



# Open Source Solution for Cloud Infrastructure Platform Using Apache CloudStack

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*Abstract: Cloud computing is a service in which shared resources like hardware and software are provided on demand of clients at specific time. In Cloud computing the computing resources like memory, processor, storage and network that can be easily provisioned and released on-demand with minimum cloud administrator interaction are provided on sharing basis. In its general form, definition of 'cloud' can be given as, "Cloud is a model for providing convenient, on-demand remote access to a pool of configurable computing resources like servers, storage, and services that can be easily provisioned and released with minimal management effort or administrator interaction". Services on cloud are divided into three broad categories: Software as a Service, Infrastructure as a Service & Platform as a Service. Same as services cloud is also classified as Private Cloud, Public Cloud & Hybrid Cloud. Private cloud is increasingly become popular between every private organization either large or small wants .To deploy public or private cloud there are many open source software available some are Eucalyptus, Nimbus, OpenStack, Open Nebula Cloud stack and Amazon Web Services .This paper, I provide a comparative study of Cloud Computing Platform such as Eucalyptus, OpenStack, OpenNebula and cloudstack for cloud implementation. which is open source software. CloudStack is an open source platform for develop private as well as public cloud. The aim of this paper is to show mainly importance of CloudStack as a Cloud provider and give the best solution for service providers as well as enterprises.*

**Keywords—** *Cloud Computing, CloudStack, Eucalyptus, OpenStack, Open Nebula*

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## I. INTRODUCTION

In recent year cloud computing become a most popular word in the world of Information Technology. Cloud computing is a service in which shared resources like hardware and software are provided on demand of clients at specific time. In Cloud computing the computing resources like memory, processor, storage and network that can be easily provisioned and released on-demand with minimum cloud administrator interaction are provided on sharing basis. In its general form, definition of 'cloud' can be given as, "Cloud is a model for providing convenient, on-demand remote access to a pool of configurable computing resources like servers, storage, and services that can be easily provisioned and released with minimal management effort or administrator interaction".

## II. CLOUD COMPUTING

The simplest definition of Cloud computing is, delivering the computing services over the Internet. The services provided by the cloud allow individuals and organisations to use software and hardware that are managed by third parties at remote locations. Services may be of software resources (Software as a Service, SaaS) or pool of services (Platform as a Service, PaaS) or infrastructure (Infrastructure as a Service, IaaS). Amazon EC2 (Amazon Elastic Compute Cloud), Windows Azure, Google app engine and salesforce.com are popular examples of cloud computing services which are used by many cloud users now-a-days. Using cloud computing model we can gain access to computer resources and information from any place wherever a network connection is available. Cloud computing provides a shared pool of resources comprising of data storage space, networks, computer processing power, and specialized corporate and user applications. Cloud computing is nothing but an on demand service in which shared resources like software and hardware are provided on demand of clients at specific time.[1]

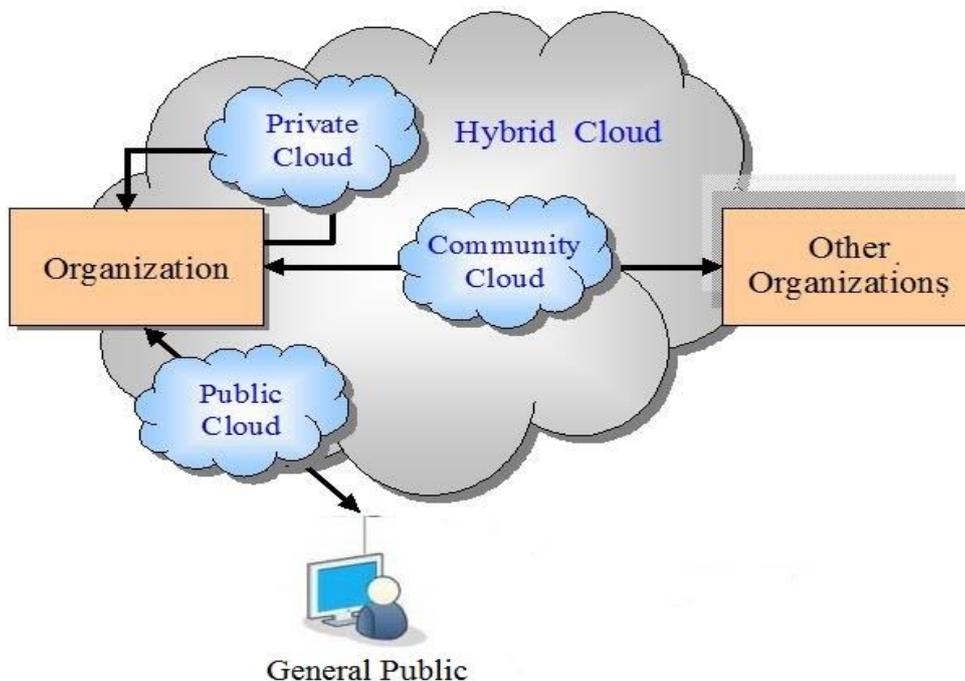


Figure 1. Types of Cloud Computing

### III. JOURNEY OF CLOUD COMPUTING

In 1951, John McCarthy’s notes on the time share computer. In 1961 John McCarthy talks suggestion that computers should become a utility similar to telephone services. In 1966 Douglas Parkhill publishes a book titled Challenges of computer utility. In 1995 Amazon starts selling books using the World Wide Web. In 1999 Lan foster and Carl kesselman publish a book titled the grid: the blueprint for a new computing infrastructure and develop Globus tool kit to create computer grid. In 2004 Google start free email service. In 2006 Amazon introduces pay for use computing (Amazon web services) and elastic cloud computing (EC2). In 2006 Google starts offering Google apps with 2 GB free disk space on their infrastructure. In 2010 Microsoft start providing a cloud service called Azure. in 2011 IBM offer smart cloud.



Figure 2 :- Cloud computing Evaluation

### IV. OPEN SOURCE CLOUD PLATFORM

#### A. CloudStack

Apache CloudStack is an open source Infrastructure-as-a-Service platform for creating and managing cloud services. Many of the world’s largest public and private clouds use it. . It was launched by Cloud.com and made generally available in May of 2010 as free software under the GNU General Public License. In July 2011, Citrix purchased Cloud.com that resulted in Citrix donating CloudStack to the Apache Software Foundation (ASF), where it was accepted as part of the Apache Incubator. Today CloudStack is a single top level ASF project built around a committee of developers and a VP/Chair. The project is led by Hugo Trippaers - Engineer at Schuberg Phillis, who is also active in the Open Daylight project. Even though the project has a smaller community of committers than OpenStack, it is a cohesive single project that is commercially backed by a primary contributor, Citrix.

## **B. OpenStack**

OpenStack was Launched by NASA and Rackspace in July 2010. It is managed by the OpenStack Foundation. It is the fastest growing free open source cloud software. Rackspace contributed their "Cloud Files" platform (code) to power the Object Storage part of the OpenStack, while NASA contributed their "Nebula" platform (code) to power the Compute part. OpenStack is a collection of open source software project that developers and cloud computing technologist can use to setup and run their cloud compute and storage infrastructure. Its services are available through Amazon EC2/S3 compatible APIs and hence the client tools written for AWS can also be used with OpenStack. It consist of three core software project: OpenStack Compute Infrastructure also called Nova; OpenStack Object Storage Infrastructure also called Swift and OpenStack Image Service Infrastructure also called Glance. Nova is the main part of Infrastructure as a service and it also is the computing Fabric controller for the OpenStack cloud. Enterprises / Organization can use Nova to host and manage their cloud computing systems. Nova manages all the activities that are needed to support life cycle of instances within the open stack. Swift offers a distributed, consistent virtual object containers in which lots of data can be store and from which data can be retrieve It is capable of storing large number of object distributed across nodes. Glance is a lookup and retrieval system for virtual machine images.

## **C. Eucalyptus**

EUCALYPTUS is the short form of Elastic Utility Computing Architecture for Linking Your Program to Useful System, it is free and open source computer software for building Amazon Web Services (AWS) compatible private and hybrid cloud computing environments marketed by the company Eucalyptus Systems. It was developed by the University of California-Santa Barbara as an open source Infrastructure as a service and was released in 2008. It provides an Elastic Compute Cloud (EC2) -compatible cloud Computing Platform and Simple Storage Service (S3)-compatible Cloud Storage. Eucalyptus has some high-level components such as Cloud Controller (CLC), Cluster Controller (CC), Storage Controller (SC), and Node Controller (NC). The main benefits to use this open source software for private clouds which provide highly scalability, efficient, organization agility.

## **D. OpenNebula**

OpenNebula, mainly a virtualization tool used to manage virtualized infrastructure in the data center or cluster (usually referred as private cloud), was first established as a research project back in 2005 by Ignacio M. Liorente and Ruben S. Montero. It is a computing platform used to manage heterogeneous distributed data center infrastructures. It supports hybrid cloud to combine local infrastructure with public cloud-based infrastructure, enabling highly scalable hosting environments.

OpenNebula is a turnkey enterprise-ready solution that includes all the features needed to provide an on-premises (private) cloud offering, and to offer public cloud services. It also support Public cloud by providing cloud interfaces to expose its functionality for virtual machine, storage and network management. Its virtual infrastructure interface disclose user and administrator functionality for virtualization, networking, image and physical resource configuration, management etc. OpenNebula cloud infrastructure provide users with an

elastic platform for fast delivery and scalability of services to meet dynamic demand of service end-users. All the services are hosted in Virtual Machines (VM) and then submitted ,monitored and controlled in the cloud by using the virtual interfaces such as Command Line interface,XML-RPC API, Libvirt virtualization API etc.

## V. COMPARATIVE STUDY OF CLOUD SOLUTIONS

The comparative study between CloudStack, Eucalyptus, OpenStack and OpenNebula is based on the study of the architecture of respective open source platform. Each Open source software provide Infrastructure as a Service to delivers virtualization environment, as a service to user computer.

### A. Origin and Community Support

**Eucalyptus** : Eucalyptus Established in 2008 and its initial release date is 2008-05-29, Eucalyptus was the result of research project of the university of California ,Santa Barbara, Department of computer science. It has a powerful community that contributes to platform development and assists in finding and fixing.

**OpenStack**: OpenStack Established in 2010, Initial release date is 2010-10-21 OpenStack started in summer 2010 when RackSpace and NASA jointed its initial project "Cloud Files" and "Nebula" respectively. OpenStack is lead by an foundation (integrated by 850 companies and 4500 individual members) and has a broad range of support from major tech industry players,ranging from HP, Dell , IBM, RackSpace , NASA , Cisco, NEC, AT&T ,Bull , EMC,Brocade and dozens of other companies.Its community integrated by around 7000 person over 87 countries.

**OpenNebula**: Established in 2010, Initial release date is 2008-03-???. OpenNebula was funded initially by European infrastructure grants,and is now doing rather well in developments both inside Europe and overseas.Some large company such as Research In Motion,Telefoniacand China Mobile also contribute to OpenNebula.In March 2010, the main authors of OpenNebula founded C12G Labs to provide the C12G value-added professional service that many enterprise IT shops require for internal adoption and to allow the OpenNebula project to not be tied exclusively to public financing,contributing to its long-term sustainability.

**CloudStack**: Established in 2010, Initial release date is 2010-05-04 CloudStack Open source software, originally developed by Cloud.com, it was purchased by Citrix then later on released into the Apache Incubator program, but in this time governed by the Apache Software Foundation and supported by Citrix. CloudStack is relatively new in the open source IaaS space, so it lacks a large community support base.

### B. Architecture

**Eucalyptus** Hierarchical architecture consist of five components, Minimum two servers : Cloud Controller, Walrus , Cluster Controller , Nodecontroller and Storage Controller. Hierarchically grouped from CLC via the CC to the NC. **OpenStack** consist of three core software projects which are OpenStack Compute (Nova), OpenStack Object Storage (Swift) and OpenStack Image service (glance). **OpenNebula** contain three components and minimum two servers. Its follow classical cluster -like architecture with a front end and a set of cluster nodes to run the virtual machines (VMs).**CloudStack** Open source software designed for centralized management and massive scalability; it enabling the effective

management of numerous geographically distributed servers from a single portal only and follow monolithic architecture.

**C. Relation with Amazon:** Eucalyptus ,OpenNebula have embraced amazon Web Service-APIs to compatible with AWS's application programming interfaces. OpenStack , developers built tools to manage their resources using the native OpenStack RESTful APIs. OpenStack also has at least at the moment ,has AWS EC2 compatibility API, and also support AWS S3 API.

**D. Cloud Implementation:** Eucalyptus is an open source platform for private cloud. OpenStack is an open source platform for deploying private and public cloud. OpenNebula, while an open source platform for deploying hybrid cloud ,but it also deploy private and public cloud. CloudStack is an open source platform for develop private as well as public cloud.

**E. Hypervisors:** Hypervisor is a software abstraction of a physical hardware platform that enables multiple guest operating system to run concurrently on a single physical machine. Eucalyptus is compatible with KVM, Xen, and VMware hypervisor. To interact with these hypervisor eucalyptus use the Libvirt virtualization API. CloudStack is compatible with VMware, Oracle VM, KVM, XEN. OpenStack is compatible with many hypervisor such as KVM, Xen, VMware, ESX, ESXi, Hyper-v, LXC, QEMU, UML, PowerVM, Bare etc ,which make difficult for developer to choose one.OpenNebula , while support KVM, Xen, VMware ESX, ESXi.

**F. Programming/Scripting Language:** Eucalyptus has five component in which Cluster Controller and Node controller are primarily written in 'C' while Cloud Controller , Storage Controller and VMWare -Broker(not open -source due to license restriction) are written in Java. Euca2ools are written in Python. OpenStack Compute Nova is written in Python and Unix Shell (Bash sh).OpenNebula used many languages but most of its components are written in Java, Ruby and C++. CloudStack used Java language.

**G. Operating System Support:** Eucalyptus support Linux (Ubuntu, Fedora, CentOS, OpenSUSE et Debian) operating system and images of both Microsoft windows and Linux . OpenStack support Linux,Windows, Requires x86 Server. OpenNebula support CentOS, Debian, Fedora, RHEL open-SUSE, SLES, and Ubuntu. CloudStack is depending on the Hypervisor and hardware - Mac OS X, Asianux, CentOS, Debian, DOS, Fedora, FreeBSD, Novell Netware, Oracle Enterprise Linux, Ubuntu, Red Hat Enterprise Linux, Sun Solaris, SUSE Linex Enterprise, Windows.

**H. Storage:** Eucalyptus Supports for iSCSI, EBS, Amazon S3,Hardware support for industry-standard Storage Hardware . OpenNebula Hardware support for Fibre Channel, iSCSI, NAS shared storage, SCSI / SAS / SATA. Non-shared and shared file systems (NFS, LVM with CoW, VMFS, etc.). OpenStack supports Object and block storage, Volumes are persistent (data retained until the volume is deleted, independently from the VM). File storage is supported through Swift (organizing the files in containers). CloudStack Supports for iSCSI, NFS, SMB/CIFS; also support for OpenStack Swift and Amazon S3.

### **I. Image Management**

In Eucalyptus images are managed by Euca2ools distributed by eucalyptus team. One can bundle, upload, register, describe, download, unbundle and deregister VM images.

OpenStack image service (glance), provides functionality for discovering , registering and retrieving virtual machine images. While OpenNebula use image repository or data stores to allow administrator or users to set images. Datastores are generally backed with SAN/NAS servers. All images and virtual machines management files are stored in /var/lib/one.

**J. VM Migration:** Eucalyptus do not support VM migration ,While OpenStack and OpenNebula supports VM migration from one resource to another.

**K. Licensing:** Eucalyptus BSD-Licence, OpenStack, OpenNebula and CloudStack Apache Licence Version2

**L. Release Frequency:** Eucalyptus >4 months  
OpenNebula >6 months  
OpenStack <4 months  
CloudStack 4 months

**M. Source Code:** OpenStack, CloudStack and OpenNebula are fully open-source, Apache v2.0, but Eucalyptus is fully opensource, GPL v3.0 supports.

**N. Miscellaneous:** It is observed that the OpenStack has the largest active population in during the past months. And in total, it has the largest population followed by Eucalyptus and Nebula.

## VI. CLOUDSTACK

Apache CloudStack is an open source Infrastructure-as-a-Service platform for creating and managing cloud services. Many of the world's largest public and private clouds use it. It was launched by Cloud.com and made generally available in May of 2010 as free software under the GNU General Public License.

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Today over 50% of the Apache CloudStack code development is produced by a team of Citrix developers, many of whom came from the Cloud.com acquisition. Not only is Citrix involved in the development of new features and bug fixes for the CloudStack platform, but Citrix produces a commercial distribution of CloudStack called Citrix CloudPlatform.

Originally, CloudPlatform was a customized distribution of the CloudStack code base, which contained a significant feature divergence. As of the release of CloudPlatform 4.2 in

September of 2013, all Citrix customizations have been committed back to the Apache CloudStack.

Apache CloudStack is a Java-based project that provides a management server and agents (if needed) for hypervisor hosts so that you can run an IaaS cloud. Some, but not all, of the features and functionality provided by CloudStack are:

- Works with hosts running XenServer/XCP, KVM, Hyper-V, and/or VMware ESXi with vSphere
- Provides a friendly Web-based UI for managing the cloud
- Provides a native API
- May provide an Amazon S3/EC2 compatible API (optional)
- Manages storage for instances running on the hypervisors (primary storage) as well as templates, snapshots, and ISO images (secondary storage)
- Orchestrates network services from the data link layer (L2) to some application layer (L7) services, such as DHCP, NAT, firewall, VPN, and so on
- Accounting of network, compute, and storage resources
- Multi-tenancy/account separation
- User management

In short, organizations can use Apache CloudStack to deploy a full-featured public or private IaaS cloud.

## VII. INSTALLATION PROCESS OF CLOUDSTACK ON CENTOS 6.5

First of all I install CentOS 6.5 which support CloudStack. To start the installation process we first need to log in as root user via the terminal:

i. login as root su root

After login as root user we have to configure the network, by default the network will not come up on your hardware and you will need to configure it to work in your environment.

ii. Check the file `/etc/sysconfig/network-scripts/ifcfg-eth0` and Configuring the network

I change this information:

```
DEVICE=eth0
HWADDR=52:54:00:B9:A6:C0
NM_CONTROLLED=no
ONBOOT=yes
BOOTPROTO=none
IPADDR=172.16.12.91
```

```
NETMASK=255.255.255.0
GATEWAY=172.16.12.1
DNS1=8.8.8.8
DNS2=182.19.95.34
DNS3=8.8.4.4
```

iii. # chkconfig network on

iv. # service network start

v. # hostname --fqdn

vi. # service network restart

At the moment, for CloudStack to work properly SELinux must be set to permissive. We want to both configure this for future boots and modify it in the current running system.

vii. # setenforce 0

I change this information:

# This file controls the state of SELinux on the system.

# SELINUX= can take one of these three values:

# enforcing - SELinux security policy is enforced.

# permissive - SELinux prints warnings instead of enforcing.

# disabled - No SELinux policy is loaded.

SELINUX=permissive

# SELINUXTYPE= can take one of these two values:

# targeted - Targeted processes are protected,

# mls - Multi Level Security protection.

SELINUXTYPE=targeted

NTP configuration is a necessity for keeping all of the clocks in your cloud servers in sync. However, NTP is not installed by default. So we'll install and configure NTP at this stage.

viii. # yum -y install ntp

ix. # chkconfig ntpd on

x. # service ntpd start

xi. yum -y install nfs-utils

xii. # mkdir /primary , # mkdir /secondary

xiii. # service iptables restart

I am going to install the CloudStack management server and surrounding tools. I 'll start with installing MySQL and configuring some options to ensure it runs well with CloudStack.

xiv. # yum -y install mysql-server

xv. # yum -y install cloudstack-management

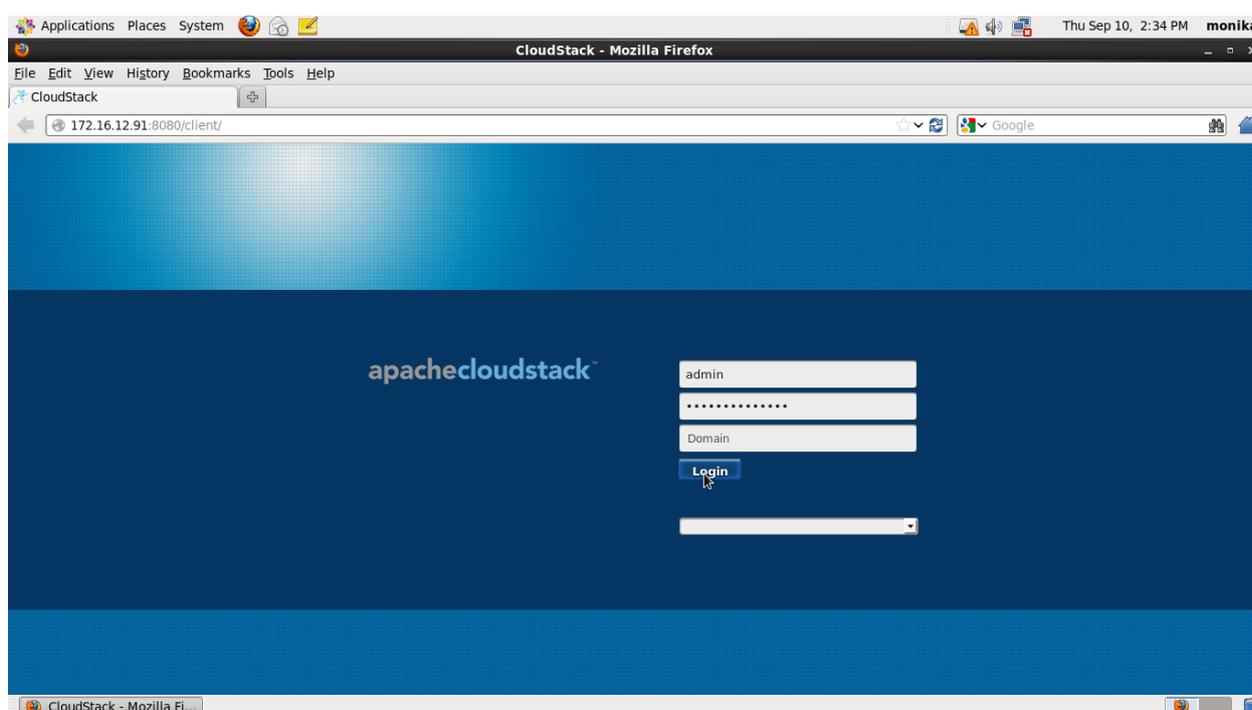
xvi. # cloudstack-setup-databases cloud:password@localhost --deploy-as=root

xvii. # cloudstack-setup-management

Now we need to download the system VM template and deploy that to the share we just mounted.

xviii /usr/share/cloudstack-common/scripts/storage/secondary/cloud-install-sys-tmpl \ -  
m/secondary\ -u http://cloudstack.apr-get.eu/systemvm/4.5/systemvm64template-  
4.5-xenserver.qcow2.bz2 \ -h xenserver -F

After the Management Server is installed and running, you can add the compute resources for it to manage. Configured the CloudStack Installation : Add a zone to the region, Add pods to the zone, Add clusters to the pod, Add hosts to the cluster , Add primary storage to the cluster, Add secondary storage to the zone, Initialize and test the new cloud. To get access to CloudStack's web interface, merely point your browser to <http://172.16.12.91:8080/client>.



**User Login**

## VIII. CONCLUSIONS

In last few years, cloud computing is an evolving technology as well as it has emerged as a modern computing paradigm that providing IT infrastructure and can be used to meet the continuously growing storage and processing requirements of today's applications. Open Source Software's are those software their source code available to the user with or without fee. The Open source cloud platform is most important which provide an alternative to end-user for improved portability, flexibility, scalability. This paper compares the four most popular and commonly used open source software which are Eucalyptus, OpenNebula, OpenStack and CloudStack; these all open source software allow users to choose better services according to their requirement. Apache CloudStack is an open source Infrastructure-as-a-Service platform for creating and managing cloud services. Many of the world's largest public and private clouds use it.. Further research is going on in the new technologies that evaluate its performances in dynamic reconfiguration.

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