



Red Hat OpenStack Platform 10

Instances and Images Guide

Managing Instances and Images

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Managing Instances and Images

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Abstract

The Instances and Images guide provides procedures for the management of instances, images of a Red Hat OpenStack Platform environment.

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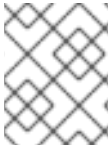
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PREFACE

Red Hat OpenStack Platform (Red Hat OpenStack Platform) provides the foundation to build a private or public Infrastructure-as-a-Service (IaaS) cloud on top of Red Hat Enterprise Linux. It offers a massively scalable, fault-tolerant platform for the development of cloud-enabled workloads.

This guide discusses procedures for creating and managing images, and instances. It also mentions the procedure for configuring the storage for instances for Red Hat OpenStack Platform.

You can manage the cloud using either the OpenStack dashboard or the command-line clients. Most procedures can be carried out using either method; some of the more advanced procedures can only be executed on the command line. This guide provides procedures for the dashboard where possible.



NOTE

For the complete suite of documentation for Red Hat OpenStack Platform, see [Red Hat OpenStack Platform Documentation Suite](#).

CHAPTER 1. IMAGE SERVICE

This chapter discusses the steps you can follow to manage images and storage in Red Hat OpenStack Platform.

A virtual machine image is a file that contains a virtual disk which has a bootable operating system installed on it. Virtual machine images are supported in different formats. The following are the formats available on Red Hat OpenStack Platform:

- **RAW** - Unstructured disk image format.
- **QCOW2** - Disk format supported by QEMU emulator.
- **ISO** - Sector-by-sector copy of the data on a disk, stored in a binary file.
- **AKI** - Indicates an Amazon Kernel Image.
- **AMI** - Indicates an Amazon Machine Image.
- **ARI** - Indicates an Amazon RAMDisk Image.
- **VDI** - Disk format supported by VirtualBox virtual machine monitor and the QEMU emulator.
- **VHD** - Common disk format used by virtual machine monitors from VMware, VirtualBox, and others.
- **VMDK** - Disk format supported by many common virtual machine monitors.

While **ISO** is not normally considered a virtual machine image format, since ISOs contain bootable filesystems with an installed operating system, you can treat them the same as you treat other virtual machine image files.

To download the official Red Hat Enterprise Linux cloud images, your account must have a valid Red Hat Enterprise Linux subscription:

- [Red Hat Enterprise Linux 7 KVM Guest Image](#)
- [Red Hat Enterprise Linux 6 KVM Guest Image](#)

You will be prompted to enter your Red Hat account credentials if you are not logged in to the Customer Portal.

1.1. UNDERSTANDING THE IMAGE SERVICE

The following notable OpenStack Image service (glance) features are available.

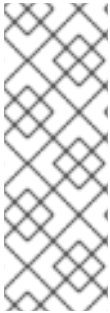
1.1.1. Image conversion

Image conversion converts images by calling the task API while importing an image.

As part of the import workflow, a plugin provides the image conversion. This plugin can be activated or deactivated based on the deployer configuration. Therefore, the deployer needs to specify the preferred format of images for the deployment.

Internally, the Image service receives the bits of the image in a particular format. These bits are stored in a temporary location. The plugin is then triggered to convert the image to the target format, and moved

to a final destination. When the task is finished, the temporary location is deleted. As a result, the format uploaded initially is not retained by the Image service.



NOTE

The conversion can be triggered only when **importing** an image (the old copy-from). It does not run when **uploading** an image. For example:

```
$ glance task-create --type import --input '{"import_from_format": "qcow2",
"import_from": "http://127.0.0.1:8000/test.qcow2", "image_properties": {"disk_format":
"qcow2", "container_format": "bare"}}'
```

1.1.2. Image introspection

Every image format comes with a set of metadata embedded inside the image itself. For example, a stream optimized **vmdk** would contain the following parameters:

```
$ head -20 so-disk.vmdk

# Disk DescriptorFile
version=1
CID=d5a0bce5
parentCID=ffffff
createType="streamOptimized"

# Extent description
RDONLY 209714 SPARSE "generated-stream.vmdk"

# The Disk Data Base
#DDB

ddb.adapterType = "buslogic"
ddb.geometry.cylinders = "102"
ddb.geometry.heads = "64"
ddb.geometry.sectors = "32"
ddb.virtualHWVersion = "4"
```

By introspecting this *vmdk*, you can easily know that the *disk_type* is *streamOptimized*, and the *adapter_type* is *buslogic*. These metadata parameters are useful for the consumer of the image. In Compute, the workflow to instantiate a *streamOptimized* disk is different from the one to instantiate a *flat* disk. This feature allows metadata extraction. You can achieve image introspection by calling the task API while importing the image. An administrator can override metadata settings.

1.1.3. Harden the Image Service

The **copy_from** feature in the Image Service API v1 allows an attacker to perform masked network port scans. It is possible to create images with a URL such as <http://localhost:22>. This could allow an attacker to enumerate internal network details, because the scan appears to originate from the Image Service. This is classified as a Server-Side Request Forgery (SSRF).

1.1.3.1. Diagnose Vulnerability

All **copy_from** calls are logged by the Image Service. This makes it possible to link the abuser of this vulnerability to the cloud user exploiting it. For this flaw to be exploited, image creation must be enabled and non-admin users must be able to use the **copy_from** function.

To diagnose this vulnerability, review the `/etc/glance/policy.json` file. If the file has the following settings, your deployment is vulnerable:

```
"add_image": "",
"copy_from": "",
```

1.1.3.2. Mitigate Vulnerability

To prevent attackers from exploiting this flaw, restrict the policy for the **copy_from** function to the **admin** role.

Add the following setting to the **copy_from** line of the `/etc/glance/policy.json` file:

```
"copy_from": "role:admin",
```



WARNING

Limiting the `copy_from` function to *admin* users impacts Orchestration and dashboard usage. For example: Any Orchestration stacks for non-admin users that create images will break. Non-admin users will not be able to create images in the dashboard by providing an image-data URI.

1.1.3.2.1. Partial Mitigation

Optionally, instead of restricting the **copy_from** function, you can partially mitigate the vulnerability by:

- Rate-limiting calls to the Image Service, which makes network probing extremely slow and may deter attacks.
- Limiting connections from the control-plane node that runs the glance-api server to the ports required for the services and ports 80 and 443 towards the external network. This action would significantly limit the scope of an attack without affecting the majority of users.

1.2. MANAGING IMAGES

The OpenStack Image service (glance) provides discovery, registration, and delivery services for disk and server images. It provides the ability to copy or snapshot a server image, and immediately store it away. Stored images can be used as a template to get new servers up and running quickly and more consistently, than installing a server operating system and individually configuring additional services.

1.2.1. Creating an image

This section provides you with the steps to manually create OpenStack-compatible images in the QCOW2 format using Red Hat Enterprise Linux 7 ISO files, Red Hat Enterprise Linux 6 ISO files, or Windows ISO files.

1.2.1.1. Using a KVM guest image with Red Hat OpenStack Platform

You can use a ready RHEL KVM guest QCOW2 image:

- [RHEL 7.2 KVM Guest Image](#)
- [RHEL 6.8 KVM Guest Image](#)

These images are configured with **cloud-init** and must take advantage of ec2-compatible metadata services for provisioning SSH keys in order to function properly.

Ready Windows KVM guest QCOW2 images are not available.



NOTE

For the KVM guest images:

- The **root** account in the image is disabled, but **sudo** access is granted to a special user named **cloud-user**.
- There is no **root** password set for this image.

The **root** password is locked in **/etc/shadow** by placing **!!** in the second field.

For an OpenStack instance, it is recommended that you generate an ssh keypair from the OpenStack dashboard or command line and use that key combination to perform an SSH public authentication to the instance as root.

When the instance is launched, this public key will be injected to it. You can then authenticate using the private key downloaded while creating the keypair.

If you do not want to use keypairs, you can use the **admin** password that has been set using the [Inject an admin Password Into an Instance](#) procedure.

If you want to create custom Red Hat Enterprise Linux or Windows images, see [Create a Red Hat Enterprise Linux 7 Image](#), [Create a Red Hat Enterprise Linux 6 Image](#), or [Create a Windows Image](#).

1.2.1.2. Creating custom Red Hat Enterprise Linux or Windows images

Prerequisites:

- Linux host machine to create an image. This can be any machine on which you can install and run the Linux packages.
- libvirt, virt-manager (run command **yum groupinstall -y @virtualization**). This installs all packages necessary for creating a guest operating system.
- Libguestfs tools (run command **yum install -y libguestfs-tools-c**). This installs a set of tools for accessing and modifying virtual machine images.
- A Red Hat Enterprise Linux 7 or 6 ISO file (see [RHEL 7.2 Binary DVD](#) or [RHEL 6.8 Binary DVD](#)) or a Windows ISO file. If you do not have a Windows ISO file, visit the [Microsoft TechNet Evaluation Center](#) and download an evaluation image.
- Text editor, if you want to change the **kickstart** files (RHEL only).

**NOTE**

In the following procedures, all commands with the **[root@host]#** prompt should be run on your host machine.

1.2.1.2.1. Creating a Red Hat Enterprise Linux 7 image

This section provides you with the steps to manually create an OpenStack-compatible image in the QCOW2 format using a Red Hat Enterprise Linux 7 ISO file.

1. Start the installation using **virt-install** as shown below:

```
[root@host]# qemu-img create -f qcow2 rhel7.qcow2 8G
[root@host]# virt-install --virt-type kvm --name rhel7 --ram 2048 \
--cdrom /tmp/rhel-server-7.2-x86_64-dvd.iso \
--disk rhel7.qcow2,format=qcow2 \
--network=bridge:virbr0 --graphics vnc,listen=0.0.0.0 \
--noautoconsole --os-type=linux --os-variant=rhel7
```

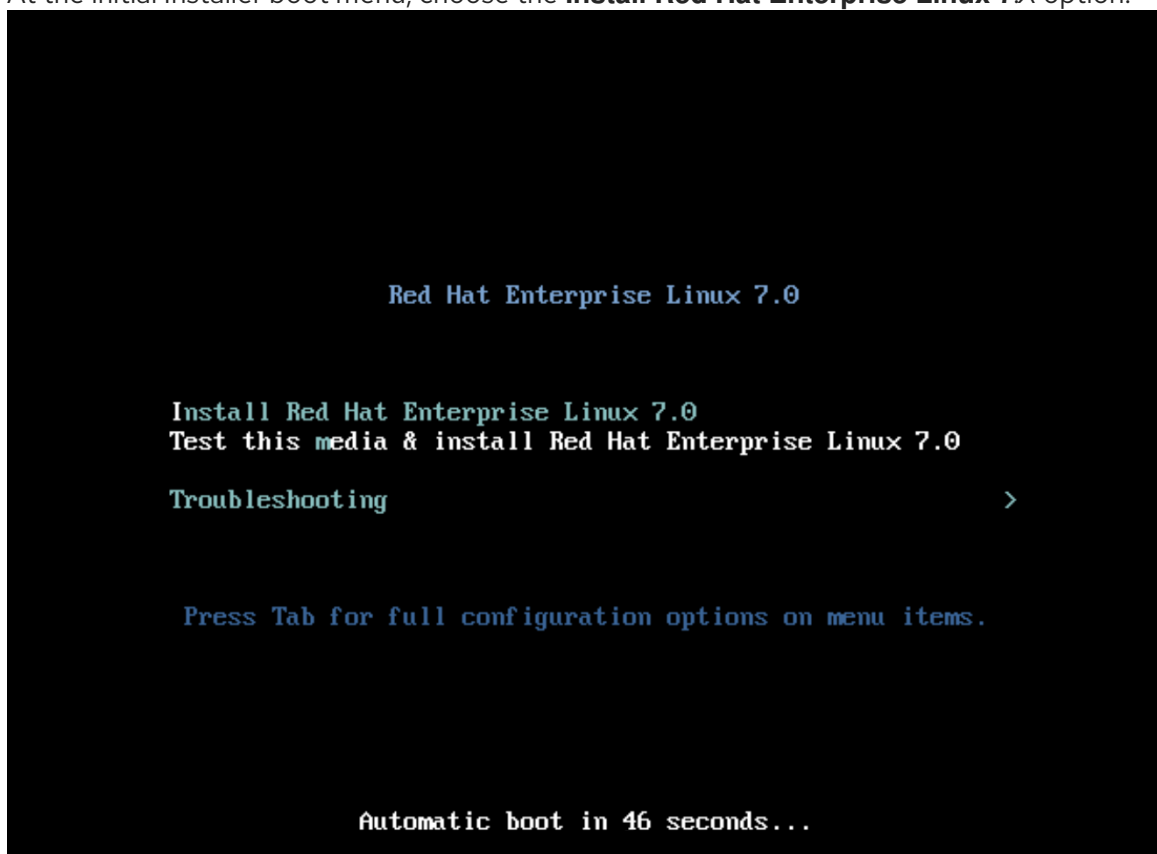
This launches an instance and starts the installation process.

**NOTE**

If the instance does not launch automatically, run the **virt-viewer** command to view the console:

```
[root@host]# virt-viewer rhel7
```

2. Set up the virtual machine as follows:
 - a. At the initial Installer boot menu, choose the **Install Red Hat Enterprise Linux 7.X** option.



- b. Choose the appropriate **Language** and **Keyboard** options.
- c. When prompted about which type of devices your installation uses, choose **Auto-detected installation media**.

INSTALLATION SOURCE RED HAT ENTERPRISE LINUX 7.0 INSTALLATION

[Done](#)

Which installation source would you like to use?

Auto-detected installation media:
 Device: sr0
 Label: RHEL-7.0_Server.x86_64 [Verify](#)

On the network:
 http:// [Proxy setup...](#)
 This URL refers to a mirror list.

Additional repositories

Enabled	Name

[+](#) [-](#) [↺](#)

Name:
 http:// This URL refers to a mirror list.
 Proxy URL:
 Username:
 Password:

- d. When prompted about which type of installation destination, choose **Local Standard Disks**.

INSTALLATION DESTINATION RED HAT ENTERPRISE LINUX 7.0 INSTALLATION

[Done](#)

Device Selection
 Select the device(s) you'd like to install to. They will be left untouched until you click on the main menu's "Begin Installation" button.

Local Standard Disks

2.04 GB

Virtio Block Device
vda / 2.04 GB free

Disks left unselected here will not be touched.

Specialized & Network Disks

[Add a disk...](#)

Disks left unselected here will not be touched.

Other Storage Options

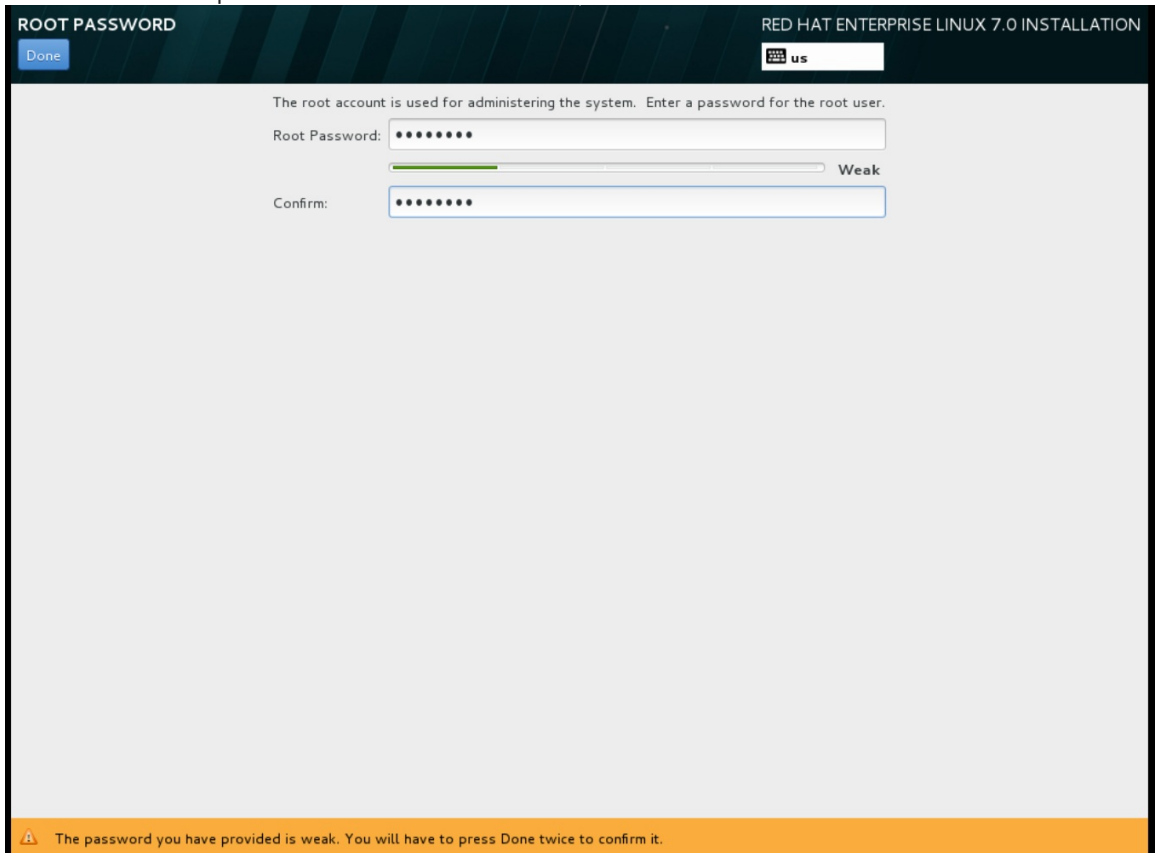
Partitioning
 Automatically configure partitioning. I will configure partitioning.
 I would like to make additional space available.

Encryption
 Encrypt my data. *You'll set a passphrase later.*

[Full disk summary and bootloader...](#) 1 disk selected; 2.04 GB capacity; 2.04 GB free

For other storage options, choose **Automatically configure partitioning**.

- e. For software selection, choose **Minimal Install**.
- f. For network and host name, choose **eth0** for network and choose a **hostname** for your device. The default host name is **localhost.localdomain**.
- g. Choose the **root** password.



The installation process completes and the **Complete!** screen appears.

3. After the installation is complete, reboot the instance and log in as the root user.
4. Update the `/etc/sysconfig/network-scripts/ifcfg-eth0` file so it only contains the following values:

```
TYPE=Ethernet
DEVICE=eth0
ONBOOT=yes
BOOTPROTO=dhcp
NM_CONTROLLED=no
```

5. Reboot the machine.
6. Register the machine with the Content Delivery Network. For details, see [Subscribe to the Required Channels](#) in *Manual Installation Procedures*.
7. Update the system:

```
# yum -y update
```

8. Install the **cloud-init** packages:

```
# yum install -y cloud-utils-growpart cloud-init
```

9. Edit the `/etc/cloud/cloud.cfg` configuration file and under `cloud_init_modules` add:

```
- resolv-conf
```

The **resolv-conf** option automatically configures the **resolv.conf** when an instance boots for the first time. This file contains information related to the instance such as **nameservers**, **domain** and other options.

10. Add the following line to `/etc/sysconfig/network` to avoid problems accessing the EC2 metadata service:

```
NOZEROCONF=yes
```

11. To ensure the console messages appear in the **Log** tab on the dashboard and the **nova console-log** output, add the following boot option to the `/etc/default/grub` file:

```
GRUB_CMDLINE_LINUX_DEFAULT="console=tty0 console=ttyS0,115200n8"
```

Run the **grub2-mkconfig** command:

```
# grub2-mkconfig -o /boot/grub2/grub.cfg
```

The output is as follows:

```
Generating grub configuration file ...
Found linux image: /boot/vmlinuz-3.10.0-229.7.2.el7.x86_64
Found initrd image: /boot/initramfs-3.10.0-229.7.2.el7.x86_64.img
Found linux image: /boot/vmlinuz-3.10.0-121.el7.x86_64
Found initrd image: /boot/initramfs-3.10.0-121.el7.x86_64.img
Found linux image: /boot/vmlinuz-0-rescue-b82a3044fb384a3f9aeacf883474428b
Found initrd image: /boot/initramfs-0-rescue-b82a3044fb384a3f9aeacf883474428b.img
done
```

12. Un-register the virtual machine so that the resulting image does not contain the same subscription details for every instance cloned based on it:

```
# subscription-manager repos --disable=*
# subscription-manager unregister
# yum clean all
```

13. Power off the instance:

```
# poweroff
```

14. Reset and clean the image using the **virt-sysprep** command so it can be used to create instances without issues:

```
[root@host]# virt-sysprep -d rhel7
```

15. Reduce image size using the **virt-sparsify** command. This command converts any free space within the disk image back to free space within the host:

```
[root@host]# virt-sparsify --compress /tmp/rhel7.qcow2 rhel7-cloud.qcow2
```


-

This creates a new **rhel7-cloud.qcow2** file in the location from where the command is run.

The **rhel7-cloud.qcow2** image file is ready to be uploaded to the Image service. For more information on uploading this image to your OpenStack deployment using the dashboard, see [Upload an Image](#).

1.2.1.2.2. Creating a Red Hat Enterprise Linux 6 image

This section provides you with the steps to manually create an OpenStack-compatible image in the QCOW2 format using a Red Hat Enterprise Linux 6 ISO file.

1. Start the installation using **virt-install**:

```
[root@host]# qemu-img create -f qcow2 rhel6.qcow2 4G
[root@host]# virt-install --connect=qemu:///system --network=bridge:virbr0 \
--name=rhel6 --os-type linux --os-variant rhel6 \
--disk path=rhel6.qcow2,format=qcow2,size=10,cache=none \
--ram 4096 --vcpus=2 --check-cpu --accelerate \
--hvm --cdrom=rhel-server-6.8-x86_64-dvd.iso
```

This launches an instance and starts the installation process.



NOTE

If the instance does not launch automatically, run the **virt-viewer** command to view the console:

```
[root@host]# virt-viewer rhel6
```

2. Set up the virtual machines as follows:

- a. At the initial Installer boot menu, choose the **Install or upgrade an existing system** option.



Step through the installation prompts. Accept the defaults.

The installer checks for the disc and lets you decide whether you want to test your installation media before installation. Select **OK** to run the test or **Skip** to proceed without testing.

- b. Choose the appropriate **Language** and **Keyboard** options.

- c. When prompted about which type of devices your installation uses, choose **Basic Storage Devices**.

What type of devices will your installation involve?

Basic Storage Devices
 Installs or upgrades to typical types of storage devices. If you're not sure which option is right for you, this is probably it.

Specialized Storage Devices
 Installs or upgrades to enterprise devices such as Storage Area Networks (SANs). This option will allow you to add FCoE / iSCSI / zFCP disks and to filter out devices the installer should ignore.

- d. Choose a **hostname** for your device. The default host name is **localhost.localdomain**.
- e. Set **timezone** and **root** password.
- f. Based on the space on the disk, choose the type of installation.

Which type of installation would you like?

Use All Space
 Removes all partitions on the selected device(s). This includes partitions created by other operating systems.
Tip: This option will remove data from the selected device(s). Make sure you have backups.

Replace Existing Linux System(s)
 Removes only Linux partitions (created from a previous Linux installation). This does not remove other partitions you may have on your storage device(s) (such as VFAT or FAT32).
Tip: This option will remove data from the selected device(s). Make sure you have backups.

Shrink Current System
 Shrinks existing partitions to create free space for the default layout.

Use Free Space
 Retains your current data and partitions and uses only the unpartitioned space on the selected device(s), assuming you have enough free space available.

Create Custom Layout
 Manually create your own custom layout on the selected device(s) using our partitioning tool.

Encrypt system
 Review and modify partitioning layout

- g. Choose the **Basic Server** install, which installs an SSH server.

The default installation of Red Hat Enterprise Linux is a basic server install. You can optionally select a different set of software now.

- Basic Server
- Database Server
- Web Server
- Identity Management Server
- Virtualization Host
- Desktop
- Software Development Workstation
- Minimal

Please select any additional repositories that you want to use for software installation.

- High Availability
- Load Balancer
- Red Hat Enterprise Linux
- Red Hat OpenStack Platform

You can further customize the software selection now, or after install via the software management application.

- Customize later
- Customize now

- h. The installation process completes and **Congratulations, your Red Hat Enterprise Linux installation is complete** screen appears.
3. Reboot the instance and log in as the **root** user.
 4. Update the **/etc/sysconfig/network-scripts/ifcfg-eth0** file so it only contains the following values:

```
TYPE=Ethernet
DEVICE=eth0
ONBOOT=yes
BOOTPROTO=dhcp
NM_CONTROLLED=no
```

5. Reboot the machine.
6. Register the machine with the Content Delivery Network. For details, see [Subscribe to the Required Channels](#) in the *Manual Installation Procedures* guide.
7. Update the system:

```
# yum -y update
```

8. Install the **cloud-init** packages:

```
# yum install -y cloud-utils-growpart cloud-init
```

9. Edit the **/etc/cloud/cloud.cfg** configuration file and under **cloud_init_modules** add:

```
- resolv-conf
```

The **resolv-conf** option automatically configures the **resolv.conf** configuration file when an instance boots for the first time. This file contains information related to the instance such as **nameservers**, **domain**, and other options.

- To prevent network issues, create the **/etc/udev/rules.d/75-persistent-net-generator.rules** file as follows:

```
# echo "#" > /etc/udev/rules.d/75-persistent-net-generator.rules
```

This prevents **/etc/udev/rules.d/70-persistent-net.rules** file from being created. If **/etc/udev/rules.d/70-persistent-net.rules** is created, networking may not function properly when booting from snapshots (the network interface is created as "eth1" rather than "eth0" and IP address is not assigned).

- Add the following line to **/etc/sysconfig/network** to avoid problems accessing the EC2 metadata service:

```
NOZEROCONF=yes
```

- To ensure the console messages appear in the **Log** tab on the dashboard and the **nova console-log** output, add the following boot option to the **/etc/grub.conf**:

```
console=tty0 console=ttyS0,115200n8
```

- Un-register the virtual machine so that the resulting image does not contain the same subscription details for every instance cloned based on it:

```
# subscription-manager repos --disable=*
# subscription-manager unregister
# yum clean all
```

- Power off the instance:

```
# poweroff
```

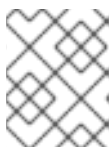
- Reset and clean the image using the **virt-sysprep** command so it can be used to create instances without issues:

```
[root@host]# virt-sysprep -d rhel6
```

- Reduce image size using the **virt-sparsify** command. This command converts any free space within the disk image back to free space within the host:

```
[root@host]# virt-sparsify --compress rhel6.qcow2 rhel6-cloud.qcow2
```

This creates a new **rhel6-cloud.qcow2** file in the location from where the command is run.



NOTE

You will need to manually resize the partitions of instances based on the image in accordance with the disk space in the flavor that is applied to the instance.

The **rhel6-cloud.qcow2** image file is ready to be uploaded to the Image service. For more information on uploading this image to your OpenStack deployment using the dashboard, see [Upload an Image](#)

1.2.1.2.3. Creating a Windows image

This section provides you with the steps to manually create an OpenStack-compatible image in the QCOW2 format using a Windows ISO file.

1. Start the installation using **virt-install** as shown below:

```
[root@host]# virt-install --name=name \
--disk size=size \
--cdrom=path \
--os-type=windows \
--network=bridge:virbr0 \
--graphics spice \
--ram=RAM
```

Replace the values of the **virt-install** parameters as follows:

- *name* – the name that the Windows guest should have.
- *size* – disk size in GB.
- *path* – the path to the Windows installation ISO file.
- *RAM* – the requested amount of RAM in MB.



NOTE

The **--os-type=windows** parameter ensures that the clock is set up correctly for the Windows guest, and enables its Hyper-V enlightenment features.

Note that **virt-install** saves the guest image as **/var/lib/libvirt/images/*name*.qcow2** by default. If you want to keep the guest image elsewhere, change the parameter of the **--disk** option as follows:

```
--disk path=filename,size=size
```

Replace *filename* with the name of the file which should store the guest image (and optionally its path); for example **path=win8.qcow2,size=8** creates an 8 GB file named **win8.qcow2** in the current working directory.

TIP

If the guest does not launch automatically, run the **virt-viewer** command to view the console:

```
[root@host]# virt-viewer name
```

2. Installation of Windows systems is beyond the scope of this document. For instructions on how to install Windows, see the relevant Microsoft documentation.

3. To allow the newly installed Windows system to use the virtualized hardware, you may need to install *virtio drivers* in it. To do so, first install the **virtio-win** package on the host system. This package contains the virtio ISO image, which is to be attached as a CD-ROM drive to the Windows guest. See [Chapter 8. KVM Para-virtualized \(virtio\) Drivers](#) in the *Virtualization Deployment and Administration Guide* for detailed instructions on how to install the **virtio-win** package, add the virtio ISO image to the guest, and install the virtio drivers.
4. To complete the setup, download and execute [Cloudbase-Init](#) on the Windows system. At the end of the installation of Cloudbase-Init, select the **Run Sysprep** and **Shutdown** check boxes. The **Sysprep** tool makes the guest unique by generating an OS ID, which is used by certain Microsoft services.



IMPORTANT

Red Hat does not provide technical support for Cloudbase-Init. If you encounter an issue, [contact Cloudbase Solutions](#).

When the Windows system shuts down, the *name.qcow2* image file is ready to be uploaded to the Image service. For more information on uploading this image to your OpenStack deployment using the dashboard or the command line, see [Upload an Image](#).

1.2.1.3. Using libosinfo

Image Service (glance) can process *libosinfo* data for images, making it easier to configure the optimal virtual hardware for an instance. This can be done by adding the libosinfo-formatted operating system name to the glance image.

1. This example specifies that the image with ID **654dbfd5-5c01-411f-8599-a27bd344d79b** uses the libosinfo value of **rhel7.2**:

```
$ openstack image set 654dbfd5-5c01-411f-8599-a27bd344d79b --property
os_name=rhel7.2
```

As a result, Compute will supply virtual hardware optimized for **rhel7.2** whenever an instance is built using the **654dbfd5-5c01-411f-8599-a27bd344d79b** image.



NOTE

For a complete list of **libosinfo** values, refer to the libosinfo project: <https://gitlab.com/libosinfo/osinfo-db/tree/master/data/os>

1.2.2. Uploading an image

1. In the dashboard, select **Project > Compute > Images**
2. Click **Create Image**.
3. Fill out the values, and click **Create Image** when finished.

Table 1.1. Image Options

Field	Notes
Name	Name for the image. The name must be unique within the project.
Description	Brief description to identify the image.
Image Source	Image source: Image Location or Image File . Based on your selection, the next field is displayed.
Image Location or Image File	<ul style="list-style-type: none"> • Select Image Location option to specify the image location URL. • Select Image File option to upload an image from the local disk.
Format	Image format (for example, qcow2).
Architecture	Image architecture. For example, use i686 for a 32-bit architecture or x86_64 for a 64-bit architecture.
Minimum Disk (GB)	Minimum disk size required to boot the image. If this field is not specified, the default value is 0 (no minimum).
Minimum RAM (MB)	Minimum memory size required to boot the image. If this field is not specified, the default value is 0 (no minimum).
Public	If selected, makes the image public to all users with access to the project.
Protected	If selected, ensures only users with specific permissions can delete this image.

When the image has been successfully uploaded, its status is changed to **active**, which indicates that the image is available for use. Note that the Image service can handle even large images that take a long time to upload – longer than the lifetime of the Identity service token which was used when the upload was initiated. This is due to the fact that the Image service first creates a trust with the Identity service so that a new token can be obtained and used when the upload is complete and the status of the image is to be updated.

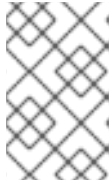


NOTE

You can also use the **glance image-create** command with the **property** option to upload an image. More values are available on the command line. For a complete listing, see [Image Configuration Parameters](#).

1.2.3. Updating an image

1. In the dashboard, select **Project > Compute > Images**
2. Click **Edit Image** from the dropdown list.

**NOTE**

The **Edit Image** option is available only when you log in as an **admin** user. When you log in as a **demo** user, you have the option to **Launch an instance** or **Create Volume**.

3. Update the fields and click **Update Image** when finished. You can update the following values - name, description, kernel ID, ramdisk ID, architecture, format, minimum disk, minimum RAM, public, protected.
4. Click the drop-down menu and select **Update Metadata** option.
5. Specify metadata by adding items from the left column to the right one. In the left column, there are metadata definitions from the Image Service Metadata Catalog. Select **Other** to add metadata with the key of your choice and click **Save** when finished.

**NOTE**

You can also use the **glance image-update** command with the **property** option to update an image. More values are available on the command line; for a complete listing, see [Image Configuration Parameters](#).

1.2.4. Deleting an image

1. In the dashboard, select **Project > Compute > Images**
2. Select the image you want to delete and click **Delete Images**.

1.2.5. Converting an image to RAW format

Red Hat Ceph can store, but does not support using, QCOW2 images to host virtual machine (VM) disks.

When you upload a QCOW2 image and create a VM from it, the compute node downloads the image, converts the image to RAW, and uploads it back into Ceph, which can then use it. This process affects the time it takes to create VMs, especially during parallel VM creation.

For example, when you create multiple VMs simultaneously, uploading the converted image to the Ceph cluster may impact already running workloads. The upload process can starve those workloads of IOPS and impede storage responsiveness.

To boot VMs in Ceph more efficiently (ephemeral back end or boot from volume), the glance image format must be RAW.

Converting an image to RAW may yield an image that is larger in size than the original QCOW2 image file. Run the following command before the conversion to determine the final RAW image size:

```
qemu-img info <image>.qcow2
```

To convert an image from QCOW2 to RAW format, do the following:

```
qemu-img convert -p -f qcow2 -O raw <original qcow2 image>.qcow2 <new raw image>.raw
```

1.2.5.1. Configuring Image Service to accept RAW and ISO only

Optionally, to configure the Image Service to accept only RAW and ISO image formats, deploy using an additional environment file that contains the following:

```
parameter_defaults:  
  ExtraConfig:  
    glance::config::api_config:  
      image_format/disk_formats:  
        value: "raw,iso"
```

CHAPTER 2. CONFIGURING OPENSTACK COMPUTE STORAGE

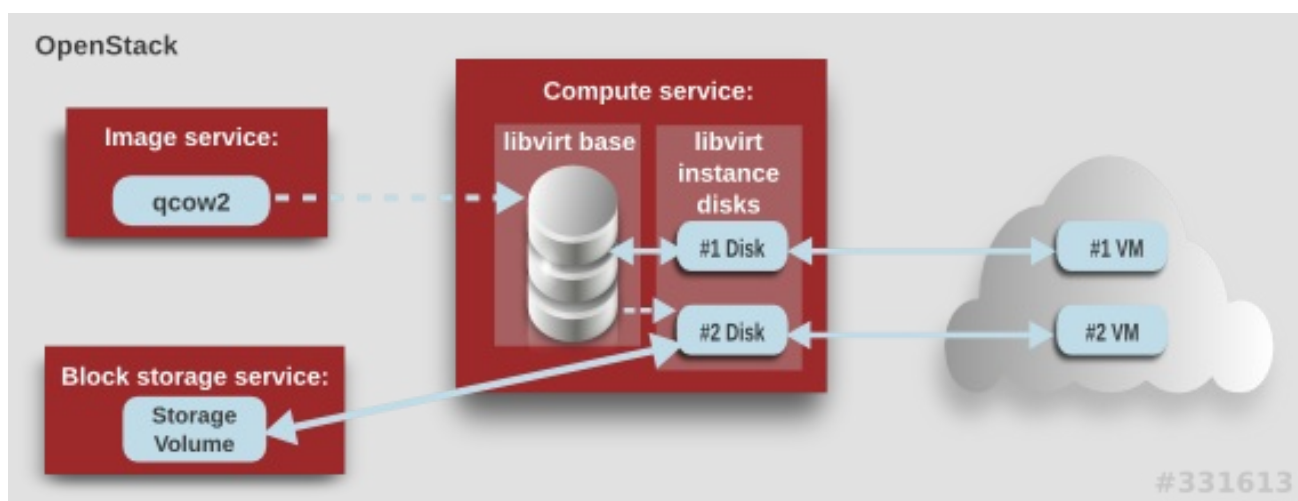
This chapter describes the architecture for the back-end storage of images in OpenStack Compute (nova), and provides basic configuration options.

2.1. ARCHITECTURE OVERVIEW

In Red Hat OpenStack Platform, the OpenStack Compute service uses the KVM hypervisor to execute compute workloads. The **libvirt** driver handles all interactions with KVM, and enables the creation of virtual machines.

Two types of **libvirt** storage must be considered for Compute:

- Base image, which is a cached and formatted copy of the Image service image.
- Instance disk, which is created using the **libvirt** base and is the back end for the virtual machine instance. Instance disk data can be stored either in Compute's ephemeral storage (using the **libvirt** base) or in persistent storage (for example, using Block Storage).



The steps that Compute takes to create a virtual machine instance are:

1. Cache the Image service's backing image as the **libvirt** base.
2. Convert the base image to the raw format (if configured).
3. Resize the base image to match the VM's flavor specifications.
4. Use the base image to create the libvirt instance disk.

In the diagram above, the #1 instance disk uses ephemeral storage; the #2 disk uses a block-storage volume.

Ephemeral storage is an empty, unformatted, additional disk available to an instance. This storage value is defined by the instance flavor. The value provided by the user must be less than or equal to the ephemeral value defined for the flavor. The default value is **0**, meaning no ephemeral storage is created.

The ephemeral disk appears in the same way as a plugged-in hard drive or thumb drive. It is available as a block device which you can check using the **lsblk** command. You can format it, mount it, and use it however you normally would a block device. There is no way to preserve or reference that disk beyond

the instance it is attached to.

Block storage volume is persistent storage available to an instance regardless of the state of the running instance.

2.2. CONFIGURATION

Compute configuration for handling the **libvirt** base and instance disks can determine both performance and security aspects of your environment; parameters are configured in the **/etc/nova/nova.conf** file.

Table 2.1. Compute Image Parameters

Section	Parameter	Description	Default
[DEFAULT]	force_raw_images	<p>Whether to convert a non-raw cached base image to be raw (boolean). If a non-raw image is converted to raw, Compute:</p> <ul style="list-style-type: none"> • Disallows backing files (which might be a security issue). • Removes existing compression (to avoid CPU bottlenecks). <p>Converting the base to raw uses more space for any image that could have been used directly by the hypervisor (for example, a qcow2 image). If you have a system with slower I/O or less available space, you might want to specify 'false', trading the higher CPU requirements of compression for that of minimized input bandwidth.</p> <p>Raw base images are always used with libvirt_images_type=lvm.</p>	true
[DEFAULT]	use_cow_images	<p>Whether to use CoW (Copy on Write) images for libvirt instance disks (boolean):</p> <ul style="list-style-type: none"> • false - The raw format is used. Without CoW, more space is used for common parts of the disk image • true - The cqow2 format is used. With CoW, depending on the backing store and host caching, there may be better concurrency achieved by having each VM operate on its own copy. 	true

Section	Parameter	Description	Default
[DEFAULT]	preallocate_images	<p>Preallocation mode for libvirt instance disks. Value can be:</p> <ul style="list-style-type: none"> ● none - No storage is provisioned at instance start. ● space - Storage is fully allocated at instance start (using fallocate), which can help with both space guarantees and I/O performance. <p>Even when not using CoW instance disks, the copy each VM gets is sparse and so the VM may fail unexpectedly at run time with ENOSPC. By running fallocate(1) on the instance disk images, Compute immediately and efficiently allocates the space for them in the file system (if supported). Run time performance should also be improved because the file system does not have to dynamically allocate blocks at run time (reducing CPU overhead and more importantly file fragmentation).</p>	none
[DEFAULT]	resize_fs_using_block_device	<p>Whether to enable direct resizing of the base image by accessing the image over a block device (boolean). This is only necessary for images with older versions of cloud-init (that cannot resize themselves).</p> <p>Because this parameter enables the direct mounting of images which might otherwise be disabled for security reasons, it is not enabled by default.</p>	false
[DEFAULT]	default_ephemeral_format	<p>The default format that is used for a new ephemeral volume. Value can be: ext2, ext3, or ext4. The ext4 format provides much faster initialization times than ext3 for new, large disks. You can also override per instance using the guest_format configuration option.</p>	ext4
[DEFAULT]	image_cache_manager_interval	<p>Number of seconds to wait between runs of the image cache manager, which impacts base caching on libvirt compute nodes. This period is used in the auto removal of unused cached images (see remove_unused_base_images and remove_unused_original_minimum_age_seconds).</p>	2400

Section	Parameter	Description	Default
[DEFAULT]	remove_unused_base_images	Whether to enable the automatic removal of unused base images (checked every image_cache_manager_interval seconds). Images are defined as unused if they have not been accessed in remove_unused_original_minimum_age_seconds seconds.	true
[DEFAULT]	remove_unused_original_minimum_age_seconds	How old an unused base image must be before being removed from the libvirt cache (see remove_unused_base_images).	86400
[libvirt]	images_type	Image type to use for libvirt instance disks (deprecates use_cow_images). Value can be: raw , qcow2 , lvm , rbd , or default . If default is specified, the value used for the use_cow_images parameter is used.	default

CHAPTER 3. VIRTUAL MACHINE INSTANCES

OpenStack Compute is the central component that provides virtual machines on demand. Compute interacts with the Identity service for authentication, Image service for images (used to launch instances), and the dashboard service for the user and administrative interface.

Red Hat OpenStack Platform allows you to easily manage virtual machine instances in the cloud. The Compute service creates, schedules, and manages instances, and exposes this functionality to other OpenStack components. This chapter discusses these procedures along with procedures to add components like key pairs, security groups, host aggregates and flavors. The term *instance* is used by OpenStack to mean a virtual machine instance.

3.1. MANAGING INSTANCES

Before you can create an instance, you need to ensure certain other OpenStack components (for example, a network, key pair and an image or a volume as the boot source) are available for the instance.

This section discusses the procedures to add these components, create and manage an instance. Managing an instance refers to updating, and logging in to an instance, viewing how the instances are being used, resizing or deleting them.

3.1.1. Adding components

Use the following sections to create a network, key pair and upload an image or volume source. These components are used in the creation of an instance and are not available by default. You will also need to create a new security group to allow SSH access to the user.


1. In the dashboard, select **Project**.
2. Select **Network > Networks** and ensure there is a private network to which you can attach the new instance (to create a network, see [Create a Network](#) section in the *Networking Guide*).
3. Select **Compute > Access & Security > Key Pairs** and ensure there is a key pair (to create a key pair, see [Section 3.3.1.1, "Creating a key pair"](#)).
4. Ensure that you have either an image or a volume that can be used as a boot source:
 - To view boot-source images, select the **Images** tab (to create an image, see [Section 1.2.1, "Creating an image"](#)).
 - To view boot-source volumes, select the **Volumes** tab (to create a volume, see [Create a Volume](#) in the *Storage Guide*).
5. Select **Compute > Access & Security > Security Groups** and ensure you have created a security group rule (to create a security group, see [Project Security Management](#) in the *Users and Identity Management Guide*).

3.1.2. Creating an instance

1. In the dashboard, select **Project > Compute > Instances**
2. Click **Launch Instance**.
3. Fill out instance fields (those marked with '*' are required), and click **Launch** when finished.

Table 3.1. Instance Options

Tab	Field	Notes
Project and User	Project	Select the project from the dropdown list.
	User	Select the user from the dropdown list.
Details	Availability Zone	Zones are logical groupings of cloud resources in which your instance can be placed. If you are unsure, use the default zone (for more information, see Section 3.5, “Managing host aggregates”).
	Instance Name	A name to identify your instance.
	Flavor	The flavor determines what resources the instance is given (for example, memory). For default flavor allocations and information on creating new flavors, see Section 3.4, “Managing flavors” .
	Instance Count	The number of instances to create with these parameters. “1” is preselected.
	Instance Boot Source	Depending on the item selected, new fields are displayed allowing you to select the source: <ul style="list-style-type: none"> • Image sources must be compatible with OpenStack (see Section 1.2, “Managing images”). • If a volume or volume source is selected, the source must be formatted using an image (see Basic Volume Usage and Configuration in the <i>Storage Guide</i>).
Access and Security	Key Pair	The specified key pair is injected into the instance and is used to remotely access the instance using SSH (if neither a direct login information or a static key pair is provided). Usually one key pair per project is created.
	Security Groups	Security groups contain firewall rules which filter the type and direction of the instance’s network traffic (for more information on configuring groups, see Project Security Management in the <i>Users and Identity Management Guide</i>).
Networking	Selected Networks	You must select at least one network. Instances are typically assigned to a private network, and then later given a floating IP address to enable external access.

Tab	Field	Notes
Post-Creation	Customization Script Source	<p>You can provide either a set of commands or a script file, which will run after the instance is booted (for example, to set the instance host name or a user password). If 'Direct Input' is selected, write your commands in the Script Data field; otherwise, specify your script file.</p> <div style="display: flex; align-items: flex-start;">  <div> <p>NOTE</p> <p>Any script that starts with '#cloud-config' is interpreted as using the cloud-config syntax (for information on the syntax, see http://cloudinit.readthedocs.org/en/latest/topics/examples.html).</p> </div> </div>
Advanced Options	Disk Partition	By default, the instance is built as a single partition and dynamically resized as needed. However, you can choose to manually configure the partitions yourself.
	Configuration Drive	If selected, OpenStack writes metadata to a read-only configuration drive that is attached to the instance when it boots (instead of to Compute's metadata service). After the instance has booted, you can mount this drive to view its contents (enables you to provide files to the instance).

3.1.3. Updating an instance

You can update an instance by selecting **Project > Compute > Instances** and selecting an action for that instance in the **Actions** column. Actions allow you to manipulate the instance in a number of ways:

Table 3.2. Update Instance Options

Action	Description
Create Snapshot	Snapshots preserve the disk state of a running instance. You can create a snapshot to migrate the instance, as well as to preserve backup copies.
Associate/Disassociate Floating IP	You must associate an instance with a floating IP (external) address before it can communicate with external networks, or be reached by external users. Because there are a limited number of external addresses in your external subnets, it is recommended that you disassociate any unused addresses.
Edit Instance	Update the instance's name and associated security groups.

Action	Description
Edit Security Groups	Add and remove security groups to or from this instance using the list of available security groups (for more information on configuring groups, see Project Security Management in the <i>Users and Identity Management Guide</i>).
Console	View the instance's console in the browser (allows easy access to the instance).
View Log	View the most recent section of the instance's console log. Once opened, you can view the full log by clicking View Full Log.
Pause/Resume Instance	Immediately pause the instance (you are not asked for confirmation); the state of the instance is stored in memory (RAM).
Suspend/Resume Instance	Immediately suspend the instance (you are not asked for confirmation); like hibernation, the state of the instance is kept on disk.
Resize Instance	Bring up the Resize Instance window (see Section 3.1.4, "Resizing an instance").
Soft Reboot	Gracefully stop and restart the instance. A soft reboot attempts to gracefully shut down all processes before restarting the instance.
Hard Reboot	Stop and restart the instance. A hard reboot effectively just shuts down the instance's power and then turns it back on.
Shut Off Instance	Gracefully stop the instance.
Rebuild Instance	Use new image and disk-partition options to rebuild the image (shut down, re-image, and re-boot the instance). If encountering operating system issues, this option is easier to try than terminating the instance and starting over.
Terminate Instance	Permanently destroy the instance (you are asked for confirmation).

You can create and allocate an external IP address, see [Section 3.3.3, "Creating, assigning, and releasing floating IP addresses"](#)

3.1.4. Resizing an instance

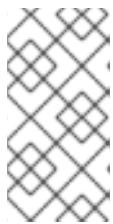
To resize an instance (memory or CPU count), you must select a new flavor for the instance that has the correct capacity. Before you increase the size of an instance, ensure that there is at least one compute node with the requested capacity (based on the new flavor).

1. Ensure communication between hosts by setting up each host with SSH key authentication so that Compute can use SSH to move disks to other hosts (for example, compute nodes can share the same SSH key).

For more information about setting up SSH key authentication, see [Configure SSH Tunneling Between Nodes](#) in the *Migrating Instances* guide.

2. Enable resizing on the original host by setting the following parameter in the `/etc/nova/nova.conf` file:

```
[DEFAULT] allow_resize_to_same_host = True
```



NOTE

The `allow_resize_to_same_host` parameter does not resize the instance on the same host. Even if the parameter equals true on all compute nodes, the scheduler does not force the instance to resize on the same host. This is the expected behavior.

3. In the dashboard, select **Project > Compute > Instances**
4. Click the instance's **Actions** arrow, and select **Resize Instance**.
5. Select a new flavor in the **New Flavor** field.
6. If you want to manually partition the instance when it launches (results in a faster build time):
 - a. Select **Advanced Options**.
 - b. In the **Disk Partition** field, select **Manual**.
7. Click **Resize**.

3.1.5. Connecting to an instance

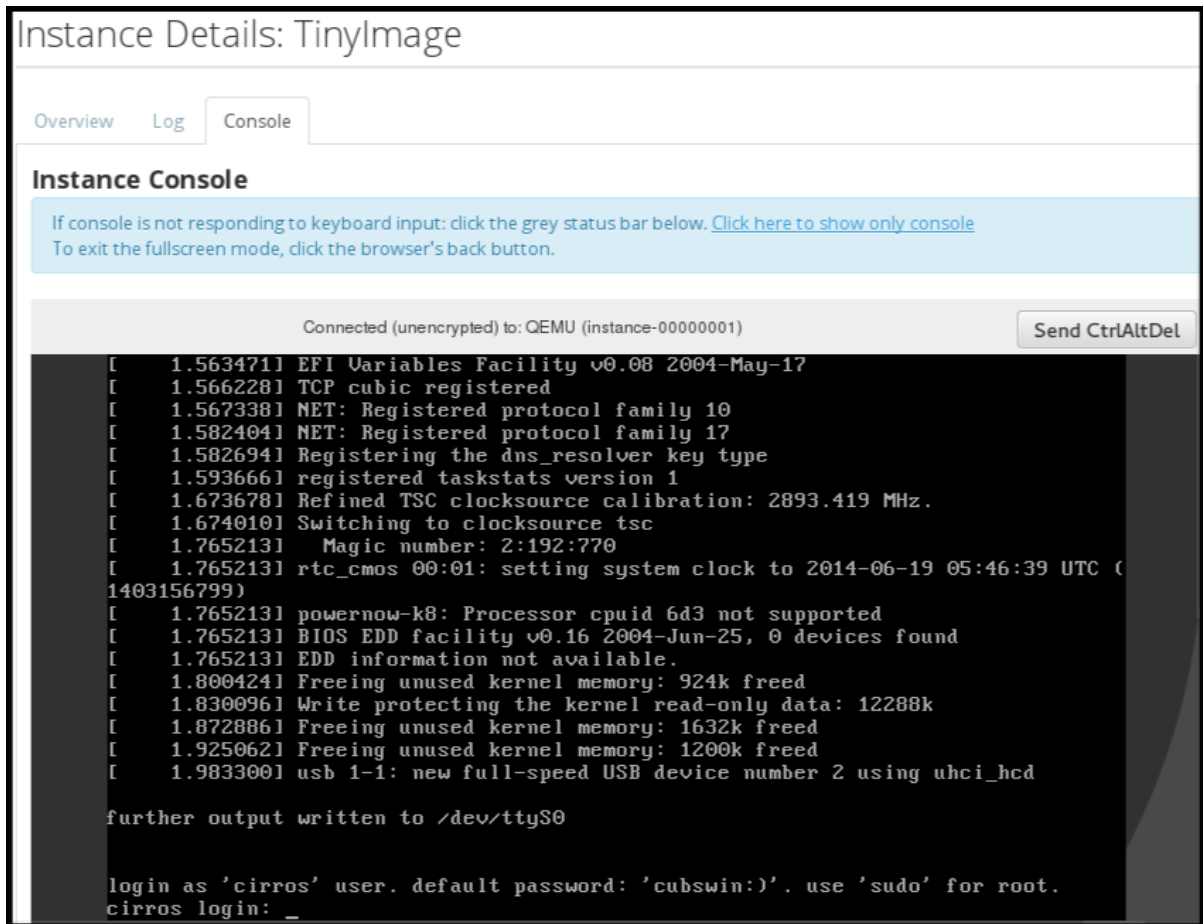
This section discusses the different methods you can use to access an instance console using the dashboard or the command-line interface. You can also directly connect to an instance's serial port allowing you to debug even if the network connection fails.

3.1.5.1. Accessing an instance console using the dashboard

The console allows you a way to directly access your instance within the dashboard.

1. In the dashboard, select **Compute > Instances**

- Click the instance's **More** button and select **Console**.



- Log in using the image's user name and password (for example, a CirrOS image uses *cirros/cubswin:)*).

3.1.5.2. Connecting directly to a VNC console

You can directly access an instance's VNC console using a URL returned by **nova get-vnc-console** command.

Browser

To obtain a browser URL, use:

```
$ nova get-vnc-console INSTANCE_ID novnc
```

Java Client

To obtain a Java-client URL, use:

```
$ nova get-vnc-console INSTANCE_ID xvpvnc
```

**NOTE**

nova-xvpngviewer provides a simple example of a Java client. To download the client, use:

```
# git clone https://github.com/cloudbuilders/nova-xvpngviewer
# cd nova-xvpngviewer/viewer
# make
```

Run the viewer with the instance's Java-client URL:

```
# java -jar VncViewer.jar URL
```

This tool is provided only for customer convenience, and is not officially supported by Red Hat.

3.1.5.3. Connecting directly to a serial console

You can directly access an instance's serial port using a websocket client. Serial connections are typically used as a debugging tool (for example, instances can be accessed even if the network configuration fails). To obtain a serial URL for a running instance, use:

```
$ nova get-serial-console INSTANCE_ID
```

**NOTE**

novaconsole provides a simple example of a websocket client. To download the client, use:

```
# git clone https://github.com/larsks/novaconsole/
# cd novaconsole
```

Run the client with the instance's serial URL:

```
# python console-client-poll.py
```

This tool is provided only for customer convenience, and is not officially supported by Red Hat.

However, depending on your installation, the administrator may need to first set up the nova-serialproxy service. The proxy service is a websocket proxy that allows connections to OpenStack Compute serial ports.

3.1.5.3.1. Installing and configuring nova-serialproxy

1. Install the **nova-serialproxy** service:

```
# yum install openstack-nova-serialproxy
```

2. Update the **serial_console** section in **/etc/nova/nova.conf**:

- a. Enable the **nova-serialproxy** service:

-

```
$ openstack-config --set /etc/nova/nova.conf serial_console enabled true
```

- b. Specify the string used to generate URLs provided by the **nova get-serial-console** command.

```
$ openstack-config --set /etc/nova/nova.conf serial_console base_url
ws://PUBLIC_IP:6083/
```

Where **PUBLIC_IP** is the public IP address of the host running the **nova-serialproxy** service.

- c. Specify the IP address on which the instance serial console should listen (string).

```
$ openstack-config --set /etc/nova/nova.conf serial_console listen 0.0.0.0
```

- d. Specify the address to which proxy clients should connect (string).

```
$ openstack-config --set /etc/nova/nova.conf serial_console proxyclient_address
ws://HOST_IP:6083/
```

Where **HOST_IP** is the IP address of your Compute host. For example, an enabled **nova-serialproxy** service is as following:

```
[serial_console]
enabled=true
base_url=ws://192.0.2.0:6083/
listen=0.0.0.0
proxyclient_address=192.0.2.3
```

3. Restart Compute services:

```
# openstack-service restart nova
```

4. Start the **nova-serialproxy** service:

```
# systemctl enable openstack-nova-serialproxy
# systemctl start openstack-nova-serialproxy
```

5. Restart any running instances, to ensure that they are now listening on the right sockets.

6. Open the firewall for serial-console port connections. Serial ports are set using **[serial_console]** **port_range** in **/etc/nova/nova.conf**; by default, the range is 10000:20000. Update iptables with:

```
# iptables -I INPUT 1 -p tcp --dport 10000:20000 -j ACCEPT
```

3.1.6. Viewing instance usage

The following usage statistics are available:

- Per Project
To view instance usage per project, select **Project > Compute > Overview**. A usage summary is immediately displayed for all project instances.

You can also view statistics for a specific period of time by specifying the date range and clicking **Submit**.

- Per Hypervisor

If logged in as an administrator, you can also view information for all projects. Click **Admin > System** and select one of the tabs. For example, the **Resource Usage** tab offers a way to view reports for a distinct time period. You might also click **Hypervisors** to view your current vCPU, memory, or disk statistics.

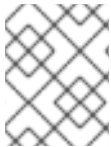


NOTE

The **vCPU Usage** value (**x of y**) reflects the number of total vCPUs of all virtual machines (x) and the total number of hypervisor cores (y).

3.1.7. Deleting an instance

1. In the dashboard, select **Project > Compute > Instances** and select your instance.
2. Click **Terminate Instance**.



NOTE

Deleting an instance does not delete its attached volumes; you must do this separately (see [Delete a Volume](#) in the *Storage Guide*).

3.1.8. Managing multiple instances simultaneously

If you need to start multiple instances at the same time (for example, those that were down for compute or controller maintenance) you can do so easily at **Project > Compute > Instances**

1. Click the check boxes in the first column for the instances that you want to start. If you want to select all of the instances, click the check box in the first row in the table.
2. Click **More Actions** above the table and select **Start Instances**.

Similarly, you can shut off or soft reboot multiple instances by selecting the respective actions.

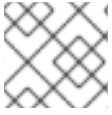
3.2. CUSTOMIZING AN INSTANCE USING CLOUD-INIT

The **cloud-init** package uses the **user data** file from the metadata service to perform an action based on the metadata. For example, you can configure the virtual machine image to create instances on boot. The **cloud-init** package also provides other functionality, such as copying a public key to an account. The process changes based on the format of the information in the **user data** file.

cloud-init supports different input formats for the **user data** file. The most commonly used are shell scripts beginning with **#!** and cloud configuration files beginning with **#cloud-config**. The **cloud-config** files use special scripts that **cloud-init** runs at first boot of a server.

You can pass information in a local file or a shell script using the **user-data** configuration file.

The following section describes the procedure to create a virtual machine in Red Hat OpenStack Platform using a script at the first boot with the **user data** file. This allows you to automate the configuration of virtual machine instances. For example, installing packages, starting certain services or managing an instance using the **puppet** service.

**NOTE**

Make sure you install the **cloud-init** package and that the service is running on the image.

This section includes an example script that you can use with **cloud-init** to create instances using the command line.

Example

The following example uses the contents of the **user_data.file** to launch an instance using a **cirros** image:

```
# nova boot --image cirros --key-name key-osp10 --flavor m1.small \
--availability-zone internal --
user-data user_data.file "Test instance"
```

A sample **user_data.file** contents are as follows:

```
#!/bin/bash
# Example script to run at first boot via OpenStack
# using the user_data and cloud-init.
KEY="key-osp10.pem"
BOOTIMG="d79afca0-ecae-4015-9255-8606bf86a3ec"
ZONE="internal"
FLAVOR="m1.small"

source ~/keystonerc_admin

for RUN in {1..2}; do
  echo "Creating VM ${RUN}""
  VMUUID=$(nova boot \
    --image "${BOOTIMG}" \
    --flavor "${FLAVOR}" \
    --availability-zone "${ZONE}" \
    --nic net-id=00000000-0000-0000-0000-000000000000 \
    --key-name "${KEY}" \
    --user-data user_data.file \
    "VPS-${RUN}-${ZONE}" | awk '/id/ {print $4}' | head -n 1);

  until [[ "$(nova show ${VMUUID}) | awk '/status/ {print $4}'" == "ACTIVE" ]]; do
    :
  done

  echo "VM ${RUN} (${VMUUID}) is active."
done
```

3.2.1. Example user-data files

The following section provides examples of common **user-data** files that you can use with the **cloud-init** package.

3.2.1.1. Example user-data file to manage users and groups

To define new users on a server, use the **users** option as follows:


```
#cloud-config
users:
- name: first_user_name
  groups: first_user_group
  passwd: first_user_password
  ...
  ...
- name: second_user_name
  groups: second_user_group
  passwd: second_user_password
  ...
  ...
```

Each new user begins with a dash. Each user defines parameters in key–value pairs.

To define groups, use the **groups** directive:

```
#cloud-config
groups:
- group1
- group2: [user1, user2]
```

This directive lists a group of users you can create. You can add a sub-list of the users you want to add to a group.

Example

The following example creates two groups - **rhel** and **cloud-users**. The **rhel** group includes the **root** and **sys** users.

```
#cloud-config
groups:
- rhel: [root,sys]
- cloud-users
```

3.2.1.2. Example user-data file to configure SSH keys for user accounts

To configure SSH keys, use the **users** directive or specify the keys in the **ssh_authorized_keys** section of your cloud config file as shown in the following example. The general format is as follows:

```
#cloud-config
ssh_authorized_keys:
- ssh_key_1
- ssh_key_2
```

You can also generate SSH keys by using the **ssh_keys** parameter and place them on the file system. Using the **ssh_keys** parameter allows the client machine to trust a server as soon as it comes online. The **ssh_keys** parameter accepts the key pairs for Rivest–Shamir–Adleman (RSA), Digital Signature Algorithm (DSA), or Elliptic Curve Digital Signature Algorithm (ECDSA) keys using the **rsa_private**, **rsa_public**, **dsa_private**, **dsa_public**, **ecdsa_private**, and **ecdsa_public** sub-items. For example:

```
#cloud-config
ssh_authorized_keys:
- ssh-rsa your_example_key1
```

```

- ssh-rsa your_example_key2

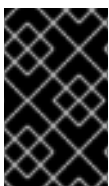
ssh_keys:
  rsa_private: |
    -----BEGIN RSA PRIVATE KEY-----
    your_rsa_private_key
    -----END RSA PRIVATE KEY-----

  rsa_public: your_rsa_public_key

  dsa_private: |
    -----BEGIN DSA PRIVATE KEY-----
    your_dsa_private_key
    -----END DSA PRIVATE KEY-----

  dsa_public: your_dsa_public_key

```



IMPORTANT

Formatting and line breaks are important in a private key. Make sure to use a block with a pipe key when specifying the values. You **must** include the **BEGIN** and **END** key lines for the keys to be valid.

For more examples on using Cloud config, see [Cloud config examples](#).

3.3. MANAGING INSTANCE SECURITY

You can manage access to an instance by assigning it the correct security group (set of firewall rules) and key pair (enables SSH user access). Further, you can assign a floating IP address to an instance to enable external network access. The sections below outline how to create and manage key pairs, security groups, floating IP addresses and logging in to an instance using SSH. There is also a procedure for injecting an **admin** password into an instance.

For information on managing security groups, see [Project Security Management](#) in the *Users and Identity Management Guide*.

3.3.1. Managing key pairs

Key pairs provide SSH access to the instances. Each time a key pair is generated, its certificate is downloaded to the local machine and can be distributed to users. Typically, one key pair is created for each project (and used for multiple instances).

You can also import an existing key pair into OpenStack.

3.3.1.1. Creating a key pair

1. In the dashboard, select **Project > Compute > Access & Security**
2. On the **Key Pairs** tab, click **Create Key Pair**.
3. Specify a name in the **Key Pair Name** field, and click **Create Key Pair**.

When the key pair is created, a key pair file is automatically downloaded through the browser. Save this file for later connections from external machines. For command-line SSH connections, you can load this file into SSH by executing:

```
# ssh-add ~/.ssh/os-key.pem
```

3.3.1.2. Importing a key pair

1. In the dashboard, select **Project > Compute > Access & Security**
2. On the **Key Pairs** tab, click **Import Key Pair**.
3. Specify a name in the **Key Pair Name** field, and copy and paste the contents of your public key into the **Public Key** field.
4. Click **Import Key Pair**.

3.3.1.3. Deleting a key pair

1. In the dashboard, select **Project > Compute > Access & Security**
2. On the **Key Pairs** tab, click the key's **Delete Key Pair** button.

3.3.2. Creating a security group

Security groups are sets of IP filter rules that can be assigned to project instances, and which define networking access to the instance. Security groups are project specific; project members can edit the default rules for their security group and add new rule sets.

1. In the dashboard, select the **Project** tab, and click **Compute > Access & Security**
2. On the **Security Groups** tab, click **+ Create Security Group**.
3. Provide a name and description for the group, and click **Create Security Group**.

For more information on managing project security, see [Project Security Management](#) in the *Users and Identity Management Guide*.

3.3.3. Creating, assigning, and releasing floating IP addresses

By default, an instance is given an internal IP address when it is first created. However, you can enable access through the public network by creating and assigning a floating IP address (external address). You can change an instance's associated IP address regardless of the instance's state.

Projects have a limited range of floating IP address that can be used (by default, the limit is 50), so you should release these addresses for reuse when they are no longer needed. Floating IP addresses can only be allocated from an existing floating IP pool, see [Create Floating IP Pools](#) in the *Networking Guide*.

3.3.3.1. Allocating a floating IP to the project

1. In the dashboard, select **Project > Compute > Access & Security**
2. On the **Floating IPs** tab, click **Allocate IP to Project**
3. Select a network from which to allocate the IP address in the **Pool** field.

4. Click **Allocate IP**.

3.3.3.2. Assigning a floating IP

1. In the dashboard, select **Project > Compute > Access & Security**
2. On the **Floating IPs** tab, click the address' **Associate** button.
3. Select the address to be assigned in the IP address field.



NOTE

If no addresses are available, you can click the **+** button to create a new address.

4. Select the instance to be associated in the **Port to be Associated** field. An instance can only be associated with one floating IP address.
5. Click **Associate**.

3.3.3.3. Releasing a floating IP

1. In the dashboard, select **Project > Compute > Access & Security**
2. On the **Floating IPs** tab, click the address' menu arrow (next to the **Associate/Disassociate** button).
3. Select **Release Floating IP**.

3.3.4. Logging in to an instance

Prerequisites:

- Ensure that the instance's security group has an SSH rule (see [Project Security Management](#) in the *Users and Identity Management Guide*).
- Ensure the instance has a floating IP address (external address) assigned to it (see [Section 3.3.3, "Creating, assigning, and releasing floating IP addresses"](#)).
- Obtain the instance's key-pair certificate. The certificate is downloaded when the key pair is created; if you did not create the key pair yourself, ask your administrator (see [Section 3.3.1, "Managing key pairs"](#)).

To first load the key pair file into SSH, and then use ssh without naming it

1. Change the permissions of the generated key-pair certificate.

```
$ chmod 600 os-key.pem
```

2. Check whether **ssh-agent** is already running:

```
# ps -ef | grep ssh-agent
```

3. If not already running, start it up with:

```
# eval `ssh-agent`
```

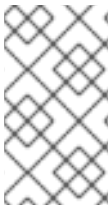
4. On your local machine, load the key-pair certificate into SSH. For example:

```
$ ssh-add ~/.ssh/os-key.pem
```

5. You can now SSH into the file with the user supplied by the image.

The following example command shows how to SSH into the Red Hat Enterprise Linux guest image with the user **cloud-user**:

```
$ ssh cloud-user@192.0.2.24
```



NOTE

You can also use the certificate directly. For example:

```
$ ssh -i /myDir/os-key.pem cloud-user@192.0.2.24
```

3.3.5. Injecting an admin password into an instance

You can inject an **admin (root)** password into an instance using the following procedure.

1. In the **/etc/openstack-dashboard/local_settings** file, set the **change_set_password** parameter value to **True**.

```
can_set_password: True
```

2. In the **/etc/nova/nova.conf** file, set the **inject_password** parameter to **True**.

```
inject_password=true
```

3. Restart the Compute service.

```
# service nova-compute restart
```

When you use the **nova boot** command to launch a new instance, the output of the command displays an **adminPass** parameter. You can use this password to log into the instance as the **root** user.

The Compute service overwrites the password value in the **/etc/shadow** file for the **root** user. This procedure can also be used to activate the **root** account for the KVM guest images. For more information on how to use KVM guest images, see [Section 1.2.1.1, "Using a KVM guest image with Red Hat OpenStack Platform"](#)

You can also set a custom password from the dashboard. To enable this, run the following command after you have set **can_set_password** parameter to **true**.

```
# systemctl restart httpd.service
```

The newly added **admin** password fields are as follows:

Launch Instance ✕

Project & User *
Details *
Access & Security
Networking *
Post-Creation

[Advanced Options](#)

Key Pair ⓘ

▼
+

Admin Password

👁

Confirm Admin Password

👁

Security Groups ⓘ

default

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

Cancel
Launch

These fields can be used when you launch or rebuild an instance.

3.4. MANAGING FLAVORS

Each created instance is given a flavor (resource template), which determines the instance's size and capacity. Flavors can also specify secondary ephemeral storage, swap disk, metadata to restrict usage, or special project access (none of the default flavors have these additional attributes defined).

Table 3.3. Default Flavors

Name	vCPUs	RAM	Root Disk Size
m1.tiny	1	512 MB	1 GB
m1.small	1	2048 MB	20 GB
m1.medium	2	4096 MB	40 GB
m1.large	4	8192 MB	80 GB
m1.xlarge	8	16384 MB	160 GB

The majority of end users will be able to use the default flavors. However, you can create and manage specialized flavors. For example, you can:

- Change default memory and capacity to suit the underlying hardware needs.
- Add metadata to force a specific I/O rate for the instance or to match a host aggregate.



NOTE

Behavior set using image properties overrides behavior set using flavors (for more information, see [Section 1.2, “Managing images”](#)).

3.4.1. Updating configuration permissions

By default, only administrators can create flavors or view the complete flavor list (select Admin > System > Flavors). To allow all users to configure flavors, specify the following in the `/etc/nova/policy.json` file (nova-api server):

```
"compute_extension:flavormanage": ""
```

3.4.2. Creating a flavor

1. As an admin user in the dashboard, select **Admin > System > Flavors**
2. Click **Create Flavor**, and specify the following fields:

Table 3.4. Flavor Options

Tab	Field	Description
Flavor Information	Name	Unique name.
	ID	Unique ID. The default value, auto , generates a UUID4 value, but you can also manually specify an integer or UUID4 value.
	VCPUs	Number of virtual CPUs.
	RAM (MB)	Memory (in megabytes).
	Root Disk (GB)	Ephemeral disk size (in gigabytes); to use the native image size, specify 0 . This disk is not used if Instance Boot Source=Boot from Volume .
	Ephemeral Disk (GB)	Secondary ephemeral disk size (in gigabytes) available to an instance. This disk is destroyed when an instance is deleted. The default value is 0 , which implies that no ephemeral disk is created.

Tab	Field	Description
	Swap Disk (MB)	Swap disk size (in megabytes).
Flavor Access	Selected Projects	Projects which can use the flavor. If no projects are selected, all projects have access (Public=Yes).

3. Click Create Flavor.

3.4.3. Updating general attributes

1. As an admin user in the dashboard, select **Admin > System > Flavors**
2. Click the flavor's **Edit Flavor** button.
3. Update the values, and click **Save**.

3.4.4. Updating flavor metadata

In addition to editing general attributes, you can add metadata to a flavor (**extra_specs**), which can help fine-tune instance usage. For example, you might want to set the maximum-allowed bandwidth or disk writes.

- Pre-defined keys determine hardware support or quotas. Pre-defined keys are limited by the hypervisor you are using (for libvirt, see [Table 3.5, "Libvirt Metadata"](#)).
- Both pre-defined and user-defined keys can determine instance scheduling. For example, you might specify **SpecialComp=True**; any instance with this flavor can then only run in a host aggregate with the same key-value combination in its metadata (see [Section 3.5, "Managing host aggregates"](#)).

3.4.4.1. Viewing metadata

1. As an admin user in the dashboard, select **Admin > System > Flavors**
2. Click the flavor's **Metadata** link (**Yes** or **No**). All current values are listed on the right-hand side under **Existing Metadata**.

3.4.4.2. Adding metadata

You specify a flavor's metadata using a **key/value** pair.

1. As an admin user in the dashboard, select **Admin > System > Flavors**
2. Click the flavor's **Metadata** link (**Yes** or **No**). All current values are listed on the right-hand side under **Existing Metadata**.
3. Under **Available Metadata**, click on the **Other** field, and specify the key you want to add (see [Table 3.5, "Libvirt Metadata"](#)).
4. Click the + button; you can now view the new key under **Existing Metadata**.

5. Fill in the key's value in its right-hand field.


The screenshot shows a window titled "Existing Metadata" with a search filter box. Below the filter, there are two rows of metadata entries. Each entry consists of a key, a value, and a minus sign in a small box on the right.

Key	Value	Minus Sign
quota:cpu_shares	200	-
quota:disk_read_byte...	10240000	-

6. When finished with adding key-value pairs, click **Save**.

Table 3.5. Libvirt Metadata

Key	Description
hw:action	<p>Action that configures support limits per instance. Valid actions are:</p> <ul style="list-style-type: none"> ● cpu_max_sockets - Maximum supported CPU sockets. ● cpu_max_cores - Maximum supported CPU cores. ● cpu_max_threads - Maximum supported CPU threads. ● cpu_sockets - Preferred number of CPU sockets. ● cpu_cores - Preferred number of CPU cores. ● cpu_threads - Preferred number of CPU threads. ● serial_port_count - Maximum serial ports per instance. <p>Example: hw:cpu_max_sockets=2</p>

Key	Description
hw:NUMA_def	<p>Definition of NUMA topology for the instance. For flavors whose RAM and vCPU allocations are larger than the size of NUMA nodes in the compute hosts, defining NUMA topology enables hosts to better utilize NUMA and improve performance of the guest OS. NUMA definitions defined through the flavor override image definitions. Valid definitions are:</p> <ul style="list-style-type: none"> ● numa_nodes - Number of NUMA nodes to expose to the instance. Specify '1' to ensure image NUMA settings are overridden. ● numa_mempolicy - Memory allocation policy. Valid policies are: <ul style="list-style-type: none"> ○ strict - Mandatory for the instance's RAM allocations to come from the NUMA nodes to which it is bound (default if numa_nodes is specified). ○ preferred - The kernel can fall back to using an alternative node. Useful when the <code>numa_nodes</code> is set to '1'. ● numa_cpus.0 - Mapping of vCPUs N-M to NUMA node 0 (comma-separated list). ● numa_cpus.1 - Mapping of vCPUs N-M to NUMA node 1 (comma-separated list). ● numa_mem.0 - Mapping N MB of RAM to NUMA node 0. ● numa_mem.1 - Mapping N MB of RAM to NUMA node 1. ● numa_cpu.N and numa_mem.N are only valid if numa_nodes is set. Additionally, they are only required if the instance's NUMA nodes have an asymmetrical allocation of CPUs and RAM (important for some NFV workloads). <p> NOTE</p> <p>If the values of numa_cpu or numa_mem.N specify more than that available, an exception is raised.</p> <p>Example when the instance has 8 vCPUs and 4GB RAM:</p> <ul style="list-style-type: none"> ● hw:numa_nodes=2 ● hw:numa_cpus.0=0,1,2,3,4,5 ● hw:numa_cpus.1=6,7 ● hw:numa_mem.0=3072 ● hw:numa_mem.1=1024 <p>The scheduler looks for a host with 2 NUMA nodes with the ability to run 6 CPUs + 3072 MB, or 3 GB, of RAM on one node, and 2 CPUs + 1024 MB, or 1 GB, of RAM on another node. If a host has a single NUMA node with capability to run 8 CPUs and 4 GB of RAM, it will not be considered a valid match. The same logic is applied in the scheduler regardless of the numa_mempolicy setting.</p>

Key	Description
hw:watchdog_action	<p>An instance watchdog device can be used to trigger an action if the instance somehow fails (or hangs). Valid actions are:</p> <ul style="list-style-type: none"> ● disabled - The device is not attached (default value). ● pause - Pause the instance. ● poweroff - Forcefully shut down the instance. ● reset - Forcefully reset the instance. ● none - Enable the watchdog, but do nothing if the instance fails. <p>Example: hw:watchdog_action=poweroff</p>
hw_rng:action	<p>A random-number generator device can be added to an instance using its image properties (see hw_rng_model in the "Command-Line Interface Reference" in Red Hat OpenStack Platform documentation).</p> <p>If the device has been added, valid actions are:</p> <ul style="list-style-type: none"> ● allowed - If True, the device is enabled; if False, disabled. By default, the device is disabled. ● rate_bytes - Maximum number of bytes the instance's kernel can read from the host to fill its entropy pool every <code>rate_period</code> (integer). ● rate_period - Duration of the read period in seconds (integer). <p>Example: hw_rng:allowed=True.</p>
hw_video:ram_max_mb	<p>Maximum permitted RAM to be allowed for video devices (in MB).</p> <p>Example: hw:ram_max_mb=64</p>
quota:option	<p>Enforcing limit for the instance. Valid options are:</p> <ul style="list-style-type: none"> ● cpu_period - Time period for enforcing cpu_quota (in microseconds). Within the specified cpu_period, each vCPU cannot consume more than cpu_quota of runtime. The value must be in range [1000, 1000000]; '0' means 'no value'. ● cpu_quota - Maximum allowed bandwidth (in microseconds) for the vCPU in each `cpu_period. The value must be in range [1000, 18446744073709551]. '0' means 'no value'; a negative value means that the vCPU is not controlled. cpu_quota and cpu_period can be used to ensure that all vCPUs run at the same speed. ● cpu_shares - Share of CPU time for the domain. The value only has meaning when weighted against other machine values in the same domain. That is, an instance with a flavor with '200' will get twice as much machine time as an instance with '100'. ● disk_read_bytes_sec - Maximum disk reads in bytes per second. ● disk_read_iops_sec - Maximum read I/O operations per second.

Key	Description
	<ul style="list-style-type: none"> ● disk_write_bytes_sec - Maximum disk writes in bytes per second. ● disk_write_iops_sec - Maximum write I/O operations per second. ● disk_total_bytes_sec - Maximum total throughput limit in bytes per second. ● disk_total_iops_sec - Maximum total I/O operations per second. ● vif_inbound_average - Desired average of incoming traffic. ● vif_inbound_burst - Maximum amount of traffic that can be received at vif_inbound_peak speed. ● vif_inbound_peak - Maximum rate at which incoming traffic can be received. ● vif_outbound_average - Desired average of outgoing traffic. ● vif_outbound_burst - Maximum amount of traffic that can be sent at vif_outbound_peak speed. ● vif_outbound_peak - Maximum rate at which outgoing traffic can be sent. <p>Example: quota:vif_inbound_average=10240</p> <p>In addition, the VMware driver supports the following quota options, which control upper and lower limits for CPUs, RAM, disks, and networks, as well as <i>shares</i>, which can be used to control relative allocation of available resources among tenants:</p> <ul style="list-style-type: none"> ● cpu_limit - Maximum CPU frequency available to a virtual machine (in MHz). ● cpu_reservation - Guaranteed minimum amount of CPU resources available to a virtual machine (in MHz). ● cpu_shares_level - CPU allocation level (shares) in the case of contention. Possible values are high, normal, low, and custom. ● cpu_shares_share - The number of allocated CPU shares. Applicable when cpu_shares_level is set to custom. ● memory_limit - Maximum amount of RAM available to a virtual machine (in MB). ● memory_reservation - Guaranteed minimum amount of RAM available to a virtual machine (in MB). ● memory_shares_level - RAM allocation level (shares) in the case of contention. Possible values are high, normal, low, and custom. ● memory_shares_share - The number of allocated RAM shares. Applicable when memory_shares_level is set to custom. ● disk_io_limit - Maximum I/O utilization by a virtual machine (in I/O operations per second). ● disk_io_reservation - Guaranteed minimum amount of disk resources available to a virtual machine (in I/O operations per second). ● disk_io_shares_level - I/O allocation level (shares) in the case of contention. Possible values are high, normal, low, and custom.

Key	Description
	<ul style="list-style-type: none"> ● disk_io_shares_share - The number of allocated I/O shares. Applicable when disk_io_shares_level is set to custom. ● vif_limit - Maximum network bandwidth available to a virtual network adapter (in Mbps). ● vif_reservation - Guaranteed minimum network bandwidth available to a virtual network adapter (in Mbps). ● vif_shares_level - Network bandwidth allocation level (shares) in the case of contention. Possible values are high, normal, low, and custom. ● vif_shares_share - The number of allocated network bandwidth shares. Applicable when vif_shares_level is set to custom.

3.5. MANAGING HOST AGGREGATES

A single Compute deployment can be partitioned into logical groups for performance or administrative purposes. OpenStack uses the following terms:

- *Host aggregates* - A host aggregate creates logical units in a OpenStack deployment by grouping together hosts. Aggregates are assigned Compute hosts and associated metadata; a host can be in more than one host aggregate. Only administrators can see or create host aggregates.

An aggregate's metadata is commonly used to provide information for use with the Compute scheduler (for example, limiting specific flavors or images to a subset of hosts). Metadata specified in a host aggregate will limit the use of that host to any instance that has the same metadata specified in its flavor.

Administrators can use host aggregates to handle load balancing, enforce physical isolation (or redundancy), group servers with common attributes, or separate out classes of hardware. When you create an aggregate, a zone name must be specified, and it is this name which is presented to the end user.

- *Availability zones* - An availability zone is the end-user view of a host aggregate. An end user cannot view which hosts make up the zone, nor see the zone's metadata; the user can only see the zone's name.

End users can be directed to use specific zones which have been configured with certain capabilities or within certain areas.

3.5.1. Enabling host aggregate scheduling

By default, host-aggregate metadata is not used to filter instance usage. You must update the Compute scheduler's configuration to enable metadata usage:

1. Edit the **/etc/nova/nova.conf** file (you must have either root or nova user permissions).
2. Ensure that the **scheduler_default_filters** parameter contains:
 - **AggregateInstanceExtraSpecsFilter** for host aggregate metadata. For example:

```
scheduler_default_filters=AggregateInstanceExtraSpecsFilter,RetryFilter,RamFilter,ComputeFilter,ComputeCapabilitiesFilter,ImagePropertiesFilter,CoreFilter
```



NOTE

Scoped specifications must be used for setting flavor **extra_specs** when specifying both **AggregateInstanceExtraSpecsFilter** and **ComputeCapabilitiesFilter** filters as values of the same **scheduler_default_filters** parameter, otherwise the **ComputeCapabilitiesFilter** will fail to select a suitable host. See [Table 3.7, “Scheduling Filters”](#) for further details.

- **AvailabilityZoneFilter** for availability zone host specification when launching an instance. For example:

```
scheduler_default_filters=AvailabilityZoneFilter,RetryFilter,RamFilter,ComputeFilter,ComputeCapabilitiesFilter,ImagePropertiesFilter,CoreFilter
```

3. Save the configuration file.

3.5.2. Viewing availability zones or host aggregates

As an admin user in the dashboard, select **Admin > System > Host Aggregates**. All currently defined aggregates are listed in the **Host Aggregates** section; all zones are in the **Availability Zones** section.

3.5.3. Adding a host aggregate

1. As an admin user in the dashboard, select **Admin > System > Host Aggregates**. All currently defined aggregates are listed in the **Host Aggregates** section.
2. Click **Create Host Aggregate**.
3. Add a name for the aggregate in the **Name** field, and a name by which the end user should see it in the **Availability Zone** field.
4. Click **Manage Hosts within Aggregate**.
5. Select a host for use by clicking its + icon.
6. Click **Create Host Aggregate**.

3.5.4. Updating a host aggregate

1. As an admin user in the dashboard, select **Admin > System > Host Aggregates**. All currently defined aggregates are listed in the **Host Aggregates** section.
2. To update the instance's **Name** or **Availability zone**:
 - Click the aggregate's **Edit Host Aggregate** button.
 - Update the **Name** or **Availability Zone** field, and click **Save**.
3. To update the instance's **Assigned hosts**:
 - Click the aggregate's arrow icon under **Actions**.
 - Click **Manage Hosts**.

- Change a host's assignment by clicking its + or - icon.
 - When finished, click **Save**.
4. To update the instance's **Metadata**:
- Click the aggregate's arrow icon under **Actions**.
 - Click the **Update Metadata** button. All current values are listed on the right-hand side under **Existing Metadata**.
 - Under **Available Metadata**, click on the **Other** field, and specify the key you want to add. Use predefined keys (see [Table 3.6, "Host Aggregate Metadata"](#)) or add your own (which will only be valid if exactly the same key is set in an instance's flavor).
 - Click the + button; you can now view the new key under **Existing Metadata**.

**NOTE**

Remove a key by clicking its - icon.

- Click **Save**.

Table 3.6. Host Aggregate Metadata

Key	Description
cpu_allocation_ratio	Sets allocation ratio of virtual CPU to physical CPU. Depends on the AggregateCoreFilter filter being set for the Compute scheduler.
disk_allocation_ratio	Sets allocation ratio of Virtual disk to physical disk. Depends on the AggregateDiskFilter filter being set for the Compute scheduler.
filter_tenant_id	If specified, the aggregate only hosts this tenant (project). Depends on the AggregateMultiTenancyIsolation filter being set for the Compute scheduler.
ram_allocation_ratio	Sets allocation ratio of virtual RAM to physical RAM. Depends on the AggregateRamFilter filter being set for the Compute scheduler.

3.5.5. Deleting a host aggregate

1. As an admin user in the dashboard, select **Admin > System > Host Aggregates** All currently defined aggregates are listed in the **Host Aggregates** section.
2. Remove all assigned hosts from the aggregate:
 - a. Click the aggregate's arrow icon under **Actions**.
 - b. Click **Manage Hosts**.
 - c. Remove all hosts by clicking their - icon.
 - d. When finished, click **Save**.

3. Click the aggregate's arrow icon under **Actions**.
4. Click **Delete Host Aggregate** in this and the next dialog screen.

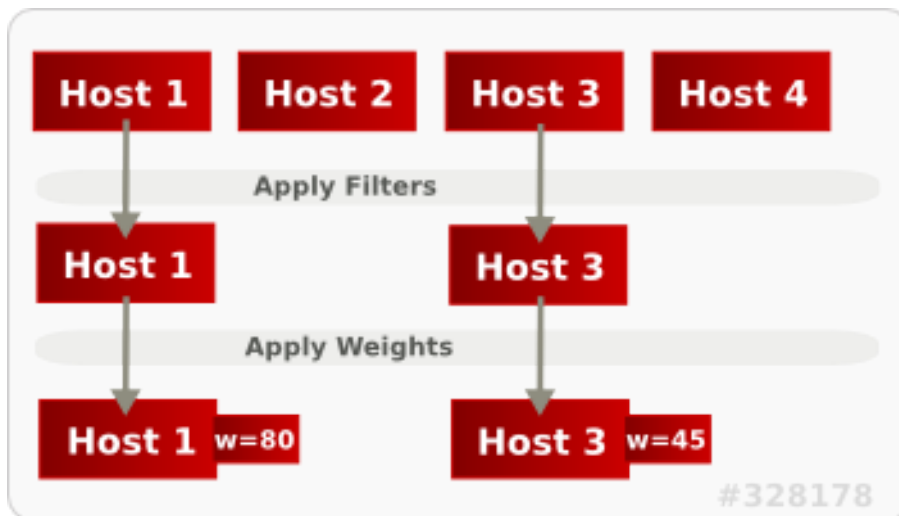
3.6. SCHEDULING HOSTS AND CELLS

The Compute scheduling service determines on which cell or host (or host aggregate), an instance will be placed. As an administrator, you can influence where the scheduler will place an instance. For example, you might want to limit scheduling to hosts in a certain group or with the right RAM.

You can configure the following components:

- Filters - Determine the initial set of hosts on which an instance might be placed (see [Section 3.6.1, "Configuring scheduling filters"](#)).
- Weights - When filtering is complete, the resulting set of hosts are prioritized using the weighting system. The highest weight has the highest priority (see [Section 3.6.2, "Configuring scheduling weights"](#)).
- Scheduler service - There are a number of configuration options in the `/etc/nova/nova.conf` file (on the scheduler host), which determine how the scheduler executes its tasks, and handles weights and filters. There is both a host and a cell scheduler. For a list of these options, see the [Configuration Reference](#) guide.

In the following diagram, both host 1 and 3 are eligible after filtering. Host 1 has the highest weight and therefore has the highest priority for scheduling.



3.6.1. Configuring scheduling filters

You define which filters you would like the scheduler to use in the `scheduler_default_filters` option (`/etc/nova/nova.conf` file; you must have either root or nova user permissions). Filters can be added or removed.

By default, the following filters are configured to run in the scheduler:

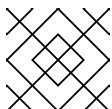
```
scheduler_default_filters=RetryFilter,AvailabilityZoneFilter,RamFilter,ComputeFilter,ComputeCapabilitiesFilter,ImagePropertiesFilter,ServerGroupAntiAffinityFilter,ServerGroupAffinityFilter
```

Some filters use information in parameters passed to the instance in:

- The **nova boot** command, see [Command-Line Interface Reference](#) guide.
- The instance's flavor (see [Section 3.4.4, "Updating flavor metadata"](#))
- The instance's image (see [Appendix A, Image Configuration Parameters](#)).

The following table lists all the available filters.

Table 3.7. Scheduling Filters

Filter	Description
AggregateCoreFilter	Uses the host-aggregate metadata key cpu_allocation_ratio to filter out hosts exceeding the over-commit ratio (virtual CPU to physical CPU allocation ratio); only valid if a host aggregate is specified for the instance.
	If this ratio is not set, the filter uses the cpu_allocation_ratio value in the <code>/etc/nova/nova.conf</code> file. The default value is 16.0 (16 virtual CPU can be allocated per physical CPU).
AggregateDiskFilter	Uses the host-aggregate metadata key disk_allocation_ratio to filter out hosts exceeding the over-commit ratio (virtual disk to physical disk allocation ratio); only valid if a host aggregate is specified for the instance.
	If this ratio is not set, the filter uses the disk_allocation_ratio value in the <code>/etc/nova/nova.conf</code> file. The default value is 1.0 (one virtual disk can be allocated for each physical disk).
AggregateImagePropertiesIsolation	Only passes hosts in host aggregates whose metadata matches the instance's image metadata; only valid if a host aggregate is specified for the instance. For more information, see Section 1.2.1, "Creating an image" .
AggregateInstanceExtraSpecsFilter	Metadata in the host aggregate must match the host's flavor metadata. For more information, see Section 3.4.4, "Updating flavor metadata" . This filter can only be specified in the same scheduler_default_filters parameter as ComputeCapabilitiesFilter when you scope your flavor extra_specs keys by prefixing them with the correct namespace: <ul style="list-style-type: none"> • ComputeCapabilitiesFilter namespace = "capabilities:" • AggregateInstanceExtraSpecsFilter namespace = "aggregate_instance_extra_specs:"
AggregateMultiTenancyIsolation	A host with the specified filter_tenant_id can only contain instances from that tenant (project).  NOTE The tenant can still place instances on other hosts.

Filter	Description
AggregateRamFilter	Uses the host-aggregate metadata key ram_allocation_ratio to filter out hosts exceeding the over commit ratio (virtual RAM to physical RAM allocation ratio); only valid if a host aggregate is specified for the instance.
	If this ratio is not set, the filter uses the ram_allocation_ratio value in the /etc/nova/nova.conf file. The default value is 1.5 (1.5 RAM can be allocated for each physical RAM).
AllHostsFilter	Passes all available hosts (however, does not disable other filters).
AvailabilityZoneFilter	Filters using the instance's specified availability zone.
ComputeCapabilitiesFilter	Ensures Compute metadata is read correctly. Anything before the : is read as a namespace. For example, quota:cpu_period uses quota as the namespace and cpu_period as the key.
ComputeFilter	Passes only hosts that are operational and enabled.
CoreFilter	Uses the cpu_allocation_ratio in the /etc/nova/nova.conf file to filter out hosts exceeding the over commit ratio (virtual CPU to physical CPU allocation ratio). The default value is 16.0 (16 virtual CPU can be allocated per physical CPU).
DifferentHostFilter	Enables an instance to build on a host that is different from one or more specified hosts. Specify different hosts using the nova boot option --different_host option.
DiskFilter	Uses disk_allocation_ratio in the /etc/nova/nova.conf file to filter out hosts exceeding the over commit ratio (virtual disk to physical disk allocation ratio). The default value is 1.0 (one virtual disk can be allocated for each physical disk).
ImagePropertiesFilter	Only passes hosts that match the instance's image properties. For more information, see Section 1.2.1, "Creating an image" .
IsolatedHostsFilter	Passes only isolated hosts running isolated images that are specified in the /etc/nova/nova.conf file using isolated_hosts and isolated_images (comma-separated values).
JsonFilter	Recognises and uses an instance's custom JSON filters: <ul style="list-style-type: none"> Valid operators are: =, <, >, in, €, >=, not, or, and Recognised variables are: \$free_ram_mb, \$free_disk_mb, \$total_usable_ram_mb, \$vcpus_total, \$vcpus_used

Filter	Description
	The filter is specified as a query hint in the nova boot command. For example: --hint query='[>=, '\$free_disk_mb', 200 * 1024]'
MetricFilter	Filters out hosts with unavailable metrics.
NUMATopologyFilter	Filters out hosts based on its NUMA topology; if the instance has no topology defined, any host can be used. The filter tries to match the exact NUMA topology of the instance to those of the host (it does not attempt to pack the instance onto the host). The filter also looks at the standard over-subscription limits for each NUMA node, and provides limits to the compute host accordingly.
RamFilter	Uses ram_allocation_ratio in the /etc/nova/nova.conf file to filter out hosts exceeding the over commit ratio (virtual RAM to physical RAM allocation ratio). The default value is 1.5 (1.5 RAM can be allocated for each physical RAM).
RetryFilter	Filters out hosts that have failed a scheduling attempt; valid if scheduler_max_attempts is greater than zero (by default, scheduler_max_attempts=3).
SameHostFilter	Passes one or more specified hosts; specify hosts for the instance using the --hint same_host option for nova boot .
ServerGroupAffinityFilter	Only passes hosts for a specific server group: <ul style="list-style-type: none"> ● Give the server group the affinity policy (nova server-group-create --policy affinity groupName). ● Build the instance with that group (nova boot option --hint group=UUID)
ServerGroupAntiAffinityFilter	Only passes hosts in a server group that do not already host an instance: <ul style="list-style-type: none"> ● Give the server group the anti-affinity policy (nova server-group-create --policy anti-affinity groupName). ● Build the instance with that group (nova boot option --hint group=UUID).
SimpleCIDRAffinityFilter	Only passes hosts on the specified IP subnet range specified by the instance's cidr and build_new_host_ip hints. Example: --hint build_near_host_ip=192.0.2.0 --hint cidr=/24

3.6.2. Configuring scheduling weights

Both cells and hosts can be weighted for scheduling; the host or cell with the largest weight (after filtering) is selected. All weighers are given a multiplier that is applied after normalising the node's weight. A node's weight is calculated as:

$$w1_multiplier * norm(w1) + w2_multiplier * norm(w2) + \dots$$

You can configure weight options in the scheduler host's `/etc/nova/nova.conf` file (must have either root or nova user permissions).

3.6.2.1. Configure Weight Options for Hosts

You can define the host weighers you would like the scheduler to use in the `[DEFAULT]` `scheduler_weight_classes` option. Valid weighers are:

- **nova.scheduler.weights.ram** - Weighs the host's available RAM.
- **nova.scheduler.weights.metrics** - Weighs the host's metrics.
- **nova.scheduler.weights.affinity** - Weighs the host's proximity to other hosts in the given server group.
- **nova.scheduler.weights.all_weighers** - Uses all host weighers (default).

Table 3.8. Host Weight Options

Weigher	Option	Description
All	<code>[DEFAULT]</code> <code>scheduler_host_subset_size</code>	Defines the subset size from which a host is selected (integer); must be at least 1 . A value of 1 selects the first host returned by the weighing functions. Any value less than 1 is ignored and 1 is used instead (integer value).
affinity	<code>[default]</code> <code>soft_affinity_weight_multiplier</code>	Used for weighing hosts for group soft-affinity. Should be a positive floating-point number, because a negative value results in the opposite behavior, which is normally controlled by <code>soft_anti_affinity_weight_multiplier</code> .
affinity	<code>[default]</code> <code>soft_anti_affinity_weight_multiplier</code>	Used for weighing hosts for group soft-anti-affinity. Should be a positive floating-point number, because a negative value results in the opposite behavior, which is normally controlled by <code>soft_affinity_weight_multiplier</code> .
metrics	<code>[metrics]</code> required	Specifies how to handle metrics in <code>[metrics]</code> <code>weight_setting</code> that are unavailable: <ul style="list-style-type: none"> • True- Metrics are required; if unavailable, an exception is raised. To avoid the exception, use the <code>MetricFilter</code> filter in the <code>scheduler_default_filters</code> option. • False - The unavailable metric is treated as a negative factor in the weighing process; the returned value is set by <code>weight_of_unavailable</code>.

Weigher	Option	Description
metrics	[metrics] weight_of_unavailable	Used as the weight if any metric in [metrics] weight_setting is unavailable; valid if required=False .
metrics	[metrics] weight_multiplier	Multplier used for weighing metrics. By default, weight_multiplier=1.0 and spreads instances across possible hosts. If this value is negative, the host with lower metrics is prioritized, and instances are stacked in hosts.
metrics	[metrics] weight_setting	Specifies metrics and the ratio with which they are weighed; use a comma-separated list of metric=ratio pairs. Valid metric names are: <ul style="list-style-type: none"> ● cpu.frequency - Current CPU frequency ● cpu.user.time - CPU user mode time ● cpu.kernel.time - CPU kernel time ● cpu.idle.time - CPU idle time ● cpu.iowait.time - CPU I/O wait time ● cpu.user.percent - CPU user mode percentage ● cpu.kernel.percent - CPU kernel percentage ● cpu.idle.percent - CPU idle percentage ● cpu.iowait.percent - CPU I/O wait percentage ● cpu.percent - Generic CPU utilization Example: weight_setting=cpu.user.time=1.0
ram	[DEFAULT] ram_weight_multiplier	Multplier for RAM (floating point). By default, ram_weight_multiplier=1.0 and spreads instances across possible hosts. If this value is negative, the host with less RAM is prioritized, and instances are stacked in hosts.

3.6.2.2. Configure Weight Options for Cells

You define which cell weighers you would like the scheduler to use in the [cells] scheduler_weight_classes option (`/etc/nova/nova.conf` file; you must have either **root** or **nova** user permissions).



NOTE

The use of cells is available in this release as a *Technology Preview*, and therefore is not fully supported by Red Hat. It should only be used for testing, and should not be deployed in a production environment. For more information about Technology Preview features, see [Scope of Coverage Details](#).

Valid weighers are:

- **nova.cells.weights.all_weighers** - Uses all cell weighers(default).
- **nova.cells.weights.mute_child** - Weighs whether a child cell has not sent capacity or capability updates for some time.
- **nova.cells.weights.ram_by_instance_type** - Weighs the cell's available RAM.
- **nova.cells.weights.weight_offset** - Evaluates a cell's weight offset.



NOTE

A cell's weight offset is specified using **--woffset** in the **nova-manage cell create** command.

Table 3.9. Cell Weight Options

Weighers	Option	Description
mute_child	[cells] mute_weight_multiplier	Multiplier for hosts which have been silent for some time (negative floating point). By default, this value is -10.0 .
mute_child	[cells] mute_weight_value	Weight value given to silent hosts (positive floating point). By default, this value is 1000.0 .
ram_by_instance_type	[cells] ram_weight_multiplier	Multiplier for weighing RAM (floating point). By default, this value is 1.0 , and spreads instances across possible cells. If this value is negative, the cell with fewer RAM is prioritized, and instances are stacked in cells.
weight_offset	[cells] offset_weight_multiplier	Multiplier for weighing cells (floating point). Enables the instance to specify a preferred cell (floating point) by setting its weight offset to 9999999999999999 (highest weight is prioritized). By default, this value is 1.0 .

3.7. EVACUATING INSTANCES

If you want to move an instance from a dead or shut-down compute node to a new host server in the same environment (for example, because the server needs to be swapped out), you can evacuate it using **nova evacuate**.

- An evacuation is only useful if the instance disks are on shared storage or if the instance disks are Block Storage volumes. Otherwise, the disks will not be accessible and cannot be accessed by the new compute node.
- An instance can only be evacuated from a server if the server is shut down; if the server is not shut down, the **evacuate** command will fail.



NOTE

If you have a functioning compute node, and you want to:

- Make a static copy (not running) of an instance for backup purposes or to copy the instance to a different environment, make a snapshot using **nova image-create** (see [Chapter 2. How to Migrate a Static Instance](#)). Images created using **nova image-create** are only usable by nova (and not glance).
- Move an instance in a static state (not running) to a host in the same environment (shared storage not needed), migrate it using **nova migrate** (see [Migrate a Static Instance](#)).
- Move an instance in a live state (running) to a host in the same environment, migrate it using **nova live-migration** (see [Migrate a Live \(running\) Instance](#)).

3.7.1. Evacuating one instance

1. Evacuate an instance using:

```
# nova evacuate [--password pass] instance_name [target_host]
```

Where:

- **--password** - Admin password to set for the evacuated instance. If a password is not specified, a random password is generated and output when evacuation is complete.
- **instance_name** - Name of the instance to be evacuated.
- **target_host** - Host to which the instance is evacuated; if you do not specify the host, the Compute scheduler selects one for you. You can find possible hosts using:

```
# nova host-list | grep compute
```

For example:

```
# nova evacuate myDemoInstance Compute2_OnEL7.myDomain
```

3.7.2. Evacuating all instances

Evacuate all instances on a specified host using:

```
# nova host-evacuate [--target_host <target_host>] [--force] <host>
```

Where:

- **<target_host>** - The host the instance is evacuated to. If you do not specify the host, the Compute scheduler selects one for you. You can find possible hosts using the following command:

```
# nova host-list | grep compute
```

- **<host>** - Name of the host to be evacuated.

For example:

```
# nova host-evacuate --target_host Compute2_OnEL7.localdomain myDemoHost.localdomain
```

3.7.3. Configuring shared storage

If you are using shared storage, this procedure exports the instances directory for the Compute service to the two nodes, and ensures the nodes have access. The directory path is set in the **state_path** and **instances_path** parameters in the **/etc/nova/nova.conf** file. This procedure uses the default value, which is **/var/lib/nova/instances**. Only users with root access can set up shared storage.

1. On the controller host:

- Ensure the **/var/lib/nova/instances** directory has read-write access by the Compute service user (this user must be the same across controller and nodes). For example:

```
drwxr-xr-x. 9 nova nova 4096 Nov  5 20:37 instances
```

- Add the following lines to the **/etc/exports** file; switch out node1_IP and node2_IP for the IP addresses of the two compute nodes:

```
/var/lib/nova/instances (rw,sync,fsid=0,no_root_squash)
/var/lib/nova/instances (rw,sync,fsid=0,no_root_squash)
```

- Export the **/var/lib/nova/instances** directory to the compute nodes.

```
# exportfs -avr
```

- Restart the NFS server:

```
# systemctl restart nfs-server
```

2. On each compute node:

- Ensure the **/var/lib/nova/instances** directory exists locally.

- Add the following line to the **/etc/fstab** file:

```
:/var/lib/nova/instances /var/lib/nova/instances nfs4 defaults 0 0
```

- Mount the controller's instance directory (all devices listed in **/etc/fstab**):

```
# mount -a -v
```

- Ensure qemu can access the directory's images:


```
# ls -ld /var/lib/nova/instances
drwxr-xr-x. 9 nova nova 4096 Nov  5 20:37 /var/lib/nova/instances
```

- e. Ensure that the node can see the instances directory with:

```
drwxr-xr-x. 9 nova nova 4096 Nov  5 20:37 /var/lib/nova/instances
```



NOTE

You can also run the following to view all mounted devices:

```
# df -k
```

3.8. MANAGING INSTANCE SNAPSHOTS

An instance snapshot allows you to create a new image from an instance. This is very convenient for upgrading base images or for taking a published image and customizing it for local use.

The difference between an image that you upload directly to the Image Service and an image that you create by snapshot is that an image created by snapshot has additional properties in the Image Service database. These properties are found in the **image_properties** table and include the following parameters:

Table 3.10. Snapshot Options

Name	Value
image_type	snapshot
instance_uuid	<uuid of instance that was snapshotted>
base_image_ref	<uuid of original image of instance that was snapshotted>
image_location	snapshot

Snapshots allow you to create new instances based on that snapshot, and potentially restore an instance to that state. Moreover, this can be performed while the instance is running.

By default, a snapshot is accessible to the users and projects that were selected while launching an instance that the snapshot is based on.

3.8.1. Creating an instance snapshot



NOTE

If you intend to use an instance snapshot as a template to create new instances, you must ensure that the disk state is consistent. Before you create a snapshot, set the snapshot image metadata property **os_require_quiesce=yes**. For example,

```
$ glance image-update IMAGE_ID --property os_require_quiesce=yes
```

For this to work, the guest should have the **qemu-guest-agent** package installed, and the image should be created with the metadata property parameter **hw_qemu_guest_agent=yes** set. For example,

```
$ glance image-create --name NAME \
--disk-format raw \
--container-format bare \
--file FILE_NAME \
--is-public True \
--property hw_qemu_guest_agent=yes \
--progress
```

If you unconditionally enable the **hw_qemu_guest_agent=yes** parameter, then you are adding another device to the guest. This consumes a PCI slot, and will limit the number of other devices you can allocate to the guest. It also causes Windows guests to display a warning message about an unknown hardware device.

For these reasons, setting the **hw_qemu_guest_agent=yes** parameter is optional, and the parameter should be used for only those images that require the QEMU guest agent.

1. In the dashboard, select **Project > Compute > Instances**
2. Select the instance from which you want to create a snapshot.
3. In the **Actions** column, click **Create Snapshot**.
4. In the **Create Snapshot** dialog, enter a name for the snapshot and click **Create Snapshot**. The **Images** category now shows the instance snapshot.

To launch an instance from a snapshot, select the snapshot and click **Launch**.

3.8.2. Managing a snapshot

1. In the dashboard, select **Project > Images**.
2. All snapshots you created, appear under the **Project** option.
3. For every snapshot you create, you can perform the following functions, using the dropdown list:
 - a. Use the **Create Volume** option to create a volume and entering the values for volume name, description, image source, volume type, size and availability zone. For more information, see [Create a Volume](#) in the *Storage Guide*.
 - b. Use the **Edit Image** option to update the snapshot image by updating the values for name, description, Kernel ID, Ramdisk ID, Architecture, Format, Minimum Disk (GB), Minimum RAM (MB), public or private. For more information, see [Section 1.2.3, "Updating an image"](#).

- c. Use the **Delete Image** option to delete the snapshot.

3.8.3. Rebuilding an instance to a state in a snapshot

In an event that you delete an instance on which a snapshot is based, the snapshot still stores the instance ID. You can check this information using the **nova image-list** command and use the snapshot to restore the instance.

1. In the dashboard, select **Project > Compute > Images**
2. Select the snapshot from which you want to restore the instance.
3. In the **Actions** column, click **Launch Instance**.
4. In the **Launch Instance** dialog, enter a name and the other details for the instance and click **Launch**.

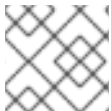
For more information on launching an instance, see [Section 3.1.2, “Creating an instance”](#).

3.8.4. Consistent Snapshots

Previously, file systems had to be quiesced manually (`fsfreeze`) before taking a snapshot of active instances for consistent backups.

Compute’s **libvirt** driver automatically requests the *QEMU Guest Agent* to freeze the file systems (and applications if **fsfreeze-hook** is installed) during an image snapshot. Support for quiescing file systems enables scheduled, automatic snapshots at the block device level.

This feature is only valid if the QEMU Guest Agent is installed (**qemu-ga**) and the image metadata enables the agent (**hw_qemu_guest_agent=yes**)



NOTE

Snapshots should not be considered a substitute for an actual system backup.

3.9. USING RESCUE MODE FOR INSTANCES

Compute has a method to reboot a virtual machine in rescue mode. Rescue mode provides a mechanism for access when the virtual machine image renders the instance inaccessible. A rescue virtual machine allows a user to fix their virtual machine by accessing the instance with a new root password. This feature is useful if an instance’s filesystem is corrupted. By default, rescue mode starts an instance from the initial image attaching the current boot disk as a secondary one.

3.9.1. Preparing an image for a rescue mode instance

Due to the fact that both the boot disk and the disk for rescue mode have same UUID, sometimes the virtual machine can be booted from the boot disk instead of the disk for rescue mode.

To avoid this issue, you should create a new image as rescue image based on the procedure in [Section 1.2.1, “Creating an image”](#):

**NOTE**

The **rescue** image is stored in **glance** and configured in the **nova.conf** as a default, or you can select when you do the rescue.

3.9.1.1. Rescuing image if using ext4 filesystem

When the base image uses **ext4** filesystem, you can create a rescue image from it using the following procedure:

1. Change the *UUID* to a random value using the **tune2fs** command:

```
# tune2fs -U random /dev/DEVICE_NODE
```

Here *DEVICE_NODE* is the root device node (for example, **sda**, **vda**, and so on).

2. Verify the details of the filesystem, including the new *UUID*:

```
# tune2fs -l
```

3. Update the **/etc/fstab** to use the new *UUID*. You may need to repeat this for any additional partitions you have, that are mounted in the **fstab** by *UUID*.
4. Update the **/boot/grub2/grub.conf** file and update the *UUID* parameter with the new *UUID* of the root disk.
5. Shut down and use this image as your rescue image. This will cause the rescue image to have a new random *UUID* that will not conflict with the instance that you are rescuing.

**NOTE**

The XFS filesystem cannot change the *UUID* of the root device on the running virtual machine. Reboot the virtual machine until the virtual machine is launched from the disk for rescue mode.

3.9.2. Adding the rescue image to the OpenStack Image Service

When you have completed modifying the *UUID* of your image, use the following commands to add the generated rescue image to the OpenStack Image service:

1. Add the rescue image to the Image service:

```
# glance image-create --name IMAGE_NAME --disk-format qcow2 \
  --container-format bare --is-public True --file IMAGE_PATH
```

Here *IMAGE_NAME* is the name of the image, *IMAGE_PATH* is the location of the image.

2. Use the **image-list** command to obtain the *IMAGE_ID* required for launching an instance in the rescue mode.

```
# glance image-list
```

You can also upload an image using the OpenStack Dashboard, see [Section 1.2.2, "Uploading an image"](#).

3.9.3. Launching an instance in rescue mode

1. Since you need to rescue an instance with a specific image, rather than the default one, use the **--image** parameter:

```
# nova rescue --image IMAGE_ID VIRTUAL_MACHINE_ID
```

Here *IMAGE_ID* is the ID of the image you want to use and *VIRTUAL_MACHINE_ID* is ID of a virtual machine that you want to rescue.



NOTE

The **nova rescue** command allows an instance to perform a soft shut down. This allows the guest operating system to perform a controlled shutdown before the instance is powered off. The shut down behavior is configured by the **shutdown_timeout** parameter that can be set in the **nova.conf** file. The value stands for the overall period (in seconds) a guest operation system is allowed to complete the shutdown. The default timeout is 60 seconds.

The timeout value can be overridden on a per image basis by means of **os_shutdown_timeout** that is an image metadata setting allowing different types of operating systems to specify how much time they need to shut down cleanly.

2. Reboot the virtual machine.
3. Confirm the status of the virtual machine is *RESCUE* on the controller node by using **nova list** command or by using dashboard.
4. Log in to the new virtual machine dashboard by using the password for rescue mode.

You can now make the necessary changes to your instance to fix any issues.

3.9.4. Unrescuing an instance

You can **unrescue** the fixed instance to restart it from the boot disk.

1. Execute the following commands on the controller node.

```
# nova unrescue VIRTUAL_MACHINE_ID
```

Here *VIRTUAL_MACHINE_ID* is ID of a virtual machine that you want to unrescue.

The status of your instance returns to *ACTIVE* once the unrescue operation has completed successfully.

3.10. SETTING A CONFIGURATION DRIVE FOR INSTANCES

You can use the **config-drive** parameter to present a read-only drive to your instances. This drive can contain selected files that are then accessible to the instance. The configuration drive is attached to the instance at boot, and is presented to the instance as a partition. Configuration drives are useful when combined with *cloud-init* (for server bootstrapping), and when you want to pass large files to your instances.

3.10.1. Configuration drive options

Set the initial configuration drive options under **[DEFAULT]** in *nova.conf*:

- **config_drive_format** - sets the format of the drive, and accepts the options **iso9660** and **vfat**. By default, it uses **iso9660**.
- **force_config_drive=true** - this forces the configuration drive to be presented to all instances.
- **mkisofs_cmd=genisoimage** - specifies the command to use for ISO file creation. This value must not be changed, as only *genisoimage* is supported.

3.10.2. Using a configuration drive

An instance attaches its configuration drive at boot time. This is enabled by the **--config-drive** option. For example, this command creates a new instance named *test-instance01* and attaches a drive containing a file named */root/user-data.txt*:

```
# nova boot --flavor m1.tiny --config-drive true --file /root/user-data.txt=/root/user-data.txt --image cirros test-instance01
```

Once the instance has booted, you can log in to it and see a file named */root/user-data.txt*.



NOTE

You can use the configuration drive as a source for *cloud-init* information. During the initial instance boot, *cloud-init* can automatically mount the configuration drive and run the setup scripts.

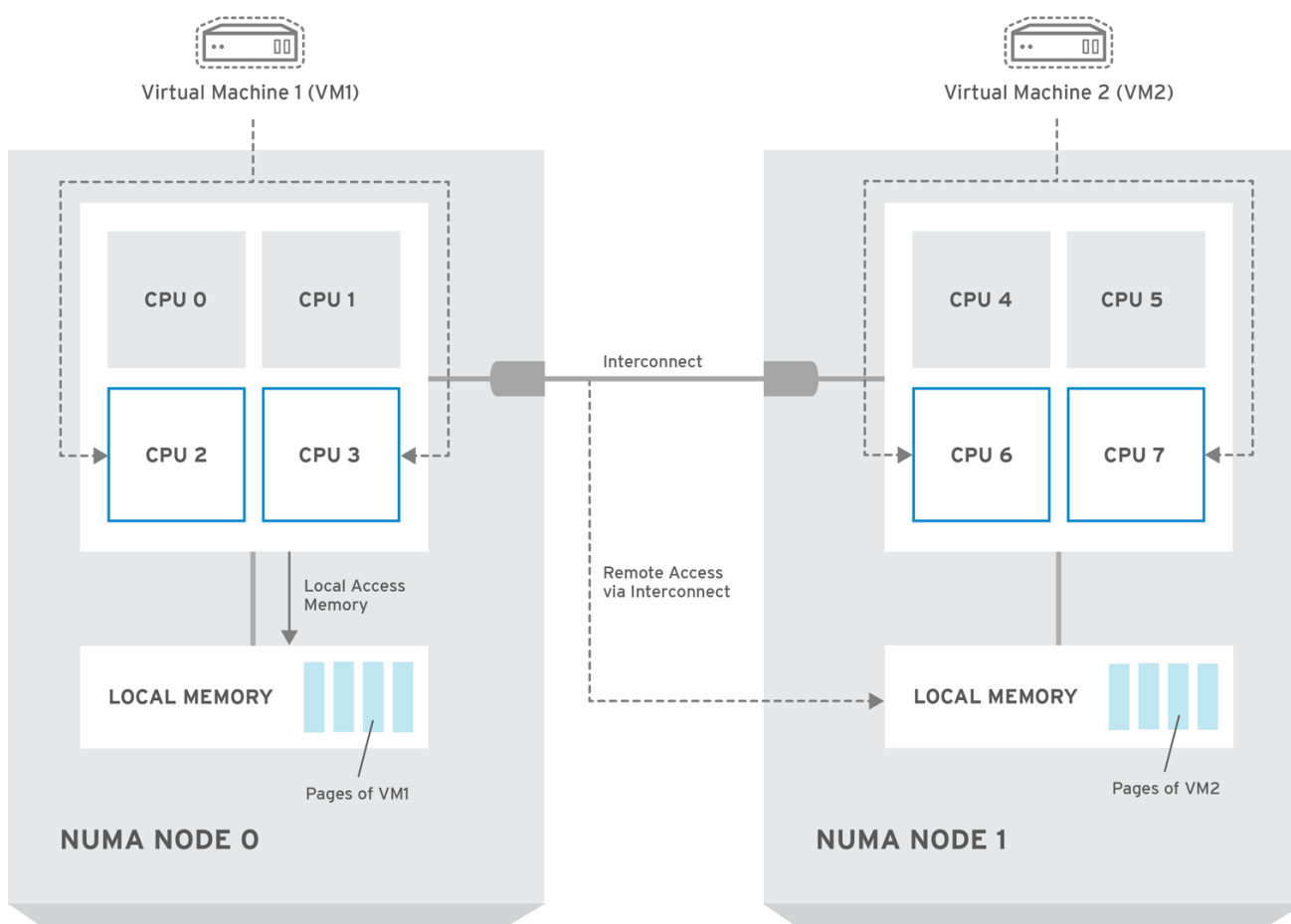
CHAPTER 4. CONFIGURING CPU PINNING WITH NUMA

This chapter concerns NUMA topology awareness and the configuration of an OpenStack environment on systems supporting this technology. With this setup, virtual machine instances are pinned to dedicated CPU cores, which enables smarter scheduling and therefore improves guest performance.

TIP

Background information about NUMA is available in the following article: [What is NUMA and how does it work on Linux ?](#)

The following diagram provides an example of a two-node NUMA system and the way the CPU cores and memory pages are made available:



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NOTE

Remote memory available via Interconnect is accessed **only** if VM1 from NUMA node 0 has a CPU core in NUMA node 1. In this case, the memory of NUMA node 1 will act as local for the third CPU core of VM1 (for example, if VM1 is allocated with CPU 4 in the diagram above), but at the same time, it will act as remote memory for the other CPU cores of the same VM.

For more details on NUMA tuning with libvirt, see the [Virtualization Tuning and Optimization Guide](#).

**WARNING**

At present, it is impossible to migrate an instance which has been configured to use CPU pinning. For more information about this issue, see the following solution: [Instance migration fails when using cpu-pinning from a numa-cell and flavor-property "hw:cpu_policy=dedicated"](#).

4.1. COMPUTE NODE CONFIGURATION

The exact configuration depends on the NUMA topology of your host system; however, you must reserve some CPU cores across all the NUMA nodes for host processes and let the rest of the CPU cores handle your guest virtual machine instances. For example, with eight CPU cores evenly spread across two NUMA nodes, the layout can be illustrated as follows:

Table 4.1. Example of NUMA Topology

	Node 0		Node 1	
Host processes	Core 0	Core 1	Core 4	Core 5
Guest processes	Core 2	Core 3	Core 6	Core 7

**NOTE**

The number of cores to reserve for host processes should be determined by observing the performance of the host under typical workloads.

The configuration of the Compute nodes consists of the following steps:

1. Set the **vcpu_pin_set** option in the `/etc/nova/nova.conf` file to the list of CPU cores reserved for guest processes. Using the example above, you would set:

```
vcpu_pin_set=2,3,6,7
```

The **vcpu_pin_set** option will also ensure that a **cpuset** attribute similar to the following will be added to the XML configuration file for libvirt:

```
<vcpu placement='static' cpuset='2-3,6-7'>1</vcpu>
```

This will pin the guest vCPUs to the listed physical CPU cores and allow the scheduler to see only these cores.

2. Set the **reserved_host_memory_mb** option in the same file to the amount of RAM to reserve for host processes. If you want to reserve 512 MB, use:

```
reserved_host_memory_mb=512
```

3. Restart the Compute service on the Compute nodes by running the following command:


```
systemctl restart openstack-nova-compute.service
```

4. Ensure that host processes do not run on the CPU cores reserved for guest processes by adding the **isolcpus** argument to the system's boot configuration. Use the list of CPU cores reserved for guest processes as a parameter of this argument. Using the topology from the example above, you would run the following command:

```
grubby --update-kernel=ALL --args="isolcpus=2,3,6,7"
```



NOTE

The **cpuset** option along with the **isolcpus** kernel argument will ensure that the underlying compute node will not be able to use the corresponding pCPUs for itself. The pCPUs will be dedicated to instances.



WARNING

The **isolcpus** argument is not fully functional on Red Hat Enterprise Linux 7.1. There is a bug which allows kernel processes to use CPUs that have been isolated. This bug was fixed in Red Hat Enterprise Linux 7.2, however some users have experienced performance problems.

Because of this, the **isolcpus** solution has been deprecated and there is a replacement solution which relies on **systemd**. However, this solution is still a work-in-progress, since it currently cannot isolate all of the kernel threads.

To use the systemd solution, edit the **/etc/systemd/system.conf** file and uncomment the following line:

```
CPUAffinity=1 2
```

The **CPUAffinity** option takes a list of CPU indices or ranges separated by a whitespace.

5. Update the boot record for this change to take effect:

```
grub2-install /dev/device
```

Replace *device* with the name of the device that contains the boot record, usually *sda*.

6. Reboot the system.

4.2. SCHEDULER CONFIGURATION

1. Edit the **/etc/nova/nova.conf** file on each system running the OpenStack Compute Scheduler. Find the **scheduler_default_filters** option, uncomment it if commented out, and add **AggregateInstanceExtraSpecFilter** and **NUMATopologyFilter** to the list of filters. The whole

line can look like this:

```
scheduler_default_filters=RetryFilter,AvailabilityZoneFilter,RamFilter,
ComputeFilter,ComputeCapabilitiesFilter,ImagePropertiesFilter,CoreFilter,
NUMATopologyFilter,AggregateInstanceExtraSpecsFilter
```

- Restart the `openstack-nova-scheduler` service:

```
systemctl restart openstack-nova-scheduler.service
```

4.3. AGGREGATE AND FLAVOR CONFIGURATION

Prepare your OpenStack environment for running virtual machine instances pinned to specific resources by completing the following steps on a system with the Compute command-line interface:

- Load the **admin** credentials:

```
source ~/keystonerc_admin
```

- Create an aggregate for the hosts that will receive pinning requests:

```
nova aggregate-create name
```

Replace *name* with a suitable name, such as *performance* or *cpu_pinning*.

- Enable the pinning by editing the metadata for the aggregate:

```
nova aggregate-set-metadata 1 pinned=true
```

In this command, number *1* matches the ID of the aggregate created in the previous step.

- Create an aggregate for other hosts:

```
nova aggregate-create name
```

Replace *name* with another suitable name, such as *normal*.

- Edit the metadata for this aggregate accordingly:

```
nova aggregate-set-metadata 2 pinned=false
```

Here, number *2* is used because it comes after *1*, which is the ID of the first aggregate.

- Change your existing flavors' specifications to this one:

```
for i in $(nova flavor-list | cut -f 2 -d ' ' | grep -o '[0-9]*'); do nova flavor-key $i set
"aggregate_instance_extra_specs:pinned"="false"; done
```

- Create a flavor for the hosts that will receive pinning requests:

```
nova flavor-create name ID RAM disk vCPUs
```

Replace *name* with an appropriate name, such as *m1.small.performance* or *pinned.small*, *ID* with

the identifier for the new flavor (**6** if you have five standard flavors, or **auto** if you want **nova** to generate a UUID), *RAM* with the desired amount of RAM in MB, *disk* with the desired disk size in GB, and *vCPUs* with the number of virtual CPUs that you want to reserve.

- Set the **hw:cpu_policy** specification of this flavor to **dedicated** so as to require dedicated resources, which enables CPU pinning, and also the **hw:cpu_thread_policy** specification to **require**, which places each vCPU on thread siblings:

```
nova flavor-key ID set hw:cpu_policy=dedicated
nova flavor-key ID set hw:cpu_thread_policy=require
```

Replace *ID* with the ID of the flavor created in the previous step.



NOTE

If the host does not have an SMT architecture or enough CPU cores with free thread siblings, scheduling will fail. If such behavior is undesired, or if your hosts simply do not have an SMT architecture, do not use the **hw:cpu_thread_policy** specification, or set it to **prefer** instead of **require**. The (default) **prefer** policy ensures that thread siblings are used when available.

- Set the **aggregate_instance_extra_specs:pinned** specification to *true* so as to ensure that instances based on this flavor have this specification in their aggregate metadata:

```
nova flavor-key ID set aggregate_instance_extra_specs:pinned=true
```

Again, replace *ID* with the ID of the flavor.

- Add some hosts to the new aggregates:

```
nova aggregate-add-host ID_1 host_1
```

Replace *ID_1* with the ID of the first ("performance"/"pinning") aggregate and *host_1* with the host name of the host that you want to add to the aggregate.

```
nova aggregate-add-host ID_2 host_2
```

Replace *ID_2* with the ID of the second ("normal") aggregate and *host_2* with the host name of the host that you want to add to it.

You can now boot an instance using the new flavor:

```
nova boot --image image --flavor flavor server_name
```

Replace *image* with a saved VM image name (see **nova image-list**), *flavor* with the name of the flavor (*m1.small.performance*, *pinned.small*, or any other name that you used), and *server_name* with the name for the new server.

To verify that the new server has been placed correctly, run the following command and check for **OS-EXT-SRV-ATTR:hypervisor_hostname** in the output:

```
nova show server_name
```

APPENDIX A. IMAGE CONFIGURATION PARAMETERS

The following keys can be used with the **property** option for both the **glance image-update** and **glance image-create** commands.

```
$ glance image-update IMG-UUID --property architecture=x86_64
```



NOTE

Behavior set using image properties overrides behavior set using flavors. For more information, see [Section 3.4, “Managing flavors”](#).

Table A.1. Property Keys

Specific to	Key	Description	Supported values
All	architecture	The CPU architecture that must be supported by the hypervisor. For example, x86_64 , arm , or ppc64 . Run uname -m to get the architecture of a machine. We strongly recommend using the architecture data vocabulary defined by the libosinfo project for this purpose.	<ul style="list-style-type: none"> alpha-DEC 64-bit RISC armv7l-ARM Cortex-A7 MPCore cris-Ethernet, Token Ring, AXis-Code Reduced Instruction Set i686-Intel sixth-generation x86 (P6 micro architecture) ia64-Itanium lm32-Lattice Micro32 m68k-Motorola 68000 microblaze-Xilinx 32-bit FPGA (Big Endian) microblazeel-Xilinx 32-bit FPGA (Little Endian) mips-MIPS 32-bit RISC (Big Endian) mipsel-MIPS 32-bit RISC (Little Endian) mips64-MIPS 64-bit RISC (Big Endian) mips64el-MIPS 64-bit RISC (Little Endian) openrisc-OpenCores RISC parisc-HP Precision Architecture RISC parisc64-HP Precision Architecture 64-bit RISC ppc-PowerPC 32-bit ppc64-PowerPC 64-bit

Specific to	Key	Description	Supported values
			<ul style="list-style-type: none"> ● ppcemb-PowerPC (Embedded 32-bit) Architecture/390 ● s390-IBM Enterprise Systems Architecture/390 ● s390x-S/390 64-bit ● sh4-SuperH SH-4 (Little Endian) ● sh4eb-SuperH SH-4 (Big Endian) ● sparc-Scalable Processor Architecture, 32-bit ● sparc64-Scalable Processor Architecture, 64-bit ● unicore32-Microprocessor Research and Development Center RISC Unicores32 ● x86_64-64-bit extension of IA-32 ● xtensa-Tensilica Xtensa configurable microprocessor core ● xtensaeb-Tensilica Xtensa configurable microprocessor core (Big Endian)
All	hypervisor_type	The hypervisor type.	kvm, vmware
All	instance_uuid	For snapshot images, this is the UUID of the server used to create this image.	Valid server UUID
All	kernel_id	The ID of an image stored in the Image Service that should be used as the kernel when booting an AML-style image.	Valid image ID

Specific to	Key	Description	Supported values
All	os_distro	<p>The common name of the operating system distribution in lowercase (uses the same data vocabulary as the libosinfo project). Specify only a recognized value for this field.</p> <p>Deprecated values are listed to assist you in searching for the recognized value.</p>	<ul style="list-style-type: none"> ● arch-Arch Linux. Do not use archlinux or org.archlinux ● centos-Community Enterprise Operating System. Do not use org.centos or CentOS ● debian-Debian. Do not use Debian or org.debian ● fedora-Fedora. Do not use Fedora, org.fedora, or org.fedoraproject ● freebsd-FreeBSD. Do not use org.freebsd, freeBSD, or FreeBSD ● gentoo-Gentoo Linux. Do not use Gentoo or org.gentoo ● mandrake-Mandrakelinux (MandrakeSoft) distribution. Do not use mandrakelinux or MandrakeLinux ● mandriva-Mandriva Linux. Do not use mandrivalinux ● mes-Mandriva Enterprise Server. Do not use mandrivaent or mandrivaES ● msdos-Microsoft Disc Operating System. Do not use ms-dos ● netbsd-NetBSD. Do not use NetBSD or org.netbsd ● netware-Novell NetWare. Do not use novell or NetWare ● openbsd-OpenBSD. Do not use OpenBSD or org.openbsd ● opensolaris-OpenSolaris. Do not use OpenSolaris or org.opensolaris ● opensuse-openSUSE. Do not use suse, SuSE, or org.opensuse ● rhel-Red Hat Enterprise Linux. Do not use redhat, RedHat, or com.redhat ● sled-SUSE Linux Enterprise Desktop. Do not use com.suse ● ubuntu-Ubuntu. Do not use Ubuntu, com.ubuntu, org.ubuntu, or canonical ● windows-Microsoft Windows. Do not use com.microsoft.server

Specific to	Key	Description	Supported values
All	os_version	The operating system version as specified by the distributor.	Version number (for example, "11.10")
All	ramdisk_id	The ID of image stored in the Image Service that should be used as the ramdisk when booting an AMI-style image.	Valid image ID
All	vm_mode	The virtual machine mode. This represents the host/guest ABI (application binary interface) used for the virtual machine.	hvm —Fully virtualized. This is the mode used by QEMU and KVM.
libvirt API driver	hw_disk_bus	Specifies the type of disk controller to attach disk devices to.	scsi, virtio, ide, or usb.
libvirt API driver	hw_numa_nodes	Number of NUMA nodes to expose to the instance (does not override flavor definition).	Integer. For a detailed example of NUMA-topology definition, see the hw:NUMA_def key in Add Metadata .
libvirt API driver	hw_numa_mempolicy	NUMA memory allocation policy (does not override flavor definition).	strict - Mandatory for the instance's RAM allocations to come from the NUMA nodes to which it is bound (default if numa_nodes is specified). preferred - The kernel can fall back to using an alternative node. Useful when the 'hw:numa_nodes' parameter is set to '1'.
libvirt API driver	hw_numa_cpus. 0	Mapping of vCPUs N-M to NUMA node 0 (does not override flavor definition).	Comma-separated list of integers.

Specific to	Key	Description	Supported values
libvirt API driver	hw_numa_cpus.1	Mapping of vCPUs N-M to NUMA node 1 (does not override flavor definition).	Comma-separated list of integers.
libvirt API driver	hw_numa_mem.0	Mapping N MB of RAM to NUMA node 0 (does not override flavor definition).	Integer
libvirt API driver	hw_numa_mem.1	Mapping N MB of RAM to NUMA node 1 (does not override flavor definition).	Integer
libvirt API driver	hw_qemu_guest_agent	Guest agent support. If set to yes , and if qemu-ga is also installed, file systems can be quiesced (frozen) and snapshots created automatically.	yes / no

Specific to	Key	Description	Supported values
libvirt API driver	hw_rng_model	<p>Adds a random-number generator device to the image's instances. The cloud administrator can enable and control device behavior by configuring the instance's flavor. By default:</p> <ul style="list-style-type: none"> • The generator device is disabled. • /dev/random is used as the default entropy source. To specify a physical HW RNG device, use the following option in the nova.conf file: <code>rng_dev_path = /dev/hwrng</code> 	virtio , or other supported device.

Specific to	Key	Description	Supported values
libvirt API driver	hw_scsi_model	Enables the use of VirtIO SCSI (virtio-scsi) to provide block device access for compute instances; by default, instances use VirtIO Block (virtio-blk). VirtIO SCSI is a para-virtualized SCSI controller device that provides improved scalability and performance, and supports advanced SCSI hardware.	virtio-scsi
libvirt API driver	hw_video_model	The video image driver used.	vga, cirrus, vmvga, xen, or qxl
libvirt API driver	hw_video_ram	Maximum RAM for the video image. Used only if a hw_video:ram_max_mb value has been set in the flavor's extra_specs and that value is higher than the value set in hw_video_ram .	Integer in MB (for example, '64')

Specific to	Key	Description	Supported values
libvirt API driver	hw_watchdog_action	Enables a virtual hardware watchdog device that carries out the specified action if the server hangs. The watchdog uses the i6300esb device (emulating a PCI Intel 6300ESB). If hw_watchdog_action is not specified, the watchdog is disabled.	<ul style="list-style-type: none"> ● disabled-The device is not attached. Allows the user to disable the watchdog for the image, even if it has been enabled using the image's flavor. The default value for this parameter is disabled. ● reset-Forcefully reset the guest. ● poweroff-Forcefully power off the guest. ● pause-Pause the guest. ● none-Only enable the watchdog; do nothing if the server hangs.
libvirt API driver	os_command_line	The kernel command line to be used by the libvirt driver, instead of the default. For Linux Containers (LXC), the value is used as arguments for initialization. This key is valid only for Amazon kernel, ramdisk, or machine images (aki, ari, or ami).	
libvirt API driver and VMware API driver	hw_vif_model	Specifies the model of virtual network interface device to use.	<p>The valid options depend on the configured hypervisor.</p> <ul style="list-style-type: none"> ● KVM and QEMU: e1000, ne2k_pci, pcnet, rtl8139, and virtio. ● VMware: e1000, e1000e, VirtualE1000, VirtualE1000e, VirtualPCNet32, VirtualSriovEthernetCard, and VirtualVmxnet. ● Xen: e1000, netfront, ne2k_pci, pcnet, and rtl8139.

Specific to	Key	Description	Supported values
VMware API driver	vmware_adapter_type	The virtual SCSI or IDE controller used by the hypervisor.	lsiLogic , busLogic , or ide
VMware API driver	vmware_ostype	A VMware GuestID which describes the operating system installed in the image. This value is passed to the hypervisor when creating a virtual machine. If not specified, the key defaults to otherGuest .	See thinkvirt.com .
VMware API driver	vmware_image_version	Currently unused.	1
XenAPI driver	auto_disk_config	If true, the root partition on the disk is automatically resized before the instance boots. This value is only taken into account by the Compute service when using a Xen-based hypervisor with the XenAPI driver. The Compute service will only attempt to resize if there is a single partition on the image, and only if the partition is in ext3 or ext4 format.	true / false

Specific to	Key	Description	Supported values
XenAPI driver	os_type	The operating system installed on the image. The XenAPI driver contains logic that takes different actions depending on the value of the os_type parameter of the image. For example, for os_type=windows images, it creates a FAT32-based swap partition instead of a Linux swap partition, and it limits the injected host name to less than 16 characters.	linux or windows