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Cloud Computing: History, Architecture, Security Issues

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ABSTRACT- Cloud computing is a collection of IT services provided to customer over a network along with the ability to scale up down the service requirements. Cloud computing has the potential to eliminate the requirements for setting up of high cost infrastructure for IT-based solutions and services that industry uses. This promises to provide a flexible IT architecture, accessible through internet and portable devices. But despite the gain achieved from cloud computing, the organizations are slow in accepting it due to security issues and challenges associated with it. Security is one of the major issues which hinder the growth of cloud. This research paper analyzes the architecture of cloud along with definition of cloud computing, the various cloud models and brief overview of cloud contain any reference citations or displayed equations.

Index terms- Cloud Computing, history, architecture, security issues.

1. INTRODUCTION

Internet is driving force towards the different technologies that have been developed. One of the most discussed among all of these is Cloud Computing. Over the last few years, cloud computing paradigm has a drastic and enormous shift towards its adoption and it has become a new trend in Information Technology as it promises significance cost reduction and new business potential to its users and providers. In order to define Cloud Computing, it is first necessary to explain what is mean by the phrase "The Cloud". The first reference to "The Cloud" originated from the telephone industry in

1990s, when Virtual Private Network (VPN) service was first offered. This VPN service was used By providers along with customer, telephone companies despite of using hard wire data circuits to transmit data. This allowed provides and customers to offer the same amount of band width at a lower cost by rerouting the network traffic in real time to accommodate ever-changing network utilization. The term "Cloud" in phrase Cloud Computing refers to the internet and its infrastructure. Cloud computing is in general sense on demand utility computing for anyone with access to cloud. The advantages of cloud

computing includes:

- i. Reduced hardware and maintenance cost,
- ii. Accessibility around the world, and
- iii. Flexibility and highly automated processes wherein the customers need not to worry about software up-gradation.

In early days, the mainframe computer was very large or bulk in size and the computing platform was centralized with limited power and resources, CPU, memory so used by limited no of users. As origin of mainframe computer was 1920s so it gives the concept of Cloud Computing as all the data of user stored on server and user access the data from anywhere at any time. No hard drive or special system required only his account is necessary. From the example we understand the overall concept of "Cloud Computing". When we store our photos or data online

(internet) instead of our home PC or we use our webmail or social networking site then it is "CLOUD COMPUTING". There are three service models of

Cloud Computing SaaS, PaaS, and IaaS. SaaS refers to Software as a Service in this a system with operating systems, hardware and network provided or we can say a pre developed system. PaaS refers to Platform as a Service in this the operating system, hardware and network are provided and customer/user installs or develops its own software. And IaaS refers to Infrastructure as a Service in this the customer has the knowledge about all the stuff. There are no publically available standards specific to cloud computing security. In this paper we propose the following standards for maintaining security in an unsafe environment.

Main characteristics include:

- i. Broad network access: Ability to access the service via standard platform like desktop, laptop, mobile etc.
- ii. Resource pooling: Resources are pooled across multiple customers.
- iii. Rapid elasticity: capability to cope with demand peaks.

- iv. Measured service: Billing is metered and delivered as utility service.

Cloud Computing is an emerging trend to maintain and deploy software and it is adopted by many industries such as Google, IBM, Microsoft and Amazon. Cloud computing acts as a next progression that impact many organizational businesses and how they manage their IT infrastructure, technology and architecture that cloud service are the key areas of research.

2. HISTORY

The concept of Cloud Computing was introduced back in 1960s by John McCarthy. According to him “computation may someday be organized as a public utility”. The characteristics of cloud computing were explored first time in 1966 by Douglas Parkhill in his book, “*The challenge of the Computer Utility*”. The history of term “Cloud” is originated from telecommunications world, where telecom companies started offering Virtual Private Network (VPN) services along with comparable quality of service at a much lower cost. Before invention of VPN, they provided dedicated point-to-point data circuits which are nothing but wastage of bandwidth. But by using VPN services they able to switch traffic to balance utilization of overall network. Cloud computing now extends this to cover servers and network

infrastructure. Many players in industries have jumped into cloud computing and implemented it. For example Amazon has played a important role and launched the Amazon Web Service (AWS) in 2006. Along with this Google and IBM also started research projects in Cloud Computing. Eucalyptus become the first open source platform for deploying the private clouds

3. ARCHITECTURE

Cloud Computing is a collection of all IT services that are provided to a customer over a network on leased basis and with the ability to scale up or down their service requirements. Most of the time cloud computing services are delivered by third party provider who owns the infrastructure. There are two basic cloud models, first the **Cloud Service Model** and **Cloud Deployment Model**

3.1 Cloud Service Model

Cloud Computing is delivery of computing where massively scalable IT-based capabilities are provided, as service across the internet clients. This term effectively focus the different aspects of Cloud Computing paradigm which can be found at different levels of infrastructure. There are three types of services provided by Cloud Computing architecture namely SaaS, PaaS, IaaS. The figure 3.1 shows the hierarchy of services.

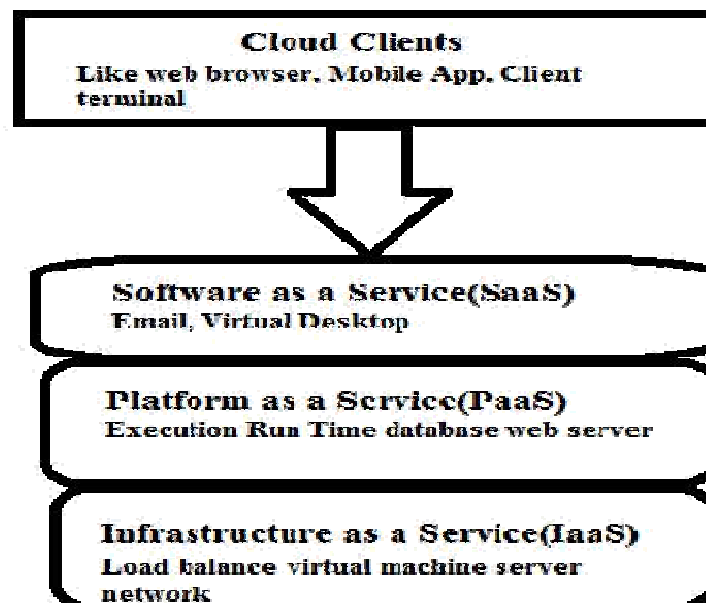


Figure 3.1 Cloud Computing Services.

3.1.1 Software as a Service (SaaS)

SaaS is easily available to users and customers via internet. Through this service delivery model end user consumes the software application services over the network by on demand basis. For example Gmail is SaaS where Google is provider and we are consumer. Other example includes billing services provided by Arial system.

Characteristics of SaaS:

- Internet access to commercial software. Software is managed from central location.
- Delivery of software in “one to many” model.
- No need for frequent software up-gradation. Application Programming Interface (APIs) allows integration of different pieces of software. Used for that software which are used for short term Example: collaboration software in any project

3.1.2 Platform as a Service(PaaS)

In PaaS the platform is itself given to consumer and they deploy their own software, coding and application in Cloud. Its approach is towards the software and development tools. For example: Application Server (java, .NET framework) and database server (My sql, Oracle), which client may use to make their own applications to meet its specific needs.

Characteristics of PaaS:

- Reduces development and maintenance cost when we develop, deploy and test any application on same integrated environment.
- Provide security services. Database management.
- No need for downloading or installing for user to experience the software online. We all use the website like Face book, Gmail and Yahoo etc.
- Provides scalability, reliability and security which is in built.
- Proper and deeper understanding of user activities.
- Shared architecture means concurrent user can access the application.

Example: Microsoft Azure, Amazon EC2, GAE.

3.1.3 Infrastructure as a Service (IaaS)

It provides the delivery of computing resources in the form of hardware, network, storage, operating system and storage devices as on demand service. It is the combination of both public and private infrastructure or can be obtain as individual. For IT resources IaaS provide a new consumption model as compare to SaaS and PaaS, IaaS is growing rapidly.

Characteristics of IaaS:

- It distributes resources as a service.
- Dynamic scaling is allowed in IaaS.
- In IaaS cost varies.
- Multiple users or customers can access on same hardware.
- Scalable.
- No need of administration.

3.2 Cloud Deployment Model

For deploying a cloud computing solution, the major task is to decide the type of cloud to be implemented. There are the four cloud computing deployment models which are available to service customer as shown in figure 3.2 shown below

3.2.1 Public Cloud:

This type of cloud allows users access to cloud via interfaces using web browsers. Users only need to pay for the duration they use the service, i.e. pay-per-use. It can be compared to electricity service received at our homes. We pay for only the amount of that we use. The same concept is used here. This help in reducing operation cost on IT expenditure. Public cloud is less secure than the other cloud models as all the data and application on public cloud are prone to malicious attacks. The solution to this is that security checks can be implemented through validation by both sides, by cloud vender as well as client. As well as both parties need to identify their responsibilities within their boundaries of operation. Public cloud is off premise in which varies enterprises can be used to deliver services to user by taking it from third party.

3.2.2 Private Cloud:

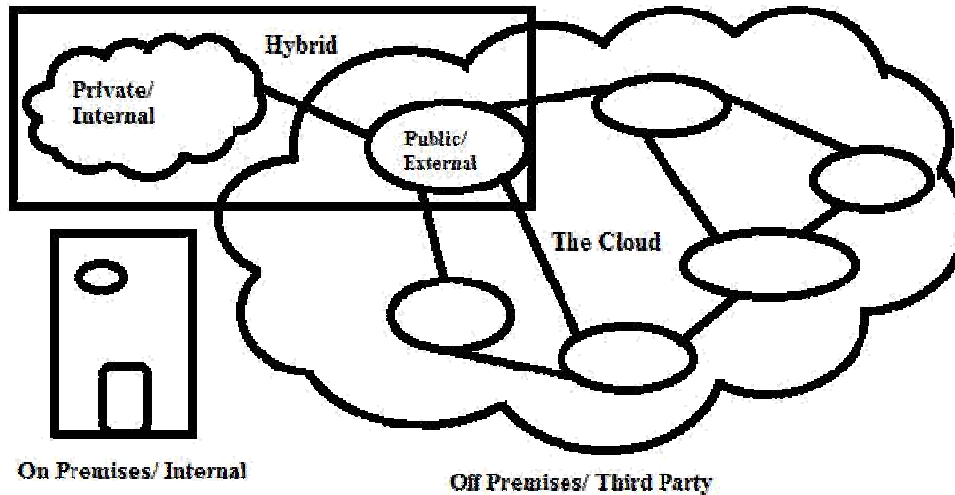
Private clouds operation is within an organization's internal enterprise data centre. The main advantage is that it is easier to manage security, maintenance and upgrades and also provides control over deployment and use. It can be compared to internet. As compared to public cloud where all resources and application were managed by service provider, in private cloud

these services are pooled together and made available to user at the organizational level. These resources and applications are managed by organization itself.

As only the organization's users have access to private cloud the security is enhanced.

3.2.3 Hybrid Cloud:

This model is composed of both public and private cloud models, where cloud computing environment is



- Cloud Data Management & Security
- Migration of virtual Machines
- Interoperability
- Access Controls

Figure 3.2 Types of Cloud Deployment Model

hosted and managed by third party but some dedicated resources are privately used only by an organization. In this model a private cloud is linked to one or more external cloud services. It is more secure way to control data and applications and allows the party to access the information over the internet. It enables the organization to serve its need in private cloud and if some occasional need occur it ask the public cloud for intensive computing resources.

- Energy Management
- Multi-tenancy
- Server Consolidation
- Reliability & Availability of Service
- Platform Management

3.2.4 Community Cloud:

It allows the cloud computing environment which is shared or managed by number of related organization. When many organizations combine construct and share the cloud infrastructure, their policies and requirements then such a model is called as a community cloud. The cloud infrastructure is host by third party provider or within one of the organizations in the community.

4. SECURITY ISSUES

Security issue has played an important role in hindering Cloud computing acceptance. Various security issues possible in Cloud computing are as below:

- Service Level Agreement (SLA's)
- Data Encryption

Service Level Agreement (SLA's):

The big challenge for Cloud customers is to evaluate

SLA's of cloud vendors. Most vendors create SLA's to make a defensive shield against legal action, while offering minimal assurances to customers. Cloud is administrated by the service level agreement s that allows a several instances of one application to be replicated on multiple servers if needed; it is dependent on priority scheme. The specification of

SLA's better reflect the customers need if they address the required issue at right time.

Data Encryption:

It is the key technology for data security. That is data

in motion and in rest encryption. Security can range from simple all the way to highly secure. For example the web services APIs that we use to access the cloud, either programmatically or with clients written to those APIs, provide SSL encryption for access, this is generally considered to be a standard.

Cloud Data Management & Security:

Cloud data can be very large, unstructured and typically append only with rare updates. Cloud data management is an important research topic in cloud computing. Since service providers typically do not have access to the physical security system of data centers, they must rely on the infrastructure provider to achieve full data security. For a virtual private cloud, the service provider can only specify the security setting remotely, without knowing whether it is fully implemented.

Migration of virtual Machines:

The major advantage of VM (Virtual Machine) migration is to avoid hotspots, however this is not straightforward. These Applications are not hardware specific; various programs may run on one machine using virtualization or many machines may run one program. Virtualization can provide significant benefits in cloud computing by enabling virtual machine migration to balance load across the data center. In addition, virtual machine migration enables robust and highly responsive provisioning in data centers.

Interoperability:

This is the ability of two or more system to work together in order to exchange the information and use that information. The lack of integration between these networks makes it difficult for organizations to combine their IT systems in the cloud and realize productivity gains and cost savings. There are many public cloud networks are configured as closed systems and are not designed to interact with each other.

Access Controls:

Identity management and authentication is more important than anything. And, it is not really all that different. What level of enforcement of password strength does the service provider invoke, the recovery methodology for password and account name. And how are password delivered to users upon change. This is not all that different from how you secure your internal systems and data, and it works the same way, if you use strong passwords, changed frequently, with typical IT security processes, you will protect that element of access.

Energy Management:

Significant saving in the energy of a cloud data center without sacrificing SLA are an excellent economic incentive for data center operators and would also make a significant contribution to greater environmental sustainability. It has been estimated that the cost of powering and cooling accounts for 53% of the total operational expenditure of data centers. The goal is not only to cut down energy cost in data centers, but also to meet government regulations and environmental standards. Designing energy-efficient data centers has recently received considerable attention. This problem can be approached from several directions. For example, energy efficient hardware architecture that enables slowing down CPU speeds and turning off partial hardware components has become commonplace.

Multi-tenancy:

There are number of types of cloud applications that (1)

user can access through internet, Internet, from small Internet-based widgets to large enterprise software applications that have increased security requirements based on the type of data being stored on the software vendor's infrastructure. These application requests require multi-tenancy for many reasons, the most important is cost. Multiple customers accessing the same hardware, application servers, and databases may affect response times and performance for other customers. For application-layer multi-tenancy specifically, resources are shared at each infrastructure layer and have valid security and performance concerns.

Server Consolidation:

Server consolidation is an effective approach to maximize resource utilization while minimizing energy consumption in a cloud computing environment. The increased resource utilization and reduction in power and cooling requirements achieved by server consolidation are now being expanded into the cloud. The VM migration technology is often used to consolidate VMs residing on multiple under-utilized servers onto a single server, so that the remaining servers can be set to an energy-saving state. The problem of optimally consolidating servers in a data center is often formulated as a variant of the vector bin-packing problem; various heuristics have been proposed for this problem. Additionally, dependencies among VMs, such as communication requirements, have also been considered recently.

Reliability & Availability of Service:

The reliability comes into picture when a cloud provider delivers on demand software as a service. The software most includes reliability quality so that users can access it under any network condition.

There are few cases identified due to the unreliability of on-demand software. Example includes Apple's

MobileMe cloud service, which stores and synchronizes data across multiple devices.

Platform Management:

One of the most important parts of cloud platforms provide various kind of platform for developers to write applications that run in the cloud, or use services provided from the cloud, or both. There are many challenges in delivering middleware capabilities for building, deploying, integrating and managing applications in a multi-tenant, elastic and scalable environments. Different names are used for this kind of platform today, including on-demand platform and platform as a service (PaaS). This new way of supporting applications has great potential. When a development team creates an on-premises application (i.e., one that will run within an organization), much of what that application needs already exists. An operating system provides basic support for executing the application, interacting with storage, and more, while other computers in the environment offer services such as remote storage.

5. FUTURE SCOPE OF CLOUD COMPUTING

As we know cloud computing has become an important part of our daily life. With the invention of this, the conventional view of computing has been changed. Due to the positive response of the users because of its user friendly and easy configuration techniques; the future of cloud computing seems very bright. The future of cloud computing is becoming bright due to: the presence of High Speed internet becoming cloud computing more important. We are getting closer because the world has been globalised due to the internet facility through satellites. From some organization's survey, it has been noted that in next decades 70% of Americans will use its various application for personal and official use. The internet is connecting people from one country to another within seconds through various cloud based websites like Skype, Whats App etc. Some points helps to boost the cloud computing in future they are, internet, entertainment will be unlimited, hardware will be optional, no need of software updates and paperless work.

6. CONCLUSION

In this review paper we have discussed the brief concept of cloud computing that is what is the word cloud suggest, its meaning, its computing with environment along with history of cloud computing, characteristics. As we have studied about the cloud

computing and its approaches, we got to know that the study of this topic is in depth and range of application areas will continue to increase. From this we understand that the cloud computing have major impact on society and business. Also we get to know that there are many new technologies emerging at a rapid rate; each with technological advancements and with the potential of making human's lives easier.

This paper presents the overview of cloud computing and the various cloud service models along with different types deployment model. Cloud computing has the potential to become a frontrunner in promoting a secure, virtual and economically viable IT solution in the future.

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