              neutron-server:
              - helion-ccp-comp0001
   MANAGEMENT-NET-RACK2:
     INTERNAL-API-NET:
        default: false
        used_by:
          nova-compute:
```

```
        neutron-server:
        - helion-ccp-comp0003
```

8.7 Configuring Neutron Provider VLANs

Neutron provider VLANs are networks that map directly to an 802.1Q VLAN in the cloud provider's physical network infrastructure. There are four aspects to a provider VLAN configuration:

- Network infrastructure configuration (e.g. the top-of-rack switch)
- Server networking configuration (for compute nodes and Neutron network nodes)
- Neutron configuration file settings
- Creation of the corresponding network objects in Neutron

The physical network infrastructure must be configured to convey the provider VLAN traffic as tagged VLANs to the cloud compute nodes and Neutron network nodes. Configuration of the physical network infrastructure is outside the scope of the HPE Helion OpenStack 5.0 software.

HPE Helion OpenStack 5.0 automates the server networking configuration and the Neutron configuration based on information in the cloud definition. To configure the system for provider VLANs, specify the `neutron.networks.vlan` tag with a `provider-physical-network` attribute on one or more *network-groups* as described in . For example (some attributes omitted for brevity):

```
network-groups:

  - name: NET_GROUP_A
    tags:
      - neutron.networks.vlan:
            provider-physical-network: physnet1

  - name: NET_GROUP_B
    tags:
      - neutron.networks.vlan:
            provider-physical-network: physnet2
```

A *network-group* is associated with a server network interface via an *interface-model* as described in *Section 7.11, "Interface Models"*. For example (some attributes omitted for brevity):

```
interface-models:
```

```
    - name: INTERFACE_SET_X
      network-interfaces:
        - device:
              name: bond0
          network-groups:
            - NET_GROUP_A
        - device:
              name: hed3
          network-groups:
            - NET_GROUP_B
```

A *network-group* used for provider VLANs may contain only a single HPE Helion OpenStack *network*, because that VLAN must span all compute nodes and any Neutron network nodes/controllers (i.e. it is a single L2 segment). The HPE Helion OpenStack *network* must be defined with `tagged-vlan: false`, otherwise a linux VLAN network interface will be created. For example:

```
networks:
    - name: NET_A
      tagged-vlan: false
      network-group: NET_GROUP_A
    - name: NET_B
      tagged-vlan: false
      network-group: NET_GROUP_B
```

When the cloud is deployed, HPE Helion OpenStack 5.0 will create the appropriate bridges on the servers, and set the appropriate attributes in the Neutron configuration files (e.g. bridge_mappings).

After the cloud has been deployed, create Neutron network objects for each provider VLAN using the Neutron CLI:

```
neutron net-create --provider:network_type vlan --provider:physical_network physnet1 --
provider:segmentation_id 101 mynet101
```

```
neutron net-create --provider:network_type vlan --provider:physical_network physnet2 --
provider:segmentation_id 234 mynet234
```

8.8 Standalone Lifecycle Manager

All the examples use a “deployer-in-the-cloud” scenario where the first controller is also the deployer/lifecycle manager. If you want to use a standalone lifecycle manager, you will need to add the relevant details in `control_plane.yml`, `servers.yml` and related configuration files.

control_plane.yml

```
control-planes:
- clusters:
  - allocation-policy: strict
    cluster-prefix: c0
    member-count: 1
    name: c0
    server-role: DEPLOYER-ROLE
    service-components:
    - lifecycle-manager
    - ntp-server
```

servers.yml

```
servers:
- id: deployer
  ilo-ip: 10.1.8.73
  ilo-password: mul3d33r
  ilo-user: hosqaadm
  ip-addr: 10.240.20.21
  is-deployer: true
  mac-addr: 8c:dc:d4:b5:ce:18
  nic-mapping: HP-DL360-4PORT
  role: DEPLOYER-ROLE
  server-group: RACK1
```

server_roles.yml

```
server-roles:
- disk-model: DEPLOYER-600GB-DISKS
  interface-model: DEPLOYER-INTERFACES
  name: DEPLOYER-ROLE
```

disks_deployer_600GB.yml:

```
disk-models:
- device-groups:
  - consumer:
      attrs:
        rings:
        - account
        - container
        - object-0
      name: swift
    devices:
```

```
    - name: /dev/sdc
    - name: /dev/sdd
    - name: /dev/sde
    name: swiftobj
  name: DEPLOYER-600GB-DISKS
  volume-groups:
  - consumer:
      name: os
    logical-volumes:
    - fstype: ext4
      mount: /
      name: root
      size: 6%
...
```

9 Configuration Processor Information Files

In addition to producing all of the data needed to deploy and configure the cloud, the configuration processor also creates a number of information files that provide details of the resulting configuration.

These files can be found in `~/helion/my_cloud/info` after the first configuration processor run. This directory is also rebuilt each time the Configuration Processor is run.

Most of the files are in YAML format, allowing them to be used in further automation tasks if required.

File	Provides details of
`address_info.yml`	IP address assignments on each network. See *Section 9.1, "address_info.yml"*
`firewall_info.yml`	All ports that are open on each network by the firewall configuration. Can be used if you want to configure an additional firewall in front of the API network, for example. See *Section 9.2, "firewall_info.yml"*
`net_info.yml`	IP addresses assigned to services. For example, this provides the data needed to complete the configuration of VSA clusters. See *Section 9.3, "net_info.yml"*
`route_info.yml`	Routes that need to be configured between networks. See *Section 9.4, "route_info.yml"*
`server_info.yml`	How servers have been allocated, including their network configuration. Allows details of a server to be found from its ID. See *Section 9.5, "server_info.yml"*
`service_info.yml`	Details of where components of each service are deployed. See *Section 9.6, "service_info.yml"*

File	Provides details of
control_plane_topology.yml	Details the structure of the cloud from the perspective of each control-plane. See *Section 9.7, "control_plane_topology.yml"*
network_topology.yml	Details the structure of the cloud from the perspective of each control-plane. See *Section 9.8, "network_topology.yml"*
region_topology.yml	Details the structure of the cloud from the perspective of each region. See *Section 9.9, "region_topology.yml"*
service_topology.yml	Details the structure of the cloud from the perspective of each service. See *Section 9.10, "service_topology.yml"*
private_data_metadata.yml	Details the secrets that are generated by the configuration processor – the names of the secrets, along with the service(s) that use each secret and a list of the clusters on which the service that consumes the secret is deployed. See *Section 9.11, "private_data_metadata.yml"*
password_change.yml	Details the secrets that have been changed by the configuration processor – information for each secret is the same as for private_data_metadata.yml. See *Section 9.12, "password_change.yml"*
explain.txt	An explanation of the decisions the configuration processor has made when allocating servers and networks. See *Section 9.13, "explain.txt"*
CloudDiagram.txt	A pictorial representation of the cloud. See *Section 9.14, "CloudDiagram.txt"*

The examples are taken from the entry-scale-kvm-vsa example configuration.

9.1 address_info.yml

This file provides details of all the IP addresses allocated by the Configuration Processor:

```
<Network Groups>
   <List of Networks>
      <IP Address>
         <List of Aliases>
```

Example:

```
EXTERNAL-API:
   EXTERNAL-API-NET:
      10.0.1.2:
         - helion-cp1-c1-m1-extapi
      10.0.1.3:
         - helion-cp1-c1-m2-extapi
      10.0.1.4:
         - helion-cp1-c1-m3-extapi
      10.0.1.5:
         - helion-cp1-vip-public-SWF-PRX-extapi
         - helion-cp1-vip-public-FRE-API-extapi
         - helion-cp1-vip-public-GLA-API-extapi
         - helion-cp1-vip-public-HEA-ACW-extapi
         - helion-cp1-vip-public-HEA-ACF-extapi
         - helion-cp1-vip-public-NEU-SVR-extapi
         - helion-cp1-vip-public-KEY-API-extapi
         - helion-cp1-vip-public-MON-API-extapi
         - helion-cp1-vip-public-HEA-API-extapi
         - helion-cp1-vip-public-NOV-API-extapi
         - helion-cp1-vip-public-CND-API-extapi
         - helion-cp1-vip-public-CEI-API-extapi
         - helion-cp1-vip-public-SHP-API-extapi
         - helion-cp1-vip-public-OPS-WEB-extapi
         - helion-cp1-vip-public-HZN-WEB-extapi
         - helion-cp1-vip-public-NOV-VNC-extapi
EXTERNAL-VM:
   EXTERNAL-VM-NET: {}
GUEST:
   GUEST-NET:
      10.1.1.2:
         - helion-cp1-c1-m1-guest
      10.1.1.3:
         - helion-cp1-c1-m2-guest
      10.1.1.4:
         - helion-cp1-c1-m3-guest
      10.1.1.5:
```

```
        - helion-cp1-comp0001-guest
MANAGEMENT:
...
```

9.2 firewall_info.yml

This file provides details of all the network ports that will be opened on the deployed cloud. Data is ordered by network. If you want to configure an external firewall in front of the External API network, then you would need to open the ports listed in that section.

```
<Network Name>
   List of:
      <Port>
      <Protocol>
      <List of IP Addresses>
      <List of Components>
```

Example:

```
EXTERNAL-API:
-   addresses:
    - 10.0.1.5
    components:
    - horizon
    port: '443'
    protocol: tcp
-   addresses:
    - 10.0.1.5
    components:
    - keystone-api
    port: '5000'
    protocol: tcp
```

Port 443 (tcp) is open on network EXTERNAL-API for address 10.0.1.5 because it is used by Horizon

Port 5000 (tcp) is open on network EXTERNAL-API for address 10.0.1.5 because it is used by Keystone API

9.3 net_info.yml

This file provides details of IP addresses that have been allocated for a service. This data is typically used for service configuration after the initial deployment.

```
service_ips:
   <Service-Name>
       control_plane:  <Control Plane Name>
       cluster: <Cluster or Resource Name>
       network:  <Network Name>
       cluster_ip:
           hostname:  <Hostname alias of address allocated for the cluster>
           ip_address: <IP address allocated for the cluster>
       hosts: (list)
           hostname:  <Hostname of server in the cluster>
           ip_address: <IP address of server the cluster>
```

Example:

```
service_ips:
   vsa:
   -   cluster: vsa
       cluster_ip:
           hostname: helion-cp1-vsa-VSA-BLK-mgmt
           ip_address: 192.168.10.7
       control_plane: control-plane-1
       hosts:
       -   hostname: helion-cp1-vsa0001-VSA-BLK-mgmt
           ip_address: 192.168.10.2
       -   hostname: helion-cp1-vsa0002-VSA-BLK-mgmt
           ip_address: 192.168.10.8
       -   hostname: helion-cp1-vsa0003-VSA-BLK-mgmt
           ip_address: 192.168.10.12
       network: MANAGEMENT-NET
```

Resource group "vsa" in "control-plane-1" has been allocated 192.168.10.7 on network MANAGEMENT-NET as a cluster address and consists of 3 servers with addresses 192.168.10.2, 192.168.192.8, and 192.168.10.12.

9.4 route_info.yml

This file provides details of routes between networks that need to be configured. Available routes are defined in the input model as part of the *network-groups* data; this file shows which routes will actually be used. HPE Helion OpenStack will reconfigure routing rules on the servers, you must configure the corresponding routes within your physical network. Routes must be configured to be symmetrical -- only the direction in which a connection is initiated is captured in this file.

Note that simple models may not require any routes, with all servers being attached to common L3 networks. The following example is taken from the `tech-preview/mid-scale-kvm-vsa` example.

```
  <Source-Network-Name>
      <Target-Network-Name>
           default:   <true if this is this the result of a "default" route rule>
           used_by:
                <source-service>
                     <target-service>
                     <list of hosts using this route>
```

Example:

```
MANAGEMENT-NET-RACK1:
    INTERNAL-API-NET:
         default: false
         used_by:
            ceilometer-client:
            ceilometer-api:
            - helion-cp1-mtrmon-m1
            keystone-api:
            - helion-cp1-mtrmon-m1
     MANAGEMENT-NET-RACK2:
         default: false
         used_by:
            cinder-backup:
            rabbitmq:
            - helion-cp1-core-m1
```

*A route is required from network **MANAGEMENT-NET-RACK1** to network **INTERNAL-API-NET** so that **ceilometer-client** can connect to **ceilometer-api** from server **helion-cp1-mtrmon-m1** and to **keystone-api** from the same server.*

*A route is required from network **MANAGEMENT-NET-RACK1** to network **MANAGEMENT-NET-RACK2** so that **cinder-backup** can connect to **rabbitmq** from server **helion-cp1-core-m1***

9.5 server_info.yml

This file provides details of how servers have been allocated by the Configuration Processor. This provides the easiest way to find where a specific physical server (identified by `server-id`) is being used.

```
<Server-id>
      failure-zone: <failure zone that the server was allocated from>
      hostname: <hostname of the server>
      net_data: <network configuration>
      state: < "allocated" | "available" >
```

Example:

```
controller1:
      failure-zone: AZ1
      hostname: helion-cp1-c1-m1-mgmt
      net_data:
           BOND0:
                EXTERNAL-API-NET:
                    addr: 10.0.1.2
                    tagged-vlan: true
                    vlan-id: 101
                EXTERNAL-VM-NET:
                    addr: null
                    tagged-vlan: true
                    vlan-id: 102
                GUEST-NET:
                    addr: 10.1.1.2
                    tagged-vlan: true
                    vlan-id: 103
                MANAGEMENT-NET:
                    addr: 192.168.10.3
                    tagged-vlan: false
                    vlan-id: 100
      state: allocated
```

9.6 service_info.yml

This file provides details of how services are distributed across the cloud.

```
#60;control-plane>
    <service>
        <service component>
             <list of hosts>
```

Example:

```
control-plane-1:
      neutron:
```

```
            neutron-client:
               - helion-cp1-c1-m1-mgmt
               - helion-cp1-c1-m2-mgmt
               - helion-cp1-c1-m3-mgmt
            neutron-dhcp-agent:
               - helion-cp1-c1-m1-mgmt
               - helion-cp1-c1-m2-mgmt
               - helion-cp1-c1-m3-mgmt
            neutron-l3-agent:
                - helion-cp1-comp0001-mgmt
            neutron-lbaasv2-agent:
                - helion-cp1-comp0001-mgmt
         ...
```

9.7 control_plane_topology.yml

This file provides details of the topology of the cloud from the perspective of each control plane:

```
control_planes:
  <control-plane-name>
      load-balancers:
         <load-balancer-name>:
             address:  <IP address of VIP>
             cert-file:  <name of cert file>
             external-name: <name to used for endpoints>
             network: <name of the network this LB is connected to>
             network_group: <name of the network group this LB is connect to
             provider: <service component providing the LB>
             roles:  <list of roles of this LB>
             services:
                <service-name>:
                    <component-name>:
                        aliases:
                           <role>:  <Name in /etc/hosts>
                        host-tls:  <Boolean, true if connection from LB uses TLS>
                        hosts:  <List of hosts for this service>
                        port:  <port used for this component>
                        vip-tls: <Boolean, true if the VIP terminates TLS>
      clusters:
          <cluster-name>
              failure-zones:
                 <failure-zone-name>:
                    <list of hosts>
              services:
                 <service name>:
```

```
                components:
                   <list of service components>
                regions:
                   <list of region names>
    resources:
       <resource-name>:
           <as for clusters above>
```

Example:

```
  control_planes:
  control-plane-1:
      clusters:
          cluster1:
              failure_zones:
                  AZ1:
                  - helion-cp1-c1-m1-mgmt
                  AZ2:
                  - helion-cp1-c1-m2-mgmt
                  AZ3:
                  - helion-cp1-c1-m3-mgmt
              services:
                  barbican:
                      components:
                      - barbican-api
                      - barbican-worker
                      regions:
                      - region1
                                              …
      load-balancers:
          extlb:
              address: 10.0.1.5
              cert-file: my-public-entry-scale-kvm-vsa-cert
              external-name: ''
              network: EXTERNAL-API-NET
              network-group: EXTERNAL-API
              provider: ip-cluster
              roles:
              - public
              services:
                  barbican:
                      barbican-api:
                          aliases:
                              public: helion-cp1-vip-public-KEYMGR-API-extapi
                          host-tls: true
                          hosts:
                          - helion-cp1-c1-m1-mgmt
                          - helion-cp1-c1-m2-mgmt
```

```
                              - helion-cp1-c1-m3-mgmt
                              port: '9311'
                              vip-tls: true
```

9.8 network_topology.yml

This file provides details of the topology of the cloud from the perspective of each network_group:

```
network-groups:
  <network-group-name>:
      <network-name>:
          control-planes:
              <control-plane-name>:
                  clusters:
                     <cluster-name>:
                         servers:
                            <hlm-server-name>: <ip address>
                         vips:
                            <ip address>: <load balancer name>
                  resources:
                     <resource-group-name>:
                         servers:
                            <hlm-server-name>: <ip address>
```

Example:

```
   network_groups:
    EXTERNAL-API:
        EXTERNAL-API-NET:
            control_planes:
                control-plane-1:
                    clusters:
                        cluster1:
                            servers:
                                helion-cp1-c1-m1: 10.0.1.2
                                helion-cp1-c1-m2: 10.0.1.3
                                helion-cp1-c1-m3: 10.0.1.4
                            vips:
                                10.0.1.5: extlb
    EXTERNAL-VM:
        EXTERNAL-VM-NET:
            control_planes:
                control-plane-1:
```

```
                clusters:
                    cluster1:
                        servers:
                            helion-cp1-c1-m1: null
                            helion-cp1-c1-m2: null
                            helion-cp1-c1-m3: null
                resources:
                    compute:
                        servers:
                            helion-cp1-comp0001: null
```

9.9 region_topology.yml

This file provides details of the topology of the cloud from the perspective of each region:

```
regions:
  <region-name>:
      control-planes:
          <control-plane-name>:
              services:
                 <service-name>:
                     <list of service components>
```

Example:

```
regions:
    region1:
        control-planes:
            control-plane-1:
                services:
                    barbican:
                    - barbican-api
                    - barbican-worker
                    ceilometer:
                    - ceilometer-common
                    - ceilometer-agent-notification
                    - ceilometer-api
                    - ceilometer-polling
                    cinder:
                    - cinder-api
                    - cinder-volume
                    - cinder-scheduler
                    - cinder-backup
```

9.10 service_topology.yml

This file provides details of the topology of the cloud from the perspective of each service:

```
services:
    <service-name>:
        components:
            <component-name>:
                control-planes:
                    <control-plane-name>:
                        clusters:
                            <cluster-name>:
                                <list of servers>
                        resources:
                            <resource-group-name>:
                                <list of servers>
                        regions:
                            <list of regions>
```

Example:

```
services:
    freezer:
        components:
            freezer-agent:
                control_planes:
                    control-plane-1:
                        clusters:
                            cluster1:
                            - helion-cp1-c1-m1-mgmt
                            - helion-cp1-c1-m2-mgmt
                            - helion-cp1-c1-m3-mgmt
                        regions:
                        - region1
                        resources:
                            compute:
                            - helion-cp1-comp0001-mgmt
                            vsa:
                            - helion-cp1-vsa0001-mgmt
                            - helion-cp1-vsa0002-mgmt
                            - helion-cp1-vsa0003-mgmt
                        regions:
                        - region1
```

9.11 private_data_metadata.yml

This file provide details of the secrets that are generated by the configuration processor. The details include:

- The names of each secret
- Metadata about each secret. This is a list where each element contains details about each `component` service that uses the secret.
  - The `component` service that uses the secret, and if applicable the service that this component "consumes" when using the secret
  - The list of clusters on which the `component` service is deployed
  - The control plane `cp` on which the services are deployed
- A version number (the model version number)

```
<secret>
    <metadata>
         <list of metadata>
             <clusters>
                 <list of clusters>
             <component>
             <consumes>
             <control-plane>
     <version>
```

For example:

```
barbican_admin_password:
    metadata:
    -   clusters:
        - cluster1
        component: barbican-api
        cp: ccp
    version: '2.0'
keystone_swift_password:
    metadata:
    -   clusters:
        - cluster1
        component: swift-proxy
        consumes: keystone-api
        cp: ccp
    version: '2.0'
```

```
metadata_proxy_shared_secret:
    metadata:
    -   clusters:
        - cluster1
        component: nova-metadata
        cp: ccp
    -   clusters:
        - cluster1
        - compute
        component: neutron-metadata-agent
        cp: ccp
    version: '2.0'
    …
```

9.12 password_change.yml

This file provides details equivalent to those in private_data_metadata.yml for passwords which have been changed from their original values, using the procedure outlined in the HPE Helion OpenStack documentation

9.13 explain.txt

This file provides details of the server allocation and network configuration decisions the configuration processor has made. The sequence of information recorded is:

- Any service components that are automatically added
- Allocation of servers to clusters and resource groups
- Resolution of the network configuration for each server
- Resolution of the network configuration of each load balancer

Example:

```
        Add required services to control plane control-plane-1
        ======================================================
        control-plane-1: Added nova-metadata required by nova-api
        control-plane-1: Added swift-common required by swift-proxy
        control-plane-1: Added swift-rsync required by swift-account

        Allocate Servers for control plane control-plane-1
        ==================================================
```

```
        cluster: cluster1
        -----------------
          Persisted allocation for server 'controller1' (AZ1)
          Persisted allocation for server 'controller2' (AZ2)
          Searching for server with role ['CONTROLLER-ROLE'] in zones: set(['AZ3'])
          Allocated server 'controller3' (AZ3)

        resource: vsa
        -------------
          Persisted allocation for server 'vsa1' (AZ1)
          Persisted allocation for server 'vsa2' (AZ2)
          Persisted allocation for server 'vsa3' (AZ3)
          Searching for server with role ['VSA-ROLE'] in zones: set(['AZ1', 'AZ2',
 'AZ3'])

        resource: compute
        -----------------
          Persisted allocation for server 'compute1' (AZ1)
          Searching for server with role ['COMPUTE-ROLE'] in zones: set(['AZ1', 'AZ2',
 'AZ3'])

        Resolve Networks for Servers
        ============================
        server: helion-cp1-c1-m1
        ------------------------
          add EXTERNAL-API for component ip-cluster
          add MANAGEMENT for component ip-cluster
          add MANAGEMENT for lifecycle-manager (default)
          add MANAGEMENT for ntp-server (default)
          ...
          add MANAGEMENT for swift-rsync (default)
          add GUEST for tag neutron.networks.vxlan (neutron-openvswitch-agent)
          add EXTERNAL-VM for tag neutron.l3_agent.external_network_bridge (neutron-vpn-
agent)
          Using persisted address 10.0.1.2 for server helion-cp1-c1-m1 on network
 EXTERNAL-API-NET
          Using address 192.168.10.3 for server helion-cp1-c1-m1 on network MANAGEMENT-
NET
          Using persisted address 10.1.1.2 for server helion-cp1-c1-m1 on network GUEST-
NET

        …
        Define load balancers
        =====================

        Load balancer: extlb
```

```
       --------------------
         Using persisted address 10.0.1.5 for vip extlb helion-cp1-vip-extlb-extapi on
network EXTERNAL-API-NET
         Add nova-api for roles ['public'] due to 'default'
         Add glance-api for roles ['public'] due to 'default'
         ...

       Map load balancers to providers
       ===============================

       Network EXTERNAL-API-NET
       ------------------------
         10.0.1.5: ip-cluster nova-api roles: ['public'] vip-port: 8774 host-port: 8774
         10.0.1.5: ip-cluster glance-api roles: ['public'] vip-port: 9292 host-port:
 9292
         10.0.1.5: ip-cluster keystone-api roles: ['public'] vip-port: 5000 host-port:
 5000
         10.0.1.5: ip-cluster swift-proxy roles: ['public'] vip-port: 8080 host-port:
 8080
         10.0.1.5: ip-cluster monasca-api roles: ['public'] vip-port: 8070 host-port:
 8070
         10.0.1.5: ip-cluster heat-api-cfn roles: ['public'] vip-port: 8000 host-port:
 8000
         10.0.1.5: ip-cluster ops-console-web roles: ['public'] vip-port: 9095 host-
port: 9095
         10.0.1.5: ip-cluster heat-api roles: ['public'] vip-port: 8004 host-port: 8004
         10.0.1.5: ip-cluster nova-novncproxy roles: ['public'] vip-port: 6080 host-
port: 6080
         10.0.1.5: ip-cluster neutron-server roles: ['public'] vip-port: 9696 host-port:
 9696
         10.0.1.5: ip-cluster heat-api-cloudwatch roles: ['public'] vip-port: 8003 host-
port: 8003
         10.0.1.5: ip-cluster ceilometer-api roles: ['public'] vip-port: 8777 host-port:
 8777
         10.0.1.5: ip-cluster freezer-api roles: ['public'] vip-port: 9090 host-port:
 9090
         10.0.1.5: ip-cluster horizon roles: ['public'] vip-port: 443 host-port: 80
         10.0.1.5: ip-cluster cinder-api roles: ['public'] vip-port: 8776 host-port:
 8776
```

9.14 CloudDiagram.txt

This file provides a pictorial representation of the cloud. Although this file is still produced, it is superseded by the HTML output described in the following section.

Example:

```
        +-ControlPlane: region1 (control-
plane-1)---------------------------------------------------------------------------------------------------------
+
        |
                                                                              |
        | +-Cluster cluster1
 ()---------------------------------------------------------------------------------------------------------------
+ |
        | |
                                                                            | |
        | | +-helion-cp1-c1-m1 (192.168.10.3)-------------+    +-helion-cp1-c1-m2
 (192.168.10.4)-------------+    +-helion-cp1-c1-m3 (192.168.10.5)-------------+ | |
        | | |                                              |    |
                      |    |                                              | | |
        | | | ceilometer                                   |    | ceilometer
                      |    | ceilometer                                   | | |
        | | |   ceilometer-agent-central                   |    |   ceilometer-agent-
central                 |    |   ceilometer-agent-central                   | | |
        | | |   ceilometer-agent-notification              |    |   ceilometer-agent-
notification            |    |   ceilometer-agent-notification              | | |
        | | |   ceilometer-api                             |    |   ceilometer-api
                      |    |   ceilometer-api                             | | |
        | | |   ceilometer-client                          |    |   ceilometer-client
                      |    |   ceilometer-client                          | | |
        | | |   ceilometer-collector                       |    |   ceilometer-collector
                      |    |   ceilometer-collector                       | | |
        | | |   ceilometer-common                          |    |   ceilometer-common
                      |    |   ceilometer-common                          | | |
        | | |   ceilometer-expirer                         |    |   ceilometer-expirer
                      |    |   ceilometer-expirer                         | | |
        | | | cinder                                       |    | cinder
                      |    | cinder                                       | | |
        | | |   cinder-api                                 |    |   cinder-api
                      |    |   cinder-api                                 | | |
        | | |   cinder-backup                              |    |   cinder-backup
                      |    |   cinder-backup                              | | |
        | | |   cinder-client                              |    |   cinder-client
                      |    |   cinder-client                              | | |
        | | |   cinder-scheduler                           |    |   cinder-scheduler
                      |    |   cinder-scheduler                           | | |
        | | |   cinder-volume                              |    |   cinder-volume
                      |    |   cinder-volume                              | | |
        | | | foundation                                   |    | foundation
                      |    | foundation                                   | | |
```

```
        | | |   apache2                                   |    |   apache2
                       |    |   apache2                                 | | |
        | | |   ip-cluster                                |    |   ip-cluster
                       |    |   ip-cluster                              | | |
        | | |   kafka                                     |    |   kafka
                       |    |   kafka                                   | | |
        | | |   memcached                                 |    |   memcached
                       |    |   memcached                               | | |
        | | |   mysql                                     |    |   mysql
                       |    |   mysql                                   | | |
        | | |   ntp-server                                |    |   ntp-server
                       |    |   ntp-server                              | | |
        | | |   openstack-client                          |    |   openstack-client
                       |    |   openstack-client                        | | |
        | | |   rabbitmq                                  |    |   rabbitmq
                       |    |   rabbitmq                                | | |
                      | | |
        | | |   storm                                     |    |   storm
                       |    |   storm                                   | | |
        | | |   stunnel                                   |    |   stunnel
                       |    |   stunnel                                 | | |
        | | |   swift-common                              |    |   swift-common
                       |    |   swift-common                            | | |
        | | |   swift-rsync                               |    |   swift-rsync
                       |    |   swift-rsync                             | | |
        | | |   vertica                                   |    |   vertica
                       |    |   vertica                                 | | |
        | | |   zookeeper                                 |    |   zookeeper
                       |    |   zookeeper                               | | |
        | | | freezer                                     |    | freezer
                       |    | freezer                                   | | |
        | | |   freezer-agent                             |    |   freezer-agent
                       |    |   freezer-agent                           | | |
        | | |   freezer-api                               |    |   freezer-api
                       |    |   freezer-api                             | | |
        | | | glance                                      |    | glance
                       |    | glance                                    | | |
        | | |   glance-api                                |    |   glance-api
                       |    |   glance-api                              | | |
        | | |   glance-client                             |    |   glance-client
                       |    |   glance-client                           | | |
        | | |   glance-registry                           |    |   glance-registry
                       |    |   glance-registry                         | | |
        | | | heat                                        |    | heat
                       |    | heat                                      | | |
        | | |   heat-api                                  |    |   heat-api
                       |    |   heat-api                                | | |
```

```
        | | |   heat-api-cfn                                  |    |   heat-api-cfn
                      |    |   heat-api-cfn                                  | | |
        | | |   heat-api-cloudwatch                           |    |   heat-api-cloudwatch
                      |    |   heat-api-cloudwatch                           | | |
        | | |   heat-client                                   |    |   heat-client
                      |    |   heat-client                                   | | |
        | | |   heat-engine                                   |    |   heat-engine
                      |    |   heat-engine                                   | | |
        | | | horizon                                         |    | horizon
                      |    | horizon                                         | | |
        | | |   horizon                                       |    |   horizon
                      |    |   horizon                                       | | |
        | | | keystone                                        |    | keystone
                      |    | keystone                                        | | |
        | | |   keystone-api                                  |    |   keystone-api
                      |    |   keystone-api                                  | | |
        | | |   keystone-client                               |    |   keystone-client
                      |    |   keystone-client                               | | |
        | | | logging                                         |    | logging
                      |    | logging                                         | | |
        | | |   logging-producer                              |    |   logging-producer
                      |    |   logging-producer                              | | |
        | | |   logging-server                                |    |   logging-server
                      |    |   logging-server                                | | |
        | | | monasca                                         |    | monasca
                      |    | monasca                                         | | |
        | | |   monasca-agent                                 |    |   monasca-agent
                      |    |   monasca-agent                                 | | |
        | | |   monasca-api                                   |    |   monasca-api
                      |    |   monasca-api                                   | | |
        | | |   monasca-client                                |    |   monasca-client
                      |    |   monasca-client                                | | |
        | | |   monasca-notifier                              |    |   monasca-notifier
                      |    |   monasca-notifier                              | | |
        | | |   monasca-persister                             |    |   monasca-persister
                      |    |   monasca-persister                             | | |
        | | |   monasca-threshold                             |    |   monasca-threshold
                      |    |   monasca-threshold                             | | |
        | | | neutron                                         |    | neutron
                      |    | neutron                                         | | |
        | | |   neutron-client                                |    |   neutron-client
                      |    |   neutron-client                                | | |
        | | |   neutron-dhcp-agent                            |    |   neutron-dhcp-agent
                      |    |   neutron-dhcp-agent                            | | |
        | | |   neutron-metadata-agent                        |    |   neutron-metadata-
agent                      |    |   neutron-metadata-agent                       | | |
```

```
        | | |   neutron-ml2-plugin                            |    |   neutron-ml2-plugin
                      |    |   neutron-ml2-plugin                          | | |
        | | |   neutron-openvswitch-agent                     |    |   neutron-openvswitch-
agent                  |    |   neutron-openvswitch-agent                  | | |
        | | |   neutron-server                                |    |   neutron-server
                      |    |   neutron-server                              | | |
        | | |   neutron-vpn-agent                             |    |   neutron-vpn-agent
                      |    |   neutron-vpn-agent                           | | |
        | | | nova                                            |    | nova
                      |    | nova                                          | | |
        | | |   nova-api                                      |    |   nova-api
                      |    |   nova-api                                    | | |
        | | |   nova-client                                   |    |   nova-client
                      |    |   nova-client                                 | | |
        | | |   nova-conductor                                |    |   nova-conductor
                      |    |   nova-conductor                              | | |
        | | |   nova-console-auth                             |    |   nova-console-auth
                      |    |   nova-console-auth                           | | |
        | | |   nova-metadata                                 |    |   nova-metadata
                      |    |   nova-metadata                               | | |
        | | |   nova-novncproxy                               |    |   nova-novncproxy
                      |    |   nova-novncproxy                             | | |
        | | |   nova-scheduler                                |    |   nova-scheduler
                      |    |   nova-scheduler                              | | |
        | | | operations                                      |    | operations
                      |    | operations                                    | | |
        | | |   lifecycle-manager                             |    |   lifecycle-manager
                      |    |   lifecycle-manager                           | | |
        | | |   lifecycle-manager-target                      |    |   lifecycle-manager-
target                   |    |   lifecycle-manager-target                  | | |
        | | |   ops-console-monitor                           |    |   ops-console-monitor
                      |    |   ops-console-monitor                         | | |
        | | |   ops-console-web                               |    |   ops-console-web
                      |    |   ops-console-web                             | | |
        | | | swift                                           |    | swift
                      |    | swift                                         | | |
        | | |   swift-account                                 |    |   swift-account
                      |    |   swift-account                               | | |
        | | |   swift-client                                  |    |   swift-client
                      |    |   swift-client                                | | |
        | | |   swift-container                               |    |   swift-container
                      |    |   swift-container                             | | |
        | | |   swift-object                                  |    |   swift-object
                      |    |   swift-object                                | | |
        | | |   swift-proxy                                   |    |   swift-proxy
                      |    |   swift-proxy                                 | | |
```

```
        | | |   swift-ring-builder                         |    |   swift-ring-builder
                      |    |   swift-ring-builder                        | | |
        | | | vsa-storage                                  |    | vsa-storage
                      |    | vsa-storage                                 | | |
        | | |   cmc-service                                |    |   cmc-service
                      |    |   cmc-service                               | | |
        | | |                                              |    |
                      |    |                                             | | |
        | | | --------------------------------------------
 |    | -------------------------------------------- |    |
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        | | |                                              |    |
                      |    |                                             | | |
        | | | bond0 (hed3, hed4)                           |    | bond0 (hed3, hed4)
                      |    | bond0 (hed3, hed4)                          | | |
        | | |   EXTERNAL-API-NET (10.0.1.2)                |    |   EXTERNAL-API-NET
 (10.0.1.3)                |    |   EXTERNAL-API-NET (10.0.1.4)               | | |
        | | |   EXTERNAL-VM-NET                            |    |   EXTERNAL-VM-NET
                      |    |   EXTERNAL-VM-NET                           | | |
        | | |   GUEST-NET (10.1.1.2)                       |    |   GUEST-NET (10.1.1.3)
                      |    |   GUEST-NET (10.1.1.4)                      | | |
        | | |   MANAGEMENT-NET (192.168.10.3)              |    |   MANAGEMENT-NET
 (192.168.10.4)              |    |   MANAGEMENT-NET (192.168.10.5)             | | |
        | | |                                              |    |
                      |    |                                             | | |
        | | +----------------------------------------------
+    +--------------------------------------------+
 +--------------------------------------------+ | |
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+ |
        |
                                                                             |
        | +-compute------------------------------------------+
                                                                             |
        | |                                                  |
                                                                             |
        | | +-COMPUTE-ROLE (AZ1) (1 servers)---------------+ |
                                                                             |
        | | |                                              | |
                                                                             |
        | | | foundation                                   | |
                                                                             |
        | | |   ntp-client                                 | |
                                                                             |
```

```
| | |   stunnel                                   | |
                                                                  |
| | | freezer                                     | |
                                                                  |
| | |   freezer-agent                             | |
                                                                  |
| | | logging                                     | |
                                                                  |
| | |   logging-producer                          | |
                                                                  |
| | | monasca                                     | |
                                                                  |
| | |   monasca-agent                             | |
                                                                  |
| | | neutron                                     | |
                                                                  |
| | |   neutron-l3-agent                          | |
                                                                  |
| | |   neutron-lbaasv2-agent                     | |
                                                                  |
| | |   neutron-metadata-agent                    | |
                                                                  |
| | |   neutron-openvswitch-agent                 | |
                                                                  |
| | | nova                                        | |
                                                                  |
| | |   nova-compute                              | |
                                                                  |
| | |   nova-compute-kvm                          | |
                                                                  |
| | | operations                                  | |
                                                                  |
| | |   lifecycle-manager-target                  | |
                                                                  |
| | |                                             | |
                                                                  |
| | | ------------------------------------------- | |
                                                                  |
| | |                                             | |
                                                                  |
| | | bond0 (hed3, hed4)                          | |
                                                                  |
| | |   EXTERNAL-VM-NET                           | |
                                                                  |
| | |   GUEST-NET (10.1.1.0/24)                   | |
                                                                  |
```

```
        | | |   MANAGEMENT-NET (192.168.10.0/24)           | |
                                                                             |
        | | |                                              | |
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        | | +----------------------------------------------+ |
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        | +--------------------------------------------------+
                                                                             |
        |
                                                                             |
        | +-
vsa-----------------------------------------------------------------------------------------------------
+ |
        | |
                                                                           | |
        | | +-VSA-ROLE (AZ1) (1 servers)-------------------+    +-VSA-ROLE (AZ2) (1
 servers)-------------------+    +-VSA-ROLE (AZ3) (1 servers)-------------------+ | |
        | | |                                              |    |
                      |    |                                              | | |
        | | | foundation                                   |    | foundation
                      |    | foundation                                   | | |
        | | |   ntp-client                                 |    |   ntp-client
                      |    |   ntp-client                                 | | |
        | | |   stunnel                                    |    |   stunnel
                      |    |   stunnel                                    | | |
        | | | freezer                                      |    | freezer
                      |    | freezer                                      | | |
        | | |   freezer-agent                              |    |   freezer-agent
                      |    |   freezer-agent                              | | |
        | | | logging                                      |    | logging
                      |    | logging                                      | | |
        | | |   logging-producer                           |    |   logging-producer
                      |    |   logging-producer                           | | |
        | | | monasca                                      |    | monasca
                      |    | monasca                                      | | |
        | | |   monasca-agent                              |    |   monasca-agent
                      |    |   monasca-agent                              | | |
        | | | operations                                   |    | operations
                      |    | operations                                   | | |
        | | |   lifecycle-manager-target                   |    |   lifecycle-manager-
target                   |    |   lifecycle-manager-target                   | | |
        | | | vsa-storage                                  |    | vsa-storage
                      |    | vsa-storage                                  | | |
        | | |   vsa                                        |    |   vsa
                      |    |   vsa                                        | | |
        | | |                                              |    |
                      |    |                                              | | |
```

```
       | | | --------------------------------------------
 |    | -------------------------------------------- |    |
 -------------------------------------------- | | |
       | | |                                              |    |
                     |    |                                              | | |
       | | | bond0 (hed3, hed4)                           |    | bond0 (hed3, hed4)
                     |    | bond0 (hed3, hed4)                           | | |
       | | |   MANAGEMENT-NET (192.168.10.0/24)           |    |   MANAGEMENT-NET
 (192.168.10.0/24)          |    |   MANAGEMENT-NET (192.168.10.0/24)          | | |
       | | |                                              |    |
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```

9.15 HTML Representation

An HTML representation of the cloud can be found in `~/helion/my_cloud/html` after the first Configuration Processor run. This directory is also rebuilt each time the Configuration Processor is run. These files combine the data in the input model with allocation decisions made by the Configuration processor to allow the configured cloud to be viewed from a number of different perspectives.

Most of the entries on the HTML pages provide either links to other parts of the HTML output or additional details via hover text.

Cloud: entry-scale-kvm-vsa

[Control Plane View] [Region View] [Service View] [Network View] [Server View] [Server Groups View]

control-plane-1

	Clusters	Resources		Load Balancers	
	cluster1 barbican ceilometer cinder designate freezer glance heat horizon keystone logging monasca neutron nova octavia operations swift tempest vsa-storage foundation clients hlm	**vsa** freezer logging monasca vsa-storage foundation hlm	**compute** freezer logging monasca neutron nova foundation hlm	**extlb** barbican ceilometer cinder designate freezer glance heat horizon keystone logging monasca neutron nova operations swift hlm 10.0.1.5	**lb** barbican ceilometer cinder designate freezer glanc heat horizo keysto loggir monas neutron nova octavia operations swift foundation hlm 192.168.10.13
AZ1	helion-cp1-c1-m1-mgmt	helion-cp1-vsa0001-mgmt	helion-cp1-comp0001-mgmt		
AZ2	helion-cp1-c1-m2-mgmt	helion-cp1-vsa0002-mgmt			
AZ3	helion-cp1-c1-m3-mgmt	helion-cp1-vsa0003-mgmt			

freezer-api (9090) TLS
helion-cp1-vip-admin-FRE-API-mgmt
helion-cp1-vip-FRE-API-mgmt
hosts:
helion-cp1-c1-m1-mgmt
helion-cp1-c1-m2-mgmt
helion-cp1-c1-m3-mgmt

Cloud: entry-scale-kvm-vsa

[Control Plane View] [Region View] [Service View] [Network View] [Server View] [Server Groups View]

Network Topology

	control-plane-1		
	Clusters	**Resources**	
	cluster1	**vsa**	**compute**
EXTERNAL-API	EXTERNAL-API-NET		
MANAGEMENT	MANAGEMENT-NET	MANAGEMENT-NET	MANAGEMENT-NET
GUEST	GUEST-NET		GUEST-NET
EXTERNAL-VM	EXTERNAL-VM-NET		EXTERNAL-VM-NET
OCTAVIA-MGMT-NET			

Network Groups

EXTERNAL-API

Network Group	Networks	Address	Server	Interface Model
Components: powerdns-ext Load Balancers: extlb control-plane-1	EXTERNAL-API-NET vlan id: 101 (tagged) cidr: 10.0.1.0/24 gateway-ip: 10.0.1.1 mtu: 1500	10.0.1.4 10.0.1.3 10.0.1.2 10.0.1.5	helion-cp1-c1-m3 helion-cp1-c1-m2 helion-cp1-c1-m1 extlb	CONTROLLER-INTERFACES

10 Example Configurations

The HPE Helion OpenStack 5.0 system ships with a collection of pre-qualified example configurations. These are designed to help you to get up and running quickly with a minimum number of configuration changes.

The HPE Helion OpenStack input model allows a wide variety of configuration parameters that may, at first glance, appear daunting. The example configurations are designed to simplify this process by providing pre-built and pre-qualified examples that need only a minimum number of modifications to get started.

10.1 HPE Helion OpenStack Example Configurations

This section briefly describes the various example configurations and their capabilities. It also describes in detail, for the entry-scale-kvm-vsa example, how you can adapt the input model to work in your environment.

The following pre-qualified examples are shipped with HPE Helion OpenStack 5.0:

Name	Location
Section 10.4.1, "Entry-scale KVM with VSA Model"	`~/helion/examples/entry-scale-kvm-vsa`
Section 10.4.2, "Entry-scale KVM with VSA model with Dedicated Cluster for Metering, Monitoring, and Logging"	`~/helion/examples/entry-scale-kvm-vsa-mml`
Section 10.4.3, "Entry-scale KVM with Ceph Model"	`~/helion/examples/entry-scale-kvm-ceph`
Section 10.4.4, "Mid-scale KVM with VSA Model"	`~/helion/examples/mid-scale-kvm-vsa`
	`~/helion/examples/entry-scale-esx-kvm-vsa`
	`~/helion/examples/entry-scale-esx-kvm-vsa-mml`
Section 10.6.1, "Entry-scale Swift Model"	`~/helion/examples/entry-scale-swift`

Name	Location
Section 10.7.1, "Entry-scale Cloud with Ironic Flat Network"	`~/helion/examples/entry-scale-ironic-flat-network`
Section 10.7.2, "Entry-scale Cloud with Ironic Multi-Tenancy"	`~/helion/examples/entry-scale-ironic-multi-tenancy`

The entry-scale systems are designed to provide an entry-level solution that can be scaled from a small number of nodes to a moderately high node count (approximately 100 compute nodes, for example).

In the mid-scale model, the cloud control plane is subdivided into a number of dedicated service clusters to provide more processing power for individual control plane elements. This enables a greater number of resources to be supported (compute nodes, Swift object servers). This model also shows how a segmented network can be expressed in the HPE Helion OpenStack model.

10.2 Modifying the Entry-scale KVM with VSA Model for Your Environment

This section covers the changes that need to be made to the input model to deploy and run this cloud model in your environment.

- *Section 11.1, "Localizing the Input Model"*
- *Section 11.2, "Customizing the Input Model"*

10.3 Alternative Configurations

In HPE Helion OpenStack 5.0 there are alternative configurations that we recommend for specific purposes and this section we will outline them.

-
-
- *Section 13.4, "Using a Dedicated Lifecycle Manager Node"*

- *Section 13.5, “Configuring HPE Helion OpenStack without DVR”*
- *Section 13.6, “Configuring HPE Helion OpenStack with Provider VLANs and Physical Routers Only”*
- *Section 13.7, “Considerations When Installing Two Systems on One Subnet”*

10.4 KVM Examples

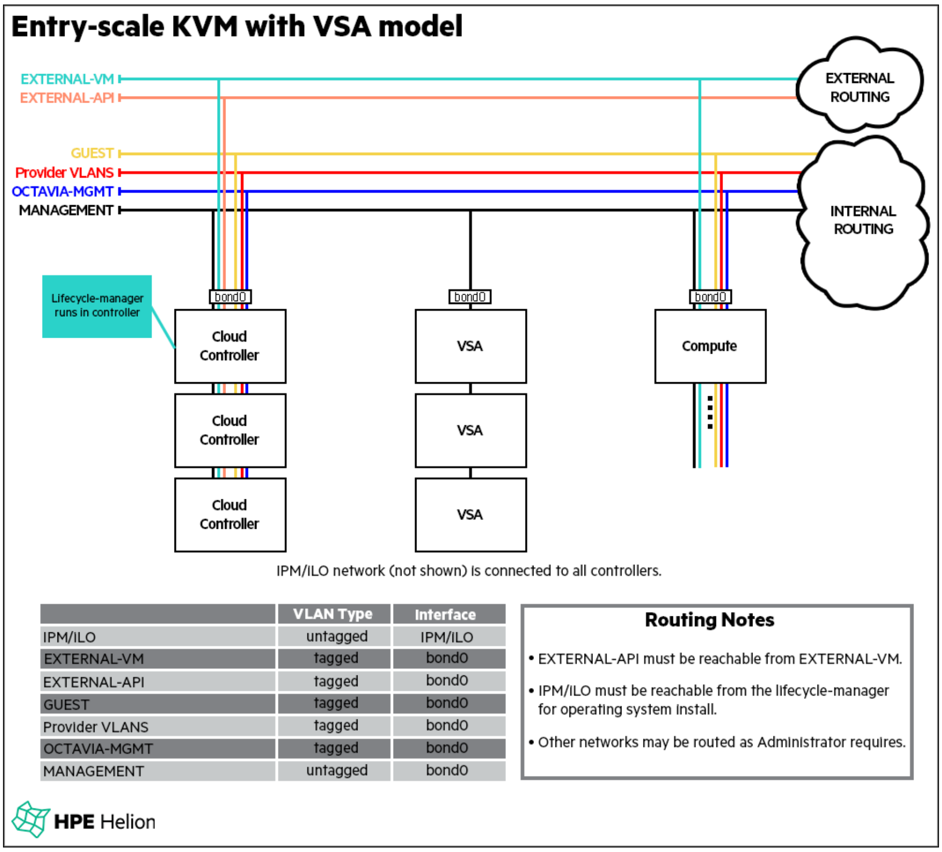
10.4.1 Entry-scale KVM with VSA Model

This model provides a KVM-based cloud with VSA for volume storage, and has been tested to a scale of 100 compute nodes.

The example is focused on the minimum server count to support a highly-available (HA) compute cloud deployment. The first (manually installed) server, often referred to as the deployer or lifecycle manager, is also used as one of the controller nodes. This model consists of a minimum server count of seven, with three controllers, three VSA storage servers, and one compute server. Swift storage in this example is contained on the controllers.

Note that the VSA storage requires a minimum of three servers for a HA configuration, although the deployment will work with as little as one VSA node.

This model can also be deployed without the VSA servers and configured to use an external storage device, such as a 3PAR array, which would reduce the minimum server count to four.



Download (../../../media/entryScale/Entry-ScaleAllNetworks.png)

Download Editable Visio Network Diagram Template (./../../../media/templates/HOS_Network_Diagram_Template.zip)

The example requires the following networks:

- **External API** - This is the network that users will use to make requests to the cloud.
- **External VM** - This is the network that will be used to provide access to virtual machines (via floating IP addresses).
- **Guest/VxLAN** - This is the network that will carry traffic between virtual machines on private networks within the cloud.
- **Octavia Management** - This is the network that will be used for the Octavia load balancing service.
- **Management** - This is the network that will be used for all internal traffic between the cloud services, including node provisioning. This network must be on an untagged VLAN.

All of these networks are configured to be presented via a pair of bonded NICs. The example also enables additional provider VLANs to be configured in Neutron on this interface.

In the diagram, "External Routing" refers to whatever routing you want to provide to allow users to access the External API and External VM networks. Note that the EXTERNAL_API network must be reachable from the EXTERNAL_VM network if you want virtual machines to be able to make API calls to the cloud. "Internal Routing" refers to whatever routing you want to provide to allow administrators to access the Management network.

If you are using HPE Helion OpenStack to install the operating system, then an IPMI/iLO network connected to the IPMI/iLO ports of all servers and routable from the lifecycle manager server is also required for BIOS and power management of the nodes during the operating system installation process.

The example uses the following disk configurations:

- **Controllers** - One operating system disk and two disks for Swift storage.
- **VSA** - One operating system disk and two disks for VSA storage.
- **Compute** - One operating system disk and one disk for virtual machine ephemeral storage.

For details about how to modify this example to match your environment, see *Chapter 11, Modifying the Entry-scale KVM with VSA Model for Your Environment*.

These recommended minimums are based on the included included with the base installation and are suitable only for demo environments. For production systems you will want to consider your capacity and performance requirements when making decisions about your hardware.

Note

The disk requirements detailed below can be met with logical drives, logical volumes, or external storage such as a 3PAR array.

Node Type	Role Name	Required Number	Server Hardware - Minimum Requirements and Recommendations			
			Disk	Memory	Network	CPU
Dedicated lifecycle	Lifecycle-manager	1	300 GB	8 GB	1 x 10 Gbit/s with PXE Support	8 CPU (64-bit) cores

Node Type	Role Name	Required Number	Server Hardware - Minimum Requirements and Recommendations			
			Disk	Memory	Network	CPU
manager (optional)						total (Intel x86_64)
Control Plane	Controller	3	• 1 x 600 GB (minimum) - operating system drive • 2 x 600 GB (minimum) - Data drive	64 GB	2 x 10 Gbit/s with one PXE enabled port	8 CPU (64-bit) cores total (Intel x86_64)
Compute	Compute	1-3	2 X 600 GB (minimum)	32 GB (memory must be sized based on the virtual machine instances hosted on	2 x 10 Gbit/s with one PXE enabled port	8 CPU (64-bit) cores total (Intel x86_64) with hardware virtualization support. The CPU cores must

Node Type	Role Name	Required Number	Server Hardware - Minimum Requirements and Recommendations			
			Disk	Memory	Network	CPU
				the Compute node)		be sized based on the VM instances hosted by the Compute node.
Block Storage (Optional)	VSA or OSD (Ceph)	0 or 3 (which will provide the recommended redundancy)	3 X 600 GB (minimum) See *Book "Installation Guide", Chapter 2 "Pre-Installation Checklist"* for more details.	32 GB	2 x 10 Gbit/s with one PXE enabled port	8 CPU (64-bit) cores total (Intel x86_64)

For more details about the supported network requirements, see .

10.4.2 Entry-scale KVM with VSA model with Dedicated Cluster for Metering, Monitoring, and Logging

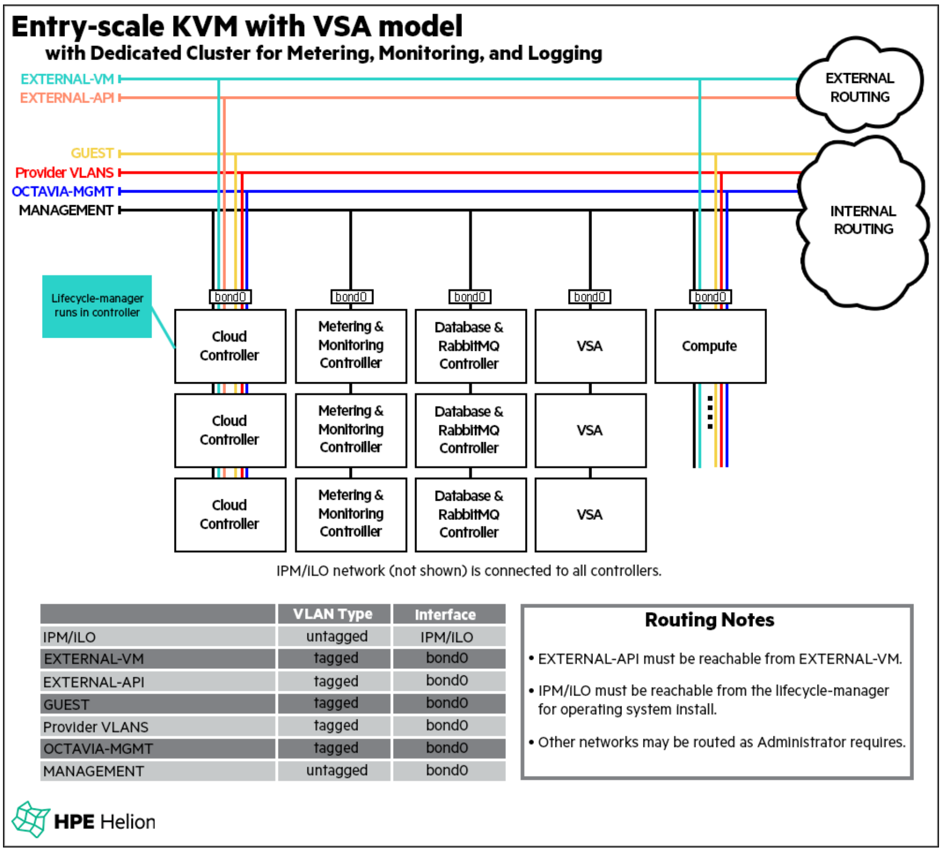
This model is a variant of the previous Entry-scale KVM with VSA model. It is designed to support greater levels of metering, monitoring, and logging.

- Metering - All meters required to support charge-back/show-back for core Infrastructure as a Service (IaaS) elements.
- Logging - Run all services at INFO level with the ability to change the settings to DEBUG in order to triage specific error conditions. Minimum retention for logs is 30 days to satisfy audit and compliance requirements.
- Monitoring - Full performance metrics and health checks for all services.

In order to provide increased processing power for these services, the following configuration changes are made to the control plane in this model:

- All services associated with metering, monitoring, and logging run on a dedicated three-node cluster. Three nodes are required for high availability with quorum.
- A dedicated three node cluster is used for RabbitMQ message queue and database services. This cluster is also used to provide additional processing for the message queue and database load associated with the additional metering, monitoring, and logging load. Three nodes are required for high availability with quorum.
- The main API cluster is reduced to two nodes. These services are stateless and do not require a quorum node for high availability.

This diagram below illustrates the physical networking used in this configuration.



Download the full image (../../../media/entryScaleDed/Entry-ScaleDedicatedAllNetworks.png)

Download Editable Visio Network Diagram Template (../../../media/templates/HOS_Network_Diagram_Template.zip)

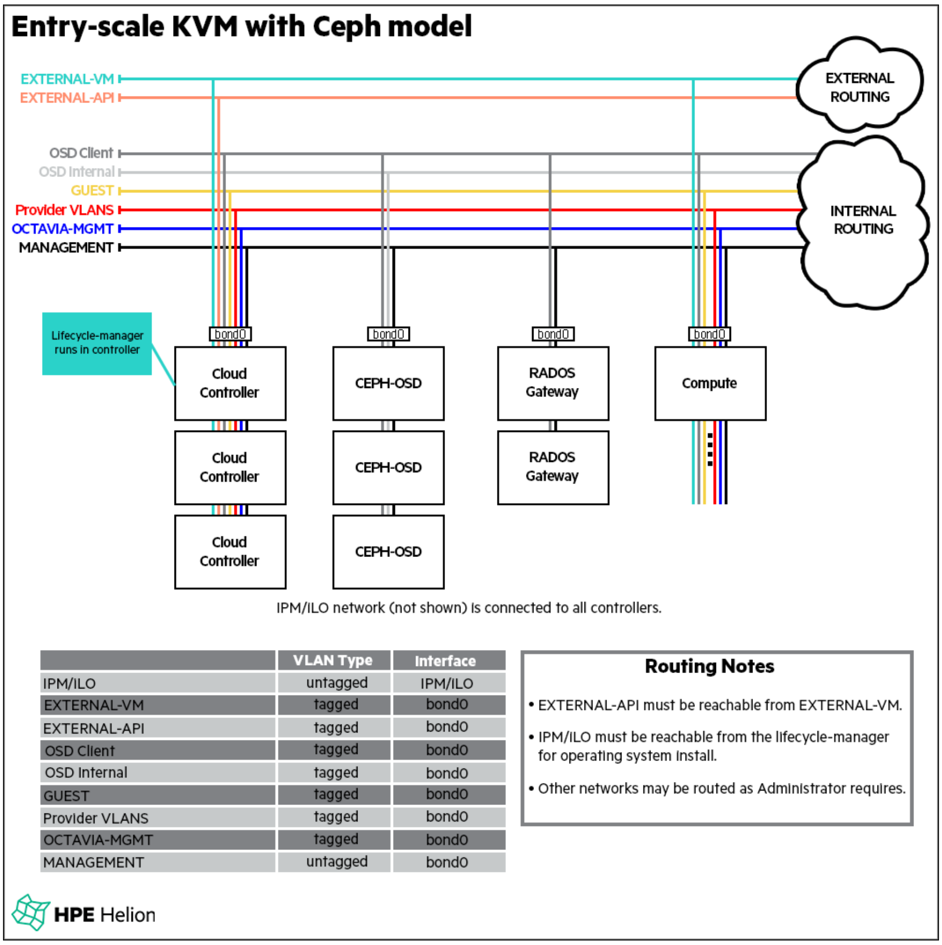
10.4.3 Entry-scale KVM with Ceph Model

This example provides a KVM-based cloud using Ceph for both block and object storage.

The network traffic is segregated into the following VLANs:

- **Cloud Management** - This is the network that will be used for all internal traffic between the cloud services.
- **OSD Internal** - This is the network that will be used for internal traffic of cluster among Ceph OSD servers. Only Ceph OSD servers will need connectivity to this network.
- **OSD Client** - This is the network that Ceph clients will use to talk to Ceph Monitor and OSDs. Cloud controllers, Nova Compute, Ceph Monitor, OSD and Rados Gateway servers will need connectivity to this network.

This diagram below illustrates the physical networking used in this configuration. Click any network name in the diagram to see that network isolated.



Download full image (../../../media/entryScaleCeph/Entry-Scale-Ceph-AllNetworks.png)

Download Editable Visio Network Diagram Template (./../../../media/templates/HOS_Network_Diagram_Template.zip)

This configuration is based on the `entry-scale-kvm-ceph` cloud input model which is included with the HPE Helion OpenStack distro. You will need to make the changes outlined below prior to the deployment of your Ceph cluster.

The table below lists out the key characteristics needed per server role for this configuration.

Node Type	Role Name	Required Number	Server Hardware - Minimum Requirements and Recommendations			
			Disk	Memory	Network	CPU
Dedicated lifecycle manager (optional)	Lifecycle-manager	1	300 GB	8 GB	1 x 10 Gbit/s with PXE Support	8 CPU (64-bit) cores total (Intel x86_64)
Control Plane	Controller	3	• 1 x 600 GB (minimum) - operating system drive • 2 x 600 GB (minimum) - Data drive	64 GB	2 x 10 Gbit/s with one PXE enabled port	8 CPU (64-bit) cores total (Intel x86_64)
Compute (KVM hypervisor)	Compute	1-3	2 X 600 GB (minimum)	32 GB (memory must be sized based on the virtual machine instances	2 x 10 Gbit/s with one PXE enabled port	8 CPU (64-bit) cores total (Intel x86_64) with hardware virtualization support.

Node Type	Role Name	Required Number	Server Hardware - Minimum Requirements and Recommendations			
			Disk	Memory	Network	CPU
				hosted on the Compute node)		The CPU cores must be sized based on the VM instances hosted by the Compute node.
CEPH-OSD	ceph-osd	0 or 3 (which will provide the recommended redundancy)	3 X 600 GB (minimum)	32 GB	2 x 10 Gbit/s with one PXE enabled port	8 CPU (64-bit) cores total (Intel x86_64)
RADOS Gateway	radosgw	2	2 x 600 GB (minimum)	32 GB	2 x 10 Gbit/s with one PXE enabled port	8 CPU (64-bit) cores total (Intel x86_64)

10.4.3.1 nic_mappings.yml

Ensure that your baremetal server NIC interfaces are correctly specified in the `~/helion/my_cloud/definition/data/nic_mappings.yml` file and that they meet the server requirements.

Here is an example with notes in-line:

```
nic-mappings:

## NIC specification for controller nodes.  A bonded interface is used for the
 management
## network while a separate interface is used to connect to the Ceph nodes.
```

```
  - name: CONTROLLER-NIC-MAPPING
    physical-ports:
       - logical-name: hed1
         type: simple-port
         bus-address: "0000:07:00.0"

       - logical-name: hed2
         type: simple-port
         bus-address: "0000:08:00.0"

       - logical-name: hed3
         type: simple-port
         bus-address: "0000:09:00.0"

       - logical-name: hed4
         type: simple-port
         bus-address: "0000:0a:00.0"

## NIC specification for compute nodes. One interface is used for the management
## network while the second interface is used to connect to the Ceph nodes.
  - name: COMPUTE-NIC-MAPPING
    physical-ports:
       - logical-name: hed3
         type: simple-port
         bus-address: "0000:04:00.0"

       - logical-name: hed4
         type: simple-port
         bus-address: "0000:04:00.1"

## NIC specification for OSD nodes. The first interface is used for management network
## traffic. The second interface is used for client or public traffic. The third
## interface is used for internal OSD traffic.
  - name: OSD-NIC-MAPPING
    physical-ports:
       - logical-name: hed1
         type: simple-port
         bus-address: "0000:06:00.0"

       - logical-name: hed2
         type: simple-port
         bus-address: "0000:06:00.1"

       - logical-name: hed3
         type: simple-port
         bus-address: "0000:06:00.2"
```

```
## NIC specification for RADOS Gateway nodes. The first interface is used for management
 network
## traffic. The second interface is used for client or public traffic.
  - name: RGW-NIC-MAPPING
    physical-ports:
       - logical-name: hed1
         type: simple-port
         bus-address: "0000:07:00.0"

       - logical-name: hed2
         type: simple-port
         bus-address: "0000:07:00.1"
```

10.4.3.2 servers.yml

Ensure that your servers in the `~/helion/my_cloud/definition/data/servers.yml` file are mapped to the correct NIC interface.

An example with the bolded line for `nic-mapping` illustrating this:

```
# Controller Nodes
  - id: controller1
    ip-addr: 10.13.111.138
    server-group: RACK1
    role: CONTROLLER-ROLE
    nic-mapping: CONTROLLER-NIC-MAPPING
    mac-addr: "f0:92:1c:05:69:10"
    ilo-ip: 10.12.8.214
    ilo-password: password
    ilo-user: admin

# Compute Nodes
  - id: compute1
    ip-addr: 10.13.111.139
    server-group: RACK1
    role: COMPUTE-ROLE
    nic-mapping: COMPUTE-NIC-MAPPING
    mac-addr: "83:92:1c:55:69:b0"
    ilo-ip: 10.12.8.215
    ilo-password: password
    ilo-user: admin

# OSD Nodes
  - id: osd1
    ip-addr: 10.13.111.140
    server-group: RACK1
```

```
    role: OSD-ROLE
    nic-mapping: OSD-NIC-MAPPING
    mac-addr: "d9:92:1c:25:69:e0"
    ilo-ip: 10.12.8.216
    ilo-password: password
    ilo-user: admin

# Ceph RGW Nodes
  - id: rgw1
    ip-addr: 192.168.10.12
    role: RGW-ROLE
    server-group: RACK1
    nic-mapping: RGW-NIC-MAPPING
    mac-addr: "8b:f6:9e:ca:3b:62"
    ilo-ip: 192.168.9.12
    ilo-password: password
    ilo-user: admin

  - id: rgw2
    ip-addr: 192.168.10.13
    role: RGW-ROLE
    server-group: RACK2
    nic-mapping: RGW-NIC-MAPPING
    mac-addr: "8b:f6:9e:ca:3b:63"
    ilo-ip: 192.168.9.13
    ilo-password: password
    ilo-user: admin
```

10.4.3.3 net_interfaces.yml

Define a new interface set for your OSD interfaces in the `~/helion/my_cloud/definition/data/net_interfaces.yml` file.

Here is an example with notes in-line:

```
- name: CONTROLLER-INTERFACES
  network-interfaces:
## This bonded interface is used by the controller
## nodes for cloud management traffic.
    - name: BOND0
      device:
         name: bond0
      bond-data:
         options:
            mode: active-backup
            miimon: 200
```

```
            primary: hed1
         provider: linux
         devices:
            - name: hed1
            - name: hed2
        network-groups:
        - EXTERNAL-API
        - EXTERNAL-VM
        - GUEST
        - MANAGEMENT
## This interface is used to connect the controller
## node to the Ceph nodes so that any Ceph client
## like cinder-volume can route data directly to
## Ceph over this interface.
    - name: ETH2
      device:
        name: hed3
      network-groups:
        - OSD-CLIENT

- name: COMPUTE-INTERFACES
  network-interfaces:
    - name: HETH3
      device:
         name: hed3
      forced-network-groups:
         - EXTERNAL-VM
         - GUEST
         - MANAGEMENT
## This interface is used to connect the compute node
## to the Ceph cluster so that a workload VM can route
## data traffic to the Ceph cluster over this interface.
    - name: HETH4
       device:
          name: hed4
       forced-network-groups:
          - OSD-CLIENT

- name: OSD-INTERFACES
  network-interfaces:
## This defines the interface used for management
## traffic like logging, monitoring, etc.
    - name: HETH1
      device:
          name: hed1
      network-groups:
        - MANAGEMENT
```

```
## This defines the interface used for client
## or data traffic.
    - name: HETH2
      device:
          name: hed2
      network-groups:
        - OSD-CLIENT
## This defines the interface used for internal
## cluster communication among OSD nodes.
    - name: HETH3
      device:
          name: hed3
      network-groups:
        - OSD-INTERNAL

   - name: RGW-INTERFACES
     network-interfaces:
       - name: BOND0
         device:
            name: bond0
         bond-data:
            options:
                mode: active-backup
                miimon: 200
                primary: hed3
            provider: linux
            devices:
              - name: hed3
              - name: hed4
         network-groups:
           - MANAGEMENT
           - OSD-CLIENT
```

10.4.3.4 network_groups.yml

Define the OSD network group in the `~/helion/my_cloud/definition/data/network_groups.yml` file:

```
#
# OSD client
#
# This is the network group that will be used for
# internal traffic of cluster among OSDs.
#
- name: OSD-CLIENT
```

```
  hostname-suffix: osdc

  component-endpoints
    - ceph-monitor
    - ceph-osd
    - ceph-radosgw

#
# OSD internal
#
# This is the network group that will be used for
# internal traffic of cluster among OSDs.
#
- name: OSD-INTERNAL
  hostname-suffix: osdi

  component-endpoints:
  - ceph-osd-internal
```

10.4.3.5 networks.yml

Define the OSD VLAN in the `~/helion/my_cloud/definition/data/networks.yml` file.

The example below defines two separate network VLANs:

```
- name: OSD-CLIENT-NET
  vlanid: 112
  tagged-vlan: true
  cidr: 192.168.187.0/24
  gateway-ip: 192.168.187.1
  network-group: OSD-CLIENT

- name: OSD-INTERNAL-NET
  vlanid: 116
  tagged-vlan: true
  cidr: 192.168.200.0/24
  gateway-ip: 192.168.200.1
  network-group: OSD-INTERNAL
```

10.4.3.6 server_groups.yml

Add the OSD network to the server groups in the ~/helion/my_cloud/definition/data/server_groups.yml file, indicated by the bold portion below:

```
- name: CLOUD
  server-groups:
   - AZ1
   - AZ2
   - AZ3
  networks:
   - EXTERNAL-API-NET
   - EXTERNAL-VM-NET
   - GUEST-NET
   - MANAGEMENT-NET
   - OSD-CLIENT-NET
   - OSD-INTERNAL-NET
```

10.4.3.7 firewall_rules.yml

Modify the firewall rules in the ~/helion/my_cloud/definition/data/firewall_rules.yml file to allow OSD nodes to be pingable via the OSD network, indicated by the bold portion below:

Note

Enabling ping for OSD-CLIENT and OSD-INTERNAL is optional. Enabling ping on these networks might make debugging connectivity issues on these networks easier.

```
- name: PING
  network-groups:
  - MANAGEMENT
  - GUEST
  - EXTERNAL-API
  - OSD-CLIENT
  - OSD-INTERNAL
  rules:
  # open ICMP echo request (ping)
  - type: allow
    remote-ip-prefix:  0.0.0.0/0
    # icmp type
    port-range-min: 8
    # icmp code
```

```
    port-range-max: 0
    protocol: icmp
```

10.4.3.8 Edit the README.html and README.md Files

You can edit the `~/helion/my_cloud/definition/README.html` and `~/helion/my_cloud/definition/README.md` files to reflect the OSD network group information if you wish. This change does not have any semantic implication and only assists with the readability of your model.

10.4.3.9 Deploying Ceph Monitor Services on Dedicated Resource Nodes

In the HPE Helion OpenStack 5.0 example configurations, the Ceph monitor service is installed on the controller nodes by default. If you wish to break these out into their own cluster then you can do so by modifying the input model to form a separate cluster.

> **Important**
>
> If you want to deploy the monitor service as a dedicated resource node, then you must decide prior to the deployment of Ceph. HPE Helion OpenStack 5.0 does not support deployment transition. Once Ceph is deployed, you cannot migrate the monitor service from controller to dedicated resource nodes.

10.4.3.9.1 Prerequisite

The lifecycle manager must be set up before starting Ceph deployment. For more details on the installation of the lifecycle manager, see .

10.4.3.9.2 To Install the Ceph Monitor Service on Dedicated Resource Nodes

Perform the following procedure to install the Ceph monitor on dedicated nodes. Note that Ceph requires at least 3 monitoring servers to form a cluster in case of node failure.

1. Log in to the lifecycle manager.

2. You will use the `entry-scale-kvm-ceph` example configuration as the base for these steps. Copy the example configuration files into the required setup directory before beginning the edit process:

```
cp -r ~/helion/examples/entry-scale-kvm-ceph/* ~/helion/my_cloud/definition/
```

3. Make the following edits to the `~/helion/my_cloud/definition/data/control_plane.yml` file:

   a. Remove the reference to `- ceph-monitor` under the `service-components` section for your control plane cluster.

   b. Add the details for your Ceph monitoring cluster. It is shown as the bolded portion in the example below, we added the rest to show the proper positioning:

```
clusters:
  - name: cluster1
    cluster-prefix: c1
    server-role: CONTROLLER-ROLE
    member-count: 3
    allocation-policy: strict
    service-components:
      - lifecycle-manager
      - ntp-server
      ...

  - name: ceph-mon
    cluster-prefix: ceph-mon
    server-role: CEP-MON-ROLE
    min-count: 3
    allocation-policy: strict
    service-components:
      - ntp-client
      - ceph-monitor

  - name: rgw
    cluster-prefix: rgw
    server-role: RGW-ROLE
    ...
```

> **Note**
>
> The indentation in the file is important to review the file to ensure it matches before continuing on.

4. Edit the `~/helion/my_cloud/definition/data/servers.yml` file to define all of the Ceph monitor nodes in the cluster. Here is an example, you will want to edit the values to match your environment:

```
# Ceph Monitor Nodes
- id: ceph-mon1
  ip-addr: 10.13.111.141
  server-group: RACK1
  role: CEP-MON-ROLE
  nic-mapping: MY-4PORT-SERVER
  mac-addr: "f0:92:1c:05:69:10"
  ilo-ip: 10.12.8.217
  ilo-password: password
  ilo-user: admin

- id: ceph-mon2
  ip-addr: 10.13.111.142
  server-group: RACK2
  role: CEP-MON-ROLE
  nic-mapping: MY-4PORT-SERVER
  mac-addr: "83:92:1c:55:69:b0"
  ilo-ip: 10.12.8.218
  ilo-password: password
  ilo-user: admin

- id: ceph-mon3
  ip-addr: 10.13.111.143
  server-group: RACK3
  role: CEP-MON-ROLE
  nic-mapping: MY-4PORT-SERVER
  mac-addr: "d9:92:1c:25:69:e0"
  ilo-ip: 10.12.8.219
  ilo-password: password
  ilo-user: admin

# Ceph RGW Nodes
- id: rgw1
  ...
```

5. Edit the `~/helion/my_cloud/definition/data/net_interfaces.yml` file to define a new network interface set for your Ceph monitors. You can copy the `RGW-INTERFACES` model as a base and then edit it to match your environment:
   Three-network Ceph example:

```
interface-models:
      # Edit the device names and bond options
      # to match your environment
      #
    - name: CONTROLLER-INTERFACES
      network-interfaces:
    ## This bonded interface is used by the controller
    ## nodes for cloud management traffic.
        - name: BOND0
          device:
             name: bond0
          bond-data:
             options:
                mode: active-backup
                miimon: 200
                primary: hed1
             provider: linux
             devices:
                - name: hed1
                - name: hed2
            network-groups:
            - EXTERNAL-API
            - EXTERNAL-VM
            - GUEST
            - MANAGEMENT
    ## This interface is used to connect the controller
    ## node to the Ceph nodes so that any Ceph client
    ## like cinder-volume can route data directly to
    ## Ceph over thisinterface.
        - name: HETH3
          device:
            name: hed3
          forced-network-groups:
            - OSD-CLIENT

    - name: COMPUTE-INTERFACES
      network-interfaces:
        - name: HETH3
          device:
              name: hed3
          network-groups:
```

```
          - EXTERNAL-VM
          - GUEST
          - MANAGEMENT
    ## This interface is used to connect the compute node
    ## to the Ceph cluster so that a workload VM can route
    ## data traffic to the Ceph cluster over thisinterface.
      - name: HETH4
        device:
            name: hed4
        forced-network-groups:
          - OSD-CLIENT

  - name: CEP-MON-INTERFACES
    network-interfaces:
    ## This defines the interface used for management
    ## traffic like logging, monitoring, etc.
      - name: BOND0
        device:
            name: bond0
        bond-data:
            options:
                mode: active-backup
                miimon: 200
                primary: hed1
            provider: linux
            devices:
              - name: hed1
              - name: hed2
        network-groups:
          - MANAGEMENT
    ## This interface is used to connect the client
    ## node to the Ceph nodes so that any Ceph client
    ## like cinder-volume can route data directly to
    ## Ceph over thisinterface.
      - name: HETH3
        device:
            name: hed3
        forced-network-groups:
          - OSD-CLIENT

  - name: OSD-INTERFACES
    network-interfaces:
    ## This defines the interface used for management
    ## traffic like logging, monitoring, etc.
      - name: BOND0
        device:
            name: bond0
```

```
          bond-data:
              options:
                  mode: active-backup
                  miimon: 200
                  primary: hed1
              provider: linux
              devices:
                - name: hed1
                - name: hed2
          network-groups:
            - MANAGEMENT
      ## This defines the interface used for client
      ## or data traffic.
        - name: HETH3
          device:
              name: hed3
          network-groups:
            - OSD-CLIENT
      ## This defines the interface used for internal
      ## cluster communication among OSD nodes.
        - name: HETH4
          device:
              name: hed4
          network-groups:
            - OSD-INTERNAL
```

Two-network Ceph example:

```
interface-models:
      # Edit the device names and bond options
      # to match your environment
      #
    - name: CONTROLLER-INTERFACES
      network-interfaces:
    ## This bonded interface is used by the controller
    ## nodes for cloud management traffic.
    ## The same interface is also used to connect the client
    ## node to the Ceph nodes so that any Ceph client
    ## like cinder-volume can route data directly to
    ## Ceph over thisinterface.
        - name: BOND0
          device:
             name: bond0
          bond-data:
             options:
                mode: active-backup
                miimon: 200
```

```
            primary: hed1
         provider: linux
         devices:
            - name: hed1
            - name: hed2
        network-groups:
        - EXTERNAL-API
        - EXTERNAL-VM
        - GUEST
        - MANAGEMENT

  - name: COMPUTE-INTERFACES
    network-interfaces:
    ## The same interface is also used to connect the compute node
    ## to the Ceph cluster so that a workload VM can route
    ## data traffic to the Ceph cluster over thisinterface.
      - name: HETH3
        device:
            name: hed3
        network-groups:
          - EXTERNAL-VM
          - GUEST
          - MANAGEMENT

  - name: CEP-MON-INTERFACES
    network-interfaces:
    ## This defines the interface used for management
    ## traffic like logging, monitoring, etc.
    ## The same interface is also used to connect the client
    ## node to the Ceph nodes so that any Ceph client
    ## like cinder-volume can route data directly to
    ## Ceph over thisinterface.
      - name: BOND0
        device:
            name: bond0
        bond-data:
            options:
                mode: active-backup
                miimon: 200
                primary: hed1
            provider: linux
            devices:
              - name: hed1
              - name: hed2
        network-groups:
          - MANAGEMENT
```

```
    - name: OSD-INTERFACES
      network-interfaces:
      ## This defines the interface used for management
      ## traffic like logging, monitoring, etc.
      ## The same interface is also used for client
      ## or data traffic.
        - name: BOND0
          device:
              name: bond0
          bond-data:
              options:
                  mode: active-backup
                  miimon: 200
                  primary: hed1
              provider: linux
              devices:
                - name: hed1
                - name: hed2
          network-groups:
            - MANAGEMENT
      ## This defines the interface used for internal
      ## cluster communication among OSD nodes.
        - name: HETH4
          device:
              name: hed4
          network-groups:
            - OSD-INTERNAL
```

Single-network Ceph example:

```
interface-models:
      # Edit the device names and bond options
      # to match your environment
      #
    - name: CONTROLLER-INTERFACES
      network-interfaces:
    ## This bonded interface is used by the controller
    ## nodes for cloud management traffic.
    ## The same interface is also used to connect the client
    ## node to the Ceph nodes so that any Ceph client
    ## like cinder-volume can route data directly to
    ## Ceph over thisinterface.
        - name: BOND0
          device:
             name: bond0
          bond-data:
             options:
```

```
            mode: active-backup
            miimon: 200
            primary: hed1
         provider: linux
         devices:
            - name: hed1
            - name: hed2
        network-groups:
        - EXTERNAL-API
        - EXTERNAL-VM
        - GUEST
        - MANAGEMENT

- name: COMPUTE-INTERFACES
## This interface is also used to connect the compute node
## to the Ceph cluster so that a workload VM can route
## data traffic to the Ceph cluster over thisinterface.
  network-interfaces:
    - name: HETH3
      device:
          name: hed3
      network-groups:
        - EXTERNAL-VM
        - GUEST
        - MANAGEMENT

- name: CEP-MON-INTERFACES
  network-interfaces:
  ## This defines the interface used for management
  ## traffic like logging, monitoring, etc.
  ## The same interface is also used to connect the client
  ## node to the Ceph nodes so that any Ceph client
  ## like cinder-volume can route data directly to
  ## Ceph over thisinterface.
    - name: BOND0
      device:
          name: bond0
      bond-data:
          options:
              mode: active-backup
              miimon: 200
              primary: hed1
          provider: linux
          devices:
            - name: hed1
            - name: hed2
      network-groups:
```

```
        - MANAGEMENT

    - name: OSD-INTERFACES
      network-interfaces:
      ## This defines the interface used for management
      ## traffic like logging, monitoring, etc.
      ## The same interface is also used for internal cluster
      ## communication among the OSD nodes.
      ## The same interface is also used for internal
      ## cluster communication among OSD nodes.
        - name: BOND0
          device:
              name: bond0
          bond-data:
              options:
                  mode: active-backup
                  miimon: 200
                  primary: hed1
              provider: linux
              devices:
                - name: hed1
                - name: hed2
          network-groups:
            - MANAGEMENT
```

6. Create a new file named `disks_ceph_monitor.yml` in the `~/helion/my_cloud/definition/data/` directory which will define the disk model for your Ceph monitors. You can use the `disks_rgw.yml` file as a base and then edit to match your environment:

```
disk-models:
- name: CEP-MON-DISKS
  # Disk model to be used for Ceph monitor nodes
  # /dev/sda_root is used as a volume group for /, /var/log and /var/crash
  # sda_root is a templated value to align with whatever partition is really used
  # This value is checked in os config and replaced by the partition actually used
  # on sda e.g. sda1 or sda5

  volume-groups:
    - name: hlm-vg
      physical-volumes:
        - /dev/sda_root

      logical-volumes:
      # The policy is not to consume 100% of the space of each volume group.
      # 5% should be left free for snapshots and to allow for some flexibility.
        - name: root
```

```
          size: 30%
          fstype: ext4
          mount: /
        - name: log
          size: 45%
          mount: /var/log
          fstype: ext4
          mkfs-opts: -O large_file
        - name: crash
          size: 20%
          mount: /var/crash
          fstype: ext4
          mkfs-opts: -O large_file
    consumer:
        name: os
```

7. Edit the `~/helion/my_cloud/definition/data/server_roles.yml` file to define a new server role for your Ceph monitors:

```
- name: CEP-MON-ROLE
  interface-model: CEP-MON-INTERFACES
  disk-model: CEP-MON-DISKS
```

8. Commit your configuration:

```
cd ~/helion/hos/ansible
git add -A
git commit -m "adding dedicated Ceph monitor cluster"
```

9. Run the following playbook to add your nodes into Cobbler:

```
cd ~/helion/hos/ansible/
ansible-playbook -i hosts/localhost cobbler-deploy.yml
```

10. To reimage all the nodes using PXE, run the following playbook:

```
cd ~/helion/hos/ansible/
ansible-playbook -i hosts/localhost bm-reimage.yml
```

11. Run the configuration processor:

```
cd ~/helion/hos/ansible/
ansible-playbook -i hosts/localhost config-processor-run.yml
```

12. Update your deployment directory with this playbook:

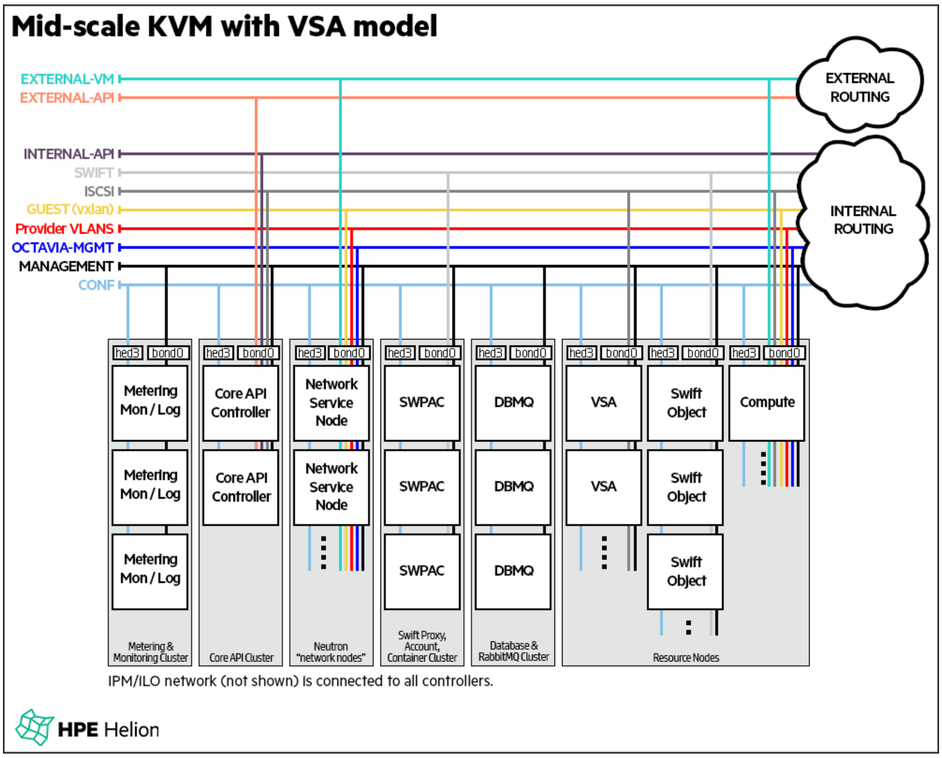
```
cd ~/helion/hos/ansible/
ansible-playbook -i hosts/localhost ready-deployment.yml
```

13. Deploy these changes:

```
cd ~/scratch/ansible/next/hos/ansible
ansible-playbook -i hosts/verb_hosts site.yml
```

10.4.4 Mid-scale KVM with VSA Model

The mid-scale model illustrates two important aspects of configuring HPE Helion OpenStack for increased scale. The controller services are distributed across a greater number of controllers and a number of the networks are configured as multiple L3 segments (implementing per-rack networking).



Network Group	VLAN type	Interface	Multiple networks per group?
IPMI/iLO	untagged	IPMI/iLO	Possible
CONF	untagged	hed3	No *
MANAGEMENT	untagged	bond0	Possible
OCTAVIA-MGMT	tagged	bond0	Possible
Provider VLANs	tagged	bond0	n/a
GUEST	tagged	bond0	Possible
ISCSI	tagged	bond0	No *
SWIFT	tagged	bond0	Possible
INTERNAL-API	tagged	bond0	No *
EXTERNAL-API	tagged	bond0	No *
EXTERNAL-VM	tagged	bond0	No *

Routing Notes:

- EXTERNAL-API must be reachable from EXTERNAL-VM so in-cloud VMs can use the OpenStack APIs via their publicURL.
- INTERNAL-API must be reachable from MANAGEMENT so services on the MANAGEMENT network can use the OpenStack APIs via their InternalURL or AdminURL.
- When there are multiple networks in a network-group, each network in the group must be reachable from other networks in that group.
- IPMI/iLO must be reachable from CONF for os-install.
- Other networks may be routed as Administrator requires.

* Regarding multiple networks per group, some groups contain only a single network due to application constraints:

- VSA nodes share a cluster virtual IP addresses on the ISCSI network, the virtual IP addresses may be hosted by any VSA node.
- Core API nodes share a cluster virtual IP addresses on both the INTERNAL-API and EXTERNAL-API networks; the virtual IP addresses may be hosted by any core API node.
- Neutron expects the EXTERNAL-VM network to span all compute nodes and network service nodes for floating IPs and router default SNAT IP addresses.
- The lifecycle-manager provides PXE boot services on CONF.

Download the full network image (../../../media/networkImages/Mid-Scale-AllNetworks.png)

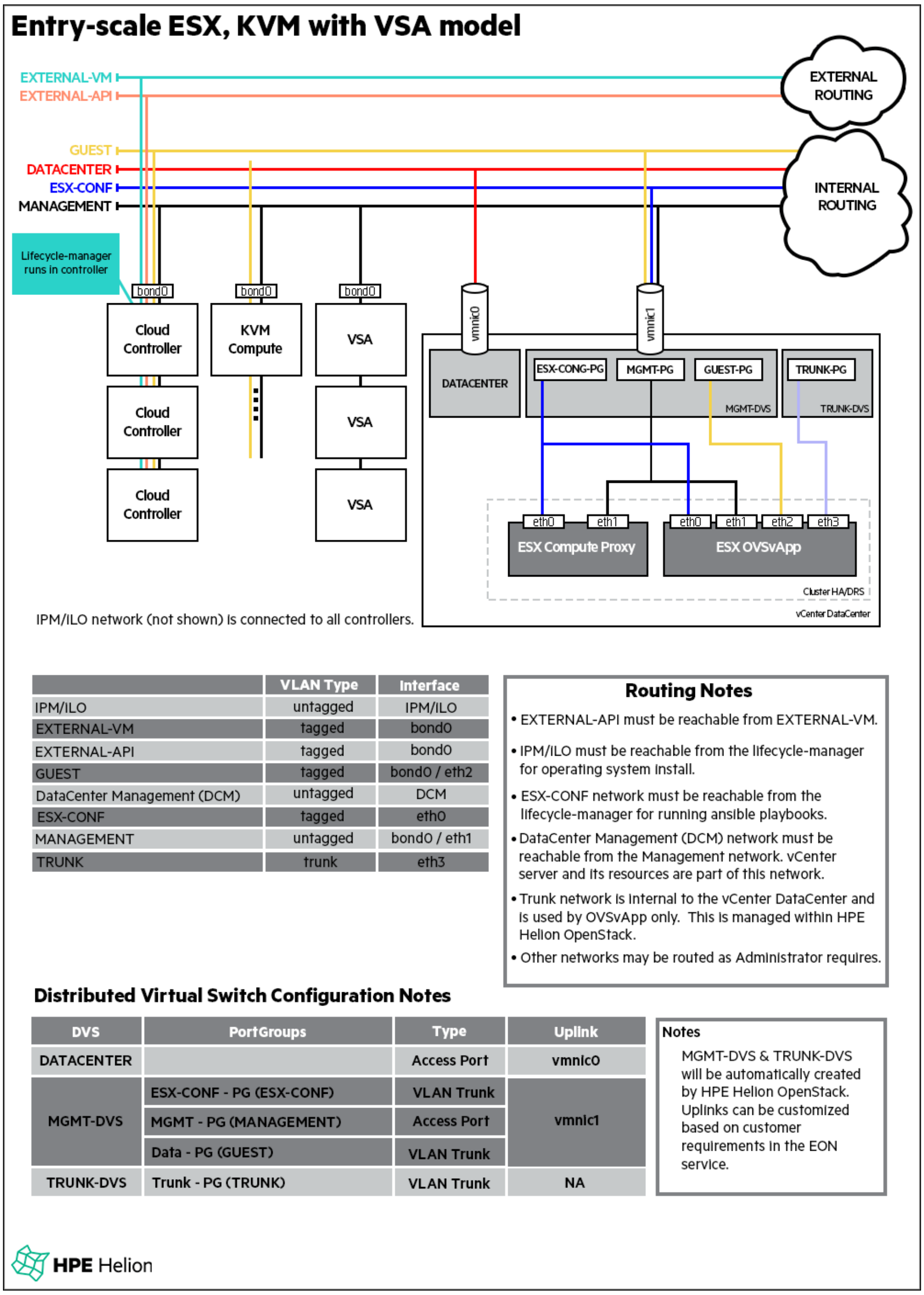
Download Editable Visio Network Diagram Template (./../../../media/templates/HOS_Network_Diagram_Template.zip)

The distribution of services across controllers is only one possible configuration, and other combinations can also be expressed.

10.5 ESX Examples

10.5.1 Entry-scale ESX, KVM with VSA Model

This example shows how to integrate HPE Helion OpenStack with ESX, KVM with VSA in the same Cloud. The controller configuration is essentially the same as in the Entry-scale KVM with VSA Model example, but the resource nodes supported are ESX (provided by vCenter), KVM and VSA. In addition, a number of controller virtual machines are created for each vCenter cluster: one ESX Compute virtual machine (which provides the nova-compute proxy for vCenter) and one OVSvApp virtual machine per cluster member (which provides network access). These virtual machines are created automatically by HPE Helion OpenStack as part of activating the vCenter cluster, and are therefore not defined in the example.



	VLAN Type	Interface
IPM/ILO	untagged	IPM/ILO
EXTERNAL-VM	tagged	bond0
EXTERNAL-API	tagged	bond0
GUEST	tagged	bond0 / eth2
DataCenter Management (DCM)	untagged	DCM
ESX-CONF	tagged	eth0
MANAGEMENT	untagged	bond0 / eth1
TRUNK	trunk	eth3

Routing Notes

- EXTERNAL-API must be reachable from EXTERNAL-VM.
- IPM/ILO must be reachable from the lifecycle-manager for operating system install.
- ESX-CONF network must be reachable from the lifecycle-manager for running ansible playbooks.
- DataCenter Management (DCM) network must be reachable from the Management network. vCenter server and its resources are part of this network.
- Trunk network is internal to the vCenter DataCenter and is used by OVSvApp only. This is managed within HPE Helion OpenStack.
- Other networks may be routed as Administrator requires.

Distributed Virtual Switch Configuration Notes

DVS	PortGroups	Type	Uplink
DATACENTER		Access Port	vmnic0
MGMT-DVS	ESX-CONF - PG (ESX-CONF)	VLAN Trunk	vmnic1
	MGMT - PG (MANAGEMENT)	Access Port	
	Data - PG (GUEST)	VLAN Trunk	
TRUNK-DVS	Trunk - PG (TRUNK)	VLAN Trunk	NA

Notes

MGMT-DVS & TRUNK-DVS will be automatically created by HPE Helion OpenStack. Uplinks can be customized based on customer requirements in the EON service.

Download (../../../media/hos.docs/exampleconfigs/Entry-ScaleESX-KVMwithVSAmodel.png)

Download Editable Visio Network Diagram Template (./../../../media/templates/HOS_Network_Diagram_Template.zip)

The physical networking configuration is also largely the same as the KVM example, with the default GUEST network VxLAN as the Neutron networking model.

A separate configuration network (CONF) is required for configuration access from the lifecycle manager. This network must be reachable from the Management network.

These recommended minimums are based on the included included with the base installation and are suitable only for demo environments. For production systems you will want to consider your capacity and performance requirements when making decisions about your hardware.

HPE Helion OpenStack 5.0 currently supports the following ESXi versions:

- ESXi version 5.5 (Update 3)
- ESXi version 6.0
- ESXi version 6.0 (Update 1b)

The following are the requirements for your vCenter server:

- Software
  - vCenter 5.5 Update 3 and above (It is recommended to run the same server version as the ESXi hosts)
- License Requirements
  - vSphere Enterprise Plus license

Node Type	Role Name	Required Number	Server Hardware - Minimum Requirements and Recommendations			
			Disk	Memory	Network	CPU
Dedicated lifecycle manager (optional)	Lifecycle-manager	1	300 GB	8 GB	1 x 10 Gbit/s with PXE Support	8 CPU (64-bit) cores total (Intel x86_64)
Control Plane	Controller	3	• 1 x 600 GB (minimum) - operating	64 GB	2 x 10 Gbit/s with one PXE enabled port	8 CPU (64-bit) cores total (Intel x86_64)

Node Type	Role Name	Required Number	Server Hardware - Minimum Requirements and Recommendations			
			Disk	**Memory**	**Network**	**CPU**
			system drive • 2 x 600 GB (minimum) - Data drive			
Compute (ESXi hypervisor)		2	2 X 1 TB (minimum, shared across all nodes)	128 GB (minimum)	2 x 10 Gbit/s +1 NIC (for DC access)	16 CPU (64-bit) cores total (Intel x86_64)
Compute (KVM hypervisor)	kvm-compute	1-3	2 X 600 GB (minimum)	32 GB (memory must be sized based on the virtual machine instances hosted on the Compute node)	2 x 10 Gbit/s with one PXE enabled port	8 CPU (64-bit) cores total (Intel x86_64) with hardware virtualization support. The CPU cores must be sized based on the VM instances

Node Type	Role Name	Required Number	Server Hardware - Minimum Requirements and Recommendations			
			Disk	Memory	Network	CPU
						hosted by the Compute node.
Block Storage (Optional)	VSA	0 or 3 (which will provide the recommended redundancy)	3 X 600 GB (minimum) See *Book "Installation Guide", Chapter 2 "Pre-Installation Checklist"* for more details.	32 GB	2 x 10 Gbit/s with one PXE enabled port	8 CPU (64-bit) cores total (Intel x86_64)

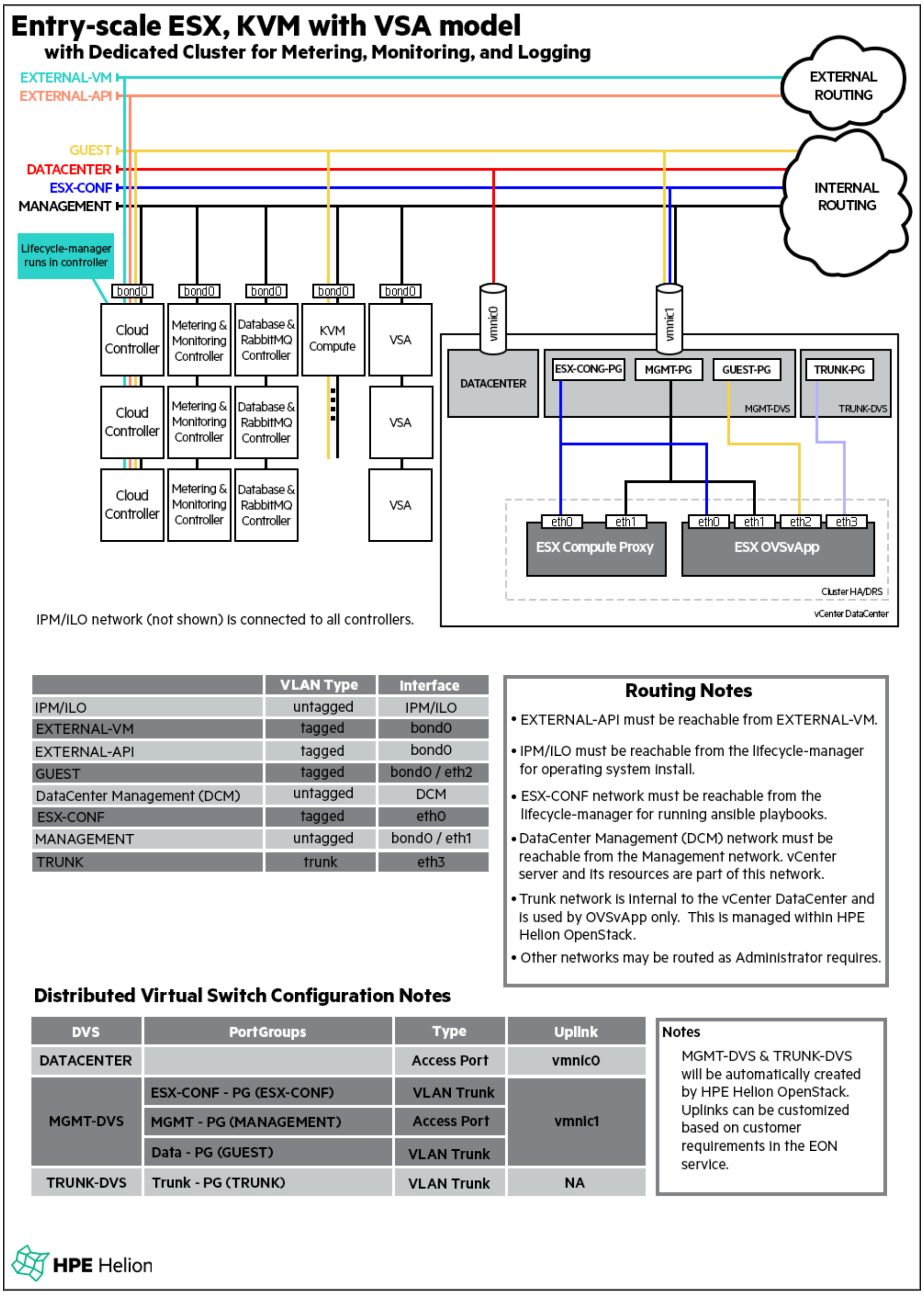
10.5.2 Entry-scale ESX, KVM with VSA Model with Dedicated Cluster for Metering, Monitoring, and Logging

This model is a variant of the Entry-scale ESX KVM with VSA model. It is designed to support greater levels of metering, monitoring, and logging.

- Metering - All meters required to support charge-back/show-back for core Infrastructure as a Service (IaaS) elements.
- Logging - Run all services at INFO level with the ability to change the settings to DEBUG in order to triage specific error conditions. Minimum retention for logs is 30 days to satisfy audit and compliance requirements.
- Monitoring - Full performance metrics and health checks for all services.

In order to provide increased processing power for these services, the following configuration changes are made to the control plane in this model:

- All services associated with metering, monitoring, and logging run on a dedicated three-node cluster. Three nodes are required for high availability with quorum.
- A dedicated three node cluster is used for RabbitMQ message queue and database services. This cluster is also used to provide additional processing for the message queue and database load associated with the additional metering, monitoring, and logging load. Three nodes are required for high availability with quorum.
- The main API cluster is reduced to two nodes. These services are stateless and do not require a quorum node for high availability.



	VLAN Type	Interface
IPM/ILO	untagged	IPM/ILO
EXTERNAL-VM	tagged	bond0
EXTERNAL-API	tagged	bond0
GUEST	tagged	bond0 / eth2
DataCenter Management (DCM)	untagged	DCM
ESX-CONF	tagged	eth0
MANAGEMENT	untagged	bond0 / eth1
TRUNK	trunk	eth3

DVS	PortGroups	Type	Uplink
DATACENTER		Access Port	vmnic0
MGMT-DVS	ESX-CONF - PG (ESX-CONF)	VLAN Trunk	vmnic1
	MGMT - PG (MANAGEMENT)	Access Port	
	Data - PG (GUEST)	VLAN Trunk	
TRUNK-DVS	Trunk - PG (TRUNK)	VLAN Trunk	NA

Download (../../../media/hos.docs/exampleconfigs/Entry-ScaleESX-KVMwithVSADedicatedMML.png) ↗

Download Editable Visio Network Diagram Template (../../../../media/templates/HOS_Network_Diagram_Template.zip) ↗

The physical networking configuration is also largely the same as the KVM example, with the default GUEST network VxLAN as the Neutron networking model.

A separate configuration network (CONF) is required for configuration access from the lifecycle manager. This network must be reachable from the Management network.

These recommended minimums are based on the included included with the base installation and are suitable only for demo environments. For production systems you will want to consider your capacity and performance requirements when making decisions about your hardware.

HPE Helion OpenStack 5.0 currently supports the following ESXi versions:

- ESXi version 5.5 (Update 3)
- ESXi version 6.0
- ESXi version 6.0 (Update 1b)

The following are the requirements for your vCenter server:

- Software
  - vCenter 5.5 Update 3 and above (It is recommended to run the same server version as the ESXi hosts)
- License Requirements
  - vSphere Enterprise Plus license

Node Type	Role Name	Required Number	Server Hardware - Minimum Requirements and Recommendations			
			Disk	Memory	Network	CPU
Dedicated lifecycle manager (optional)	Lifecycle-manager	1	300 GB	8 GB	1 x 10 Gbit/s with PXE Support	8 CPU (64-bit) cores total (Intel x86_64)
Control Plane	Core-API Controller	2	• 1 x 600 GB (minimum) - operat-	128 GB	2 x 10 Gbit/s with PXE Support	24 CPU (64-bit) cores total (Intel x86_64)

Node Type	Role Name	Required Number	Server Hardware - Minimum Requirements and Recommendations			
			Disk	Memory	Network	CPU
			ing system drive • 2 x 300 GB (minimum) - Swift drive			
	DBMQ Cluster	3	• 1 x 600 GB (minimum) - operating system drive • 1 x 300 GB (minimum)	96 GB	2 x 10 Gbit/s with PXE Support	24 CPU (64-bit) cores total (Intel x86_64)

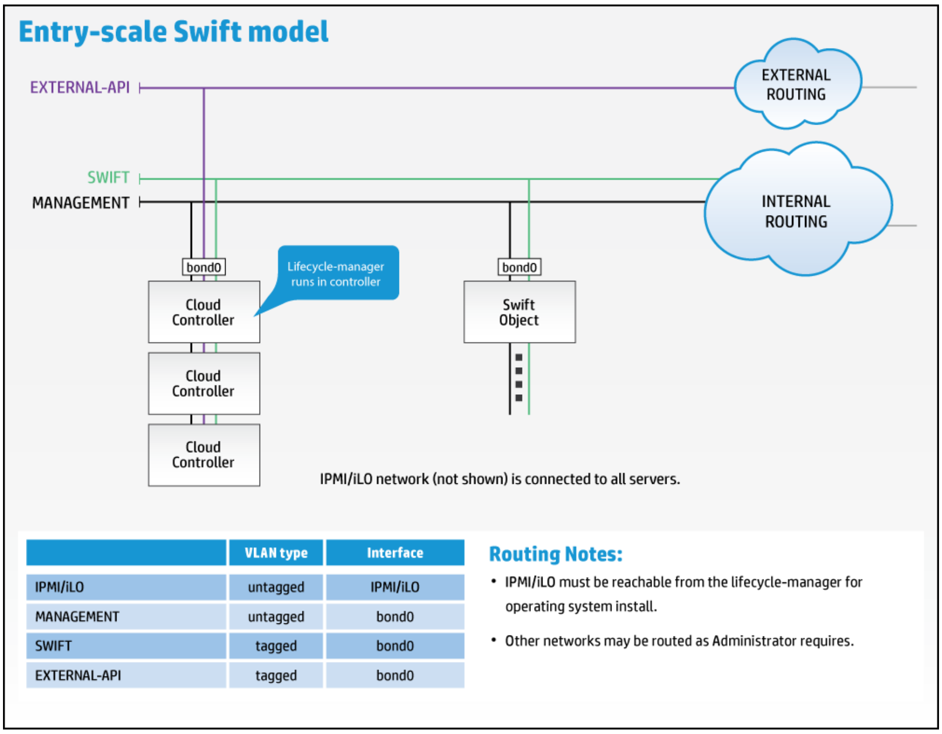
Node Type	Role Name	Required Number	Server Hardware - Minimum Requirements and Recommendations			
			Disk	Memory	Network	CPU
			- MySQL drive			
	Metering Mon/Log Cluster	3	• 1 x 600 GB (minimum) - operating system drive	128 GB	2 x 10 Gbit/s with one PXE enabled port	24 CPU (64-bit) cores total (Intel x86_64)
Compute (ESXi hypervisor)		2 (minimum)	2 X 1 TB (minimum, shared across all nodes)	64 GB (memory must be sized based on the virtual machine instances hosted on the Compute node)	2 x 10 Gbit/s +1 NIC (for Data Center access)	16 CPU (64-bit) cores total (Intel x86_64)
Compute (KVM hypervisor)	kvm-compute	1-3	2 X 600 GB (minimum)	32 GB (memory must be sized based on the vir-	2 x 10 Gbit/s with one PXE enabled port	8 CPU (64-bit) cores total (Intel x86_64) with hard-

Node Type	Role Name	Required Number	Server Hardware - Minimum Requirements and Recommendations			
			Disk	Memory	Network	CPU
				tual machine instances hosted on the Compute node)		ware virtualization support. The CPU cores must be sized based on the VM instances hosted by the Compute node.
Block Storage (Optional)	VSA	0 or 3 (which will provide the recommended redundancy)	3 X 600 GB (minimum) See *Book "Installation Guide", Chapter 2 "Pre-Installation Checklist"* for more details.	32 GB	2 x 10 Gbit/s with one PXE enabled port	8 CPU (64-bit) cores total (Intel x86_64)

10.6 Swift Examples

10.6.1 Entry-scale Swift Model

This example shows how HPE Helion OpenStack can be configured to provide a Swift-only configuration, consisting of three controllers and one or more Swift object servers.



Download a high-resolution version (../../../media/examples/entry_scale_swift_lg.png)

Download Editable Visio Network Diagram Template (../../../media/templates/HOS_Network_Diagram_Template.zip)

The example requires the following networks:

- **External API** - This is the network that users will use to make requests to the cloud.
- **Swift** - This is the network that will be used for all data traffic between the Swift services.
- **Management** - This is the network that will be used for all internal traffic between the cloud services, including node provisioning. This network must be on an untagged VLAN.

All of these networks are configured to be presented via a pair of bonded NICs. The example also enables provider VLANs to be configured in Neutron on this interface.

In the diagram "External Routing" refers to whatever routing you want to provide to allow users to access the External API. "Internal Routing" refers to whatever routing you want to provide to allow administrators to access the Management network.

If you are using HPE Helion OpenStack to install the operating system, then an IPMI/iLO network connected to the IPMI/iLO ports of all servers and routable from the lifecycle manager is also required for BIOS and power management of the node during the operating system installation process.

In the example the controllers use one disk for the operating system and two disks for Swift proxy and account storage. The Swift object servers use one disk for the operating system and four disks for Swift storage. These values can be modified to suit your environment.

These recommended minimums are based on the included included with the base installation and are suitable only for demo environments. For production systems you will want to consider your capacity and performance requirements when making decisions about your hardware.

The `entry-scale-swift` example runs the Swift proxy, account and container services on the three controller servers. However, it is possible to extend the model to include the Swift proxy, account and container services on dedicated servers (typically referred to as the Swift proxy servers). If you are using this model, we have included the recommended Swift proxy servers specs in the table below.

Node Type	Role Name	Required Number	Server Hardware - Minimum Requirements and Recommendations			
			Disk	Memory	Network	CPU
Dedicated lifecycle manager (optional)	Lifecycle-manager	1	300 GB	8 GB	1 x 10 Gbit/s with PXE Support	8 CPU (64-bit) cores total (Intel x86_64)
Control Plane	Controller	3	• 1 x 600 GB (minimum) - operating	64 GB	2 x 10 Gbit/s with one PXE enabled port	8 CPU (64-bit) cores total (Intel x86_64)

Node Type	Role Name	Required Number	Server Hardware - Minimum Requirements and Recommendations			
			Disk	Memory	Network	CPU
			system drive • 2 x 600 GB (minimum) - Swift account/container data drive			
Swift Object	swobj	3	If using x3 replication only: • 1 x 600 GB (minimum, see considerations at bottom	32 GB (see considerations at bottom of page for more details)	2 x 10 Gbit/s with one PXE enabled port	8 CPU (64-bit) cores total (Intel x86_64)

Node Type	Role Name	Required Number	Server Hardware - Minimum Requirements and Recommendations			
			Disk	Memory	Network	CPU
			of page for more details) If using Erasure Codes only or a mix of x3 replication and Erasure Codes: • 6 x 600 GB (minimum, see considerations at bottom of page for			

Node Type	Role Name	Required Number	Server Hardware - Minimum Requirements and Recommendations			
			Disk	Memory	Network	CPU
			more details) Note The disk speeds (RPM) chosen should be consistent within the same ring or storage policy. It's best to not use			

Node Type	Role Name	Required Number	Server Hardware - Minimum Requirements and Recommendations			
			Disk	Memory	Network	CPU
			disks with mixed disk speeds within the same Swift ring.			
Swift Proxy, Account, and Container	swpac	3	2 x 600 GB (minimum, see considerations at bottom of page for more details)	64 GB (see considerations at bottom of page for more details)	2 x 10 Gbit/s with one PXE enabled port	8 CPU (64-bit) cores total (Intel x86_64)

Considerations for your Swift object and proxy, account, container servers RAM and disk capacity needs

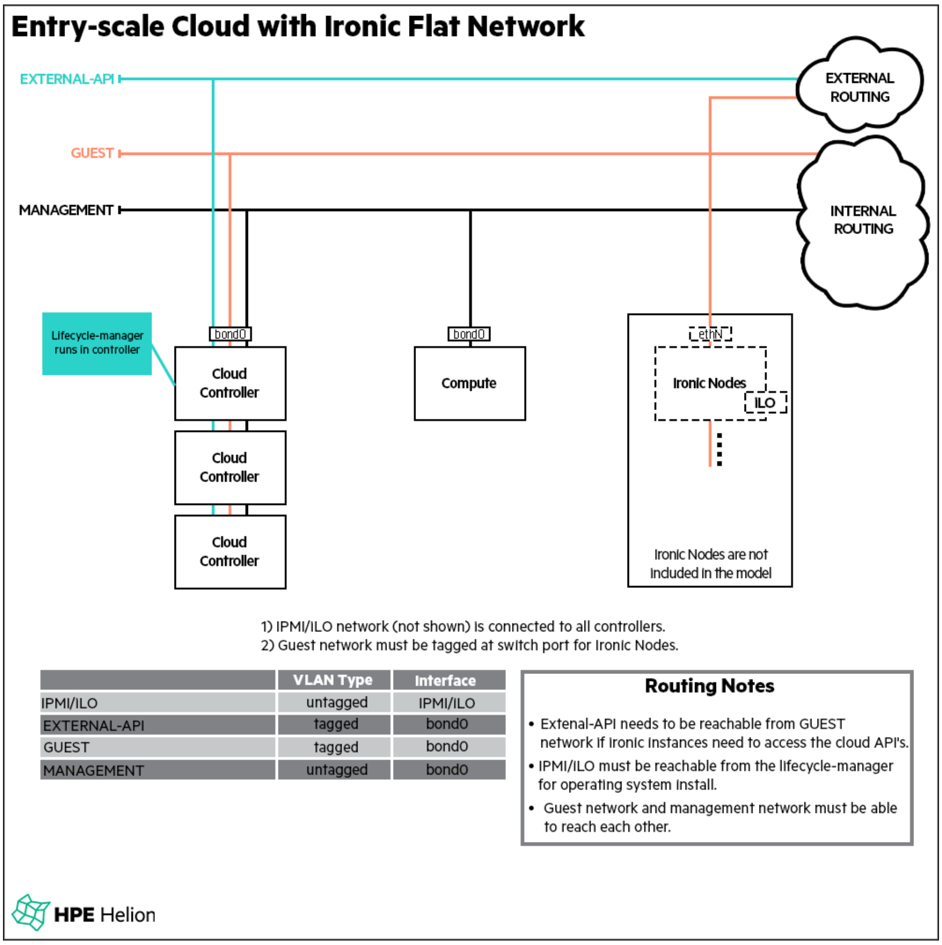
Swift can have a diverse number of hardware configurations. For example, a Swift object server may have just a few disks (minimum of 6 for erasure codes) or up to 70 and beyond. The memory requirement needs to be increased as more disks are added. The general rule of thumb for memory needed is 0.5 GB per TB of storage. For example, a system with 24 hard drives at 8TB each, giving a total capacity of 192TB, should use 96GB of RAM. However, this does not work well for a system with a small number of small hard drives or a very large number of very large drives. So, if after calculating the memory given this guideline, if the answer is less than 32GB then go with 32GB of memory minimum and if the answer is over 256GB then use 256GB maximum, no need to use more memory than that.

When considering the capacity needs for the Swift proxy, account, and container (PAC) servers, you should calculate 2% of the total raw storage size of your object servers to specify the storage required for the PAC servers. So, for example, if you were using the example we provided earlier and you had an object server setup of 24 hard drives with 8TB each for a total of 192TB and you had a total of 6 object servers, that would give a raw total of 1152TB. So you would take 2% of that, which is 23TB, and ensure that much storage capacity was available on your Swift proxy, account, and container (PAC) server cluster. If you had a cluster of three Swift PAC servers, that would be ~8TB each.

Another general rule of thumb is that if you are expecting to have more than a million objects in a container then you should consider using SSDs on the Swift PAC servers rather than HDDs.

10.7 Ironic Examples

10.7.1 Entry-scale Cloud with Ironic Flat Network



Download full image (../../../media/hos.docs/exampleconfigs/entry_scale_ironic.png)

Download Editable Visio Network Diagram Template (./../../../media/templates/HOS_Network_Diagram_Template.zip)

When using the `agent_ilo` driver, you should ensure that the most recent iLO controller firmware is installed. A recommended minimum for the iLO4 controller is version 2.30.

The recommended minimum hardware requirements are based on the included with the base installation and are suitable only for demo environments. For production systems you will want to consider your capacity and performance requirements when making decisions about your hardware.

Node Type	Role Name	Required Number	Server Hardware - Minimum Requirements and Recommendations			
			Disk	Memory	Network	CPU
Dedicated lifecycle manager (optional)	Lifecycle-manager	1	300 GB	8 GB	1 x 10 Gbit/s with PXE Support	8 CPU (64-bit) cores total (Intel x86_64)
Control Plane	Controller	3	• 1 x 600 GB (minimum) - operating system drive • 2 x 600 GB (minimum) - Data drive	64 GB	2 x 10 Gbit/s with one PXE enabled port	8 CPU (64-bit) cores total (Intel x86_64)
Compute	Compute	1	1 X 600 GB (minimum)	16 GB	2 x 10 Gbit/s with one PXE enabled port	16 CPU (64-bit) cores total (Intel x86_64)

For more details about the supported network requirements, see .

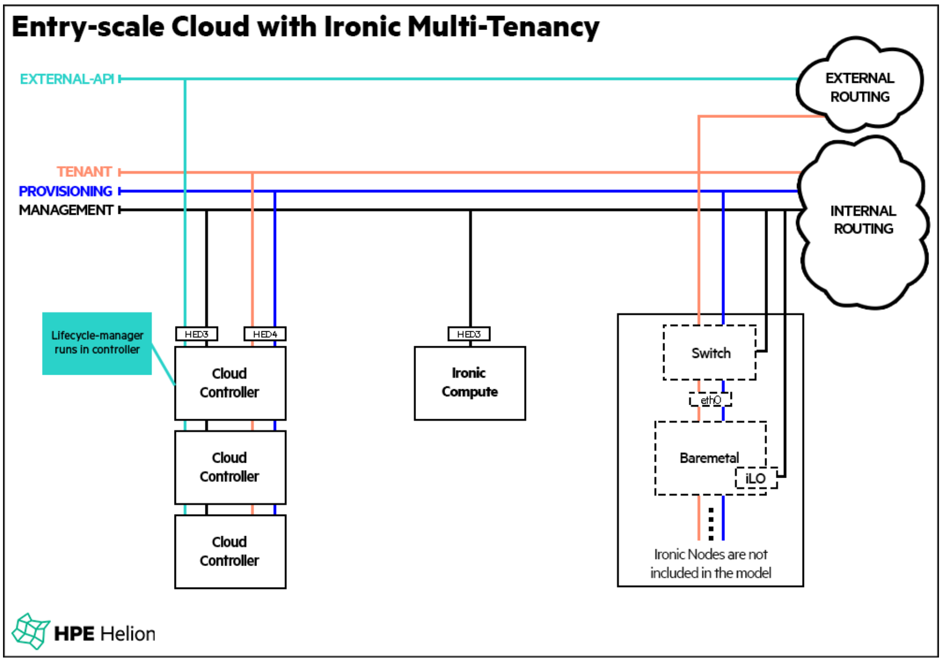
10.7.1.1 Configuration Files

This section contains examples of the configuration files for the Entry-scale Cloud with Ironic Flat Network.

--- product: version: 2 control-planes: - name: control-plane-1 control-plane-prefix: cp1 region-name: region1 failure-zones: - AZ1 - AZ2 - AZ3 common-service-components: - logging-producer - monasca-agent - freezer-agent - stunnel - lifecycle-manager-target clusters: - name: cluster1 cluster-prefix: c1 server-role: CONTROLLER-ROLE member-count: 3 allocation-policy: strict service-components: - lifecycle-manager - ntp-server - swift-ring-builder - mysql - ip-cluster - apache2 - keystone-api - keystone-client - rabbitmq - glance-api - glance-registry - glance-client - nova-api - nova-scheduler-ironic - nova-scheduler - nova-conductor - nova-console-auth - nova-novncproxy - nova-client - neutron-server - neutron-ml2-plugin - neutron-dhcp-agent - neutron-metadata-agent - neutron-openvswitch-agent - neutron-client - horizon - swift-proxy - memcached - swift-account - swift-container - swift-object - swift-client - heat-api - heat-api-cfn - heat-api-cloudwatch - heat-engine - heat-client - ironic-api - ironic-conductor - ironic-client - openstack-client - ceilometer-api - ceilometer-polling - ceilometer-agent-notification - ceilometer-common - ceilometer-client - zookeeper - kafka - vertica - storm - monasca-api - monasca-persister - monasca-notifier - monasca-threshold - monasca-client - logging-server - ops-console-web - ops-console-monitor - freezer-api - barbican-api - barbican-client - barbican-worker resources: - name: ironic-compute resource-prefix: ir-compute server-role: IRONIC-COMPUTE-ROLE allocation-policy: any service-components: - neutron-openvswitch-agent - nova-compute-ironic - nova-compute - ntp-client --- product: version: 2 networks: # # This example uses the following networks # # Network CIDR VLAN # ------- ---- ---- # External API 10.0.1.0/24 101 (tagged) # Guest 102 (tagged) # Management 192.168.10.0/24 100 (untagged) # # Notes: # 1. Defined as part of Neutron configuration # # Modify these values to match your environment # - name: EXTERNAL-API-NET tagged-vlan: true vlanid: 101 cidr: 10.0.1.0/24 gateway-ip: 10.0.1.1 network-group: EXTERNAL-API #start-address: 10.0.1.10 #end-address: 10.0.1.250 - name: GUEST-NET tagged-vlan: true vlanid: 102 network-group: GUEST - name: MANAGEMENT-NET tagged-vlan: false vlanid: 100 cidr: 192.168.10.0/24 gateway-ip: 192.168.10.1 network-group: MANAGEMENT #start-address: 192.168.10.10 #end-address: 192.168.10.250 --- product: version: 2 network-groups: # # External API # # This is the network group that users will use to # access the public API endpoints of your cloud # - name: EXTERNAL-API hostname-suffix: extapi load-balancers: - provider: ip-cluster name: extlb # If external-name is set then public urls in keystone # will use this name instead of the IP address. # You must either set this to a name that can be resolved in your network # or comment out this line to use IP addresses external-name: tls-components: - default roles: - public cert-file: my-public-entryscale-ironic-cert

This is the name of the certificate that will be used on load balancer. # Replace this with name of file in "~helion/my_cloud/config/tls/certs/". # This is the certificate that matches your setting for external-name # # Note that it is also possible to have per service certificates: # # cert-file: # default: my-public-entryscale-ironic-cert # horizon: my-horizon-cert # nova-api: my-nova-cert # # # # GUEST # # This is the network group that will be used to provide # private networks to Baremetals # - name: GUEST hostname-suffix: guest tags: - neutron.networks.flat: provider-physical-network: physnet1 # Management # # This is the network group that will be used to for # management traffic within the cloud. # # The interface used by this group will be presented # to Neutron as physnet1, and used by provider VLANS # - name: MANAGEMENT hostname-suffix: mgmt hostname: true component-endpoints: - default routes: - default load-balancers: - provider: ip-cluster name: lb components: - default roles: - internal - admin --- product: version: 2 interface-models: # These examples uses hed3 and hed4 as a bonded # pair for all networks on all three server roles # # Edit the device names and bond options # to match your environment # - name: CONTROLLER-INTERFACES network-interfaces: - name: BOND0 device: name: bond0 bond-data: options: mode: active-backup miimon: 200 primary: hed3 provider: linux devices: - name: hed3 - name: hed4 network-groups: - EXTERNAL-API - GUEST - MANAGEMENT - name: COMPUTE-IRONIC-INTERFACES network-interfaces: - name: BOND0 device: name: bond0 bond-data: options: mode: active-backup miimon: 200 primary: hed3 provider: linux devices: - name: hed3 - name: hed4 network-groups: - MANAGEMENT - GUEST

10.7.2 Entry-scale Cloud with Ironic Multi-Tenancy



	VLAN switch configuration	VLAN type in HOS	Interface
EXTERNAL-API	Tagged for controllers, needs subnet with IP address range	tagged	• hed3 on controllers
MANAGEMENT	Untagged for controllers and compute, needs subnet with IP address range	untagged	• hed3 on controllers and compute
PROVISIONING	Tagged for controllers, needs subnet with IP address range. For ironic baremetal nodes, switch config will be set dynamically by Neutron.	neutron provider VLAN (untagged)	• hed4 on controllers • eth0 on baremetal nodes

	VLAN switch configuration	VLAN type in HOS	Interface
TENANT	Tagged range of VLANs. Number of VLANs in range may be up to number of baremetal nodes (for each node have it's own network). For ironic baremetal nodes, switch config will be set dynamically by Neutron.	neutron provider VLAN (untagged)	• hed4 on controllers • eth0 on baremetal nodes

Routing notes

1. EXTERNAL-API needs to be reachable from TENANT VLANs if ironic instances need to access the cloud APIs
2. Controller and compute nodes IPMI/iLO must be reachable form lifecycle-manager for operating system install
3. Baremetal node IPMI/iLO must be reachable from controllers via MANAGEMENT network for operating system install
4. Switch management IPs must be reachable from controllers MANAGEMENT network for VLAN configuration setting
5. TENANT VLANs should be configured to allow inbound/outbound external access, if external access is needed for Ironic instances

11 Modifying the Entry-scale KVM with VSA Model for Your Environment

This section covers the changes that need to be made to the input model to deploy and run this cloud model in your environment.

This section is written from the perspective of the `entry-scale-kvm-vsa` example, although the same principles apply to all of the examples.

There are two categories of modifications that we will look at:

1. Localizations - These are the minimum set of changes that you need to make to adapt the examples to run in your environment. These are mostly concerned with networking. See *Section 11.1, "Localizing the Input Model"*.
2. Customizations - These describe more general changes that you can make to your model, e.g. changing disk storage layouts. See *Section 11.2, "Customizing the Input Model"*

Note that, as a convention, the examples use upper case for the object names, but these strings are only used to define the relationships between objects and have no specific significance to the configuration processor. You can change the names to values that are relevant to your context providing you do so consistently across the input model.

11.1 Localizing the Input Model

This section covers the minimum set of changes needed to localize the cloud for your environment. This assumes you are using other features of the example unchanged:

- Update `networks.yml` to specify the network addresses (VLAN IDs and CIDR values) for your cloud.
- Update `nic_mappings.yml` to specify the PCI bus information for your servers' Ethernet devices.
- Update `net_interfaces.yml` to provide network interface configurations, such as bond settings and bond devices.
- Update `network_groups.yml` to provide the public URL for your cloud and to provide security certificates.
- Update `servers.yml` to provide information about your servers.

networks.yml

You will need to allocate site specific CIDRs and VLANs for these networks and update these values in the `networks.yml` file. The example models define the following networks:

Network	CIDR	VLAN ID	Tagged / Untagged
External API	10.0.1.0/24	101	Tagged
External VM	Addresses configured by Neutron, leave blank in the file.	102	Tagged
Guest	10.1.1.0/24	103	Tagged
Management	192.168.10.0/24	100	Untagged

You will need to edit this file to provide your local values for these networks.

The CIDR for the External VM network is configured separately using the Neutron API. (For instructions, see .) You will only specify its VLAN ID during the installation process.

The Management network is shown as untagged. This is required if you are using this network to PXE install the operating system on the cloud nodes.

The example `networks.yml` file is shown below. Modify the bolded fields to reflect your site values.

```
networks:
   #
   # This example uses the following networks
   #
   # Network       CIDR             VLAN
   # -------       ----             ----
   # External API  10.0.1.0/24      101 (tagged)
   # External VM   see note 1       102 (tagged)
   # Guest         10.1.1.0/24      103 (tagged)
   # Management    192.168.10.0/24  100 (untagged)
   #
   # Notes:
   # 1. Defined as part of Neutron configuration
   #
   # Modify these values to match your environment
   #
   - name: EXTERNAL-API-NET
     vlanid: 101
```

```
      tagged-vlan: true
      cidr: 10.0.1.0/24
      gateway-ip: 10.0.1.1
      network-group: EXTERNAL-API

    - name: EXTERNAL-VM-NET
      vlanid: 102
      tagged-vlan: true
      network-group: EXTERNAL-VM

    - name: GUEST-NET
      vlanid: 103
      tagged-vlan: true
      cidr: 10.1.1.0/24
      gateway-ip: 10.1.1.1
      network-group: GUEST

    - name: MANAGEMENT-NET
      vlanid: 100
      tagged-vlan: false
      cidr: 192.168.10.0/24
      gateway-ip: 192.168.10.1
      network-group: MANAGEMENT
```

nic_mappings.yml

This file maps Ethernet port names to specific bus slots. Due to inherent race conditions associated with multiple PCI device discovery there is no guarantee that Ethernet devices will be named as expected by the operating system, and it is possible that different port naming will exist on different servers with the same physical configuration.

To provide a deterministic naming pattern, the input model supports an explicit mapping from PCI bus address to a user specified name. HPE Helion OpenStack uses the prefix **hed** (Helion Ethernet Device) to name such devices to avoid any name clashes with the **eth** names assigned by the operating system.

The example `nic_mappings.yml` file is shown below.

```
nic-mappings:

   - name: HP-DL360-4PORT
     physical-ports:
       - logical-name: hed1
         type: simple-port
         bus-address: "0000:07:00.0"
```

```
      - logical-name: hed2
        type: simple-port
        bus-address: "0000:08:00.0"

      - logical-name: hed3
        type: simple-port
        bus-address: "0000:09:00.0"

      - logical-name: hed4
        type: simple-port
        bus-address: "0000:0a:00.0"

  - name: MY-2PORT-SERVER
    physical-ports:
      - logical-name: hed3
        type: simple-port
        bus-address: "0000:04:00.0"

      - logical-name: hed4
        type: simple-port
        bus-address: "0000:04:00.1"
```

This defines two sets of NIC mappings, representing two different physical server types. The name of each mapping is used as a value in the `servers.yml` file to associate each server with its required mapping. This enables the use of different server models or servers with different network hardware.

Each mapping lists a set of ports with the following information:

- **Logical name** - HPE Helion OpenStack uses the form `hedN`.
- **Type** - Only simple-port types are supported in HPE Helion OpenStack 5.0.
- **Bus-address** - The PIC bus address of the port.

The PCI bus address can be found using the `lspci` command on one of the servers. This command can produce a lot of output, so you can use the following command which will limit the output to list Ethernet class devices only:

```
sudo lspci -D |grep -i net
```

Here is an example output:

```
$ sudo lspci -D |grep -i net
```

```
0000:02:00.0 Ethernet controller: Broadcom Corporation NetXtreme BCM5719 Gigabit Ethernet
 PCIe (rev 01)
0000:02:00.1 Ethernet controller: Broadcom Corporation NetXtreme BCM5719 Gigabit Ethernet
 PCIe (rev 01)
0000:02:00.2 Ethernet controller: Broadcom Corporation NetXtreme BCM5719 Gigabit Ethernet
 PCIe (rev 01)
0000:02:00.3 Ethernet controller: Broadcom Corporation NetXtreme BCM5719 Gigabit Ethernet
 PCIe (rev 01)
0000:04:00.0 Ethernet controller: Intel Corporation 82599ES 10-Gigabit SFI/SFP+ Network
 Connection (rev 01)
0000:04:00.1 Ethernet controller: Intel Corporation 82599ES 10-Gigabit SFI/SFP+ Network
 Connection (rev 01)
```

To localize this file, replace the mapping names with the names of your choice and enumerate the ports as required.

net_interfaces.yml

This file is used to define how the network interfaces are to be configured. The example reflects the slightly different configuration of controller, compute nodes, and VSA nodes.

If network bonding is to be used, this file specifies how bonding is to be set up. It also specifies which networks are to be associated with each interface.

The example uses a bond of interfaces `hed3` and `hed4`. You only need to modify this file if you have mapped your physical ports to different names, or if you need to modify the bond options.

The section of configuration file is shown below, which will create a bonded interface using the named `hed3` and `hed4` NIC mappings described in the previous section.

```
    - name: CONTROLLER-INTERFACES
      network-interfaces:
        - name: BOND0
          device:
              name: bond0
          bond-data:
              options:
                  mode: active-backup
                  miimon: 200
                  primary: hed3
          provider: linux
          devices:
              - name: hed3
              - name: hed4
          network-groups:
```

```
            - EXTERNAL-API
            - EXTERNAL-VM
            - GUEST
            - MANAGEMENT
```

If your system cannot support bonding, then you can modify this specification to specify a non-bonded interface, for example using device `hed3`:

```
    - name: CONTROLLER-INTERFACES
      network-interfaces:
        - name: hed3
          device:
             name: hed3
          network-groups:
             - EXTERNAL-API
             - EXTERNAL-VM
             - GUEST
             - MANAGEMENT
```

network_groups.yml

This file defines the networks groups used in your cloud. A network-group defines the traffic separation model, and all of the properties that are common to the set of L3 networks that carry each type of traffic. They define where services and load balancers are attached to the network model and the routing within that model.

In this example, the following network groups are defined:

- **EXTERNAL-API** - This network group is used for external IP traffic to the cloud. In addition, it defines:
  - The characteristics of the load balancer to be used for the external API.
  - The Transport Layer Security (TLS) attributes.
- **EXTERNAL-VM** - Floating IPs for virtual machines are created on this network group. This is identified by the tag value `neutron.l3_agent.external_network_bridge`.

- **GUEST** - Tenant VxLAN traffic is carried on this network group. This is identified by the tag value `neutron.networks.vxlan`.
- **MANAGEMENT** - This is the default network group for traffic between service components in the cloud. In addition, it defines:
  - An internal load balancer is defined on this network group for managing internal and administrative API requests.

Most of the values in this file should be left unmodified if you are using the network model defined by the example. More complex modifications are supported but are outside the scope of this document.

However, the values related to the external API network are site-specific and need to be modified:

- Provide an external URL for the cloud.
- Provide the name of the security certificate to use.

The example `network_groups.yml` file is shown below, modify the bolded fields to reflect your site values.

```
# External API
#
# This is the network group that users will use to
# access the public API endpoints of your cloud
#
- name: EXTERNAL-API
  hostname-suffix: extapi

  load-balancers:
    - provider: ip-cluster
      name: extlb
      # If external-name is set then public urls in keystone
      # will use this name instead of the IP address
      # You must either set this to a name that can be resolved
      # in your network
      # or comment out this line to use IP addresses
      external-name:

      tls-components:
         - default
      roles:
         - public
```

```
        cert-file: my-public-kvm-vsa-cert
```

The above bolded sections as follows:

external-name - The external name defines how the public URLs will be registered in Keystone. Users of your cloud will need to be able to resolve this URL to access the cloud APIs, and if you are using the TLS, the name must match the certificate used.

Because this value is difficult to change after initial deployment, this value is left blank in the supplied example which prevents the configuration processor from running until a value has been supplied. If you want to register the public URLs as IP addresses instead of a name, then you can comment out this line.

cert-file - Provide the name of the file located in `~/helion/my_cloud/config/tls/certs/` that will be used for your cloud endpoints. As shown above, this can be either a single certificate for all endpoints or a default certificate file and a set of service-specific certificate files.

tls-components - If you do not want to use a TLS for the public URLs then change the entry that says `tls-components` to `components`.

servers.yml

This file is where you provide the details of the physical servers that make up your cloud. There are two sections to this file: `baremetal` and `servers`:

```
baremetal:
   # NOTE: These values need to be changed to match your environment.
   # Define the network range that contains the ip-addr values for
   # the individual servers listed below.
   subnet: 192.168.10.0
   netmask: 255.255.255.0
```

The two values in this section are used to configure cobbler for operating system installation and must match the network values for the addresses given for the servers.

The servers section below provides the details of each individual server. For example, here are the details for the first controller:

```
servers:

   # Controllers
   - id: controller1
     ip-addr: 192.168.10.3
     role: CONTROLLER-ROLE
```

```
        server-group: RACK1
        nic-mapping: HP-DL360-4PORT
        mac-addr: b2:72:8d:ac:7c:6f
        ilo-ip: 192.168.9.3
        ilo-password: password
        ilo-user: admin
```

Here is a description of each of the above bolded sections:

id - A name you provide to uniquely identify a server. This can be any string which makes sense in your context, such as an asset tag, descriptive name, etc. The system will use this value to remember how the server has been allocated.

ip-addr - The IP address that the system will use for SSH connections to the server for deployment and configuration changes. This address must be in the IP range of one of the networks in the model. In the example, the servers are provided with addresses from the MANAGEMENT network.

role - A string that refers to an entry in `server_roles.yml` that tells the system how to configure the disks and network interfaces for this server. Roles are also used to define which servers can be used for specific purposes. Adding and changing roles is beyond the scope of this walkthrough - for more information, see *Section 12.10.1, "Ring Specifications in the Input Model"*.

server-group - Tells the system how this server is physically related to networks and other servers. Server groups are used to ensure that servers in a cluster are selected from different physical groups. The example provides a set of server groups that divide the servers into three sets called **RACK1**, **RACK2**, and **RACK3**. Modifying the server group structure is beyond the scope of this walkthrough - for more information, see .

nic-mapping - The name of a network port mapping definition (for more information, see). You need to set this to the mapping that corresponds to this server.

mac-addr - The MAC address of the interface associated with this server that will be used for PXE boot.

ilo-ip - The IP address of the iLO or IPMI port for this server.

ilo-user and ilo-password - The login details used to access the iLO or IPMI port of this server. The iLO password value can be provided as an OpenSSL encrypted string. (For instructions on how to generate encrypted passwords, see *Book "Installation Guide", Chapter 10 "Installing Mid-scale and Entry-scale KVM"*.

11.2 Customizing the Input Model

This section covers additional changes that you can make to further adapt the example to your environment:

- Update `disks_controller.yml` to add additional disk capacity to your controllers.
- Update `disks_vsa.yml` to add additional disk capacity to your VSA servers.
- Update `disks_compute.yml` to add additional disk capacity to your compute servers.

11.2.1 disks_controller.yml

The disk configuration of the controllers consists of two sections: a definition of a volume group that provides a number of file-systems for various subsystems, and device-group that provides disk capacity for Swift.

11.2.2 File Systems Storage

The root volume group (hlm-vg) is divided into a number of logical volumes that provide separate file systems for the various services that are co-hosted on the controllers in the entry-scale examples. The capacity of each file system is expressed as a percentage of the overall volume group capacity. Because not all file system usage scales linearly, two different disk configurations are provided:

- **CONTROLLER-DISKS** - Based on a 512 GB root volume group.
- **CONTROLLER-1TB-DISKS** - Provides a higher percentage of space for the logging service.

As supplied, the example uses the smaller disk model. To use the larger disk model you need to modify the `disk-models` parameter in the `server_roles.yml` file, as shown below:

```
server-roles:

  - name: CONTROLLER-ROLE
    interface-model: CONTROLLER-INTERFACES
    disk-model: CONTROLLER-1TB-DISKS
```

To add additional disks to the root volume group, you need to modify the volume group definition in whichever disk model you are using. The following example shows adding an additional disk, `/dev/sdd` to the `disks_controller.yml` file:

```
disk-models:
  - name: CONTROLLER-DISKS

    volume-groups:
     - name: hlm-vg
       physical-volumes:

          # NOTE: 'sda_root' is a templated value. This value is checked in
          # os-config and replaced by the partition actually used on sda
          #e.g. sda1 or sda5
          - /dev/sda_root
          - /dev/sdd
```

11.2.3 Swift Storage

Swift storage is configured as a device-group and has a syntax that allows disks to be allocated to specific rings. In the example, two disks are allocated to Swift to be shared by the account, container, and object-0 rings.

```
device-groups:
    - name: swiftobj
      devices:
          - name: /dev/sdb
          - name: /dev/sdc
          # Add any additional disks for swift here
          # -name: /dev/sdd
          # -name: /dev/sde
      consumer:
        name: swift
        attrs:
           rings:
              - account
              - container
              - object-0
```

For instruction to configure additional Swift storage, see *Section 12.5, “Allocating Disk Drives for Object Storage”*.

11.2.4 disks_vsa.yml

VSA storage is configured as a device-group and has a syntax that allows disks to be allocated for data storage or for adaptive optimization (caching). As a best practice, you should use solid state drives for adaptive optimization. The example disk configuration for VSA nodes has two disks, one for data and one of adaptive optimization. (For more information, see *Section 11.3, "VSA with or without Adaptive Optimization (AO)"*.)

```
device-groups:
    - name: vsa-data
      consumer:
        name: vsa
        usage: data
      devices:
        - name: /dev/sdc
    - name: vsa-cache
      consumer:
        name: vsa
        usage: adaptive-optimization
      devices:
         - name: /dev/sdb
```

Additional capacity can be added by adding more disks to the `vsa-data` device group. Similarly, caching capacity can be increased by adding more high speed storage devices to the `vsa-cache` device group.

11.2.5 disks_compute.yml

The example disk configuration for compute nodes consists of two volume groups: one for the operating system and one for the ephemeral storage for virtual machines, with one disk allocated to each.

Additional virtual machine ephemeral storage capacity can be configured by adding additional disks to the `vg-comp` volume group. The following example shows the addition of two more disks, `/dev/sdc` and `/dev/sdd`, to the `disks_compute.yml` file:

```
- name: vg-comp
     physical-volumes:
       - /dev/sdb
       - /dev/sdc
       - /dev/sdd
     logical-volumes:
       - name: compute
```

```
            size: 95%
            mount: /var/lib/nova
            fstype: ext4
                  mkfs-opts: -O large_file
```

11.3 VSA with or without Adaptive Optimization (AO)

VSA may be deployed with adaptive optimization (AO) or without AO. AO allows built-in storage tiering for VSA. While deploying VSA with or without AO you must ensure to use the appropriate disk input model.

If you are using VSA with AO, you will have an extra device group section where the usage is identified as adaptive-optimization as described in the following example:

```
Additional disks can be added if available
          device_groups:
            - name: vsa-data
              consumer:
                name: vsa
                usage: data
              devices:
                - name: /dev/sdc
          - name: /dev/sdd
          - name: /dev/sde
          - name: /dev/sdf

            - name: vsa-cache
              consumer:
                name: vsa
                usage: adaptive-optimization
              devices:
                - name: /dev/sdb
```

VSA without AO consists of only data disks as described in the following example:

```
Additional disks can be added if available
              device_groups:
                - name: vsa-data
                  consumer:
                    name: vsa
                    usage: data
                  devices:
                    - name: /dev/sdc
                    - name: /dev/sdd
```

```
                - name: /dev/sde
                - name: /dev/sdf
```

It is recommended to use SSD disk for AO.

> **Note**
>
> A single VSA node can have a maximum of seven raw disks (excluding the operating system disks) attached to it, which is defined in the disk input model for your VSA nodes. It is expected that no more than seven disks are specified (including Adaptive Optimization disks) per VSA node. For example, if you want to deploy VSA with two disks for Adaptive Optimization then your disk input model should not specify more than five raw disks for data and two raw disks for Adaptive Optimization. Exceeding the disk limit causes VSA deployment failure.

11.4 Creating Multiple VSA Clusters

The HPE Helion OpenStack 5.0 input model comes with one cluster and three VSA nodes. This is the default configuration available in the input model, but the input model allows you to create multiple VSA clusters of same or different types by modifying the YAML file.

> **Tip**
>
> The term **add** and **update** in the document means editing the respective YAML files to add or update the configurations/values.
>
> **Prerequisites**
>
> You must have a minimum of three nodes per VSA cluster.

11.4.1 Cloud Configuration Changes to Create More Than One Cluster

In this cloud configuration, you can modify the YAML files for a same set of disks:

1. Add new nodes in the `servers.yml` file with a unique name and `node_id` for each cluster. Example: In the following example we are adding one more cluster. Similarly, you can keep adding clusters based on your requirements.

The following `servers.yml` file lists six nodes for two clusters:

```
- id: vsa1
      ip-addr: 192.168.61.15
      role: VSA-ROLE
      server-group: RACK1
      nic-mapping: HP-BL460c-4PORT
      ilo-ip: 10.1.192.232
      ilo-password: gone2far
      ilo-user: Administrator
      mac-addr: 5C:B9:01:78:8C:B0

    - id: vsa2
      ip-addr: 192.168.61.16
      role: VSA-ROLE
      server-group: RACK2
      nic-mapping: HP-BL460c-4PORT
      ilo-ip: 10.1.192.233
      ilo-password: gone2far
      ilo-user: Administrator
      mac-addr: 5C:B9:01:78:0E:30

    - id: vsa3
      ip-addr: 192.168.61.17
      role: VSA-ROLE
      server-group: RACK3
      nic-mapping: HP-BL460c-4PORT
      ilo-ip: 10.1.192.234
      ilo-password: gone2far
      ilo-user: Administrator
      mac-addr: 5C:B9:01:78:2D:00

    - id: vsa4
      ip-addr: 192.168.62.18
      role: VSA-ROLE-1
      server-group: RACK1
      nic-mapping: HP-BL460c-4PORT
      ilo-ip: 10.1.193.232
      ilo-password: gone2far
      ilo-user: Administrator
      mac-addr: 5C:B9:01:78:8C:B0

    - id: vsa5
      ip-addr: 192.168.63.19
      role: VSA-ROLE-1
      server-group: RACK2
      nic-mapping: HP-BL460c-4PORT
```

```
      ilo-ip: 10.1.194.233
      ilo-password: gone2far
      ilo-user: Administrator
      mac-addr: 5C:B9:01:78:0E:30

    - id: vsa6
      ip-addr: 192.168.64.20
      role: VSA-ROLE-1
      server-group: RACK3
      nic-mapping: HP-BL460c-4PORT
      ilo-ip: 10.1.195.234
      ilo-password: gone2far
      ilo-user: Administrator
      mac-addr: 5C:B9:01:78:2D:00
```

2. Add a new resource in the `control_plane.yml` file with the name, resource-prefix, and server-role.
Example: The following `control_plane.yml` file contains the information of the newly added resource nodes:

```
resources:
     - name: vsa
       resource-prefix: vsa
       server-role: ROLE-VSA
       allocation-policy: strict
       min-count: 0
       service-components:
          - ntp-client
          - vsa

      - name: vsa1
        resource-prefix: vsa1
        server-role: ROLE-VSA-1
        allocation-policy: strict
        min-count: 0
        service-components:
           - ntp-client
           - vsa
```

The control plane has the following fields:

`name`	The name assigned for the cluster. In the above example **vsa** and **vsa1**.
`resource-prefix`	The prefix of that resource cluster.

`server-role`	The role must be unique for each cluster.

3. Update `server_roles.yml` with new VSA nodes.
   Example: In the following `server_roles.yml` file, new VSA nodes are added/updated:

```
server-roles:

    - name: ROLE-VSA
      interface-model: INTERFACE_SET_VSA
      disk-model: DISK_SET_VSA

    - name: ROLE-VSA-1
      interface-model: INTERFACE_SET_VSA
      disk-model: DISK_SET_VSA
```

   The server roles have the following fields:

`name`	The name assigned to the cluster. In the above example **vsa** and **vsa1**.
`disk-model`	The type of disk available for the clusters. It can be the same set of disks or a different set of disks. In the above example, only one set of disk models is shown (for example:**DISK_SET_VSA**).

11.4.2 Cloud Configuration Changes to Create Two Cluster with Different Set of Disks

You must edit the YAML files to create more than one cluster. In this cloud configuration, you can add or update the YAML files for a different set of disks, i.e., one with adoptive optimization (AO) enabled and another without adoptive optimization.

1. Add new nodes in `severs.yml` with a unique name.
2. Add a new resource node under **resources** in `control_plane.yml` with a unique name, resource-prefix, and server-role.
3. Modify the `disk_set` for AO and without AO. Ensure that you use different files and different `disk_set`.

Note

In the HPE Helion OpenStack 5.0 input model you will find only a `disks_vsa.yml` file, which contains the information for AO and without AO. You must create a separate YAML file and enter the configuration information of AO in that file. For creating non AO disk, refer to *Section 11.3, "VSA with or without Adaptive Optimization (AO)"*.

4. Update `server_roles.yml` with new VSA nodes and appropriate `disk_set` used for that node.
   Example: In the following `servers_roles.yml` file you can see both AO and without AO assigned for the node:

```
---
  product:
    version: 2

  server-roles:

    - name: ROLE-CONTROLLER
      interface-model: INTERFACE_SET_CONTROLLER
      disk-model: DISK_SET_CONTROLLER

    - name: ROLE-COMPUTE
      interface-model: INTERFACE_SET_COMPUTE
      disk-model: DISK_SET_COMPUTE

    - name: ROLE-VSA
      interface-model: INTERFACE_SET_VSA
      disk-model: DISK_SET_VSA

    - name: ROLE-VSA-1
      interface-model: INTERFACE_SET_VSA
      disk-model: DISK_SET_VSA_AO
```

Note

If you have configured your cloud to have more than one cluster or n-clusters, remember to note down all the cluster IPs.

11.5 Configuring a Separate iSCSI Network to use with VSA

This page describes the procedure to assign a separate iSCSI network to use with VSA nodes. You must configure controller and compute nodes along with VSA to use a separate iSCSI network.

Perform the following procedure to assign a separate iSCSI network:

1. Log in to the lifecycle manager.
2. Edit the following files at `~/helion/my_cloud/definition/data` to assign a separate iSCSI network to controller nodes, compute nodes, and VSA nodes:

   > **Note**
   >
   > The input YAML files need to be changed during the cloud deployment.

   a. `networks.yml`: Enter the name of the network-group as shown in the example below. In the following example, the name of the network-group is "ISCSI" and this name should remain consistent in other files too.

   ```
   - name: NET_ISCSI
     vlanid: 3287
     tagged-vlan: true
     cidr: 172.16.13.0/24
     gateway-ip: 172.16.13.1
     network-group: ISCSI
   ```

   b. `net_interfaces.yml`: A new field (forced-network-groups) is added in this file, as shown in the sample below.

   ```
   Interface-models
      - name: INTERFACE_SET_CONTROLLER
        network-interfaces:
          - name: BOND0
            device:
                name: bond0
            bond-data:
               options:
                   mode: "802.3ad"
                   miinon: 200
               provider: linux
   ```

```
          devices:
            - name: Port0_10G1
            - name: Port1_10G1
        network-groups:
          - MGMT
          - TENANT
        forced-network-groups:
          - ISCSI

    - name: INTERFACE_SET_COMPUTE
      network-interfaces:
        - name: BOND0
          device:
              name: bond0
          bond-data:
             options:
                 mode: "802.3ad"
                 miinon: 200
             provider: linux
             devices:
               - name: Port0_10G1
               - name: Port1_10G1
          network-groups:
            - MGMT
            - TENANT
          forced-network-groups:
            - ISCSI

    - name: INTERFACE_SET_VSA
      network-interfaces:
        - name: BOND0
          device:
              name: bond0
          bond-data:
             options:
                 mode: "802.3ad"
                 miinon: 200
             provider: linux
             devices:
               - name: Port0_10G1
               - name: Port1_10G1
          network-groups:
            - MGMT
            - TENANT
          forced-network-groups:
            - ISCSI
```

c. `firewall_rules.yml`

```
firewall-rules
    - name: PING
      network-groups:
      - MGMT
      - TENANT
      - EXTERNAL_API
      - ISCSI
      - SWIFT
```

d. `network_groups.yml`

```
network-groups:
    - name: ISCSI
      hostname-suffix: iscsi
      component-endpoints:
        - vsa
```

e. `server_groups.yml`

```
server_groups.yml
      networks:
     #Define the Global networks shared across all the Racks
        - NET_EXTERNAL_API
        - NET_EXTERNAL_VM
        - NET_TENANT
        - NET_MGMT
        - NET_SWIFT
        - NET_ISCSI
```

3. Commit your changes.

```
git add -A
git commit -m "Add Node <name>"
```

4. Run the configuration processor:

```
cd ~/helion/hos/ansible
ansible-playbook -i hosts/localhost config-processor-run.yml
```

5. Run the following command to create a deployment directory.

```
cd ~/helion/hos/ansible
```

```
ansible-playbook -i hosts/localhost ready-deployment.yml
```

6. Run the `site.yml` playbook using the command below.

```
cd ~/scratch/ansible/next/hos/ansible
ansible-playbook -i hosts/verb_hosts site.yml
```

> **Note**
>
> If the iSCSI network is not explicitly configured on the controller nodes then boot from cinder volumes would fail.

12 Modifying Example Configurations for Object Storage using Swift

This section contains detailed descriptions about the Swift-specific parts of the input model. For example input models, see *Chapter 10, Example Configurations*. For general descriptions of the input model, see *Section 7.14, "Networks"*. In addition, the Swift ring specifications are available in the `~/helion/my_cloud/definition/data/swift/rings.yml` file.

Usually, the example models provide most of the data that is required to create a valid input model. However, before you start to deploy, you must do the following:

- Check the disk model used by your nodes and that all disk drives are correctly named and used as described in *Section 12.6, "Swift Requirements for Device Group Drives"*.
- Select an appropriate partition power for your rings. For more information, see *Section 12.10, "Understanding Swift Ring Specifications"*.

For further information, read these related pages:

12.1 Object Storage using Swift Overview

12.1.1 What is the Object Storage (Swift) Service?

The HPE Helion OpenStack Object Storage using Swift service leverages Swift which uses software-defined storage (SDS) layered on top of industry-standard servers using native storage devices. Swift presents an object paradigm, using an underlying set of disk drives. The disk drives are managed by a data structure called a "ring" and you can store, retrieve, and delete objects in containers using RESTful APIs.

HPE Helion OpenStack Object Storage using Swift provides a highly-available, resilient, and scalable storage pool for unstructured data. It has a highly-durable architecture, with no single point of failure. In addition, HPE Helion OpenStack includes the concept of cloud models, where the user can modify the cloud input model to provide the configuration required for their environment.

12.1.2 Object Storage (Swift) Services

A Swift system consists of a number of services:

- Swift-proxy provides the API for all requests to the Swift system.
- Account and container services provide storage management of the accounts and containers.
- Object services provide storage management for object storage.

These services can be co-located in a number of ways. The following general pattern exists in the example cloud models distributed in HPE Helion OpenStack:

- The swift-proxy, account, container, and object services run on the same (PACO) node type in the control plane. This is used for smaller clouds or where Swift is a minor element in a larger cloud. This is the model seen in most of the entry-scale models.
- The swift-proxy, account, and container services run on one (PAC) node type in a cluster in a control plane and the object services run on another (OBJ) node type in a resource pool. This deployment model, known as the Entry-Scale Swift model, is used in larger clouds or where a larger Swift system is in use or planned. See *Section 10.6.1, "Entry-scale Swift Model"* for more details.

The Swift storage service can be scaled both vertically (nodes with larger or more disks) and horizontally (more Swift storage nodes) to handle an increased number of simultaneous user connections and provide larger storage space.

Swift is configured through a number of YAML files in the HPE Helion implementation of the OpenStack Object Storage (Swift) service. For more details on the configuration of the YAML files, see *Chapter 12, Modifying Example Configurations for Object Storage using Swift*.

12.2 Allocating Proxy, Account, and Container (PAC) Servers for Object Storage

A Swift proxy, account, and container (PAC) server is a node that runs the swift-proxy, swift-account and swift-container services. It is used to respond to API requests and to store account and container data. The PAC node does not store object data.

This section describes the procedure to allocate PAC servers during the **initial** deployment of the system.

12.2.1 To allocate Swift PAC servers

Perform the following steps to allocate PAC servers:

- Verify if the example input model already contains a suitable server role. The server roles are usually described in the `data/server_roles.yml` file. If the server role is not described, you must add a suitable server role and allocate drives to store object data. For instructions, see and *Section 12.5, "Allocating Disk Drives for Object Storage"*.
- Verify if the example input model has assigned a cluster to Swift proxy, account, container servers. It is usually mentioned in the `data/control_plane.yml` file. If the cluster is not assigned, then add a suitable cluster. For instructions, see .
- Identify the physical servers and their IP address and other detailed information.
  - You add these details to the servers list (usually in the `data/servers.yml` file).
  - As with all servers, you must also verify and/or modify the server-groups information (usually in `data/server_groups.yml`)

The only part of this process that is unique to Swift is the allocation of disk drives for use by the account and container rings. For instructions, see *Section 12.5, "Allocating Disk Drives for Object Storage"*.

12.3 Allocating Object Servers

A Swift object server is a node that runs the swift-object service (**only**) and is used to store object data. It does not run the swift-proxy, swift-account, or swift-container services.

This section describes the procedure to allocate a Swift object server during the **initial** deployment of the system.

12.3.1 To Allocate a Swift Object Server

Perform the following steps to allocate one or more Swift object servers:

- Verify if the example input model already contains a suitable server role. The server roles are usually described in the `data/server_roles.yml` file. If the server role is not described, you must add a suitable server role. For instructions, see *Section 12.4, "Creating*

Roles for Swift Nodes". While adding a server role for the Swift object server, you will also allocate drives to store object data. For instructions, see *Section 12.5, "Allocating Disk Drives for Object Storage"*.

- Verify if the example input model has a resource node assigned to Swift object servers. The resource nodes are usually assigned in the `data/control_plane.yml` file. If it is not assigned, you must add a suitable resource node. For instructions, see *Section 12.8, "Creating Object Server Resource Nodes"*.
- Identify the physical servers and their IP address and other detailed information. Add the details for the servers in either of the following YAML files and verify the server-groups information:
  - Add details in the servers list (usually in the `data/servers.yml` file).
  - As with all servers, you must also verify and/or modify the server-groups information (usually in the `data/server_groups.yml` file).

The only part of this process that is unique to Swift is the allocation of disk drives for use by the object ring. For instructions, see *Section 12.5, "Allocating Disk Drives for Object Storage"*.

12.4 Creating Roles for Swift Nodes

To create roles for Swift nodes, you must edit the `data/server_roles.yml` file and add an entry to the server-roles list using the following syntax:

```
server-roles:
.
.
.
- name: <pick-a-name>
  interface-model: <specify-a-name>
  disk-model: <specify-a-name>
```

The fields for server roles are defined as follows:

`name`	Specifies a name assigned for the role. In the following example, **SWOBJ-ROLE** is the role name.

`interface-model`	You can either select an existing interface model or create one specifically for Swift object servers. In the following example **SWOBJ-INTERFACES** is used. For more information, see *Section 12.9, "Understanding Swift Network and Service Requirements"*.
`disk-model`	You can either select an existing model or create one specifically for Swift object servers. In the following example **SWOBJ-DISKS** is used. For more information, see *Section 12.5, "Allocating Disk Drives for Object Storage"*.

```
server-roles:
.
.
.
- name: SWOBJ-ROLE
  interface-model: SWOBJ-INTERFACES
  disk-model: SWOBJ-DISKS
```

12.5 Allocating Disk Drives for Object Storage

The disk model describes the configuration of disk drives and their usage. The examples include several disk models. You must always review the disk devices before making any changes to the existing the disk model.

12.5.1 Making Changes to a Swift Disk Model

There are several reasons for changing the disk model:

- If you have additional drives available, you can add them to the devices list.
- If the disk devices listed in the example disk model have different names on your servers. This may be due to different hardware drives. Edit the disk model and change the device names to the correct names.
- If you prefer a different disk drive than the one listed in the model. For example, if `/dev/sdb` and `/dev/sdc` are slow hard drives and you have SDD drives available in `/dev/sdd` and `/dev/sde`. In this case, delete `/dev/sdb` and `/dev/sdc` and replace them with `/dev/sdd` and `/dev/sde`.

> **Note**
>
> Disk drives must not contain labels or file systems from a prior usage. For more information, see *Section 12.6, "Swift Requirements for Device Group Drives"*.

> **Tip**
>
> The terms **add** and **delete** in the document means editing the respective YAML files to add or delete the configurations/values.

Swift Consumer Syntax

The consumer field determines the usage of a disk drive or logical volume by Swift. The syntax of the consumer field is as follows:

```
consumer:
    name: swift
    attrs:
        rings:
        - name: <ring-name>
        - name: <ring-name>
        - etc...
```

The fields for consumer are defined as follows:

`name`	Specifies the service that uses the device group. A `name` field containing **swift** indicates that the drives or logical volumes are used by Swift.
`attrs`	Lists the rings that the devices are allocated to. It must contain a `rings` item.
`rings`	Contains a list of ring names. In the `rings` list, the `name` field is optional.

The following are the different configurations (patterns) of the proxy, account, container, and object services:

- Proxy, account, container, and object (PACO) run on same node type.
- Proxy, account, and container run on a node type (PAC) and the object services run on a dedicated object server (OBJ).

Note

The proxy service does not have any rings associated with it.

Example: **PACO** - proxy, account, container, and object run on the same node type.

```
consumer:
    name: swift
    attrs:
        rings:
        - name: account
        - name: container
        - name: object-0
```

Example: **PAC** - proxy, account, and container run on the same node type.

```
consumer:
    name: swift
```

```
    attrs:
        rings:
        - name: account
        - name: container
```

Example: **OBJ** - Dedicated object server. The following example shows two Storage Policies (object-0 and object-1). For more information, see *Section 12.11, "Designing Storage Policies"*.

```
consumer:
    name: swift
    attrs:
        rings:
        - name: object-0
        - name: object-1
```

Swift Device Groups

You may have several device groups if you have several different uses for different sets of drives.

The following example shows a configuration where one drive is used for account and container rings and the other drives are used by the object-0 ring:

```
device-groups:

- name: swiftpac
  devices:
  - name: /dev/sdb
  consumer:
      name: swift
      attrs:
      - name: account
      - name: container
  - name: swiftobj
    devices:
    - name: /dev/sdc
    - name: /dev/sde
    - name: /dev/sdf
    consumer:
       name: swift
       attrs:
           rings:
              - name: object-0
```

Swift Logical Volumes

> **Caution**
>
> Be careful while using logical volumes to store Swift data. The data remains intact during an upgrade, but will be lost if the server is reimaged. If you use logical volumes you must ensure that you only reimage one server at a time. This is to allow the data from the other replicas to be replicated back to the logical volume once the reimage is complete.

Swift can use a logical volume. To do this, ensure you meet the requirements listed in the table below:

• *mount* • *mkfs-opts* • *fstype*	Do not specify these attributes.
• *name* • *size*	Specify both of these attributes.
• *consumer*	This attribute must have a `name` field set to **swift**.

Following is an example of Swift logical volumes:

```
...
...
   - name: swift
     size: 50%
     consumer:
         name: swift
         attrs:
             rings:
             - name: object-0
             - name: object-1
```

12.6 Swift Requirements for Device Group Drives

To install and deploy, Swift requires that the disk drives listed in the devices list of the device-groups item in a disk model meet the following criteria (if not, the deployment will fail):

- The disk device must exist on the server. For example, if you add `/dev/sdX` to a server with only three devices, then the deploy process will fail.
- The disk device must be unpartitioned or have a single partition that uses the whole drive.
- The partition must not be labeled. For instructions, see .
- The XFS file system must not contain a file system label. For instructions, see .
- If the disk drive is already labeled as described above, the `swiftlm-drive-provision` process will assume that the drive has valuable data and will not use or modify the drive.

12.7 Creating a Swift Proxy, Account, and Container (PAC) Cluster

If you already have a cluster with the server-role `SWPAC-ROLE` there is no need to proceed through these steps.

12.7.1 Steps to Create a Swift Proxy, Account, and Container (PAC) Cluster

To create a cluster for Swift proxy, account, and container (PAC) servers, you must identify the control plane and node type/role:

1. In the `~/helion/my_cloud/definition/data/control_plane.yml` file, identify the control plane that the PAC servers are associated with.
2. Next, identify the node type/role used by the Swift PAC servers. In the following example, `server-role` is set to **SWPAC-ROLE**.
   Add an entry to the `clusters` item in the `control-plane` section.
   Example:

```
control-planes:
    - name: control-plane-1
```

```
    control-plane-prefix: cp1

. . .
clusters:
. . .
   - name: swpac1
     cluster-prefix: c2
     server-role: SWPAC-ROLE
     member-count: 3
     allocation-policy: strict
     service-components:
       - ntp-client
       - swift-ring-builder
       - swift-proxy
       - swift-account
       - swift-container
       - swift-client
```

> **Important**
>
> Please do not change the name of the cluster `swpac` as it may conflict with an existing cluster. A name such as `swpac1`, `swpac2` or `swpac3` would be advisable.

3. If you have more than three servers available that have the `SWPAC-ROLE` assigned to them, you must change `member-count` to match the number of servers.
   For example, if you have four servers with a role of `SWPAC-ROLE`, then the `member-count` should be 4.

12.7.2 Service Components

A Swift PAC server requires the following service components:

- ntp-client
- swift-proxy
- swift-account
- swift-container
- swift-ring-builder
- swift-client

12.8 Creating Object Server Resource Nodes

To create a resource node for Swift object servers, you must identify the control plane and node type/role:

- In the `data/control_plane.yml` file, identify the control plane that the object servers are associated with.
- Next, identify the node type/role used by the Swift object servers. In the following example, `server-role` is set to **SWOBJ-ROLE**:
  Add an entry to the `resources` item in the **control-plane**:

```
control-planes:
    - name: control-plane-1
      control-plane-prefix: cp1
      region-name: region1
  . . .
  resources:
  . . .
  - name: swobj
    resource-prefix: swobj
    server-role: SWOBJ-ROLE
    allocation-policy: strict
    min-count: 0
    service-components:
    - ntp-client
    - swift-object
```

Service Components

A Swift object server requires the following service components:

- `ntp-client`
- `swift-object`
- `swift-client` is optional; installs the `python-swiftclient` package on the server.

Resource nodes do not have a member count attribute. So the number of servers allocated with the **SWOBJ-ROLE** is the number of servers in the `data/servers.yml` file with a server role of **SWOBJ-ROLE**.

12.9 Understanding Swift Network and Service Requirements

This topic describes Swift's requirements for which service components must exist in the input model and how these relate to the network model. This information is useful if you are creating a cluster or resource node, or when defining the networks used by Swift. The network model allows many options and configurations. For smooth Swift operation, the following must be **true**:

- The following services must have a **direct** connection to the same network:
  - `swift-proxy`
  - `swift-account`
  - `swift-container`
  - `swift-object`
  - `swift-ring-builder`
- The `swift-proxy` service must have a **direct** connection to the same network as the `cluster-ip` service.
- The memcached service must be configured on a cluster of the control plane. In small deployments, it is convenient to run it on the same cluster as the horizon service. For larger deployments, with many nodes running the `swift-proxy` service, it is better to **co-locate** the `swift-proxy` and `memcached` services. The `swift-proxy` and `swift-container` services must have a **direct** connection to the same network as the `memcached` service.
- The `swift-proxy` and `swift-ring-builder` service must be **co-located** in the same cluster of the control plane.
- The `ntp-client` service must be **present** on all Swift nodes.

12.10 Understanding Swift Ring Specifications

In Swift, the ring is responsible for mapping data on particular disks. There is a separate ring for account databases, container databases, and each object storage policy, but each ring works similarly. The `swift-ring-builder` utility is used to build and manage rings. This utility uses a builder file to contain ring information and additional data required to build future rings. In HPE Helion OpenStack 5.0, you will use the cloud model to specify how the rings are configured and used. This model is used to automatically invoke the `swift-ring-builder` utility as part of the deploy process. (Normally, you will not run the `swift-ring-builder` utility directly.)

The rings are specified in the input model using the **configuration-data** key. The `configuration-data` in the `control-planes` definition is given a name that you will then use in the `swift_config.yml` file. If you have several control planes hosting Swift services, the ring specifications can use a shared `configuration-data` object, however it is considered best practice to give each Swift instance its own `configuration-data` object.

Ring Specifications in HPE Helion OpenStack 2.x and 3.x

In HPE Helion OpenStack 2.x and 3.x, ring specifications were mentioned in the `~/helion/my_cloud/definition/data/swift/rings.yml` file. HPE Helion OpenStack 4.x continues to support ring specifications in that file. If you upgrade to HPE Helion OpenStack 4.x, you do not need to make any changes.

12.10.1 Ring Specifications in the Input Model

In most models, the ring-specification is mentioned in the `~/helion/my_cloud/definition/data/swift/swift_config.yml` file. For example:

```
configuration-data:
  - name: SWIFT-CONFIG-CP1
    services:
      - swift
    data:
      control_plane_rings:
        swift-zones:
          - id: 1
            server-groups:
              - AZ1
          - id: 2
            server-groups:
              - AZ2
          - id: 3
            server-groups:
              - AZ3
        rings:
          - name: account
            display-name: Account Ring
            min-part-hours: 16
```

```
            partition-power: 12
            replication-policy:
              replica-count: 3

          - name: container
            display-name: Container Ring
            min-part-hours: 16
            partition-power: 12
            replication-policy:
              replica-count: 3

          - name: object-0
            display-name: General
            default: yes
            min-part-hours: 16
            partition-power: 12
            replication-policy:
              replica-count: 3
```

The above sample file shows that the rings are specified using the `configuration-data` object **SWIFT-CONFIG-CP1** and has three rings as follows:

- **Account ring**: You must always specify a ring called **account**. The account ring is used by Swift to store metadata about the projects in your system. In Swift, a Keystone project maps to a Swift account. The `display-name` is informational and not used.

- **Container ring**:You must always specify a ring called **container**. The `display-name` is informational and not used.

- **Object ring**: This ring is also known as a storage policy. You must always specify a ring called **object-0**. It is possible to have multiple object rings, which is known as *storage policies*. The `display-name` is the name of the storage policy and can be used by users of the Swift system when they create containers. It allows them to specify the storage policy that the container uses. In the example, the storage policy is called **General**. There are also two aliases for the storage policy name: `GeneralPolicy` and `AnotherAliasForGeneral`. In this example, you can use `General`, `GeneralPolicy`, or `AnotherAliasForGeneral` to refer to this storage policy. The aliases item is optional. The `display-name` is required.

- **Min-part-hours, partition-power, replication-policy** and **replica-count** are described in the following section.

12.10.2 Replication Ring Parameters

The ring parameters for traditional replication rings are defined as follows:

Parameter	Description
`replica-count`	Defines the number of copies of object created. Use this to control the degree of resiliency or availability. The `replica-count` is normally set to **3** (i.e., Swift will keep three copies of accounts, containers, or objects). As a best practice, you should not decrease the value to lower than 3. And, if you want a higher resiliency, you can increase the value.
`min-part-hours`	Changes the value used to decide when a given partition can be moved. This is the number of hours that the `swift-ring-builder` tool will enforce between ring rebuilds. On a small system, this can be as low as **1** (one hour). The value can be different for each ring. In the example above, the `swift-ring-builder` will enforce a minimum of 16 hours between ring rebuilds. However, this time is system-dependent so you will be unable to determine the appropriate value for `min-part-hours` until you have more experience with your system. A value of 0 (zero) is not allowed. In prior releases, this parameter was called `min-part-time`. The older name is still supported, however do not specify both `min-part-hours` and `min-part-time` in the same files.

Parameter	Description
`partition-power`	The optimal value for this parameter is related to the number of disk drives that you allocate to Swift storage. As a best practice, you should use the same drives for both the account and container rings. In this case, the `partition-power` value should be the same. For more information, see *Section 12.10.4, "Selecting a Partition Power"*.
`replication-policy`	Specifies that a ring uses replicated storage. The duplicate copies of the object are created and stored on different disk drives. All replicas are identical. If one is lost or corrupted, the system automatically copies one of the remaining replicas to restore the missing replica.
`default`	The default value in the above sample file of ring-specification is set to **yes**, which means that the storage policy is enabled to store objects. For more information, see *Section 12.11, "Designing Storage Policies"*.

12.10.3 Erasure Coded Rings

In the cloud model, a `ring-specification` is mentioned in the `~/helion/my_cloud/definition/data/swift/rings.yml` file. A typical erasure coded ring in this file looks like this:

```
- name: object-1
  display-name: EC_ring
  default: no
  min-part-hours: 16
  partition-power: 12
  erasure-coding-policy:
    ec-type: jerasure_rs_vand
    ec-num-data-fragments: 10
    ec-num-parity-fragments: 4
```

```
ec-object-segment-size: 1048576
```

The additional parameters are defined as follows:

Parameter	Description
ec-type	This is the particular erasure policy scheme that is being used. The supported ec_types in HPE Helion OpenStack 5.0 are: • `jerasure_rs_vand` => Vandermonde Reed-Solomon encoding, based on Jerasure
erasure-coding-policy	This line indicates that the object ring will be of type "erasure coding"
ec-num-data-fragments	This indicated the number of data fragments for an object in the ring.
ec-num-parity-fragments	This indicated the number of parity fragments for an object in the ring.
ec-object-segment-size	The amount of data that will be buffered up before feeding a segment into the encoder/decoder. The default value is 1048576.

When using an erasure coded ring, the number of devices in the ring must be greater than or equal to the total number of fragments of an object. For example, if you define an erasure coded ring with 10 data fragments and 4 parity fragments, there must be at least 14 (10+4) devices added to the ring.

When using erasure codes, for a PUT object to be successful it must store `ec_ndata + 1` fragment to achieve quorum. Where the number of data fragments (`ec_ndata`) is 10 then at least 11 fragments must be saved for the object PUT to be successful. The 11 fragments must be saved to different drives. To tolerate a single object server going down, say in a system with 3 object servers, each object server must have at least 6 drives assigned to the erasure coded storage policy. So with a single object server down, 12 drives are available between the remaining object servers. This allows an object PUT to save 12 fragments, one more than the minimum to achieve quorum.

Unlike replication rings, none of the erasure coded parameters may be edited after the initial creation. Otherwise there is potential for permanent loss of access to the data.

On the face of it, you would expect that an erasure coded configuration that uses a data to parity ratio of 10:4, that the data consumed storing the object is 1.4 times the size of the object just like the x3 replication takes x3 times the size of the data when storing the object. However, for erasure coding, this 10:4 ratio is not correct. The efficiency (ie. how much storage is needed to store the object) is very poor for small objects and improves as the object size grows. However, the improvement is not linear. If all of your files are less than 32K in size, erasure coding will take more space to store than the x3 replication.

12.10.4 Selecting a Partition Power

When storing an object, the object storage system hashes the name. This hash results in a hit on a partition (so a number of different object names result in the same partition number). Generally, the partition is mapped to available disk drives. With a replica count of 3, each partition is mapped to three different disk drives. The hashing algorithm used hashes over a fixed number of partitions. The partition-power attribute determines the number of partitions you have.

Partition power is used to distribute the data uniformly across drives in a Swift nodes. It also defines the storage cluster capacity. You must set the partition power value based on the total amount of storage you expect your entire ring to use.

You should select a partition power for a given ring that is appropriate to the number of disk drives you allocate to the ring for the following reasons:

- If you use a high partition power and have a few disk drives, each disk drive will have thousands of partitions. With too many partitions, audit and other processes in the Object Storage system cannot walk the partitions in a reasonable time and updates will not occur in a timely manner.

- If you use a low partition power and have many disk drives, you will have tens (or maybe only one) partition on a drive. The Object Storage system does not use size when hashing to a partition - it hashes the name.
  With many partitions on a drive, a large partition is cancelled out by a smaller partition so the overall drive usage is similar. However, with very small numbers of partitions, the uneven distribution of sizes can be reflected in uneven disk drive usage (so one drive becomes full while a neighboring drive is empty).

An ideal number of partitions per drive is 100. If you know the number of drives, select a partition power that will give you approximately 100 partitions per drive. Usually, you install a system with a specific number of drives and add drives as needed. However, you cannot change the value of the partition power. Hence you must select a value that is a compromise between current and planned capacity.

Important

If you are installing a small capacity system and you need to grow to a very large capacity but you cannot fit within any of the ranges in the table, please seek help from Professional Services to plan your system.

There are additional factors that can help mitigate the fixed nature of the partition power:

- Account and container storage represents a small fraction (typically 1 percent) of your object storage needs. Hence, you can select a smaller partition power (relative to object ring partition power) for the account and container rings.

- For object storage, you can add additional storage policies (i.e., another object ring). When you have reached capacity in an existing storage policy, you can add a new storage policy with a higher partition power (because you now have more disk drives in your system). This means that you can install your system using a small partition power appropriate to a small number of initial disk drives. Later, when you have many disk drives, the new storage policy can have a higher value appropriate to the larger number of drives.

However, when you continue to add storage capacity, existing containers will continue to use their original storage policy. Hence, the additional objects must be added to new containers to take advantage of the new storage policy.

Use the following table to select an appropriate partition power for each ring. The partition power of a ring cannot be changed, so it is important to select an appropriate value. This table is based on a replica count of 3. If your replica count is different, or you are unable to find your system in the table, then see for information of selecting a partition power.

The table assumes that when you first deploy Swift, you have a small number of drives (the minimum column in the table), and later you add drives.

Note

- Use the total number of drives. For example, if you have three servers, each with two drives, the total number of drives is six.
- The lookup should be done separately for each of the account, container and object rings. Since account and containers represent approximately 1 to 2 percent of object storage, you will probably use fewer drives for the account and container rings (i.e., you will have fewer proxy, account, and container (PAC) servers) so that your object rings may have a higher partition power.
- The largest anticipated number of drives imposes a limit in the minimum drives you can have. (For more information, see .) This means that, if you anticipate significant growth, your initial system can be small, but under a certain limit. For example, if you determine that the maximum number of drives the system will grow to is 40,000, then use a partition power of 17 as listed in the table below. In addition, a minimum of 36 drives is required to build the smallest system with this partition power.
- The table assumes that disk drives are the same size. The actual size of a drive is not significant.

12.11 Designing Storage Policies

Storage policies enable you to differentiate the way objects are stored.

Reasons to use storage policies include the following:

- Different types or classes of disk drive
  You can use different drives to store various type of data. For example, you can use 7.5K RPM high-capacity drives for one type of data and fast SSD drives for another type of data.
- Different redundancy or availability needs
  You can define the redundancy and availability based on your requirement. You can use a replica count of 3 for "normal" data and a replica count of 4 for "critical" data.
- Growing of cluster capacity

If the storage cluster capacity grows beyond the recommended partition power as described in *Section 12.10, “Understanding Swift Ring Specifications”*.

- Erasure-coded storage and replicated storage
  If you use erasure-coded storage for some objects and replicated storage for other objects.

Storage policies are implemented on a per-container basis. If you want a non-default storage policy to be used for a new container, you can explicitly specify the storage policy to use when you create the container. You can change which storage policy is the default. However, this does not affect existing containers. Once the storage policy of a container is set, the policy for that container cannot be changed.

The disk drives used by storage policies can overlap or be distinct. If the storage policies overlap (i.e., have disks in common between two storage policies), it is recommended to use the same set of disk drives for both policies. But in the case where there is a partial overlap in disk drives, because one storage policy receives many objects, the drives that are common to both policies must store more objects than drives that are only allocated to one storage policy. This can be appropriate for a situation where the overlapped disk drives are larger than the non-overlapped drives.

12.11.1 Specifying Storage Policies

There are two places where storage policies are specified in the input model:

- The attribute of the storage policy is specified in ring-specification in the `data/swift/rings.yml` file for a given region.
- When associating disk drives with specific rings in a disk model. This specifies which drives and nodes use the storage policy. In other word words, where data associated with a storage policy is stored.

A storage policy is specified similar to other rings. However, the following features are unique to storage policies:

- Storage policies are applicable to object rings only. The account or container rings cannot have storage policies.
- There is a format for the ring name: object-<index>, where index is a number in the range 0 to 9 (in this release). For example: object-0.

- The object-0 ring must always be specified.
- Once a storage policy is deployed, it should never be deleted. You can remove all disk drives for the storage policy, however the ring specification itself cannot be deleted.
- You can use the `display-name` attribute when creating a container to indicate which storage policy you want to use for that container.
- One of the storage policies can be the default policy. If you do not specify the storage policy then the object created in new container uses the default storage policy.
- If you change the default, only containers created later will have that changed default policy.

The following example shows three storage policies in use. Note that the third storage policy example is an erasure coded ring.

```
rings:
. . .
- name: object-0
  display-name: General
  default: no
  min-part-hours: 16
  partition-power: 12
  replication-policy:
      replica-count: 3
- name: object-1
  display-name: Data
  default: yes
  min-part-hours: 16
  partition-power: 20
  replication-policy:
      replica-count: 3
- name: object-2
  display-name: Archive
  default: no
  min-part-hours: 16
  partition-power: 20
  erasure-coded-policy:
    ec-type: jerasure_rs_vand
    ec-num-data-fragments: 10
    ec-num-parity-fragments: 4
    ec-object-segment-size: 1048576
```

12.12 Designing Swift Zones

The concept of Swift zones allows you to control the placement of replicas on different groups of servers. When constructing rings and allocating replicas to specific disk drives, Swift will, where possible, allocate replicas using the following hierarchy so that the greatest amount of resiliency is achieved by avoiding single points of failure:

- Swift will place each replica on a different disk drive within the same server.
- Swift will place each replica on a different server.
- Swift will place each replica in a different Swift zone.

If you have three servers and a replica count of three, it is easy for Swift to place each replica on a different server. If you only have two servers though, Swift will place two replicas on one server (different drives on the server) and one copy on the other server.

With only three servers there is no need to use the Swift zone concept. However, if you have more servers than your replica count, the Swift zone concept can be used to control the degree of resiliency. The following table shows how data is placed and explains what happens under various failure scenarios. In all cases, a replica count of three is assumed and that there are a total of six servers.

Number of Swift Zones	**Replica Placement**	**Failure Scenarios**	**Details**
One (all servers in the same zone)	Replicas are placed on different servers. For any given object, you have no control over which servers the replicas are placed on.	One server fails	You are guaranteed that there are two other replicas.
		Two servers fail	You are guaranteed that there is one remaining replica.
		Three servers fail	1/3 of the objects cannot be accessed. 2/3 of the objects have three replicas.
Two (three servers in each Swift zone)	Half the objects have two replicas in Swift	One Swift zone fails	You are guaranteed to have at least one

Number of Swift Zones	Replica Placement	Failure Scenarios	Details
	zone 1 with one replica in Swift zone 2. The other objects are reversed, with one replica in Swift zone 1 and two replicas in Swift zone 2.		replica. Half the objects have two remaining replicas and the other half have a single replica.
Three (two servers in each Swift zone)	Each zone contains a replica. For any given object, there is a replica in each Swift zone.	One Swift zone fails	You are guaranteed to have two replicas of every object.
		Two Swift zones fail	You are guaranteed to have one replica of every object.

The following sections show examples of how to specify the Swift zones in your input model.

12.12.1 Using Server Groups to Specify Swift Zones

Swift zones are specified in the ring specifications using the server group concept. To define a Swift zone, you specify:

- An id - this is the Swift zone number
- A list of associated server groups

Server groups are defined in your input model. The example input models typically define a number of server groups. You can use these pre-defined server groups or create your own.

For example, the following three models use the example server groups `CLOUD`, `AZ1`, `AZ2` and `AZ3`. Each of these examples achieves the same effect – creating a single Swift zone.

```
ring-specifications:
              - region: region1
              swift-zones:
              - id: 1
              server-groups:
```

```
            - CLOUD
            rings:
            …
```

```
ring-specifications:
            - region: region1
            swift-zones:
            - id: 1
            server-groups:
            - AZ1
            - AZ2
            - AZ3
            rings:
            …
```

```
server-groups:
            - name: ZONE_ONE
            server-groups:
            - AZ1
            - AZ2
            - AZ3
            ring-specifications:
            - region: region1
            swift-zones:
            - id: 1
            server-groups:
            - ZONE_ONE
            rings:
            …
```

Alternatively, if you omit the `swift-zones` specification, a single Swift zone is used by default for all servers.

In the following example, three Swift zones are specified and mapped to the same availability zones that Nova uses (assuming you are using one of the example input models):

```
ring-specifications:
     - region: region1
     swift-zones:
     - id: 1
     server-groups:
     - AZ1
     - id: 2
     server-groups:
     - AZ2
     - id: 3
     server-groups:
```

```
      - AZ3
```

In this example, it shows a datacenter with four availability zones which are mapped to two Swift zones. This type of setup may be used if you had two buildings where each building has a duplicated network infrastructure:

```
ring-specifications:
      - region: region1
      swift-zones:
      - id: 1
      server-groups:
      - AZ1
      - AZ2
      - id: 2
      server-groups:
      - AZ3
      - AZ4
```

12.12.2 Specifying Swift Zones at Ring Level

Usually, you would use the same Swift zone layout for all rings in your system. However, it is possible to specify a different layout for a given ring. The following example shows that the account, container and object-0 rings have two zones, but the object-1 ring has a single zone.

```
ring-specifications:
        - region: region1
        swift-zones:
        - id: 1
        server-groups:
        - AZ1
        - id: 2
        server-groups:
        - AZ2
        rings
        - name: account
        …
        - name: container
        …
        - name: object-0
        …
        - name: object-1
        swift-zones:
        - id: 1
        server-groups:
```

```
        - CLOUD
        …
```

12.13 Customizing Swift Service Configuration Files

HPE Helion OpenStack 5.0 enables you to modify various Swift service configuration files. The following Swift service configuration files are located on the lifecycle manager in the `~/helion/my_cloud/config/swift/` directory:

- `account-server.conf.j2`
- `container-reconciler.conf.j2`
- `container-server.conf.j2`
- `container-sync-realms.conf.j2`
- `object-expirer.conf.j2`
- `object-server.conf.j2`
- `proxy-server.conf.j2`
- `rsyncd.conf.j2`
- `swift.conf.j2`
- `swift-recon.j2`

There are many configuration options that can be set or changed, including **container rate limit** and **logging level**:

12.13.1 Configuring Swift Container Rate Limit

The Swift container rate limit allows you to limit the number of `PUT` and `DELETE` requests of an object based on the number of objects in a container. For example, suppose the `container_ratelimit_x = r` . It means that for containers of size `x`, limit requests per second to `r`.

To enable container rate limiting:

1. Log in to the lifecycle manager.
2. Edit the `DEFAULT` section of `~/helion/my_cloud/config/swift/proxy-server.conf.j2`:

```
container_ratelimit_0
                                        = 100 container_ratelimit_1000000 = 100
                                        container_ratelimit_5000000 = 50
```

This will set the `PUT` and `DELETE` object rate limit to 100 requests per second for containers with up to 1,000,000 objects. Also, the `PUT` and `DELETE` rate for containers with between 1,000,000 and 5,000,000 objects will vary linearly from between 100 and 50 requests per second as the container object count increases.

3. Commit your changes to git:

```
cd ~/helion/hos/ansible git add -A
                                        git commit -m "<commit message>"
```

4. Run the configuration processor:

```
cd ~/helion/hos/ansible
                                        ansible-playbook -i hosts/localhost
                                        config-processor-run.yml
```

5. Create a deployment directory:

```
cd ~/helion/hos/ansible
                                        ansible-playbook -i hosts/localhost
                                        ready-deployment.yml
```

6. Run the `swift-reconfigure.yml` playbook to reconfigure the Swift servers:

```
cd ~/scratch/ansible/next/hos/ansible
                                        ansible-playbook -i hosts/verb_hosts
                                        swift-reconfigure.yml
```

12.13.2 Configuring Swift Account Server Logging Level

By default the Swift logging level is set to `INFO`. As a best practice, do not set the log level to DEBUG for a long period of time. Use it for troubleshooting issues and then change it back to INFO.

Perform the following steps to set the logging level of the `account-server` to `DEBUG`:

1. Log in to the lifecycle manager.
2. Edit the `DEFAULT` section of `~/helion/my_cloud/config/swift/account-server.conf.j2`:

   ```
   [DEFAULT] . . log_level = DEBUG
   ```

3. Commit your changes to git:

   ```
   cd ~/helion/hos/ansible git add -A
                                           git commit -m "<commit message>"
   ```

4. Run the configuration processor:

   ```
   cd ~/helion/hos/ansible
                                           ansible-playbook -i hosts/localhost
                                           config-processor-run.yml
   ```

5. Create a deployment directory:

   ```
   cd ~/helion/hos/ansible
                                           ansible-playbook -i hosts/localhost
                                           ready-deployment.yml
   ```

6. Run the `swift-reconfigure.yml` playbook to reconfigure the Swift servers:

   ```
   cd ~/scratch/ansible/next/hos/ansible
                                           ansible-playbook -i hosts/verb_hosts
                                           swift-reconfigure.yml
   ```

For more information, see .

13 Alternative Configurations

In HPE Helion OpenStack 5.0 there are alternative configurations that we recommend for specific purposes

13.1 SLES Compute Nodes

net_interfaces.yml

```
- name: SLES-COMPUTE-INTERFACES
 network-interfaces:
   - name: BOND0
     device:
         name: bond0
     bond-data:
         options:
             mode: active-backup
             miimon: 200
             primary: hed1
         provider: linux
         devices:
             - name: hed1
             - name: hed2
     network-groups:
       - EXTERNAL-VM
       - GUEST
       - MANAGEMENT
```

servers.yml

```
    - id: compute1
      ip-addr: 10.13.111.15
      role: SLES-COMPUTE-ROLE
      server-group: RACK1
      nic-mapping: DL360p_G8_2Port
      mac-addr: ec:b1:d7:77:d0:b0
      ilo-ip: 10.12.13.14
      ilo-password: *********
      ilo-user: Administrator
      distro-id: sles12sp2-x86_64
```

server_roles.yml

```
- name: SLES-COMPUTE-ROLE
  interface-model: SLES-COMPUTE-INTERFACES
  disk-model: SLES-COMPUTE-DISKS
```

`disk_compute.yml`

```
  - name: SLES-COMPUTE-DISKS
    volume-groups:
      - name: hlm-vg
        physical-volumes:
         - /dev/sda_root

        logical-volumes:
        # The policy is not to consume 100% of the space of each volume group.
        # 5% should be left free for snapshots and to allow for some flexibility.
          - name: root
            size: 35%
            fstype: ext4
            mount: /
          - name: log
            size: 50%
            mount: /var/log
            fstype: ext4
            mkfs-opts: -O large_file
          - name: crash
            size: 10%
            mount: /var/crash
            fstype: ext4
            mkfs-opts: -O large_file

      - name: vg-comp
        # this VG is dedicated to Nova Compute to keep VM IOPS off the OS disk
        physical-volumes:
          - /dev/sdb
        logical-volumes:
          - name: compute
            size: 95%
            mount: /var/lib/nova
            fstype: ext4
            mkfs-opts: -O large_file
```

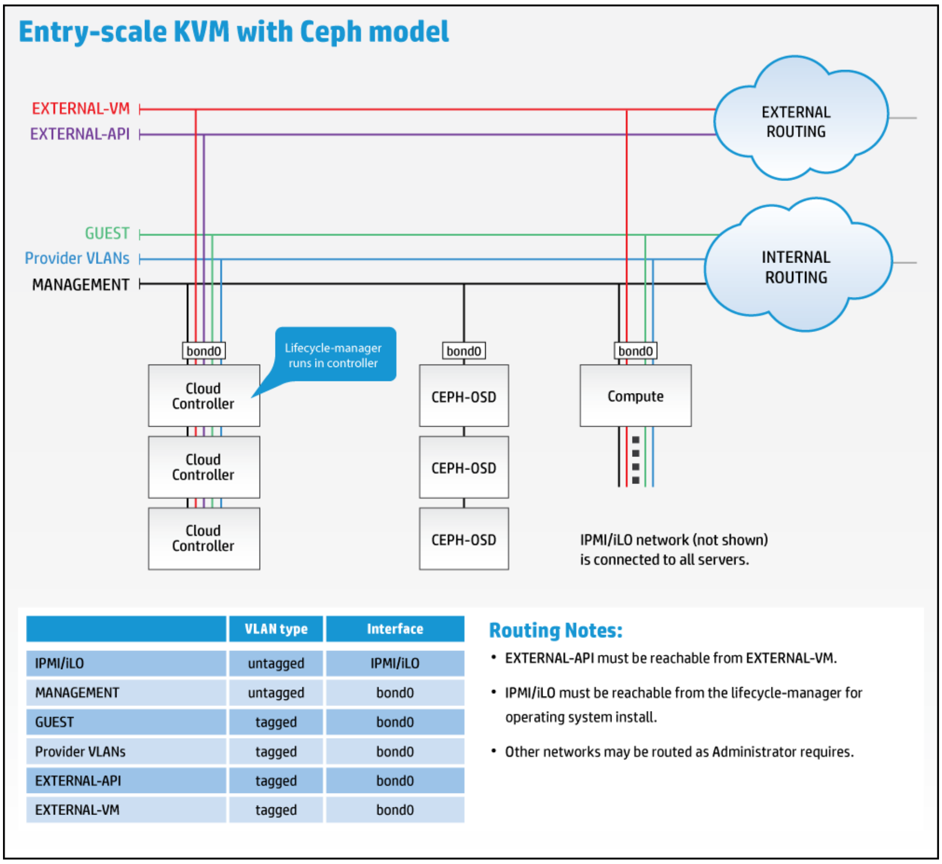
`control_plane.yml`

```
  control-planes:
    - name: control-plane-1
      control-plane-prefix: cp1
      region-name: region1
```

```
....
      resources:
        - name: sles-compute
          resource-prefix: sles-comp
          server-role: SLES-COMPUTE-ROLE
          allocation-policy: any
          min-count: 1
          service-components:
            - ntp-client
            - nova-compute
            - nova-compute-kvm
            - neutron-l3-agent
            - neutron-metadata-agent
            - neutron-openvswitch-agent
            - neutron-lbaasv2-agent
```

13.2 Entry-scale KVM with Ceph Model

For smaller environments, Ceph can be altered to use a single-network model:



Download a high-resolution version (../../../media/examples/entry_scale_kvm_ceph_lg.png)

13.3 Entry-scale KVM with Ceph Model with Two Networks

HPE Helion OpenStack Ceph is a unified storage system for various storage use cases for an OpenStack-based cloud. It is highly reliable, easy to manage, and horizontally scalable as demand grows.

Ceph clients directly talk to OSD daemons for storage operations instead of client routing the request to a specific gateway as is commonly found in other storage solutions. OSD daemons perform data replication and participate in recovery activities. In general, a pool is configured with a replica count of three, causing daemons to transact three times the amount of client data over the cluster network. So, every 4 MB of write data is likely to result in 12 MB of data movement across Ceph clusters. Considering this network traffic, it is important to segregate Ceph data traffic, which can be primarily categorized into three segments:

- **Management traffic** - primarily includes all admin related operations such as pool creation, crush map modification, user creation, etc.
- **Client (data) traffic** - primarily includes client requests sent to OSD daemons.
- **Cluster (replication) traffic** - primarily includes replication and recovery data traffic among OSD daemons.

For a high performing cluster, the network configuration is important. Segregating the data traffic using multiple networks allows for this. For medium-size production environments we recommend to have a cluster with at least two networks: a client data network (front-side) and a cluster (back-side) network. For larger production environments we recommend that you segregate all three network traffic types by utilizing three networks. This particular document shows you how to setup two networks but you can use the same principles to create three networks.

Also, segregating networks provides additional security as well because your cluster network does not need to be connected to the internet directly. This helps in preventing spoof attacks and allows the OSD daemons to keep communicating without intervention so that placement groups can be brought to active + clean state whenever required.

This model is a variant of the Entry-scale KVM with Ceph model. It is designed with two VLANs: a public (front-side) network and a cluster (back-side) network. This enables more options in regards to scaling.

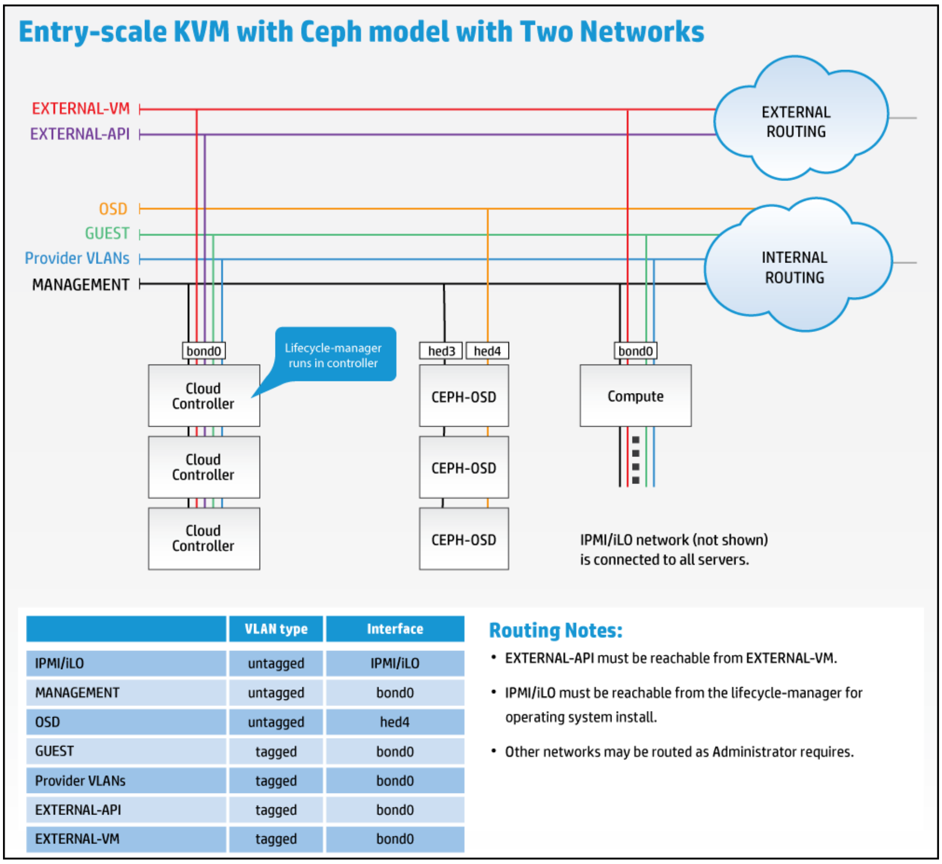
This model uses the following components:

- Three controller nodes, one KVM compute node, and three Ceph OSD nodes.
- The Ceph monitor component of the Ceph cluster is deployed on the controller nodes along with other OpenStack service components. This limits your cloud to three monitor nodes which should be suitable for most production environments.
- Allows two VLANs (i.e. management VLAN and OSD VLAN) which segregates Ceph client traffic from Ceph cluster traffic. The management network will be used to carry cloud management data, such as RabbitMQ, HOPS, and database traffic, Ceph management data, such as pool creation, as well as client data traffic, such as cinder-volume writing blocks to Ceph storage pools. The Ceph cluster network will be dedicated for OSD daemons and will be used to carry replication traffic.
- A single compute node is initially provided with this example configuration. If additional compute capacity is required then further compute nodes can be added to the configuration by adding more nodes to the compute resource plane. The same applies to OSD nodes as well. Three OSD nodes are initially provided with this example configuration. If additional OSD capacity is required then further OSD nodes can be added to the configuration by adding more nodes to the OSD resource plane.

The table below lists out the key characteristics needed per server role for this configuration.

Server role	Quantity	Compute Requirement	Network Requirement
Controller	3	2x 10 core 2.66 GHz 96 - 128 GB RAM	2x 10Gb Dual Port NIC
Compute (KVM hypervisor)	1 (minimum)	2x 12 core 2.66 GHz (ES-2690v3) Intel Xeon 256 GB RAM	1x 10Gb Dual Port NIC
OSD	3 (minimum)	RAM is dependent upon the number of disks. 1 GB per TB of disk capacity is recommended.	1x 10Gb Dual Port NIC

This diagram below illustrates the physical networking used in this configuration.



	VLAN type	Interface
IPMI/iLO	untagged	IPMI/iLO
MANAGEMENT	untagged	bond0
OSD	untagged	hed4
GUEST	tagged	bond0
Provider VLANs	tagged	bond0
EXTERNAL-API	tagged	bond0
EXTERNAL-VM	tagged	bond0

Download a high-resolution version (../../../media/hos.docs/entry_scale_kvm_ceph_two_network_l-g.png)

This configuration is based on the entry-scale-kvm-ceph cloud input model which is included with the HPE Helion OpenStack distro. You will need to make the changes outlined below prior to the deployment of your Ceph cluster with two networks. Note that if you already have a Ceph cluster deployed with a single network these steps cannot be used to migrate to a dual-network setup. The recommendation in these cases will be that you make a clean installation which will result in the loss of your existing data unless you make arrangements to have it backed up beforehand.

`Nic_mappings.yml` Ensure that your baremetal server NIC interfaces are correctly specified in the `~/helion/my_cloud/definition/data/nic_mappings.yml` file and that they meet the server requirements.

Here is an example with notes in-line:

```
nic-mappings:
```

```
## NIC specification for controller nodes.  A bonded interface is
## used for the management network.
  - name: DL360p_4PORT
    physical-ports:
      - logical-name: hed1
        type: simple-port
        bus-address: "0000:07:00.0"

      - logical-name: hed2
        type: simple-port
        bus-address: "0000:08:00.0"

      - logical-name: hed3
        type: simple-port
        bus-address: "0000:09:00.0"

      - logical-name: hed4
        type: simple-port
        bus-address: "0000:0a:00.0"

## NIC specification for compute and OSD nodes should be
## of this type.
  - name: MY-2PORT-SERVER
    physical-ports:
      - logical-name: hed3
        type: simple-port
        bus-address: "0000:04:00.0"

      - logical-name: hed4
        type: simple-port
        bus-address: "0000:04:00.1"
```

`Net_interfaces.yml` Define a new interface set for your OSD interfaces in the `~/helion/my_cloud/definition/data/net_interfaces.yml` file.

Ensure that the appropriate NIC is configured to both the Management and OSD network groups, indicated below:

```
- name: OSD-INTERFACES
 network-interfaces:
   - name: ETH3
     device:
        name: hed3
     network-groups:
        - MANAGEMENT
   - name: ETH4
     device:
```

```
      name: hed4
    network-groups:
      - OSD
```

`Network_groups.yml` Define the OSD network group in the `~/helion/my_cloud/definition/data/network_groups.yml` file:

```
#
# OSD
#
# This is the network group that will be used for
# internal traffic of cluster among OSDs.
#
- name: OSD
  hostname-suffix: osd

  component-endpoints:
    - ceph-osd-internal
```

`Networks.yml` Define the OSD VLAN in the `~/helion/my_cloud/definition/data/networks.yml` file:

```
- name: OSD-NET
  vlanid: 112
  tagged-vlan: false
  cidr: 10.0.1.0/24
  gateway-ip: 10.0.1.1
  network-group: OSD
```

`Server_groups.yml` Add the OSD network to the server groups in the `~/helion/my_cloud/definition/data/server_groups.yml` file, indicated by the bold portion below:

```
- name: CLOUD
 server-groups:
   - AZ1
   - AZ2
   - AZ3
 networks:
   - EXTERNAL-API-NET
   - EXTERNAL-VM-NET
   - GUEST-NET
   - MANAGEMENT-NET
   - OSD-NET
```

`Firewall_rules.yml` Modify the firewall rules in the `~/helion/my_cloud/definition/data/firewall_rules.yml` file to allow OSD nodes to be pingable via the OSD network, indicated by the bold portion below:

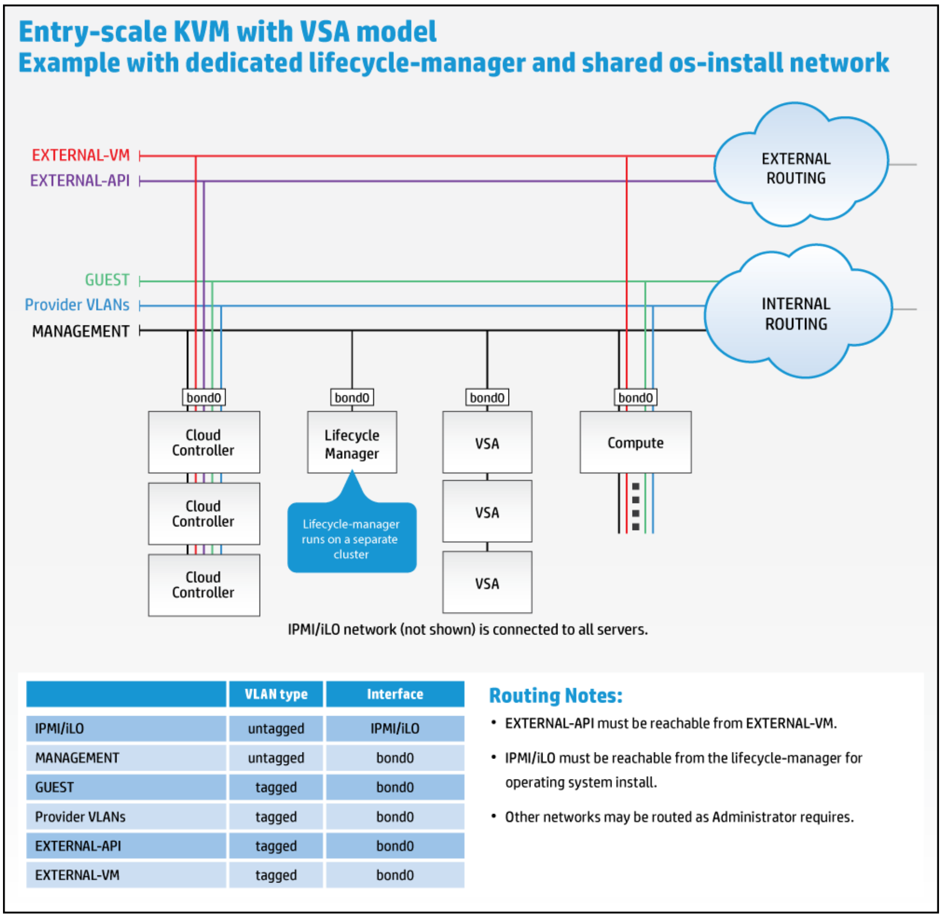
```
- name: PING
  network-groups:
  - MANAGEMENT
  - GUEST
  - EXTERNAL-API
  - OSD
  rules:
  # open ICMP echo request (ping)
  - type: allow
    remote-ip-prefix:  0.0.0.0/0
    # icmp type
    port-range-min: 8
    # icmp code
    port-range-max: 0
    protocol: icmp
```

Edit the `README.html` and `README.md` files. You can edit the `~/helion/my_cloud/definition/README.html` and `~/helion/my_cloud/definition/README.md` files to reflect the OSD network group information if you wish. This change does not have any semantic implication and only assists with the readability of your model.

13.4 Using a Dedicated Lifecycle Manager Node

All of the example configurations included host the lifecycle manager on the first controller nodes. It is also possible to deploy this service on a dedicated node. A typical use case for wanting to run the dedicated lifecycle manager is to be able to test the deployment of different configurations without having to re-install the first server. Some administrators might also prefer the additional security of keeping all of the configuration data on a separate server from those that users of the cloud connect to (although all of the data can be encrypted and SSH keys can be password protected).

Here is a graphical representation of what this setup would look like:



Download a high-resolution version (../../../media/examples/entry_scale_kvm_vsa_shared_lg.png)

13.4.1 Specifying a dedicated lifecycle manager in your input model

In order to specify a dedicated lifecycle manager in your input model, make the following edits to your configuration files.

Important

The indentation of each of the input files is important and will cause errors if not done correctly. Use the existing content in each of these files as a reference when adding additional content for your lifecycle manager.

- Update `control_plane.yml` to add the lifecycle manager.
- Update `server_roles.yml` to add the lifecycle manager role.
- Update `net_interfaces.yml` to add the interface definition for the lifecycle manager.
- Create a `disks_lifecycle_manager.yml` file to define the disk layout for the lifecycle manager.
- Update `servers.yml` to add the dedicated lifecycle manager node.

`Control_plane.yml` The snippet below shows the addition of a single node cluster into the control plane to host the lifecycle manager service. Note that, in addition to adding the new cluster, you also have to remove the lifecycle manager component from the `cluster1` in the examples:

```
clusters:
   - name: cluster0
     cluster-prefix: c0
     server-role: LIFECYCLE-MANAGER-ROLE
     member-count: 1
     allocation-policy: strict
     service-components:
       - lifecycle-manager
       - ntp-client
   - name: cluster1
     cluster-prefix: c1
     server-role: CONTROLLER-ROLE
     member-count: 3
     allocation-policy: strict
     service-components:
       - ntp-server
```

This specifies a single node of role `LIFECYCLE-MANAGER-ROLE` hosting the lifecycle manager.

`Server_roles.yml` The snippet below shows the insertion of the new server roles definition:

```
server-roles:

   - name: LIFECYCLE-MANAGER-ROLE
     interface-model: LIFECYCLE-MANAGER-INTERFACES
     disk-model: LIFECYCLE-MANAGER-DISKS

   - name: CONTROLLER-ROLE
```

This defines a new server role which references a new interface-model and disk-model to be used when configuring the server.

`Net-interfaces.yml` The snippet below shows the insertion of the network-interface info:

```
    - name: LIFECYCLE-MANAGER-INTERFACES
      network-interfaces:
        - name: BOND0
          device:
             name: bond0
          bond-data:
             options:
                 mode: active-backup
                 miimon: 200
                 primary: hed3
             provider: linux
             devices:
                 - name: hed3
                 - name: hed4
          network-groups:
             - MANAGEMENT
```

This assumes that the server uses the same physical networking layout as the other servers in the example. For details on how to modify this to match your configuration, see .

`Disks_lifecycle_manager.yml` In the examples, disk-models are provided as separate files (this is just a convention, not a limitation) so the following should be added as a new file named `disks_lifecycle_manager.yml`:

```
---
   product:
      version: 2

   disk-models:
   - name: LIFECYCLE-MANAGER-DISKS
     # Disk model to be used for Lifecycle Managers nodes
     # /dev/sda_root is used as a volume group for /, /var/log and /var/crash
     # sda_root is a templated value to align with whatever partition is really used
     # This value is checked in os config and replaced by the partition actually used
     # on sda e.g. sda1 or sda5

     volume-groups:
       - name: hlm-vg
         physical-volumes:
           - /dev/sda_root

       logical-volumes:
       # The policy is not to consume 100% of the space of each volume group.
       # 5% should be left free for snapshots and to allow for some flexibility.
```

```
          - name: root
            size: 80%
            fstype: ext4
            mount: /
          - name: crash
            size: 15%
            mount: /var/crash
            fstype: ext4
            mkfs-opts: -O large_file
        consumer:
              name: os
```

`Servers.yml` The snippet below shows the insertion of an additional server used for hosting the lifecycle manager. Provide the address information here for the server you are running on, i.e., the node where you have installed the HPE Helion OpenStack ISO.

```
servers:
   # NOTE: Addresses of servers need to be changed to match your environment.
   #
   #       Add additional servers as required

   #Lifecycle-manager
   - id: lifecycle-manager
     ip-addr: <your IP address here>
     role: LIFECYCLE-MANAGER-ROLE
     server-group: RACK1
     nic-mapping: HP-SL230-4PORT
     mac-addr: 8c:dc:d4:b5:c9:e0
     # ipmi information is not needed

   # Controllers
   - id: controller1
     ip-addr: 192.168.10.3
     role: CONTROLLER-ROLE
```

13.5 Configuring HPE Helion OpenStack without DVR

By default in the KVM model, the Neutron service utilizes distributed routing (DVR). This is the recommended setup because it allows for high availability. However, if you would like to disable this feature, here are the steps to achieve this.

On your lifecycle manager, make the following changes:

1. In the `~/helion/my_cloud/config/neutron/neutron.conf.j2` file, change the line below from:

   ```
   router_distributed = {{ router_distributed }}
   ```

   to:

   ```
   router_distributed = False
   ```

2. In the `~/helion/my_cloud/config/neutron/ml2_conf.ini.j2` file, change the line below from:

   ```
   enable_distributed_routing = True
   ```

   to:

   ```
   enable_distributed_routing = False
   ```

3. In the `~/helion/my_cloud/config/neutron/l3_agent.ini.j2` file, change the line below from:

   ```
   agent_mode = {{ neutron_l3_agent_mode }}
   ```

   to:

   ```
   agent_mode = legacy
   ```

4. In the `~/helion/my_cloud/definition/data/control_plane.yml` file, remove the following values from the Compute resource `service-components` list:

   ```
      - neutron-l3-agent
      - neutron-metadata-agent
   ```

5. Commit your changes to your local git repository:

   ```
   cd ~/helion/hos/ansible
   git add -A
   git commit -m "My config or other commit message"
   ```

6. Run the configuration processor:

   ```
   cd ~/helion/hos/ansible
   ```

```
ansible-playbook -i hosts/localhost config-processor-run.yml
```

7. Run the ready deployment playbook:

```
cd ~/helion/hos/ansible
ansible-playbook -i hosts/localhost ready-deployment.yml
```

8. Continue installation. More information on cloud deployments are available in the *Book "Installation Guide", Chapter 6 "Overview"*

13.6 Configuring HPE Helion OpenStack with Provider VLANs and Physical Routers Only

Another option for configuring Neutron is to use provider VLANs and physical routers only, here are the steps to achieve this.

On your lifecycle manager, make the following changes:

1. In the `~/helion/my_cloud/config/neutron/neutron.conf.j2` file, change the line below from:

```
router_distributed = {{ router_distributed }}
```

to:

```
router_distributed = False
```

2. In the `~/helion/my_cloud/config/neutron/ml2_conf.ini.j2` file, change the line below from:

```
enable_distributed_routing = True
```

to:

```
enable_distributed_routing = False
```

3. In the `~/helion/my_cloud/config/neutron/dhcp_agent.ini.j2` file, change the line below from:

```
enable_isolated_metadata = {{ neutron_enable_isolated_metadata }}
```

to:

```
enable_isolated_metadata = True
```

4. In the `~/helion/my_cloud/definition/data/control_plane.yml` file, remove the following values from the Compute resource `service-components` list:

```
  - neutron-l3-agent
  - neutron-metadata-agent
```

13.7 Considerations When Installing Two Systems on One Subnet

If you wish to install two separate HPE Helion OpenStack 5.0 systems using a single subnet, you will need to consider the following notes.

The `ip_cluster` service includes the `keepalived` daemon which maintains virtual IPs (VIPs) on cluster nodes. In order to maintain VIPs, it communicates between cluster nodes over the VRRP protocol.

A VRRP virtual routerid identifies a particular VRRP cluster and must be unique for a subnet. If you have two VRRP clusters with the same virtual routerid, causing a clash of VRRP traffic, the VIPs are unlikely to be up or pingable and you are likely to get the following signature in your `/etc/keepalived/keepalived.log`:

```
Dec 16 15:43:43 helion-cp1-c1-m1-mgmt Keepalived_vrrp[2218]: ip address associated with
 VRID not present in received packet : 10.2.1.11
Dec 16 15:43:43 helion-cp1-c1-m1-mgmt Keepalived_vrrp[2218]: one or more VIP associated
 with VRID mismatch actual MASTER advert
Dec 16 15:43:43 helion-cp1-c1-m1-mgmt Keepalived_vrrp[2218]: bogus VRRP packet received
 on br-bond0 !!!
Dec 16 15:43:43 helion-cp1-c1-m1-mgmt Keepalived_vrrp[2218]: VRRP_Instance(VI_2) ignoring
 received advertisment...
```

To resolve this issue, our recommendation is to install your separate HPE Helion OpenStack 5.0 systems with VRRP traffic on different subnets.

If this is not possible, you may also assign a unique routerid to your separate HPE Helion OpenStack 5.0 system by changing the `keepalived_vrrp_offset` service configurable. The routerid is currently derived using the `keepalived_vrrp_index` which comes from a configuration processor variable and the `keepalived_vrrp_offset`.

For example,

1. Log in to your lifecycle manager.

2. Edit your `~/helion/my_cloud/config/keepalived/defaults.yml` file and change the value of the following line:

```
keepalived_vrrp_offset: 0
```

   Change the off value to a number that uniquely identifies a separate vrrp cluster. For example:
   `keepalived_vrrp_offset: 0` for the 1st vrrp cluster on this subnet.
   `keepalived_vrrp_offset: 1` for the 2nd vrrp cluster on this subnet.
   `keepalived_vrrp_offset: 2` for the 3rd vrrp cluster on this subnet.

   ### Important

   You should be aware that the files in the `~/helion/my_cloud/config/` directory are symlinks to the `~/helion/hos/ansible/` directory. For example, `~/helion/my_cloud/config/keepalived/defaults.yml` is a symbolic link to `~/helion/hos/ansible/roles/keepalived/defaults/main.yml`

```
ls -al ~/helion/my_cloud/config/keepalived/defaults.yml
lrwxrwxrwx 1 stack stack 55 May 24 20:38 /home/stack/helion/my_cloud/config/
keepalived/defaults.yml -> ../../../hos/ansible/roles/keepalived/defaults/
main.yml
```

   If you are using a tool like `sed` to make edits to files in this directory, you might break the symbolic link and create a new copy of the file. To maintain the link, you will need to force `sed` to follow the link:

```
sed -i --follow-symlinks 's$keepalived_vrrp_offset: 0$keepalived_vrrp_offset:
 2$' ~/helion/my_cloud/config/keepalived/defaults.yml
```

   Alternatively, you could directly edit the target of the link `~/helion/hos/ansible/roles/keepalived/defaults/main.yml`.

3. Commit your configuration to the *FIXME: broken external xref*, as follows:

```
cd ~/helion/hos/ansible
git add -A
```

```
git commit -m "changing Admin password"
```

4. Run the configuration processor with this command:

```
cd ~/helion/hos/ansible
ansible-playbook -i hosts/localhost config-processor-run.yml
```

5. Use the playbook below to create a deployment directory:

```
cd ~/helion/hos/ansible
ansible-playbook -i hosts/localhost ready-deployment.yml
```

6. If you are making this change after your initial install, run the following reconfigure playbook to make this change in your environment:

```
cd ~/scratch/ansible/next/hos/ansible/
ansible-playbook -i hosts/verb_hosts FND-CLU-reconfigure.yml
```