



Openstack: Open Source Cloud Computing IaaS Platform

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Abstract--- Today SMEs to big enterprises, from computer professionals to smart phone users everyone is looking towards or using cloud computing in a way or other. There is lot of buzz about cloud computing as it brings many advantages in terms of service availability, scalability, use anywhere, metered use, etc. Moreover, cloud computing fulfilled a long-held dream of turning computing as a utility. Since the notion of cloud in 1960s [1] tremendous research has been carried out by various research practitioners in business and academia; also developed many solutions to put cloud computing in implementation. As a result there are lot of cloud computing solutions these days provided by various agencies both commercial and non-commercial; Openstack is one from those communities of cloud enthusiastic. Cloud computing provides primarily three service models Infrastructure as a Service (IaaS), Platform as a Service (PaaS) and Software as a Service (SaaS). And there are primarily three deployment models for cloud computing which are public cloud, private cloud and hybrid cloud. This paper analyses architecture and characteristics of an open source cloud computing platform for providing IaaS cloud deployment for public and private clouds. Openstack being open source is of tremendous consideration.

Keywords— Cloud Computing, Openstack, IaaS, Open Source Cloud Computing

I. Introduction

Cloud computing is changing the business models and turning the way software applications are developed to be able to run in a cloud environment. Cloud computing has been blogged about discussed about and always been an effervescent title in conferences, workshops, magazines, etc. Even with this huge talk about cloud computing all over the world still we don't have any unique definition for cloud computing. All this only raised confusion about what cloud computing exactly is, how it is useful and when it should be used. There are as many views and definitions for cloud computing as the number of people talking about this and no two talk the same. Still a widely accepted definition for cloud computing is from NIST [2] "A model for enabling convenient, on-demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction". Besides the various advantages of cloud computing over traditional computing what actually changed with cloud computing is the way infrastructure models are designed. The best part of cloud computing is the resources delivery (such as storage, server, network equipments, etc.) and the delivery of the associated software (such as file system, operating system, applications, etc.) as a service and that too on demand basis. This delivery of hardware resources and software resources as service is how cloud computing fulfilled the long-held dream of computing as utility. Cloud computing is not a new stand alone technology with new advantages and some traditional network challenges alone or something evolved all of a sudden; rather it stands on a strong base of various other technologies like utility computing, distributed computing, web services, networks, virtualization, etc. bringing some or all best of these underlining technologies under one head cloud computing.

II. Openstack

Openstack is open source cloud computing software that provides infrastructure as a service cloud deployment for public and private cloud. Openstack provides a significant alternative for organizations which don't wish to go for commercially provided cloud as openstack is open source. Openstack was first introduced in June 2010, born with its initial code from NASA's Nebula platform and Rackspace's Cloud Files platform. Openstack mission according to [3] is "To produce the ubiquitous open source cloud computing platform that will meet the needs of public and private cloud providers regardless of size, by being simple to implement and massively scalable". Since its very first introduction in June 2010 openstack is accelerating and gaining popularity every day. And now openstack is joined by scores of developers and support team backend by some large houses like Canonical, Rackspace, etc. Currently openstack is joined by more than 180 business houses providing to support for openstack, more than 15996 people working over it and active involvement of people from more than 137 nations [4]. Although openstack is portable software but many Linux distributions provide it as an operating system also like Ubuntu Canonical [5]. Openstack is written in python and all of the code for Openstack is freely available under the Apache 2.0 license. Today whole of the openstack project is managed by Openstack Foundation established in September, 2012. Openstack Foundation is an independent body providing shared resources to help achieve openstack mission by empowering, protecting and promoting openstack software and the community around it including users, developers and the entire ecosystem. Openstack brought jointly by NASA and

Rackspace as a new open source cloud initiative freely available under Apache License. Openstack controls large pools of compute and storage all managed either through APIs or dashboard. Dashboard provided by openstack is a web interface for provisioning to and releasing of resources from end users. Openstack delivers a scalable cloud's infrastructure as a service. Openstack community is having around six-month release cycle and till now openstack has released nine major openstack releases from Austin in October 2010 to Icehouse in April 2014 [6].

III. Openstack Architecture

Openstack is organized around three main modules i.e. compute, storage and networking. Along with these three, dashboard become an important component in providing interface to administrators and users for provisioning and release of resources. These components and their interaction with user's application and underlying hardware over which other openstack services do run can be represented as shown in **figure 1**. Openstack compute is designed for provisioning of virtual machines providing scalable cloud computing platform. Openstack storage provides objects storage to be used for storing necessary images to run virtual machines or virtual instances. Openstack network provides necessary services which are used for communication with in virtual machine i.e. inter-VM and external to virtual machines. All these modules along with other services running underneath works in a close interaction with each other which may or may not be running on single server (test environment) or on a multiple servers (production environment) jointly fulfilling the common purpose of openstack for providing a feature rich, scalable platform for infrastructure as a service cloud platform.

IV. Openstack Components

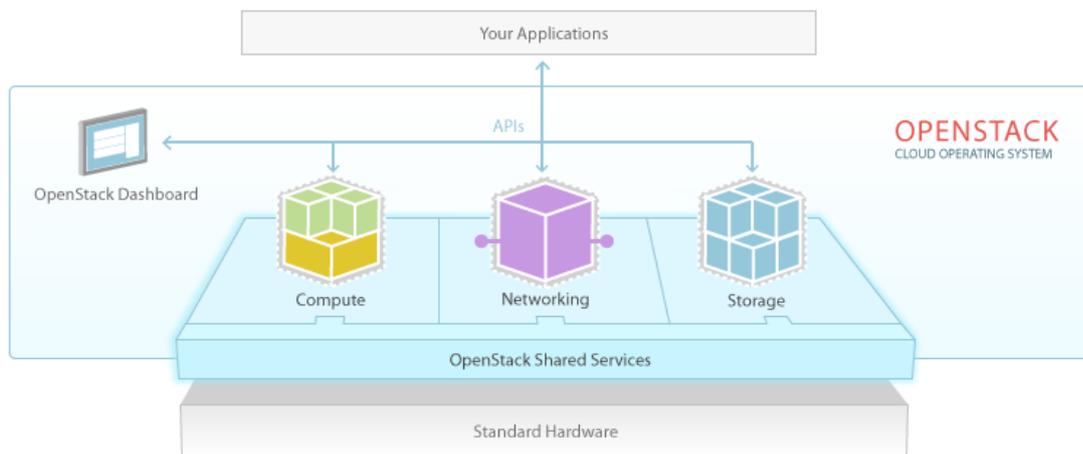


Figure 1 Openstack Architecture

Openstack currently consist of seven different service code projects to make it modular, each having its different code name for project. This code name describes the different modules of the openstack and their configuration files respectively. The seven openstack's projects along with their respective code name are listed in **table 1**.

TABLE 1

OPENSTACK PROJECTS

Sr. No.	Openstack Project Name	Codename
1	Compute	Nova
2	Object Storage	Swift
3	Identity	Keystone
4	Dashboard	Horizon
5	Block Storage	Cinder
6	Network	Quantum
7	Image Service	Glance

Compute (codenamed Nova): Openstack compute originated from NASA's Nebula platform. Compute provides the service for provisioning and un-provisioning of virtual machines on demand basis. Many companies provide compute services commercially bases on Openstack's compute moreover, compute is used internally by many organizations including where it originated i.e. NASA. Nova is main core part of openstack essential for IaaS. It is responsible for running virtual servers. It is used to host and manage cloud computing systems. Nova originated at NASA Ames Research Laboratory. Its design is built keeping in mind the ease of adding new features, scaling with workload, fault tolerance and compatibility of its APIs with other systems like Amazon EC2.

Object Storage (codenamed Swift): Object store provides object storage services with codenamed "Swift". It allows the openstack users to store or retrieve files. Several companies like KT, Rackspace, etc. provide storage services commercially based on swift. It is a safe, efficient and economical solution to store data in bulk. Swift store data in form of virtual containers. It is based on Rackspace's **Cloud Files**. Currently swift stores files less than 5GB, but large object

storage system development is under work. Besides the basic essential functionality like storing objects in containers, keeping track of stored objects, etc. swift provides additional features also, like replication, integrity audits, etc.

Identity (codename Keystone): Authentication and authorization is always been necessary concern for network technologies, openstack is not an exception. Identity services are responsible for handling authentication and authorization in openstack. It maintains and manages the rules for users of different levels like operator, admin, tenants, etc. Keystone provides authorization token for logging into virtual machines and manages the privileges of users for various services. Mysql database server is used to maintain the keystone data.

Dashboard (codename Horizon): Dash board provides web based interface to the users to interact with all the openstack services be it the glance for managing images, object storage for volumes, compute for VMs, etc. With this web based GUI provided by Horizon operations for instances (such as launching, termination, suspension, etc.), operation for IP addresses assignment, volume operations (such as creation, attachment and de-attachment, etc.), etc. can be done. The query results are fulfilled by the database server holding the authentication data and other configuration details.

Block Storage (codenamed Cinder): The running instances don't have any persistent storage; the data stored over running instance is over RAM and get lost when instance is terminated. Block storage provides a persistent storage for virtual machines in the form of volumes. These volumes are attached with the running instance and act as persistent storage medium for data storage. Block storage provides storage in form of fixed size blocks. Cinder provides storage with high availability, fault-tolerance and its APIs compatibility with other like Amazon EC2 APIs.

Network (codenamed Quantum): Network services provide "connectivity as a service". The communication between the instances created by Nova is made available by Quantum. Quantum attach interface to instances and make them capable for communication with each other or as configured for. Quantum is responsible for communication between interface devices which are managed by other Openstack services especially Nova.

Image Service (codenamed Glance): Glance at as catalogue for virtual disk images. These images are utilized by compute to launch an instance. These images are kind of disks with operating system installed over them; they are just attached with the instance when it is launched. Glance uses RESTful API for querying virtual machine image metadata and actually discovering and retrieval of virtual image when required.

V. CONCLUSIONS

The architecture analysis and characteristics feature of Openstack shows it is useful to deploy large-scale cloud deployments for private, public and hybrid cloud and that too economically. Today corporations, service providers, SMBs, researchers, and global data centres all looking towards or using Openstack. Openstack being used and supported by various commercial and non-commercial houses is a proof for the standardization and maturity of Openstack. Since its first release it has been evolved and besides fixing up of various bugs, various contributors are contributing towards it and new features are adding up day by day. Openstack matters because of all its code is licensed under Apache 2.0 license. Anyone can run it, build on it, or submit changes back to project. Openstack removing fear of proprietary lock-in for customers and create a large ecosystem that spans cloud providers.

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