Cloud Computing: Analysis of Various Platforms

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ABSTRACT
Cloud computing is fundamentally altering the expectations for how and when computing, storage and networking resources should be allocate, managed, consume and allow user to utilize services globally. Due to the powerful computing and storage, high availability and security, easy accessibility and adaptability, reliable scalability and interoperability, cost and time effective cloud computing is the top needed for current fast growing business world. A client, organization or a trade that adopting emerging cloud environment can choose a well suitable infrastructure, platform, software and a network resource, for any business, where each one has some exclusive features and advantages. In this paper, we first develop a comprehensive classification for describing cloud computing architecture. This classification help in survey of several existing cloud computing services developed by various projects globally such as Amazon, Google, Microsoft, Sun and Force.com. Then by using this survey results we identify similarities and differences of the architecture approaches of cloud computing.


INTRODUCTION
Cloud computing fulfills the long-held dream of computing as a utility and it allows leasing of IT capability, thus represents an modulation point in the natural features of computation and IT services deliverance (Rajkumar Buyya., et al., 2011, D. Parkhill., et al., 1966). Cloud computing give services in the form of infrastructure, platform, or software as services in a pay-as-you-go model. With a trend toward cloud based model, the power is shifted to consumers. This paradigm marks an elementary yet massive shifting from the traditional “Desktop-As-A-Platform” to “Internet-As-A-Platform” model. To achieve the infinite scalability, guaranteed performance, easy accessibility and nearly “Always-On” availability demands, these computing platforms typically are deployed in clusters of massive number of servers hosted in dedicated data centers (D. Parkhill., et al., 1966). In the cloud, virtualization occurs at several levels. It can range from ‘what does what’ (server & application virtualization) to ‘what goes where’ (data storage virtualization) to ‘who is where’ (mobility and virtual networking). The beauty of virtualized solutions is that user can run multiple operating systems simultaneously on a single host.

Cloud Computing has emerged recently as a label for a particular kind of datacenter, or most commonly, a group of datacenters. Computing capability has become the bottleneck of systems using traditional grid computing, which demands higher hardware requirements. Cloud computing is a kind of computing platform distributed in large-scale data center, which meets the requirements of scientific research and e-commerce by dynamically providing several types of server resources (Wenhong Tian., et al., 2010). Cloud computing platform utilize the virtualization technology to transparently and dynamically supply virtual computing and storage resources for the satisfaction of user’s different requirements according to the relative scheduling strategies (L Richardson., et al., 2007).
BACKGROUND STUDY

Cloud computing brings the difference from traditional IT approaches is the focus on service delivery as well as the consumer utilization model. In the background, service provider’s uses system architecture, particular technologies, industry best practices and design to provide and support the delivery of service-oriented and elastically scalable environment to provide better services to multiple customers. Platform-as-a-Service solutions provide applications development platforms and environment for seamlessly incorporate Cloud computing into existing services, application and infrastructure with a market-oriented approach.


The Cloud allows sharing, aggregation and allocation of software, storage and computational network resources on-demand. Some of the key benefits of Cloud computing include hiding and abstraction of complexity, virtualized resources and efficient use of distributed resources (Armburst, M., et al., 2009). Generally Cloud can be classified in three categories as public, private, or hybrid depending on the model of deployment (Rajkumar Buyya., et al., 2011).

A Public Cloud is a Cloud made available in a pay-as-you-go manner to the general public. In a typical public Cloud scenario, a third-party vendor delivers services such as computation, storage, networks, virtualization and applications to various customers. Businesses are adopting public Cloud services for sieving capital expenditure and operational cost by leveraging Cloud’s elastic scalability and market oriented costing features. Nevertheless, public Cloud computing also raises concerns about data security, data transfer, management, performance, and level of control. A Private Cloud is a data center of an organization, not made available to the general public. In a private Cloud environment, internal IT resources are used to serve their internal users and customers. A Hybrid Cloud is a seamless use of public Cloud along with private Cloud when needed. Focus on service delivery and the consumer utilization model makes Cloud computing different from traditional IT approaches. Fig 1. (Rajkumar Buyya., et al., 2011).

Platform as a Service (PaaS) of cloud computing is one of the key services in Cloud computing. PaaS is the delivery of a computing platform and environment as well as solution stack as a service without software downloads or installation for developers, IT managers or for end-users, which is also known as “Cloudware”. Through virtualization and other resource sharing mechanisms, Cloud computing can dramatically reduces costs for the user, which is the need and high demand of today’s user. Virtualization techniques make it possible to open a few logical platforms in a single physical machine (Windows, Linux etc); so that resources can be shared better and more users can get benefit and served at a time. Most of Cloud computing platforms are based on virtualized environments. In a virtualized Cloud computing lab, there are four main parts: software and hardware platforms (PaaS
resources) provided by virtualized and real servers; resource management node; database servers and users who access these resources through Internet or Intranet (Chen, K., et al., 2009).

Cloud computing is an evolving tools. In general User can keep their data, which can be stored somewhere, in some part of the world. No need to know about data that where data is going and where their data is residing. For further detail, in the cloud computing world, there is variability in terms of where the physical data resides, where processing takes place, and from where the data is accessed. Like this if a user wants to run some Application (i.e. web services), no need to have special software or hardware on their own machine to run their application. Cloud computing is having the feature of cluster computing, grid computing, service computing (Xiujuan Zhang, et al., 2010) and utility computing (Lijun Mei, et al., 2008). A User has to run one time application means, user can use cloud platform as the best choice. In future users can have dummy terminal along with keyboard and mouse to feed the data. No need to invest on resources (software and hardware), instead they can rent or lease the resources. More over they can choose the best available computing platform, since many companies are going to offer cloud based applications in near future, like mobile services. Now a day’s many data centers itself are available in which users can store their data up to 5GB and 10GB, some cloud services provide 30GB space, freely without any cost, through their online operating system. If more space is needed, with less premium amount they can store their own data. Like that, computing and data transferring with fewer premiums also available (Vincenzo D., et al., 2009). Anyhow, Cloud computing is still passing its infancy stage, there are many challenging issues waiting for tackling (David Bernstein, et al., 2010, Armbrust, M., et al., 2009, Boss, G., et al., 2007, Daniel, N., et al., 2008).

CLOUD SYSTEM COMPONENT

In this survey of open-source cloud computing system of Eucalyptus, Open Nebula and Nimbus, we make a quick overview of the entire cloud computing. Generally open-source cloud computing system has six components.

Hardware and Operating System: Hardware and software are the various back bone of any physical machine in cloud system. While proper set up is necessary for any software system. On the base of two reasons, we can make special node of the physical hardware and operating system. First, for running pure virtualization, if the processors of physical node don’t have needed hardware, then this limits the system to Paravirtualization only. Second, commercial framework of the cloud computing are not so flexible, but open source frameworks must be flexible to do work with various system.

Hypervisor: Hypervisor which is also known as Virtual Machine Monitor (VMM). Generally, popular VMMs consists Xen, KVM and Virtual Box, which are open-source, and VMware is commercial. Simply is that these programs provide framework for running VM. Each of these frameworks relies on Libvirt library. The input to Libvirt can differ slightly depending on the VMM version used. Due to this reason, the different cloud framework support different subset of the hypervisor.

Network: Network is an important component of cloud computing and, which includes DNS, DHCP and subnet organization of physical machine. Virtual bridge, which is also a part of network, provides unique virtual MAC address to each virtual machine (VM). To handle the physical node, DNS and DHCP process must be configured compatible with cloud framework, to interact MAC as well as IP address of the virtual machine (VM).

Framework: Cloud framework itself is an important component of the cloud system. Frameworks, where we can put Eucalyptus, Open Nebula or Nimbus. From the front-end, framework process inputs, through VMM we can manage VM and then through DHCP and IP bridge programs, we can manage MAC and IP addresses of the VM.

Disk Image: A virtual hardrive is the basic need to be functional a virtual machine. When we need a single VM on a single physical machine, VM installs an operating system and other software after creating a blank disk image. However from cloud computing we are expecting that hundreds of VMs will be constructed and torn down in very short time, but it is impractical to install full operating system on each VM. To avoid this problem, cloud computing has a source of desk image, easily we can copy this desk image to any VM, on the base of which VM can start work. In any cloud, we should differentiate between two different disk images, which are template disk image and run-time disk image. Template disk images are those which are stored in a disk image source to be used for multiple VMs.
**Front-End:** For user request there must be an interface, through which a user can interact with virtual machine (VM), specify parameter in order to login to the created VMs. Some cloud computing system front-end interface performs various type of scheduling to allot specific resources to the user, for which they are allowed. Furthermore, one of the most customizable pieces of the entire cloud system is front-end.

**OPEN SOURCE CLOUD**

The role of open source cloud computing is to build some mechanism around digital identity management (A.Cavoukian, et al., 2008), and outlines some technological building blocks are needed for controllable trust and identity verification. Open Nebula and Nimbus are technically sound and popular. Current Cloud is focusing on the issue of interoperability which is essential for enterprise cloud system. Most of the open source clouds are provided IaaS. Table 1.

**Table 1.** Comparison of open-source cloud platforms

<table>
<thead>
<tr>
<th>Feature</th>
<th>OpenNebula</th>
<th>Eucalyptus</th>
<th>Nimbus</th>
</tr>
</thead>
</table>
| **Computing Architecture** | -Cluster into an IaaS cloud  
-Focused on the efficient, dynamic and scalable management of VMs within datacentres (private cloud) involving a large amount of virtual and physical servers  
-Based on Haizea scheduling | -Ability to configure multiple clusters, each with private internal network addresses, into a single cloud.  
-Private Cloud. | -Science cloud  
-Client-Side cloud-computing interface to Globus-enabled TeraPort cluster  
-Nimbus Context Broker that combines several deployed virtual machines into “turnkey” virtual clusters  
-Heterogeneous clusters of auto-configuring VMs with one command |
| **Virtualization Management** | -Xen KVM and on-demand access to Amazon EC2 | -Xen hypervisor | -Xen Virtualization |
| **Service** | IaaS | IaaS | IaaS |
| **Load Balancing** | -Nginx Server configured as load balancer, used round-robin | -Simple load-balancing cloud controller | -Launches self-configuring virtual cluster i.e. the context broker |
| **Interoperability** | -Interoperable between intra cloud services | -Multiple cloud computing interfaces using the same “back-end” infrastructure | -Standards: “rough consensus and working code” |
| **Fault Tolerance** | -The daemon can be restarted and all the running VMs recovered  
-Persistent database backend to store host and VM information | -Separate cluster within the Eucalyptus cloud reduce the chance of correlated failure | -Checking worker nodes periodically and recovery |
| **Security** | -Firewall, Virtual Private | -WS-security for authentication, cloud | -PKI credential required  
-Works with Grid proxies |
Network Tunnel controller generates the public/private key VOMS, Shibboleth (via GridShip), custom PDPs

Programming Framework
- Java, Ruby
- Hibernate, Axis2 and Axis2c, Java
Python, Java

Storage
- Database, persistent storage for ONE data structures
- SQLite3 backend is the core component of the OpenNebula internal data structures
- Walrus (the front end for the storage subsystem)
- Grid FTP and SCP

CLOUD PLATFORM AS A SERVICE (PAAS)
In our Global village, there are various cloud computing platforms; each one has its own characteristics and advantages (Nawsher Khan., et al., 2011).

For better understanding, we analyze these platforms and give comparison from different implementation aspects. Table 2.

Table 2. Comparison of Some Cloud Computing Platforms

<table>
<thead>
<tr>
<th>Property</th>
<th>Amazon Elastic Compute Cloud (EC2)</th>
<th>Microsoft Azure</th>
<th>Google App Engine</th>
<th>Sun Network.com (Sun Grid)</th>
<th>GRIDS Lab Aneka</th>
</tr>
</thead>
<tbody>
<tr>
<td>Focus</td>
<td>Infrastructure</td>
<td>Platform</td>
<td>Platform</td>
<td>Infra-structure</td>
<td>Enterprise clouds</td>
</tr>
<tr>
<td>Service Type</td>
<td>Compute, Storage (Amazon S3)</td>
<td>Web and non-web application</td>
<td>Web Application</td>
<td>Computing</td>
<td>Computing</td>
</tr>
<tr>
<td>User Access interface</td>
<td>Amazon EC2 command-line tools</td>
<td>Microsoft windows azure portal</td>
<td>Web-based administratio</td>
<td>scripts, Sun Grid web portal</td>
<td>Work-bench, web-based portal</td>
</tr>
<tr>
<td>Value-added service providers</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Virtualization</td>
<td>OS level running on a Xen hypervisor</td>
<td>OS level through fabric controller</td>
<td>Application container</td>
<td>Job management system (Sun Grid Engine)</td>
<td>Resource manager and scheduler</td>
</tr>
<tr>
<td>Web APIs</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Dynamic negotiation of QoS</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>SLA-base resources reservation</td>
</tr>
<tr>
<td>Programming framework</td>
<td>Amazon Machine Images (AMI)</td>
<td>Microsoft.NET</td>
<td>Python</td>
<td>Solaris OS, Java, C, C++, FORTRAN</td>
<td>APIs supporting models in c# .Net</td>
</tr>
</tbody>
</table>
COMPARISON OF CLOUD PLATFORMS WITH IMPLEMENTATION ASPECTS

We have different kinds of cloud platforms; each one has its own characteristics and advantages. For better understanding, we analyze and give with detail comparison from different implementation aspects. As shown in Table 3.

Table 3. Comparison of cloud platforms with implementation aspects

<table>
<thead>
<tr>
<th></th>
<th>Eucalyptus</th>
<th>Nimbus</th>
<th>OpenNebula</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cloud Character</td>
<td>Public</td>
<td>Public</td>
<td>Private</td>
</tr>
<tr>
<td>Scalability</td>
<td>Scalable</td>
<td>Scalable</td>
<td>Dynamical, Scalable</td>
</tr>
<tr>
<td>Cloud Form</td>
<td>IaaS</td>
<td>IaaS</td>
<td>IaaS</td>
</tr>
<tr>
<td>Compatibility</td>
<td>Support EC2, S3</td>
<td>Support EC2</td>
<td>Open, Multi-Platform</td>
</tr>
<tr>
<td>Deployment</td>
<td>Dynamical Deployment</td>
<td>Dynamical Deployment</td>
<td>Dynamical Deployment</td>
</tr>
<tr>
<td>Deployment Manner</td>
<td>Commandline</td>
<td>Commandline</td>
<td>Commandline</td>
</tr>
<tr>
<td>Transplantability</td>
<td>Common</td>
<td>Common</td>
<td>Common</td>
</tr>
<tr>
<td>VM Support</td>
<td>VMware, Xen, KVM</td>
<td>Xen</td>
<td>Xen, VMware</td>
</tr>
<tr>
<td>Web Interface</td>
<td>Web Service</td>
<td>EC2 WSDL, WSRF</td>
<td>Libvirt, EC2, OCCI API</td>
</tr>
<tr>
<td>Structure</td>
<td>Module</td>
<td>Lightweight Components</td>
<td>Module</td>
</tr>
<tr>
<td>Reliability</td>
<td>-</td>
<td>-</td>
<td>Rollback host and VM</td>
</tr>
<tr>
<td>OS Support</td>
<td>Linux</td>
<td>Linux</td>
<td>Linux</td>
</tr>
<tr>
<td>Development Language</td>
<td>Java</td>
<td>Java, Python</td>
<td>Java</td>
</tr>
</tbody>
</table>

PRICE COMPARISON

Several Cloud Computing and Conventional Computing datacenters are being built in seemingly surprising locations, such as Quincy, Washington (Google, Microsoft, Yahoo! etc) and San Antonio, Texas (Microsoft, US National Security Agency etc). The motivation behind choosing these locales is that the costs for electricity, cooling, labour, property purchase costs and taxes are geographically variable and of these costs, electricity and cooling alone can account for a third of the costs of the datacenter. Even prices are changing, but we compare currently prices below. As a successful example, Elastic Compute Cloud (EC2) from Amazon Web Services (AWS) sells 1.0-GHz x86 ISA “slices” for $0.10 per hour, and a new “slice” or instance can be added in 2 to 5 minutes. Amazon’s Scalable Storage Service (S3) charges $0.12 to $0.15 per GB/Month, with additional bandwidth charges of $0.10 to $0.15 per GB to move data IN and OUT of (AWS) over the Internet.

CONCLUSION

Cloud Computing is the fifth utility after water, electricity, gas and telephony, and it is the promising paradigm for delivering IT services as computing utilities. This paper presents a comprehensive comparison of different aspects of cloud’s platforms. In analysis of these various open-source cloud computing frameworks, we found that there are salient philosophical differences between them regarding the overall scheme of their design. After this analysis user can better understand the characteristic and will be able to do better selection of cloud platform, implementation and deployment requirement. In current cloud still we have challenges i.e. continuously availability, data security and privacy. In current cloud environment, user can’t fine the status of their data may be someone is using these data for his/her own purposes. Our future work lies in the areas of data replication and data scheduling in cloud computing as well as on the combination of these both, replication and scheduling techniques.
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