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Cloud Computing – Infrastructure, Benefits, Architecture, Platforms and Application

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Abstract

Cloud computing is the development of parallel computing, distributed computing, grid computing and virtualization technologies which define the shape of a new area. Cloud computing is an emerging model of business computing. In this paper, we explore the concept of cloud architecture and compares cloud computing with grid computing. We also address the characteristics and applications of several popular cloud computing platforms. In this paper, we aim to pinpoint the challenges and issues of cloud computing. We identified several challenges from the cloud computing adoption perspective and we also highlighted the cloud interoperability issue that deserves substantial further research and development. However, security and privacy issues present a strong barrier for users to adapt into cloud computing systems. This paper presents a review on the cloud computing concepts as well as security issues inherent within the context of cloud computing and cloud platform and applications.

1. INTRODUCTION

Cloud computing is a complete new technology. It is the development of parallel computing, distributed computing grid computing, and is the combination and evolution of Virtualization, Utility computing, Software-as-a-Service (SaaS), Infrastructure-as-a-Service (IaaS) and Platform-as-a-Service (PaaS). Cloud is a metaphor to describe web as a space where computing has been pre installed and exist as a service; data, operating systems, applications, storage and processing power exist on the web ready to be shared. To users, cloud computing is a Pay-per-Use-On-Demand mode that can conveniently access shared IT resources through the Internet. Where the IT resources include network, server, storage, application, service and so on and they can be deployed with much quick and easy manner and least management and also interactions with service providers. Cloud computing can much improve the availability of IT resources and owns many advantages over other computing techniques. Users can use the IT infrastructure with Pay-per-Use-On-Demand mode; this would benefit and save the cost to buy the physical resources may be vacant.

2. ARCHITECTURAL COMPONENTS

Cloud service models are commonly divided into SaaS, PaaS, and IaaS that exhibited by a given cloud infrastructure. It's helpful to add more structure to the service model stacks: Fig. 1 shows a cloud reference architecture[13] that makes the most important security-relevant cloud components explicit and provides an abstract overview of cloud computing for security issue analysis

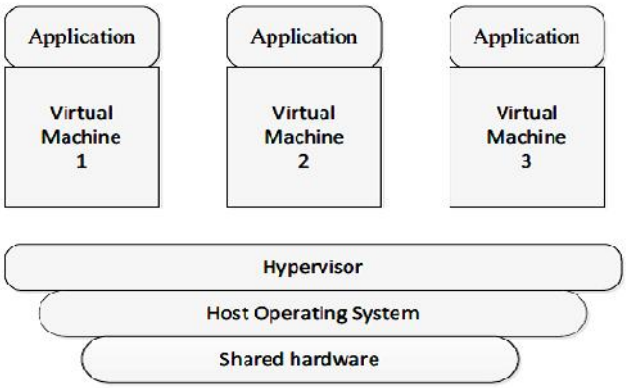

Fig. 3 Cloud Architecture

A. Software as a Service (SaaS):

Cloud consumers release their applications in a hosting environment, which can be accessed through networks from various clients (e.g. Web browser, PDA, etc.) by application users. Cloud consumers do not have control over the cloud infrastructure that often employs multi-tenancy system architecture, namely, different cloud consumers' applications are organized in a single logical environment in the SaaS cloud to achieve economies of scale and optimization terms of speed, security, availability, disaster recovery and maintenance. Examples of SaaS include SalesForce.com, Google Mail, Google Docs, and so forth.

B. Platform as a Service (PaaS)

PaaS is a development platform supporting the full "Software Lifecycle" which allows cloud consumers to Develop cloud services and applications (e.g. SaaS) directly on the PaaS cloud. Hence, the difference between SaaS and PaaS is that SaaS only hosts completed cloud applications whereas PaaS offers a development platform that hosts both completed and in-progress cloud applications. This requires PaaS, in addition to supporting application hosting environment, to possess development infrastructure including programming environment, tools, configuration management, and so forth. An example of PaaS is Google AppEngine.

C. Infrastructure as a Service (IaaS)

Cloud consumers directly use IT infrastructures (processing, storage, networks and other fundamental computing resources) provided in the IaaS cloud. Virtualization is extensively used in IaaS cloud In order to integrate/decompose physical resources in an ad-hoc manner to meet growing or shrinking resource demand from cloud consumers. The basic strategy of virtualization is to set up independent virtual machines (VM) that are isolated from both the underlying hardware and other VMs. Notice that this strategy is different from the multi-tenancy model, which aims to transform the application software architecture so that multiple instances (from multiple cloud consumers) can run on a single application (i.e. the same logic machine). An example of IaaS is Amazon's EC2.

D. Data as a Service (DaaS)

The delivery of virtualized storage on demand becomes a separate Cloud service - data storage service. Notice that DaaS could be seen as a special type IaaS. The motivation is that on-premise enterprise database systems are often tied in a prohibitive upfront cost in dedicated server, software license, post-delivery services and in-house IT maintenance. DaaS allows consumers to pay for what they are actually using rather than the site license for the entire database. In addition to traditional storage interfaces such as RDBMS and file systems, some DaaS offerings provide table-style abstractions that are designed to scale out to store and retrieve a huge amount of data within a very compressed timeframe, often too large, too expensive or too slow for most commercial RDBMS to cope with. Examples of this kind of DaaS include Amazon S3, Google BigTable, and Apache HBase.

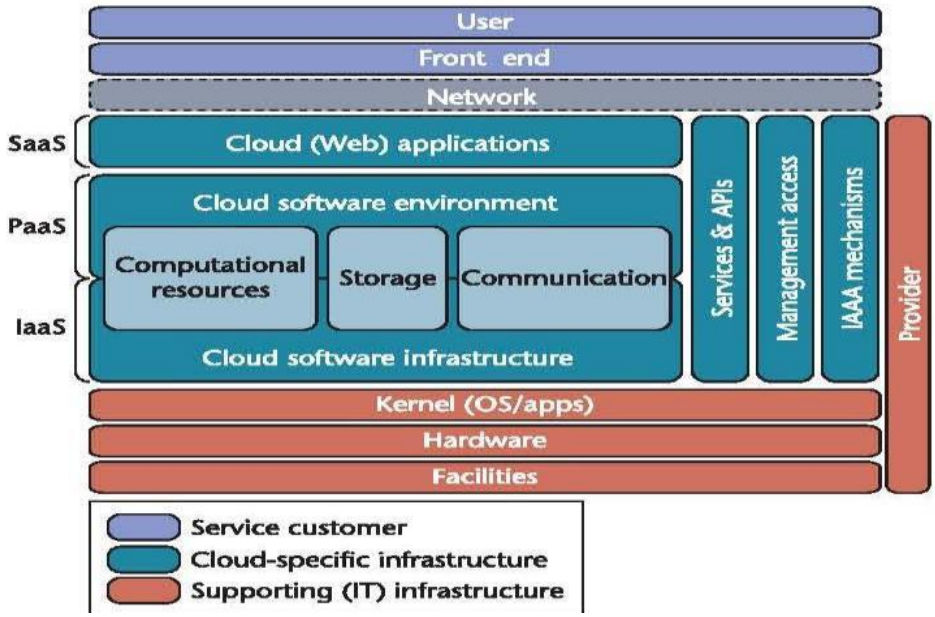

Fig. 1. The cloud reference architecture

III.POPULAR CLOUD COMPUTING PLATFORMS

A. AbiCloud

Abicloud[5] is a cloud computing platform, It can be used to build, integrate and manage public as well as private cloud in the homogeneous environments. Using Abicloud, user can easily and automatically deploy and manage the server, storage system, network, virtual devices and applications and so on. The main difference between Abicloud and other cloud computing platforms is its powerful web-based management function and its core encapsulation manner. Using the Abicloud, user can finish deploying a new service by just dragging a virtual machine with mouse. This is much easier and flexible than other cloud computing platforms that deploy new services through command lines. Abicloud can be used to deploy and implement private cloud as well as hybrid cloud according to the cloud providers' request and configuration. It can also manage EC2 according to the rules of protocol. Besides, apply the Abicloud, a whole cloud platform based on Abicloud can be packed and redeployed at any other Abicloud platform. This is much helpful for the transformation of the working environment and will make the cloud deployment process much easier and flexible.

B. Eucalyptus

Eucalyptus (Elastic Utility Computing Architecture for Linking Your Programs to Useful Systems) [5] mainly was used to build open-source private cloud platform. Eucalyptus is an elastic computing structure that can be used to connect the users' programs to the useful systems, it is an open-source infrastructure using clusters or workstation implementation of elastic, utility, cloud computing and a popular computing standard based on a service level protocol that permit users lease network for computing capability. Currently, Eucalyptus is compatible with EC2 from Amazon, and may support more other kinds of clients with minimum modification and extension.

C.Nimbus

Nimbus[5] is an open tool set and also a cloud computing solution providing IaaS. It permits users lease remote resources and build the required computing environment through the deployment of virtual machines.

Generally, all these functional components can be classified as three kinds. One kind is client- supported modules which are used to support all kinds of cloud clients. Context client module, cloud client module, reference client module and EC2 client module are all belonging to this kind of component. The second kind of component is service- supported modules of cloud platform, providing all kinds of cloud services. It includes a context agent module, web service resource framework module, EC2 WSDL module and a remote interface module. The third kind of component is the background resource management modules which are mainly used to manage all kinds of physical resources

on the cloud computing platform, including work service management module, IaaS gateway module, EC2 and other cloud platform support module, workspace pilot module, workspace resource management module and workspace controller.

D. OpenNebula

OpenNebula is also an open source cloud service framework. It allows user deploy and manage virtual machines on physical resources and it can set user's data centers or clusters to flexible virtual infrastructure that can automatically adapt to the change of the service load. The main difference of OpenNebula and nimbus is that nimbus implements remote interface based on EC2 or WSRF through which user can process all security related issues, while OpenNebula does not. OpenNebula is also an open and flexible virtual infrastructure management tool, which can use to synchronize the storage, network and virtual techniques and let users dynamically deploy services on the distributed infrastructure according to the allocation strategies for data center and remote cloud resources. Through the interior interfaces and OpenNebula data center environment, users can easily deploy any types of clouds.

Table I: The comparision of server cloud computing platforms [5]

	Abicloud	Eucalyptus	Nimbus	OpenNebula
Cloud Character	Public/private	Public	public	Private
Scalability	Scalable	Scalable	scalable	Dynamic/scalable
Clouds form	Iaas	Iaas	Iaas	Iaas
Compatibility	Not Support EC2	Support EC2,S3	Support EC2	Open, multi-platform
Deployment	Pack & Redeplay	Dynamical Deployment	Dynamical	Dynamical
Deployment Manner	Web Interface Drags	Command Line	Command Line	Command Line
Transplant-ability	Easy	Common	Common	Common
VM Support	Virtual Box , Xen, VMware, VM	Xen,VMware ,KVM	Xen	Xen,VMware
Web interface	Libvirt	Webservice	EC2,WSDL, WSRF	Libvirt,OCCI,EC2, API
Structure	Open Platform encapsulates care	Module	Light Weight Component	Module
Reliability	-	-	-	Rollback host and VM
OS support	Linux	Linux	Linux	Linux
Development language	Ruby ,c++,python	Java	Java, python	Java

V. APPLICATIONS & SECURITY ISSUES-CLOUD COMPUTING

There are a few applications of cloud computing [4] as follows:

1. Cloud computing provides dependable and secure data storage center.
2. Cloud computing can realize data sharing between different equipments.
3. The cloud provides nearly infinite possibility for users to use the internet.
4. Cloud computing does not need high quality equipment for the user and it is easy to uses.

Security issues-Cloud computing

1. Security issues describe the problems encountered during implementation of cloud computing (CC).

2. Security standards provide some security templates, which are mandatory for cloud service providers. The Open Visualization Format (OVF) is a standard for creating new business models that help the company to sell a roduct on premises, on demand, or in a hybrid deployment model.

3. Security management models are designed based on the security standards And best practices.

Cloud computing comes with numerous possibilities and challenges simultaneously. Of the challenges, security is considered to be a critical barrier for cloud computing in its path to success (Khorshed, Ali & Wasimi, 2012). The security challenges for cloud computing approach are somewhat dynamic and vast. Data location is a crucial factor in cloud computing security (Teneyuca, 2011). Location transparency is one of the prominent flexibilities for cloud computing, which is a security threat at the same time – without knowing the specific location of data storage, the provision of data protection act for some region might be severely affected and violated. Cloud users' personal data security is thus a crucial concern in a cloud computing environment (Joint, Baker & Eccles, 2009; Ismail, 2011; King & Raja, 2012). In terms of customers' personal or business data security, the strategic policies of the cloud providers are of highest significance (Joint & Baker, 2011) as the technical security solely is not adequate to address the problem. Trust is another problem which raises security concerns to use cloud service (Ryan & Falvy, 2012) for the reason that it is directly related to the credibility and authenticity of the cloud service providers. Trust establishment might become the key to establish a successful cloud computing environment. The provision of trust model is essential in cloud computing as this is a common interest area for all stakeholders for any given cloud computing scenario. Trust in cloud might be dependent on a number of factors among which some are automation management, human factors, processes and policies (Abbadi & Martin, 2011). Trust in cloud is not a technical security issue, but it is the most influential soft factor that is driven by security issues inherent in cloud computing to a great extent. All kinds of attacks that are applicable to a computer network and the data in transit equally applies to cloud based services – some threats in this category are man-in-the-middle attack, phishing, eavesdropping, sniffing and other similar attacks. DDoS (Distributed Denial of Service) attack is one common yet major attack for cloud computing infrastructure (Dou, Chen & Chen, 2013). The well known DDoS attack can be a potential problem for cloud computing, though not with any exception of having no option to mitigate this. The security of virtual machine will define the integrity and level of security of a cloud environment to greater extent (Rakhmi, Sahoo & Mehfuz, 2013; Agarwal & Agarwal, 2011). Accounting & authentication as well as using encryption falls within the practice of safe computing - they can be well considered as part of security concerns for cloud computing (Lee, 2012; Ogigau-Neamtiu, 2012; Singh & Jangwal, 2012). However, it is important to distinguish between risk and security concerns in this regard. For example, vendor lock-in might be considered as one of the possible risks in cloud based services which do not essentially have to be related to security aspects. On the contrary, using specific type of operating system (e.g. opensource vs. proprietary) might pose security threat and concerns which, of course, is a security risk. Other examples of business risks of cloud computing could be licensing issues, service unavailability, provider's business discontinuity that do not fall within the security concerns from a technical viewpoint. Thus, in cloud computing context, a security concern is always some type of risk but any risk cannot be blindly judged to be a security concern. Allocation of responsibilities among the parties involved in a cloud computing infrastructure might result in experiencing inconsistency which might eventually lead to a situation with security vulnerabilities. Like any other network scenario, the provision of insider-attack remains as a valid threat for cloud computing (Ogigau-Neamtiu, 2012). Any security tools or other kinds of software International Journal of Network Security & Its Applications (IJNSA), used in a cloud environment might have security loopholes which in turn would pose security risks to the cloud infrastructure itself. The problem with third party APIs as well as spammers are threats to the cloud environment (Bisong & Rahman, 2011; Singh & Jangwal, 2012).

VI. BENEFITS OF CLOUD COMPUTING

Some common benefits of CC are

• Reduced Cost:

Since cloud technology is implemented incrementally (step by-step), it saves organizations total expenditure.

• Increased Storage:

When compared to private computer systems, huge amounts of data can be stored than usual.

• Flexibility:

Compared to traditional computing methods, cloud computing allows an entire organizational segment or portion of it to be outsourced.

• Greater mobility:

Accessing information, whenever and wherever needed unlike traditional systems (storing data in personal computers and accessing only when near it).

• Shift of IT focus:

Organizations can focus on innovation (i.e., implementing new products strategies in organization) rather than worrying about maintenance issues such as software updates or computing issue.

These benefits of cloud computing draw lot of attention from Information and Technology Community (ITC). A survey by ITC in the year 2008, 2009 shows that many companies and individuals are noticing that CC is proving to be helpful when compared to traditional computing methods

VII. CONCLUSION

This paper discussed the architecture and popular platforms of cloud computing. It also addressed challenges and issues of cloud computing in detail. In spite of the several limitations and the need for better methodologies processes, cloud computing is becoming a hugely attractive paradigm, especially for large enterprises.

Cloud Computing initiatives could affect the enterprises within two to three years as it has the potential to significantly change IT.

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