

A Survey on Cloud Computing Models and it's Applications

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Abstract - Cloud computing is an Internet and computing based stack model which provides more number of services and resources. These services are accessed through Cloud Service Providers to Cloud Users on-demand basis without buying the underlying infrastructure and follows pay-per-use basis. Cloud computing usage has increased rapidly in many companies. Cloud computing offers many benefits in terms of low cost and accessibility of data. The distribution of resources and services are on web, so this has opened many new ways of providing services, these services are termed as e-services. In this paper we will go through cloud computing services, cloud services models, cloud deployment models and application of cloud computing in different fields. This will help in understanding cloud computing and it's services in a better way. The cloud provides many options for the everyday computer user as well as large and small businesses. It opens up the world of computing to a broader range of uses and increases the ease of use by giving access through any internet connection. The primary business service models (such as SaaS, PaaS and IaaS) and common deployment models employed by service providers and users to use and maintain the cloud services (such as the private, public, community, and hybrid clouds) are we will discussed in this research work. Hence Cloud computing is the well-known technology for scaling of extensive data and complex computation.

Key Words: SaaS, PaaS, IaaS, Cloud Service Providers, Deployment Models, E-Services.

1. INTRODUCTION

Information Technology has always been considered a major point of an every enterprise organizations, from the perspectives of both cost and management. However, the information technology industry has experienced a dramatic shift in the past decade - factors such as hardware commoditization, open-source software, virtualization, workforce globalization, and agile IT processes have supported the development of new technology and business models.

Cloud computing now offers organizations more choices regarding how to run infrastructures, save costs, and delegate liabilities to third-party providers. It has become an integral part of technology and business models, and has forced businesses to adapt to new technology strategies.

Accordingly, the demand for cloud computing has forced the development of new market offerings, representing various cloud service and delivery models. These models significantly expand the range of available options, and task

organizations with dilemmas over which cloud computing model to employ.

Cloud computing is an internet based computing which helps in sharing various processed resources and data to computers and other devices. Cloud computing is one of the booming technologies which provides many services such as, computing, databases, storages, virtual machines, servers, analytics, machine intelligence and many more. Cloud provides these services over internet which makes it scalable and hence helps the enterprises to eliminate the capital expenditure on purchasing hardware for their organizations.

According to NIST [2], Cloud computing is defined as "A model for enabling ubiquitous, convenient or demand network access to a shared pool of configurable computing resources that can be rapidly provisional and related with minimal management effort or service provider interaction." Self-service, Rapid elasticity and scalability, reduced costs, broad network access, increased performance and productivity, reliability, service-oriented, utility-based pricing and resource pooling are some of the known features of cloud. Cloud provides models for using these services for the user.

There are two types of cloud models- Service models and Deployment models. Service models are classified on the basis of the types of services provided by the cloud, whereas Deployment models are classified on the basis of how and by whom the cloud services are used. Service models are broadly classified to three types: IaaS (Infrastructure as a Service), PaaS (Platform as a Service) and SaaS (Software as a Service). These three models are recognized by NIST officially.

There are many other known services by cloud such as MBaaS (Mobile Backend as a Service), DaaS (Data as a Service), MaaS (Monitoring as a Service) etc. Deployment models include public cloud, private cloud, community cloud and hybrid cloud. There are other deployment models for cloud such as Inter cloud, Distributed cloud etc.

Figure 1, depicts the graphical representation of the architecture of cloud computing:

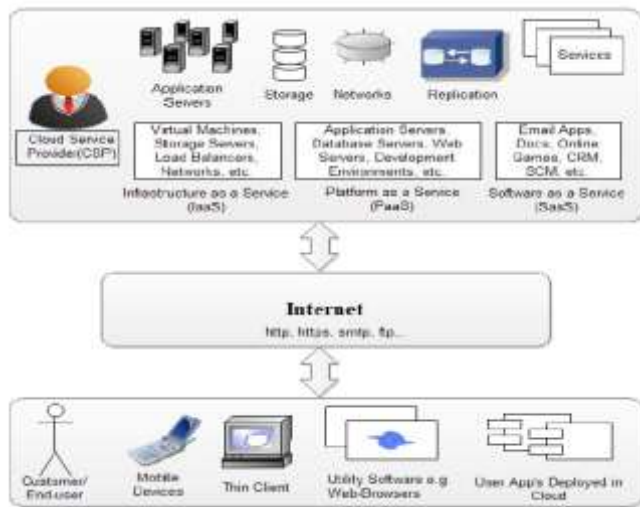


Fig - 1: Cloud Computing Architecture

IaaS stands for Infrastructure as a Service. This service models rents the basic infrastructure facilities such as virtual machines and servers [2]. It is the most basic service provided by the cloud. PaaS stands for Platform as a Service. This service model supplies the required on-demand environment or platform for developing, testing, deploying and maintaining software applications. It is designed to develop and test web and mobile applications easily for the developer. SaaS stands for Software as a Service. This service model provides the facility to host and manage software applications over the internet along with the necessary infrastructure and maintenances such as security and updates for the software application. A public cloud hosts the cloud services over the internet by a third party service provider and is available for public use. A private cloud is used exclusively by a single organization or a business. Hybrid cloud is a combination of both public cloud and private cloud and provides greater flexibility for the organizations. Community cloud is managed by a community or a group of organizations.

1.1 Characteristics of Cloud Computing

The essential characteristics of the cloud computing model were defined by the National Institute of Standards and technology (NIST) and have since been redefined by number of architects and experts. According to NIST, Cloud computing is a model for enabling ubiquitous, 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 interaction.

Although there are many parameters on the basis of which you can characterize a cloud computing environment but five important characteristics of a cloud computing environment are as follows [3],

1.1.1 Universal access

Capabilities are available over the network and accessed through standard mechanism that promotes the use of heterogeneous thin or thick client platform like mobile phones, tablets, laptops etc.

1.1.2 Scalable Services

The infrastructure of the cloud is very elastic to expand with respect to nodes and the services. Cloud providers have the capability to add new nodes in the cloud and adding services for the customers in the cloud.

1.1.3 On-Demand self services

Cloud provides us the capability of consuming computing resources such as server time, network and storage automatically without the interaction of any human being.

1.1.4 Pay-Per-Use scenario

Services provided by the cloud service providers are not free of cost; customers have to pay for accessing and using the services but only for what they use.

1.1.5 Collaboration

Cloud allows many individual organizations to collaborate and work together for finding the solution to a problem or for any research work.

Some other characteristics of cloud are Reliability, customization, measured services, management and virtualization.

2. RELATED WORK

Chinthagunta Mukundha et al[2], proposed and explain about Cloud Computing can be beneficial to all those embryonic businesses which are in the stage of development. The services and deployment models provided by cloud form the basic functionality of cloud. Cloud computing, thus, provides the benefits of resources at economical scale, with flexibility, scalability and multi-tenancy. Cloud can be the platform for executing all the crucial and core business processes.

IlangoSriram et al[8], proposed and explain about Clouds are a large pool of easily usable and accessible virtualized resources (such as hardware, development platforms and/or services). These resources can be dynamically reconfigured to adjust to a variable load (scale), allowing also for optimum resource utilization. Typically these pool of resources exploited by a pay-per-use model in which guarantees are offered by the Infrastructure Provider by means of customized SLAs.

Nitin Kumar et al[3], proposed and explain about Cloud computing is a widely used technology providing many types of services to the customers online on the basis of Pay-Per-

Use mechanism. Different type of cloud deployment models are available for making information available to the customers but each having its own significance depending upon the scope and who is going to use it and hence the security of the deployment models also varies accordingly. However due to the collaborative nature and the heterogeneous environment of cloud many security and privacy issues are dominant issues in cloud. Many cloud service providers like Microsoft, Google and Amazon Web Services have their own cloud environment and provides many significant Cloud services.

Syed Neha Samreen et al[7], proposed and explain about Cloud Computing is a huge scale distributed computing prototype that is manage by economies of scale, in which services are provided on demand over the internet for customers. Central remote servers and Internet are used to maintain application and data in cloud computing. It allows using application without access and installation their personal files on computer with internet access because of which data storage, bandwidth and processing became more efficient.

3. CLOUD SERVICE MODELS

Cloud supports XaaS (Everything as a Service), but offers its services as three major service models recognized as IaaS, PaaS and SaaS [2].

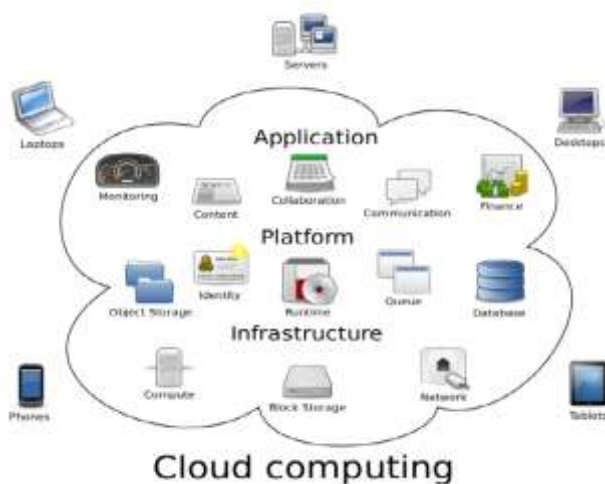


Fig - 2: Cloud Service Models

3.1 Infrastructure as a Service (IaaS)

This service model delivers computer infrastructure as a service. This service is made available as a platform for virtualized machines. Unlike, traditional hardware machines which require special maintenance and limited flexibility, cloud makes these machines easily available virtually on the internet with flexible specifications and improved performance, optimized according to the requirements of the customer.

Developers can run the platforms necessary for their software development and run them. This service also makes it easy for the customer to create instance for his required virtual machine simple and easy. In most of the cloud services provided by various service providers, setting up of virtual machines can be done with no or less cost. Cloud provides this virtualization feature in the form of containers. A direct virtual machine needs a hypervisor on its hardware above the kernel for efficient virtualization whereas containerization doesn't need a hypervisor which saves the processor efficiency and improves its performance. And also, container size is flexible i.e., it can be changed dynamically, hence eliminates over-provisioning. Generally, these virtual machines are installed as a form disk images, object, load balancers or IP addresses which can be dynamically installed on the cloud and also ensure the security of the virtual machine by allotting the virtual instance with a unique host address each time installed. These virtual instances are pre-installed on large pools of equipment called data centres. These virtual machines are billed by the service providers on the utility computing basis.

3.1.1 Virtual Components offered by IaaS:

- Computer Hardware.
- Computer Networks (such as routers, firewalls, load balancers etc.).
- Internet Connectivity (using optical carriers).
- Platform virtualization environment for running client-specified virtual machines.
- Service level agreements.

3.1.2 Benefits of IaaS:

- Readily available environment, customized for client, promotes efficient IT services.
- Maintenance such as software updates, latest versions can be readily available on the internet.
- Reduces the maintenance cost for the hardware which is quite expensive.
- Data stored on the virtual machine is secured and can be recovered in case of any failure of host allocation.
- Can accommodate many virtual instances as per the demand.
- Virtual instances can be rented for machines like servers, operating systems, networks as a fully outsourced service.

3.1.3 IaaS Cloud Service Providers:

- Amazon Elastic Cloud Compute (EC2) service from Amazon Web Services by Amazon.
- Google Compute Engine from Google Cloud Services by Google.
- Windows Azure Virtual Machines from Windows Azure by Microsoft.
- IBM Smart Cloud Enterprise by IBM.
- HP Enterprise Converged Infrastructure from HP.

3.2 Platform as a Service (PaaS)

This service model delivers platforms for building and running web-based applications. It provides all the facilities required to support the complete software development life cycle. This service basically delivers a computing platform for the customer who includes operating system, programming platforms, web servers, databases etc. Since everything is run on internet, there is no need to worry about the infrastructure and minimum requirements for the platform. This model can hence eliminates the worry of incompatibility of software environment on the machine, since hardware specifications required by the platform are met by the cloud service provider directly, thus providing powerful and unlimited computing power. Anyone with an internet connection can now develop powerful and efficient applications without worrying about the infrastructural and cost issues. The traditional on premise models were expensive and complex, which required specific, set of hardware and software specifications. For every problem statement, there is a different business solution, which meant different set of hardware and software specifications. This situation used to force the developers to change the application every now and then. Enormous electricity power was also required to run the hardware. With the entry of PaaS model of cloud, application development became quick, cost effective and efficient. PaaS provides infrastructure along with the workflow facilities required for the software development. It also provides application services for the software development such as security, storage, database integration, instrumentation etc. Another characteristic of PaaS models is the integration of web and mobile applications and services with the databases using Simple Object Access Protocol.

3.2.1 Main Components of PaaS:

- Stack- consisting of all the backend implementation components such as language virtual machine, servers, databases load balancers, caching mechanisms etc.
- Deployment Machinery- consisting of scripts and services for deploying the developed applications on the internet.

- User Experience- consisting of all the frontend components such as user interface, customized abstraction, flexibility to choose the environments and design.

3.2.2 Benefits of Paas:

- Can develop and deploy agile applications.
- Can focus on the important resources for the enterprise without worrying about the cost of infrastructure.
- The platforms provided by a PaaS provider are revised editions which are updated time to time, thus applications can be built using best technologies.
- Maximizes the productivity and minimized the development time.
- Doesn't require the developer to know the backend processes of the platform environment of the cloud.

3.2.3 PaaS Cloud Service providers:

- Google App Engine by Google Cloud services from Google.
- Windows Azure PaaS services by Windows Azure from Microsoft.
- Amazon Elastic BeanStalk by Amazon Web Services from Amazon.
- Openshift by Red Hat from Linux.
- Engine Yard run on Amazon Web Services by Amazon.

3.3 Software as a Service (SaaS)

This service model provides the access to the application services and databases. Cloud providers take care of the infrastructure and platforms required to run the software applications on the Internet. It is sometimes referred to as 'on-demand software', which can be used after paying the subscription fees. In this model, cloud users directly install the subscribed applications on the cloud and directly access the software from their cloud clients. The cloud users need not manage the necessary infrastructure or the platforms required to run the software application. Some of the SaaS applications are Customer Relationship Management (CRM), Enterprise Resource Planning (ERP), accounting and other business software, which are mainly non-core-competency software. Most of the companies today opt for SaaS solutions, which don't require the employee to know the infrastructure, background logics and platform details to run the application. Instead he can just install the application on the cloud and run the application as a browser based service

on the Internet. The present day advancements in cloud make it easier for the customer to use these SaaS applications anywhere at any time. These applications can be used on a web browser or a program interface without having to manage the specifications of the software. These applications have limited user-specific configuration settings which abstract most of the complex background details, making it easier for the user to deploy these applications.

3.3.1 Main Features of SaaS:

- Can manage applications on a strong network and access to licensed software at low costs.
- Follows Multitenancy model.
- Customer specific enhancements of the software.

3.3.2 Benefits of SaaS:

- Easily available software reduces the time required for the application development.
- Increases the availability of the applications globally.
- Data consistency and compatibility across the company/organization/enterprise.
- These applications are scalable and flexible.
- The updated versions of the SaaS software are looked after by the service providers.

3.3.3 SaaS Cloud Service Providers:

- Salesforce CRM from Salesforce.
- Oracle CRM from Oracle On-Demand from Oracle.
- SAP ERP and SAP CRM by SAP Business By Design from SAP.
- SaaS applications and services from Cloud9 Analytics.

4. CLOUD DEPLOYMENT MODELS

There are four major deployment models of cloud recognized by National Institute of Standards and technology (NIST).

4.1 Public cloud

This deployment model of cloud renders all its applications and services available and open to public use, over a network. These services may be free most of the times. The user can meet his needs for little or no cost sometimes. These clouds can be used by anyone, a single user or an organization. Some of the known public clouds are Amazon

Web Services, Google AppEngine, Windows Azure, IBM Blue Cloud, etc.

4.2 Private cloud

This deployment model of cloud is operated by a single organization. It can be managed by the organization itself, or by a third party service provider, located internally or externally. This kind of cloud is preferred by the businesses with dynamic needs and which require direct control to the work environment. Some of the private clouds are Amazon Private Cloud by Amazon Web Services, SUSE Open Stack Private Cloud, etc.

4.3 Community cloud

This deployment cloud is operated by a community of group of organizations which share common concerns such as storage or security. These clouds can also be hosted and managed, both internally and externally. This model of cloud follows multi-tenant infrastructure. Some of the community clouds are Salesforce and QTS DataCenters.

4.4 Hybrid cloud

This deployment cloud is a combination of two or more clouds (public, private or community). In this model, the privacy of the organization along with the availability for multi-tenancy with the ability to connect with other organizations is satisfied. For example, an organization uses a private cloud to store its client-sensitive data, uses community cloud to connect with other similar organizations and uses a public cloud that connect a business intelligence tool to a software application. Some of the hybrid clouds are RackSpace and SoftLayer.com.

Table - 1: Comparison of Cloud Computing Deployment Models

Deployment Model	Scope of Services	Managed by	Security Level
Public model	General public and large industry groups	Cloud service provider	low
Private model	Single organization	Single organization	high
Community model	Organization those share the same policy, mission and same security aspects	Several organization or Cloud service providers	High
Hybrid model	Organization and public	Organization and public	medium

4.5 Other Deployment Clouds

4.5.1 Distributed cloud

If a cloud computing platform is distributed across different locations on different machines, then that kind of cloud model is called distributed model. There are two types of distributed clouds- public resource cloud and volunteer cloud. This model can provide fast and responsive communication services globally.

Inter Cloud

It is known as cloud of clouds. Here each cloud can use the computational capacity and other infrastructure resources of other clouds simultaneously for generating effective and productive solutions. Cisco uses Inter Cloud.

Multi Cloud

It is the use of multiple cloud computing resources under a single heterogeneous architecture. These kinds of clouds are used to minimize the loss of data or any other component in the cloud. This kind of cloud improves overall performance of the cloud.

4.6 Cloud Service Providers

4.6.1 Google

It has become a synonym for the word "search". People are noticed often saying that "Just Google it and you will find everything. But it is not the only thing Google provide as service it also provides us the cloud services like: - G-mail, Google docs, Picasa, Google Analytics, Google Ad words and Ad sense.[3]

4.6.2 Microsoft

It provides its own platform for providing a set of cloud services offered to users and application developers. Services run in Microsoft Data centre. Services provided by Microsoft are: - Windows Azure, SQL Azure, Windows Azure App Fabric and Windows Azure Marketplace.

4.6.3 Amazon Web Services (AWS)

It provides a cloud computing platform for all business sizes. AWS helps business organization to choose their own computing platform as in need of the organization and pay for what they use. Services provided AWS are:- Amazon Elastic compute cloud, Amazon Simple Storage services, Amazon Virtual Private Cloud, Amazon Cloud front, Amazon Relational Database and Amazon Simple Queue services.

5. APPLICATIONS OF CLOUD COMPUTING

Cloud Computing is one of the most dominant field of computing resources online because sharing and management of resources is easy using cloud. These

properties have made it an active component in the following fields as follows,[3]

5.1 E-Learning

It is a new trend in the field of education that provides an attractive environment for students, faculty members, and researchers. Students, faculty members, researchers can connect to the cloud of their organization and access data and information from there.

5.2 Enterprise resource planning (ERP)

Use of Cloud in ERP comes into existence when the business of any organization grows. The work of managing applications, human resources, payroll etc becomes expensive and complex. To overcome it service providers can install ERP in the cloud itself.

5.3 E-Governance

Cloud computing can improve the functioning of a government by improving the way it provides the services to its citizens, institutions and cooperation with other governments. This can be done by expanding the availability of environment, making environment more scalable and customized. It also cut off the burden of managing, installing and upgrading applications.

Table - 2: Different applications of cloud computing

Application	Services provided
E-learning	E-mail, Simulation tools, Files Broadcasting, Class recording, Virtual classrooms, Virtual labs, Surveys, Education forums
ERP Cloud	Supply chain and vendor, Project and HR Management, Customer Relationship Management, Finance and Accounting
E-governance	Complaint resolution system, Employee management system, E-police, E-court, pay

6. CONCLUSION

Cloud computing is expressively leading today's IT enterprises towards achieving their business goals alongside providing utmost customer satisfaction with very lower cost with respect to infrastructure, platforms, and software perspectives. While these infrastructure-related hassles handled by a CSP, cloud service provider, organization needs to completely focus on the service to their customers. Being a user of cloud services from CSP, organizations need not have high technical potential with respect infrastructure and platforms. Whereas, Cloud Service Users need to have expertise on the functionality provisioning/servicing based on their customer requirements. Alongside to its benefits, cloud computing is also comes with various challenges. Many cloud service providers like Microsoft, Google and Amazon

Web Services have their own cloud environment and provides many significant Cloud services. Hence, Cloud can be the platform for executing all the crucial and core business processes.

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BIOGRAPHIES



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