Cloud Computing: Architecture, Services, Deployment Models, Storage, Benefits and Challenges

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ABSTRACT

Cloud computing is known to all as one of the most popular technology in IT industries. Even non IT people are becoming habituated to use many applications of cloud computing day by day as well. New techniques of cloud computing are used to align information technology and business targets. So many opportunities are creating daily in the field of cloud computing. It offers easier access and excellent performance to execute the data on server through internet. Cloud Computing is forming itself as the soul of Internet gradually. Most of the internet users visit some common but very much popular websites like Facebook, Twitter, LinkedIn which are all based on cloud computing. Apart from these, people use YouTube, Gmail and so on as well which are completely dependent on cloud storage. Here in this paper, we will discuss in brief on cloud architecture, services, storage, deployment models, benefits and challenges of cloud computing in real life.

KEYWORDS: Cloud Computing, IaaS, PaaS, SaaS

I. INTRODUCTION

Cloud computing has changed the thinking of industrial and scientific people in many ways. Minimizing the cost, it provides the solution of IT infrastructure easily. Cloud computing is the technique that is defined as on demand delivery of IT resources through the internet with pay-as-you-go pricing system. There are two kinds of people involved to this system. One of them is service provider and other one is subscriber. Service providers are actually company's IT people or a third party or a combination of company and the third party. On the other hand subscriber may be anyone who takes the services from the service providers.

Cloud providers give the services of computing resources like databases, computing power and storage to the users where users need not to buy or become owner or maintain the physical data servers and centers [1]. Users can access the data hosted on cloud storage from any place in any time. Having internet connection to Laptop, Tab, Desktop and Smart Phone, they can manage or insert the data very smoothly on time [2]. The big challenge of cloud computing is to have high speed internet connection to the devices always.

People of all spheres are now concerned about their larger amount of data which are stored in their computers. They are trying to find out a system where they can store their significant data, manage the data, access the data universally and share those data easily and safely. In this circumstance, cloud computing is one and only solution for people's concern.

Some significant characteristics of cloud computing is given below:
- ➢ **On-demand self-service:** Users can get the services of cloud computing whenever they need.
- ➢ **Resource pooling:** Several resources are pooled simultaneously and provided to the users dynamically.
- ➢ **Rapid elasticity:** Scalable services are provided by rapid elasticity. If the users need extra space on the cloud, they can take the permission by this.
- ➢ **Broad network access:** All the services those are available on the cloud can be accessed by the users by following some methods.
- ➢ **Measured service:** Resource utilization is definitely monitored and controlled. So transparent service is provided to customer and provider.
- ➢ **Pay as you go:** User needs not to pay extra charge for

the service that he taken from the provider. He needs to pay only for the service he has taken. Instead of extra payment, provider gives some extra spaces always for free [3].

➢ **Easy maintenance:** Maintenance of the servers is very easy and the downtime is ignorable.

➢ **Automatic System:** Demand of the users may be measured automatically. Since the overall scenario of the service is monitored, it is possible to report to the user about their total usages of the services.

➢ **Security:** This is a very much important issue of cloud computing. If any server even gets damaged, data will not get lost because it takes a snapshot of the stored data. The storage devices are used to store the data that is about to impossible for any other person to utilize or hack.

➢ **Device and Location Independence:** Cloud computing allows the users to access the system from any location using any kind of device (PC or Mobile) via internet by any browser.

II. Cloud Computing architecture

To store the data on cloud all kinds of organizations are using cloud computing system so that they can access to their system whenever they want. Basically cloud computing architecture is classified into two ways. One is Front End and other is Back End [4]. Both of the ends are connected via internet.

To provide the security of the information for cloud users, back end is responsible [5]. The service providers use the back end. All the resources those are needed to give services are managed by it. It comprises a security mechanism, large volume of data storage, servers, virtual machines, traffic control mechanisms, deploying models and so on.
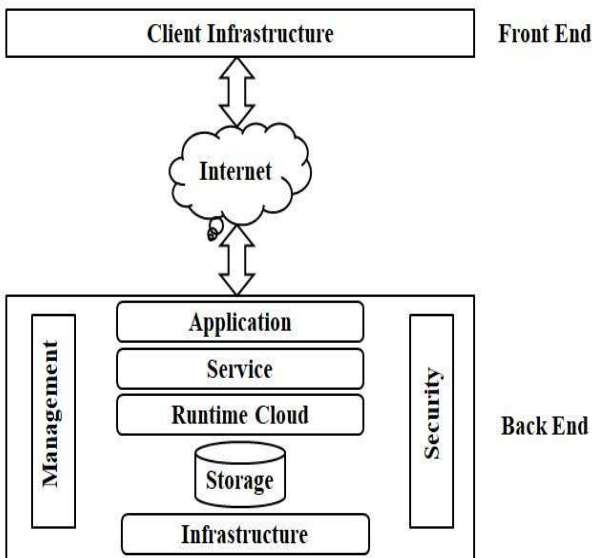

Fig. 1.Cloud Computing Architecture

On the other hand, users use the front end. Client-side interfaces and applications are needed to have access over the cloud computing in front end. It comprises tablets, web servers, and mobile devices.

Since the cloud contains various kinds of data of various users, the access systems for cloud are various from conventional storage. Multiple access systems are performed by the maximum providers [6].

Some elements of cloud computing architecture are mentioned below:

➢ **Client Infrastructure:** It is considered front end element. To interact with the cloud, Graphical User Interface is provided by client infrastructure.

➢ **Internet:** It is a medium by which both ends can communicate with each other.

➢ **Application:** It may be any software or platform that user wants to get access.

➢ **Service:** It provides three kinds of services like

➢ SaaS, PaaS and IaaS.

➢ **Runtime Cloud:** Execution and runtime environment are offered by runtime cloud to the virtual machines.

➢ **Storage:** One of the most important elements of cloud computing architecture. To store and manage data, a large amount of storage capacity in the cloud is offered by it.

➢ **Infrastructure:** It offers services on the application level, host level and network level. It comprises hardware as well as software elements.

➢ **Management:** It is used to manage all the elements of back end like application, service, runtime cloud, storage, infrastructure and security issues. It also forms coordination among them.

➢ **Security:** It performs a security system in the back end.

III. Cloud Computing services

Cloud is visible in every sector of life wherever it may be office or home. People need to communicate with their relatives, friends and colleagues. So they need various apps and devices which are interacted with the cloud [7]. It can be classified into three main services:

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

This classification creates the cloud stack as mentioned in fig.2. In this cloud stack, SaaS is on the top, PaaS is in the middle, and IaaS is on the bottom. Users do not interact with the platform or infrastructure on which it runs. Rather they interact with the software that is hosted on the cloud. So, SaaS is kept on the top of the cloud stack.

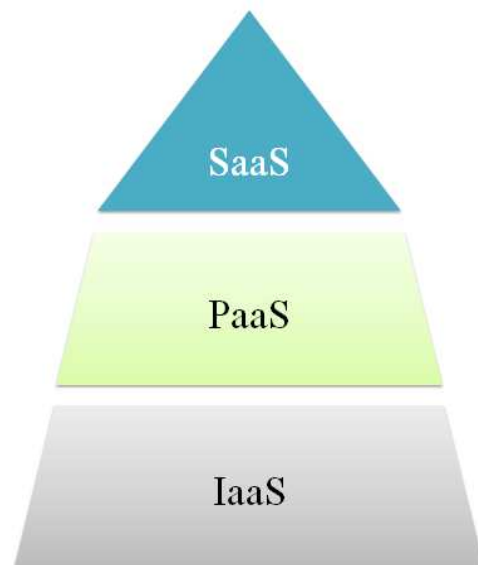The three main services are discussed below:

Fig. 2.Cloud Computing Stack

1. Software as a Service (SaaS)

It offers software applications on cloud. Since software is installed already and running on the cloud, users may use the software easily. It is not necessary to install the software in their personal computer. Maintenance of software is fully done by service providers even they are more liable than the users of the software [8]. SaaS offers many applications like Human Resource solutions, Customer Relationship Management, Help desk application, Billing and invoicing system and so on. Some name of the SaaS providers are Microsoft Office live, Google Apps, QuickBooks, Gmail, Amazon, LinkedIn and Facebook etc.
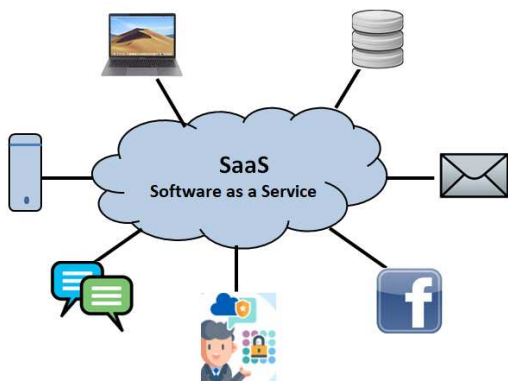

Fig. 3.   Software as a Service (SaaS)

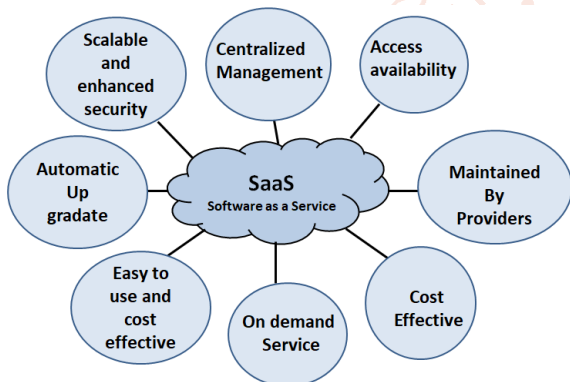Some Characteristics of SaaS are listed in the following figure:

Fig. 4.   Characteristics of SaaS

2. Platform as a Service (PaaS)

It provides the runtime environment for the applications as well as deployment and development tools needed to develop various applications [9]. Here in PaaS, Users need not to install platform on the local system to deploy their applications. Users are completely free of tension for up gradation of platform and storage. The implementation of PaaS may be different from one service provider to another service provider. Some of the PaaS providers are Amazon web services, Google cloud, Windows Azure, LongJump, OpenShift, Salesforce and so on.
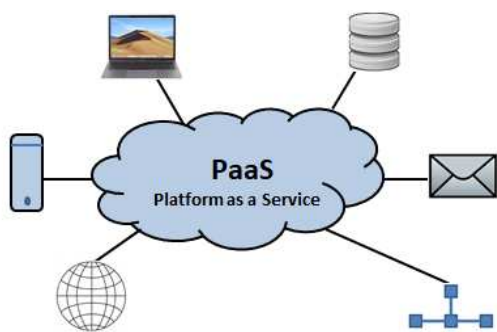

Fig. 5.   Platform as a Service (PaaS)

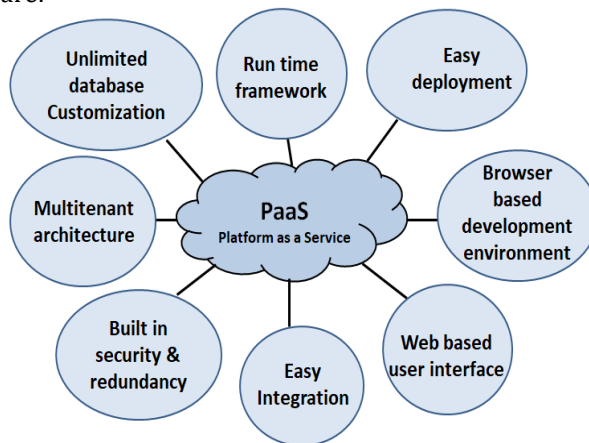Some Characteristics of PaaS are listed in the following figure:

Fig. 6.   Characteristics of PaaS

3. Infrastructure as a Service (IaaS)

Hardware resource is offered by IaaS as service. It also provides Load balancers, Virtual local area network (VLANs), Software bundles and IP addresses. The application is deployed by using many hardware resources like servers, memory, networking devices and processing power.

Infrastructure can be used by multiple users via the use of virtual machines. Rackspace, Amazon Web Services EC2, Amazon S3 and IBM cloud are examples for IaaS.
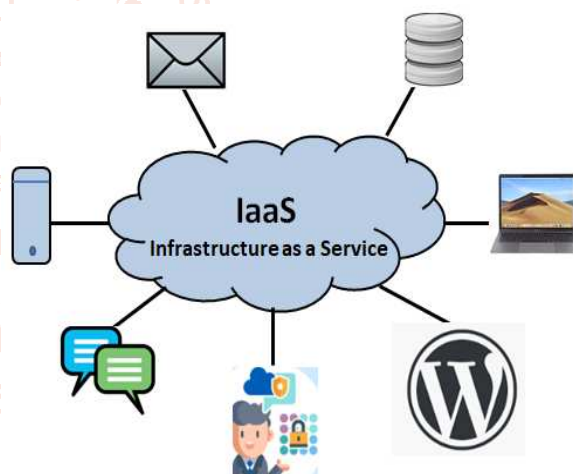

Fig. 7.   Infrastructure as a Service (IaaS)

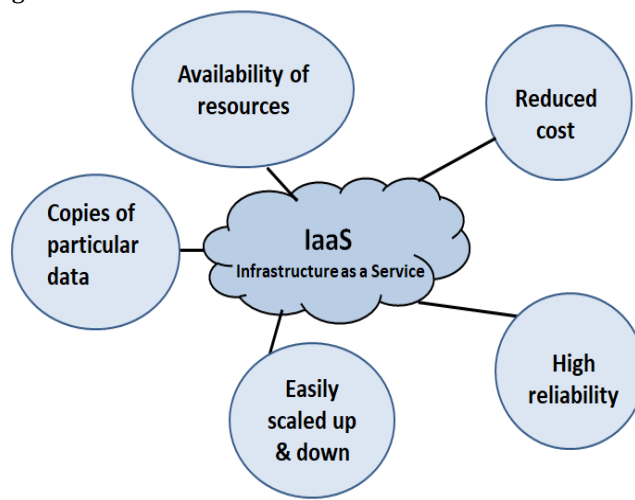Some Characteristics of IaaS are listed in the following figure:

Fig. 8.   Characteristics of IaaS

IV. Cloud Computing deployment models

Cloud Computing Deployment Model is classified into four ways: 1) Public Cloud, 2) Private Cloud, 3) Hybrid Cloud and 4) Community Cloud. A brief discussion on all cloud deployment model is given below.
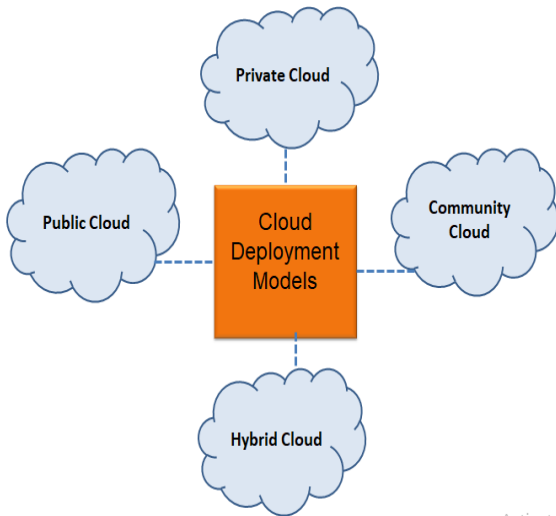

Fig. 9. Cloud Computing Deployment Model

1. Public Cloud Model

It makes the way easier so that general public gets the access to the systems and the services easily. Third party as the cloud service provider is considered the owner and responsible of all the physical resources. It has many benefits like flexibility, high scalability, and independence of location and so on.

This is not best for larger sized business. Rather these clouds are appropriate for medium as well as small sized business. As all the users have access to the all resources as public, it offers less security comparing to the other cloud models.
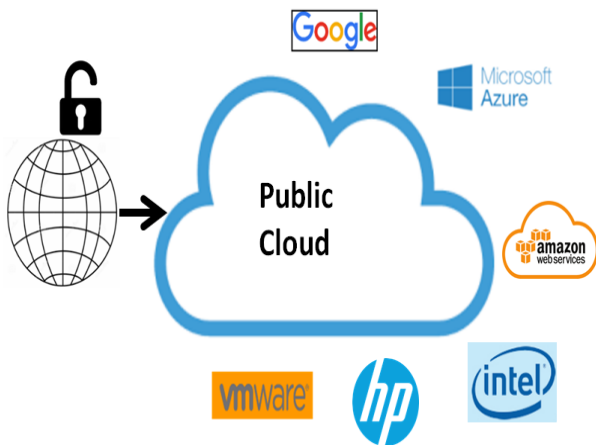

Fig. 10. Public Cloud Model

2. Private Cloud Model

The Private Cloud model is run within a specific organization. Since only the authorized users can access to the system of the organization, this cloud model offers more security than other cloud model. This model is appropriate for the organizations where security is treated as main headache. Third party or the organization itself may be responsible to manage it.

Cost Efficiency, High Security and Privacy, More Control and reliability are the main advantages of private cloud model.

The main problem of this cloud model is to face some difficulties for deploying it globally.
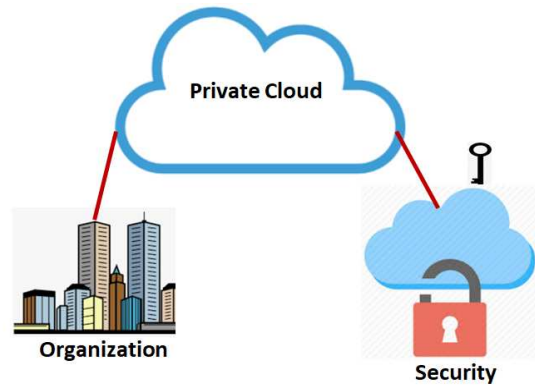

Fig. 11. Private Cloud Model

3. Hybrid Cloud Model

Hybrid cloud model is the infrastructure which comprises links between public cloud and private cloud [10]. It offers the scope of multiple deployment models at a time. Although the private and public parts of the hybrid cloud are tied together, they stay as unique entities.

Application and operation teams are the liable for all the difficulties of the two different infrastructures. Flexibility, Security Scalability, cost efficiency is the benefits of Hybrid cloud.

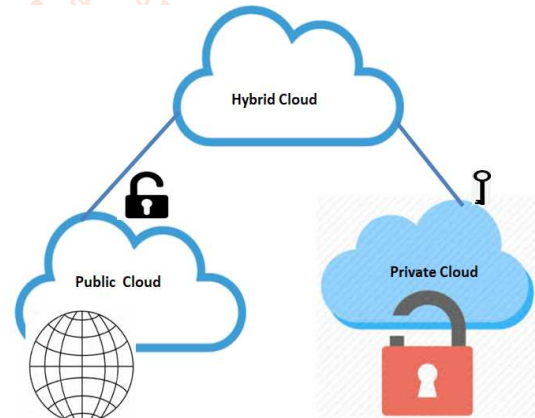**Fig. 12. Hybrid Cloud Model**

4. Community Cloud Model

Community cloud model is shared by few organizations and supports a particular community that has shared their concerns [11]. It is possible to manage the system internally by organizations or by the third-party. It is more secured than the public cloud and less secured compared to the private cloud.
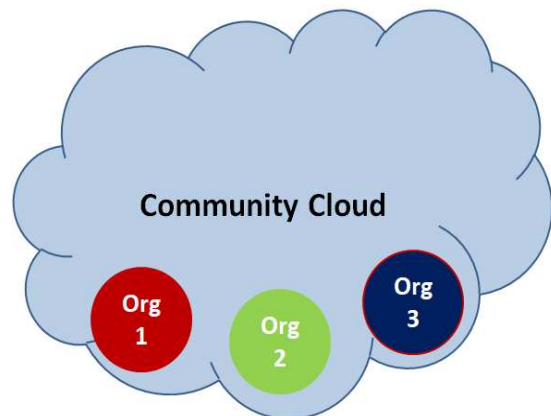

Fig. 13. Community Cloud Model

V. Cloud Computing Storages

Cloud storage is a model of data storage where the digital data is stored safely. It is a one kind of service that is used to manage, backup and maintain data remotely and make the data available to users via the network. It has made the sharing and collaboration easier for the user. Number of people is increasing day by day who are using cloud storage to share their important file. People of Businesses have transferred their storage from the local storage to the cloud storage [12]. Cloud storage should be autonomic, computable, cost effective, available, multi-tenant, scalable, control and efficient otherwise people will not use the cloud storage. After all it must be secured and reliable as well. Providers are responsible for overall activities related to cloud storage. There are many providers for providing the cloud storage. But we have mentioned some names of the best providers as follows.

1. IDrive

This is more reliable service and has become our best cloud storage solution. It has some attractive features like fast and easy to use, strong security, physical backup if needed, no two-factor authentication. It provides free space up to 5GB.

2. pCloud

It is the secure cloud storage, where user can share and store their files easily. It has some attractive features like intuitive interface, good value, enticing lifetime subscription. It provides free space up to 10GB.

3. OneDrive

This is service is provided by Windows 10. It has some attractive features like ready to use on Windows file restoration features. It provides free space up to 5GB [13].

4. Apple iCloud

It is a good storage only for Apple users. It has some features like built into MacOS and iOS, good value, limited free storage, no good for sharing. It provides free space up to 5GB.

5. Google Drive

Since it is integrated with android, it becomes auto choice for the users. It provides free space up to 15GB.

6. Box

It has some attractive features like data loss protection on business plans, plays nicely with many apps, unlimited storage on most business plans, and 250MB upload limit on free accounts. It provides free space up to 10GB.

7. Mega

It provides the most generous free option. It has some attractive features like easy to use, lots of free storage, poor collaboration options and open source. It provides free space up to 50GB.

Fig. 14. Cloud Storages

8. Dropbox

It provides free space up to 2GB.

9. NextCloud

It is not online based provider, but it provides free software for downloading and installing a cloud storage service on the user's personal server.

10. SpiderOak

It offers an easier, secure and free online sharing, backup, sync, access as well as storage solution for Linux, Windows and Mac.

VI. Benefits of Cloud Computing

- ➢ It is not necessary for installing software to access cloud application.
- ➢ Lower cost is one of the important benefits of cloud computing. It offers service to the companies at the cheapest rates possible.
- ➢ It is possible to retrieve the data from other database if one database is crashed.
- ➢ Since all the data is stored in one location, users can access it from any places.
- ➢ It provides on-demand self-service.
- ➢ It provides load balancing which makes it more reliable.
- ➢ Users need not to have idea about the internal operation of the system. They will just enjoy the cloud services.

VII. Challenges of Cloud Computing

Here, is the list of challenges of Cloud Computing:

- ➢ **Reliable and Availability:** Since most of the businesses are now dependent on the cloud services provided by the third-party, cloud system should be robust, reliable and available.
- ➢ **Security & Privacy:** Security and Privacy of data is the main challenge of cloud computing. It can be possible to overcome by using encryption, security hardware as well as security applications.
- ➢ **Interoperability:** It means that the application on one platform should have the ability to merge services from the other platforms.
- ➢ **Cost:** Cost should be minimized for the huge number of users. But it may be big challenge for the cloud providers.
- ➢ **Portability:** Migration of any application from one cloud provider to other provider is another challenge of cloud computing.
- ➢ **Downtime:** It is the average challenges of cloud computing since no cloud provider ensures a platform that is completely free from downtime.
- ➢ **Lack of resources:** It is also one of the major challenges faced by the cloud provider.
- ➢ **Computing Performance:** To get the maximum computing performance, it is must to have high bandwidth. Since network bandwidth is high, cost is also high.

VIII. CONCLUSION

In this paper, we have discussed about cloud computing architecture, service and deployment models and storage which are extensively used in many IT sectors. It is a recent technology of Computing that provides to users less expensive, more flexibility and more efficiency in IT services. We have also discussed about benefits and challenges of cloud computing. Some issues are faced by the cloud storage

may be improved by load balancing technique. We are going to do research on load balancing in near future.

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