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The Cloud Computing: A Review

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Abstract
The term Cloud Computing has been a long-held dream in recent technologies. Cloud computing is the effort in delivering computing resources as a service. It has been emerged as a computing which points towards achieving objectives i.e. reliable, better quality of service, and infrastructure facilities without much financial burden. This paper explains the basic terms, service models and deployment models used in cloud computing. Also, this paper involves in explaining the various research areas and issues arising in using all the service models.
Keywords: *Cloud computing, IaaS, SaaS, Data Security*

1. Introduction

Cloud computing is considered as a fifth generation of computing. Also, Cloud computing is also known as fifth utility (along with water, electricity, gas and telephone) which is available as per the demand of the user [1]. Cloud computing refers to a model providing online computing services on demand. These services can be software, platform and infrastructure (later discussed in the paper). Also, Cloud offers various benefits i.e. pay-for-use, lesser cost, geographically available, security against the network attacks etc. In this, users can buy these services as per their requirement or on lease and then can release them back as their requirement is over. CC is a pool where large volume of load is supported including backend and frontend applications.

In a cloud computing environment, the traditional role of service provider is divided into two: the infrastructure providers who manage cloud platforms and lease resources according to a usage-based pricing model, and service providers, who rent resources from one or many infrastructure providers to serve the end users. A cloud is more than a collection of computer resources because a cloud provides a mechanism to manage those resources. Management includes provisioning, change requests, reimaging, workload rebalancing, deprovisioning, and monitoring.

Moreover, it can be applicable in several ways i.e. ability to rent a server, loading of software on it, storing a large amount of data on it[13].

This paper has been structured as Section 2: Literature survey, terminology and features Section 3: Service models, Section 4: Deployment models and finally Section 5 concludes the review by summing up the future research areas under Cloud computing.

2. Literature survey and basic terms used in Cloud computing

CLOUD stands for *Common Location-independent Online Utility service, available on-Demand* [2].Many researchers and engineers from various backgrounds i.e grid computing etc have involved in cloud computing. All of them worked on this computing with their own different viewpoints [3].

Armbrust (2009) [4] elaborated that cloud computing uses the Internet and central remote servers to maintain data and applications and has been broken down into three segments i.e. “applications”, “platforms”, and “infrastructure”.
According to [5], computing resources can be leased and released as by the requirement of the resources. In this way, resources are conserved by letting machines and storage freed when no longer in use. Till date, the definition given by NIST is the most appropriate and acceptable almost all the organizations i.e.[6]

Cloud computing is a model for enabling convenient, on-demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider’s interaction.

Also, according to [14], a lot many projects in industries and in an academia are already in a running state. For example the RESERVOIR project [15], an IBM and European Union joint research initiative for Cloud computing, Amazon Elastic Compute Cloud [16], IBM’s Blue Cloud[17], scientific Cloud projects such as Stratus [18], and OpenNebula [19].

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The IT industries are now spending at large scale with great speed. Even the academicians have come to know about its importance which can be proved from conferences, seminars held on aspects of cloud computing.

3. Characteristics of Cloud computing

Further NIST suggests that Cloud model should be made of five essential features or characteristics. i.e.[6]
On-demand self-service. A consumer can request for computing facilities, such as server time and storage, as needed automatically without requiring any human interaction with each service provider.

Broad network access. Capabilities are available geographically over the large network and accessed through standard mechanisms that promote use by heterogeneous thin or thick client platforms (e.g., mobile phones, tablets, laptops, and workstations).

Resource pooling. The provider's computing resources are pooled to serve multiple consumers using a multi-tenant model, with different physical and virtual resources dynamically assigned and reassigned according to consumer demand. There is a sense of location independence in that the customer generally has no control or knowledge over the exact location of the provided resources but may be able to specify location at a higher level of abstraction (e.g., country, state, or datacenter). Examples of resources include storage, processing, memory, and network bandwidth.

Rapid elasticity. Capabilities can be elastically provisioned and released, in some cases automatically, to scale rapidly outward and inward commensurate with demand. To the consumer, the capabilities available for provisioning often appear to be unlimited and can be appropriated in any quantity at any time.

Measured service. Cloud systems automatically control and optimize resource use by leveraging a metering capability1 at some level of abstraction appropriate to the type of service (e.g., storage, processing, bandwidth, and active user accounts). Resource usage can be monitored, controlled, and reported, providing transparency for both the provider and consumer of the utilized service.

4. Service models

The architecture of cloud computing can be described into three layers i.e. Software as a Service (SaaS), Platform as a Service (PaaS) and Infrastructure as a Service(IaaS). IaaS, PaaS and SaaS are inherently interrelated with each building on the former. These three layers reflect a full spectrum of cloud computing services. These services are described as follows: [1]

4.1 Software as a Service (SaaS)

This service helps in providing the on-demand usage of software applications as per the requirement of the user. When a particular software service is requested by the user, a single instance of the software runs on the cloud and provide services to user or/organizations. Here, the consumer no need to worry or manage about the infrastructure overheads such operating system, storage etc. [2][6] SaaS is sometimes referred to as "on-demand software" and is usually priced on a pay-per-use basis. Cloud applications are different from other applications in their scalability—which can be achieved by cloning tasks onto multiple virtual machines at run-time to meet changing work demand [7]. This approach is helpful in eliminating installation and maintenance needs on local systems.

A common example of SaaS can be Salesforce.com's online CRM system. Here, a user is provided with the CRM applications as well as user side customization platform. In the former, 'point-and-click' configuration is used where no coding is required whereas in the later one, 'customize with code' that allows developers to create new functionalities as per their requirement[1].

Issues of using SaaS

As SaaS is a dynamic model which can be used as per the requirement but it also has some inherent issues. The data transferred from source to destination is not secured as required to be. Also, this service model is not adopted by most of the industries as storage and security of the data is not transparent. The vulnerabilities in the applications could lead to loss of sensitive data and money.

4.2 Platform as a Service (PaaS)

PaaS acts as an intermediate between SaaS and IaaS. It provides the interface and integrated design that further facilitates the benefits of developing, testing and deploying platform. In this, the user is allowed to create applications using languages and APIs environments and can directly deploy those developed applications on the cloud infrastructure. Application developers can develop and run their software solutions on a cloud platform without the cost and complexity of buying and managing the underlying hardware and software layers [8].

The consumer need not to manage or to control the underlying cloud infrastructure including network, servers, operating systems, or storage, but has control over the

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deployed applications and possibly configuration settings delivered by the application-hosting environment.

PaaS can be utilized in two perspectives i.e. generating services as PaaS and using services as PaaS. Someone *generating PaaS* generates a platform or an application environment that can be used for developing applications by the customer whereas someone *using PaaS* will interact with the platform through API and it also does what is necessary to manage and scale itself to provide a level of services [3].

One of the famous examples of PaaS is Google's App Engine, which helps users in building applications on the systems powered by Google Applications. Another example of PaaS is VMware, which provides an easy way out of building Java-Based websites (providing JVM), enabling non-experienced programmers to build their own applications in the cloud [1**].**

Issues of using PaaS
As PaaS provides virtual platforms for various applications to be developed are far away somewhere on cloud, the tendency of hacking also increases.

4.3 Infrastructure as a Service (IaaS)

In this service model, virtual machines are provided by the main servers. Here, the virtual station runs on the user's system and provide functionalities needed by the user. User is given the control over the operating systems, storage etc but in a limited manner i.e. he will not be given control over the selected network components. The users need not to establish their own data centers, or need not to hire employees their job done rather than they just need to contact the Amazon web services say EC2 (Elastic cloud 2) and can give the requirements to get fulfilled. By doing this, they get a virtual server running in seconds and pay as per they use[2] So, rather than purchasing servers, storage media, network equipments instead buy the virtually and get work done.

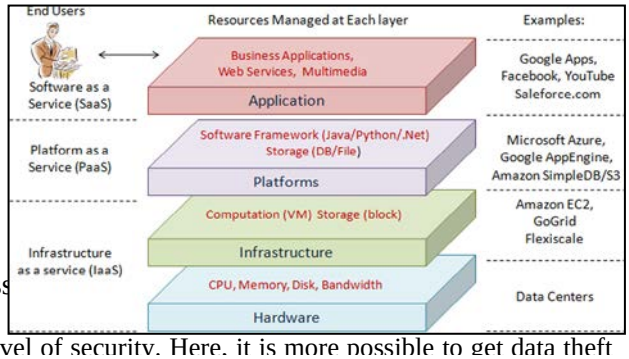

Fig. 1 Architecture of Cloud Computing [9]

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level of security. Here, it is more possible to get data theft over the network as compared to buying own resources and getting work done.

5. Deployment models

Cloud computing employs various kinds of deployment models which has been explained as follows:

5.1 Private cloud: This kind of cloud is operated, owned and managed by any particular organisation or any third party or by somewhat their combination. It can be used exclusively by an organisation which provides high performance, reliability and protection of data exchanged over the server, also known as internal clouds. Inspite of having benefits, private cloud are generally expensive in nature as the assets used are to be refreshed periodically. This has lead to rise in criticism in users as they have to buy them, build them and manage them.

5.2 Public cloud: This cloud is operated, owned and managed by any business or any government organization. Basically public cloud can be used openly by the general public. The only difference between private and public cloud is that data transferred using public cloud is not secure. It can easily be tampered over the network.

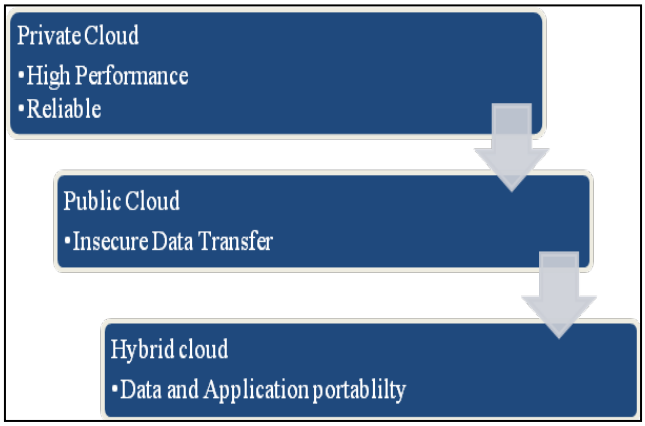

Fig. 2 Deployment Models

5.3 Hybrid cloud: The cloud infrastructure is a composition of two or more distinct cloud infrastructures (private, community, or public) that remain unique entities, but are bound together by standardized or proprietary technology that enables data and application portability (e.g., cloud bursting for load balancing between clouds).

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6. Opportunities/ Research challenges for cloud computing

Following are some of the areas where research challenges can be taken into an account:

6.1 Data Security: Data security is one of major challenge in cloud computing utility. Whether the data is stored over the network or transferred over the network, users must have the assurance about the security of the data. Thus, the data stored should not be accessed by the unauthorized user. In this case, various encryption algorithms must be deployed. Arfeen et al. [11] focused on network awareness and consistent optimization of resource allocation strategies and highlighted the research issues prevailing in this field. Safiriyu [12] proposed a user identity management protocol (UIDM) in cloud paradigm. It accommodates all stakeholders i.e. end user and providers. It provides authentication, encryption and key management mechanism. They have tested weak, strong and very strong user identity and observed more failure in case of weak IDM.

6.2. Availability of service: Services provided to the users are not sufficient as needed by them. Basically, organizations worry about whether cloud will be having enough availability of the required resources or not. For example, if Google search is not available, many users assume that the Internet was down. Same facility is expected by all the customers that are hard to maintain [10].

6.3. Load Balancing: It has an objective which shows that the services are to be balanced properly as demanded by the user. Many algorithms have already been designed and many areas of improvement are still required [2].

6.4. Data lock in: In cloud, data cannot be extracted easily by the user and also programs cannot be run from one site to another. Some organizations are preventing themselves from adopting cloud computing only because of extracting data issues [10].

6.5. Scalability: These opportunities automatically scale up and down in order to save economy but without any violation of service level agreements. Here, a server may contact another cloud provider in case it gets out of services. Scaling also help in conserving resources as well. As, an idle computer uses about two-thirds of power of a busy computer, it can be used carefully to reduce the impact of datacenters on environment, which is receiving negative attention [10].

4. Conclusions

This paper has presented the work published by the academic community advancing the technology of cloud computing. Also, the paper has presented the various research challenges that can be carried out as a scope in the field of cloud computing. Many definitions have been discussed of cloud computing and the NIST working definition by Mell and Grance [6] was found to be useful with its characteristics, deployment models and service models. Presently, the field is gaining a lot of attention, even a lot of work has been done under it, but still the number of efforts, research work has to be done to overcome its major challenges.

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