

Unit-I Fundamentals of Cloud Computing

1.1 Definition of Cloud Computing

The term "cloud" has historically been used in the telecommunication industry as an abstraction of the network in the system diagrams.

- It then became the symbol of the most popular computer network: internet.
- This meaning applies to cloud computing as well which refers to an internet-centric way of doing computing.
- "cloud computing refers to both the applications delivered as services over the internet, and the hardware & system software in the datacenters that provide those services."
- cloud computing is a delivery model for providing on-demand information technology infrastructure and services over the internet.

* Characteristics of cloud computing

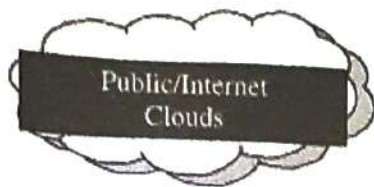
- 1) No upfront commitments.
- 2) on demand access;
- 3) Nice pricing;
- 4) simplified application acceleration and scalability;
- 5) Efficient resource allocation.

- 6) Energy efficiency; and
 - 7) seamless creation and use of third party services.
- OR
- 1) Customer can provision computing resource by themselves on demand.
 - 2) Resources are provisioned and accessed over the internet.
 - 3) Resources are pooled together to serve the needs of multiple customers.
 - 4) Resources can be rapidly scaled horizontally or scaled doesnot depending on need.
 - 5) Resource use is controlled by the customer and can be monitored in real time.

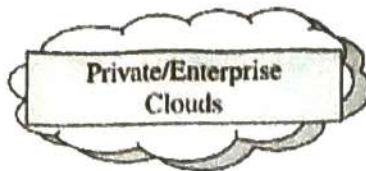
1.2 Cloud Deployment Models

Although 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.

- In this sense, regardless of its service class, a cloud can be classified as public, private, community, or hybrid based on model of deployment as shown in Fig.



3rd party, multi-tenant Cloud infrastructure & services:
* available on subscription basis (pay as you go)



Cloud computing model run within a company's own Data Center/ infrastructure for internal and/or partners use.



Mixed usage of private and public Clouds:
Leasing public cloud services when private cloud capacity is insufficient



public cloud - A cloud made available in a pay-as-you-go manner to the general public.

private cloud - Internal data centers of a business or other organization, not made available to the general public.

In most cases, establishing a 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 advantage of public clouds most notably self service interface, privileged access to virtual servers, and per usage metering & billing.

Community cloud - It is shared by several organizations and supports specific community that has shared concerns (e.g. missions, security requirements, policy, and compliance considerations)

Hybrid cloud - 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 the load is known as "cloud bursting"

1.3 Cloud Service Models

IaaS - (Infrastructure as a service)

PaaS - (Platform as a service)

SaaS - (Software as a service)

IaaS -

Offering virtualized resources (computation, storage and communication) on demand is known as 'infrastructure as a service (IaaS)

- A cloud infrastructure enables on demand provisioning servers running several choices of operating systems and a customized software stack.

Paas -

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 a 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 model 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

- Infrastructure services considered to be the bottom layer of cloud computing service systems.
- Amazon web services mainly offers IaaS, which in the case of its EC2 service means offering VM's with a software stack that can be customized similar to how an ordinary physical server would be customized.
- Users are given privileges to perform numerous activities to the server, such as starting & stopping it, customizing it by installing software packages, attaching virtual disk on it and configuring access permissions and Firewall rules.

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

FIGURE 1.3. The cloud computing stack.

the services own proprietary structured object data store. Building blocks include an in-memory object cache (mem-cache), mail service, instant messaging service (XMPP), an image manipulation service, and integration with Google Accounts authentication service.

SaaS:-

Applications resides 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 online software services that offers the same functionality

- Traditional desktop applications such as word processing and spreadsheet can now be accessed as a service in the website.
- This model of delivering the applications, known as software as a service (SaaS) alleviates the burden of software maintenance for customers and simplifies development and testing for providers
- Salesforce.com, which relies on the SaaS model

offers business productivity applications (CRM) that resides completely on their servers, allow customers to customize and access applications on demand.

1.4 Cloud Cost benefits

Although moving to the cloud requires an upfront financial investment, the cost benefits of cloud computing are actually one of the top reasons many organizations consider making the switch in the first place.

- There are several cost benefits of cloud computing

1) Energy savings -

When you switch to the cloud, you are no longer paying for unused infrastructure (like redundant servers). Efficient hardware utilization means less energy output and more money in your pocket.

2) Scalable Infrastructure -

One of the biggest advantages to cloud computing is ability to scale your operations flexibly. In other words, you only pay for what you use.

3) No Capital Costs -

Operating and maintaining physical data centers and servers is a big investment with cloud computing, you no longer have to deal with these capital costs. Instead you can redirect these resources towards other priorities and initiatives.

4) Decrease of Downtime -

The cost of downtime is only going up when the average cost of downtime in 2024 is over \$1 million/hour business can't afford to go offline. The cloud significantly reduces this risk with more redundant and reliable service.

5) Increased Efficiency -

On-premises computing requires a lot of attention and maintenance from IT to keep things running smoothly.

Moving to the cloud free your staff to focus on other priorities in the business, streamlining your talent and increasing operational

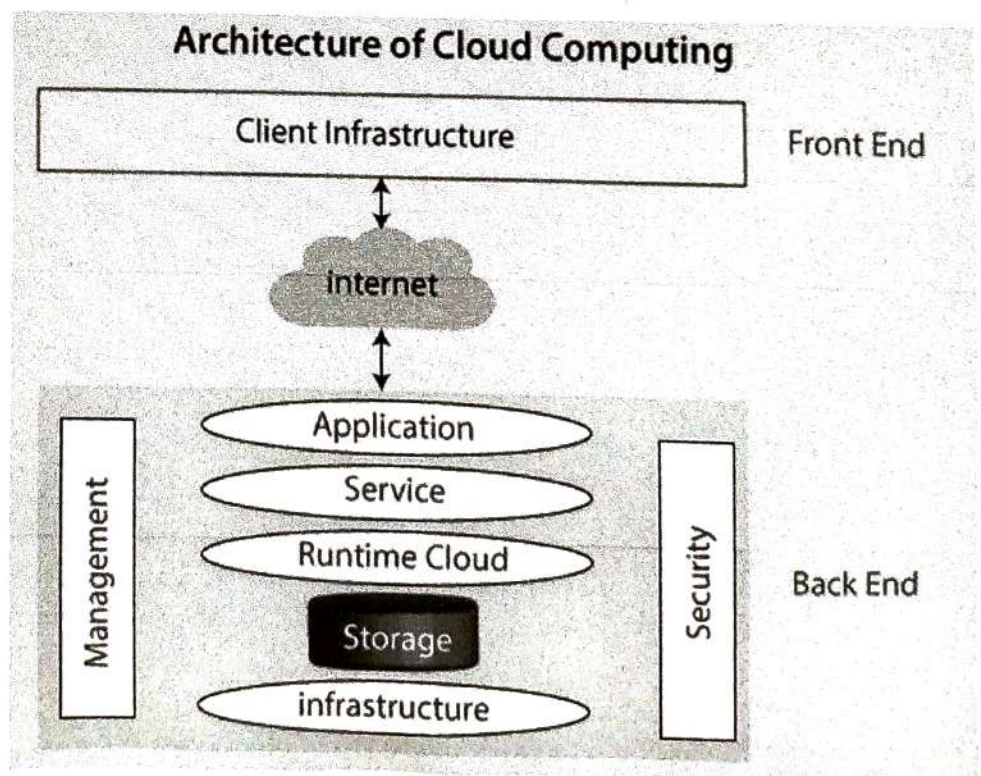
efficiency. Although, migrating to cloud can mean greater efficiency, higher productivity and lower operating costs for your business.

1.5 Architectural & Infrastructural components of cloud computing

Architecture of cloud computing is the combination of both SOA (Service Oriented Architecture) and EDA (Event driven architecture) client infrastructure, application, service, storage runtime cloud, infrastructure, management and security all these are components of cloud computing architecture.

The cloud architecture is divided into 2 parts

1. Frontend
2. Backend



Frontend -

Frontend of the cloud architecture refers to the client side of cloud computing system.

- Means it contains all the user interfaces and applications which are used by the client to access the cloud computing services / resources.

Backend -

Backend refers to the cloud itself which is used by the service provider.

- It contains the resources as well as manages the resources and provides the security mechanism.
- Along with this, it includes huge storage, virtual applications, virtual machines, traffic control mechanisms, deployment models etc.

* Components of cloud computing Architecture :->

1. Client Infrastructure -

client infrastructure is a part of frontend component. It contains the applications and user interfaces which are required to access

the cloud platform. In other words, it provides a GUI (Graphical User Interface) to interact with the cloud.

2. Applications -

Application is a part of backend component that refers to a software or platform to which client accesses, means it provides the service as per the client requirement.

3. Service -

A service in backend refers to the major three types of cloud based services like SaaS, IaaS, PaaS. Also manages which type of service that user accesses.

4. Runtime Cloud -

Runtime cloud in backend provides the execution and runtime platform / environment to the virtual machine.

5. Storage -

The storage in backend provides flexible and scalable storage services and management of stored data.

Infrastructure -

cloud infrastructure in backend refers to the hardware and software components of cloud like it includes servers, storage, network devices, virtualization software etc.

7. Management -

Management in backend refers to management of backend components like application, service, runtime cloud, storage, infrastructure, and other security mechanisms etc.

8. Security -

security in backend refers to implementation of different security mechanisms in the backend for secure cloud resources systems; Files and infrastructure to end users.

9. Internet -

Internet connection acts as the medium or bridge between frontend and backend establishes the interaction and communication between frontend & backend.

10. Database -

Database in backend refers to provide database for storing structured data, such as SQL and NOSQL databases. e.g. database service. includes Amazon RDS, Microsoft Azure SQL database and Google Cloud SQL.


22/7/16

Unit 1 Fundamentals of Cloud Computing

Questions

- 2 Marks Questions

- 1) Define cloud computing. [summer 2024] CO1-1a-R
- 2) state any four characteristics of cloud computing
[Winter 2023] CO1-1a-R
- 3) List different cloud deployment models.
[summer 2024] CO1-1a-R
- 4) Define software as service (SaaS) [Winter 2023] CO1-1a-R
- 5) state any four advantages of cloud computing
[summer 2023] CO1-1a-R

- 4 Marks Questions

- 6) Explain the characteristics of cloud computing.
[summer 2024] CO1-1a-R
- 7) Explain different cloud deployment Models.
[Winter 2023] CO1-1a-U
- 8) Explain infrastructure as a service with suitable example. [summer 2023] CO1-1a-U
(SaaS)
- 9) Explain platform as a service (PaaS) with suitable example. [Winter 2022] CO1-1a-U [I]
- 10) Differentiate between public cloud & private cloud.
[summer 2024] CO1-1a-U

- 6 Marks Questions

- 11) Explain cloud service models (IaaS, SaaS, PaaS) with suitable examples. [summer 2024] CO1-1a-U
- 12) Explain different cloud deployment models with advantages and disadvantages [Winter 2023] CO1-1a-U
- 13) Explain cloud computing architecture with neat diagram. [summer 2023] CO1-1a-U
- 14) Explain benefits and challenges of cloud computing. [Winter 2022] CO1-1a-U
- 15) Explain various components of cloud computing infrastructure [summer 2024] CO1-1a-U.

sl
24/7/26