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Infrastructure as a Service with Apache CloudStack: A Study

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ABSTRACT: Cloud computing is distributed computing technology which provides various services like on-demand Software, information, resources, infrastructure etc. Apache CloudStack is cloud computing technology founded by the Apache Software Foundation (ASF). Apache CloudStack is an open source, multi-tenanted cloud orchestration platform for delivering Infrastructure-as-a-Service (IAAS) in cloud computing environments. Apache CloudStack is used to deploy and manage the public, private and hybrid cloud. Apache CloudStack supports multiple hypervisors such as KVM, VMware ESXi/vSphere and XenServer for virtualization, highly available, highly scalable, complex networking, load balancer and VPN configurations in a multi-tenant environment. In this review paper, we discuss the main purpose of Apache CloudStack, architecture, deployment model and advantages and disadvantages.

KEYWORDS: Apache CloudStack, Cloud Computing, IAAS (Infrastructure As A Service), Hypervisor, Virtual Machine

I. INTRODUCTION

Cloud Computing

Cloud computing uses shared multi-tenant environment which highly emphasizes on efficient, automated, and preferably virtualized IT infrastructure. Cloud provides IT resources (provided by third-party data centers) on demand from anywhere over a broad network and can be metered [2]. Enablement of these features is made simpler and convenient using the technology called as virtualization [2].

IAAS

Cloud mainly provides three types of services, SAAS (Software As A Service), PAAS (Platform As A Service) and IAAS.

IAAS service model provides IT infrastructure resources like storage, networks, a capability of providing processing and other fundamental computing resources as services to the end users. The cloud infrastructure which relies on its own cloud is managed and control by service providers whereas consumer has control over an operating system, storage, deployed applications and may have control over networking services [2].

CloudStack

CloudStack is used to build private, public, community and hybrid IAAS clouds by pooling computing resources which is an open source cloud computing software [1]. The deployment models of cloud are public, private, community and hybrid.

- **Private Cloud:** This infrastructure is operated solely for an organization and may be exists as on primes and off primes. It can be managed and controlled by their own organization or third party provider [2].
- **Public Cloud:** This service is provided to a large industry group or general public, and is owned and managed by the organization providing cloud services [2].

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- **Community Cloud:** This is shared by multiple organizations and is supported by a specific community that has shared concerns. It may exist on premise or off premise, and can be managed by organization or third party provider [2].
- **Hybrid Cloud:** This deployment model is combination of two or more types of clouds (i.e. public, private, or community) and enables data and application portability between the clouds [2].

II.APACHE CLOUDSTACK

1.History Of Apache CloudStack

Initially, CloudStack invented by Cloud.com. Most of the CloudStack software released as a free software under the GNU General Public License, version 3 (GPLv3), in May 2010. Citrix System purchased the Cloud.com on July 12, 2011. Then CloudStack software made available under Apache Software License and further development made by the Apache Foundation [3]. Under GPLv3 Citrix released the remaining code and move towards for achieving more open process. In April 2012, Citrix donated CloudStack to Apache Software Foundation (ASF). After joining ASF on November 6, 2012, CloudStack 4.0.0 was declared the first stable release. Then Apache CloudStack becomes a top level project of ASF [3].

2. Deployment Architecture of Apache CloudStack

In Apache CloudStack deployment architecture consists primary system as a CloudStack Management server (Apache CloudStack software that manages cloud resources) and the secondary system performs as cloud infrastructure (Here, simple infrastructure consisting of one system running hypervisor software) [1][6]. In a case of smallest deployment, a single system can act as Management Server and Hypervisor host. An advanced installation of Apache CloudStack consists highly available, multi-node Management Server and hosts in ten thousands of number which may consist of various networking technologies [6]. You provision resources such as storage, hosts, and IP addresses into the Management Server while setting up as well as managing an Apache CloudStack cloud [1].

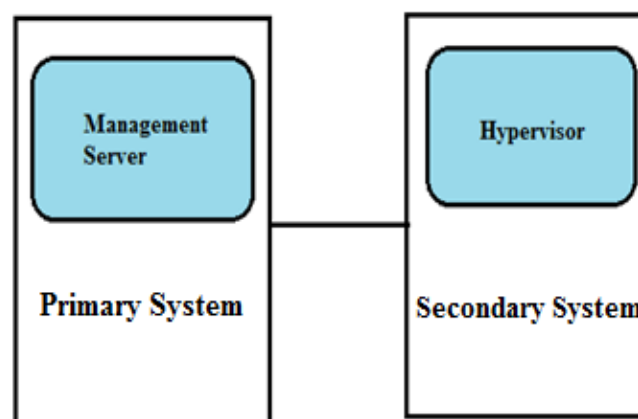


Fig.1 Deployment Architecture

A single machine can act as both the Management Server and the hypervisor host when a user uses the KVM hypervisor (in smallest deployment). Administrators can manage and interact with the management server by using a UI or APIs, which also helps to control the cloud resources [1]. Multiple management servers can be configured for redundancy and load balancing [3].

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III. APACHE CLOUDSTACK COMPONENTS

3.1 Region

To increase a reliability of the cloud, you can optionally group resources into multiple geographic regions. A region is the largest available organizational unit within a CloudStack deployment, which is a useful technique for providing disaster recovery and fault tolerance. A region is made by multiple availability zones, where each zone roughly equal to a datacenter and typically located in close geographical proximity. Each region is controlled by its own cluster of Management Servers, running in one of the zones [6].

3.2 Zone

In CloudStack deployment, a zone is next largest organizational unit. The single zone corresponds to a single datacenter, but sometimes one datacenter may permissible to have multiple zones. A zone consists one or more pods, cluster, and primary as well as secondary storage area. Zones are visible to users. For starting the guest virtual machine user must select a zone for their guest. There are two types of zones: public zone, any user can create a guest and it is visible to all users and private zone, reserved for a specific domain, users within that domain or sub domains may create guests in that zone[6].

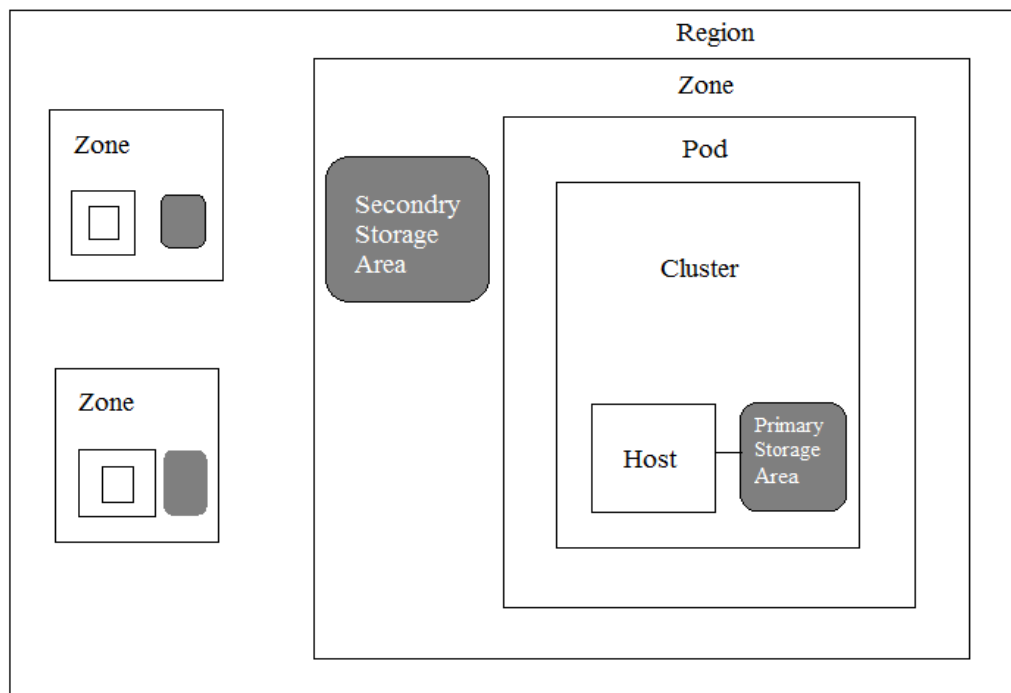


Fig.2 CloudStack region with multiple zones

3.3 Pod

Pod is like a single rack, it is not visible to end user. Hosts in one pod are related same subnet [6].

3.4 Cluster

A cluster creates a group of hosts. A cluster made by XenServer server pool, group of KVM server, or VMware cluster preconfigured in Vcenter and primary storage area. Hosts consist identical hardware, run on same hypervisor, are on the same subnet, and access same shared primary storage in same cluster. Virtual machine instances can be migrated between multiple hosts within same cluster, without interrupting services of end user [6].



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3.5 Host

Host is computer resources, which provides ability to run guest virtual machine. Host consist hypervisor software installed, which is use to manage and control guest VMs like Citrix XenServer server. Host provides CPU, memory, storage, networking resources [6].

3.6 Primary Storage Area

Primary storage is linked with a cluster and maintains a virtual disk for all the VMs running on the host for particular cluster and could consist of multiple primary storage servers. CloudStack is responsible to maintain allocation of guest virtual disks to a particular primary storage [6].

3.7 Secondary Storage Area

Secondary storage stores or maintains Templates, ISO Images, and Disk Volume Snapshots. The content of this storage is available to all the hosts within the scope of the secondary storage which may be defined as per zone or region. In order to make data available to zones beyond the scope of the secondary storage, backing up object storage could be used [6].

IV. KEY FEATURES AND BENEFITS

4.1 Features of CloudStack

Apache CloudStack consists of various features as discussed below:

- **Secure Single Sign On:** This feature provides integration of existing applications with Apache CloudStack user interface through secure single sign-on option [5].
- **Multi-role Support:** This feature is used to provide multiple role for managing and accessing the resources. It consist of three distinct roles, Admin role which have the access to manage and access physical resources, Domain-Admin role which can manage only virtual resources within a particular domain and User role that can manage their own virtual resources [5].
- **On Demand Virtual Data center Hosting:** This feature provides users with unlimited virtual resources – on demand, and on a Pay-as-you-go model [5].
- **Broad network Virtualization Capabilities:** This feature provides support for embedded software based network management and VLAN. Direct Attached IP enables users to integrate their needs with virtual network architecture [5].
- **Secure Cloud Deployments:** This feature ensures that the resources that are available to one particular user account are isolated from other user account based on their roles and zones [5].
- **Snapshot Management:** This feature helps to overcome data loss and provides a way of disaster recovery, by providing the users capability of either capturing ad hoc snapshots of their disk or initiating a comprehensive schedule for taking snapshots of their data at regular intervals [5].
- **Notification & Capacity Thresholds:** This feature allows admin to set notification threshold to receive an alert when the resource pool exceeds the notification threshold [5].

4.2 Benefits of CloudStack

- CloudStack allows users to serve themselves giving the information technology sector to remove roadblocks from providing fast service delivery and to shift focus on business problems [4].
- CloudStack easily automates the intensive tasks thereby reducing the cost incurred by the IT operations and provide services quickly [4].
- It allows providing standard workloads to ensure consistency within application and service delivery.
- Provides enhanced visibility into resource allocation and usage of services [4].
- Enhance the server/admin ratio by leveraging benefits of scale on a global basis.



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V. VERSIONS

Apache CloudStack release numbering makes use of Semantic Versioning. Before CloudStack donation to the ASF, Releases did not follow Semantic Versioning [7].

Usually the feature releases increment the minor version number of the project and if the feature releases break backward compatibility, then it would require to increment major version number of the project. Bug fix release will only increment the patch number [7].

The CloudStack 4.0.0 was declared to be the first stable release after joining ASF on Nov 6, 2012 and CloudStack updated from Apache Incubator and became a Top-Level Project (TLP) of ASF on March 20, 2013. The CloudStack 4.0.2 was the first stable (maintenance) release after graduation. The current stable release is CloudStack 4.9.2.0, released on January 3, 2017 [3].

VI. ADVANTAGES AND DISADVANTAGES

The main advantages of Apache CloudStack are, it provides a various featured solution to manage a cloud through an easy-to-use web interface, command line tools and a Restful API which allows easy integration of other tools and automation frameworks. Other advantages of Apache CloudStack are as follows:

- Apache CloudStack is easy to use, configure and maintain
- It provides Enterprise-level Support
- Allows support for plugin framework

The major disadvantage of Apache CloudStack is it requires knowledge of Java, PHP, HTTP GET/POST, XML, JSON, URL of CloudStack server, API Key as well as a secret key. Other disadvantages of Apache CloudStack are as follows:

- It does not provide customizable flexibility and modularity
- Provides support only for Fiber Channel as primary storage through hypervisor
- Backup and restore is not provided efficiently

VII. CONCLUSION

Cloud Computing is the next big thing in delivering on demand IT services. The major success of cloud computing is attracting more users towards adopting cloud computing as a strategy for their business process as it provides easy, instant and individualized access to resources and services. In this paper, more emphasis is given on Apache CloudStack which is open source cloud computing software which allows building public, private and hybrid clouds and provides IAAS through pooling required computational resources. With the growing demand for Cloud computing, Apache CloudStack would surely be a boon in deploying various cloud models and IAAS and as it provides various major features it has more opportunities to improvements, growths and turn out to be a popular IAAS provider and serve various cloud computing requirements.

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