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Cloud Computing Characteristics and Services: A Brief Review

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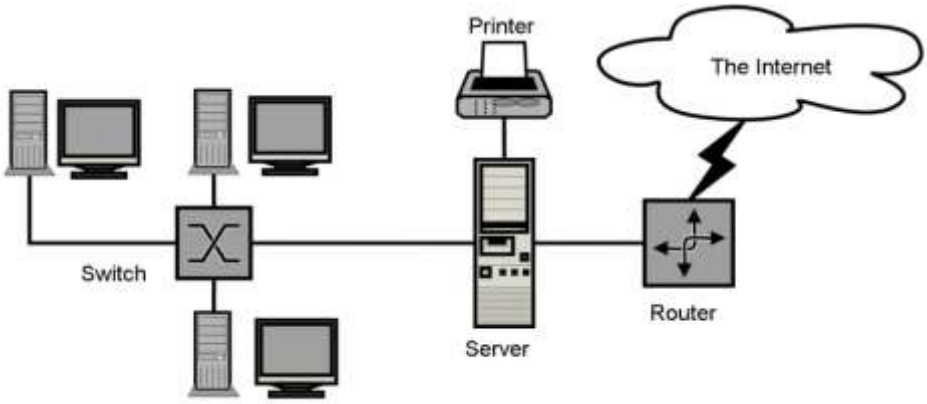
Abstract –

In a wide range of applications, cloud computing may offer enterprises and individuals dependable, specialised, and affordable services. This paper explains how. We have explored several cloud computing services, applications, and characteristics in this paper; we provide examples of the most popular cloud services. Google, Microsoft, and Amazon are popular Cloud Service Providers (CSPs). Additionally, we talked about cloud computing, benefits of service models.

KEYWORDS – Cloud Computing, Virtualization, Data recovery, E-Governance, Service provider.

INTRODUCTION

In plain English, cloud computing refers to the process of storing and accessing data and software over the Internet as opposed to our computer's hard drive. The Internet can b compared to a cloud. In a computer network, the internet is typically represented as a cloud, as in the figure.



Utilizing hardware and software to deliver a service through a network is known as cloud computing (typically the Internet).

Users of cloud computing can access data and use applications from any computer or device that has Internet connectivity.

Google's Gmail is an illustration of a cloud computing provider.

(Cloud computing as defined by NIST) A shared pool of reconfigurable computing resources (such as networks, servers, storage, applications, and services) that can be quickly provisioned and released with little management work or service provider interaction is made possible by the cloud computing model. Three service models, four deployment models, and five key characteristics make up this cloud model. [1]

Cloud service providers (CSPs), such as Google, Microsoft, and Amazon, are businesses that offer their clients access to cloud computing resources and services that are dynamically used in response to client demand [2]. Customers can access online services in many different fields, including business, education, and governance, using a web browser, while data and software are kept on cloud servers housed in data centres [3].

In the field of IT, cloud computing has achieved a significant breakthrough. Its appearance has genuinely altered the IT industry. It has been crucial in meeting the growing demand for infrastructure and storage. The capacity of cloud to deliver resources like hardware and software through a network is a remarkable capability. Numerous cloud computing resources are available and can be hired on a pay-per-use basis. We can broadly categorise the cloud as [4]

1. **Private cloud:** such as those used by a single organisation, are one example of this type of cloud.

2. **Public cloud:** Public clouds from Google, Amazon, Microsoft, etc. are readily available. Any enterprise or the general public can access infrastructure and services via public clouds. Hundreds or thousands of people share resources.
3. **Community cloud:** Services and infrastructure are offered to organisations with comparable interests in a community cloud.
4. **Hybrid cloud:** These clouds combine elements of both private and public clouds. Even though the clouds are mingled together, each one still has a distinct identity, helping numerous deployments.

Table 1: Comparison of Cloud Computing Service Models

MODEL	SCOPE	MANAGED BY	SECURITY LEVEL
Public Model	General public and industries	Cloud service providers	Low
Private Model	General public and industries	Single organization	High
Community Model	Organizations having similar policies and same security concerns	Many organizations or cloud service providers	High
Hybrid Model	Public and organization	Public and organization	Medium

Some common Cloud Service Providers

1. Google: This is a pure cloud computing service that uses online storage for all of its data so that Google Docs, Google Sheets, and Google Slides can be used. In fact, the majority of Google's services—including Gmail, Google Calendar, Google Maps, Picasa, Google Analytics, and others—could be categorised as cloud computing.
2. Apple's cloud service, iCloud, is largely used for online backup, synchronisation, and storage of your mail, contacts, calendar, and other data. The information we require is still accessible on an iOS, Mac OS, or Windows device.
3. Amazon Cloud Drive: If you have Amazon Prime, you get unlimited image storage. The big retailer's storage is primarily for music, preferably MP3 that you buy from Amazon, and images. In essence, it serves as storage for any digital items you purchase from Amazon and is incorporated into all of its goods and services.

I. CLOUD COMPUTING TECHNOLOGY

A microprocessor or a cell phone are examples of discrete pieces of technology; cloud computing is not. Instead, it's a system that essentially consists of three services: platform as a service, software as a service, and infrastructure as a service (IaaS) (PaaS).

Technology companies are increasingly accessing informational technology infrastructure, such as software and hardware resources, through the use of cloud computing. Utilizing services managed by outside companies is made possible for businesses by cloud technology. Systems for cloud computing are especially well-established for commercial or academic uses. Businesses can work more productively and spend less on the hardware and software necessary to run various operations thanks to cloud computing [5].

Businesses can use cloud computing to expand their IT capabilities without having to hire more staff, buy more software, spend more on training, or build new infrastructure.

II. CLOUD COMPUTING SERVICE MODELS

The following list includes the fundamental cloud computing models:

A) Infrastructure as a Service (IaaS)

In Infrastructure as a Service (IaaS), the cloud service provider offers a collection of virtualized computer resources including CPU, Memory, OS, and Application Software etc. Virtualization technology [6] is used by IaaS to transform physical resources into logical resources that customers can dynamically provision and release as needed. Rackspace Cloud Servers, Google, Amazon EC2, IBM, and Verizon are some of the well-known businesses that provide infrastructure as a service.

Benefits of IaaS Solutions

- Reduces cost of capital expenditures.
- Users pay for the service they want.
- Access to enterprise-grade IT resources and infrastructure.
- Users can scale up and scale down the resources based on their requirements at any time.

B) Platform as a Service (PaaS)

This type of cloud computing service is more sophisticated. In PaaS, a cloud service provider provides, manages, and runs additional computing resources as well as system software (i.e., the operating system). PaaS services cover application design, development, and hosting. Collaboration, DB integration, security, web service integration, scaling, and other services are also provided. Users are not required to manage their own hardware and software resources or to employ professionals to do so. This system offers flexibility in how software is installed on the system, and PaaS is also scalable. The lack of interoperability and portability among providers is a drawback of PaaS.

Customers can deploy their own software and apps in the cloud by purchasing access to the platforms.

PaaS examples include Microsoft Azure, Google App Engine, and Rackspace Cloud Sites from Salesforce.com.

Benefits of PaaS Solutions

Community - Creating cloud applications in PaaS environments typically involves a large number of people. This builds a solid, encouraging community that can support your development team on its journey.

Upgrading of infrastructure software is no longer needed of businesses. Instead, all software updates, patches, and regular maintenance are handled by the PaaS provider.

Less expensive - Companies take on less risk since they don't need to invest money in hardware and software up front.

Simplified deployment - Without having to worry about the infrastructure for testing and deployment, the development team can focus on creating the cloud application.

C) Software as a Service (SaaS)

In this arrangement, operating systems, application software, and other resources are managed and updated by cloud service providers. When a consumer uses a web browser to access services delivered via the internet, they see the SaaS model as a web-based application interface. Mobile phones, PCs, and other devices can all be used to access hosted services like Gmail and Google Docs. SaaS provides the benefit of not requiring the consumer to purchase licences, install, upgrade, maintain, or use software on his own computer [7]. Additionally, it has other benefits including multitenant effectiveness, configurability, and scalability [8].

Benefits of SaaS Solutions

- Rapid Scalability
- Accessibility from any location with Internet
- Eliminates infrastructure concerns
- Custom levels of service offerings
- Bundled maintenance and Support

D) Recovery as a Service (RaaS)

Companies can replace their backup, archiving, disaster recovery, and business continuity solutions with a single, integrated platform by using recovery as a service (RaaS) solutions. Companies can recover entire data centres, servers (OS, applications, configuration, and data), and database files with the aid of RaaS providers.

RaaS assists commercial buildings in lessening the effects of downtime in the event of disasters or similar circumstances. Disaster Recovery as a Service, or DRaaS, is another name for RaaS. Examples of firms that offer RaaS include WindStream Business, Geminare, and others.

Benefits of RaaS Solutions

- Prevent temporary or permanent loss of critical company data.
- Prevents permanent loss of physical infrastructure, including IT infrastructure.
- Cost-effective way of recovering data.
- Enables faster recovery while maintaining accuracy.
- Offer greater flexibility on the type of backup required (either primary or secondary backup)

By increasing productivity and cutting costs, cloud services can help businesses. Different businesses can adopt various cloud services, business processes, and areas of expertise depending on their priorities. Before utilising cloud services for an IT project, careful planning and preparation should be used.

III. CHARACTERISTICS OF CLOUD COMPUTING

Systems for cloud computing meet a number of intriguing criteria that make them viable for upcoming IT services and applications. Five key features for cloud computing systems have been identified by the National Institute of Standard and Technology (NIST) [9], and we discuss them below**.**

• **On-demand self-service:** Cloud services including CPU time, storage, network access, server time, and web applications, among others, can be automatically allocated as needed by the users without requiring human input.

• **Cost effectiveness:** The cloud service providers offer very affordable, if not free, services. Pay as you go billing eliminates the need to purchase infrastructure, which lowers maintenance costs.

• **Broad Network Access (mobility):** Customers can access cloud resources via the Internet constantly and from any location (i.e., ubiquitously) via a variety of devices (e.g., mobile phones, laptops, and PDAs)

• **Resource Pooling:** The cloud combines physical and virtual computing resources. In the sense that the customer has no control over or knowledge of their location, these resources are not location-dependent.

• **Rapid Elasticity:** Depending on consumer demand, computing resources can be quickly and elastically allocated and released. These resources are viewed by consumers as boundless and available for purchase at any time in any quantity.

• **Measured Services:** The CSPs use a pay-per-use business model to monitor, regulate, and optimise cloud resources and services. Consumers use these services in a similar way to how they use gas, water, and electricity. Other characteristics of cloud computing include [15, 16]:

• **Multitenancy:** A cloud offers services to numerous users simultaneously. Each of those users is segregated within a unique virtual application instance while sharing network, host, and application resources in the cloud**.**

• **Scalability**: The cloud's infrastructure is highly scalable. With only minor adjustments to the cloud infrastructure and software, cloud providers can add new nodes and servers.

• **Reliability:** Redundancy in cloud computing is accomplished by using numerous redundant sites. The cloud is an ideal alternative for business-critical processes and disaster recovery because of its high reliability.

• **Economies of scale:** in order to benefit from

Using scale economies, clouds are made to be as big as possible.

the maximum. Other factors are taken into account as well.

reducing costs by placing the cloud near inexpensive power plants

and in affordable housing.

• **Customization:** a cloud is a reconfigurable environment that can be customized and adjusted in terms of infrastructure and applications based on user demand.

• **Efficient resource utilization:** It is possible to efficiently use resources by only providing them for as long as they are required.

- **Virtualization:** Cloud computing enables users to access services from any type of terminal, anywhere. It needed resources from the cloud rather than a visible entity. Using a laptop or a mobile phone with internet service, you can accomplish anything you want. Users can access or share it securely at any time or location using a simple method. A task that cannot be completed by a single computer can be completed by users.

V. APPLICATIONS OF CLOUD COMPUTING

Because resource sharing and management are made simple utilising the cloud, cloud computing is one of the most important areas of internet computing. As a result, the following areas are important for cloud computing:-

A. **E-Learning** As far as education is concerned, this field offers faculty, researchers, and students an inviting environment. Researchers, faculty members, and students can connect to their organization's cloud and access data and information there.

B. **E-Governance** Cloud computing can help the government operate more efficiently. In this way, the various government organisations can supply their services in a better and more complex manner. The hassle of managing, installing, and upgrading apps will be eliminated by cloud computing.

C. **Enterprise resource planning (ERP)** The use of cloud-based ERP technology develops as a company's business expands. The cost and complexity of managing applications, human resources, payroll, etc. increases. ERP can be installed directly in the cloud by service providers to solve such issues.

Table 2: Different applications of cloud computing

APPLICATION	SERVICE DELIVERD
E-Learning	E-mail, simulation tools, files broadcasting, class recording, virtual classrooms, virtual labs, surveys, education forums etc.
E-governance	Complaint resolution system, employee management system, Epolice, E-Tendering, E-court, payment and tax system, agriculture and food, industry and energy etc.
ERP Cloud	Supply chain and vendor, project and HR Management, customer Relationship management, finance and accounting etc.

IV. CLOUD COMPUTING CHALLENGES

Cloud computing concerns are still a problem despite its rising significance. A few typical difficulties are:

A) Data Protection Data security is an important factor that should always be taken into account. Businesses are hesitant to pay a vendor for a guarantee of business data security. They worry about losing data to rival businesses and about customer privacy. The fact that the actual storage location is frequently kept a secret raises additional security issues for organisations. In the current models, firewalls between data centres (owned by businesses) guard this sensitive data. Enterprises would have to rely on service providers, who bear a heavy share of responsibility for data security under the cloud model.

B) Data Recovery and Availability Service level agreements (SLAs) are included for all business applications and are closely adhered to. Operational teams are crucial to the administration of service level agreements and application runtime governance. Production environments are supported by operational teams, which:

- Data Replication
- Appropriate clustering and Fail over
- System monitoring (Transactions monitoring, logs monitoring and others)
- Disaster recovery
- Capacity and performance management
- Maintenance (Runtime Governance)

A data disaster may result if one of the aforementioned services is not adequately provided for by a cloud provider.

Management Capabilities Despite the fact that there are numerous cloud providers, infrastructure and platform management are still in their infancy. For many businesses, features like dynamic resource allocation and dynamic scaling are essential. The scalability and load balancing features currently offered have a lot of room for improvement.

Regulatory and Compliance Restrictions Government rules in various European nations prohibit the physical storage of customers' personal information or other sensitive data outside of the state or nation. Cloud providers must build up a data centre or a storage facility only within the nation to comply with laws in order to achieve these requirements.

It may not always be possible to have such an infrastructure, which is a significant hurdle for cloud providers.

With cloud computing, the focus shifts to the interface, namely the interface between various groups of service users and service providers. When it comes to distributed services, procurement, risk assessment, and service negotiation, cloud services will require knowledge that many businesses lack.

VII. CONCLUSION AND FUTURE WORK

In the coming years, the IT industry is anticipated to undergo a significant transition due to the rising technology of cloud computing. Due to the Cloud's many fascinating and promising properties, services, and applications, a wide range of applications and services can be offered there. We examined a few of these features, services, and applications in this paper, and we are confident that many more will be examined in the near future. Our study enables them to comprehend the effects of these services on their businesses. However, cloud computing technology is not without risks and concerns. As a result, it is anticipated that many organisations and individuals from various disciplines will be drawn to cloud services and applications. Concerns about security and privacy continue to be the main factor preventing widespread use of cloud computing. Future work in cloud computing will undoubtedly centre on creating different strategies that can address its security issues. In our upcoming work, we'd like to address the issue of cloud computing security and try to suggest a framework and security model that would address security threats and reduce risks related to cloud computing.

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