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CLOUD COMPUTING

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Abstract

"Cloud" is a collective term for a large number of developments and possibilities. It is not an invention, but more of a "practical innovation", combining several earlier inventions into something new and compelling. Much like the iPod is comprised of several existing concepts and technologies (the Walkman, MP3 compression and a portable hard disk), cloud computing merges several already available technologies: high bandwidth networks, virtualization, Web 2.0 interactivity, time sharing, and browser interfaces. Cloud Computing is a popular phrase that is shorthand for applications that were developed to be rich Internet applications that run on the Internet (or "Cloud"). Cloud computing enables tasks to be assigned to a combination of software and services over a network. This network of servers is the cloud. Cloud computing can help businesses transform their existing server infrastructures into dynamic environments, expanding and reducing server capacity depending on their requirements. A cloud computing platform dynamically provisions, configures, reconfigures, and deprovisions servers as needed. Servers in the cloud can be physical machines or virtual machines. Advanced clouds typically include other computing resources such as storage area networks (SANs), network equipment, firewall and other security devices.

CLOUD COMPUTING

1. Introduction

Nowadays, **Cloud computing** is adopted by every company, whether it is a MNC or a startup and many are still migrating towards it because of the cost-cutting, lesser maintenance, and the increased capacity of the data with the help of servers maintained by the cloud providers.

One more reason for this drastic change from the On-premises servers of the companies to the Cloud providers is the **'Pay as you go**' service provided by them i.e., you only have to pay for the service which you are using. The disadvantage On-premises server holds is that if the server is not in use the company still has to pay for it.

2. What is Cloud Computing?

Cloud computing means storing and accessing the data and programs on remote servers that are hosted on the internet instead of the computer's hard drive or local server. Cloud computing is also referred to as **Internet-based computing**, it is a technology where the resource is provided as a service through the Internet to the user. The data which is stored can be files, images, documents, or any other storable document.

Some operations which can be performed with cloud computing are –

- Storage, backup, and recovery of data
- Delivery of software on demand
- Development of new applications and services
- Streaming videos and audio

3. Cloud Computing Architecture:

Cloud architecture is the way technology components combine to build a cloud, in which resources are pooled through virtualization technology and shared across a network. The components of a cloud architecture include:

- A front-end platform (the client or device used to access the cloud)
- A back-end platform (servers and storage)
- A cloud-based delivery model
- A network

Together, these technologies create a cloud computing architecture on which applications can run, providing end-users with the ability to leverage the power of cloud resources. A Cloud computing system is composed of two sides. These two sides are known as the **Front End and the Back End**, and they are connected to each other usually through the internet.

Here, the front end represents the user side and the back end acts as the "cloud" section of the system. The client's computer, along with the application required to access the cloud computing system forms the front end. This end is an interface that is visible to all computer users or clients through their web-enabled client devices.

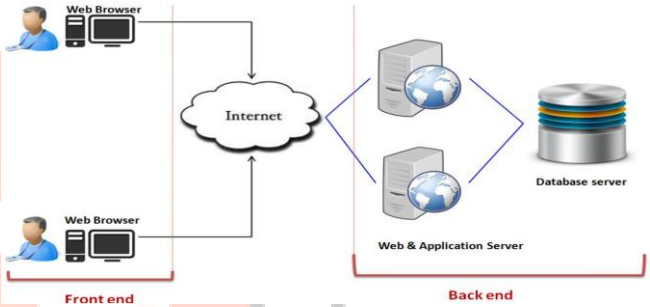

Figure 1: Cloud Architecture

Whereas the back end of the system is where, various computers, servers, and data storage systems that create the "cloud" of computing services reside. Also, there exists a central server that takes care of system administration, traffic monitoring, and client demands to ensure everything is running in an efficient and smooth manner. Apart from this, it adheres to a set of rules called protocol and makes use of Cloud middleware.

4. Characteristics of Cloud Computing

There are many characteristics of Cloud Computing here are few of them :

- ✓ **On-demand self-services:** The Cloud computing services does not require any human administrators, user themselves are able to provision, monitor and manage computing resources as needed.
- ✓ **Broad network access:** The Computing services are generally provided over standard networks and heterogeneous devices.

- ✓ **Rapid elasticity:** The Computing services should have IT resources that are able to scale out and in quickly and on as needed basis. Whenever the user require services it is provided to him and it is scale out as soon as its requirement gets over.
- ✓ **Resource pooling:** The IT resource (e.g., networks, servers, storage, applications, and services) present are shared across multiple applications and occupant in an uncommitted manner. Multiple clients are provided service from a same physical resource.
- ✓ **Measured service:** The resource utilization is tracked for each application and occupant, it will provide both the user and the resource provider with an account of what has been used. This is done for various reasons like monitoring billing and effective use of resource.
- ✓ **Multi-tenancy:** Cloud computing providers can support multiple tenants (users or organizations) on a single set of shared resources.
- ✓ **Virtualization:** Cloud computing providers use virtualization technology to abstract underlying hardware resources and present them as logical resources to users.
- ✓ **Resilient computing:** Cloud computing services are typically designed with redundancy and fault tolerance in mind, which ensures high availability and reliability.
- ✓ **Flexible pricing models:** Cloud providers offer a variety of pricing models, including pay-per-use, subscription-based, and spot pricing, allowing users to choose the option that best suits their needs.
- ✓ **Security:** Cloud providers invest heavily in security measures to protect their users' data and ensure the privacy of sensitive information.
- ✓ **Automation:** Cloud computing services are often highly automated, allowing users to deploy and manage resources with minimal manual intervention.
- ✓ **Sustainability:** Cloud providers are increasingly focused on sustainable practices, such as energy-efficient data centers and the use of renewable energy sources, to reduce their environmental impact.

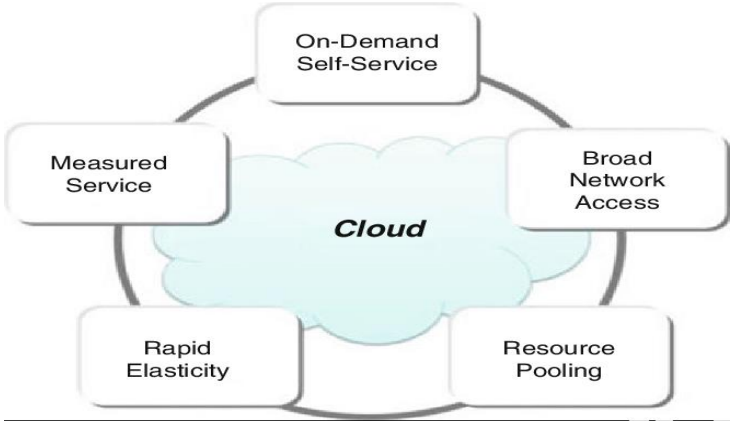

Figure 2: Characteristics of Cloud

5. Cloud deployment models

When adopting cloud architecture, there are three different types of cloud deployment models that help deliver cloud computing services: public cloud, private cloud, and hybrid cloud.

- ➢ **Public Cloud:** Public clouds deliver resources, such as compute, storage, network, develop-and-deploy environments, and applications over the internet. They are owned and run by third-party cloud service providers like Google Cloud.

- ➢ **Private Cloud:** Private clouds are built, run, and used by a single organization, typically located on-premises.

- ➢ **Types of cloud services:**

  Cloud Computing services are deployed broadly in three business models viz. SaaS, PaaS and IaaS.

  - ➢ **Software as a Service (SaaS): In** this service model, consumers purchase the ability to access and use an application or service that is hosted in the cloud. The applications are accessible from various client devices through a thin client interface such as a web browser (e.g., web based email).
  - The consumer does not manage or control the underlying cloud infrastructure including network, servers, operating systems, storage, or even individual application capabilities, with the possible exception of limited user-specific application configuration settings. An example of this is Salesforce.com where necessary

information for the interaction between the consumer and the service is hosted as part of the service in the cloud.

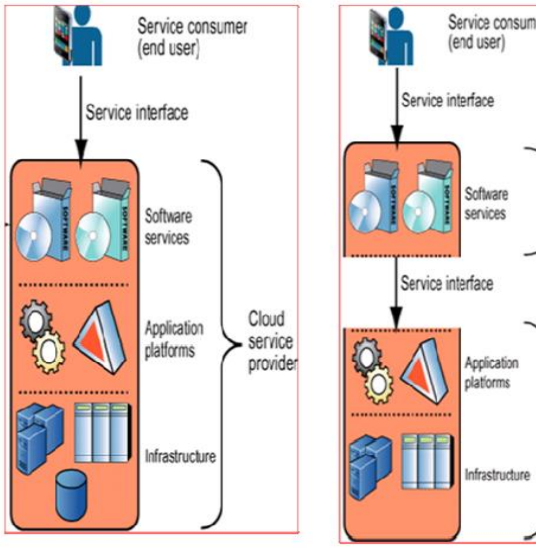

Figure 3 Types of Cloud Service Model

- **Platform as a Service (PaaS)**: In this service model the consumers purchase access to the platforms, enabling them to deploy their own software and applications in the cloud. The consumer does not manage or control the underlying cloud infrastructure including network, servers, operating systems, or storage, but has control over the deployed applications and possibly application hosting environment configurations. In this there might be constraints as to which applications can be deployed. i.e. consumer can deploy applications created using programming languages and tools supported by the provider
- **Infrastructure as a Service (IaaS):** : In this service model the capability provided to the consumer is to provision processing, storage, networks, and other fundamental computing resources where the consumer is able to deploy and run arbitrary software, which can include operating systems and applications. The consumer does not manage or control the underlying cloud infrastructure but has control over operating systems, storage, deployed applications, and possibly limited control of select networking components (e.g., host firewalls

6. Deployment models of Cloud Computing

Cloud Computing deployment has mainly flowing four deployment models from the point of view of architecture, each with specific characteristics that support the needs of the services and users of the clouds in particular ways :

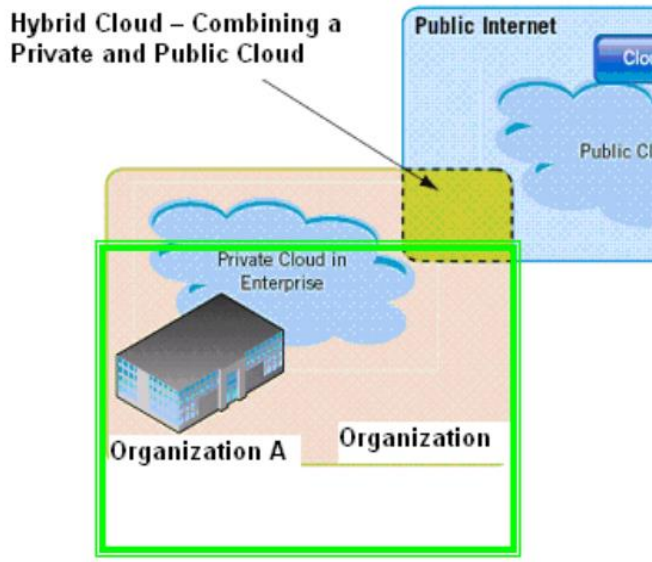

Figure 4 Cloud Deployment Model

- **Private Cloud:** The cloud infrastructure is maintained and operated for a specific organization. It may be managed by the organization or a third party and may exist on premise or off premise.

- **Public Cloud:** The cloud infrastructure is available to the public on a commercial basis by the cloud service provider. A consumer can develop and deploy a service in the cloud with very little financial outlay compared to the capital expenditure requirements normally associated with other deployment options.

- **Hybrid Cloud:** The cloud infrastructure is a composition of two or more clouds (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).

7. Leading Cloud Service Providers

- **Amazon Web Services (AWS):** One of the most successful cloud-based businesses is Amazon Web Services(AWS), which is an Infrastructure as a Service(Iaas) offering that pays rent for virtual computers on Amazon's infrastructure.

- **Microsoft Azure Platform**: Microsoft is creating the Azure platform which enables the .NET Framework Application to run over the internet as an alternative platform for Microsoft developers. This is the classic Platform as a Service **(PaaS).**

- **Google:** Google has built a worldwide network of data centers to service its search engine. From this service, Google has captured the world's advertising revenue. By using that revenue, Google offers free software to users based on infrastructure. This is called Software as a Service **(SaaS).**

- **IBM Cloud** is a collection of cloud computing services for businesses provided by the IBM Corporation. It provides infrastructure as a service, software as a service, and platform as a service.

- **Oracle Cloud** is a collection of cloud services offered by Oracle Corporation, including infrastructure as a service (IaaS), platform as a service (PaaS), and software as a service (SaaS)

- **Alibaba Cloud** is the cloud computing arm of Alibaba Group, providing a comprehensive suite of global cloud computing services to power both their international customers' online businesses and Alibaba Group's own e-commerce ecosystem

8. Areas of Concern

The following are some of the challenges associated with cloud computing which are being addressed or to be addressed for successful and further deployment of cloud services:

- **Security and Privacy:** Security and privacy involving storing and securing data, and monitoring the use of the cloud by the service providers is one of the main concerns. The security mechanisms between organization and the cloud need to be robust.

- **Lack of Standards:** Clouds have no standards associated with interfaces and thus it is unlikely that most clouds will be interoperable. The Open Grid Forum is developing an Open Cloud Computing Interface to resolve this issue and the Open Cloud Consortium is working on cloud computing standards and practices. The findings of these groups will need to mature, but it is not known whether they will address the needs of the people deploying the services and the specific interfaces these services need.

- **Continuously Evolving**: User requirements are continuously evolving, as are the requirements for interfaces, networking, and storage. This means that a "cloud," especially a public one, does not remain static and is also continuously evolving

- **Compliance Concerns:** The Sarbanes-Oxley Act (SOX) in the US and Data Protection directives in the EU are just two among many compliance issues affecting cloud computing, based on the type of data and application for which the cloud is being used. The EU has a legislative backing for data protection across all member states, but in the US data protection is different and can vary from state to state.

9. Conclusion

The application of Cloud computing architecture allows enterprises to achieve more efficient use of their IT hardware and software investments. Pooling resources into large clouds reduces the costs and increases utilization by delivering resources only for as long as those resources are needed. While there are many benefits of cloud computing from economies of scale to acceleration of speed to market, there are also some risks or challenges associated with it.

Some of these are interoperability of clouds, integration of IT and network resources, testing and deploying applications, SLAs, data protection, privacy, security in clouds, regulatory aspects, and software licensing.

10. Glossary

- **MNC -** Multi National Company
- **SaaS -** Software as a Service
- **IaaS -** Infrasructure as a Service
- **AWS -** Amazon Web Services
- **SLA -** Service Level Agreements

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12. List of Figure