Red Hat Gluster Storage 3.1

Deployment Guide for Public Cloud

Deploying Red Hat Gluster Storage on Public Cloud

Last Updated: 2017-10-17

Red Hat Gluster Storage 3.1 Deployment Guide for Public Cloud

Deploying Red Hat Gluster Storage on Public Cloud

Divya Muntimadugu
Red Hat Customer Content Services
divya@redhat.com

Legal Notice

Abstract

This guide provides instructions to deploy Red Hat Gluster Storage on Public Cloud.

Table of Contents

CHAPTER 1. RED HAT STORAGE ON PUBLIC CLOUD

Red Hat Gluster Storage for Public Cloud packages glusterFS for deploying scalable NAS in the public cloud. This powerful storage server provides all the features of On-Premise deployment, within a highly available, scalable, virtualized, and centrally managed pool of NAS storage hosted off-premise.

Additionally, Red Hat Gluster Storage can be deployed in the public cloud using Red Hat Gluster Storage for Public Cloud, for example, within the Amazon Web Services (AWS) cloud. It delivers all the features and functionality possible in a private cloud or datacenter to the public cloud by providing massively scalable and high available NAS in the cloud.

The POSIX compatible glusterFS servers, which use XFS file system format to store data on disks, can be accessed using industry-standard access protocols including Network File System (NFS) and Server Message Block (SMB) (also known as CIFS).

1.1. ABOUT GLUSTERFS

glusterFS aggregates various storage servers over network interconnects into one large parallel network file system. Based on a stackable user space design, it delivers exceptional performance for diverse workloads and is a key building block of Red Hat Gluster Storage.

CHAPTER 2. ACCESSING RED HAT GLUSTER STORAGE USING AMAZON WEB SERVICES

Red Hat Gluster Storage for Public Cloud packages glusterFS as an Amazon Machine Image (AMI) for deploying scalable network attached storage (NAS) in the Amazon Web Services (AWS) public cloud. This powerful storage server provides a highly available, scalable, virtualized, and centrally managed pool of storage for Amazon users. Red Hat Gluster Storage for Public Cloud provides highly available storage within AWS. Synchronous n-way replication across AWS Availability Zones provides high availability within an AWS Region. Asynchronous geo-replication provides continuous data replication to ensure high availability across AWS regions. The glusterFS global namespace capability aggregates disk and memory resources into a unified storage volume that is abstracted from the physical hardware.

The following diagram illustrates Amazon Web Services integration with Red Hat Gluster Storage:

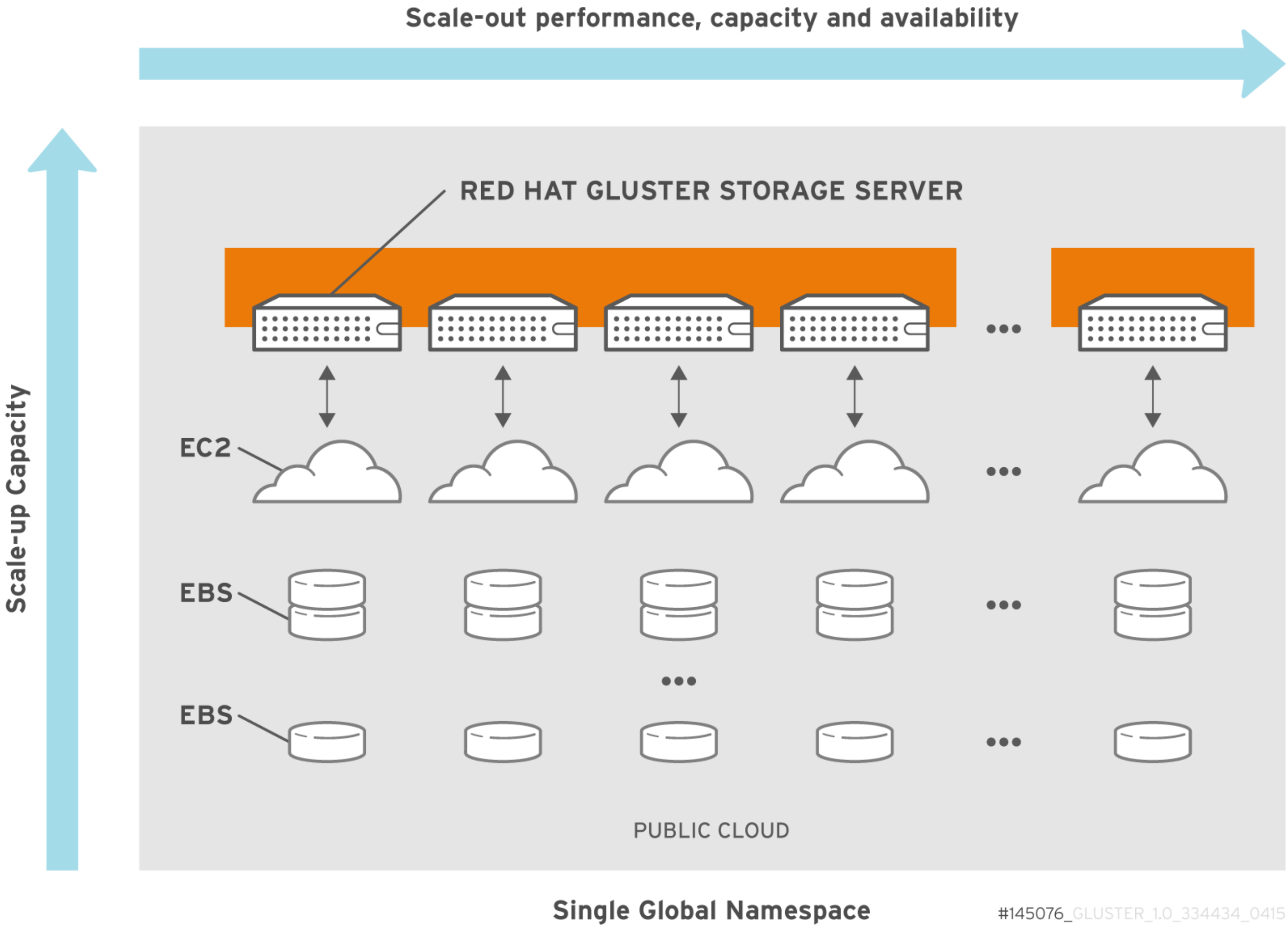


Figure 2.1. Amazon Web Services integration Architecture

IMPORTANT

The following features of Red Hat Gluster Storage Server is not supported on Amazon Web Services:

- Red Hat Gluster Storage Console and Nagios Monitoring

- NFS and CIFS High Availability

NOTE

For information on obtaining access to AMI, see https://access.redhat.com/knowledge/articles/145693.

2.1. LAUNCHING RED HAT GLUSTER STORAGE INSTANCES

This section describes how to launch Red Hat Gluster Storage instances on Amazon Web Services.

The supported configuration for two-way and three-way replication is up to 24 Amazon EBS volumes of equal size.

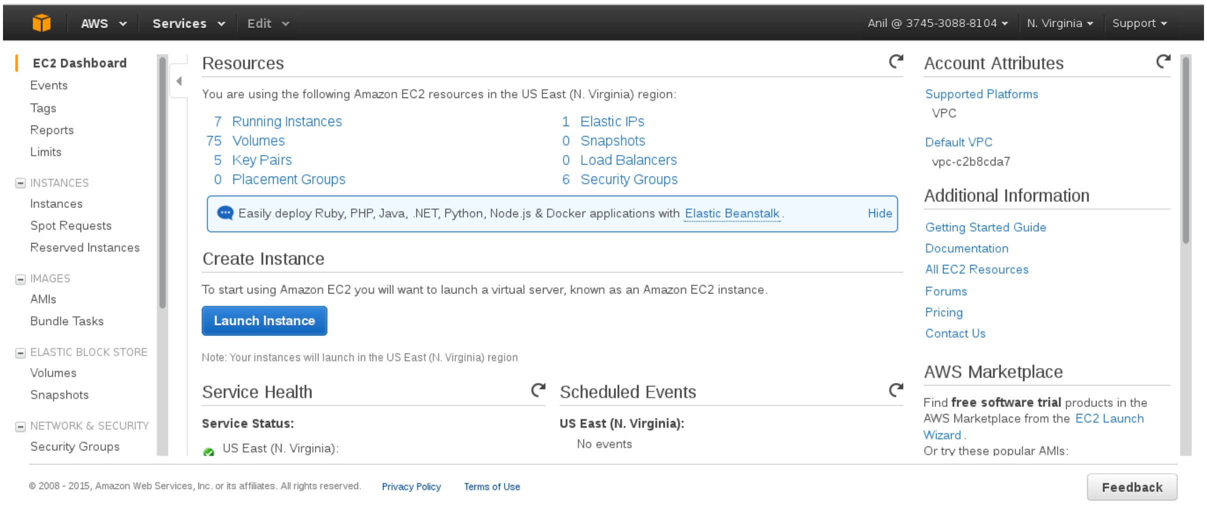
Table 2.1. Supported Configuration on Amazon Web Services

EBS Volume Type	Minimum Number of Volumes per Instance	Maximum Number of Volumes per Instance	EBS Volume Capacity Range	Brick Range
Magnetic	1	24	1 GiB - 1 TiB	1 GiB - 24 TiB
General purpose SSD	1	24	1 GiB - 16 TiB	1GiB - 384 TiB
PIOPS SSD	1	24	4 GiB - 16 TiB	128 GiB - 384 TiB

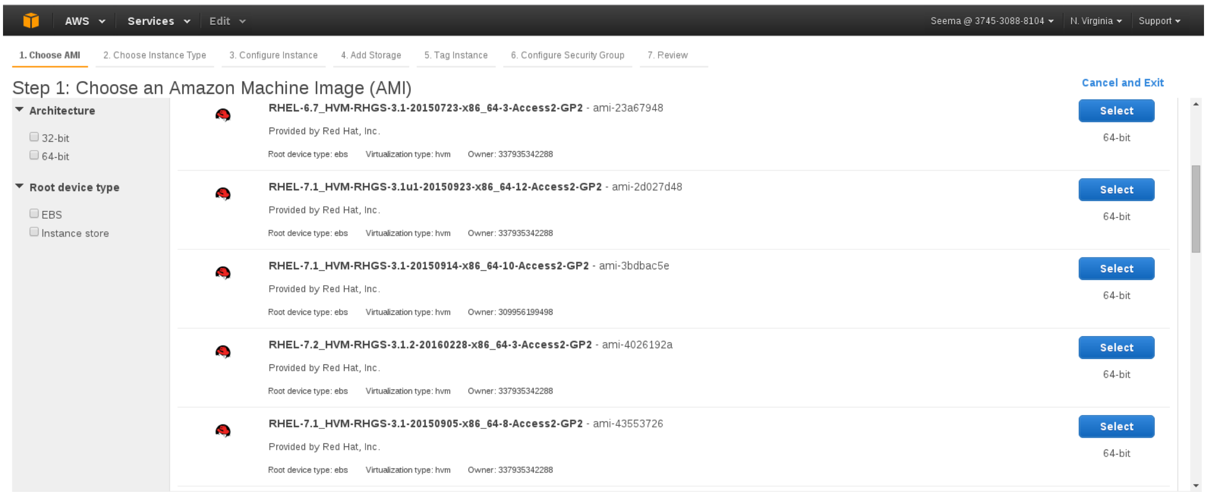
- There is a limit on the total provisioned IOPS per volume and the limit is 40,000. Hence, while adding 24 PIOPS SSD disks, you must ensure that the total IOPS of all disks does not exceed 40,000.
- Creation of Red Hat Gluster Storage volume snapshot is supported on magnetic, general purpose SSD and PIOPS EBS volumes. You can also browse the snapshot content using USS. See chapter *Managing Snapshots* in the *Red Hat Gluster Storage 3.1 Administration Guide* for information on managing Red Hat Gluster Storage volume snapshots.
- Tiering feature of Red Hat Gluster Storage is supported in the Amazon Web Service environment. You can attach bricks created out of PIOPS or general purpose SSD volumes as hot tier to an existing or new Red Hat Gluster Storage volume created out of magnetic EBS volumes. See chapter *Managing Tiering* in the *Red Hat Gluster Storage 3.1 Administration Guide* for information on creation of tiered volumes.

To launch the Red Hat Gluster Storage Instance

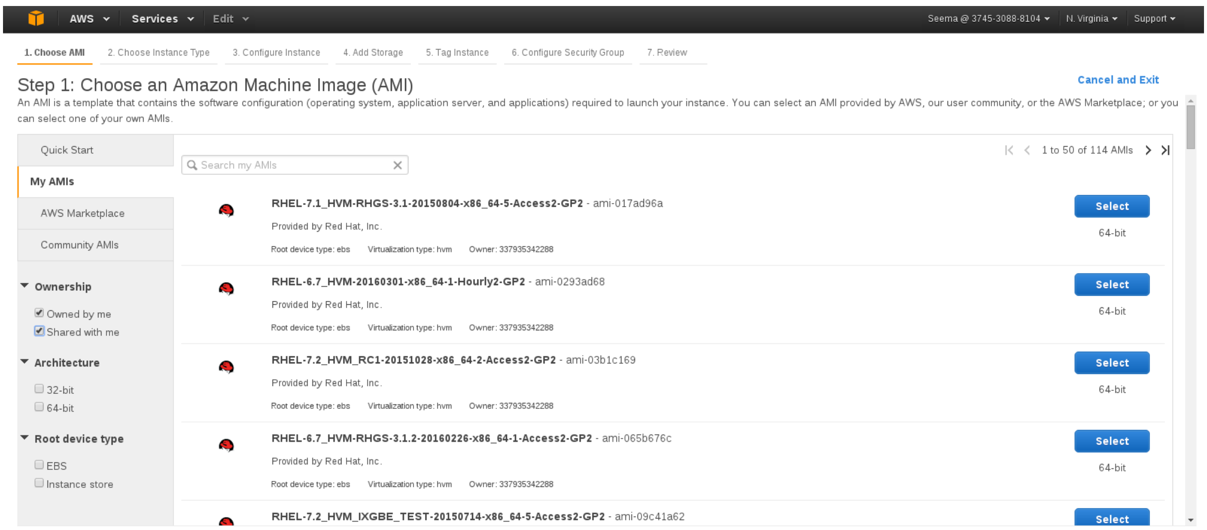
1. Navigate to the Amazon Web Services home page at http://aws.amazon.com. The Amazon Web Services home page appears.
2. Login to Amazon Web Services. The **Amazon Web Services** main screen is displayed.
3. Click the **Amazon EC2** tab. The **Amazon EC2 Console Dashboard** is displayed.



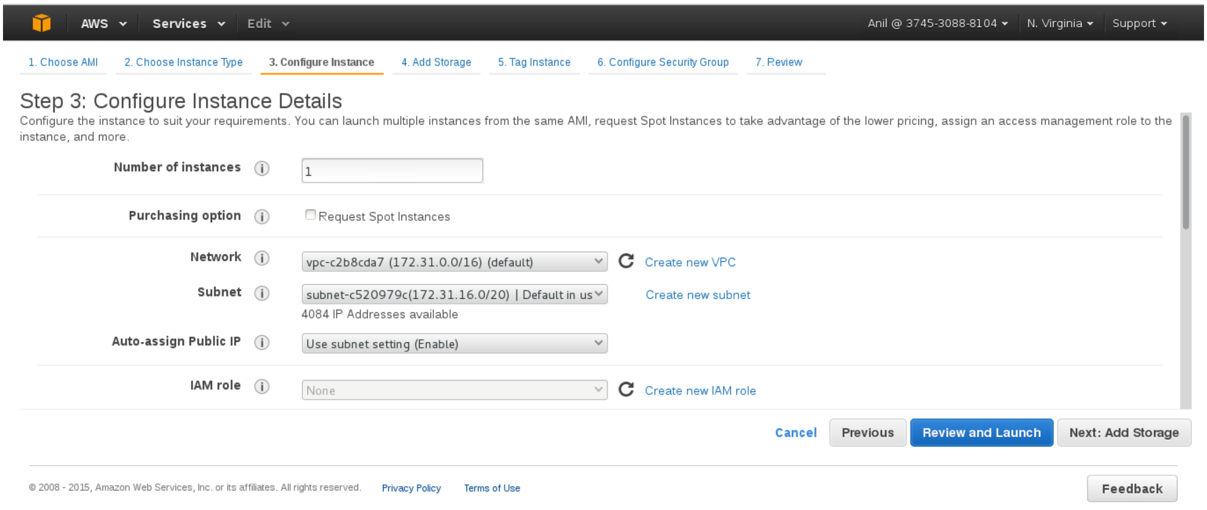
4. Click **Launch Instance**.The **Step 1: Choose an AMI** screen is displayed.



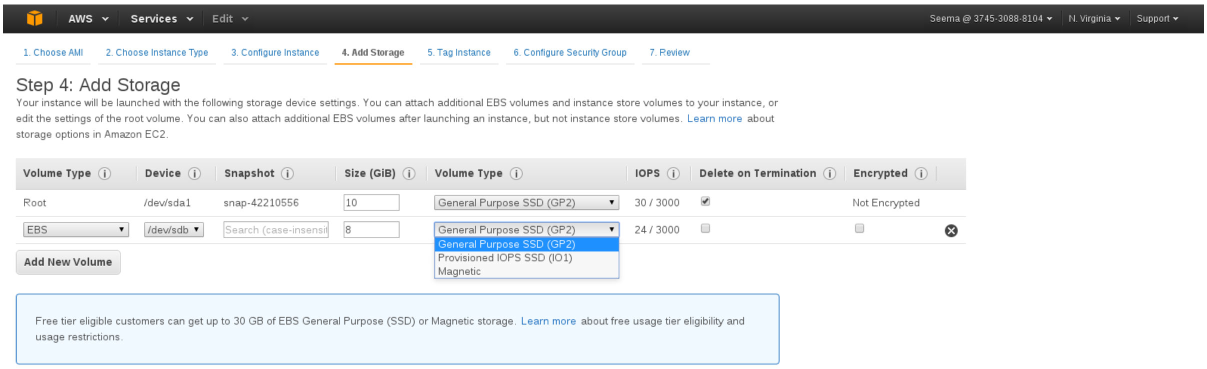
5. Click **My AMIs** and select **shared with me** checkbox. Click **Select** for the corresponding AMI and click **Next: Choose an Instance Type**. The **Step 2: Choose an Instance Type** screen is displayed.



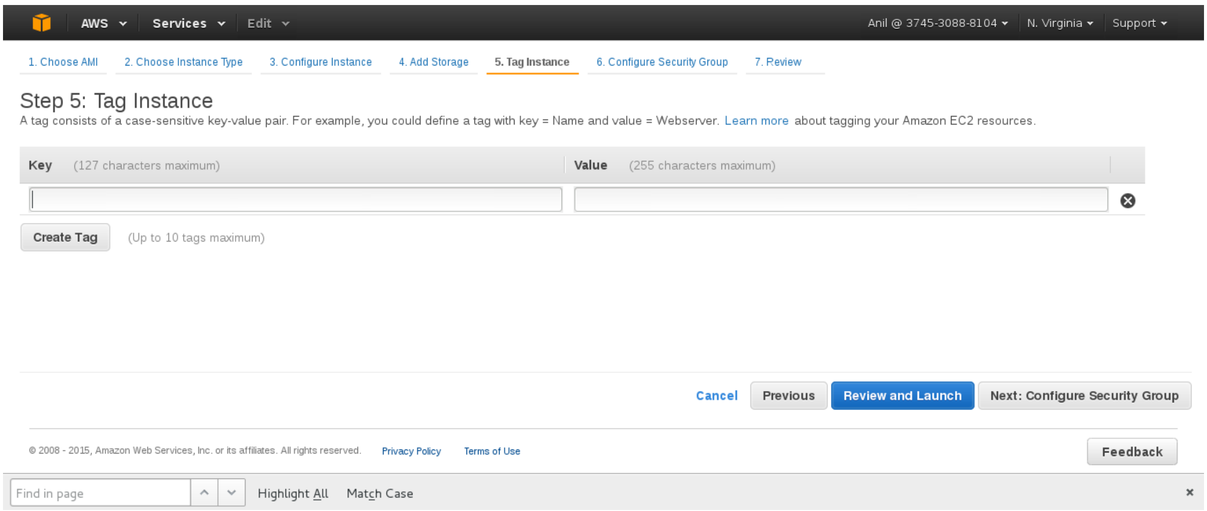
6. Select **Large** as the instance type, and click **Next: Configure Instance Details** . The **Step 3: Configure Instance Details** screen displays.



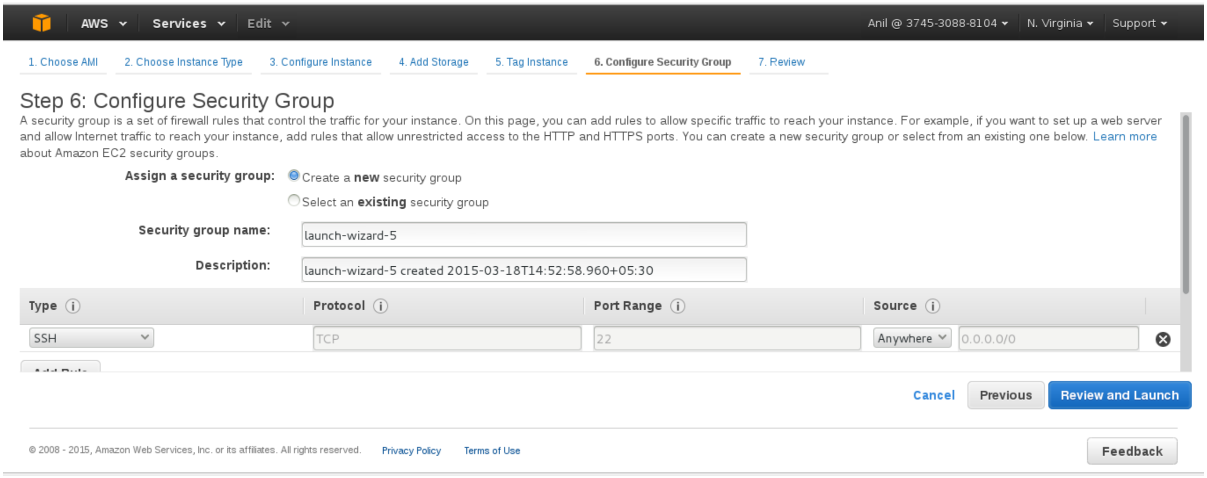
7. Specify the configuration for your instance or continue with the default settings, and click **Next: Add Storage** The **Step 4: Add Storage** screen displays.



8. In the **Add Storage** screen, specify the storage details and click **Next: Tag Instance**. The **Step 5: Tag Instance** screen is displayed.



9. Enter a name for the instance in the **Value** field for **Name**, and click **Next: Configure Security Group**. You can use this name later to verify that the instance is operating correctly. The **Step 6: Configure Security Group** screen is displayed.

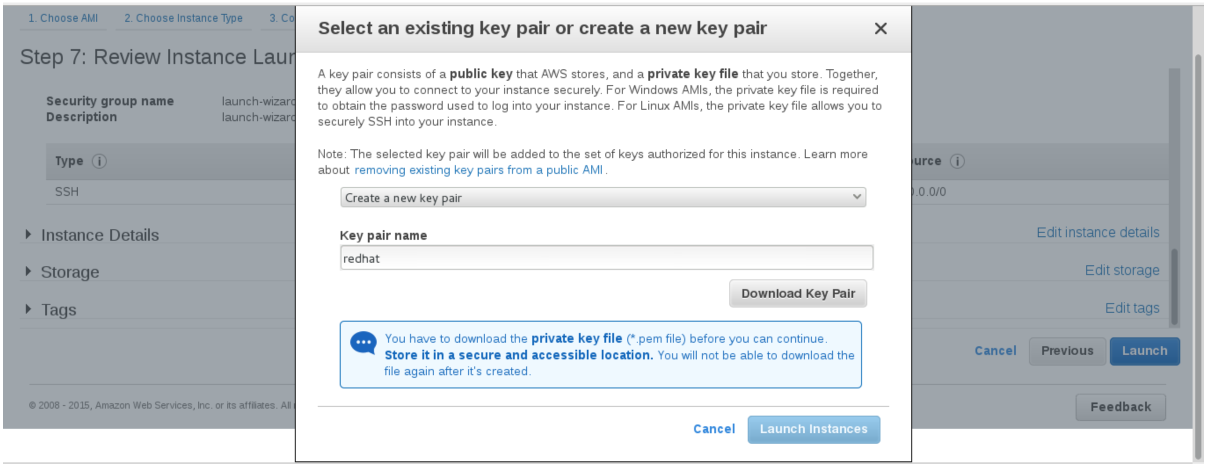


10. Select an existing security group or create a new security group and click **Review and Launch**.

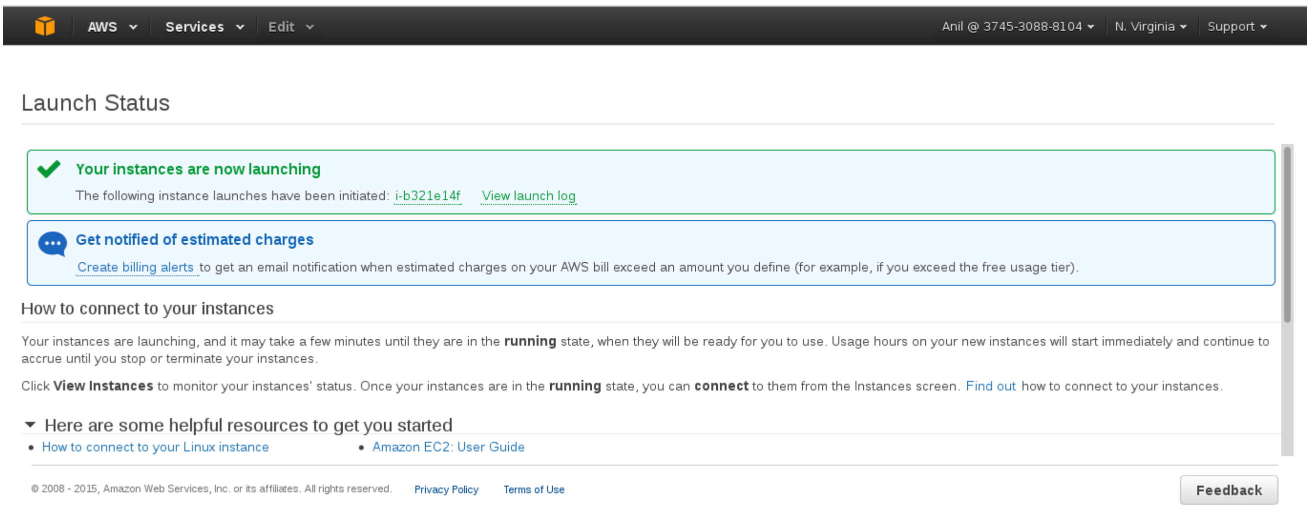
    You must ensure to open the following TCP port numbers in the selected security group:

    - 22
    - 6000, 6001, 6002, 443, and 8080 ports if Red Hat Gluster Storage for OpenStack Swift is enabled

11. Choose an existing key pair or create a new key pair, and click **Launch Instance**.



The **Launch Status** screen is displayed indicating that the instance is launching.

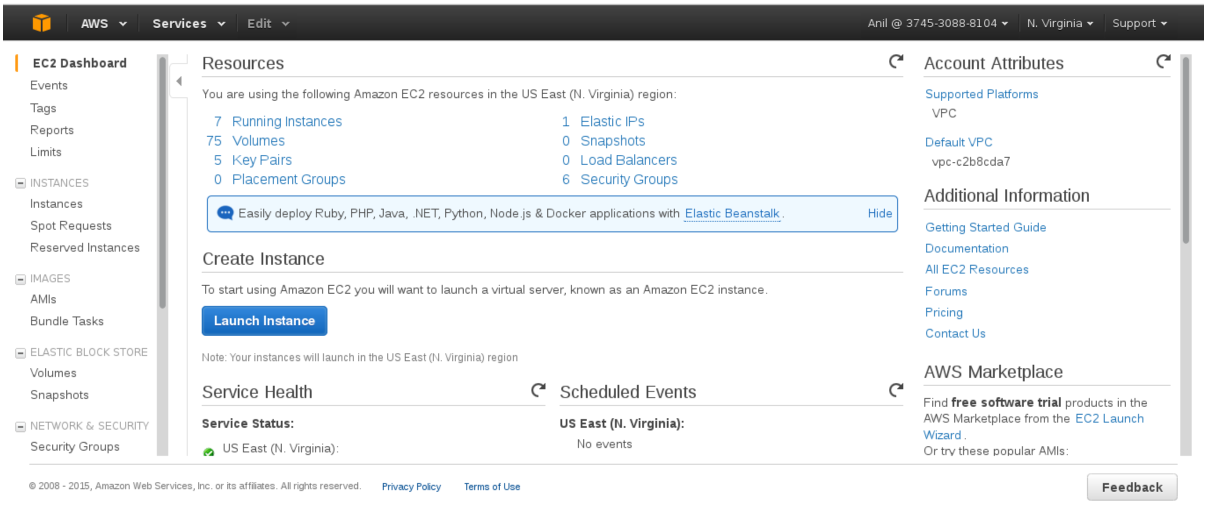


2.2. VERIFYING THAT RED HAT GLUSTER STORAGE INSTANCE IS RUNNING

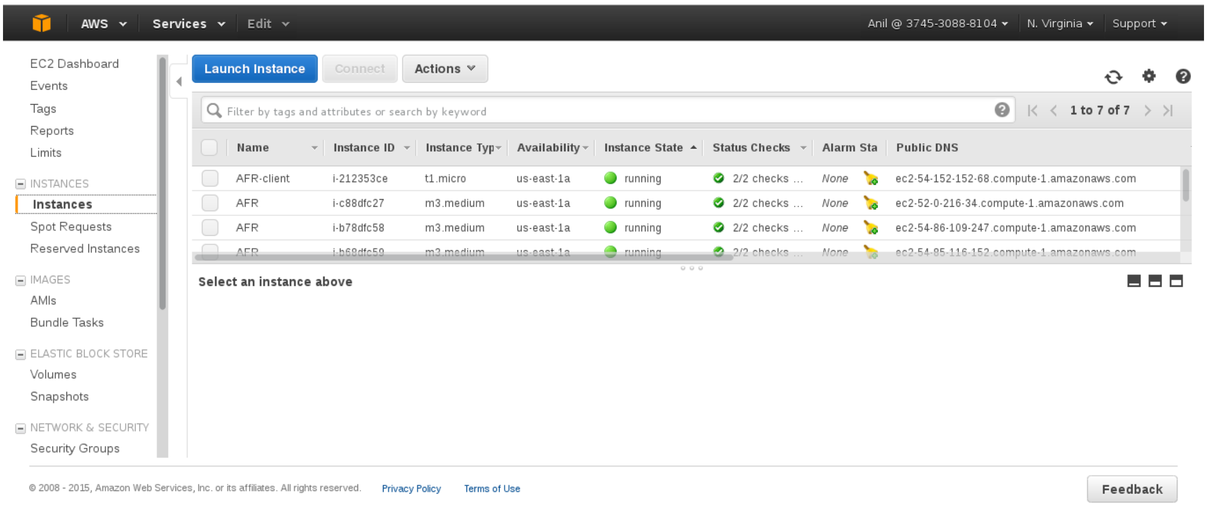
You can verify that Red Hat Gluster Storage instance is running by performing a remote login to the Red Hat Gluster Storage instance and issuing a command.

To verify that Red Hat Gluster Storage instance is running

1. On the Amazon Web Services home page, click the **Amazon EC2** tab. The **Amazon EC2 Console Dashboard** is displayed.

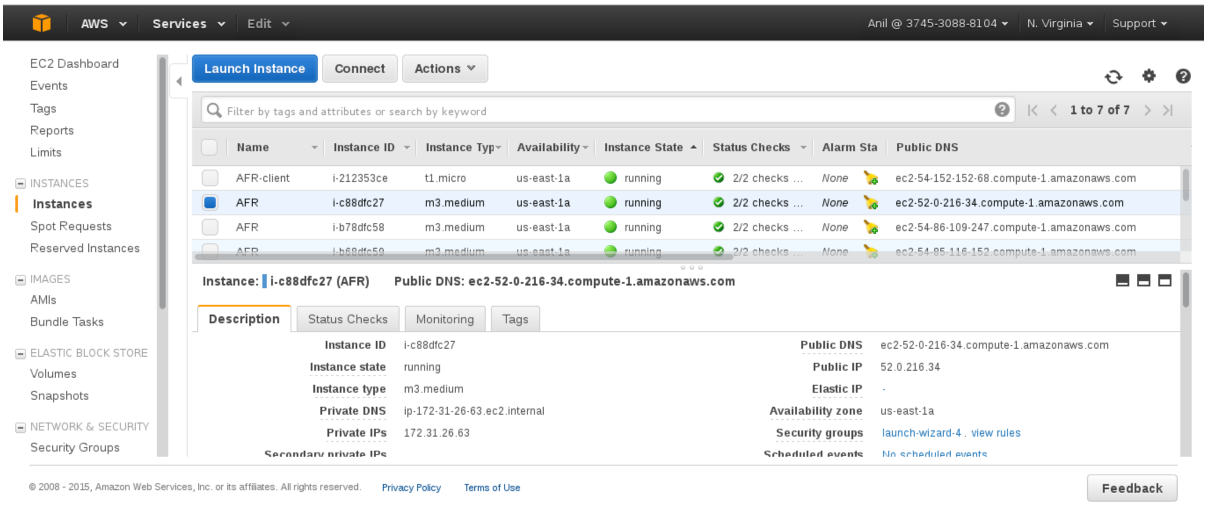


2. Click the **Instances** link from the **Instances** section on the left. The screen displays your current instances.



3. Check the Status column and verify that the instance is running. A yellow circle indicates a status of pending while a green circle indicates that the instance is running.

   Click the instance and verify the details displayed in the **Description** tab.



4. Note the domain name in the **Public DNS** field. You can use this domain to perform a remote login to the instance.

5. Using SSH and the domain from the previous step, login to the Red Hat Amazon Machine Image instance. You must use the key pair that was selected or created when launching the instance.

   Example:

   Enter the following in command line:

   ```
   # ssh -i rhs-aws.pem ec2-user@ec2-23-20-52-123.compute-
   1.amazonaws.com
   # sudo su
   ```

6. At the command line, enter the following command:

   `# service glusterd status`

   Verify that the command indicates that the **`glusterd`** daemon is running on the instance.

   NOTE

   Samba and NFS-Ganesha channels are disabled by default. To use standalone Samba and NFS-Ganesha, perform the following steps to enable the repos and install the relevant packages.

   - For enabling the Red Hat Gluster Storage Samba repo, run the following command:

     ```
     # yum-config-manager --enable rhui-REGION-rh-gluster-3-samba-for-
     rhel-6-server-rpms
     ```

   - For enabling the Red Hat Gluster Storage NFS-Ganesha repo, run the following command:

     ```
     # yum-config-manager --enable rhui-REGION-rh-gluster-3-nfs-for-
     rhel-6-server-rpms
     ```

IMPORTANT

Before using **yum update** to update the Amazon EC2 Red Hat Gluster Storage AMI, follow the steps listed in https://access.redhat.com/solutions/1556793 Knowledgebase article.

2.3. PROVISIONING STORAGE

Amazon Elastic Block Storage (EBS) is designed specifically for use with Amazon EC2 instances. Amazon EBS provides storage that behaves like a raw, unformatted, external block device.

IMPORTANT

External snapshots, such as snapshots of a virtual machine/instance, where Red Hat Gluster Storage Server is installed as a guest OS or FC/iSCSI SAN snapshots are not supported.

2.3.1. Provisioning Storage for Two-way Replication Volumes

The supported configuration for two-way replication is upto 24 Amazon EBS volumes of equal size, attached as a brick, which enables consistent I/O performance.

Single EBS volumes exhibit inconsistent I/O performance. Hence, other configurations are not supported by Red Hat.

To Add Amazon Elastic Block Storage Volumes

1. Login to Amazon Web Services at http://aws.amazon.com and select the **Amazon EC2** tab.

2. In the **Amazon EC2 Dashboard** select the **Elastic Block Store > Volumes** option to add the Amazon Elastic Block Storage Volumes

3. Create a thinly provisioned logical volume using the following steps:

   1. Create a physical volume (PV) by using the **pvcreate** command.

      For example:

      ```
      # pvcreate --dataalignment 1280K /dev/sdb
      ```

      NOTE

      - Here, **/dev/sdb** is a storage device. This command has to be executed on all the disks if there are multiple volumes. For example:

        ```
        # pvcreate --dataalignment 1280K /dev/sdc /dev/sdd
        /dev/sde ...
        ```

      - The device name and the alignment value will vary based on the device you are using.

      Use the correct **dataalignment** option based on your device. For more information, see section *Brick Configuration* in the *Red Hat Gluster Storage 3.1 Administration Guide*.

2. Create a Volume Group (VG) from the PV using the **vgcreate** command:

   For example:

   ```
   # vgcreate --physicalextentsize 128K rhs_vg /dev/sdb
   ```

   NOTE

   Here, **/dev/sdb** is a storage device. This command has to be executed on all the disks if there are multiple volumes. For example:

   ```
   # vgcreate --physicalextentsize 128K rhs_vg /dev/sdc
   /dev/sdd /dev/sde ...
   ```

3. Create a thin-pool using the following commands:

   1. Create an LV to serve as the metadata device using the following command:

      ```
      # lvcreate -L metadev_sz --name metadata_device_name VOLGROUP
      ```

      For example:

      ```
      # lvcreate -L 16776960K --name rhs_pool_meta rhs_vg
      ```

   2. Create an LV to serve as the data device using the following command:

      ```
      # lvcreate -L datadev_sz --name thin_pool VOLGROUP
      ```

      For example:

      ```
      # lvcreate -L 536870400K --name rhs_pool rhs_vg
      ```

   3. Create a thin pool from the data LV and the metadata LV using the following command:

      ```
      # lvconvert --chunksize STRIPE_WIDTH --thinpool
      VOLGROUP/thin_pool --poolmetadata
      VOLGROUP/metadata_device_name --zero n
      ```

      For example:

      ```
      # lvconvert --chunksize 1280K --thinpool rhs_vg/rhs_pool --
      poolmetadata rhs_vg/rhs_pool_meta --zero n
      ```

      NOTE

      By default, the newly provisioned chunks in a thin pool are zeroed to prevent data leaking between different block devices. In the case of Red Hat Gluster Storage, where data is accessed via a file system, this option can be turned off for better performance.

4. Create a thinly provisioned volume from the previously created pool using the **lvcreate** command:

   For example:

   ```
   # lvcreate -V 1G -T rhs_vg/rhs_pool -n rhs_lv
   ```

   It is recommended that only one LV should be created in a thin pool.

4. Format the logical volume using the following command:

   ```
   # mkfs.xfs -i size=512 DEVICE
   ```

   For example, to format **/dev/glustervg/glusterlv**:

   ```
   # mkfs.xfs -i size=512 /dev/glustervg/glusterlv
   ```

5. Mount the device using the following commands:

   ```
   # mkdir -p /export/glusterlv
   # mount /dev/glustervg/glusterlv /export/glusterlv
   ```

6. Using the following command, add the device to **/etc/fstab** so that it mounts automatically when the system reboots:

   ```
   # echo "/dev/glustervg/glusterlv /export/glusterlv xfs defaults 0 2"
   >> /etc/fstab
   ```

After adding the EBS volumes, you can use the mount point as a brick with existing and new volumes. For more information on creating volumes, see chapter *Red Hat Gluster Storage Volumes* in the *Red Hat Gluster Storage 3.1 Administration Guide*..

2.3.2. Provisioning Storage for Three-way Replication Volumes

Red Hat Gluster Storage supports synchronous three-way replication across three availability zones. The supported configuration for three-way replication is upto 24 Amazon EBS volumes of equal size, attached as a brick, which enables consistent I/O performance.

1. Login to Amazon Web Services at http://aws.amazon.com and select the **Amazon EC2** tab.

2. Create three AWS instances in three different availability zones. All the bricks of a replica pair must be from different availability zones. For each replica set, select the instances for the bricks from three different availability zones. A replica pair must not have a brick along with its replica from the same availability zone.

3. Add single EBS volume to each AWS instances

4. Create a thinly provisioned logical volume using the following steps:

   1. Create a physical volume (PV) by using the **pvcreate** command.

      For example:

      ```
      # pvcreate --dataalignment 1280K /dev/sdb
      ```

NOTE

- Here, **/dev/sdb** is a storage device. This command has to be executed on all the disks if there are multiple volumes. For example:

  ```
  # pvcreate --dataalignment 1280K /dev/sdc /dev/sdd
  /dev/sde ...
  ```

- The device name and the alignment value will vary based on the device you are using.

Use the correct **dataalignment** option based on your device. For more information, see section *Brick Configuration* in the *Red Hat Gluster Storage 3.1 Administration Guide*.

2. Create a Volume Group (VG) from the PV using the **vgcreate** command:

   For example:

   ```
   # vgcreate --physicalextentsize 128K rhs_vg /dev/sdb
   ```

   NOTE

   Here, **/dev/sdb** is a storage device. This command has to be executed on all the disks if there are multiple volumes. For example:

   ```
   # vgcreate --physicalextentsize 128K rhs_vg /dev/sdc
   /dev/sdd /dev/sde ...
   ```

3. Create a thin-pool using the following commands:

   1. Create an LV to serve as the metadata device using the following command:

      ```
      # lvcreate -L metadev_sz --name metadata_device_name VOLGROUP
      ```

      For example:

      ```
      # lvcreate -L 16776960K --name rhs_pool_meta rhs_vg
      ```

   2. Create an LV to serve as the data device using the following command:

      ```
      # lvcreate -L datadev_sz --name thin_pool VOLGROUP
      ```

      For example:

      ```
      # lvcreate -L 536870400K --name rhs_pool rhs_vg
      ```

   3. Create a thin pool from the data LV and the metadata LV using the following command:

```
# lvconvert --chunksize STRIPE_WIDTH --thinpool
VOLGROUP/thin_pool --poolmetadata
VOLGROUP/metadata_device_name
```

For example:

```
# lvconvert --chunksize 1280K --thinpool rhs_vg/rhs_pool --
poolmetadata rhs_vg/rhs_pool_meta
```

NOTE

By default, the newly provisioned chunks in a thin pool are zeroed to prevent data leaking between different block devices. In the case of Red Hat Gluster Storage, where data is accessed via a file system, this option can be turned off for better performance.

```
# lvchange --zero n VOLGROUP/thin_pool
```

For example:

```
# lvchange --zero n rhs_vg/rhs_pool
```

4. Create a thinly provisioned volume from the previously created pool using the **`lvcreate`** command:

   For example:

   ```
   # lvcreate -V 1G -T rhs_vg/rhs_pool -n rhs_lv
   ```

   It is recommended that only one LV should be created in a thin pool.

5. Format the logical volume using the following command:

   ```
   # mkfs.xfs -i size=512 DEVICE
   ```

   For example, to format **`/dev/glustervg/glusterlv`**:

   ```
   # mkfs.xfs -i size=512 /dev/glustervg/glusterlv
   ```

6. Mount the device using the following commands:

   ```
   # mkdir -p /export/glusterlv
   # mount /dev/glustervg/glusterlv /export/glusterlv
   ```

7. Using the following command, add the device to **`/etc/fstab`** so that it mounts automatically when the system reboots:

   ```
   # echo "/dev/glustervg/glusterlv /export/glusterlv xfs defaults 0 2"
   >> /etc/fstab
   ```

Client-side Quorum

You must ensure to create each replica set of a volume in three difference zones. With this configuration, there will be no impact on the data availability even if two availability zones have hit an outage. However, when you set **`client-side quorum`** to avoid split-brain scenarios, unavailability of two zones would make the access **`read-only`**.

For information on creating three-way replicated volumes, see section *Creating Three-way Replicated Volumes* and for information on configuring client-side quorum, see section *Configuring Client-Side Quorum* in the *Red Hat Gluster Storage 3.1 Administration Guide*.

2.4. STOPPING AND RESTARTING RED HAT GLUSTER STORAGE INSTANCE

When you stop and restart a Red Hat Gluster Storage instance, Amazon Web Services assigns the instance a new IP address and hostname. This results in the instance losing its association with the virtual hardware, causing disruptions to the trusted storage pool. To prevent errors, add the restarted Red Hat Gluster Storage instance to the trusted storage pool. See section *Adding Servers to the Trusted Storage Pool* in the *Red Hat Gluster Storage 3.1 Administration Guide*.

Rebooting the Red Hat Gluster Storage instance preserves the IP address and hostname and does not lose its association with the virtual hardware. This does not cause any disruptions to the trusted storage pool.

CHAPTER 3. ACCESSING RED HAT GLUSTER STORAGE USING MICROSOFT AZURE

Red Hat Gluster Storage is designed to provide a flexible file services layer for users and applications in a way that can be easily scaled to adjust to your workloads. Deployment flexibility is a key strength of Red Hat Gluster Storage. Gluster can be deployed to virtual or physical servers in on-premise environments, private clouds, and public clouds, including Microsoft Azure.

This chapter enables you to deploy a Red Hat Gluster Storage environment in Microsoft Azure. The procedures in this chapter uses ASM mode and ASM cross-platform CLI command for deployment..

Integration Architecture

The architecture of Microsoft Azure itself shapes the way solutions are designed. Microsoft Azure offers a cloud service that can function either as a platform-as-a-service (PaaS) or infrastructure-as-a-service (IaaS) environment. For Gluster Storage, the cloud service should be an IaaS layer that provides a logical container to deploy virtual instances to. Within the IaaS container, Microsoft Azure provides network services like DNS and DHCP, which makes managing the virtual instances similar to managing a physical deployment.

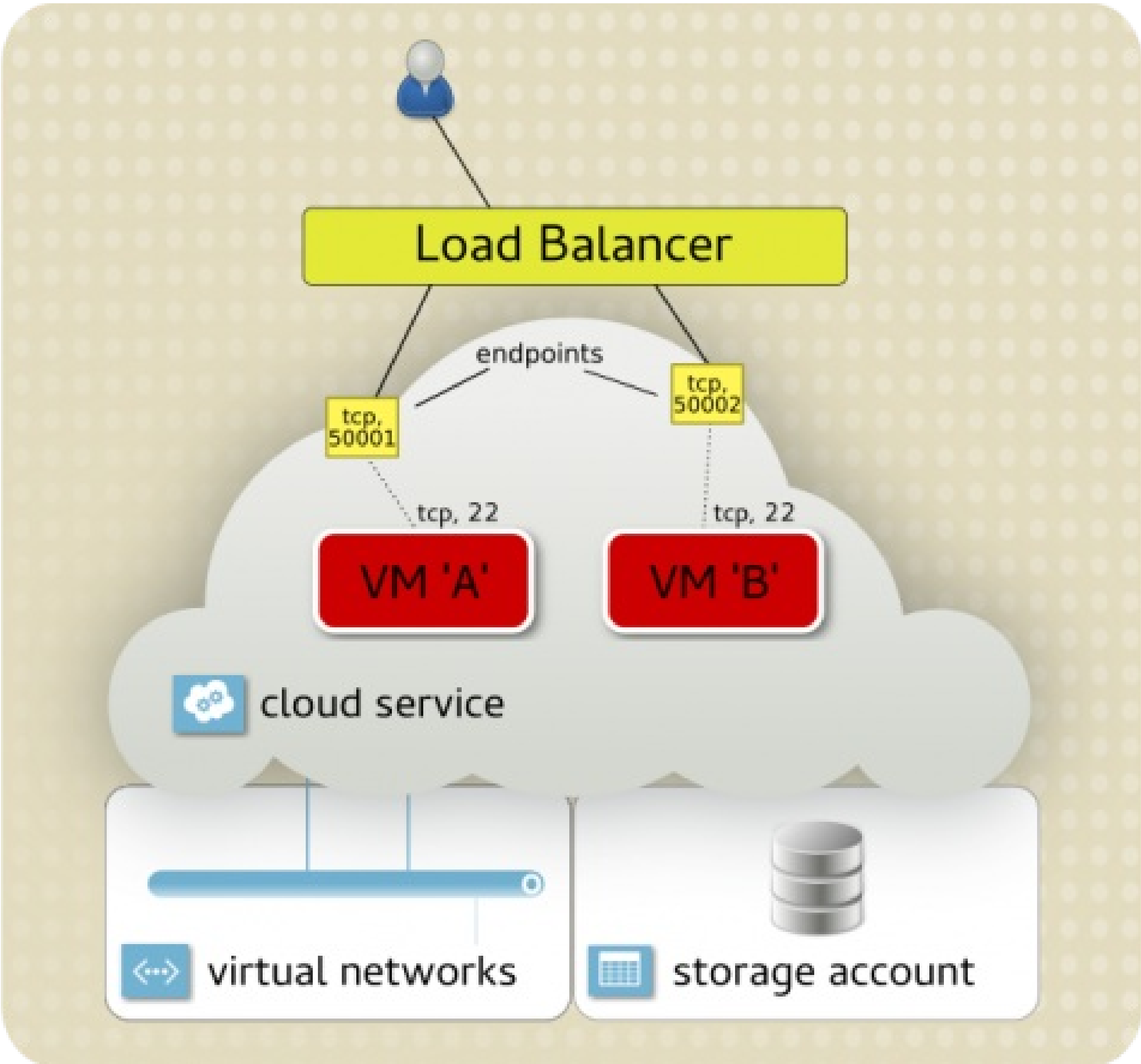


Figure 3.1. integration Architecture

A cloud service is defined by a name, which is a prefix applied to the **cloudapp.net** domain. Access to instances inside the cloud service is done by specifying the cloud service name and TCP port (endpoint). Most typically, this is SSH access. For example, you may have 30 virtual instances running inside a cloud service, so accessing them individually is done by exposing a different endpoint for each instance: **`50,001`** links to port 22 on instance A, and **`50,002`** links to port 22 on instance B.

A virtual network allows greater control and connectivity for instances inside a cloud service. Virtual networks can be configured to function purely within the Microsoft Azure infrastructure or can be used to connect on-premise networks to cloud services through site-to-site VPN connections.

The last key architecture element is the storage account. A storage account provides access to storage services within Microsoft Azure. The account provides a unique namespace for data and supports a number of access protocols, including blob, table, queue, and file. Data can be stored physically either on SSD (premium) or HDD (standard).

The workflow described in this chapter creates Red Hat Gluster Storage cluster.

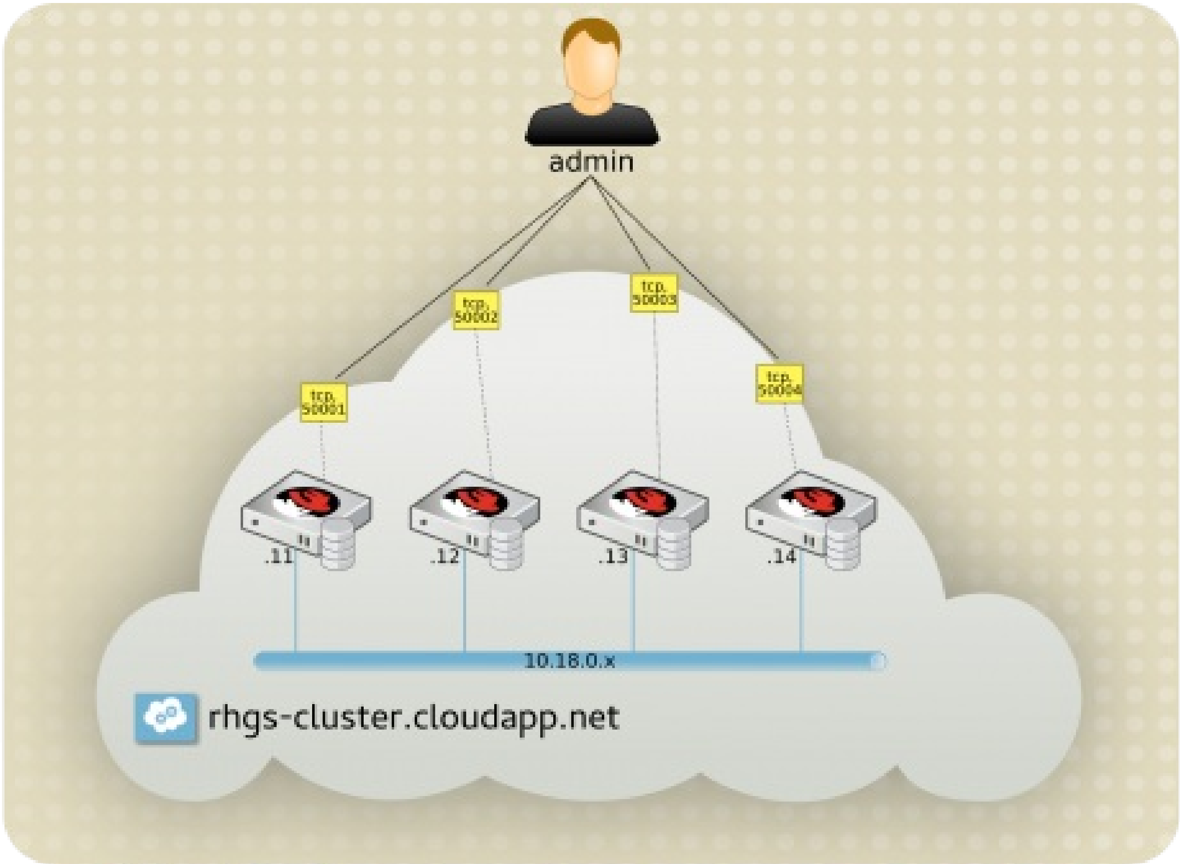


Figure 3.2. Microsoft Azure and Red Hat Gluster Storage workflow

IMPORTANT

The following features of Red Hat Gluster Storage Server is not supported on Microsoft Azure:

- Red Hat Gluster Storage Console and Nagios Monitoring

- NFS-Ganesha and CIFS High Availability

3.1. IMAGE PROFILE AND SIZING

Microsoft Azure offers various virtual machine configurations to choose from, based on the projected workload. The example configuration assumes a Standard Tier/A2 instance.

As a guide, the tasks performed within this chapter are based on the Standard Tier/A2 instance size:

NOTE

A minimum of two cores is required for each instance of Red Hat Gluster Storage.

In addition to the operating system disk, Microsoft Azure also allocates every instance a resource disk. This is a non-persistent (ephemeral) disk, provided at runtime to the instance from the local storage on the physical host the instance is running on. The resource disk is visible at **`/mnt/resource`** and is configured by the Windows Azure Linux Agent to provide swap space and temporary storage for applications.

For each instance type, the Microsoft Azure portal shows a clear indication of the CPU core count and RAM, but it does not show the number of configurable disks that each instance supports. The number of configurable data disks ranges between 1 and 32, dependent upon the instance type.

Since Red Hat Gluster Storage is a storage platform, there are some additional planning considerations when sizing instances:

- A virtual disk has a maximum size of 1023 GB. Larger disk sizes can be accommodated by aggregating multiple 1023 GB disks together.

- Once a disk has been defined, its size cannot be changed easily. Because capacity costs in Microsoft Azure Standard Storage are based on use, not allocated space, it is recommended that all disks assigned to a Red Hat Gluster Storage node are 1023 GB.

- Although attributes like CPU, RAM, and disk count can be easily changed after an instance is created, networking characteristics cannot. When planning your configuration, consider the network topology and connectivity you need before the instance are created. Microsoft Azure instance supports multiple network cards and multiple virtual networks, but these types of advanced networking features are only configurable using the Windows Powershell.

3.2. PREREQUISITES

- Install the Microsoft Azure CLI based on the instructions listed at https://access.redhat.com/articles/uploading-rhel-image-to-azure#install-the-azure-cross-platform-cli-on-your-azure-administration-server-6.

- Migrate your subscriptions from Red Hat to Microsoft Azure based on the instructions listed at https://access.redhat.com/articles/migrating-to-red-hat-cloud-access.

It is also possible to manage Gluster Storage using the Windows Powershell environment based on the instructions at: https://azure.microsoft.com/en-in/documentation/articles/powershell-install-configure. But that is not listed in this chapter. All of the procedures here will use the Microsoft Azure CLI.

3.3. PLANNING GUIDELINES

The following are the guidelines for setting up Red Hat Gluster Storage on Microsoft Azure.

- Designate a management server for interaction and control with Microsoft Azure services. For simple Gluster Storage deployments (single site, single NIC), the management platform can be a Linux server/workstation. For more complex deployments, a Windows desktop with Powershell is recommended.

- Build custom images based on Red Hat Enterprise Linux 7 with the Hyper-V drivers included within the initramfs file. **Instances will fail to start if these drivers are not present.**

- Use a virtual network for your Red Hat Gluster Storage nodes.

- For geo-replication, deploy a common **`/etc/hosts`** file to all nodes or use a shared DNS server.

- Pricing for standard storage is based on used capacity. It therefore makes sense to use the maximum size for data disks (1023 GB) and allocate as many as the instance supports at install time to minimize future administration overheads.

- If NFS is the preferred way to connect to the Gluster Storage nodes, consider using a **`D`** series instance that has a more modern CPU with a higher clock speed.

- Use availability sets to group Gluster Storage nodes within a replication set together to enhance availability.

- Use **`mdadm`** to combine disks to form a larger disk.

- Use fewer, larger virtual machines to deliver the highest capacity.

- For highly available data access, use a replicated GlusterFS volume with the native **`glusterfs`** client.

- Use a non-default SSH port for public access to the SSH services running on each of the Gluster Storage nodes (that is, use **--ssh** with **vm create**).

3.4. SETTING UP RED HAT GLUSTER STORAGE IN MICROSOFT AZURE

This section provides step-by-step instructions to set up Red Hat Gluster Storage in Microsoft Azure.

3.4.1. Obtaining Red Hat Gluster Storage for Microsoft Azure

To download the Red Hat Gluster Storage Server files using a Red Hat Subscription or a Red Hat Evaluation Subscription:

1. Visit the Red Hat Customer Service Portal at https://access.redhat.com/login and enter your user name and password to log in.

2. Click **`Downloads`** to visit the **`Software & Download Center`**.

3. In the Red Hat Gluster Storage Server area, click **Download Software** to download the latest version of the **`VHD`** image.

3.4.2. Define the Network Topology

By default, deploying an instance into a cloud service will pick up a dynamically assigned, internal IP address. This address may change and vary from site to site. For some configurations, consider defining one or more virtual networks within your account for instances to connect to. That establishes a networking configuration similar to an on-premise environment.

To create a simple network:

1. Create the cloud service for the Gluster Storage nodes.

```
# azure service create --serviceName service_name --location
location
```

For example,

```
# azure service create --serviceName rhgs313-cluster --location
"East US"
info:    Executing command service create
+ Creating cloud service
data:    Cloud service name rhgs313-cluster
info:    service create command OK
```

cloudapp.net will be appended to the service name, and the full service name will be exposed directly to the Internet. In this case, **rhgs313-cluster.cloudapp.net.**

2. Create a virtual network for the Gluster Storage nodes to connect to. In this example, the network is created within the East US location.

```
# azure network vnet create --vnet "rhgs313-vnet" --location "East
US" --address-space 10.18.0.0 --cidr 16
info:    Executing command network vnet create
info:    Using default subnet start IP: 10.18.0.0
info:    Using default subnet cidr: 19
+ Looking up network configuration
+ Looking up locations
+ Setting network configuration
info:    network vnet create command OK
```

This defines a network within a single region.

Features like geo-replication within Gluster Storage require a vnet-to-vnet configuration. A vnet-to-vnet configuration connects virtual networks through VPN gateways. Each virtual network can be within the same region or across regions to address disaster recovery scenarios. Joining VPNs together requires a shared key, and it is not possible to pass a shared key through the Microsoft Azure CLI. To define a vnet-to-vnet configuration, use the Windows Powershell or use the Microsoft Azure REST API.

3.4.3. Resizing Virtual Hard Disks

Virtual Hard Disk (VHD) images on Microsoft Azure must have a virtual size aligned to 1MB. Typically, VHDs created using Hyper-V should already be aligned correctly. If the VHD is not aligned correctly then you may receive an error message similar to the following when you attempt to create an image from your VHD:

```
"The VHD http://mystorageaccount.blob.core.windows.net/vhds/MyLinuxVM.vhd
has an unsupported virtual size of 21475270656 bytes. The size must be a
whole number (in MBs)."
```

To remedy this you can resize the VM using either the Hyper-V Manager console or the Resize-VHD Powershell cmdlet as per the instruction available at: http://technet.microsoft.com/library/hh848535.aspx. If you are not running in a Windows environment then it is recommended to use **qemu-img** to convert (if needed) and resize the VHD.

NOTE

There is a known bug in qemu-img versions >=2.2.1 that results in an improperly formatted VHD. The issue will be fixed in an upcoming release of qemu-img. For now it is recommended to use qemu-img version 2.2.0 or lower. For more information on the bug https://bugs.launchpad.net/qemu/+bug/1490611 .

1. Resizing the VHD directly using tools such as **qemu-img** or **vbox-manage** may result in an unbootable VHD. So it is recommended to first convert the VHD to a RAW disk image. If the VM image was already created as RAW disk image (the default for some Hypervisors such as KVM) then you may skip this step:

```
# qemu-img convert -f vpc -O raw rhgs313-cluster.vhd rhgs313-
cluster.raw
```

2. Calculate the required size of the disk image to ensure that the virtual size is aligned to 1MB. The following bash shell script can assist with this. The script uses **qemu-img info** to determine the virtual size of the disk image and then calculates the size to the next 1MB:

```
rawdisk="rhgs313-cluster.raw"
vhddisk="rhgs313-cluster.vhd"

MB=$((1024*1024))
size=$(qemu-img info -f raw --output json "$rawdisk" | \
       gawk 'match($0, /"virtual-size": ([0-9]+),/, val) {print
val[1]}')

rounded_size=$((($size/$MB + 1)*$MB))
echo "Rounded Size = $rounded_size"
```

3. Resize the raw disk using **$rounded_size** as set in the above script:

```
# qemu-img resize rhgs31-cluster.raw $rounded_size
```

4. Now, convert the RAW disk back to a fixed-size VHD:

```
# qemu-img convert -f raw -o subformat=fixed -O rhgs313-cluster.raw
rhgs313-cluster.vhd
```

3.4.4. Upload the Disk Image to Microsoft Azure

The disk image has now been prepared and can be uploaded and used as a template for Gluster Storage nodes.

NOTE

Microsoft Azure commands must be issued from the local account configured to use the xplat-cli.

To upload the image to Microsoft Azure, navigate to the directory where the VHD image is stored and run the following command:

```
# azure vm image create image_name --location location --os linux
VHD_image_name
```

For example,

```
 # azure vm image create rhgs-3.1.3 --location "East US" --os linux
rhgs313.vhd
 info:    Executing command vm image create
+ Retrieving storage accounts
info:    VHD size : 20 GB
info:    Uploading 20973568.5 KB
Requested:100.0% Completed:100.0% Running:   0 Time: 7m50s Speed:  3876
KB/s
info:    https://bauderhel7.blob.core.windows.net/vm-images/rhgs313.vhd
was uploaded successfully
info:    vm image create command OK
```

Once complete, confirm the image is available:

```
# azure vm image list | awk '$3 == "User" {print $2;}'
```

NOTE

The output of an instance image list will show public images as well as images specific to your account (User), so **awk** is used to display only the images added under the Microsoft Azure account.

3.4.5. Deploy the Gluster Storage Instances

Individual Gluster Storage instances in Microsoft Azure can be configured into a cluster. You must first create the instances from the prepared image and then attach the data disks.

1. To create instances from the prepared image

```
# azure vm create --vm-name vm_name --availability-set
name_of_the_availability_set --vm-size size --virtual-network-name
vnet_name --ssh port_number --connect cluster_name
username_and_password
```

For example,

```
# azure vm create --vm-name rhgs313-1 --availability-set AS1 -S
10.18.0.11 --vm-size Medium --virtual-network-name rhgs313-vnet --
ssh 50001 --connect rhgs313-cluster rhgs-3.1.3  rhgsuser
'AzureAdm1n!'
 info:    Executing command vm create
+ Looking up image rhgs-313
+ Looking up virtual network
+ Looking up cloud service
+ Getting cloud service properties
```

```
 + Looking up deployment
+ Creating VM
info:    OK
info:    vm create command OK
```

2. Adding 1023 GB data disk to each of the instances.

```
# azure vm disk attach-new VM_name 1023
```

For example

```
# azure vm disk attach-new rhgs313-1 1023
info:    Executing command vm disk attach-new
+ Getting virtual machines
+ Adding Data-Disk
info:    vm disk attach-new command OK
```

3. Perform the above steps of creating instances and attaching disks for all the instances

4. Confirm that the instances have been properly created:

```
# azure vm list
# azure vm show vm-name
```

- A Microsoft Azure availability set provides a level of fault tolerance to the instances it holds, protecting against system failure or planned outages. This is achieved by ensuring instances within the same availability set are deployed across different fault and upgrade domains within a Microsoft Azure datacenter.

- When Gluster Storage replicates data between bricks, associate the replica sets to a specific availability set. By using availability sets in the replication design, incidents within the Microsoft Azure infrastructure cannot affect all members of a replica set simultaneously.

- Each instance is assigned a static IP (**-S**) within the **rhgs--** virtual network and an endpoint added to the cloud service to allow SSH access (**--ssh port**).

- There are single quotation marks (') around the password to prevent bash interpretation issues.

Example

Following is the example for creating four instances from the prepared image.

- They are named **rhgs31-n** .

- Their IP address are 10.18.0.11 to 10.18.0.14.

As the instances are created (**azure vm create**), they can be added to the same availability set (**--availability-set**).

```
for i in 1 2 3 4; do as=$((i/3)); azure vm create --vm-name rhgs31-$i --
availability-set AS$as -S 10.18.0.1$i --vm-size Medium --virtual-network-
name rhgs-vnet --ssh 5000$i --connect rhgs-cluster rhgs3.1 rhgsuser
'AzureAdm1n!'; done
```

Add four 1023 GB data disks to each of the instances.

```
for node in 1 2 3 4; do for disk in 1 2 3 4; do azure vm disk attach-new
rhgs31-$node 1023; done ; done
```

Confirm that the instances have been properly created:

```
# azure vm list
# azure vm show vm-name
```

NOTE

This example uses static IP addresses, but this is not required. If you’re creating a single Gluster Storage cluster and do not need features like geo-replication, it is possible to use the dynamic IPs automatically assigned by Microsoft Azure. The only important thing is that the Gluster Storage cluster is defined by name.

3.4.6. Configure the Gluster Storage Cluster

Configure these instances to form a trusted storage pool (cluster).

NOTE

If you are using Red Hat Enterprise Linux 7 machines, log in to the Azure portal and reset the password for the VMs and also restart the VMs. On Red Hat Enterprise Linux 6 machines, password reset is not required.

1. Log into each node.

   ```
   # ssh rhgsuser@rhgs313-cluster.cloudapp.net -p 50001
   ```

2. Register each node to Red Hat Network using the **`subscription-manager`** command, and attach the relevant Red Hat Storage subscriptions.

   For information on registering to the Red Hat Network, see https://access.redhat.com/documentation/en-US/Red_Hat_Storage/3.1/html-single/Installation_Guide/index.html#chap-Installing_Red_Hat_Storage-Subscribing-RHGS

3. Update each node to ensure the latest enhancements and patches are in place.

   ```
   # yum update
   ```

4. Follow the instructions in the Red Hat Gluster Storage Administration Guide to create the trusted storage pool: https://access.redhat.com/documentation/en-US/Red_Hat_Storage/3.1/html/Administration_Guide/chap-Trusted_Storage_Pools.html.

3.5. APPENDIX - CREATING A CUSTOM DISK IMAGE FROM ISO

Instances within Microsoft Azure are created from disk images. Gluster Storage requires a custom image, rather than one of the default Microsoft Azure-supplied images. Building custom virtual machine images is typically done with Hyper-V, but custom images for Microsoft Azure can also be built using native Linux tools.

The overall process to configure a custom image takes about 30 minutes.

1. Download the latest ISO for Gluster Storage from here: https://access.redhat.com/downloads/content/186/ver=3.1/rhel---7/3.1/x86_64/product-software

2. Using **virt-manager**, create a qcow2 image with two cores, 4 GB RAM, 20 GB virtio HDD, and a single NIC.

3. Boot the instance from the ISO image and complete the installation of Gluster Storage. Do not allocate swap space since the Windows Azure agent sets up an ephemeral disk at runtime for swap space.

4. Reboot the instance and log in.

5. Set a generic hostname.

   On Red Hat Enterprise Linux 7:

   ```
   # hostnamectl set-hostname localhost.localdomain
   ```

   On Red Hat Enterprise Linux 6:

   ```
   # vim /etc/sysconfig/network

   NETWORKING=yes
   HOSTNAME=localhost.localdomain
   ```

6. Confirm that DHCP is configured in **/etc/sysconfig/network-scripts/ifcfg-eth0.**

   ```
   DEVICE=eth0
   ONBOOT=yes
   BOOTPROTO=dhcp
   IPV6INIT=no
   TYPE=Ethernet
   USERCTL=no
   PEERDNS=yes
   ```

7. Update the udev rules to avoid conflicts with Microsoft Azure and Hyper-V.

   ```
   # rm -f /etc/udev/rules.d/70-persistent-net.rules
   # rm -f /lib/udev/rules.d/75-persistent-net-generator.rules
   ```

8. On Red Hat Enterprise Linux 7, apply the default firewall rules for Gluster Storage. These rulesets are used for inter-node communication, the GlusterFS client, and NFS.

   ```
   # firewall-cmd --zone=public --add-service=glusterfs --permanent
   # firewall-cmd --zone=public --add-service=nfs --add-service=rpc-
   bind --permanent
   ```

9. Register the virtual machine.

   ```
   # subscription-manager register --auto-attach
   # subscription-manager repos --disable=*
   ```

10. Enable the Extras and Gluster Storage repositories. This is either rhel-6- or rhel-7-.

```
# subscription-manager repos --enable rhel-7-server-rpms --enable
rhel-7-server-extras-rpms --enable rh-gluster-3-for-rhel-7-server-
rpms
```

11. Update the system and install the Microsoft Azure Linux agent.

    ```
    # yum update –y
    # yum –y install WALinuxAgent
    ```

12. Disable any swap space defined during the Gluster Storage installation. This is required on Red Hat Enterprise Linux 7. Microsoft Azure allocates ephemeral storage at runtime, which is used for swap, so swap space does not need to be explicitly defined.

    ```
    # swapoff -v /dev/rhgs/swap
    # sed -i '/.* swap/d' /etc/fstab
    ```

    On Red Hat Enterprise Linux 6, the installer enables disk configuration to be changed, so the swap is not defined. However, if a logical volume was created, then remove the configuration as on RHEL 7.

13. **Red Hat Enterprise Linux 7 only**. A Linux virtual machine running in Azure requires the hv_storvsc and hv_vmbus drivers within the initramfs image. The Red Hat Enterprise Linux 6 installer includes these drivers automatically, but under Red Hat Enterprise Linux 7, the installer only adds these drivers if Hyper-V devices are detected at installation time. When building a virtual machine image using virt-manager, add these Hyper-V drivers manually.

    1. Add the following content to **`/etc/dracut.conf.`**.

    2. Regenerate **`initramfs.`**

       ```
       # dracut -f -v
       ```

14. Update the kernel boot settings.

    On Red Hat Enterprise Linux 7:

    1. Set the GRUB_CMDLINE_LINUX variable in /etc/default/grub.

       ```
       ``rd.lvm.lv=rhgs/root console=ttyS0 earlyprintk=ttyS0
       rootdelay=300
       ```

    2. Refresh the grub2 configuration.

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

    3. Remove the rhqb, quiet, or crashkernel=auto parameters.

    On Red Hat Enterprise Linux 6:

    1. Update the kernel boot line in /boot/grub/menu.lst:

       ```
       console=ttyS0 earlyprintk=ttyS0 rootdelay=300 numa=off
       ```

2. Remove the rhqb, quiet, or crashkernel=auto parameters.

15. Enable the Windows Azure agent to start at boot.

    - On Red Hat Enterprise Linux 7:.

```
# systemctl enable waagent
```

    - On Red Hat Enterprise Linux 6:.

```
# chkconfig waagent on
```

16. Unregister the virtual machine using Red Hat Subscription Manager.

```
# subscription-manager unregister
```

17. De-provision the instance to remove the local settings; this allows the instance to be used as a disk image within Microsoft Azure.

```
# yum clean all
# waagent -force -deprovision
# export HISTSIZE=0
# poweroff
```

18. Dump the XML of the instance to find the filename of the virtual disk that was created, and convert it to a Microsoft Azure compatible VHD file. In this example, the instance was initially created using the **qcow2** disk format.

```
# virsh dumpxml image-name
# qemu-img convert -f qcow2 -O vpc -o subformat=fixed -O vpc
rhgs313.qcow2 rhgs313.vhd
```

3.6. APPENDIX - PERFORMANCE CATEGORIZATION

There are a number of infrastructure and architectural factors that determine the potential performance that Red Hat Gluster Storage within Microsoft Azure can deliver.

3.6.1. Storage Type

Microsoft Azure offers two classes of physical storage: standard and premium. Standard storage is backed by hard disk drives, whereas premium storage is delivered by solid state drives. These classes of storage provide an IOPS target of 500 IOPS and 5,000 IOPS per disk, respectively.

A more general consideration is how the data are protected. By default, Microsoft Azure protects the data by synchronously storing three copies of data in separate failure domains, and then asynchronously places another three copies of the data in a secondary datacenter (a default GRS replication scheme).

3.6.2. Bandwidth

A simple test was performed using **iperf** to determine the upper limit between the client and Red Hat Gluster Storage node. This testing showed that a single network interface can be expected to deliver between 600 - 700 Mbit.

3.6.3. Disk Latencies

Four disks were attached to a Standard Tier/A2 instance and aggregated to form a RAID0 set using the **mdadm** tool. The LUN was then configured using recommended best practices, based on LVM, dm-thinp, and the XFS file system. The **fio** tool was then used to reveal the random read profile of the underlying disks at increasing levels of concurrency.

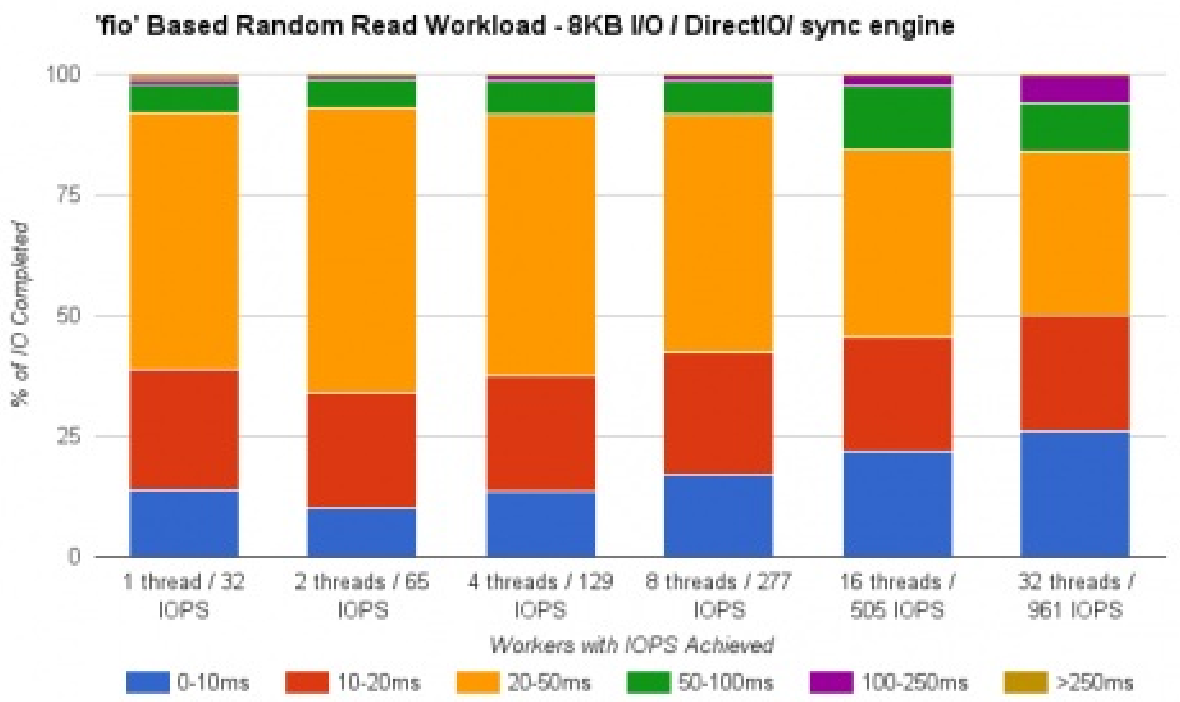


Figure 3.3. Disk Latencies

This benchmark does not produce a definitive result, but it indicates the potential I/O profile of the underlying storage.

Observations

- Typical latencies are in the 20 - 50 ms range.
- Attaining higher IOPS requires a multi-threaded workload; that is, one thread=32 IOPS, 32 threads = 961 IOPS.
- Combining the virtual drives with **mdadm** allows the LUN to deliver IOPS beyond that of a single virtual disk.

3.6.4. GlusterFS

The performance tests for Gluster Storage are only indicative and illustrate the expected performance from a similar environment. For the purposes of benchmarking, the smallfile tool has been used to simulate multiple concurrent file creations that are typical of user environments.

The create workload creates a series of 10 MB files within a nested directory hierarchy, exercising metadata operations as well as file creation and throughput.

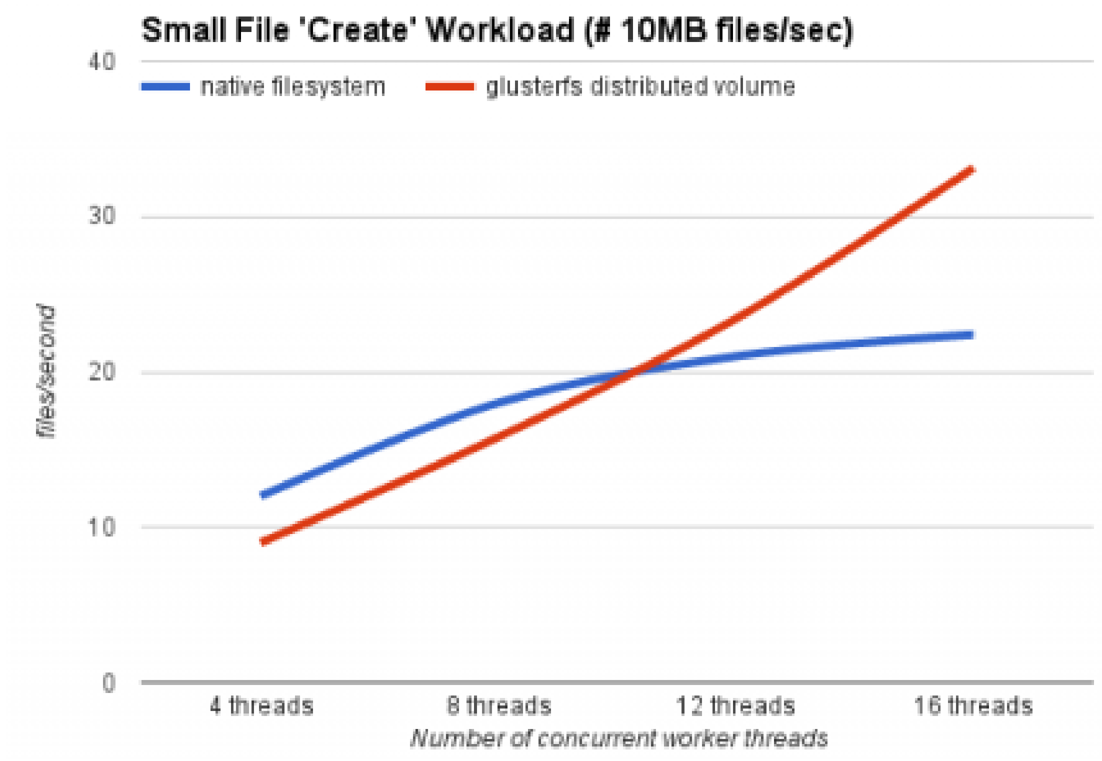
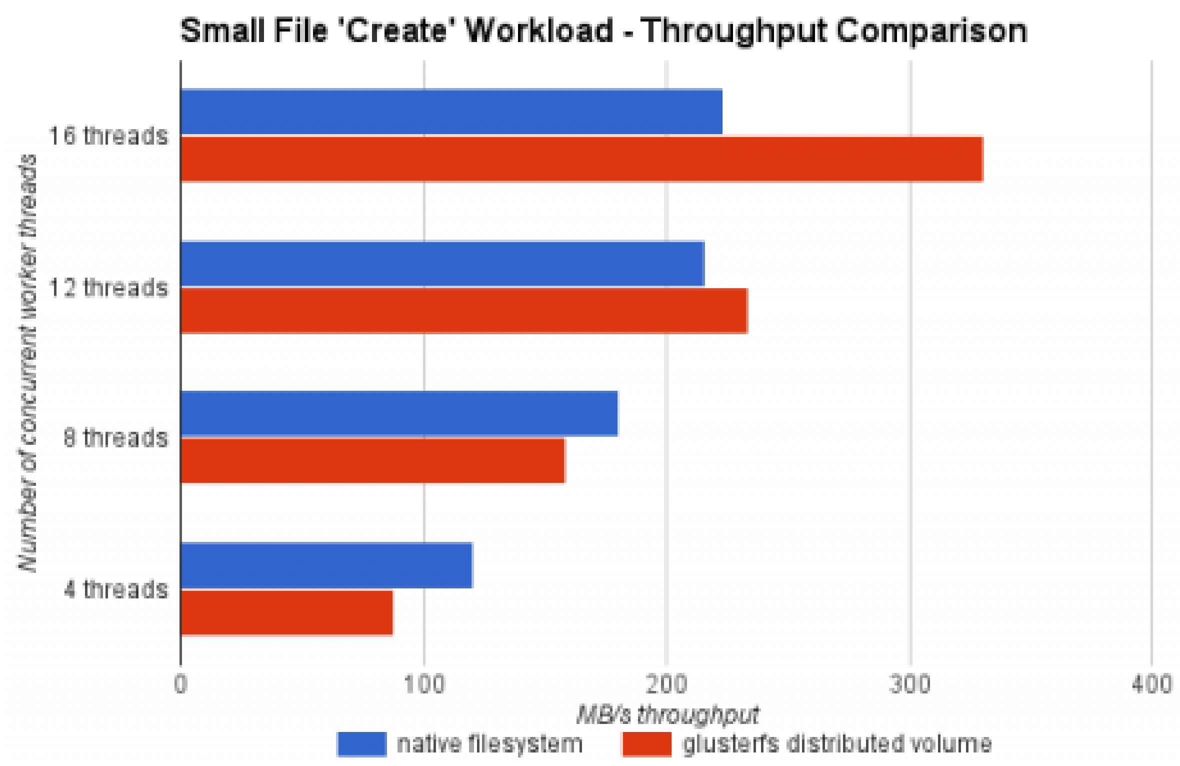


Figure 3.4. Gluster Performance: Small File "Create" Workload



Observations:

- Although the native file system starts well, a performance cross-over occurs between 8 - 12 threads, with the native file system fading and the GlusterFS volume continuing to scale.
- The throughput of the GlusterFS volume scales linearly with the increase in client workload.
- At higher concurrency, the GlusterFS volume outperforms the local file system by up to 47%.

- During high concurrency, the native file system slows down under load. Examining the disk subsystems statistics during the test run revealed the issue was increased I/O wait times (70 - 90%).

CHAPTER 4. USING RED HAT GLUSTER STORAGE IN THE GOOGLE CLOUD PLATFORM

Red Hat Gluster Storage provides support to the data needs of cloud-scale applications on Google Cloud Platform (GCP). Red Hat Gluster Storage provides software-defined file storage solution to run on GCP so that customer's applications can use traditional file interfaces with scale-out flexibility and performance.

At the core of the Red Hat Gluster Storage design is a completely new method of architecting storage. The result is a system that has immense scalability, is highly resilient, and offers extraordinary performance.

Google Cloud Platform Overview

The Google Cloud Platform is Google's public cloud offering, which provides many services to run a fully integrated cloud-based environment. The Google Compute Engine is what drives and manages the virtual machine environment. **This chapter is based on this virtual machine infrastructure**. This virtual framework provides networking, storage, and virtual machines to scale out the Red Hat Gluster Storage environment to meet the demands of the specified workload.

For more information on Google Cloud Platform, see https://cloud.google.com, and for information on the Google Compute Engine, see https://cloud.google.com/compute/docs.

The following diagram illustrates Google Cloud Platform integration with Red Hat Gluster Storage.

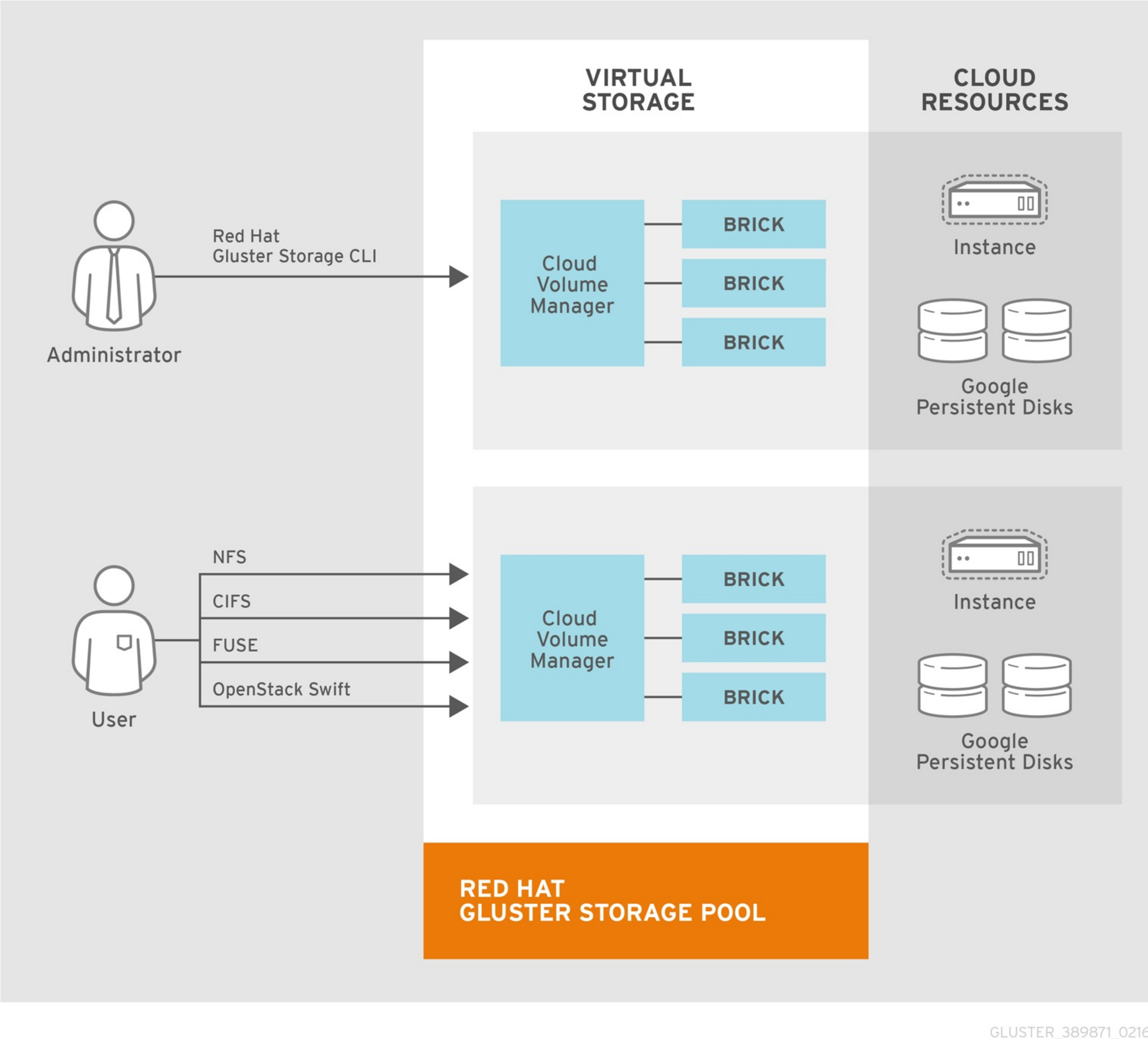


Figure 4.1. Integration Architecture

For more information on Red Hat Gluster Storage architecture, concepts, and implementation, see *Red Hat Gluster Storage Administration Guide*: https://access.redhat.com/documentation/en-US/Red_Hat_Storage/3.1/html/Administration_Guide/index.html.

This chapter describes the steps necessary to deploy a Red Hat Gluster Storage environment to Google Cloud Platform using 10 x 2 Distribute-Replicate volume.

4.1. PLANNING YOUR DEPLOYMENT

This chapter models a 100 TB distributed and replicated file system space. The application server model, which is a Red Hat Gluster Storage client, includes 10 virtual machine instances running a streaming video capture and retrieval simulation. This simulation provides a mixed workload representative of I/O patterns that may be common among other common use cases where a distributed storage system may be most suitable.

While this scale allows us to model a high-end simulation of storage capacity and intensity of client activity, a minimum viable implementation may be achieved at a significantly smaller scale. As the model is scaled down your individual requirements and use cases are considered, certain fundamental approaches of this architecture should be taken into account, such as instance sizing, synchronous replication across zones, careful isolation of failure domains, and asynchronous replication to a remote geographical site.

Maximum Persistent Disk Size

The original test build was limited by the maximum per-VM persistent disk size of 10 TB. Google has since increased that limit to 64 TB. Red Hat will support persistent disks per VM up to Google's current maximum size of 64 TB. (Note that 64 TB is both a per-disk and a per-VM maximum, so the actual data disk maximum will be 64 TB minus the operating system disk size.)

Other real-world use cases may involve significantly more client connections than represented in this chapter. While the particular study performed here was limited in client scale due to a focus on server and storage scale, some basic throughput tests showed the linear scale capabilities of the storage system. As always, your own design should be tuned to your particular use case and tested for performance and scale limitations.

4.1.1. Environment

The scale target is roughly 100 TB of usable storage, with 2-way synchronous replication between zones in the primary pool, and additionally remote asynchronous geo-replication to a secondary pool in another region for disaster recovery. As of this writing, the current maximum size of a Google Compute Engine persistent disk is 10 TB, therefore our design requires 20 bricks for the primary pool and 10 bricks for the secondary pool. The secondary pool will have single data copies which are not synchronously replicated.

Note that there is also currently a per-VM limit of 10 TB of persistent disk, so the actual data disk will be configured at 10,220 GB in order to account for the 20 GB root volume persistent disk.

All nodes will use a Red Hat Gluster Storage 3.1 on Red Hat Enterprise Linux 7 image that will be manually created and configured with a local virtualization system, that is KVM. Red Hat Gluster Storage replica peers in the local region are placed in separate zones within each region. This allows our synchronous replica copies to be highly available in the case of a zone outage.

The Red Hat Gluster Storage server nodes are built as **n1-highmem-4** machine types. This machine type is the minimally viable configuration based on the published resource requirements for Red Hat Gluster Storage. Some concession has been made for the minimum memory size based on expected cloud use cases. The **n1-highmem-8** machine type may be a more appropriate match, depending on your application and specific needs.

4.1.2. Prerequisites

- Google account
- Google Cloud SDK. The Google Cloud SDK contains tools and libraries that enable you to easily create and manage resources on Google Cloud Platform. It will be used later to facilitate the creation of the multiple Red Hat Gluster Storage instances . For instructions to setup and install the Google Cloud SDK, see https://cloud.google.com/sdk.
- Subscription to access the Red Hat Gluster Storage software channels. For information on subscribing to the Red Hat Gluster Storage 3.1 channels, see https://access.redhat.com/documentation/en-US/Red_Hat_Storage/3.1/html-single/Installation_Guide/index.html#chap-Installing_Red_Hat_Storage-Subscribing-RHGS.

4.1.3. Primary Storage Pool Configuration

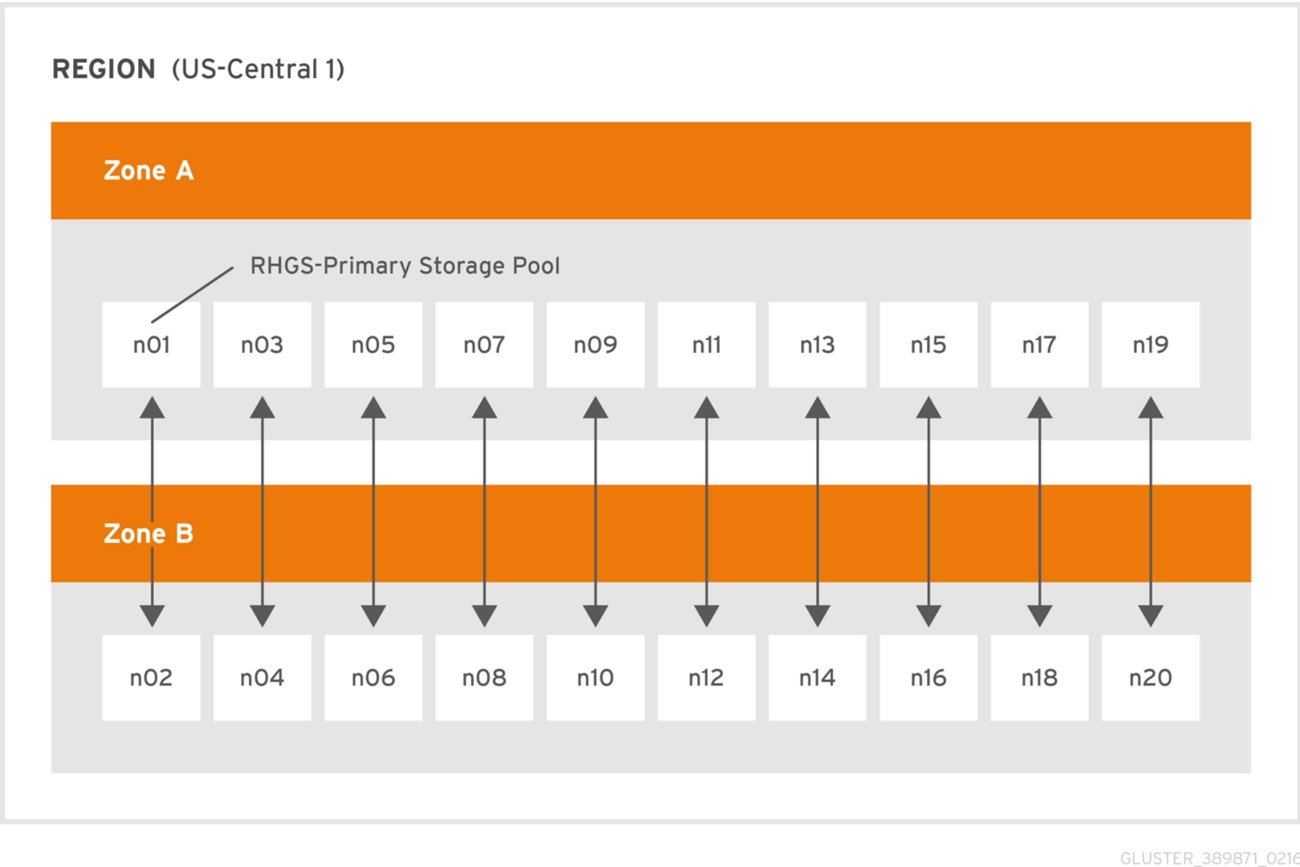
- Red Hat Gluster Storage configured in a 10 x 2 Distribute-Replicate volume

- 20 x n1-highmem-4 instances:

Resource	Specification
vCPU	4
Memory	26 GB
Boot Disk	20 GB standard persistent disk
Data Disk	10,220 GB standard persistent disk. The maximum persistent disk allocation for a single instance is 10 TB. Therefore the maximum size of our data disk is necessarily 10 TB minus the 20 GB size of the boot disk, or 10,220 GB.
Image	Custom Red Hat Gluster Storage 3.1 on Red Hat Enterprise Linux 7

- VM zone allocation:

  Each Gluster synchronous replica pair is placed across zones in order to limit the impact of a zone failure. A single zone failure will not result in a loss of data access. Note that the setting synchronous replica pairs is a function of the order the bricks defined in the **`gluster volume create`** command.



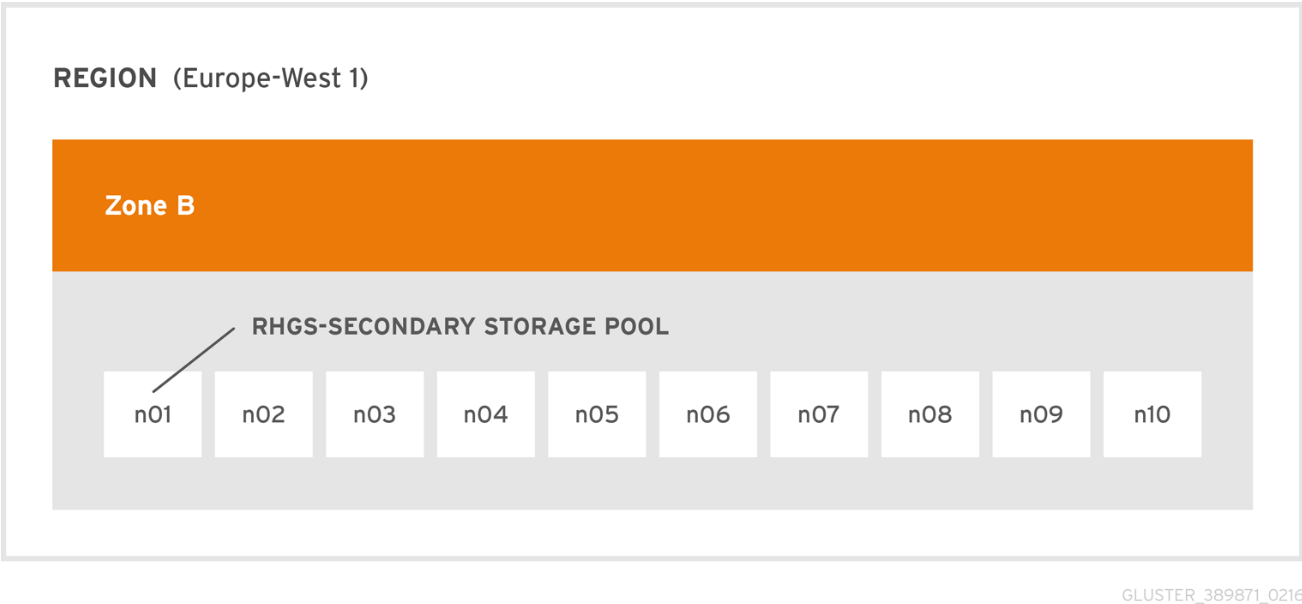
4.1.4. Secondary Storage Pool Configuration

- Gluster configured in a 10 x 1 Distribute volume
- 10 x n1-highmem-4 instances:

Resource	Specification
vCPU	4
Memory	24 GB
Boot Disk	20 GB standard persistent disk
Data Disk	10,220 GB standard persistent disk
Image	Custom Red Hat Gluster Storage 3.1 on Red Hat Enterprise Linux 7

- VM zone allocation:

  The secondary storage pool as designed as a receiver of asynchronous replication, via geo-replication, in a remote region for disaster recovery. To limit the cost of this protective layer, this storage pool is not synchronously replicated within its local region and a distribute-only gluster volume is used. In order to limit the potential impact of an outage, all nodes in this region are placed in the same zone.



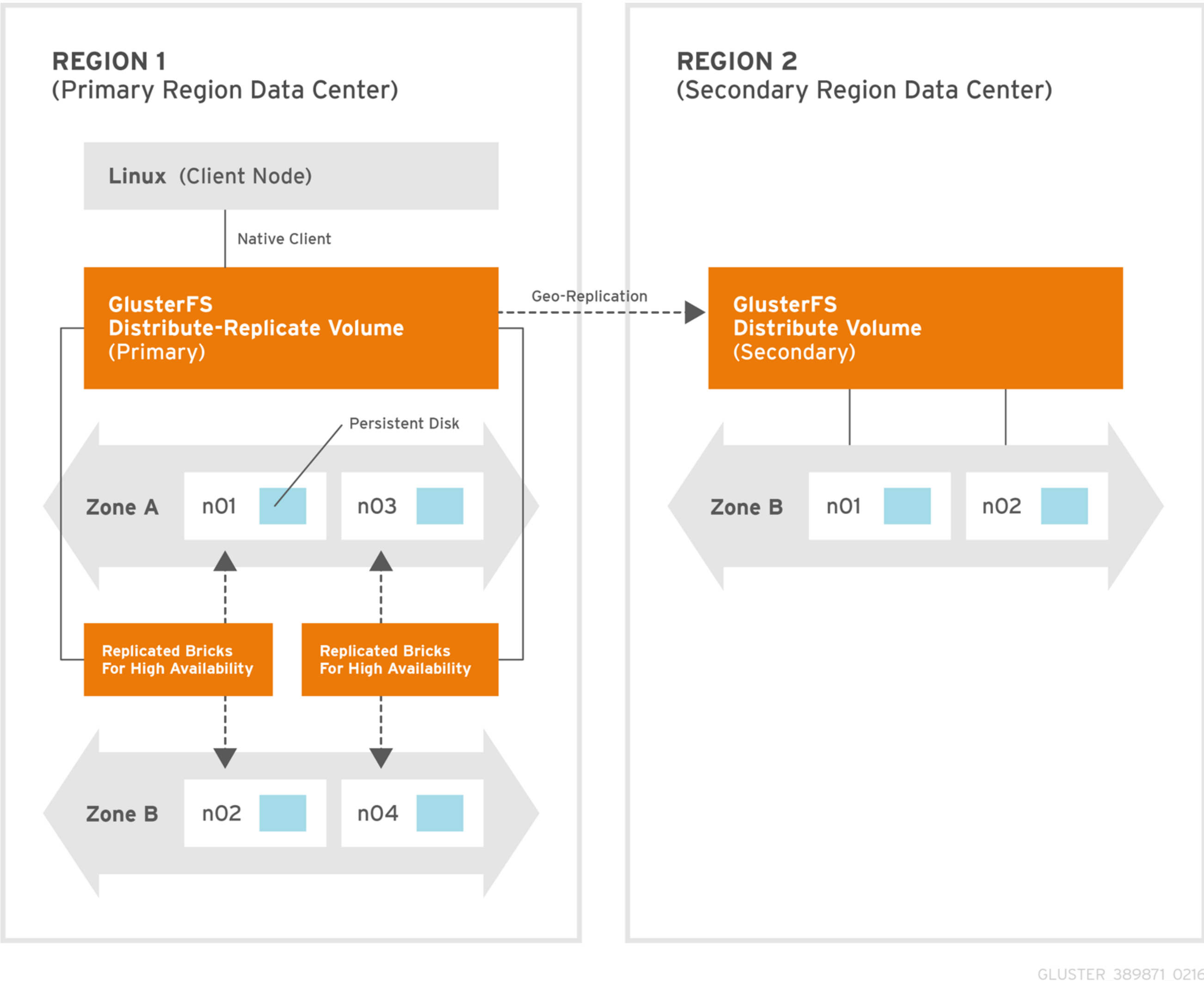
4.1.5. Client Configuration

Client VMs have been distributed as evenly as possible across the US-CENTRAL1 region, zones A and B.

- 10 x n1-standard-2 instances:

Resource	Specification
vCPU	2
Memory	7.5 GB
Boot Disk	10 GB standard persistent disk
Image	Custom Red Hat Gluster Storage 3.1 on Red Hat Enterprise Linux 7

4.1.6. Trusted Pool Topology



4.1.7. Obtaining Red Hat Gluster Storage for Google Cloud Platform

To download the Red Hat Gluster Storage Server files using a Red Hat Subscription or a Red Hat Evaluation Subscription:

1. Visit the Red Hat Customer Service Portal at https://access.redhat.com/login and enter your user name and password to log in.

2. Click **Downloads** to visit the **Software & Download Center**.

3. In the Red Hat Gluster Storage Server area, click **Download Software** to download the latest version of the **qcow2** image.

4.2. SETTING UP GOOGLE COMPUTE ENGINE

To set up Google Compute engine, perform the following steps:

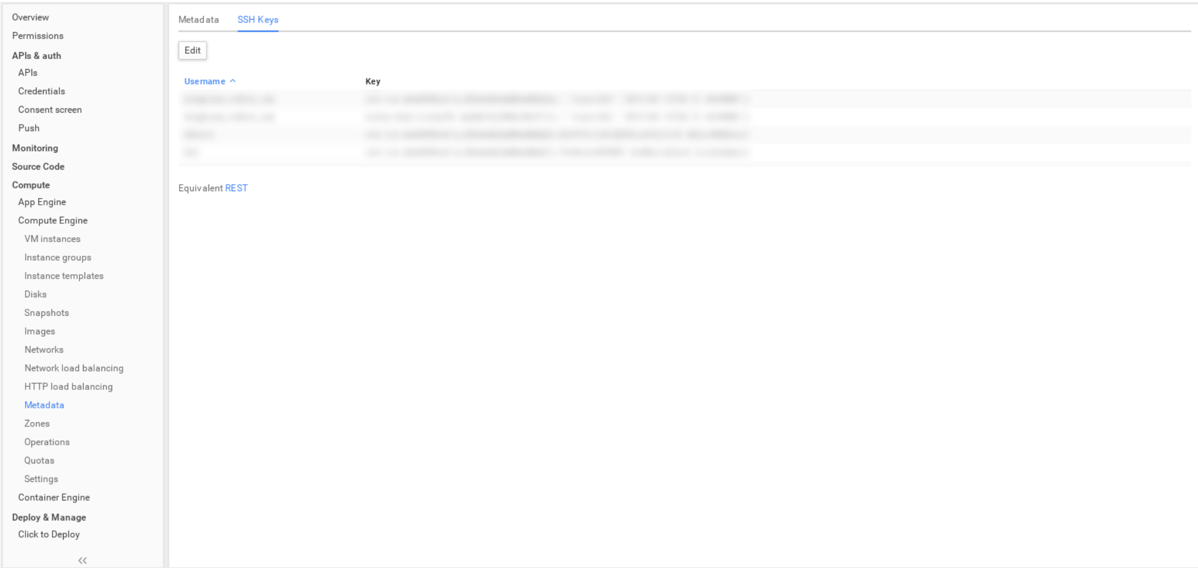
4.2.1. SSH Keys

SSH keys must be generated and registered with the Google Compute Engine project to connect via standard SSH. You can SSH directly to the instance public IP addresses after it is generated.

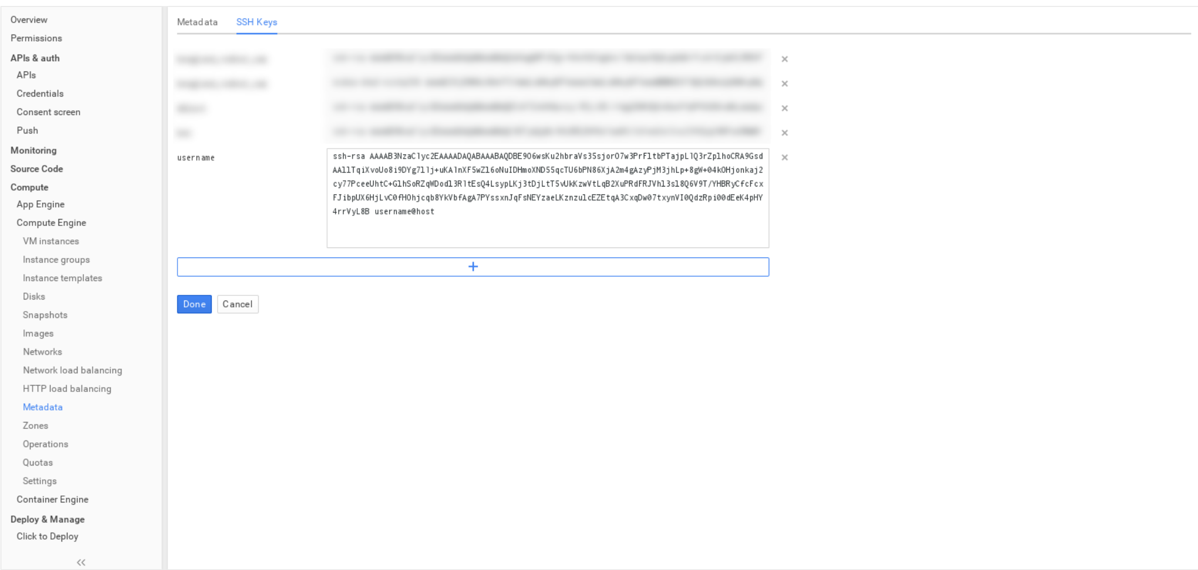
1. Generate SSH keypair for use with Google Compute Engine using the following command:

```
# ssh-keygen -t rsa -f ~/.ssh/google_compute_engine
```

2. In the Google Developers Console, click **Computer > Compute Engine > Metadata > SSH Keys > Edit**.



3. Enter the output generated from **~/.ssh/google_compute_engine.pub** file, and click **Save**.



4. To enable SSH agent to use this identity file for each new local console session, run the following command on the console:

```
# ssh-add ~/.ssh/google_compute_engine
```

5. Adding the below line to your **~/.ssh/config** file helps you automate this command.

```
IdentityFile ~/.ssh/google_compute_engine
```

6. You can now connect via standard SSH to the new VM instances created in your Google Compute Engine project.

```
# ssh -i ~/.ssh/google_compute_engine
<username>@<instance_external_ip>
```

The gcloud compute config-ssh command from the Google Cloud SDK populates your**~/.ssh/config** file with aliases that allows simple SSH connections by instance name.

4.2.2. Setting up Quota

The minimum persistent disk quotas listed below are required for this deployment. It may be necessary to request a quota increase from Google.

- Local region (see US-CENTRAL1 illustration in Section 4.1.3, “Primary Storage Pool Configuration”)
  - Total persistent disk reserved (GB) >= 206,000
  - CPUs >= 100
- Remote region (see EUROPE-WEST1 illustration in Section 4.1.4, “Secondary Storage Pool Configuration”)
  - Total persistent disk reserved (GB) >= 103,000
  - CPUs >=40

4.3. CONVERTING QCOW2 TO .RAW FORMAT

Convert the downloaded **qcow2** image to **.raw** format using the following command:

```
# qemu-img  convert image_name disk.raw
```

For example:

```
# qemu-img   convert RHGS-3.1.3-9.x86_64.qcow2 disk.raw
```

4.4. PACKAGING THE IMAGE FOR GOOGLE COMPUTE ENGINE

Create a gzip sparse tar archive to package the image for Google Compute Engine, using the following command:

```
# tar -czSf disk.raw.tar.gz disk.raw
```

4.5. UPLOADING THE IMAGE INTO GOOGLE CLOUD STORAGE

You must login using **gcloud auth login** command before uploading the image to the Google cloud. Running the command will open a browser and prompts for google account credentials. The PROJECT_ID is set by default and follow the subsequent CLI instructions and make changes if required.

Use Google's **gsutil** command to create the storage bucket and upload the image.

```
# gsutil mb gs://rhgs_image_upload
# gsutil cp disk.raw.tar.gz gs://rhgs_image_upload
```

4.6. IMPORTING THE IMAGE INTO GOOGLE COMPUTE ENGINE

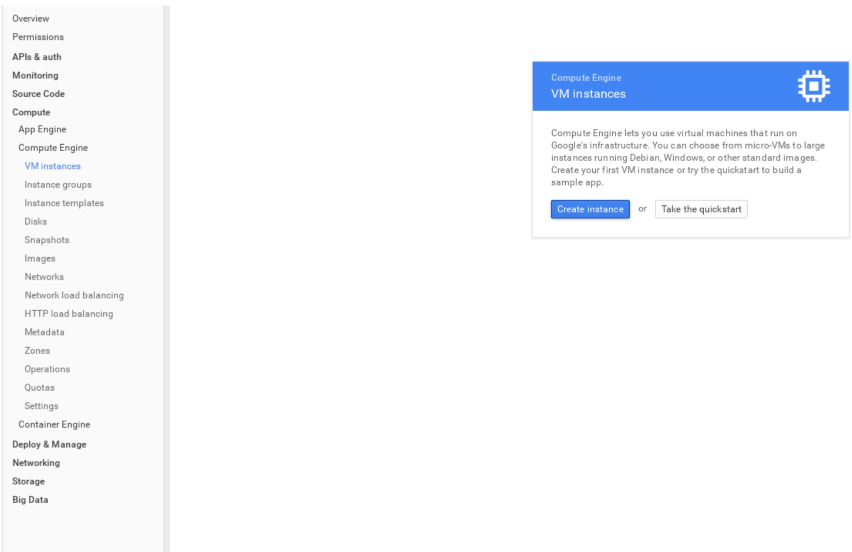
Use the following command to import the image to Google Compute Engine:

```
# gcloud compute images create rhgs31 --source-uri
gs://rhgs_image_upload/disk.raw.tar.gz
```

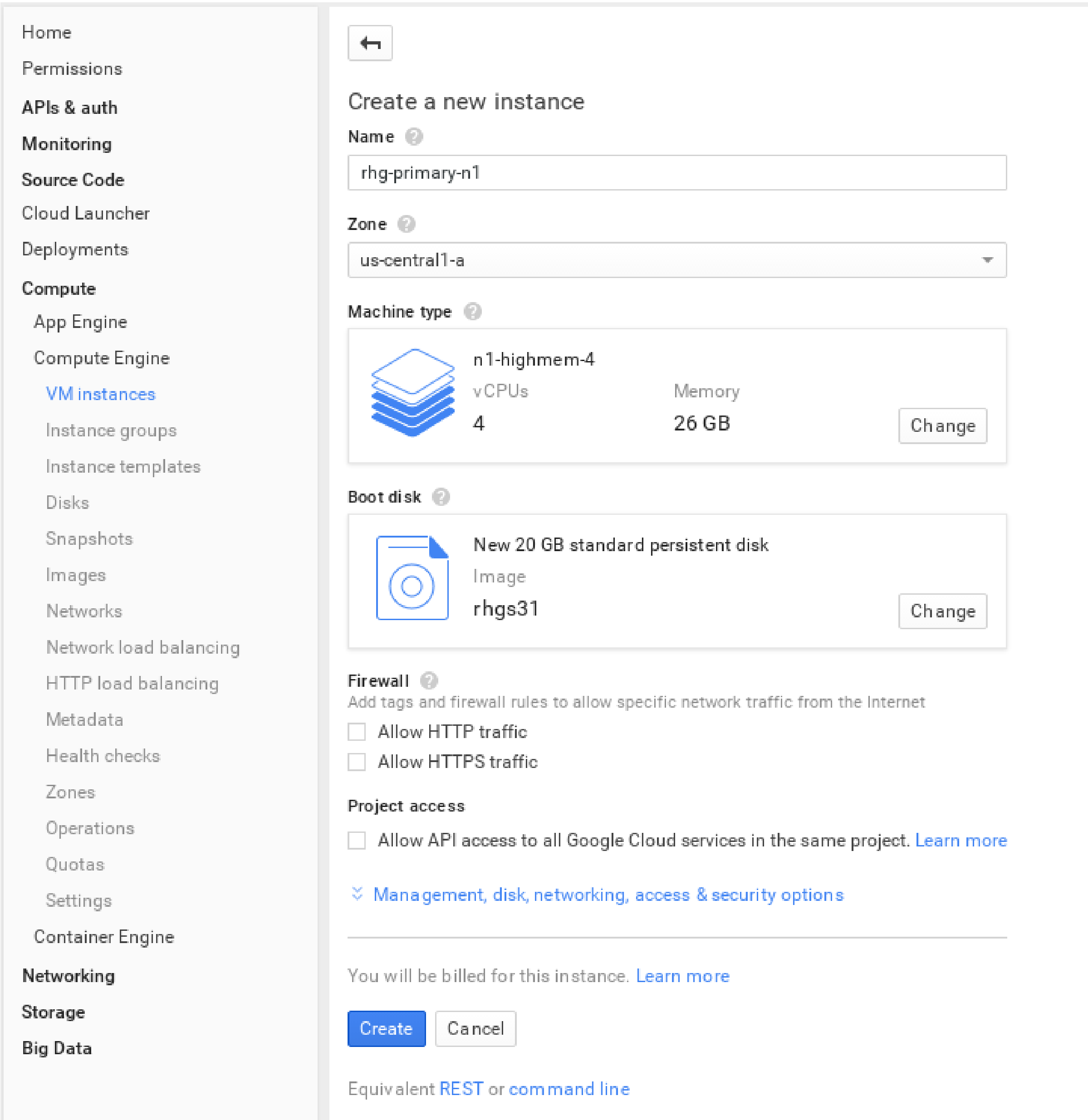
For information on using the saved image, see https://cloud.google.com/compute/docs/images/create-delete-deprecate-private-images#use_saved_image.

4.7. CREATING A VM INSTANCE TO CONFIGURE THE DISKS FOR RED HAT GLUSTER STORAGE INSTANCES

1. In the Google Developers Console, click **Compute** > **Compute Engine** > **VM instances** > **Create Instance**.



The **Create Instance** window is displayed.



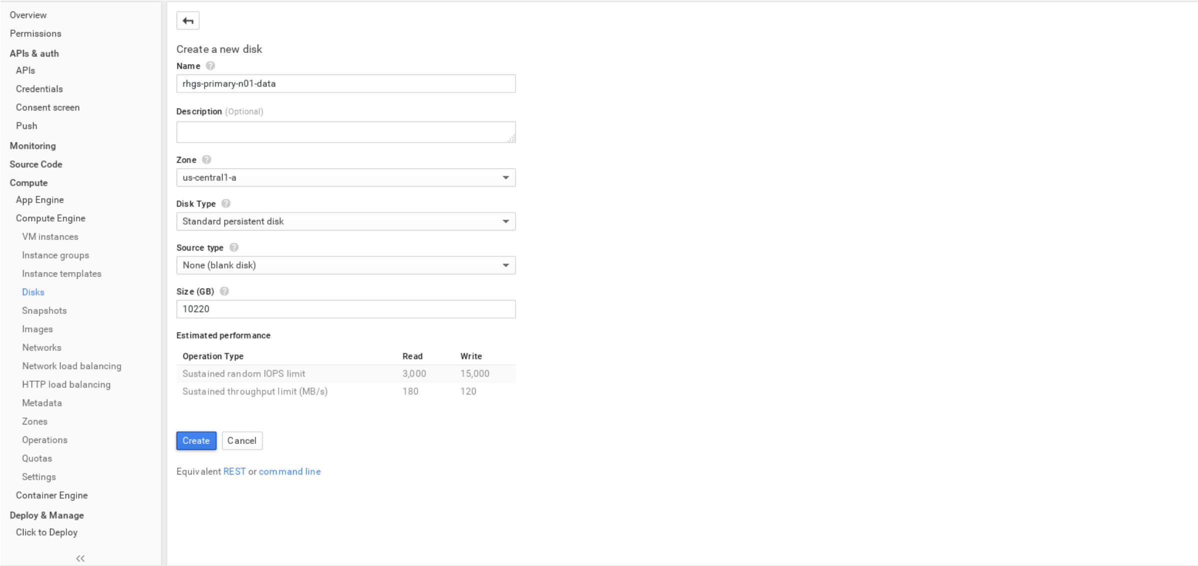
2. Enter the following in the **Create a new instance** window and click **Create**.

   - Name: rhgs-primary-n01
   - Zone: us-central1-a
   - Machine type: n1-highmem-4 (4 vCPUs, 26 GB memory)
   - Boot disk: New 20 GB standard persistent disk
   - Image: rhgs31 (our uploaded image file)

4.8. CREATING THE INITIAL DATA DISK

Create a 10,220 GB standard persistent disk for the rhgs-primary-n01 VM instance in the same zone as the instance.

1. In the Google Developers Console, click **Compute** > **Compute Engine** > **Disks** > **New disk**.

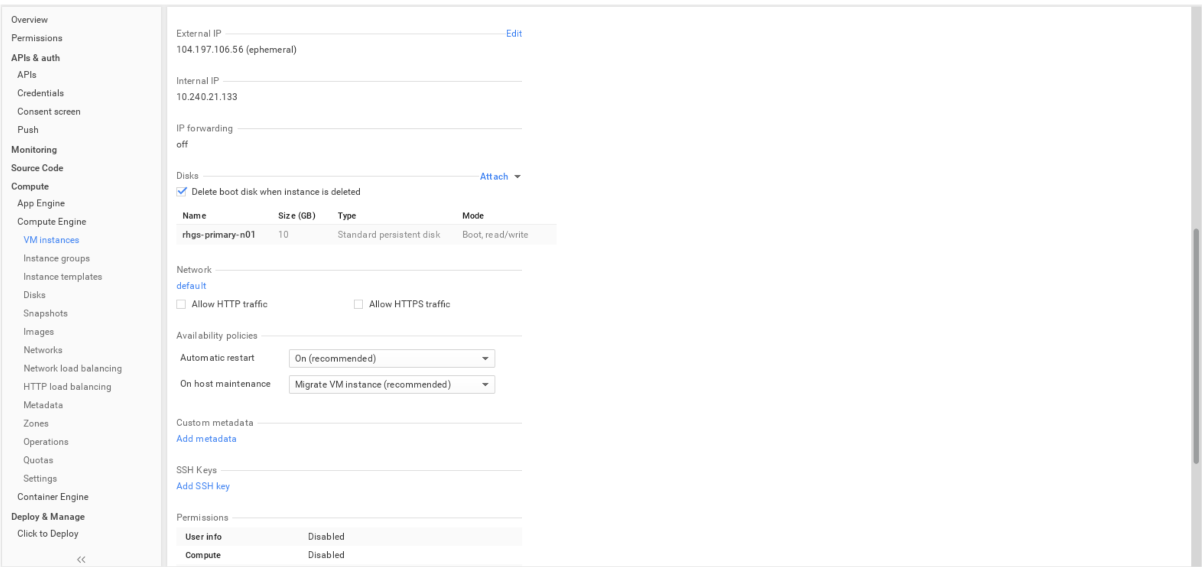


2. Enter the following in the **New Disk** window and click **Create**.

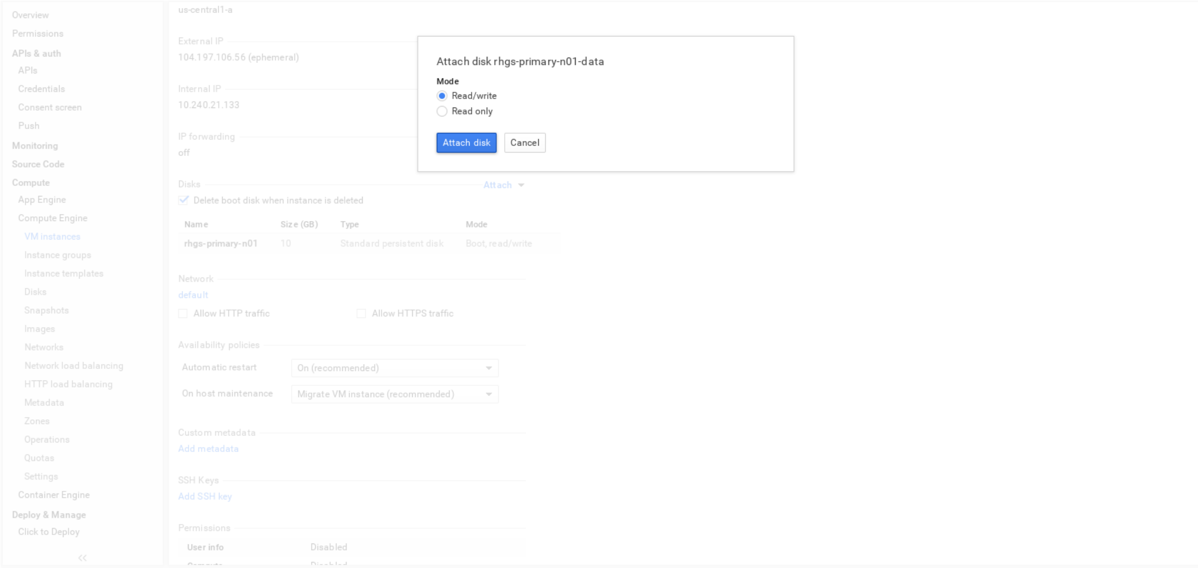
   - Name: rhgs-primary-n01-data
   - Zone: us-central1-a
   - Disk Type: Standard persistent disk
   - Source Type: None (blank disk)
   - Size (GB): 10220

4.9. ATTACHING AND CONFIGURING THE DATA DISK

1. From the Google Developers Console, click **Compute** > **Compute Engine** > **VM instances** > **rhgs-primary-n01** > **Attach** > **rhgs-primary-n01-data**.



2. Choose the mode as **Read/write**.



3. Connect to the rhgs-primary-n01 instance via SSH, and configure the data disk:

```
# ssh username@instance_external_ip
```

4. Confirm the data disk is visible as /dev/sdb:

```
# fdisk -l /dev/sdb

Disk /dev/sdb: 10984.4 GB, 10984378859520 bytes
255 heads, 63 sectors/track, 1335441 cylinders
Units = cylinders of 16065 * 512 = 8225280 bytes
Sector size (logical/physical): 512 bytes / 4096 bytes
I/O size (minimum/optimal): 4096 bytes / 4096 bytes
Disk identifier: 0x00000000
```

5. Configure LVM, format the filesystem, and mount the data disk:

   The script below can be used to complete this process per documented recommendations.

> **WARNING**
>
> This script assumes a large enough block device to accommodate the maximum supported metadata LV size of 16 GB for LVM thin provisioning needed for snapshots. You should understand what each step in the script is doing before using it.

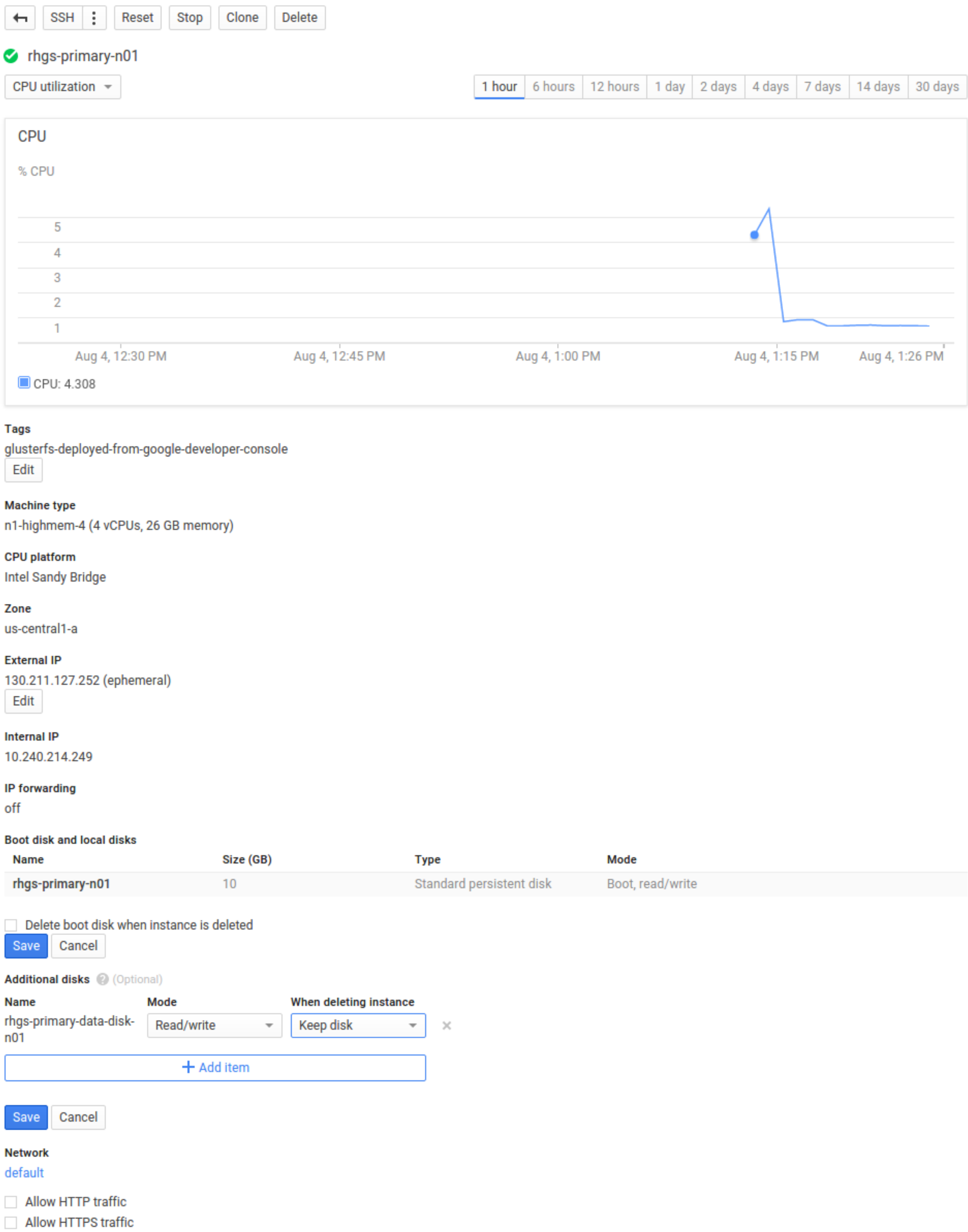
```
#!/bin/bash
pvcreate /dev/sdb
vgcreate rhgs_vg /dev/sdb
# Create metadata LV with the maximum supported size of 16GB
lvcreate -L 16777216K --name rhgs_pool_meta rhgs_vg
# Create data LV with the remainder of the VG space
```

```
lvcreate -l 100%FREE --name rhgs_pool rhgs_vg
# The lvconvert command below required 4096 free extents, so reduce
the LV
lvreduce -f -l 4096 /dev/rhgs_vg/rhgs_pool
# Convert our LVs to a thin pool
lvconvert --yes --thinpool rhgs_vg/rhgs_pool --poolmetadata
rhgs_vg/rhgs_pool_meta
# Disable zeroing of thin pool chunks for performance boost
lvchange --zero n rhgs_vg/rhgs_pool
# The -V flag for lvcreate does not allow a ‘100%FREE’ option like -
l does.
# So we’ll get the size of rhgs_pool from lvs for maximum efficiency
LVSIZE=$(lvs --units g | grep rhgs_pool | awk '{print $4}' | awk -F.
'{print $1}')
# Create the thin LV for the bricks
lvcreate -V ${LVSIZE}G -T rhgs_vg/rhgs_pool -n rhgs_lv
# Create the XFS filesystem with 512B inode size and 8KB directory
block size
# This step may take a while...
mkfs.xfs -f -i size=512 -n size=8192 -L rhgs_lv /dev/rhgs_vg/rhgs_lv
# Create mountpoint and fstab entry
mkdir -p /rhgs/bricks
echo "LABEL=rhgs_lv /rhgs/bricks xfs rw,inode64,noatime,nouuid 1 2"
>> /etc/fstab
mount /rhgs/bricks
df -h /rhgs/bricks
```

4.10. DETACHING THE DISKS FOR THE IMAGE CREATION PROCESS

Now that the disks have been set up, they must be detached from the VM instances so that they can be used for the next step. The VM instance is deleted in the process.

- In the Google Developers Console, click **Compute > Compute Engine > VM instances > rhgs-primary-n01**.



Scroll down to the **Disks** section (there should be one for the boot disk and one for the additional disks). Ensure that the checkbox **delete boot disk when instance is deleted** is unchecked and the option for **When deleting instance** is selected the additional disk shows **Keep disk**.

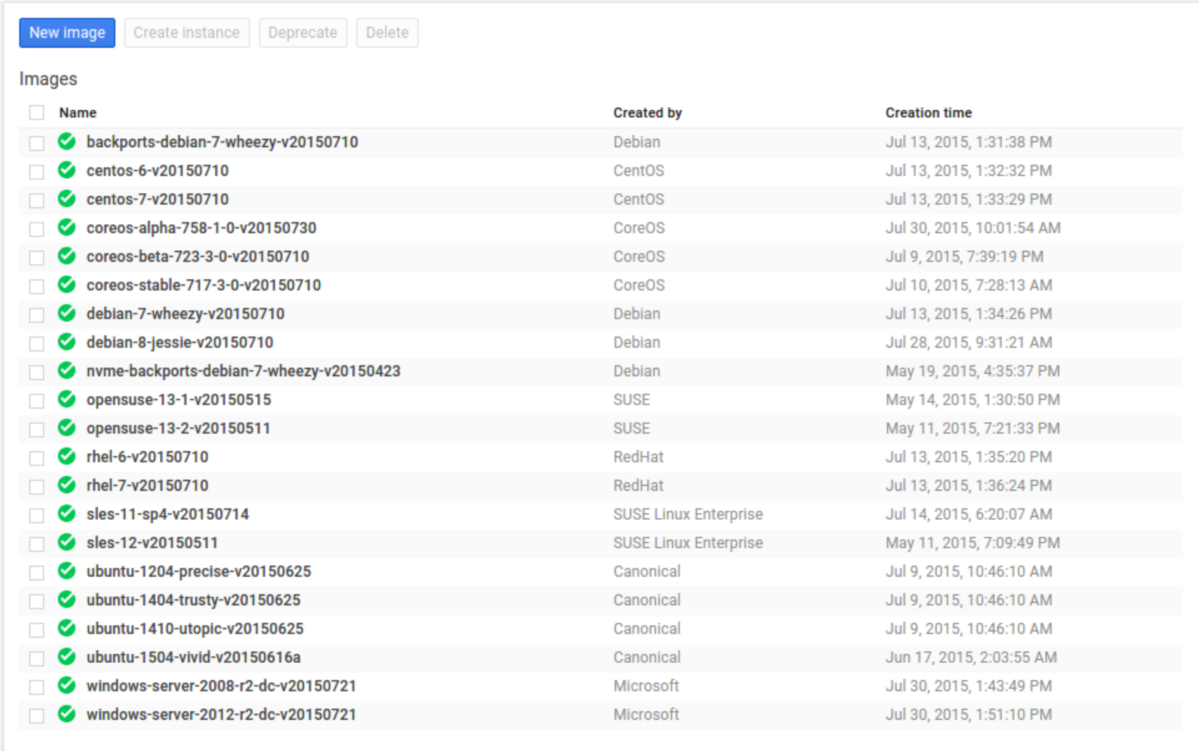
Now, click **Delete** on the top to delete the VM instance.

4.11. CREATING MULTIPLE RED HAT GLUSTER STORAGE INSTANCES USING IMAGES

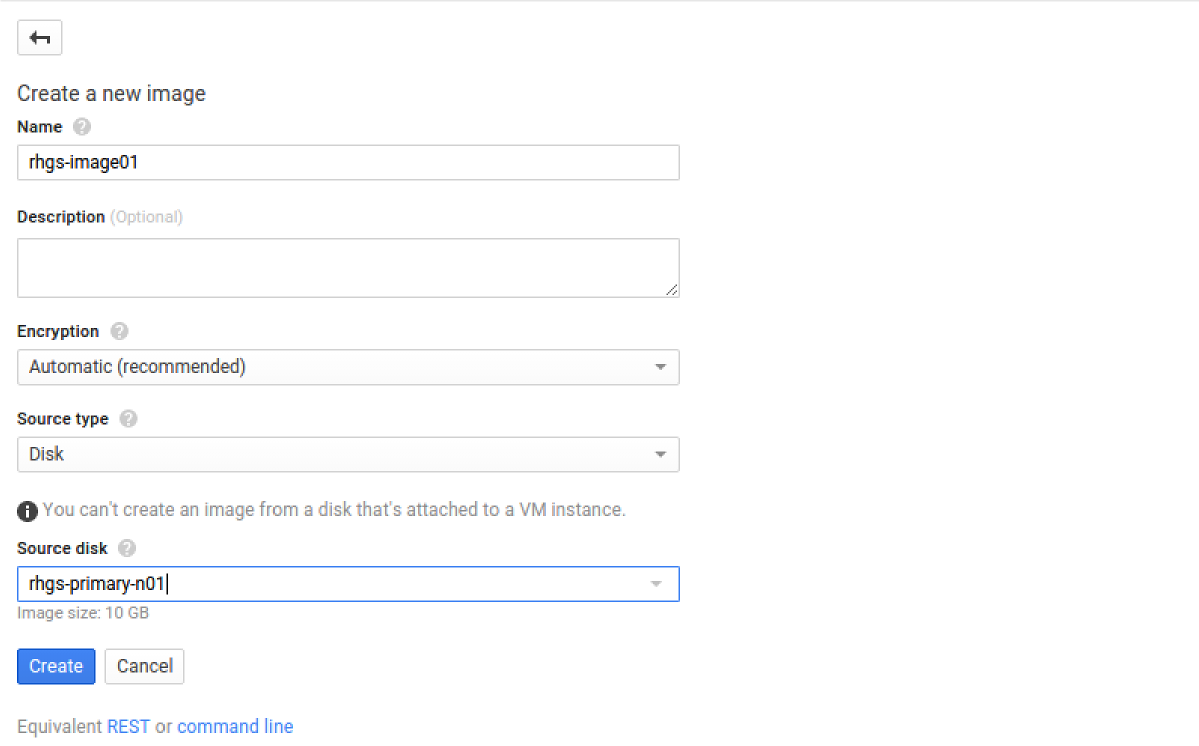
In this chapter, we are using 20 VM instances in the local region, US-CENTRAL1, and 10 VM instances in the remote region, EUROPE-WEST1.

1. Creating an image of the rhgs-primary-n01 as Root persistent disk.

   In the Google Developers Console, click **Compute > Compute Engine > Images > New image**.



   The **Create a new image** window is displayed.



   Enter the following in **Create a new image** window and click **Create** .

   - Name: rhgs-image01
   - Source disk: rhgs-primary-n01

2. Creating an image of the rhgs-primary-n01-data as Data persistent disk.

   In the Google Developers Console, click **Compute** > **Compute Engine** > **Images** > **New image** .

   Enter the following in **Create a new image** window and click **Create** .

   - Name: rhgs-data-image01
   - Source disk: rhgs-primary-n01-data

4.12. USING GOOGLE CLOUD DEPLOYMENT MANAGER TO DEPLOY MULTIPLE INSTANCES

Using the google cloud deployment manager facilitates creation of multiple RGHS instances.

1. Login and authenticate to Google Cloud by following the steps listed at https://cloud.google.com/sdk/gcloud/#gcloud.auth.

2. Copy the configuration contents in the Section 4.16, “Appendix: Configuration files for Red Hat Gluster Storage Deployment”.

3. Run the following gcloud command:

```
# gcloud deployment-manager deployments create rghs  --config
glusterfs-config.yaml
```

4.13. CONFIGURING RED HAT GLUSTER STORAGE

4.13.1. Peer the Nodes

From rhgs-primary-n01, peer nodes rhgs-primary-n{02..20}:

```
# for i in {02..20};
 do gluster peer probe rhgs-primary-n${i};
 done
```

From rhgs-primary-n02, re-peer node rhgs-primary-n01:

Note the problem. This step is done in order to clean up the initial peering process which leaves rhgs-primary-n01 defined by its IP address in the other peers Gluster trusted pool configuration files. This is important because the IP addresses are ephemeral:

```
# gluster peer status | grep Hostname | grep -v rhgs
Hostname: 10.240.21.133
```

And correct it:

```
# gluster peer probe rhgs-primary-n01
peer probe: success.
# gluster peer status | grep Hostname | grep n01
Hostname: rhgs-primary-n01
```

From rhgs--n01, peer nodes rhgs-secondary-n{02..10}:

```
# for i in {02..10};
 do gluster peer probe rhgs-secondary-n${i};
 done
```

From rhgs-secondary-n02, peer node rhgs-secondary-n01:

```
# gluster peer probe rhgs-secondary-n01
```

4.13.2. Creating Distribute-Replicate Volumes

On the primary trusted pool, create a 10x2 Distribute-Replicate volume, ensuring that bricks are paired appropriately with their replica peers as defined inSection 4.1.3, "Primary Storage Pool Configuration".

```
# gluster volume create myvol replica 2 \
 rhgs-primary-n01:/rhgs/bricks/myvol rhgs-primary-n02:/rhgs/bricks/myvol \
 rhgs-primary-n03:/rhgs/bricks/myvol rhgs-primary-n04:/rhgs/bricks/myvol \
 rhgs-primary-n05:/rhgs/bricks/myvol rhgs-primary-n06:/rhgs/bricks/myvol \
 rhgs-primary-n07:/rhgs/bricks/myvol rhgs-primary-n08:/rhgs/bricks/myvol \
rhgs-primary-n09:/rhgs/bricks/myvol rhgs-primary-n10:/rhgs/bricks/myvol \
 rhgs-primary-n11:/rhgs/bricks/myvol rhgs-primary-n12:/rhgs/bricks/myvol \
 rhgs-primary-n13:/rhgs/bricks/myvol rhgs-primary-n14:/rhgs/bricks/myvol \
 rhgs-primary-n15:/rhgs/bricks/myvol rhgs-primary-n16:/rhgs/bricks/myvol \
 rhgs-primary-n17:/rhgs/bricks/myvol rhgs-primary-n18:/rhgs/bricks/myvol \
 rhgs-primary-n19:/rhgs/bricks/myvol rhgs-primary-n20:/rhgs/bricks/myvol
volume create: myvol: success: please start the volume to access data

# gluster volume start myvol
volume start: myvol: success

# gluster volume info myvol
Volume Name: myvol
Type: Distributed-Replicate
Volume ID: f093e120-b291-4362-a859-8d2d4dd87f3a
Status: Started
Snap Volume: no
Number of Bricks: 10 x 2 = 20
Transport-type: tcp
Bricks:
Brick1: rhgs-primary-n01:/rhgs/bricks/myvol
Brick2: rhgs-primary-n02:/rhgs/bricks/myvol
Brick3: rhgs-primary-n03:/rhgs/bricks/myvol
Brick4: rhgs-primary-n04:/rhgs/bricks/myvol
Brick5: rhgs-primary-n05:/rhgs/bricks/myvol
Brick6: rhgs-primary-n06:/rhgs/bricks/myvol
Brick7: rhgs-primary-n07:/rhgs/bricks/myvol
Brick8: rhgs-primary-n08:/rhgs/bricks/myvol
Brick9: rhgs-primary-n09:/rhgs/bricks/myvol
Brick10: rhgs-primary-n10:/rhgs/bricks/myvol
Brick11: rhgs-primary-n11:/rhgs/bricks/myvol
Brick12: rhgs-primary-n12:/rhgs/bricks/myvol
Brick13: rhgs-primary-n13:/rhgs/bricks/myvol
Brick14: rhgs-primary-n14:/rhgs/bricks/myvol
Brick15: rhgs-primary-n15:/rhgs/bricks/myvol
```

```
Brick16: rhgs-primary-n16:/rhgs/bricks/myvol
Brick17: rhgs-primary-n17:/rhgs/bricks/myvol
Brick18: rhgs-primary-n18:/rhgs/bricks/myvol
Brick19: rhgs-primary-n19:/rhgs/bricks/myvol
Brick20: rhgs-primary-n20:/rhgs/bricks/myvol
Options Reconfigured:
performance.readdir-ahead: on
auto-delete: disable
snap-max-soft-limit: 90
snap-max-hard-limit: 256
```

The resulting Gluster volume topology is:

```
Distribute set
|
+-- Replica set 0
|    |
|    +-- Brick 0: rhgs-primary-n01:/rhgs/bricks/myvol
|    |
|    +-- Brick 1: rhgs-primary-n02:/rhgs/bricks/myvol
|
+-- Replica set 1
|    |
|    +-- Brick 0: rhgs-primary-n03:/rhgs/bricks/myvol
|    |
|    +-- Brick 1: rhgs-primary-n04:/rhgs/bricks/myvol
|
+-- Replica set 2
|    |
|    +-- Brick 0: rhgs-primary-n05:/rhgs/bricks/myvol
|    |
|    +-- Brick 1: rhgs-primary-n06:/rhgs/bricks/myvol
|
+-- Replica set 3
|    |
|    +-- Brick 0: rhgs-primary-n07:/rhgs/bricks/myvol
|    |
|    +-- Brick 1: rhgs-primary-n08:/rhgs/bricks/myvol
|
+-- Replica set 4
|    |
|    +-- Brick 0: rhgs-primary-n09:/rhgs/bricks/myvol
|    |
|    +-- Brick 1: rhgs-primary-n10:/rhgs/bricks/myvol
|
+-- Replica set 5
|    |
|    +-- Brick 0: rhgs-primary-n11:/rhgs/bricks/myvol
|    |
|    +-- Brick 1: rhgs-primary-n12:/rhgs/bricks/myvol
|
+-- Replica set 6
|    |
|    +-- Brick 0: rhgs-primary-n13:/rhgs/bricks/myvol
|    |
|    +-- Brick 1: rhgs-primary-n14:/rhgs/bricks/myvol
```

```
|
+-- Replica set 7
|    |
|    +-- Brick 0: rhgs-primary-n15:/rhgs/bricks/myvol
|    |
|    +-- Brick 1: rhgs-primary-n16:/rhgs/bricks/myvol
|
+-- Replica set 8
|    |
|    +-- Brick 0: rhgs-primary-n17:/rhgs/bricks/myvol
|    |
|    +-- Brick 1: rhgs-primary-n18:/rhgs/bricks/myvol
|
+-- Replica set 9
      |
      +-- Brick 0: rhgs-primary-n19:/rhgs/bricks/myvol
      |
      +-- Brick 1: rhgs-primary-n20:/rhgs/bricks/myvol
```

On the secondary trusted pool, create a 10-brick Distribute volume:

```
# gluster volume create myvol-slave \
 rhgs-secondary-n01:/rhgs/bricks/myvol-slave \
 rhgs-secondary-n02:/rhgs/bricks/myvol-slave \
 rhgs-secondary-n03:/rhgs/bricks/myvol-slave \
 rhgs-secondary-n04:/rhgs/bricks/myvol-slave \
 rhgs-secondary-n05:/rhgs/bricks/myvol-slave \
 rhgs-secondary-n06:/rhgs/bricks/myvol-slave \
 rhgs-secondary-n07:/rhgs/bricks/myvol-slave \
 rhgs-secondary-n08:/rhgs/bricks/myvol-slave \
 rhgs-secondary-n09:/rhgs/bricks/myvol-slave \
 rhgs-secondary-n10:/rhgs/bricks/myvol-slave
volume create: myvol-slave: success: please start the volume to access
data
```

```
# gluster volume start myvol-slave
volume start: myvol-slave: success
```

```
# gluster volume info myvol-slave
Volume Name: myvol-slave
Type: Distribute
Volume ID: 64295b00-ac19-436c-9aac-6069e0a5b8cf
Status: Started
Snap Volume: no
Number of Bricks: 10
Transport-type: tcp
Bricks:
Brick1: rhgs-secondary-n01:/rhgs/bricks/myvol-slave
Brick2: rhgs-secondary-n02:/rhgs/bricks/myvol-slave
Brick3: rhgs-secondary-n03:/rhgs/bricks/myvol-slave
Brick4: rhgs-secondary-n04:/rhgs/bricks/myvol-slave
Brick5: rhgs-secondary-n05:/rhgs/bricks/myvol-slave
Brick6: rhgs-secondary-n06:/rhgs/bricks/myvol-slave
Brick7: rhgs-secondary-n07:/rhgs/bricks/myvol-slave
Brick8: rhgs-secondary-n08:/rhgs/bricks/myvol-slave
```

```
Brick9: rhgs-secondary-n09:/rhgs/bricks/myvol-slave
Brick10: rhgs-secondary-n10:/rhgs/bricks/myvol-slave
Options Reconfigured:
performance.readdir-ahead: on
snap-max-hard-limit: 256
snap-max-soft-limit: 90
auto-delete: disable
```

The resulting Gluster volume topology is:

```
Distribute set
|
+-- Brick 0: rhgs-secondary-n01:/rhgs/bricks/myvol-slave
|
+-- Brick 1: rhgs-secondary-n02:/rhgs/bricks/myvol-slave
|
+-- Brick 2: rhgs-secondary-n03:/rhgs/bricks/myvol-slave
|
+-- Brick 3: rhgs-secondary-n04:/rhgs/bricks/myvol-slave
|
+-- Brick 4: rhgs-secondary-n05:/rhgs/bricks/myvol-slave
|
+-- Brick 5: rhgs-secondary-n06:/rhgs/bricks/myvol-slave
|
+-- Brick 6: rhgs-secondary-n07:/rhgs/bricks/myvol-slave
|
+-- Brick 7: rhgs-secondary-n08:/rhgs/bricks/myvol-slave
|
+-- Brick 8: rhgs-secondary-n09:/rhgs/bricks/myvol-slave
|
+-- Brick 9: rhgs-secondary-n10:/rhgs/bricks/myvol-slave
```

4.13.3. Setting up Geo-Replication from the Primary to the Secondary Region

From a primary region node, establish geo-replication from the local **myvol** volume to the remote region **myvol-slave** volume.

1. As a prerequisite, all secondary/slave side nodes must allow root user login via SSH. The below commands should be run on all of nodes rhgs-secondary-n{01..10}.

   ```
   # sed -i s/PermitRootLogin\ no/PermitRootLogin\ yes/ \
   /etc/ssh/sshd_config
   # service sshd restart
   ```

2. Create a SSH keypair for the root user on rhgs-primary-n01, and copy the contents of the public key:

   ```
   # ssh-keygen
   # cat ~root/.ssh/id_rsa.pub
   ssh-rsa
   AAAAB3NzaC1yc2EAAAABIwAAAQEAmtzZdIR+pEl16LqH0kbGQfA7sTe1iWHhV/x+5zVD
   b91Z+gzMVdBTBaLyugeoBlxzOeFFnc/7a9TwNSr7YWt/yKZxh+lnqq
   /9xcWtONUrfvLH4TEWu4dlRwCvXGsdv23lQK0YabaY9hqzshscFtSnQTmzT13LPc9drH
   +k7lHBu4KjA4igDvX/j41or0weneg1vcqAP9vRyh4xXgtocqBiAqJegBZ5O
   ```

```
/QO1ynyJBysp7tIHF7HZuh3sFCxtqEPPsJkVJDiQZ/NqTr3hAqDzmn4USOX3FbSOvoml
Wa8We6tGb9nfUH6vBQGyKbWk4YOzm6E5oTzuRBGA1vCPmwpwR/cw==
root@rhgs-primary-n01
```

3. On rhgs-secondary-n01, add the SSH public key from rhgs-primary-n01 to the root user's authorized_keys file:

```
# echo "ssh-rsa
AAAAB3NzaC1yc2EAAAABIwAAAQEAmtzZdIR+pEl16LqH0kbGQfA7sTe1iWHhV/x+5zVD
b91Z+gzMVdBTBaLyugeoBlxzOeFFnc/7a9TwNSr7YWt
/yKZxh+lnqq7/9xcWtONUrfvLH4TEWu4dlRwCvXGsdv23lQK0YabaY9hqzshscFtSnQT
mzT13LPc9drH+k7lHBu4KjA4igDvX
j41or0weneg1vcqAP9vRyh4xXgtocqBiAqJegBZ5O/QO1ynyJBysp7tIHF7HZuh3sFCx
tqEPPsJkVJDiQZ
/NqTr3hAqDzmn4USOX3FbSOvomlWa8We6tGb9nfUH6vBQGyKbWk4YOzm6E5oTzuRBGA1
vCPmwpwR/cw== root@rhgs-primary-n01" | sudo tee ~root/.ssh
/authorized_keys > /dev/null
```

NOTE

The above SSH public key is for illustration purposes only. Use the key from your own **`id_rsa.pub`** file on rhgs-primary-n01.

At this point, the root user on rhgs-primary-n01 should have passwordless SSH access to rhgs-secondary-n01. This is a prerequisite for setting up geo-replication.

1. Create a common pem pub file on rhgs-primary-n01:

NOTE

This must be done on the node where passwordless SSH to the secondary node was configured.

```
# gluster system:: execute gsec_create
```

2. Create the geo-replication session from the primary site to the secondary site. The push-pem option is needed to perform the necessary pem-file setup on the slave nodes.

```
# gluster volume geo-replication myvol \
rhgs-secondary-n01::myvol-slave create push-pem
```

```
# gluster volume geo-replication myvol \
rhgs-secondary-n01::myvol-slave start
```

3. Verify the geo-replication status. After a few minutes, the initialization stage should complete, and each connection should show Active or Passive for its status.

```
# gluster volume geo-replication myvol rhgs-secondary-n01::myvol-
slave status
MASTER NODE         MASTER VOL    MASTER BRICK          SLAVE USER
SLAVE                                STATUS     CHECKPOINT STATUS
```

```
CRAWL STATUS
----------------------------------------------------------------
----------------------------------------------------------------
----------------------------------------------------------------
------------
rhgs-primary-n01    myvol         /rhgs/bricks/myvol    root
rhgs-secondary-n10::myvol-slave    Active     N/A
Changelog Crawl
rhgs-primary-n18    myvol         /rhgs/bricks/myvol    root
rhgs-secondary-n05::myvol-slave    Passive    N/A
N/A
rhgs-primary-n06    myvol         /rhgs/bricks/myvol    root
rhgs-secondary-n07::myvol-slave    Passive    N/A
N/A
rhgs-primary-n02    myvol         /rhgs/bricks/myvol    root
rhgs-secondary-n02::myvol-slave    Passive    N/A
N/A
rhgs-primary-n10    myvol         /rhgs/bricks/myvol    root
rhgs-secondary-n09::myvol-slave    Passive    N/A
N/A
rhgs-primary-n14    myvol         /rhgs/bricks/myvol    root
rhgs-secondary-n01::myvol-slave    Passive    N/A
N/A
rhgs-primary-n03    myvol         /rhgs/bricks/myvol    root
rhgs-secondary-n03::myvol-slave    Active     N/A
Changelog Crawl
rhgs-primary-n09    myvol         /rhgs/bricks/myvol    root
rhgs-secondary-n08::myvol-slave    Active     N/A
Changelog Crawl
rhgs-primary-n11    myvol         /rhgs/bricks/myvol    root
rhgs-secondary-n10::myvol-slave    Active     N/A
Changelog Crawl
rhgs-primary-n13    myvol         /rhgs/bricks/myvol    root
rhgs-secondary-n03::myvol-slave    Active     N/A
Changelog Crawl
rhgs-primary-n19    myvol         /rhgs/bricks/myvol    root
rhgs-secondary-n08::myvol-slave    Active     N/A
Changelog Crawl
rhgs-primary-n17    myvol         /rhgs/bricks/myvol    root
rhgs-secondary-n04::myvol-slave    Active     N/A
Changelog Crawl
rhgs-primary-n05    myvol         /rhgs/bricks/myvol    root
rhgs-secondary-n06::myvol-slave    Active     N/A
Changelog Crawl
rhgs-primary-n15    myvol         /rhgs/bricks/myvol    root
rhgs-secondary-n06::myvol-slave    Active     N/A
Changelog Crawl
rhgs-primary-n16    myvol         /rhgs/bricks/myvol    root
rhgs-secondary-n07::myvol-slave    Passive    N/A
N/A
rhgs-primary-n07    myvol         /rhgs/bricks/myvol    root
rhgs-secondary-n04::myvol-slave    Active     N/A
Changelog Crawl
rhgs-primary-n20    myvol         /rhgs/bricks/myvol    root
rhgs-secondary-n09::myvol-slave    Passive    N/A
N/A
```

```
rhgs-primary-n12    myvol         /rhgs/bricks/myvol    root
rhgs-secondary-n02::myvol-slave    Passive    N/A
N/A
rhgs-primary-n04    myvol         /rhgs/bricks/myvol    root
rhgs-secondary-n01::myvol-slave    Passive    N/A
N/A
rhgs-primary-n08    myvol         /rhgs/bricks/myvol    root
rhgs-secondary-n05::myvol-slave    Passive    N/A
N/A
```

At this point, the 100 TB Gluster volume is fully ready for use, with cross-zone synchronous data replication on the primary side and remote asynchronous data replication to a read-only volume on the secondary side located in a separate region.

4.14. SETTING UP CLIENTS TO ACCESS DATA

- **NFS and SMB clients**

  The NFS and SMB protocols are available for use, but due to limitations in the network configuration these protocols cannot be made highly available with CTDB or Pacemaker as would be normally recommended.

Prerequisites

You must ensure to register and subscribe your system before installing Native Client. Instructions for registering the system is available at: https://access.redhat.com/documentation/en-US/Red_Hat_Storage/3.1/html/Administration_Guide/chap-Accessing_Data_-_Setting_Up_Clients.html#Installing_Native_Client.

4.14.1. Installing Native Client

Run the following command to install the native client:

```
# yum -y install glusterfs-fuse attr
```

4.14.2. Mounting Red Hat Gluster Storage Volumes

After installing Native Client, the Red Hat Gluster Storage volumes must be mounted to access data. Mount the myvol Gluster volume to the local directory /rhgs/client/myvol:

```
# mkdir -p /rhgs/client/myvol
```

```
# sh -c 'echo "rhgs-primary-n01:myvol /rhgs/client/myvol \
 glusterfs defaults 0 0" >> /etc/fstab'
```

4.14.3. Testing Mounted Volumes

Test the mounted volume by running the following command:

```
# mount /rhgs/client/myvol'
```

4.15. APPENDIX - BUILDING RED HAT GLUSTER STORAGE COMPUTE ENGINE IMAGE FROM SCRATCH

It is possible to deploy an existing Red Hat Enterprise Linux public image and perform a layered install of Red Hat Gluster Storage. This creates an effective "double charge" for each Red Hat Enterprise Linux instance.

NOTE

Google Compute Engine charges a premium fee for using a public Red Hat Enterprise Linux image for instances in order to cover the expense of the Red Hat subscription.

When deploying a layered install, you must re-register the instances with Red Hat Subscription Manager, thus consuming a Red Hat Enterpise Linux entitlement that you have paid for separately. After registering with Subscription Manager, however, Google Compute Engine will continue to charge the premium fee for the instances.

To avoid this, we will build a custom image, which will not be subject to the Google Compute Engine premium fee. For infomration on building a custom image from scratch, see https://cloud.google.com/compute/docs/tutorials/building-images.

4.15.1. Installing Red Hat Gluster Storage from the ISO to a RAW Disk Image File

Using your local virtualization manager, create a virtual machine with a RAW format sparse flat-file backing the system disk. The suggested minimum disk size for the Red Hat Gluster Storage 3.1 system disk is 20 GB and the maximum disk size for import into Google Compute Engine is 100 GB. Google Compute Engine additionally requires the disk size be in whole GB increments, that is, 20 GB or 21 GB, but not 20.5 GB. The RAW disk file should have the disk.raw file name. The disk.raw file must include an MS-DOS (MBR) partition table.

For example, run the following **dd** command to create a 20 GB sparse file to serve as the RAW disk image:

```
# dd if=/dev/zero of=disk.raw bs=1 count=0 seek=20G
```

Refer to the Google Compute Engine Hardware Manifest guide at https://cloud.google.com/compute/docs/tutorials/building-images#hardwaremanifest to ensure your virtual machine image is compatible with the Google Compute Engine platform.

NOTE

The steps below assumes KVM/QEMU as your local virtualization platform.

Attach the Red Hat Gluster Storage ISO, available from the Red Hat Customer Portal, as a bootable CD-ROM device to the image. Boot the VM to the ISO, and perform the installation of Red Hat Gluster Storage according to the instructions available at: https://access.redhat.com/documentation/en-US/Red_Hat_Storage/3.1/html/Installation_Guide/index.html.

4.15.2. Enabling and Starting the Network Interface

To enable and start the network interface:

- Enable the default eth0 network interface at boot time:

```
# sed -i s/ONBOOT=no/ONBOOT=yes/ /etc/sysconfig/network-
scripts/ifcfg-eth0
```

- Start the eth0 network interface:

```
# ifup eth0
```

4.15.3. Subscribing to the Red Hat Gluster Storage Server Channels

You must register the system and enable the required channels for Red Hat Gluster Storage. For information on subscribing and connecting to the appropriate pool and repositories, see https://access.redhat.com/documentation/en-US/Red_Hat_Storage/3.1/html-single/Installation_Guide/index.html#chap-Installing_Red_Hat_Storage-Subscribing-RHGS .

4.15.4. Updating your System

Update your systems using the following command:

```
# yum -y update
```

4.15.5. Tuning and Miscellaneous Configuration

Set the tuned profile to **rhgs-sequential-io** using the following command:

```
# tuned-adm profile rhgs-sequential-io
```

NOTE

The **rhgs-sequential-io** profile is appropriate for this environment, but the **rhgs-random-io** profile may be more appropriate for different workloads.

Disable SElinux:

```
# setenforce 0
```

If SELinux support is required, refer the Red Hat Gluster Storage 3.1 Installation Guide available at: https://access.redhat.com/documentation/en-US/Red_Hat_Storage/3.1/html/Installation_Guide/chap-Enabling_SELinux.html.

4.15.6. Customizing the Virtual Machine for Google Compute Engine

The Google Compute Engine's "Build a Compute Engine Image from Scratch" documentation includes specific instructions for configuring the kernel, network, packages, SSH, and security of the virtual machine. It is recommended that you reference this documentation directly for updated information to ensure compatibility of your image with Google Compute Engine.

Power off the instance to apply all changes and prepare the image import:

```
# init 0
```

4.16. APPENDIX: CONFIGURATION FILES FOR RED HAT GLUSTER STORAGE DEPLOYMENT

Filename: glusterfs-config.yaml

```
# Copyright 2015 Google Inc. All Rights Reserved.
#
# Licensed under the Apache License, Version 2.0 (the "License");
# you may not use this file except in compliance with the License.
# You may obtain a copy of the License at
#
#     http://www.apache.org/licenses/LICENSE-2.0
#
# Unless required by applicable law or agreed to in writing, software
# distributed under the License is distributed on an "AS IS" BASIS,
# WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.
# See the License for the specific language governing permissions and
# limitations under the License.

#
# glusterfs-config.yaml
#
# The Gluster FS deployment consists of a primary pool and a secondary
pool
#   of resources, each on a separate zone.
#

imports:
  - path: gluster_instance.jinja
  - path: path_utils.jinja
resources:
- name: gluster_instance
  type: gluster_instance.jinja
  properties:
    namePrefix: rhgs
    numPrimaryReplicas: 10
    primaryZone: us-central1-a
    secondaryZone: us-central1-b
    numSecondaryReplicas: 10
    backupZone: europe-west1-b
    sourceImage: global/images/rhgs-image01
    dataSourceImage: global/images/rhgs-data-image01
    machineType: n1-highmem-4
    network: default
    bootDiskType: pd-standard
    dataDiskType: pd-standard
    dataDiskSizeGb: 10230
```

Filename: gluster_instance.jinja

```
# Copyright 2015 Google Inc. All Rights Reserved.
#
# Licensed under the Apache License, Version 2.0 (the "License");
# you may not use this file except in compliance with the License.
# You may obtain a copy of the License at
```

```
#
#     http://www.apache.org/licenses/LICENSE-2.0
#
# Unless required by applicable law or agreed to in writing, software
# distributed under the License is distributed on an "AS IS" BASIS,
# WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.
# See the License for the specific language governing permissions and
# limitations under the License.

# GlusterFs configuration variables
#
# Required Cloud resource input parameters:
#  * numPrimaryReplicas - number of instances to create in the primary
zone
#  * numSecondaryReplicas - number of instances to create in the secondary
zone
#  * namePrefix - hostname prefix
#    The instance number (0 based) will be appended ("-n<#><#>")
#  * primaryZone - Compute Engine zone for the instance (short name)
#  * secondaryZone - Compute Engine zone for the instance (short name)
#  * network - Compute Engine network for the instance (full URI)
#  * image - Compute Engine image for the instance (full URI)
#  * machineType - Compute Engine machine type for the instance (full URI)
#  * bootDiskType - Compute Engine boot disk type for the instance (full
URI)
#  * dataDiskType: Compute Engine data disk type for the instance (full
URI)
#  * dataDiskSizeGb: Data disk size in Gigabytes

{% import 'path_utils.jinja' as path_utils with context %}

# Grab the config properties
{% set numPrimaryReplicas = properties["numPrimaryReplicas"] + 1%}
{% set numSecondaryReplicas = properties["numSecondaryReplicas"] + 1 %}
{% set image = properties["image"] %}

# Macros and variables dealing with naming
{% set prefix = properties["namePrefix"] %}

{% macro hostname(prefix, id) -%}
{{ "%s-n%02d"|format(prefix, id) }}
{%- endmacro %}

{% macro diskname(prefix, id) -%}
{{ "%s-data-disk-n%02d"|format(prefix, id) }}
{%- endmacro %}

# Expand resource input parameters into full URLs
{% set network = path_utils.networkPath(properties["network"]) %}
{% set primaryZone = properties["primaryZone"] %}
{% set bootDiskType = path_utils.diskTypePath(
    primaryZone, properties["bootDiskType"]) %}
{% set dataDiskType = path_utils.diskTypePath(
    primaryZone, properties["dataDiskType"]) %}
{% set machineType = path_utils.machineTypePath(
    primaryZone, properties["machineType"]) %}
```

```
resources:
# Add clone instances in the local Zone
{% for n_suffix in range(1, numPrimaryReplicas) %}

  {% set namePrefix = prefix + '-primary' %}

- type: compute.v1.disk
  name: {{ diskname(namePrefix, n_suffix) }}
  properties:

    zone: {{ primaryZone }}
    type: {{ dataDiskType }}
    sizeGb: {{ properties["dataDiskSizeGb"] }}
    sourceImage: {{ properties["dataSourceImage"] }}

- type: compute.v1.instance
  name: {{ hostname(namePrefix, n_suffix) }}
  properties:
    zone: {{ primaryZone }}
    machineType: {{ machineType }}

    disks:
    # Request boot disk creation (mark for autodelete)
    - deviceName: boot
      type: PERSISTENT
      boot: true
      autoDelete: true
      initializeParams:
        sourceImage: {{ properties["sourceImage"] }}
        diskType: {{ bootDiskType }}
        diskSizeGb: 10

    # Attach the existing data disk (mark for autodelete)
    - deviceName: {{ diskname(namePrefix, n_suffix) }}
      source: $(ref.{{ diskname(namePrefix, n_suffix) }}.selfLink)
      autoDelete: true
      type: PERSISTENT

    networkInterfaces:
    - network: {{ network }}
      accessConfigs:
      - name: External NAT
        type: ONE_TO_ONE_NAT

    tags:
      items:
      - "glusterfs-deployed-from-google-developer-console"

{% endfor %}

# Setup in-region replicas
{% set network = path_utils.networkPath(properties["network"]) %}
{% set secondaryZone = properties["secondaryZone"] %}
{% set bootDiskType = path_utils.diskTypePath(
    secondaryZone, properties["bootDiskType"]) %}
```

```
{% set dataDiskType = path_utils.diskTypePath(
    secondaryZone, properties["dataDiskType"]) %}
{% set machineType = path_utils.machineTypePath(
    secondaryZone, properties["machineType"]) %}
{% for n_suffix in range(1, numPrimaryReplicas) %}

  {% set namePrefix = prefix + '-secondary' %}

- type: compute.v1.disk
  name: {{ diskname(namePrefix, n_suffix) }}
  properties:
    zone: {{ secondaryZone }}
    type: {{ dataDiskType }}
    sizeGb: {{ properties["dataDiskSizeGb"] }}
    sourceImage: {{ properties["dataSourceImage"] }}

- type: compute.v1.instance
  name: {{ hostname(namePrefix, n_suffix) }}
  properties:
    zone: {{ secondaryZone }}
    machineType: {{ machineType }}

    disks:
    # Request boot disk creation (mark for autodelete)
    - deviceName: boot
      type: PERSISTENT
      boot: true
      autoDelete: true
      initializeParams:
        sourceImage: {{ properties["sourceImage"] }}
        diskType: {{ bootDiskType }}
        diskSizeGb: 10

    # Attach the existing data disk (mark for autodelete)
    - deviceName: {{ diskname(namePrefix, n_suffix) }}
      source: $(ref.{{ diskname(namePrefix, n_suffix) }}.selfLink)
      autoDelete: true
      type: PERSISTENT

    networkInterfaces:
    - network: {{ network }}
      accessConfigs:
      - name: External NAT
        type: ONE_TO_ONE_NAT

    tags:
      items:
      - "glusterfs-deployed-from-google-developer-console"

{% endfor %}


# Add clone instances in the remote Zone
{% set backupZone = properties["backupZone"] %}
{% set bootDiskType = path_utils.diskTypePath(
    backupZone, properties["bootDiskType"]) %}
```

```
{% set dataDiskType = path_utils.diskTypePath(
    backupZone, properties["dataDiskType"]) %}
{% set machineType = path_utils.machineTypePath(
    backupZone, properties["machineType"]) %}
{% for n_suffix in range(1, numSecondaryReplicas) %}
  {% set namePrefix = prefix + '-backup' %}

- type: compute.v1.disk
  name: {{ diskname(namePrefix, n_suffix) }}
  properties:
    zone: {{ backupZone }}
    type: {{ dataDiskType }}
    sizeGb: {{ properties["dataDiskSizeGb"] }}
#     sourceImage: {{ properties["dataSourceImage"] }}

- type: compute.v1.instance
  name: {{ hostname(namePrefix, n_suffix) }}
  properties:
    zone: {{ backupZone }}
    machineType: {{ machineType }}

    disks:
    # Request boot disk creation (mark for autodelete)
    - deviceName: boot
      type: PERSISTENT
      boot: true
      autoDelete: true
      initializeParams:
        sourceImage: {{ properties["sourceImage"] }}
        diskType: {{ bootDiskType }}
        diskSizeGb: 10

    # Attach the existing data disk (mark for autodelete)
    - deviceName: {{ diskname(namePrefix, n_suffix) }}
      source: $(ref.{{ diskname(namePrefix, n_suffix) }}.selfLink)
      autoDelete: true
      type: PERSISTENT

    networkInterfaces:
    - network: {{ network }}
      accessConfigs:
      - name: External NAT
        type: ONE_TO_ONE_NAT

    tags:
      items:
      - "glusterfs-deployed-from-google-developer-console"

{% endfor %}
```

Filename: path_utils.jinja

```
# Copyright 2015 Google Inc. All rights reserved.
#
# Licensed under the Apache License, Version 2.0 (the "License");
# you may not use this file except in compliance with the License.
```

```
# You may obtain a copy of the License at
#
#     http://www.apache.org/licenses/LICENSE-2.0
#
# Unless required by applicable law or agreed to in writing, software
# distributed under the License is distributed on an "AS IS" BASIS,
# WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.
# See the License for the specific language governing permissions and
# limitations under the License.

# path_utils.jinja
#
# Jinja macros for expanding short resource names into full paths
# Must have reference to the global env object, so when including this
file,
# use the jinja import "with context" option.

{% macro projectPrefix() -%}
{{
"https://www.googleapis.com/compute/v1/projects/%s"|format(env["project"])
}}
{%- endmacro %}

{% macro imagePath(image) -%}
{% if image.startswith("https://") -%}
{{ image }}
{% elif image.startswith("debian-") -%}
{{ "https://www.googleapis.com/compute/v1/projects/debian-
cloud/global/images/" + image }}
{% elif image.startswith("windows-") -%}
{{ "https://www.googleapis.com/compute/v1/projects/windows-
cloud/global/images/" + image }}
{% endif -%}
{%- endmacro %}

{% macro machineTypePath(zone, machineType) -%}
{% if machineType.startswith("https://") -%}
{{ machineType }}
{% else -%}
{{ "%s/zones/%s/machineTypes/%s"|format(projectPrefix(), zone,
machineType) }}
{% endif -%}
{%- endmacro %}

{% macro networkPath(network) -%}
{% if network.startswith("https://") -%}
{{ network }}
{% else -%}
{{ "%s/global/networks/%s"|format(projectPrefix(), network) }}
{% endif -%}
{%- endmacro %}

{% macro diskTypePath(zone, diskType) -%}
{% if diskType.startswith("https://") -%}
{{ diskType }}
{% else -%}
```

```
{{ "%s/zones/%s/diskTypes/%s"|format(projectPrefix(), zone, diskType) }}
{% endif -%}
{%- endmacro %}
```

APPENDIX A. REVISION HISTORY

Revision 2.0-1	**Oct 20 2016**	**Divya Muntimadugu**

Added `Using Red Hat Gluster Storage in the Google Cloud Platform` chapter.

Revision 1.0-1	**Aug 25 2016**	**Divya Muntimadugu**

Added `Accessing Red Hat Gluster Storage using Microsoft Azure` chapter.

Revision 1.0-0	**Jun 21 2016**	**Divya Muntimadugu**

Version for 3.1 Update 3 release.