

# Private Cloud IaaS Architecture in CloudStack

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**Abstract:** Cloud Computing is now fast transforming as the latest business model due to its ‘pay as you use’ nature, where user can use infrastructure, hardware, software etc. Organizations are also interested in setting up their own cloud, which can be used for their internal purposes. This paper is outcome of detailed study and analysis on setting up a private cloud infrastructure as a service in CloudStack. This paper stands as a proof of concept of setting up the environment for industry-ready usage and investigation purpose, thus enabling us with providing efficient IaaS setup. It initially discuss Infrastructure as a service concepts, then elaborate the design of the private cloud and then discuss the details of CloudStack architecture. The paper then focuses on the statistics exhibited by this setup.

**Keywords:** Cloud Computing, Private Cloud, Infrastructure as a Service, CloudStack, hypervisor, XenServer

## I. INTRODUCTION

The use of cloud computing is growing, and by 2016 this growth will increase to become the bulk of new IT spend, according to Gartner, Inc. 2016 will be a defining year for cloud as private cloud begins to give way to hybrid cloud, and nearly half of large enterprises will have hybrid cloud deployments by the end of 2017. Gartner also describes cloud computing as a style of computing in which scalable and elastic IT-enabled capabilities are delivered “as a service” using Internet technologies. It heralds an evolution of business in positive and negative ways. It has also become a hot industry term that has been used in many contradictory ways. In India, “cloud services revenue is projected to have a five-year projected compound annual growth rate (CAGR) of 33.2 percent from 2012 through 2017 across all segments of the cloud computing market. Segments such as software as a service (SaaS) and infrastructure as a service (IaaS) have even higher projected CAGR growth rates of 34.4 percent and 39.8 percent” said Ed Anderson, research director at Gartner. According to the InformationWeek 2014 Private Cloud Survey, more than 36% of private cloud projects are successful and another 33% of cloud adopters used internal expertise to build their systems, and have invested in training employees in private cloud technologies.

Since the private cloud is continuing to grow in the market, it is becoming highly essential to analyze this technology and provide with a proof of concept and various statistics about setting up a private cloud within an organization.

## II. CLOUD COMPUTING MODELS

Cloud can be categorized according to the service model it offers [1]. The cloud is strongly focused towards Service orientation. Instead of offering a packaged solution, cloud computing offers solutions as a service. So here the end users are saved from investing in large scale systems, servers etc. More over this model is best suitable for those users who want the resources as a one-time requirement. Cloud Services can be classified in to three types. Software as a Service, Platform as a Service and Infrastructure as a

Service. Salesforce.com is an example of Software as a service. Google App Engine is an example of Platform as a Service. Amazon Elastic Compute Cloud (EC2) is an example for Infrastructure as a service. Even though we are trying to classify the cloud in to the three types. Most of the Cloud facilities do not fit exactly into these categories. The exact line of difference between these types is blurred. We can consider that the Software as a Service is highly optimized but less flexible. In case of Infrastructure as a Service, it will have high flexibility but less optimization. Platform as a service falls in the mid-way between these two models. In the Cloud Computing the different models can be ordered as shown in the below figure Fig.1.

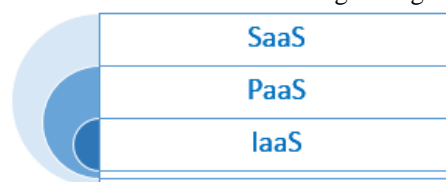


Fig. 1. Cloud Computing Models

In this the Software as a Service shall form the top of the hierarchy. In SaaS an application or software is hosted as a service to the users. At the top of the hierarchy, the application layer consists of the actual cloud applications. Compared to the traditional server hosting, the architecture of the cloud is more modular. Each layer has loose coupling with the other layers. This helps the other layers to evolve without changing the other layer.

In Platform as a service layer, the development environments are offered. This layer is capable of hosting cloud ready applications. This layer has dynamic scaling capabilities so that it can grow whenever required. This layer typically consists of operating systems and application frameworks. This layer reduces the burden of deploying the application.

The Infrastructure as a service layer is responsible for managing the physical resources of the cloud, including the physical servers, routers, etc. Rather than buying and owning the infrastructure, clients can buy these resources

fully outsourced services. Clients pay only for the resources they consume.

### III. DEPLOYMENT MODELS

There are many deployment models in cloud. Irrespective of the service model, based on the way end-users publish their application in cloud, deployment models are categorized as follows

#### Private Cloud

This kind of cloud setup is for the sole use of a single company/organization and its customers. This setup may reside inside or outside the customer premises. This cloud setup could be controlled, maintained or maneuvered by a third party or the organization itself or the combination of them.

#### Public Cloud

This kind of cloud setup is for open use by the general public i.e. individuals or organizations. It resides on the premises of the CSP. This cloud setup could be controlled, maintained or maneuvered by different government organizations or corporate organizations or academic institutions or combination of them to the extent permitted by the CSP.

#### Hybrid Cloud

This cloud setup is a composition of two or more distinct and unique cloud setup (private, community, or public) and is tied together by standardized or registered technology that ensures and allows data and application portability.

### IV. CLOUDSTACK ARCHITECTURE

*Apache CloudStack is open source software designed to deploy and manage large networks of virtual machines, as a highly available, highly scalable Infrastructure as a Service (IaaS) cloud computing platform. CloudStack is used by a number of service providers to offer public cloud services, and by many companies to provide an on-premises (private) cloud offering, or as part of a hybrid cloud solution [2].*

CloudStack, which has been known as one of the most popular open source cloud computing software, was chosen by many cloud vendors for creating, managing, and deploying their infrastructure cloud services. The deployment architecture of CloudStack is classified in to two. The management server and the cloud infrastructure. The management server shall manage the cloud infrastructure. We need to provision resources like hosts, storage devices to the management server which will in turn manages them. The architecture of our CloudStack setup is as below figure Fig.2

A host is a terminal in which the guest virtual machines run using the provided computing resources. Every host is installed with a hypervisor software to manage the guest virtual machines. The role of the host in CloudStack

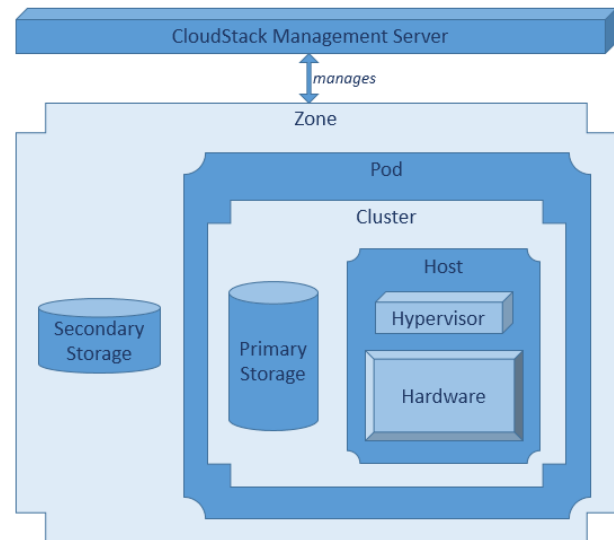


Fig. 2. CloudStack Architecture

deployment is to provide the networking resources, processing units, storage and memory which shall be utilized for hosting the virtual machines. It must also connect to internet or intranet to other machines. The hosts shall reside across different data centers in different geographical locations. Each of these host shall have variety of CPU Speeds, RAM's, Operating systems etc. but it is necessary that all the hosts present within a cluster must be homogenous [2].

Multiple hosts are grouped to form cluster. Inside the cluster all the hosts shall have identical hardware, same type and version of hypervisor. Moreover all of the hosts in a cluster must be in the same subnet and share the primary storage. Live migration of Virtual Machine instances from one host to the other host within the same cluster is possible without interrupting any service to the end-user. Typically multiple clusters are stored in a single rack as they need to present in the same subnet. A cluster can be associates with a primary storage. This shall hold the data for that specific cluster. A single rack is represented a Pod. In a pod, all the hosts will be in the same subnet. Pods will not be visible to the end user.it is an internal classification of CloudStack. Multiple pods are present within a zone. The zone provides redundancy and physical isolation for the CloudStack infrastructure. Multiple zones can be present in a data center. Although usually only a single zone is present in a datacenter, which is separated geographically.

### V. MULTI-NODE UNI-SERVER ARCHITECTURE

The CloudStack has many different varieties of architecture to be deployed. Here we look at a specific kind of deployment architecture. The multi-node uni-server architecture contains many nodes that acts as the base infrastructure nodes and a single server in which the CloudStack shall be deployed. All the machines shall be in the same network with the same subnet mask so that it would be added into a single pod. Since the cluster must be containing a homogenous setup, in this two different

versions of operating systems are given. We used Citrix XenServer as the Hypervisor [3]. So our set up shall be having two cluster with a single CloudStack maintaining it. The below figure illustrates the multi-node uni-server architecture model.

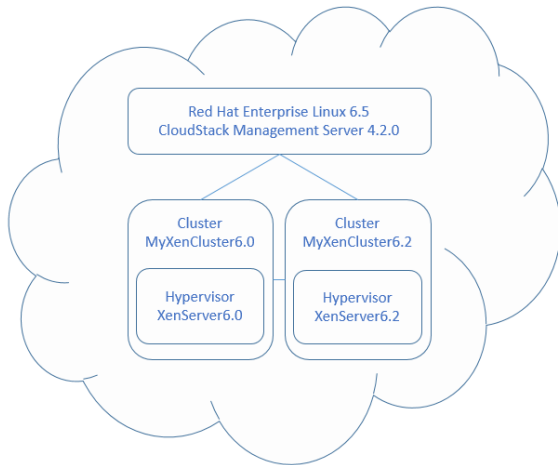


Fig. 3. CloudStack Multi-node uni-server Architecture

## VI. SETTING UP THE BASE INFRASTRUCTURE

We deployed the CloudStack architecture in a multi-node uni-server architecture. To analyze the working of the systems, three machines were configured to be the part of this Cloud infrastructure. All the 3 machines used were having 450 Gigabyte hard disk each. They had dual core AMD Athlon II X2 245 Processor, with a system memory of 8 Gigabyte. These machines were interconnected with each other and they formed the Infrastructure for this cloud architecture. In one of these machines which formed the base of cloud infrastructure, Citrix XenServer 6.2.0 was installed. In another machine, Citrix XenServer 6.0.0 was installed. These machines were interconnected to each other using Local Area Network. These machines were provided with the static IP Address ranging from 192.168.1.2 and 192.168.1.3 and there machines were provided with the subnet mask 255.255.255.0 Since the machines must be identified by the CloudStack independent of any IP Address changes, these machines were given with static IP addresses.

Among these machines, the other free machine has been installed with Linux Operating System. This machine had its Kernel Linux X86\_64 and installed with Red Hat Enterprise Linux Server 6.5 version, with the GNOME 2.28.2 version. This machine is provided with static IP 192.168.1.1 and connected to the same Local Area Network of the above infrastructure, with the subnet mask of 255.255.255.0. This machine shall also act as the gateway so the IP Address of this machine shall be given as the gateway to other machines.

## VII. CLOUDSTACK MANAGEMENT SERVER

The CloudStack was installed in the 192.168.1.1 machine. CloudStack 6.2.0 version was used for this machine. The other 2 machines which forms the core part of the infrastructure was configured in to this. A single

zone was used to set up the network. The Zone was named as *zone*. Every zone can contain one or multiple pods. Since there must be a minimum of one pod in a zone, a pod was created and named as *pod*. Every pod can contain multiple clusters with a minimum of one cluster. So we created two clusters for this operation. One cluster was named as MyXenCluster6.0 and the other was named as MyXenCluster6.2. A cluster can contain one or multiple hosts. But it is necessary that within a cluster, all the machines added must be having the same version of Hypervisor. We added 1 machine to MyXenCluster6.0 and 1 machine to MyXenCluster6.2. So the machine having Citrix XenServer 6.0.0 Hypervisor [4] was added to the MyXenCluster6.0. The other machine having Citrix XenServer 6.2.0 Hypervisor is added to the MyXenCluster6.2. So together all the machines in MyXenCluster6.0 and MyXenCluster6.2 will form the Infrastructure behind our Cloud Environment.

## VIII. CONCLUSION

It is almost certain that cloud is dominating the current enterprise computing with tempting benefits. At the same time, cloud equally attracts attackers on par with customers. The amount of investment made by these cloud vendors are very high. CloudStack setup was carried out and a multi-node uni-server architecture was established. This paper stands as the proof of concept for this architecture, as this has been implemented and tested in our test bed. This paper can form base for any cloud enthusiast to set up a cloud environment and use it. This paper can further be extended for deploying an application across this Infrastructure and testing its performance. Setting up a heterogeneous clusters using hypervisors like KVM, VMWare etc. would be highly beneficial, as that setup would provide us insight for setting up cloud across geographies.

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