

On known  
Servers computer system  
→ provides resources, data, service  
Programs as clients to other computers,  
over network

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## Cloud Computing

### Cloud:

- \* servers that are accessed over the internet

### Cloud Computing

- \* ~~ever~~ on-demand availability of computer system resources
- \* manage & process data on remote servers

### Service Providers:

- \* Google Cloud
- \* AWS (Amazon Web Services)
- \* Microsoft Azure
- \* IBM Cloud
- \* Alibaba Cloud

### Types of Cloud:

#### 1) Public Cloud:

- \* accessible to all

## 2) Private Cloud:

- \* Resources accessible within an organization

## 3) Hybrid Cloud:

- \* public + private Cloud features

## 4) Community Cloud:

- \* resources accessible by a group of organizations

Characteristics of Cloud Computing

1) On demand self service:

- \* request & receive access to a service offering, without administrator to fulfil the request manually

## 2) Broad Network Access:

- \* anywhere access & anytime

### 3) Resource Pooling:

- \* multiple customers are serviced from the same physical resources
- resources → storage, memory, nw bandwidth, virtual machine

### 4) Measured Services:

- \* pay according to the services you use

### 5) Rapid Elasticity & Scalability:

- \* ability to quickly provision resources in the cloud as organization need them,  
(then to remove them when they don't need them)

### 6) No mainframe

### 6) No maintenance

### 7) Security:

- \* copy of our data on various servers. If one fails, data is safe on other

Advantages:

- i) resources accessible anywhere & anytime
- ii) on-demand self service (no third party)
- iii) reduced IT cost
- iv) Scalability
- v) collaboration
- vi) offers security  
location & device independence  
Server our time

Disadvantages:

- i) Network connection dependency
- ii) Lack of support  
(e.g. unable to answer your data before a meeting etc)
- iii) May not get all features  
- Not all cloud service providers are same
- iv) Vendor - lock - in problem

## Vendor Lock-in Problem in

### Cloud Computing:

\* customer are ~~dependent~~ (i.e. locked-in) on a single cloud providers and cannot move easily to a different vendor without substantial cost, legal constraints or technical incompatibilities.

### Types of vendor lock-in Problem:

#### i) Data Transfer Risks:

It is not easy to transfer data from one CSP to another.

A lot of ques arises:

(i) Who is responsible for extracting the data from database.

(ii) In what format the data will be? what will be the format of new CSP etc.

## 2) Application Transfer Risk.

- \* If we build one application on a CSP that leverages many of its offerings, the reconfiguration of this application to run natively on another provider can be an extremely expensive & difficult process.
- \* Reason for this difficulty is lack of standard interfaces & open APIs. Every CSP has their own standard.

## 3) Human Resource Knowledge Risk:

- \* When we move from one CSP to another, our team will need to learn again all tools, implementation processes & so on.

# Cloud Computing

## Architecture:

Two parts:

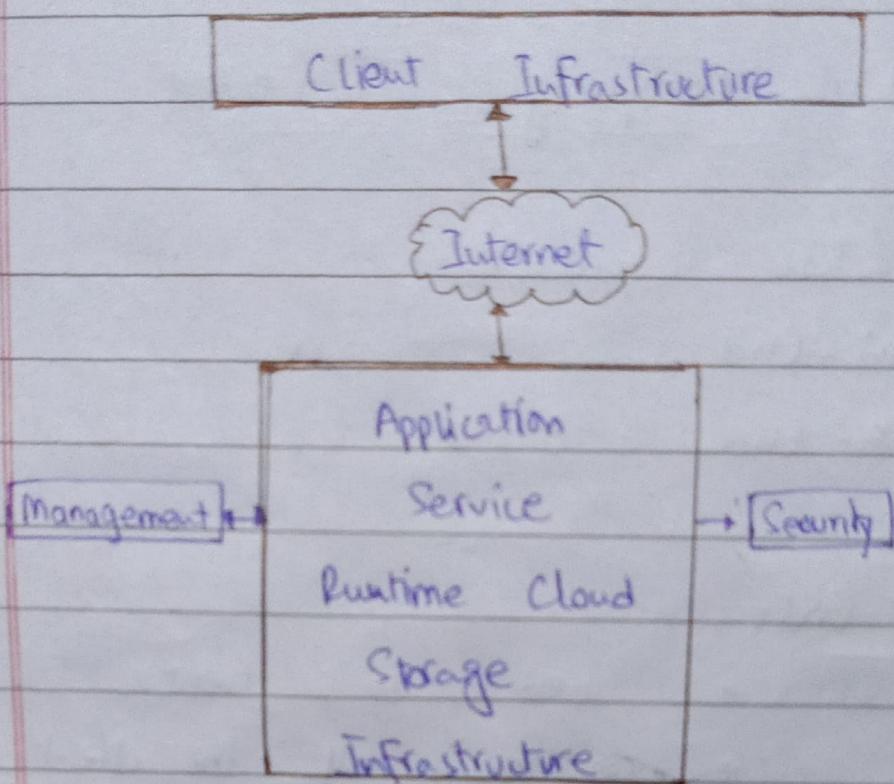
- \* Front - End
- \* Back - End

### Front - End:

\* used by client  
\* contains all the client side interfaces & applications that are required to access the cloud platform.

### Back end:

\* used by service providers  
\* manages all the resources that are required to provide cloud computing services.  
\* include data storage, security mechanisms, virtual machines etc.



Cloud Computing  
Components of Client Architecture:

1) Client Infrastructure:

- \* front end component  
 (provides GUI to interact with cloud)

2) Application:

May be any software or platform that a client wants to access.

3) Services:

- \* manages that which type of service you access according to clients requirements.

Cloud computing offers:

- SaaS
- PaaS
- IaaS

4) Runtime Cloud:

- \* provides "execution & runtime environment" to the virtual machines

5) Storage:

- \* provides huge amount of storage capacity in the cloud to store and manage data.

## 6) Infrastructure:

- \* include hardware & software components such as " servers, storage, network devices , virtualization software & other resources needed for cloud computing model.

## 7) Management:

- \* manages components (like application, service , infrastructure)

## 8) Security:

- \* in-built backend component provides security mechanism in the backend.

## 9) Internet:

Medium through which frontend & backend interacts.

## Types of Cloud Computing Services:

- \* SaaS (Software as a Service)
- \* IaaS (Infrastructure as a Service)
- \* PaaS (Platform as a Service)

### SaaS (Software as a Service):

- \* type of cloud computing services
- \* way of delivering services and applications over the internet
- \* maintenance of software & hardware done by the vendor
- \* need not to install software in our machine
- \* removes the cost of software and hardware maintenance.
- \* generally used by end users

### Characteristics:

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- i) Make software available over internet
- ii) Software application maintained by the vendor
- iii) cost effective (pay as per use)
- iv) Available on demand
- v) can be scaled up or down anytime according to our need
- vi) works on shared model, one software is used by multiple clients.
- vii) Software automatically upgraded

### Benefits:

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- i) platform independence to me user (we can use android, mac, windows)

Multi-Tenant  
kind of architecture where  
one a single instance of software  
runs on a server and serves  
multiple customers. DATE: 1/20

- i) Multitenant Solutions
- ii) Scale up or Scale down
- iii) Accessible anytime, anywhere
- iv) Reduced time (we can use already application from browser)
- v) Cost effective (pay as per use)

Example:

- \* Dropbox
- \* Cisco Webex
- \* SalesForce
- \* Gmail
- \* Office 365
- \* Google Drive
- \* PaaS (Platform as a Service)
  - \* developers use it
  - \* It provides a platform & environment (i.e. runtime envi.) to allow developers to build applications & services over the Internet

- \* offers development and deployment tools required to develop applications
- \* PaaS services are hosted on the cloud & accessed by users via web browser.
- \* no control over the infrastructure. we will interact with user interface only.  
O.S will be provided by vendor. We do not have control over it.
- \* PaaS provider hosts the hardware & software on its own infrastructure.
- \* we do not have control over the cloud infrastructure including network, servers, O.S, or storage, but we have control over the deployed application and possibly configuration settings for the

application hosting environment.

### Advantages:

- i) cost effective (pay as per use)
- ii) no need to purchase expensive servers, software or data storage
- iii) Scale application anytime
- iv) Software management manage by the provider
- v) Easy deployment of web application.

IaaS (Infrastructure as a Service) in clouds

- \* provides us infrastructure
- \* type of cloud computing services used by system administrator / network architects.

- \* provider the underlying OS, security, networking, and servers for developing the applications
- \* provides access to fundamental resources such as physical machines, virtual machines, virtual storage etc.
- \* we can ~~stop~~ scale up & shrink the resources as per requirement

IaaS also offers:

- virtual machine disk storage
- IP addresses
- VLAN (Virtual Local Area Network)
- load balance

Benefit:

- \* We have full control over computing resources through administrative access to VMs.

Example:

- \* IBM Cloud
- \* AWS
- \* Oracle ~~Cloud~~ Infrastructure
- \* Google Cloud

Applications = For Cloud  
Computing =

\* Business application:

Every organization requires the cloud business application to grow their business e.g. paypal → (safe payment)

\* Data Storage & backup applications:  
e.g. google drive

\* Education applications

e.g. Google Documents

\* Entertainment applications:

e.g. online games, video conferencing

\* Art Applications

e.g. Moocloud → cloud art application

## \* Social Application

e.g., facebook, instagram

## Cloud Deployment Models

### \* Public Cloud:

- Open to all to store & access information via internet
- pay as per use (for the services)
- managed by third parties  
(Cloud Service Provider)

Fundamental characteristics of  
public cloud is Multitenancy

e.g) EC2 (Amazon elastic  
compute cloud)

Google App Engine, Dropbox,  
(Google Drive etc.)

Advantages:

- It is maintained by Cloud Service Providers.
- location independent
- high Scalability
- cost effective

Disadvantages:

- less secure because resources are shared publically
- less customizable as compared to private cloud

\* Private Cloud:

- services accessible within an organization
- can be managed by → organization

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### Advantages:

- i) High Security
- ii) Data Privacy
- iii) More customizable

### Disadvantages:

- i) High Cost
- ii) Limited Scalability
- iii) area of operations is limited

### Hybrid Cloud:

- features of public & private cloud
- critical activities performed by private cloud
- Non-critical activities by public cloud

Advantages:

- Scalability
- Security
- Low cost
- Flexibility

Disadvantages:

- Managing is difficult because there are more than 1 type of deployment model
- dependency on infrastructure

\* Community Cloud:

- allows services to be available by a group of several organizations to share the info between the organization & a specific community

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- owned, managed & operated by one or more organizations in the community or 3<sup>rd</sup> party

### Advantages:

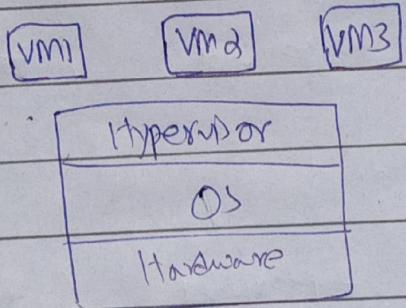
- (i) Cost Reduction / Cost Effective
- (ii) Sharing among companies (resour<sup>ces</sup>)
- (iii) More secure than public cloud but less than private cloud

### Disadvantages:

- (i) Data is accessible between organizations
- (ii) Consistent maintenance cost
- (iii) overall increased cost. (vs private cloud)

## Virtualization

- Technique
- Share single res or app
- share single instance of physical instance of an app or res. among multiple organization or customers.
- All virtual resources will work independently



\* HOST machine  
 → machine on which  
 virtual m/c is going to  
 build

Guest machine → Virtual machine

Hypervisor (VMM)

↓  
Virtual Machine Monitor

e.g.

VMware

Hyper-V

\* Software that creates & runs the virtual machine (also manage)

\* used to create virtual on physical machine

Hypervisors are of 2 types:

i) Type 1 Hypervisor (~~bare metal~~ or native hypervisor).

ii) Type 2 Hypervisor (hosted or embed ")

Benefits of virtualization:

(i) better resource utilization

(ii) lower the cost of IT infrastructure

(iii) remote access

(iv) pay per use of the IT

(v) enables running multiple O.S. on demand

(vi) If one virtual machine is

not working or having any problem, others will not be affected.

## Serverless Computing:

- \* **NO Servers?**

→ Servers are there we don't manage them

Provider: Cloud computing execution model  
allocate resources on demand

- \* take care of resources on behalf of their customer.

- \* to build & run application & services without having to manage infrastructure.

- \* Your appli. still run on server but all the service management is done by the provider.

⇒ You ~~don't~~ no longer have to provision, ~~allocate~~ resources to run your application

⇒ no infrastructure management

⇒ auto scaling based on incoming requests

managed by  
Cloud Provider

→ Reduces cost / cost effective

(no charge for idle time)

2.

Note:

When the app is not in use  
there are no computing resources  
allocation to the app.  
i.e.

Run for a short duration  
only when invoked.

Note → It enables developer to  
focus more on code/business  
logic (manage as we ~~need~~ not  
the infrastructure).

Application of Serverless services:

- i) weather update component in an application

Others will not be affected.