CHAPTER

1

Cloud Computing - Overview

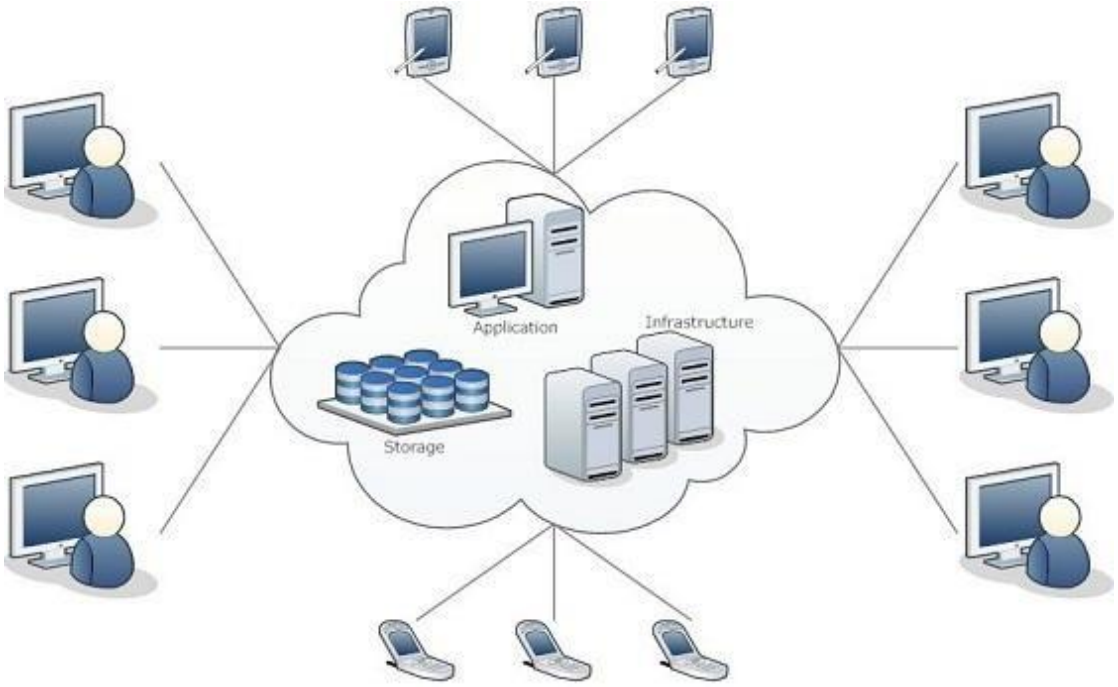
Computing provides us a means by which we can access the applications as utilities, over the Internet. It allows us to create, configure, and customize applications online.

What is Cloud?

The term **Cloud** refers to a **Network** or **Internet**. In other words, we can say that Cloud is something, which is present at remote location. Cloud can provide services over network, i.e., on public networks or on private networks, i.e., WAN, LAN or VPN.
Applications such as **e-mail, web conferencing, customer relationship management (CRM),**all run in cloud.

What is Cloud Computing?

Cloud Computing refers to **manipulating, configuring,** and **accessing** the applications online. It offers online data storage, infrastructure and application.



We need not to install a piece of software on our local PC and this is how the cloud computing overcomes **platform dependency issues**. Hence, the Cloud Computing is making our business application **mobile** and **collaborative**.

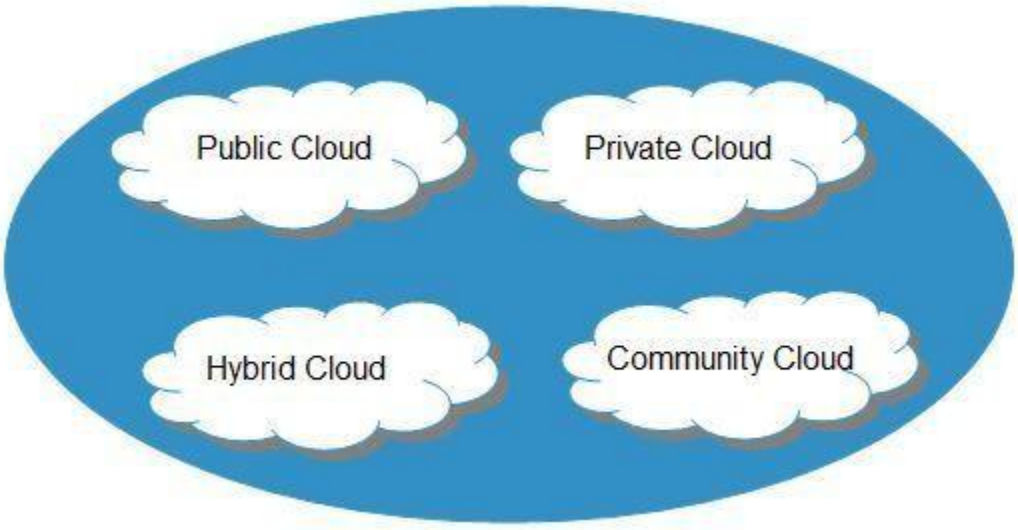
Basic Concepts

There are certain services and models working behind the scene making the cloud computing feasible and accessible to end users. Following are the working models for cloud computing:

- Deployment Models
- Service Models

DEPLOYMENT MODELS

Deployment models define the type of access to the cloud, i.e., how the cloud is located? Cloud can have any of the four types of access: Public, Private, Hybrid and Community.



PUBLIC CLOUD

The **Public Cloud** allows systems and services to be easily accessible to the general public. Public cloud may be less secure because of its openness, e.g., e-mail.

PRIVATE CLOUD

The **Private Cloud** allows systems and services to be accessible within an organization. It offers increased security because of its private nature.

COMMUNITY CLOUD

The **Community Cloud** allows systems and services to be accessible by group of organizations.

HYBRID CLOUD

The **Hybrid Cloud** is mixture of public and private cloud. However, the critical activities are performed using private cloud while the non-critical activities are performed using public cloud.

SERVICE MODELS

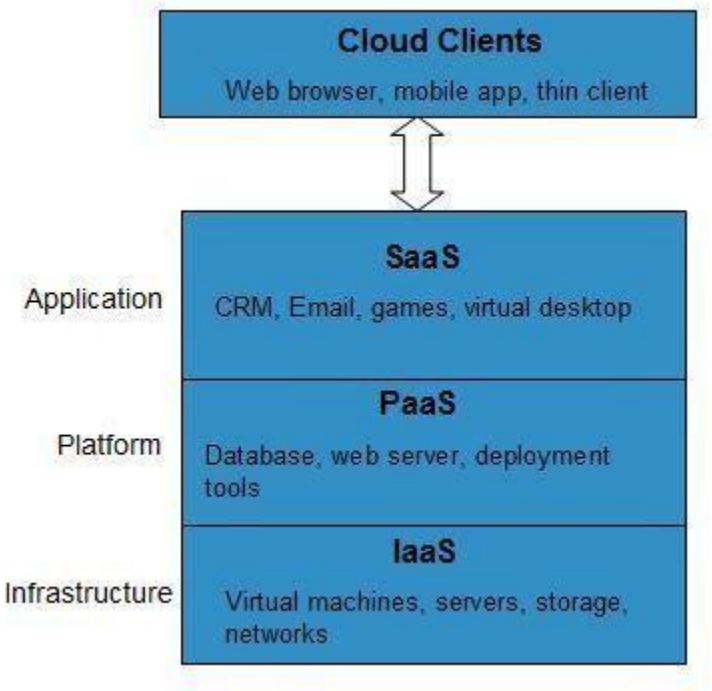
Service Models are the reference models on which the Cloud Computing is based. These can be categorized into three basic service models as listed below:

1. Infrastructure as a Service (IaaS)

2. Platform as a Service (PaaS)

3. Software as a Service (SaaS)

There are many other service models all of which can take the form like **XaaS**, i.e., **Anything as a Service**. This can be **Network as a Service, Business as a Service, Identity as a Service, Database as a Service** or **Strategy as a Service.**
The **Infrastructure as a Service (IaaS)** is the most basic level of service. Each of the service models make use of the underlying service model, i.e., each inherits the security and management mechanism from the underlying model, as shown in the following diagram:



INFRASTRUCTURE AS A SERVICE (IAAS)

IaaS provides access to fundamental resources such as physical machines, virtual machines, virtual storage, etc.

PLATFORM AS A SERVICE (PAAS)

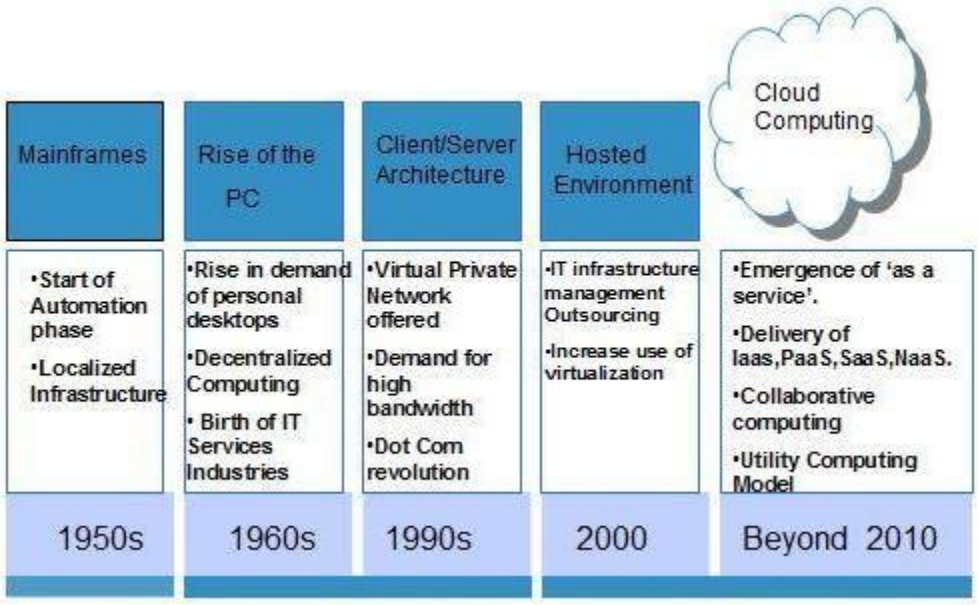
PaaS provides the runtime environment for applications, development & deployment tools, etc.

SOFTWARE AS A SERVICE (SAAS)

SaaS model allows to use software applications as a service to end users.

History

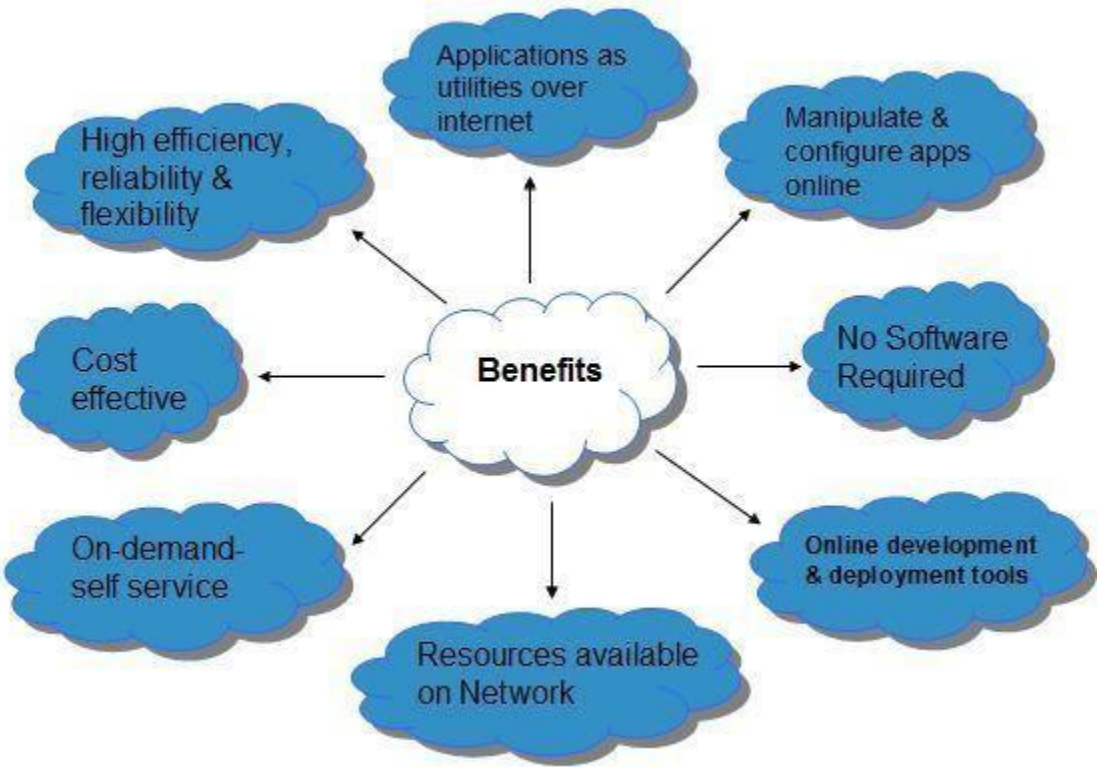
The concept of **Cloud Computing** came into existence in 1950 with implementation of mainframe computers, accessible via **thin/static clients**. Since then, cloud computing has been evolved from static clients to dynamic ones from software to services. The following diagram explains the evolution of cloud computing:



Benefits

Cloud Computing has numerous advantages. Some of them are listed below:

- One can access applications as utilities, over the Internet.
- Manipulate and configure the application online at any time.
- It does not require to install a specific piece of software to access or manipulate cloud application.
- Cloud Computing offers online development and deployment tools, programming runtime environment through **Platform as a Service model**.
- Cloud resources are available over the network in a manner that provides platform independent access to any type of clients.
- Cloud Computing offers **on-demand self-service**. The resources can be used without interaction with cloud service provider.
- Cloud Computing is highly cost effective because it operates at higher efficiencies with greater utilization. It just requires an Internet connection.
- Cloud Computing offers load balancing that makes it more reliable.



Risks

Although Cloud Computing is a great innovation in the world of computing, there also exist downsides of cloud computing. Some of them are discussed below:

SECURITY & PRIVACY

It is the biggest concern about cloud computing. Since data management and infrastructure management in cloud is provided by third-party, it is always a risk to handover the sensitive information to such providers.

Although the cloud computing vendors ensure more secure password protected accounts, any sign of security breach would result in loss of clients and businesses.

LOCK-IN

It is very difficult for the customers to switch from one **Cloud Service Provider (CSP)** to another. It results in dependency on a particular CSP for service.

ISOLATION FAILURE

This risk involves the failure of isolation mechanism that separates storage, memory, routing between the different tenants.

MANAGEMENT INTERFACE COMPROMISE

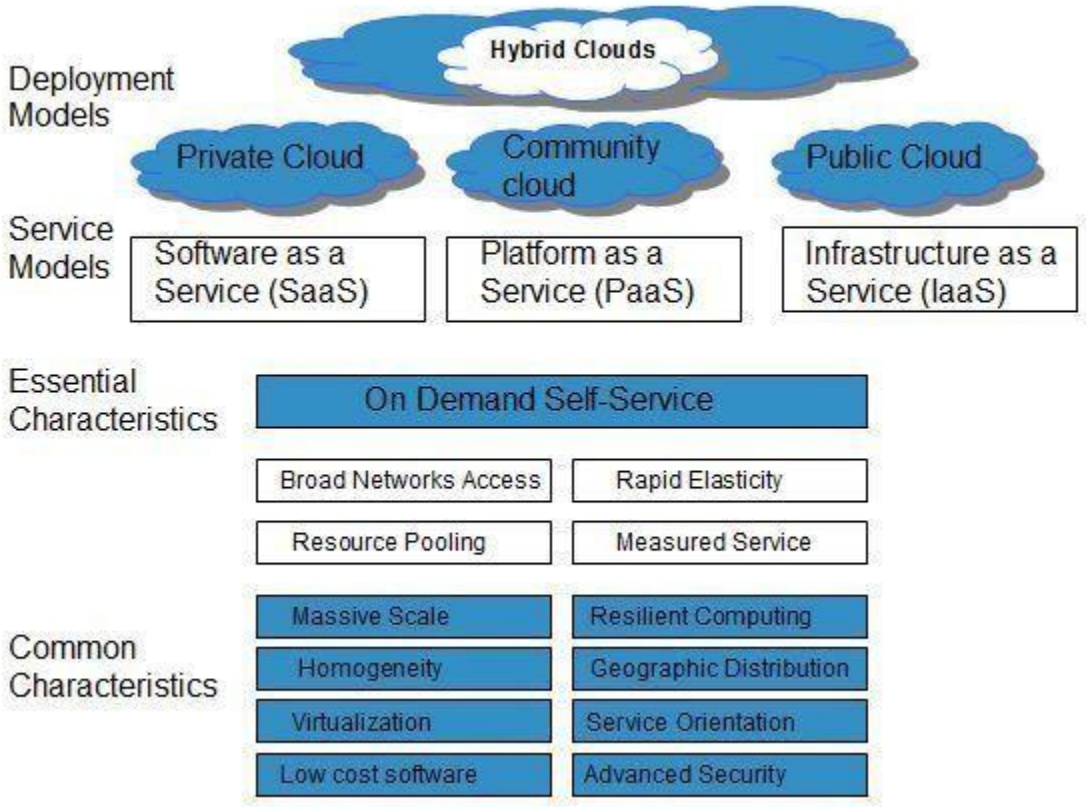
In case of public cloud provider, the customer management interfaces are accessible through the Internet.

INSECURE OR INCOMPLETE DATA DELETION

It is possible that the data requested for deletion may not get deleted. It happens either because extra copies of data are stored but are not available or disk destroyed also stores data from other tenants.

Characteristics

There are four key characteristics of cloud computing. They are shown in the following diagram:



ON DEMAND SELF-SERVICE

Cloud Computing allows the users to use web services and resources on demand. One can logon to a website at any time and use them.

BROAD NETWORK ACCESS

Since Cloud Computing is completely web based, it can be accessed from anywhere and at any time.

RESOURCE POOLING

Cloud Computing allows multiple tenants to share a pool of resources. One can share single physical instance of hardware, database and basic infrastructure.

RAPID ELASTICITY

It is very easy to scale up or down the resources at any time.

Resources used by the customers or currently assigned to customers are automatically monitored and resources. It make it possible

MEASURED SERVICE

Service Models & Deployment Models are described in above section.

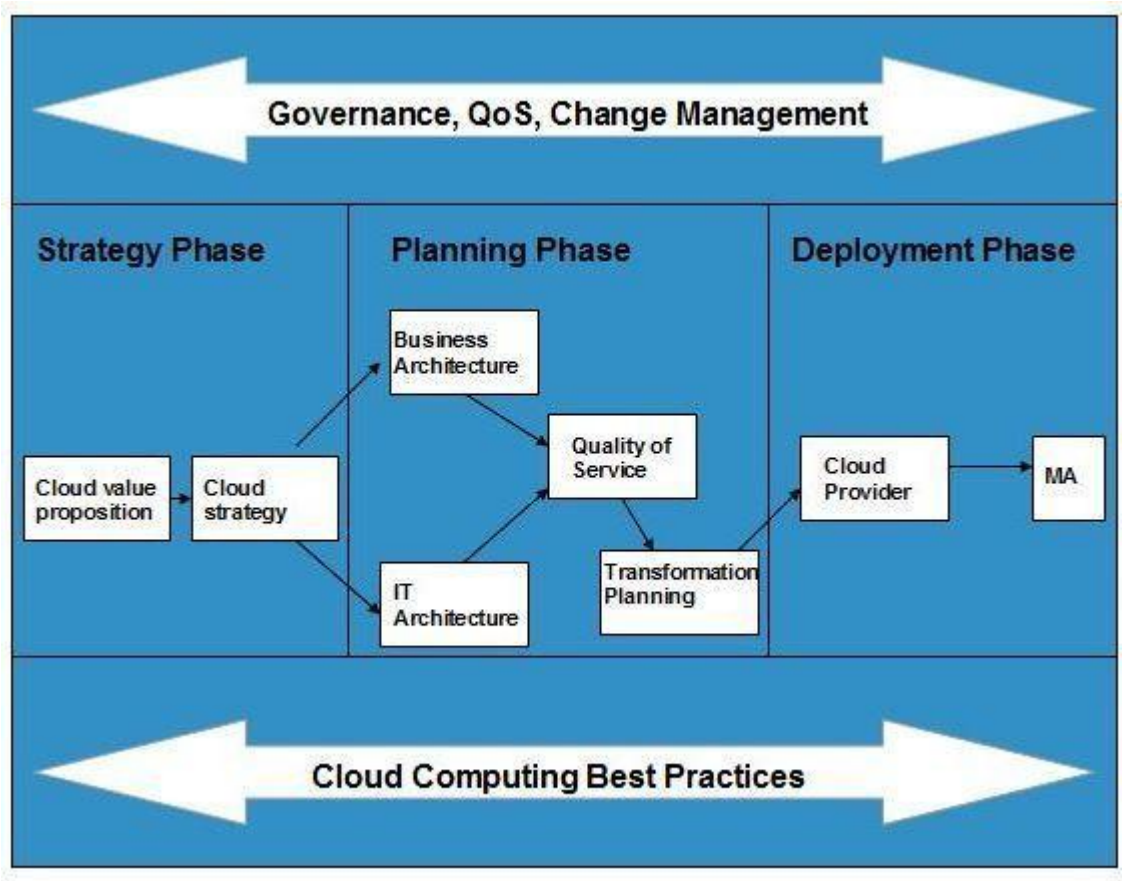
CHAPTER 2

Cloud Computing - Planning

deploying applications to cloud, it is necessary to consider your business requirements. Following are the issues one must have to think about:

- Data Security and Privacy Requirement
- Budget Requirements
- Type of cloud - public, private or hybrid
- Data backup requirements
- Training requirements
- Dashboard and reporting requirements
- Client access requirements
- Data export requirements

To meet all of these requirements, it is necessary to have well-compiled planning. Here in this tutorial, we will discuss the various planning phases that must be practised by an enterprise before migrating the entire business to cloud. Each of these planning phases are described in the following diagram:



Strategy Planning Phase

In this, we analyze the strategy problems that customer might face. There are two steps to perform this analysis:

- Cloud Computing Value Proposition
- Cloud Computing Strategy Planning

CLOUD COMPUTING VALUE PROPOSITION

In this, we analyze the factors influencing the customers when applying cloud computing mode and target the key problems they wish to solve. These key factors are:

- IT management simplification
- operation and maintenance cost reduction
- business mode innovation
- low cost outsourcing hosting
- high service quality outsourcing hosting.

All of the above analysis helps in decision making for future development.

CLOUD COMPUTING STRATEGY PLANNING

The strategy establishment is based on the analysis result of the above step. In this step, a strategy document is prepared according to the conditions a customer might face when applying cloud computing mode.

Cloud Computing Tactics Planning Phase

This step performs analysis of problems and risks in the cloud application to ensure the customers that the cloud computing successfully meet their business goals. This phase involves the following planning steps:

- Business Architecture Development
- IT Architecture development
- Requirements on Quality of Service Development
- Transformation Plan development

BUSINESS ARCHITECTURE DEVELOPMENT

In this step, we recognize the risks that might be caused by cloud computing application from a business perspective.

IT ARCHITECTURE DEVELOPMENT

In this step, we identify the applications that support the business processes and the technologies required to support enterprise applications and data systems.

REQUIREMENTS ON QUALITY OF SERVICE DEVELOPMENT

Quality of Service refers to the non-functional requirements such as reliability, security, disaster recovery, etc. The success of applying cloud computing mode depends on these non-functional factors.

TRANSFORMATION PLAN DEVELOPMENT

In this step, we formulate all kinds of plans that are required to transform current business to cloud computing modes.

Cloud Computing Deployment Phase

This phase focuses on both of the above two phases. It involves the following two steps:

- Cloud Computing Provider
- Maintenance and Technical Service

CLOUD COMPUTING PROVIDER

This step includes selecting a cloud provider on basis of Service Level Agreement (SLA), which defines the level of service the provider will meet.

MAINTENANCE AND TECHNICAL SERVICE

Maintenance and Technical services are provided by the cloud provider. They must have to ensure the quality of services.

CHAPTER

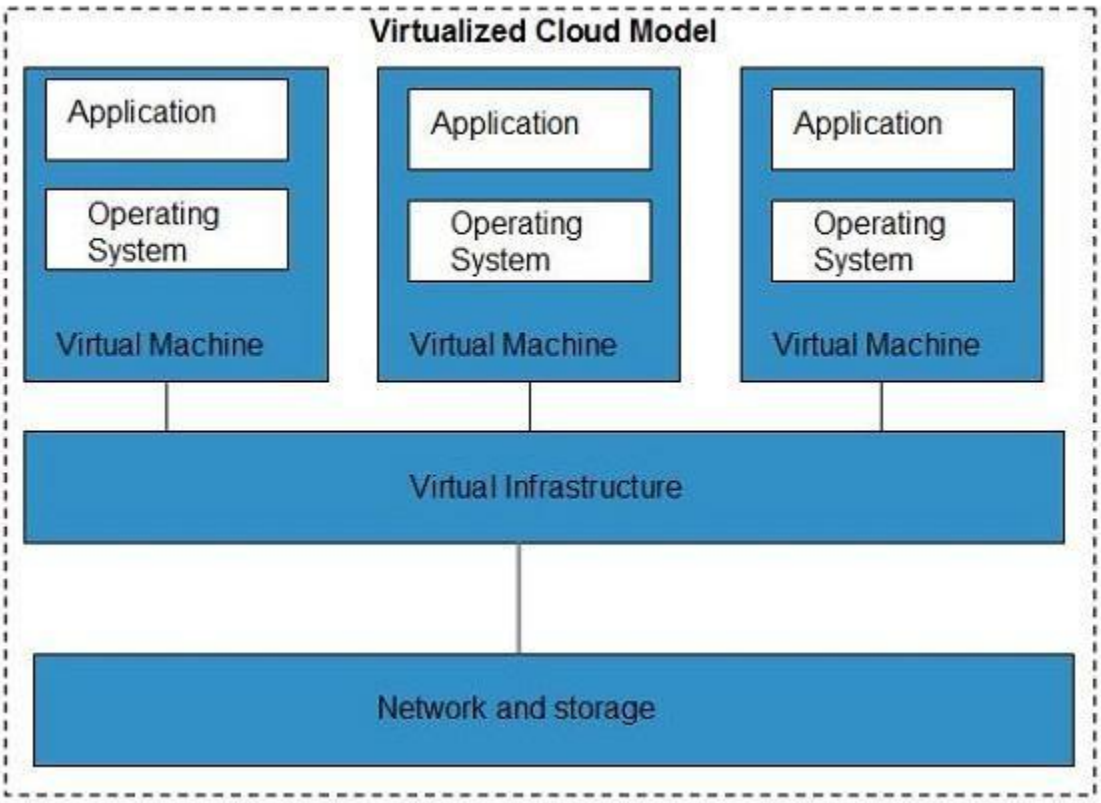
3

Cloud Computing-Technologies

- Virtualization
- Service-Oriented Architecture (SOA)
- Grid Computing
- Utility Computing

Virtualization

Virtualization is a technique, which allows to share single physical instance of an application or resource among multiple organizations or tenants (customers). It does so by assigning a logical name to a physical resource and providing a pointer to that physical resource when demanded.

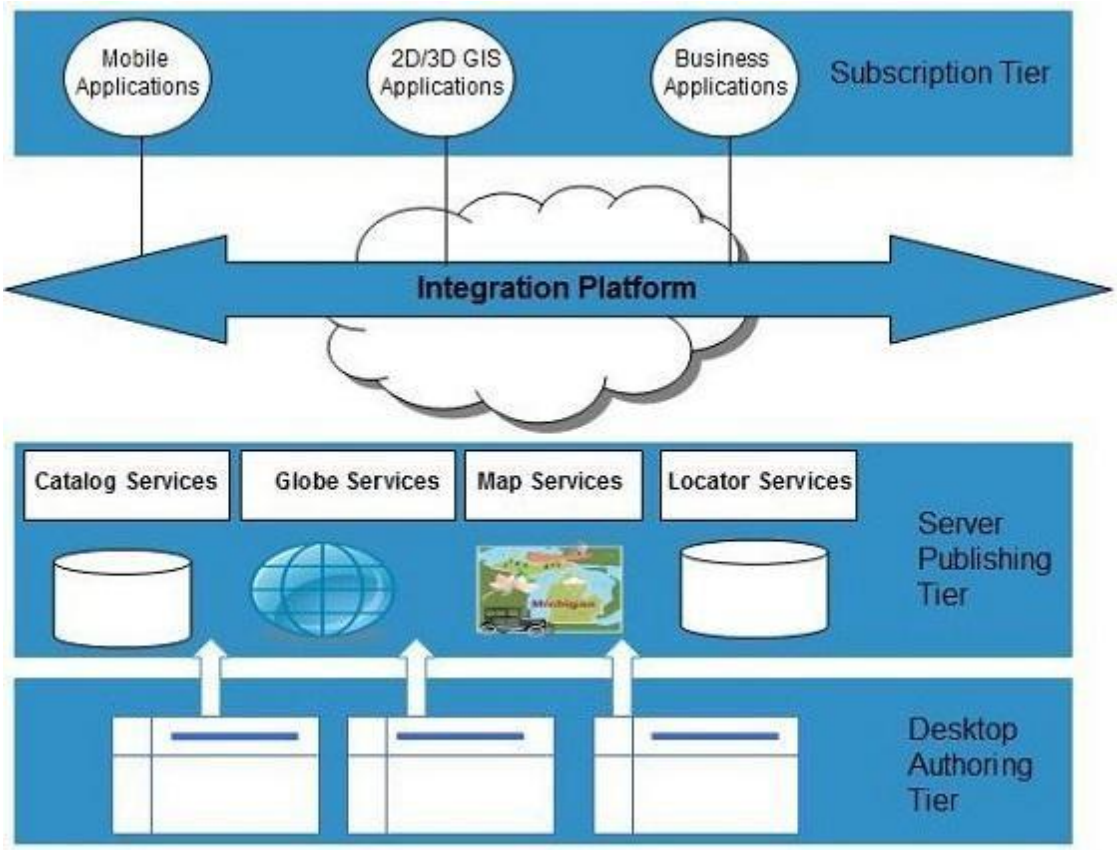


The **Multitenant** architecture offers **virtual isolation** among the multiple tenants and therefore the organizations can use and customize the application as though they each have its own instance running.

Service-Oriented Architecture(SOA)

Service-Oriented Architecture helps to use applications as a service for other applications regardless the type of vendor, product or technology. Therefore, it is possible to exchange of data between applications of different vendors without additional programming or making changes to services.

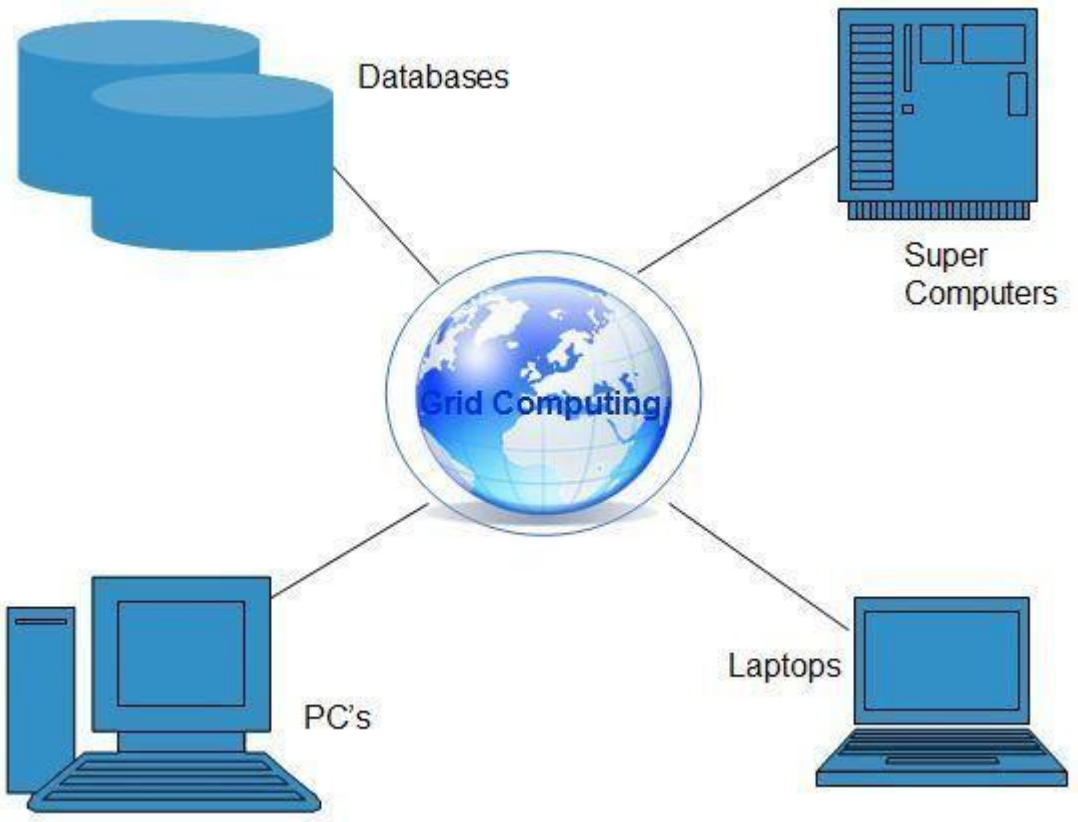
cloud_computing-service_oriented_architecture



Grid Computing

Grid Computing refers to distributed computing in which a group of computers from multiple locations are connected with each other to achieve common objective. These computer resources are heterogeneous and geographically dispersed.

Grid Computing breaks complex task into smaller pieces. These smaller pieces are distributed to CPUs that reside within the grid.



Utility Computing

Utility computing is based on **Pay per Use** model. It offers computational resources on demand as a metered service. Cloud computing, grid computing, and managed IT services are based on the concept of Utility computing.

CHAPTER

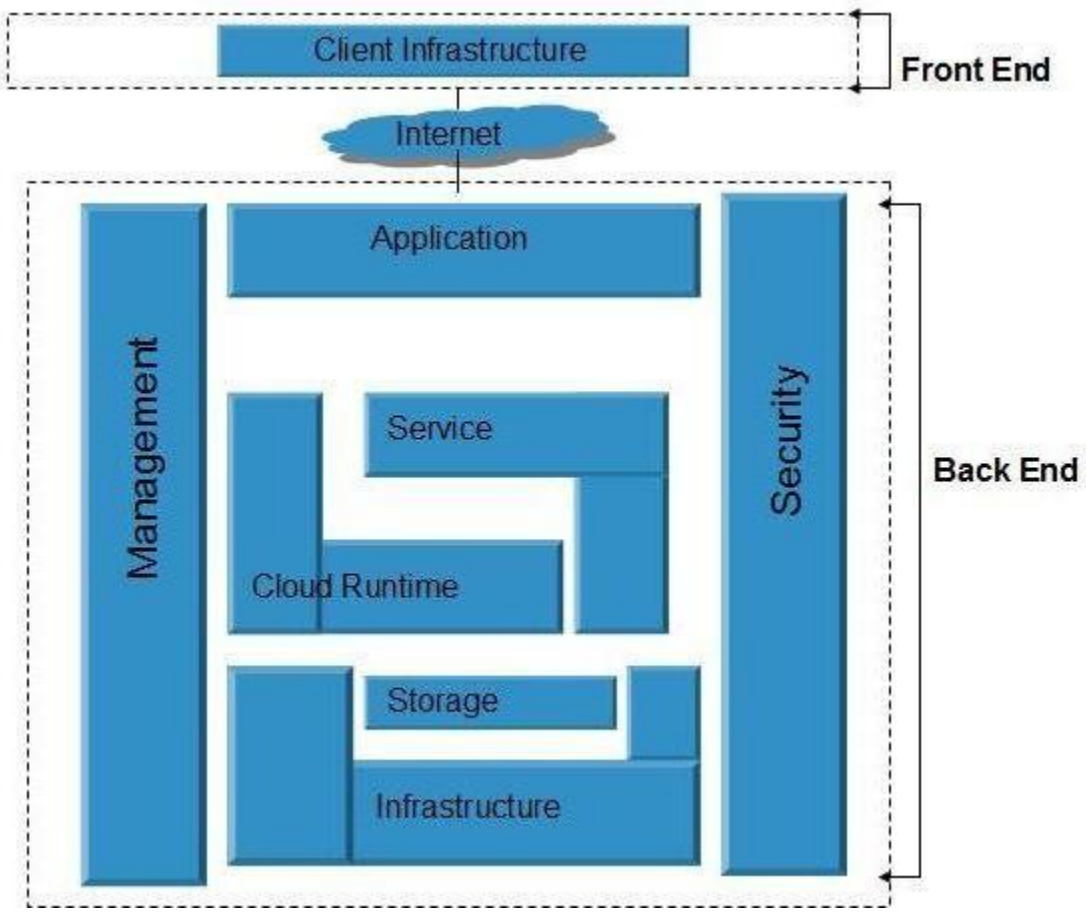
4

Cloud Computing-Architecture

Cloud Computing architecture comprises of many cloud components, each of them are loosely coupled. We can broadly divide the cloud architecture into two parts:

- Front End
- Back End

Each of the ends are connected through a network, usually via Internet. The following diagram shows the graphical view of cloud computing architecture:



FRONT END

Front End refers to the client part of cloud computing system. It consists of interfaces and applications that are required to access the cloud computing platforms, e.g., Web Browser.

BACK END

Back End refers to the cloud itself. It consists of all the resources required to provide cloud computing services. It comprises of huge **data storage, virtual machines, security mechanism, services, deployment models, servers**, etc.

Important Points

- It is the responsibility of the back end to provide built-in security mechanism, traffic control and protocols.
- The server employs certain protocols, known as middleware, helps the connected devices to communicate with each other.

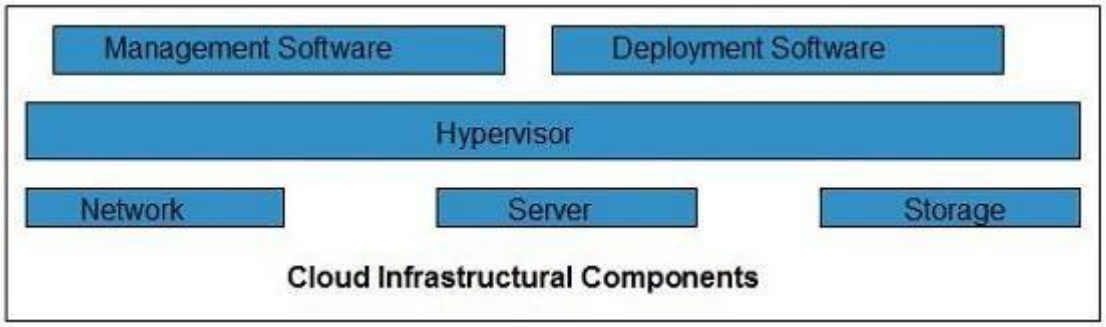
CHAPTER

5

Cloud Computing Infrastructure

Cloud Infrastructure Components

infrastructure consists of servers, storage, network, management software, and deployment software and platform virtualization.



HYPERVISOR

Hypervisor is a **firmware** or **low-level program** that acts as a Virtual Machine Manager. It allows to share the single physical instance of cloud resources between several tenants.

MANAGEMENT SOFTWARE

Management Software helps to maintain and configure the infrastructure.

DEPLOYMENT SOFTWARE

Deployment software helps to deploy and integrate the application on the cloud.

NETWORK

Network is the key component of cloud infrastructure. It allows to connect cloud services over the Internet. It is also possible to deliver network as a utility over the Internet, i.e., the consumer can customize the network route and protocol.

SERVER

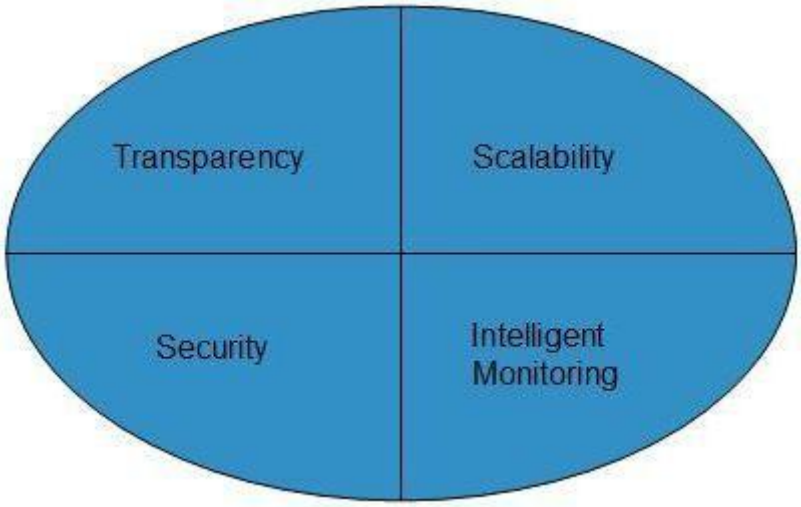
Server helps to compute the resource sharing and offer other services such as resource allocation and deallocation, monitoring resources, security, etc.

STORAGE

Cloud uses distributed file system for storage purpose. If one of the storage resource fails, then it can be extracted from another one which makes cloud computing more reliable.

Infrastructural Constraints

Fundamental constraints that cloud infrastructure should implement are shown in the following diagram:



TRANSPARENCY

Since virtualization is the key to share resources in cloud environment. But it is not possible to satisfy the demand with single resource or server. Therefore, there must be transparency in resources, load balancing and application, so that we can scale them on demand.

SCALABILITY

Scaling up an application delivery solution is not that easy as scaling up an application because it involves configuration overhead or even re-architecting the network. So, application delivery solution is need to be scalable which will require the virtual infrastructure such that resource can be provisioned and de-provisioned easily.

INTELLIGENT MONITORING

To achieve transparency and scalability, application solution delivery will need to be capable of intelligent monitoring.

SECURITY

The mega data center in the cloud should be securely architected. Also the control node, a entry point in mega data center also needs to be secure.