

18<sup>th</sup> September 2020

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# A Review on Cloud Computing Technology

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**ABSTRACT:** In recent years, Cloud Computing is one of the most discussed emerging technologies. Cloud computing has become the ideal way to deliver various computing services including servers, software, storage and databases via the internet. It offers flexible resources and economies of scale so it is a popular choice for people and businesses. A user can use the cloud services anywhere, anytime with any device. This article presents a comprehensive review of cloud computing services, cloud services models, cloud deployment models and application of cloud computing in various fields. This will help to understand cloud computing and its services in a better way.

**KEYWORDS:** cloud computing, deployment model, IaaS, PaaS, SaaS, storage, service

## I. INTRODUCTION

Cloud computing offers the facility to access shared resources and services on demand over the network. The location of devices and physical resources being accessed are not known to the end user. Using Cloud computing users can develop, deploy and manage their applications 'on the cloud' and they can store files and applications on remote servers and then access all the data through the internet [1].

Google Apps is an example of Cloud computing, it enables to access services using the browser and it can be deployed on millions of machines over the Internet. Resources are accessible from the cloud from any place at any time across the world using the internet. Cloud computing is cheaper compared with other computing technologies. Here the maintenance cost involved is zero since the service provider is responsible for the availability of services and clients are free from maintenance and management issues of the resource machines [2].

Cloud computing has become an essential part of the computing world. It is described based on either deployment model or service. Based on deployment model, we can classify the cloud as Public, Private, Hybrid, and Community. The following diagram Fig.1 shows the cloud deployment model.

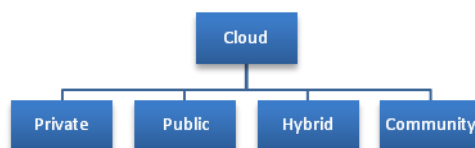


Fig.1 Cloud deployment Models

- Private Cloud - It allows services and systems to be accessible within an organization. It is more secured. This type of cloud is also known as Internal Cloud.
- Public Cloud - It allows services and systems to be easily accessible to the public. This type of cloud may be less secure because of its openness. This type of cloud is also known as External Cloud.
- Hybrid Cloud –Combination of public and private cloud is known as Hybrid cloud.
- Community Cloud - It allows services and systems to be accessible by a group of organizations.



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Based on service the cloud model is divided into the following

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

### Infrastructure as a Service (IaaS)

IaaS gives access to fundamental resources such as virtual storage, physical machines, CPU, disk space, network components, virtual machines etc. Example Google Compute Engine (GCE), AWS EC2, Digital Ocean, Rackspace, etc.

### Platform as a Service (PaaS)

PaaS provides the flexible runtime environment for applications, development and deployment tools, etc to the users. Example Microsoft Azure, Google App engine, etc.

### Software as a Service (SaaS)

In SaaS, software is available for a monthly subscription fee to users via the internet. In SaaS, we don't need to install and run software applications on our computer. Everything is available over the internet when we log in to our account online. SaaS is usually referred to business software rather than consumer software. Example Google Apps, Salesforce, Dropbox, BigCommerce, MailChimp, DocuSign, Hubspot [1] [3].

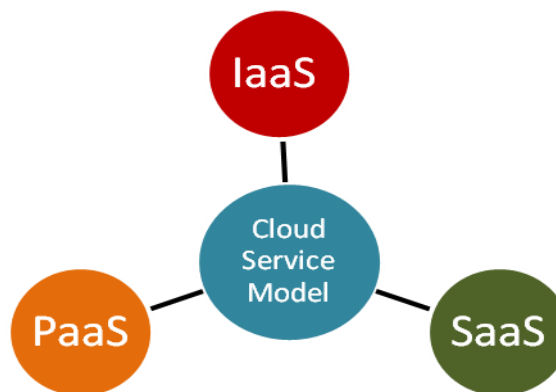


Fig.2 Cloud Service Models

The above diagram Fig.2 shows the Cloud service models.

## II. ARCHITECTURE OF CLOUD COMPUTING

We can divide the cloud architecture into two parts such as Front end and Backend.

The Front end refers to the client part of cloud computing system. It includes interfaces and applications that are required to access the cloud computing platforms example browser.

The Backend refers to the cloud itself. It contains all the resources required to provide cloud computing services such as data storage, virtual machines, security mechanism services, deployment models, servers, etc [8]. The below diagram Fig.3 shows the architecture of Cloud computing.

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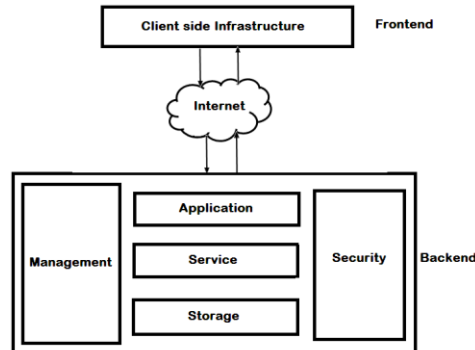


Fig.3 Architecture of Cloud Computing

### III. ELEMENTS OF CLOUD COMPUTING

The following diagram Fig.4 shows the elements of Cloud computing.

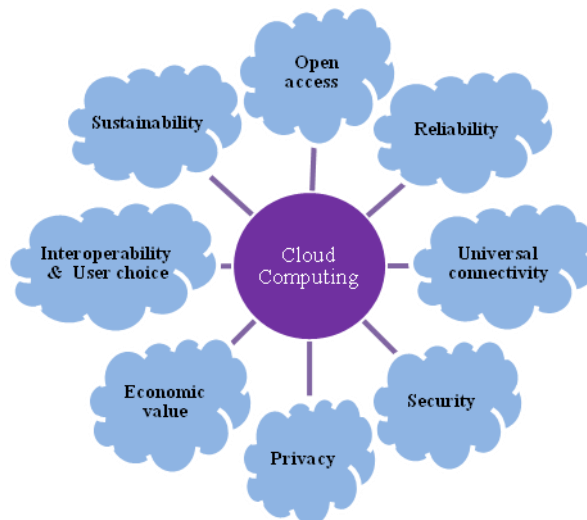


Fig.4 Elements of Cloud Computing

- Open access: Users must have fair and open access to the internet and cloud services.
- Reliability: Cloud must function at levels better than or equal to current stand alone systems.
- Security: Data on the cloud must be safe and secure.
- Privacy: Users data must be protected and access rights defined.
- Economic value: Cloud must deliver tangible savings and benefits.
- Universal connectivity: Always users must have internet access to use cloud services.
- Interoperability and user choice: Users can move from one cloud platforms to other.
- Sustainability: The cloud must raise energy efficiency and reduce ecological impact [4].

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#### IV. ADVANTAGES OF CLOUD COMPUTING

Cloud computing offers a number of advantages to the users. Some of the advantages of Cloud computing are given below

- Cost Efficiency – This is one of the biggest advantage of cloud computing. Companies don't need to invest money for software and also it can save its license amount. They can eliminate overhead charges such as the cost of data storage, software updates, hardware and maintenance etc. The cloud is available in cheaper rates than traditional approaches and it can reduce the overall IT expenses.
- Continuous availability - Public clouds enables easy access to information and accommodates the needs of users in different time zones and various locations. Also cloud provides continuous availability of resources. Multiple servers are used by many cloud vendors for maximum redundancy. Alternative instances are automatically generated on other machine in case of system failure.
- Backup and Recovery - Reliable and flexible backup/ recovery solutions are provided by various cloud providers. The cloud itself is used solely as a backup repository of the data located in local computers in some cases so the process of backing up and recovering data is simplified.
- Cloud is environmentally friendly - The cloud is well-organized than the typical IT infrastructure and it takes fewer resources to compute, thus it saves energy. For example if servers are not used then the infrastructure is generally scales down, freeing up resources so it consumes less power. Always the system consumes only the resources that are truly needed [5].
- Scalability - Cloud services can be utilized efficiently at a known cost because of its rapid scalability and deployment capabilities.
- Versatility - The use of heterogeneous platforms which can be thin or thick cloud and applications are promoted on the computing cloud.
- High reliability - It is more reliable than a local computer and has better disaster recovery facilities.

#### V. CLOUD SERVICE PROVIDERS

Some Examples of Cloud Service Providers

- Google - Google provides the cloud services like G-mail, Google docs, Picasa, Google Analytics, Google Ad words and Ad sense.
- Microsoft - It provides the Services like Windows Azure, SQL Azure, Windows Azure App Fabric and Windows Azure Marketplace.
- Amazon Web Services (AWS) – It provides services like Amazon Elastic compute cloud, Amazon Simple Storage services, Amazon Virtual Private Cloud, Amazon Cloud front, Amazon Relational Database and Amazon Simple Queue services [6].
- 

#### VI. APPLICATIONS OF CLOUD COMPUTING

Nowadays Cloud Computing is used in many fields such as business, social networking, management, entertainment, education, art and global positioning system, etc. Some of the widely famous cloud computing applications are given below

##### E-learning

It is a latest trend in the field of education that provides an attractive environment for faculty members, students and researchers. They can connect to the cloud of their organization and access data and information from there. Nowadays many schools, colleges, universities preferred this low cost option for using high concept computing systems.

##### E-Governance

Cloud computing improves the functions of our government by providing the better services to its citizens, institutions and cooperation with other governments. This is done by expanding the availability of environment, making environment more scalable. It also reduces the burden of managing, installing and upgrading applications [6].



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### Healthcare

With the help of Cloud computing Medical technology-based devices and equipments such as Computed Tomography (CT) Scanners, Magnetic Resonance Imaging (MRI) Scanner, Diagnostic Sonographic Scanners, remote monitoring devices, health and wellness-check devices are used in diagnosing health problems.

### Data Storage and Backup

Data storage and backup services are offered by the following applications.

- Mozy- It offers online backup service for files to avoid data loss.
- Box.com - It offers drag and drop service for files. The users just drop the files into Box then they can access it from anywhere.

### Business Applications

Cloud computing has made businesses easy and more collaborative by incorporating various apps like MailChimp, Chatter, Google Apps for business Quickbooks.

- MailChimp - An e-mail publishing platform is offered by MailChimp. It is used to design and send the e-mail campaigns in business.
- Google Apps for Business - Google offers documents, spreadsheets, presentations, etc. Google Docs allows the business users to share them in collaborating manner.
- Quickbooks - Online accounting solutions for a business is offered by Quickbooks. It helps to generate business reports, VAT returns and monitor cash flow.

### Management Applications

Management task such as time tracking, organizing notes are performed by the following applications.

- Toggl - It helps to track time period assigned to a particular project.
- Outright - It is an accounting app. It helps to track expenses, income, profits and losses in real time.
- Evernote - It manages the sticky notes and even can read the text from images which helps the user to locate the notes easily.

### Social Applications

Facebook and Twitter are some of the social networking services websites.

- Facebook - It offers social networking service. We can share photos, videos, files, status and so on.
- Twitter – Using Twitter we can interact with the public directly. One can follow any organization, celebrity and any person who is on twitter and can have latest updates regarding the same.

### Entertainment Applications

- Audio box.fm - This is used to store, manage and stream our media library online anytime and everywhere. It also provides integrations with a lot of third party services, such as YouTube, Dropbox, Twitter and Facebook [7] [8].

## VII. RISKS RELATED TO CLOUD COMPUTING

Although cloud Computing is a promising innovation with various benefits in the world of computing but it comes with the following risks.

- **Security and Privacy** - This is the biggest concern about cloud computing. Since third-party provides the infrastructure management and data management in cloud, it is always a risk to handover the sensitive information to cloud service providers. Although the cloud computing vendors ensure highly secured password protected accounts, any type of security breach may result in loss of customers and businesses.
- **Vendor Lock In** - To switch from one Cloud Service Provider (CSP) to another is difficult for the customers. It results in dependency on a specific CSP for service.
- **Isolation failure** - Multi-tenancy and shared resources are define the characteristics of public cloud computing. This type of risk includes the failure of mechanisms separating the usage of storage, memory, routing and even reputation between tenants.

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- **Account hijacking** - Account hijacking is a major risk in cloud computing. It is the process in which individual user's or organizations cloud account like e-mail account, social media account is stolen by hackers.
- **Data Breach** – Data breach is the process in which the confidential information is accessed or stolen by third party without any authorization.
- **Incomplete data deletion**– Sometime the termination of an agreement with the cloud service provider produces the incomplete deletion of the customer data. Backup copies of exist data may be mixed on the same media with other customer data so it create a problem.
- **Service unavailability** - This could be caused by hardware, software or communication network failures [9].

### VIII. CONCLUSION

In recent past years, Cloud computing is getting more and more popularity day by day. Today World depends on Cloud computing to store their public as well as personal information. Nowadays Cloud computing becomes the requirement for every user because it provides virtualized computing, storage, and networking resources, over the Internet in a dynamic way. These cloud resources are easier to manage, cheaper and more flexible than sets of local, physical ones. Cloud computing can play a major role in data transfer and communication efficiently so it is preferred for many applications.

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