A Study of Issues and Challenges in Cloud Computing

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Abstract

Information technology is growing precipitately that is increasingly changing every aspect of our life. Cloud Computing is a growing technology for delivering services through internet. It is a technology archetype that helps businesses and individuals to share various services in a consistent and cost-effective manner. In a cloud computing environment, one works with data and applications that are maintained and stored on shared machines that exists in a web-based environment rather than physically located in the home of a user or a corporate environment. This paper attempts to investigate the crucial threats and issues faced in cloud computing and to have better understanding of it along with a glimpse of challenges.

Keywords: Cloud Computing, Application Programming Interface (API), Infrastructure, Virtual Machines

INTRODUCTION

Cloud computing is an informal term in IT industry. The concept of cloud computing is very common now a days which is very beneficial not only for industry but also for clients. This concept describes computing as a cloud, i.e. a large number of computers are connected with each other to communicate and share resource via network (i.e. internet) [1]. Cloud computing is an Internet-based computing and latest trend in IT world. Cloud computing implements distributed computing as in cloud we can communicate, use and run different resources such as applications and hardware resources, connected with each other at the same time. This term is also common to refer the network based services. These services use real server hardware. Then the server hardware uses hardware called virtual hardware which are software simulation running on one or multiple real hardware.

Cloud Computing is a new concept and considered as emerging technology in the domain of information technology to provide services to the client and server using cloud (Internet). It has service oriented architecture with different infrastructure. This architecture reduces resources-overhead for the end-user and provides flexibility, which also reduces ownership cost and different other services. This term is popular because of its marketing as it provides services using client server software's (client side) to a large group of users (worldwide) for sharing and communication [2-4].

The beginning of the term cloud computing is unclear. After the evolution and combination of different existing technologies of computing, this concept came into IT market [5, 6]. Cloud computing exhibits the following key characteristics: Agile (accept and response to change), Application Programming Interface (API), Scalability with Elasticity, Expenditure, Machine and Location Independence, Multi-tenancy [7], Security, Virtualization of Hardware (machine), Performance and Maintenance.

There are a lot of problems that are faced in cloud computing such as threats and opportunities of the cloud, privacy of data and information, compliance, legality of data, open source (software), de facto standards, services security, information abuse, domination and privatization of internet and services, governance of IT, storage of data, ambiguity of terminology and noisy neighbors. This paper has elaborated above mentioned threats and discussed the solutions available. Future opportunities have also been discussed.

Objective/Goal

In this paper, our primary goal is to understand the concept of cloud architecture, and its services regarding network. Secondary goal is to study the encroachment with Issues and Challenges of Cloud Computing.

To achieve these goals, we must:

- Understand the Cloud Computing concept and its different services.

- Familiarize with Cloud Infrastructure types.

- Know about Cloud Architecture types (Hosted and Bare-metal).

Main objective of cloud computing is that user who have the need to know about each and every thing of expertise and technology gets benefit without knowing all of this. The cloud computing inspires users (clients) by cost cutting and also by facilitating the users without having any difficulty in IT resources [8]. Reliable and secure network connection is needed for this purpose which involves protection of data, its integrity, usability and security. We must be aware of the threats which cause these issues to get the network security.

Paper Overview

The paper is organized in four sections. The first section includes introduction. The next section of literature review gives background information relevant to the paper, such as the Cloud Computing and its different infrastructure techniques; an outline of Cloud Architecture is briefly quoted, with its different types. The subsequent Section describes overview of Cloud Computing issues and challenges due to constant change in technology. The last Section briefly concludes the evaluation of the networking with Cloud Computing and its issues and challenges.

LITERATURE REVIEW

In this section, we are going to discuss major concepts of Cloud Computing, architecture, its basics, emerging of this concept.

Due to the high demand of challenges of internet technologies and computer applications in the future, IBM and Google (two computing companies) brought the concept of cloud computing to the public in October 2007 [9]. Cloud computing is defined from different world, but it is still in the discovering stage [10]. National Institute of Standards and Technology (NIST) model defines Cloud Computing Services for various clients, which allows the sharing of many computing resources. NIST presents a range of basic services provided by cloud computing, which includes software, platform and infrastructure [11].

Armbrust *et al.*, define cloud computing, which highlights the importance of services in cloud computing as the services through the delivery of both applications and system software in the data center [10]. Cloud computing clouds include both the hardware and software system in Data center [12, 13]. Buyya *et al.*, illustrates the cloud computing as the difference of cloud computing from the cluster and grid computing standards. Cloud computing cannot be taken as a simple association of the cluster and grid computing calculation, there is a new generation of data centers, that highlights virtual nodes in the system [14].

Vouk *et al.*, demonstrated that cloud computing will be the next in developments on-demand IT services and products that can be employed through the service-oriented architecture (SOA) [6]. Relationship between Cloud Computing and SOA is described by Linthicum [12]. In principle, SOA technology that uses cloud computing facts provides IT resources. Therefore, on the basis of previous research on Cloud Computing, researchers gave the clear definition of cloud computing.

Cloud computing is the exchange of services and information, both on the Internet and Intranet. Customers can decide what information or services that you want to use, depending on the customer receivables. He also summarizes seven branches of cloud computing including storage, database, information, process, application, platform, and integration as a service [5]. Miller suggests that the cloud computing is a form of distributed computing that is more useful for sharing resources and for collaborating in work group, it is task centric and user centric [9].

CLOUD COMPUTING

In science, cloud is a term to indicate large collection (quantity) of objects, these objects appears virtually as a cloud from a distance (i.e. virtualization) (Figure 1). It expresses these objects which can't be inspected further in certain perspectives. It is the advancement and espousal of on the hand computing technologies.
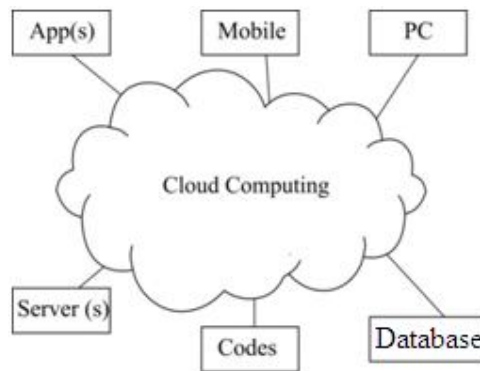
Figure 1: Cloud in General

In a cloud computing environment application(s), work, data storage and maintenance all done at back-end, (i.e. web) instead of home or a corporate environment, for individuals and businesses on shared machines [15]. Cloud Computing means sharing of application services on internet and to be able to access a wide range of services with the greater use of the Internet. For example, mails can be accessed anywhere in the world in real time from a machine connected with an Internet-connection, as web-based applications.

The term Cloud was used to symbolize the Internet. In the start, it was used as standardized shape to symbolize a network on telephony schematics (cloud-like) but after that in 1994 used to represent the Internet in computer network diagrams [16]. The term became popular in 2006, when Amazon introduced the Elastic Compute Cloud.

The significance of cloud computing can be represented by its primary characteristics. Following five are the key characteristics of cloud computing which aims to use clouds seamlessly and transparently:

1. On-demand service
2. Global network access
3. Measured service
4. Elasticity
5. Resource pooling (Location independent)

CLOUD INFRASTRUCTURE

Cloud infrastructure also known as Deployment Model of a cloud. Cloud computing have different types of infrastructures (Figure 2):

1. Private Cloud
2. Public Cloud
3. Hybrid Cloud
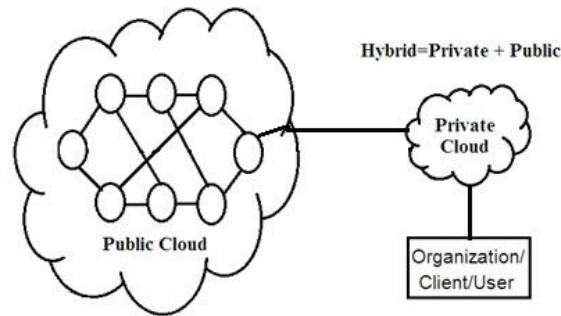4. Community Cloud
5. Distributed Cloud

Figure 2: Cloud Computing Infrastructure Types

1. *Private Cloud*

Private Cloud infrastructures are exclusively designed for an organization, whether controlled by the organization or (under third-party control) and hosted either internally (by organization) or externally (third party) [17]. It requires a considerable involvement to virtualize the business. It also involves some decisions to reconsider about existing resources. There are some security issues which must be catered to avoid severe risks. Somehow it is considered as a safer model in terms of security but more costly option.

2. *Public Cloud*

In a Public Cloud services are open for everyone who is a part of that network. There may be no or some differences between public and private cloud infrastructure, but when a user have to select services, security is the point where user considerations are different. Any kind of services that are made available by a service provider for its network user either be private or public. Normally, public cloud service providers have their own infrastructures and operate it simply by using Internet (direct connectivity is not allowed) [18].

3. *Hybrid Cloud*

It is a framework of two or more clouds (private, community or public). Each cloud is connected with other one but persists as distinctive structure to provide the benefits of these multiple structures altogether. This service allows cloud service providers (organizations) to use resources (publically available) to meet short-term organizational requirements. It also facilitates the deployment of applications through Cloud Burst and it lacks the flexibility, security and certainty of home applications.

4. *Community Cloud*

A cloud infrastructure which is shared between multiple users (individual/organizations) who have same concerns (security, compliance, etc.).

5. *Distributed Cloud*

Cloud that provides connection between multiple machines (distributive) uses a single network running at different locations. Examples of distributed cloud are distributed computing platforms such as BOINC.

CLOUD MODEL SERVICES

There are three service model architectures available in cloud computing. Figure 3 shows the interaction of these three architectures with each other and with the client. Following are the three models:

1- Software as a Service (SaaS)
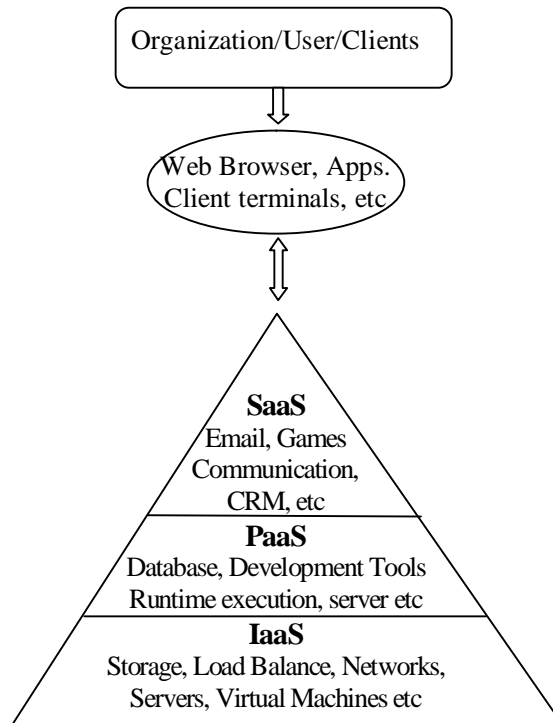2- Infrastructure as a Service (IaaS)
3- Platform as a Service (PaaS)

Figure 3: Cloud Model Services

1) *Infrastructure as a Service (IaaS)*

Infrastructure as a Service (IaaS) is the base of cloud services as it provides clients access to server hardware (as virtual machines VMs). It is also responsible to provide storage, bandwidth and other essential computing resources to the clients. The application resides on the virtual hardware with its virtual operating system (Figure 4). Some critical areas create issues in e.g. trusting the virtual hardware image etc.
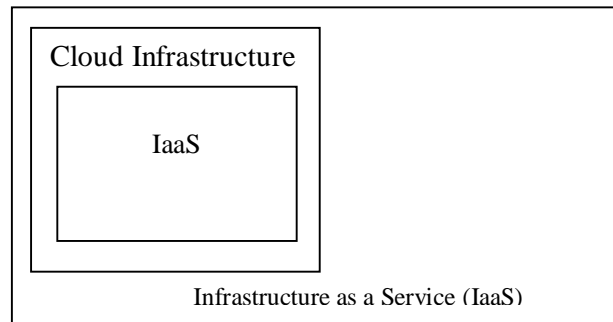
Figure 4: Infrastructure as a Service (IaaS) Architecture

2) Platform as a Service (PaaS)

Platform as a Service (PaaS) builds upon IaaS and gives computing infrastructure without any need to buy and manage it (Figure 5). It also provides access of the software's and services to the clients to develop (enables programming environments) and use the applications (software).
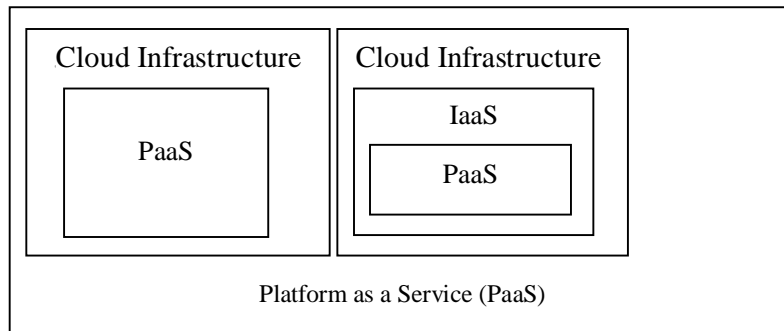

Figure 5: Platform as a Service (PaaS) Architecture

3) Software as a Service (SaaS)

IaaS and PaaS provide the elementary architecture to Software as a Service (SaaS). This service enables clients to access software applications (as on demand service) with integrated. In this architecture, client gets hold and use software components from different providers (Figure 6). Protection of the information and secure connection for these composed services are major issues in SaaS.
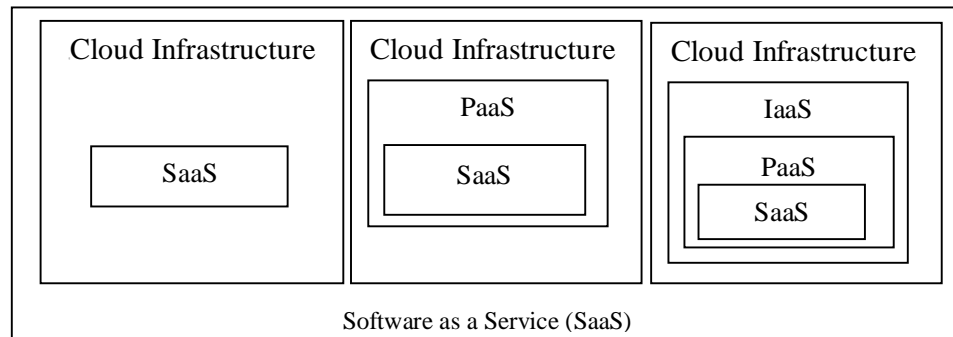
Figure 6: Software as a Service (SaaS) Architecture

CLOUD ARCHITECTURE

The Cloud Computing Architecture consists of On-premise resources (which are installed and managed locally by individual/organization), these resources also known as SaaS, Middleware (software that connects computers and devices to other applications), Software components and their location. It usually involves multiple cloud components over a loose coupling mechanism communicating with each other for example a messaging queue [18].
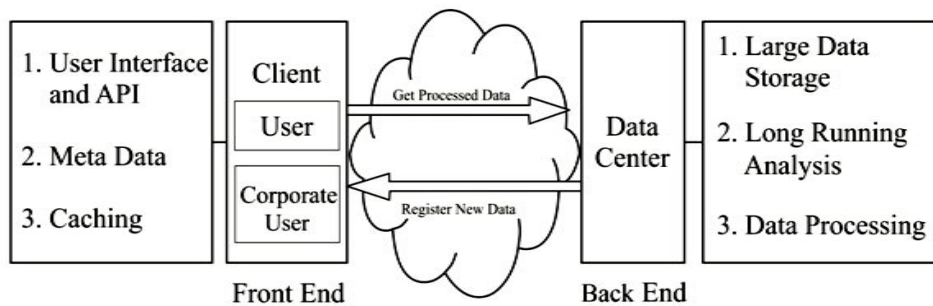

Figure 7: General Cloud Architecture

Business parties must identify each individual requirement of their application. If organizations already have a cloud platform then they must understand the corresponding requirements for maintenance of existing cloud.

A cloud architecture has two major parts, one is a front end and other is back end (Figure 7 & 8). The connection between front end and backend is through a network as a cloud, generally the Internet. Computer users are mostly at the front end in architecture. The back end in architecture is known as cloud or Data Store, where large data processing is done.

In Cloud Computing, the front of the system contains devices for client usage to access the network or may be a computer network to communicate with cloud. Some application software's are also needed to access the system. But it's not the same interface for

all users of cloud computing system. For example email programs use existing web browsers such as Google, Microsoft's IE. etc. Some unique applications are used for other types of systems which provide network access to their clients.
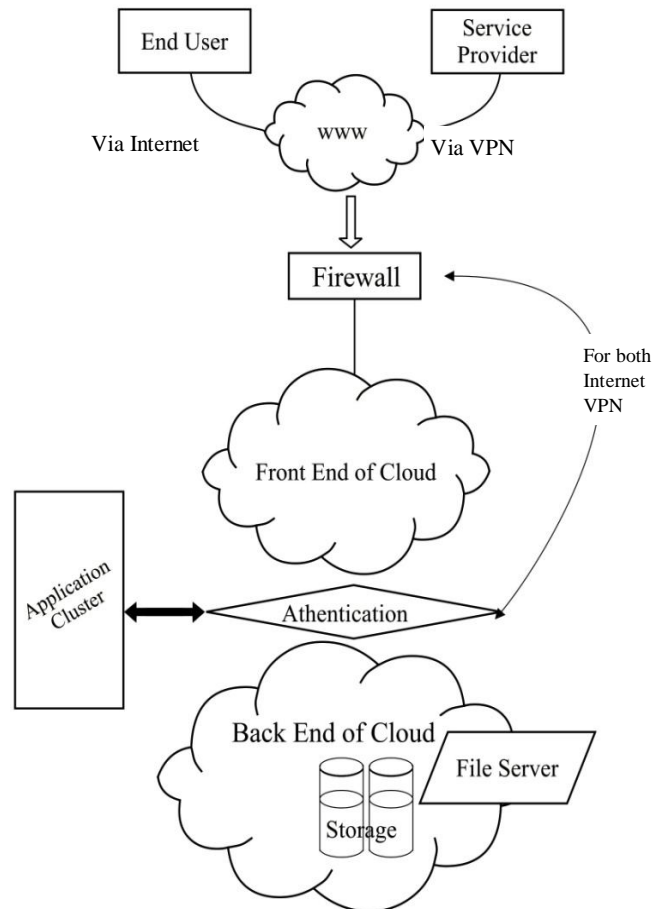

Figure 8: High level Cloud Architecture

When the clouds are combined together, they make a Cloud Computing System. Generally, there is an individual dedicated server for services of each application. For system administration (all individual servers), client demand and traffic monitoring, there is a central server. It ensures that every system component runs effectively. Middleware allows computers to communicate with each other that are connected on networks (cloud) [17]. For a large number of customers in cloud computing, service providers need a huge storage space to tackle all demands.

ISSUES AND CHALLENGES

A - Issues

1. Attacks That Target Shared Channel

The software implementation of a machine is called a Virtual machine that runs its own OS. Software application on different OS environment can simultaneously run multiple VMs. Data can be hosted on different VMs in a shared cloud media from different sources but located on an independent physical server. Software applications
running on one VM doesn't impact software running on another VM. This ensures maximum flexibility. In a recent study, it is possible to locate the internal cloud framework and map where a particular virtual machine resides. The results from this study may only be proof of concept at this stage but it is likely possible that cloud servers being a central point of susceptibility can be maneuvered criminally.

2. Data and Service Availability

A major liability in cloud computing environment is failure of internet connectivity as most organizations are reliant on the internet access to their shared and collective data. In addition if susceptibility is indicated in a cloud environment, the business might end all connection to the cloud service provider until the threat is eliminated.

3. Compatibility

Compatibility is another major issue in cloud computing. Different services are being provided by different dealers that may not be compatible with each other, thus making it difficult for the end user to switch the vendor. Constant changes and frequent improvements are likely to occur in cloud computing and businesses must keep themselves updated to ensure data integrity and security. These changes will be impacting both security and software development life cycle.

B - Challenges

Due to the immaculate use of computer, storage access, data security and data communication has become of high importance. The external communication of cloud is similar as any other communication over the Internet [14]. Technologies that ensure specific control policies should be used to protect it [5]. There are many problems that show inimical impact on cloud computing with respect to security.

An implementation of cloud computing infrastructure means storing hypercritical data in hand of a third party. This is important to ensure the data security. Data is encrypted all the times with clearly defined tasks. The only way to ensure the encrypted data's confidentiality on a cloud storage server is that the user/client can administer the encryption process.

Privacy is one of the core issue that is faced in all the challenges that includes the urge to protect the confidential information. System must ensure the data confidentiality as the companies doing large scale business would not be preferring to do the transactions of data through cloud servers which involve the interference of another system.

Data integrity ensures the validation of data and protecting the data from getting deleted or corrupted. It ensures that only authorized users should be able to access the data. There is no inclusive practice that guarantees data security and finally it leads to the trust among the users [18]. In cloud-based storage, data may be scattered across multiple servers and locations. The user loses control over his data and is unable to inspect the data links visually [19] . The cloud data must be accessible to only those who are authorized, making it critical and thus monitoring who is accessing the data via cloud. To ensure the user authentication integrity, data access logs needs to be maintained to verify the authorized users accessing the data.

By the usage of cloud computing services, one can easily have access to the information stored on the shared medium and make it accessible to different services across the internet. An identity management system can help authenticating the users and services that are based on credentials. A major issue in this approach is interoperability problem that may result from using different identity credentials and negotiation protocols. Current authentications that are based on passwords have different drawbacks and reflect notable risks. An identity management system should be capable to protect the users and services private information.

CONCLUSION

The key motivation for writing this paper is to have a glimpse of cloud computing as an emerging technology in the new era. It can be used to address tactical issues which IT industry faces like resource availability and reliability; data center cost, operational process evenness and also implies a design paradigm to construct computer software as a service, reduced information technology aerial and great flexibility. Cloud computing is a growing technology paradigm that most of the infrastructure and services industries are focusing to capture potential opportunities. This paper highlighted some of the issues faced by cloud computing and also discussed some challenges. It is important for the cloud computing to have standardized security measures.

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