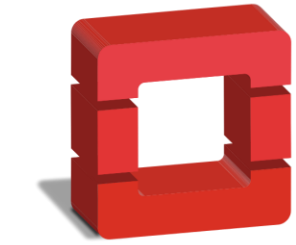


# Cloud Platform Openstack

**Madhubala Ganesan**

Erasmus Mundus PERCCOM

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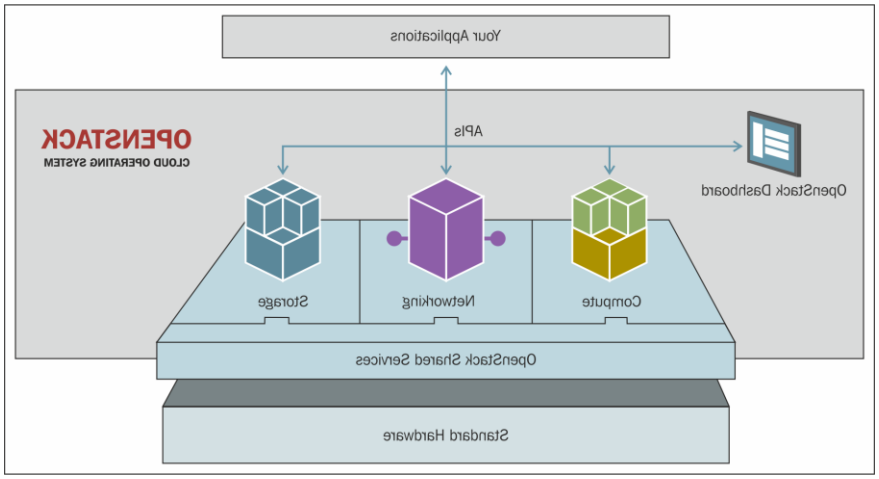
## Introduction

OpenStack is a free and open-source software platform for cloud computing, mostly deployed as infrastructure-as-a-service (IaaS), whereby virtual servers and other resources are made available to customers. The software platform consists of interrelated components that control diverse, multi-vendor hardware pools of processing, storage, and networking resources throughout a data center. It gives an illusion of infinite capacity. Users either manage it through a web-based dashboard, through command-line tools, or through a RESTful Application Programming Interface (API). It is written in Python. OpenStack.org released it under the terms of the Apache License.




OpenStack is a set of software tools for building and managing cloud computing platforms for public and private clouds. It is the second largest community after Linux.

## History

Rackspace and NASA together worked in developing the first version of Openstack. It all started with an email from Jim Curry suggesting to work with NASA. While Rackspace worked on object storage, NASA provided all the computing resources. The following image is the email which was a trigger for the Openstack project.

From: **Jim Curry** <jim.curry@rackspace.com>
Date: Fri, Jun 4, 2010 at 11:02 AM
Subject: Rackspace
To: "Chris.C.Kemp@nasa.gov" <Chris.C.Kemp@nasa.gov>

Chris,

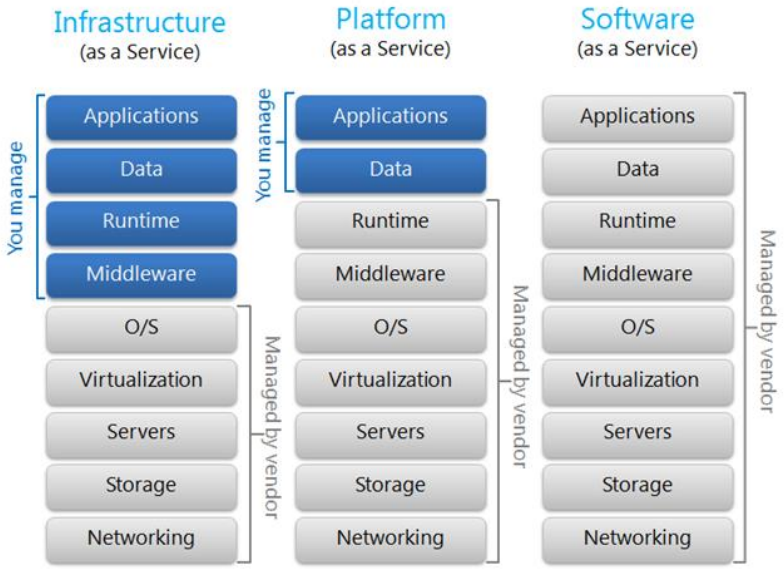
I run corporate development at Rackspace, and am very interested in talking with your team about Nebula. Confidentially, we are in the process of open sourcing our cloud stack and I am interested in seeing if there might be some synergies / opportunities for the two projects to work together. Would it be possible to setup some time to discuss with your team?

Thanks in advance!
Jim

Jim Curry
VP Corporate Development, Rackspace
Work: (210) 312-5142
Cell: (512) 636-0587
Twitter: @jimcurry

## Cloud Service Models

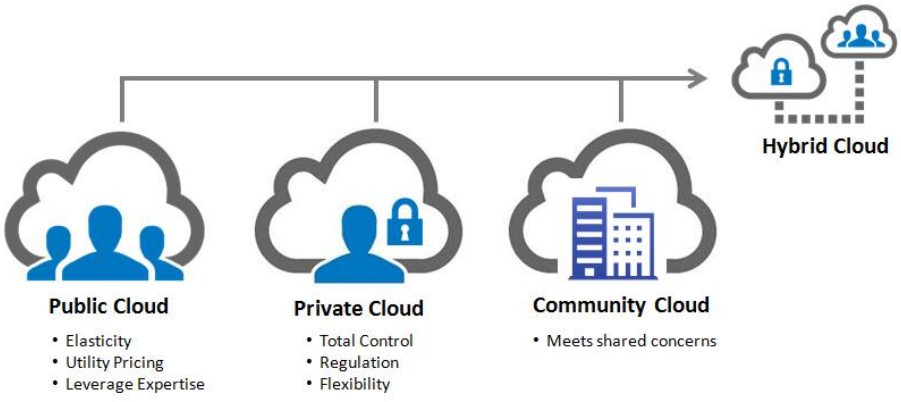
SPI is an acronym for the most common cloud computing service models, Software as a Service, Platform as a Service and Infrastructure as a Service.




Software as a Service (SaaS) is a software distribution model in which applications are hosted by a vendor or service provider and made available to customers over a network, typically the Internet. Example, Office 365. Platform as a Service (PaaS) is a paradigm for delivering operating systems and associated services over the Internet without downloads or installation. Example, Google App Engine. Infrastructure as a Service (IaaS) involves outsourcing the equipment used to support operations, including storage, hardware, servers and networking components. Example, AWS and Openstack.

## Cloud Deployment Models

OpenStack is a key enabler in adoption of cloud technology and has several common deployment use cases. These are commonly known as Public, Private, and Hybrid models.



**Public cloud**

A public cloud is one in which the infrastructure is open to the general public for consumption. OpenStack public clouds are typically run by a service provider and can be consumed by individuals, corporations, or any paying customer. A public cloud provider may expose a full set of features such as software-defined networking, block storage, in addition to multiple instance types. Due to the nature of public clouds, they are exposed to a higher degree of risk. As a consumer of a public cloud you should validate that your selected provider has the necessary certifications, attestations, and other regulatory considerations. As a public cloud provider, depending on your target customers, you may be subject to one or more regulations.

**Private cloud**

At the opposite end of the spectrum is the private cloud. A private cloud is provisioned for exclusive use by a single organization comprising multiple consumers, such as business units. It may be owned, managed, and operated by the organization, a third-party, or some combination of them, and it may exist on or off premises. Private cloud use cases are diverse, as such, their individual security concerns vary.

**Community cloud**

A community cloud is one whose infrastructure is provisioned for the exclusive use by a specific community of consumers from organizations that have shared concerns. For example, mission, security requirements, policy, and compliance considerations. It may be owned, managed, and operated by one or more of the organizations in the community, a third-party, or some combination of them, and it may exist on or off premises.

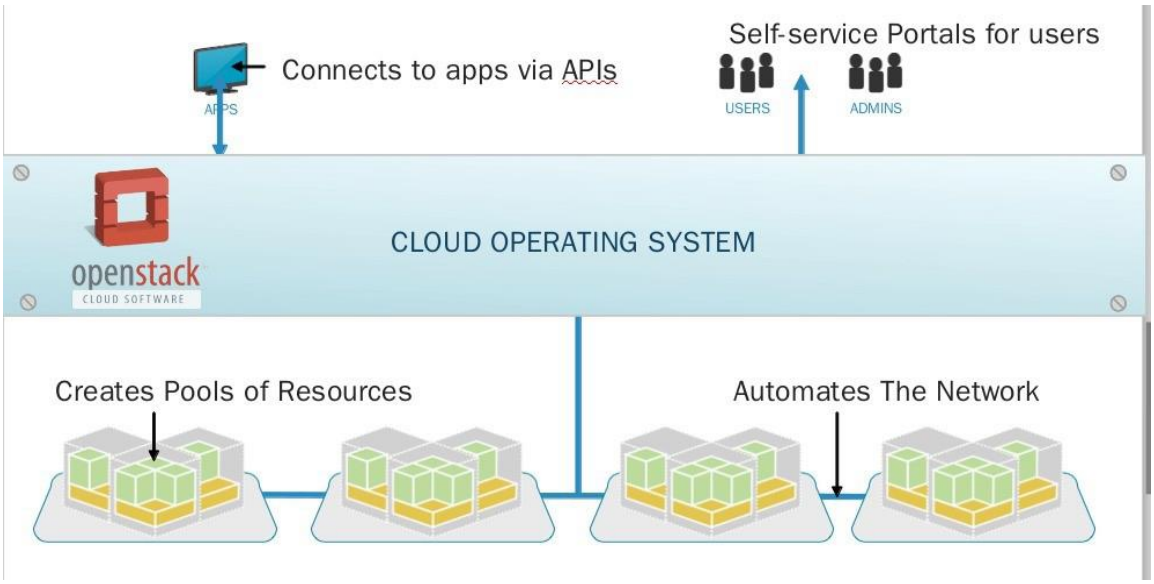
**Hybrid cloud**

A hybrid cloud is a composition of two or more distinct cloud infrastructures, such as private, community, or public, that remain unique entities, but are bound together by standardized or proprietary technology that enables data and application portability, such as cloud bursting for load balancing between clouds.

Openstack can act as both public and private cloud platforms.

## Cloud Operating System

Openstack is a Cloud operating system controls large pools of compute, storage, and networking resources throughout a datacenter, all managed through a dashboard that gives administrators control while empowering the users to provision resources through a web interface.

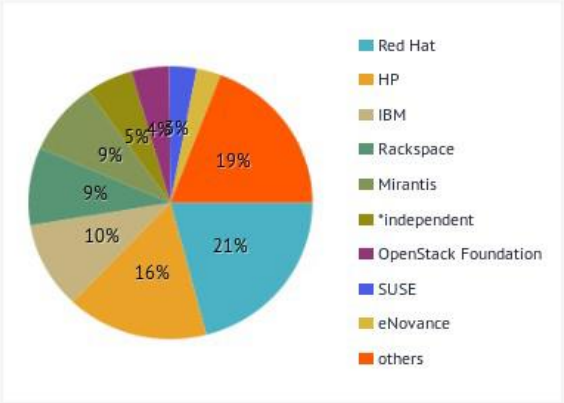



## Stable Releases of Openstack

A new version of openstack is released every 6 months and the names are given in alphabetical order.

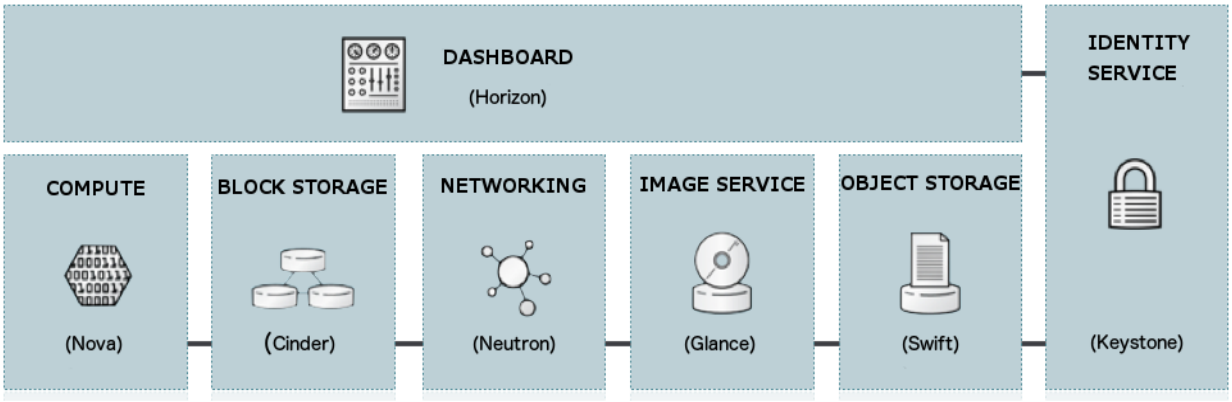
| Name | Released on | Name | Released on |
|---|---|---|---|
| **Austin** | 21 Oct 2010 | **Icehouse** | 17 Apr 2014 |
| **Bexar** | 3 Feb 2011 | **Juno** | 16 Oct 2014 |
| **Cactus** | 15 Apr 2011 | **Kilo** | 30 Apr 2015 |
| **Diablo** | 22 Sept 2011 | **Liberty** | 16 Oct 2015 |
| **Essex** | 5 Apr 2012 | **Mitaka** | 7 Apr 2016 |
| **Folsom** | 27 Sept 2012 | **Newton** | 6 Oct 2016 |
| **Grizzly** | 4 Apr 2013 | **Ocata** | 22 Feb 2017 |
| **Havana** | 17 Oct 2013 | **Pike** | 6 Oct 2017 |

The following are the companies that contributed to the development of Openstack.




## OpenStack Architecture

OpenStack embraces a modular architecture to provide a set of core services that facilitates scalability and elasticity as core design tenets. The following is a review based on (growing) set of core services of OpenStack components.




### Compute

OpenStack Compute service (nova) provides services to support the management of virtual machine instances at scale, instances that host multi-tiered applications, dev/test environments, "Big Data" crunching Hadoop clusters, and/or high performance computing.

The Compute service facilitates this management through an abstraction layer that interfaces with supported hypervisors.

Core compute service comprised of

- Compute Nodes – hypervisors that run virtual machines
  - – Supports multiple hypervisors KVM, Xen, LXC, Hyper-V and ESX
- Distributed controllers that handle scheduling, API calls, etc
  - – Native OpenStack API and Amazon EC2 compatible API

**Object Storage**

The OpenStack Object Storage service (Swift) provides support for storing and retrieving arbitrary data in the cloud. The Object Storage service provides both a native API and an Amazon Web Services S3 compatible API. The service provides a high degree of resiliency through data replication and can handle petabytes of data. The object storage differs from traditional file system storage. It is best used for static data such as media files (MP3s, images, videos), virtual machine images, and backup files.

**Block Storage**

The OpenStack Block Storage service (cinder) provides persistent block storage for compute instances. The Block Storage service is responsible for managing the life-cycle of block devices, from the creation and attachment of volumes to instances, to their release.

**Networking**

The OpenStack Networking service (neutron, previously called quantum) provides various networking services to cloud users (tenants) such as IP address management, DNS, DHCP, load balancing, and security groups (network access rules, like firewall policies). It provides a framework for software defined networking (SDN) that allows for pluggable integration with various networking solutions.

OpenStack Networking allows cloud tenants to manage their guest network configurations. Security concerns with the networking service include network traffic isolation, availability, integrity and confidentiality.

**Dashboard**

The OpenStack Dashboard (horizon) provides a web-based interface for both cloud administrators and cloud tenants. Through this interface administrators and tenants can provision, manage, and monitor cloud resources. Horizon is commonly deployed in a public facing manner with all the usual security concerns of public web portals.

**Identity service**

The OpenStack Identity service (keystone) is a shared service that provides authentication and authorization services throughout the entire cloud infrastructure. The Identity service has pluggable support for multiple forms of authentication. Security concerns here pertain to trust in authentication, management of authorization tokens, and secure communication.

**Image service**

The OpenStack Image service (glance) provides disk image management services. The Image service provides image discovery, registration, and delivery services to the Compute service, as needed. Trusted processes for managing the life cycle of disk images are required, as are all the previously mentioned issues with respect to data security. Supports Raw, QCOW, VMDK, VHD, ISO, OVF & AMI/AKI. Backend storage : Filesystem, Swift, Amazon S3

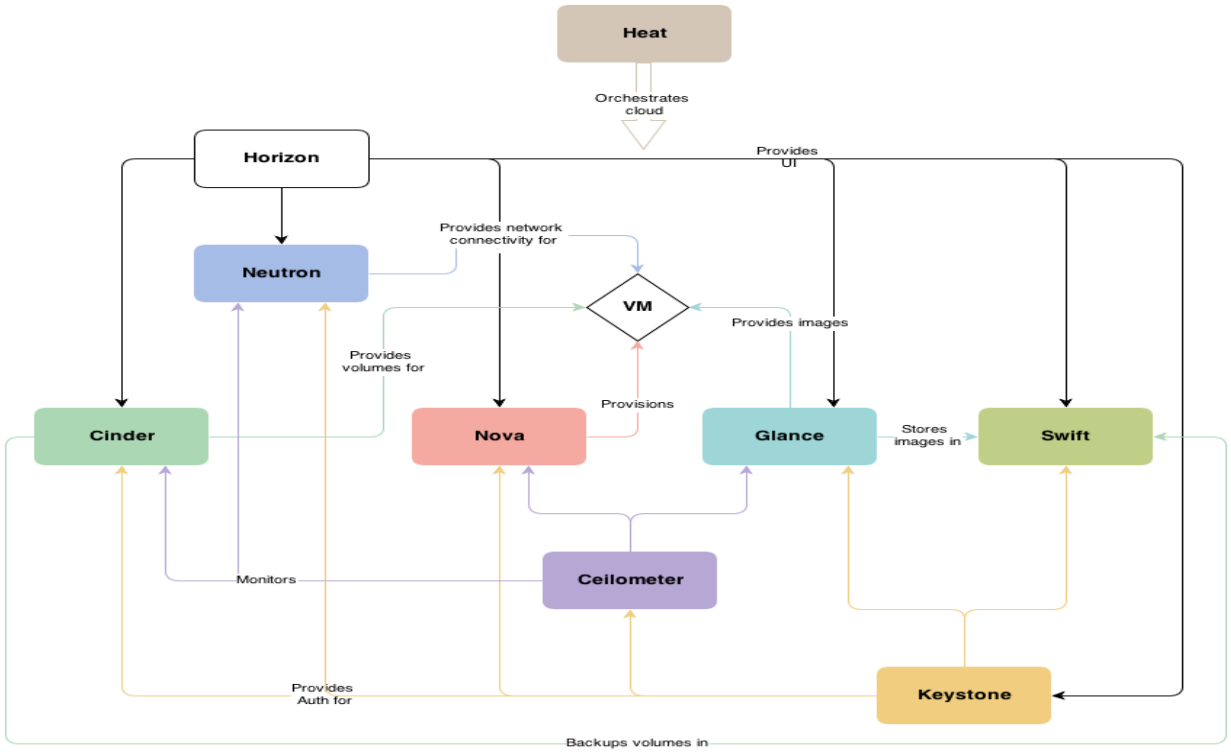
**Others Services:**

The other services / modules include the following:

- Orchestration (Heat)
- Workflow (Mistral)
- Telemetry (Ceilometer)
- Database (Trove)
- Elastic map reduce (Sahara)
- Bare metal (Ironic)
- Messaging (Zaqar)
- Shared file system (Manila)
- DNS (Designate)
- Key manager (Barbican)

## A loosely coupled architecture

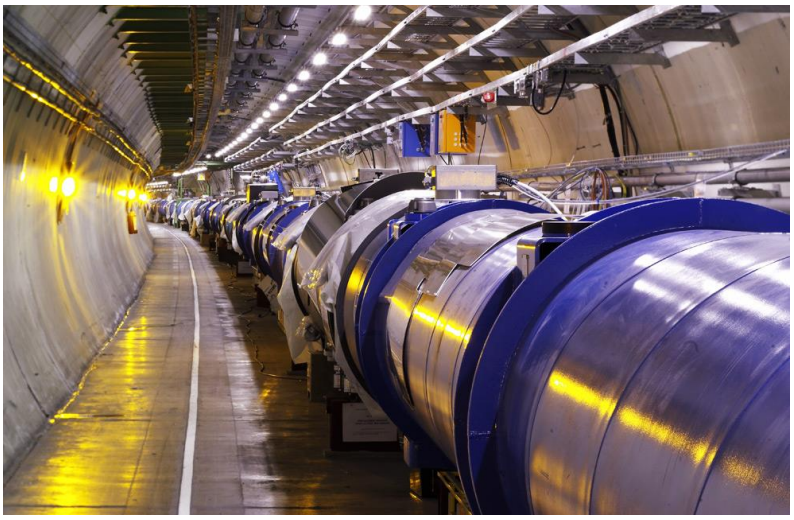
OpenStack is fully distributed system. OpenStack keeps its services as decoupled as possible. OpenStack Compute or "Nova" is the service responsible for providing compute provisioning functionality to a cloud. It can be thought of as a management layer that runs on top of a free choice of supported hypervisors, exposing a RESTful API for the purpose of provisioning and management. Nova consists of service binaries which work together to provide desired service. They all interact through messaging and in some cases directly through shared state stored in central nova-database.



Nova-compute basically is a daemon that does the job of creating and terminating virtual machines. It does this job through virtual machine API calls. There is something called as a libvirt library. Libvirt is nothing but an API for interacting with Linux virtualization technologies. Compute uses the nova-scheduler service to determine how to dispatch compute and volume requests. For example, the nova-scheduler service determines which host a VM should launch on. The term host in the context of filters means a physical node that has a nova-compute service running on it.

## CERN's Infrastructure

The European Organization for Nuclear Research known as CERN is a European research organization that operates the largest particle physics laboratory in the world. CERN is an official United Nations Observer. CERN's main function is to provide the particle accelerators and other infrastructure needed for high-energy physics research – as a result, numerous experiments have been constructed at CERN through international collaborations.



The main site at Meyrin hosts a large computing facility, which is primarily used to store and analyse data from experiments, as well as simulate events. Researchers need remote access to these facilities, so the lab has historically been a major wide area network hub. CERN is also the birthplace of the World Wide Web. CERN uses Openstack for provisioning and manage these computing resources. It runs 1300 compute nodes and runs approximately 1000 VMs simultaneously. Around 250 VMs were provisioned in 5 minutes using Openstack.

## Demonstration of Openstack

I have installed a all-in-one Devstack installation of Openstack in a Ubuntu 14.04 Server running on VMware Workstation 12 Player. I created an admin, cloud (tenant) admin and end user accounts and a project named PERCCOM. I created two private and public networks (and subnet) for assigning IPs to the Virtual Machines. I have configured the public network for providing

floating IPs. I have enabled cinder service so that volumes can be created and attached to the machines. Using the existing cirros image, I provisioned a VM under the project PERCCOM. I have uploaded the video demo in YouTube. The link below shows the video demonstration:

https://www.youtube.com/watch?v=-86OmgqwOuo&t=7s

## Distributions of Openstack

The following is the list of distributions of Openstack:

- HPE
- IBM
- Mirantis
- Oracle OpenStack for Oracle Linux / Solaris
- Red Hat
- Stratoscale
- SUSE
- VMware Integrated OpenStack (VIO)

## Advantages of Openstack

- Control & Flexibility: not locked to a proprietary vendor
- Industry Standard: > 200 companies are contributing
- Proven Software: power some of the largest public & private clouds
- Compatible & Connected: easy to migrate data and applications to public clouds

## References for more information and implementation

- The OpenStack Foundation - http://www.openstack.org/
- Official OpenStack Documentation - http://docs.openstack.org/
- The OpenStack Cloud Computing Cookbook (Second Edition) - http://www.amazon.com/OpenStack-Cloud-Computing-Cookbook-Jackson/dp/1782167587/ref=sr_1_1?s=books&ie=UTF8&qid=1382033707&sr=1-1
- TryStack (OpenStack Sandbox) - http://trystack.org/
- Rackspace Public Cloud - http://www.rackspace.com/cloud/
- Devstack - https://docs.openstack.org/developer/devstack/guides/single-machine.html
- Join The OpenStack Community - http://www.openstack.org/community
- Open Source - https://github.com/openstack