UNIT II

Technologies such as cluster, grid, and now, cloud computing, have all aimed at allowing access to large amounts of computing power in a fully virtualized manner, by aggregating resources and offering a single system view. In addition, an important aim of these technologies has been delivering computing as a utility. Utility computing describes a business model for on-demand delivery of computing power; consumers pay providers based on usage ("payas-you-go"), similar to the way in which we currently obtain services from traditional public utility services such as water, electricity, gas, and telephony. The main principle behind this model is offering computing, storage, and software "as a service."

Buyya defined as "Cloud is a parallel and distributed computing system consisting of a collection of inter-connected and virtualised computers that are dynamically provisioned and presented as one or more unified computing resources based on service-level agreements (SLA) established through negotiation between the service provider and consumers."

Vaquero defined as "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 an optimum resource utilization. This pool of resources is typically exploited by a pay-per-use model in which guarantees are offered by the Infrastructure Provider by means of customized Service Level Agreements."

McKinsey and Co defined as "Clouds are hardwarebased services offering compute, network, and storage capacity where: Hardware management is highly abstracted from the buyer, buyers incur infrastructure costs as variable OPEX, and infrastructure capacity is highly elastic." The National Institute of Standards and Technology (NIST) characterizes cloud computing as ". . . a pay-per-use model for enabling available, convenient, on-demand network access to a shared pool of configurable computing resources (e.g. networks, servers, storage, applications, services) that can be rapidly provisioned and released with minimal management effort or service provider interaction."

LAYERS AND TYPES OF CLOUDS

Cloud computing services are divided into three classes, according to the abstraction level of the capability provided and the service model of providers, namely:

(1) Infrastructure as a Service,

(2) Platform as a Service,

(3) Software as a Service.

Infrastructure as a Service Offering virtualized resources (computation, storage, and communication) on demand is known as Infrastructure as a Service (IaaS). A cloud infrastructureenables on-demand provisioning of servers running several choices of operating systems and a customized software stack. Infrastructure services are considered to be the bottom layer of cloud computing systems.

Service Class	Main Access & Management Tool	Service content
SaaS	Web Browser	**Cloud Applications** Social networks, Office suites, CRM, Video processing
PaaS	Cloud Development Environment	**Cloud Platform** Programming languages, Frameworks, Mashups editors, Structured data
IaaS	Virtual Infrastructure Manager	**Cloud Infrastructure** Compute Servers, Data Storage, Firewall, Load Balancer

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Amazon Web Services mainly offers IaaS, which in the case of its EC2 service means offering VMs with a software stack that can be customized similar to how an ordinary physical server would be customized.

Platform as a Service In addition to infrastructure-oriented clouds that provide raw computing and storage services, another approach is to offer a higher level of abstraction to make a cloud easily programmable, known as Platform as a Service (PaaS). A cloud platform offers an environment on which developers create and deploy applications and do not necessarily need to know how many processors or how much memory that applications will be using. In addition, multiple programming models and specialized services (e.g., data access, authentication, and payments) are offered as building blocks to new applications.

Google AppEngine, an example of Platform as a Service, offers a scalable environment for developing and hosting Web applications, which should be written in specific programming languages such as Python or Java, and use the services' own proprietary structured object data store.

Software as a Service

Applications reside on the top of the cloud stack. Services provided by this layer can be accessed by end users through Web portals. Therefore, consumers are increasingly shifting from locally installed computer programs to on-line software services that offer the same functionally. Traditional desktop applications such as word processing and spreadsheet can now be accessed as a service in the Web. This model of delivering applications, known as Software as a Service (SaaS), alleviates the burden of software maintenance for customers and simplifies development and testing for providers.

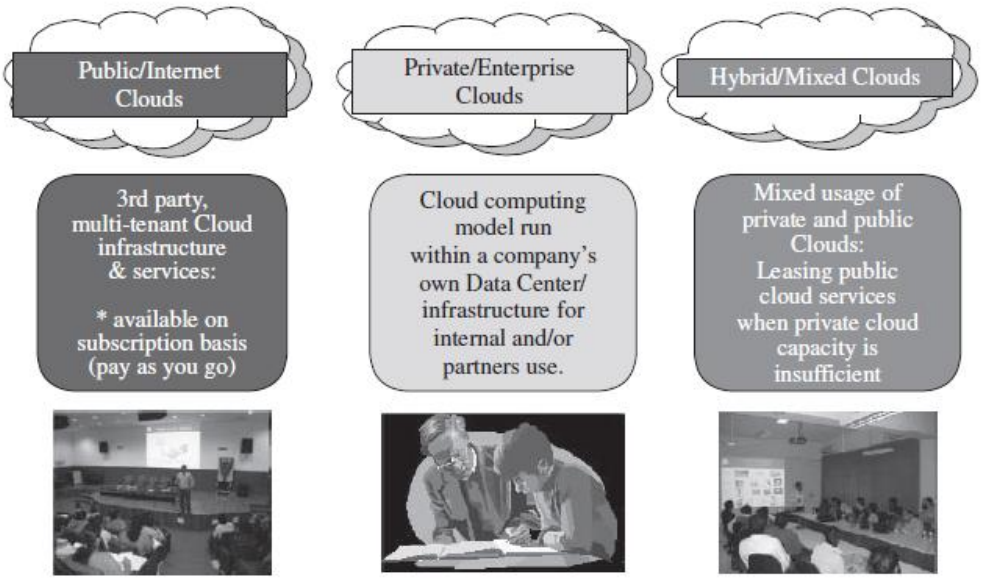
Deployment Models:- cloud computing has emerged mainly from the appearance of public computing utilities, other deployment models, with variations in physical location and distribution, have been adopted.

Public cloud as a "cloud made available in a pay-as-you-go manner to the general public" and private cloud as "internal data center of a business or other organization, not made available to the general public."

Private cloud means restructuring an existing infrastructure by adding virtualization and cloud-like interfaces. This allows users to interact with the local data center while experiencing the same advantages of public clouds, most notably self-service interface, privileged access to virtual servers, and per-usage metering and billing.

A community cloud is "shared by several organizations and supports a specific community that has shared concerns (e.g., mission, security requirements, policy, and compliance considerations)."

A hybrid cloud takes shape when a private cloud is supplemented with computing capacity from public clouds. The approach of temporarily renting capacity to handle spikes in load is known as "cloud-bursting".



DESIRED FEATURES OF A CLOUD

Certain features of a cloud are essential to enable services that truly represent the cloud computing model and satisfy expectations of consumers, and cloud offerings must be (i) self-service, (ii) per-usage metered and billed, (iii) elastic, and (iv) customizable.

Self-Service

Consumers of cloud computing services expect on-demand, nearly instant access to resources. To support this expectation, clouds must allow self-service access so that customers can request, customize, pay, and use services without intervention of human operators

Per-Usage Metering and Billing

Cloud computing eliminates up-front commitment by users, allowing them to request and use only the necessary amount. Services must be priced on a shortterm basis (e.g., by the hour), allowing users to release (and not pay for) resources as soon as they are not needed [5]. For these reasons, clouds must implement features to allow efficient trading of service such as pricing, accounting, and billing [2]. Metering should be done accordingly for different types of service (e.g., storage, processing, and bandwidth) and usage promptly reported, thus providing greater transparency [6].

Elasticity

Cloud computing gives the illusion of infinite computing resources available on demand [5]. Therefore users expect clouds to rapidly provide resources in any quantity at any time. In particular, it is expected that the additional resources can be (a) provisioned, possibly automatically, when an application load increases and (b) released when load decreases (scale up and down) [6].

Customization

In a multi-tenant cloud a great disparity between user needs is often the case. Thus, resources rented from the cloud must be highly customizable. In the case of infrastructure services, customization means allowing users to deploy specialized virtual appliances and to be given privileged (root) access to the virtual servers. Other service classes (PaaS and SaaS) offer less flexibility and are not suitable for general-purpose computing [5], but still are expected to provide a certain level of customization.