

Cluster Computing

25/2/25

A cluster is a group of independent IT resources that are interconnected & work as a single system.

DisAdv -

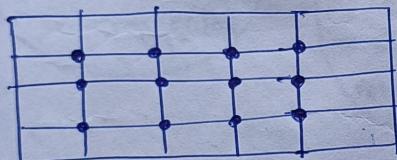
Availability of the resources.

DisAdv -

Redundancy & failure.

Grid Computing

Grid Computing provides a platform in which computing resources are organised into one or more logical pools.



These pools are collectively coordinated to

provide high performance distributed grids.
It is also called super virtual computer.

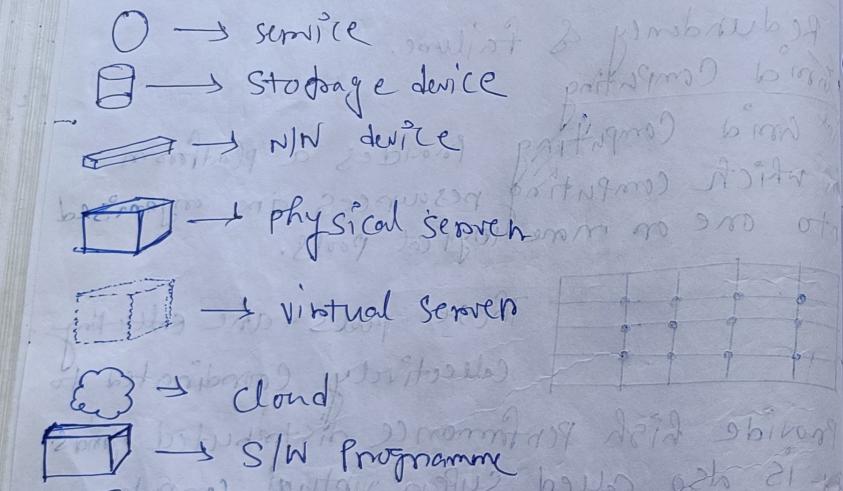
Cloud

A cloud refers to distinct IT environment that is designed for the purpose of remotely provisioning scalable & major IT resources.

The term originated from the visual rep. of the internet infrastructure in early network diagrams.

Components of IT

IT resources - An IT resource is a physical or virtual IT related artifact that can be either software (such as virtual or custom software) or hardware based (such as physical servers or a physical device).



On-Premise

An IT resource that is hosted in a conventional IT enterprise within an organisational boundary is considered to be located on the premises of the IT enterprise or on-premise.

Cloud consumers v/s cloud providers

Cloud providers - The party that provides cloud based

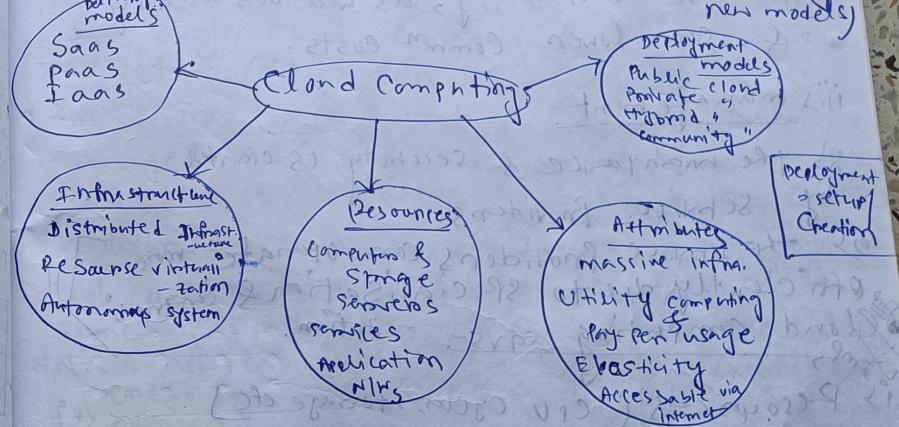
IT resources is the Cloud Providers, the party that uses cloud services that are called Cloud Consumers.

Cloud

27/2/25

Cloud computing models, resources & attributes

Here there are 3 models (they are old models, nowadays there are many new models)



- Public cloud ≈ SaaS / PaaS / IaaS (can be any)
- Resource virtualization = Google servers (google drive)
- Autonomous system = weather forecasting
- Cloud Computing - characteristics (P.T.O)

- 1) Shared resources & resource management
- 2) It uses shared pool of resources
- 3) Scalable & elastic
- 4) Elastic computing = The ability of dynamically on demand acquiring computing resources & supporting

a variable workload.
if Resources are tested metioned & users are
changed accordingly.

5) It is more cost-effective due to resource-multiplexing.

Data storage

- 6) Data is stored
 - 7) the data storage strategy can increase reliability, as well as security & can lower Comm' costs.

iii) management

- 8) The maintenance & security is ensured

by Service Providers.

3) the service providers can operate more efficiently due to specialisation & centralisation.

→ Resources [CPU cycles, storage etc]

one shaped.

ii) multiplexing leads to a higher resource utilization as multiple users/applications share

iii) Eliminates the initial investment

cost reduction [concentration of resources
the opportunity to pay as you
for competing].

✓ Elasticity (the ability to accommodate workload with very large peak-to-avg ratios)

✓) User Conference (visits abstrac

To operate ~~the farm~~ with a limitation allows the farmer to have more time for other activities.

→ Data sharing facilitates collaborative

activities. 20 patients with ≥ 1 symptom were included.

B. (T.?) fusciventer (Blyth) from IV P. S. brownish

Types of clouds - Computing deployment models are described below:

↳ Public - It's a commonly adopted cloud model, where the cloud services provider owns the infrastructure & openly provides access to it for the public to consume.
Eg - Google Cloud, Amazon AWS.

ii) Private - It can be thought of as an environment that is fully owned & managed by a single tenant. [It's a c.c. env. that is dedicated to a single organis

iii) Hybrid - It's a computing env. as corporate on internal cloud. that combines public & private clouds, & some on-premises data centers. It allows data & applications to move b/w the different envs. Eg - Netflix uses a hybrid c. m. to store & manage a large amount of video contents. Other types: Community / Federated

It's a c. infrastructure in which multiple organizations share resources & services based on common operational & regulatory requirements. It's a semi-public cloud. Eg - Heroku etc

• Why C.C. is successful, when others paradigm
- gms have failed?

It's in a better position to exploit recent advances in SW, hw ing, storage & processor technologies promoted by the same companies who provide cloud services.

ii) Economical reasons - It is used S/W requirement are coming due to the rapid growth of hardware

for enterprise computing; its adoption by industrial organisations, government etc has a huge impact on the economy.

iii) Infrastruct. management reasons -

a) A single cloud consists of a mostly homogeneous set of hardware & S/N resources.

b) The resources are in a single administrative domain (AD).

• Challenges of C.C

i) Security risks - Data breaches, unauthorized access, & compliance issues.

ii) Downtime & reliability - Potential service outages affecting business operations.

iii) Cost management - Unexpected costs due to scaling & data transfer.

iv) Limited control - Dependence on cloud providers for infrastructure management.

v) Integration challenges - Compatibility with existing on-premise systems is low.

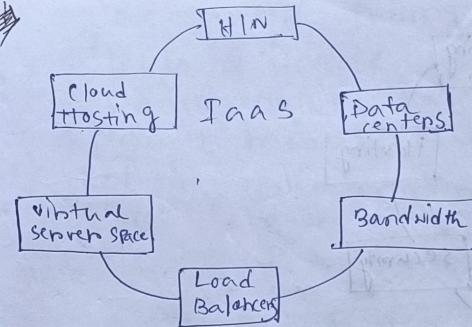
vi) Performance issues - Latency & speed variations.

vii) Cloud delivery (deployment) model based on N/W conditions.

i) IaaS, ii) PaaS, iii) SaaS

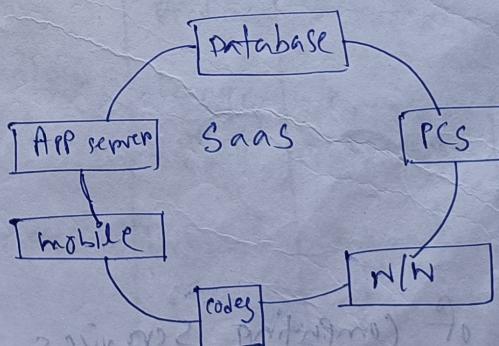
The three main cloud delivery models are Infrastructure as a Service (IaaS), PaaS, SaaS.

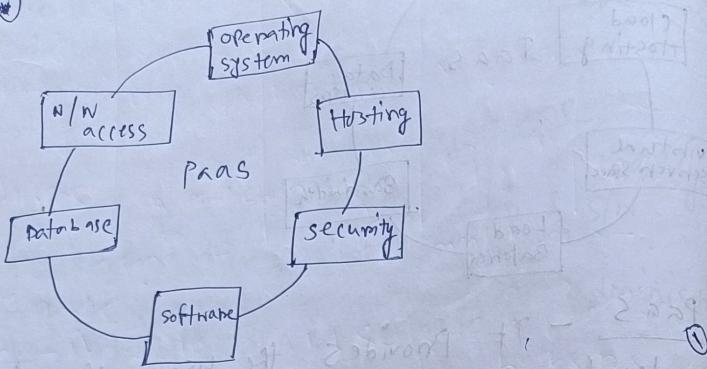
i) IaaS - It provides the ability to use the computing & storage resources. Eg - Google drive etc.



ii) PaaS - It provides the users the ability to develop & deploy application in cloud using the development tools, APIs, SW libraries & services provided by the cloud service provider (CSP). Eg - ~~Amazon~~ AWS, IBM Cloud, Red Hat OpenShift etc.

iii) SaaS as a service (SaaS) - Provides users a complete SW application / the user interface to the application. Eg - google sheet, Powerpoint etc.





CW

- Cloud manipulation
- accessing the services provided by cloud
- configuration

16/4/25

Cloud computing

It is the delivery of computing services of computing services (like servers, storage, databases, networking, SW) over the Internet ('the cloud').

Characteristics -

- on-demand access from anywhere.

- 'pay-as-you-go' pricing model.
- Scalable & flexible resources.
- 3 service models: PaaS, SaaS, IaaS.
- deployment models: Public, Private, Hybrid, Community cloud.
- Real-time collaboration support.
- Reduces hardware & infrastructure costs.
- Data backup & recovery options.

These are certain services & models working behind the C.C. - 1. Deployment models, 2. Service model.

Deployment models - 4 types

- Public cloud, i) private cloud, ii) hybrid cloud, iii) Community cloud (Done Pw)

	Public	Private	Hybrid	Community
Host	Service Providers	Enterprise	Enterprise	Community (3rd Party)
Features				Other clouds
i) Suitable for	Large enterprise	Large enterprise	Small & mid-size	Financial, health & legal companies.
ii) Access	Internet	Intranet VPN, Intranet	Intranet VPN	Intranet VPN
iii) Security	Low	most Secured	moderate	Secured
iv) Cost	cheapest	High cost	cost effective	(cost effective)
v) Owner	Service Provider	Enterprise	Enterprise	Community

vii) Reliability	moderate	very high	medium-high	very high
viii) Scalability	very high	Limited	very high	Limited
ix) Users	organization, public etc	Business organizations	Business org.	Community members

• Adv & disadvantages of each deployment models -

i) Public

- Adv - i) Cost effective, ii) Scalable & flexible, iii) No maintenance is needed by users, iv) Fast setup & deployment

Disadv - i) Less control over infrastructure, ii) Potential security concerns, iii) Limited customization, iv) Shared resources can affect performance.

ii) Private

Adv - i) Greater control & customization, ii) Enhanced security & privacy, iii) Better performance, iv) Strong regulations.

Disadv - i) High cost, ii) Requires in-house expertise, iii) Longer deployment time, iv) Scalability can be limited.

iii) Hybrid

Adv - i) Flexible, ii) Scalable, iii) Balanced cost & control, iv) Improved business continuity, v) Allows sensitive data to stay on private cloud.

Disadv - i) Complex management, ii) Integration challenges, iii) Security risks in data transfers, iv) Higher setup costs than public cloud.

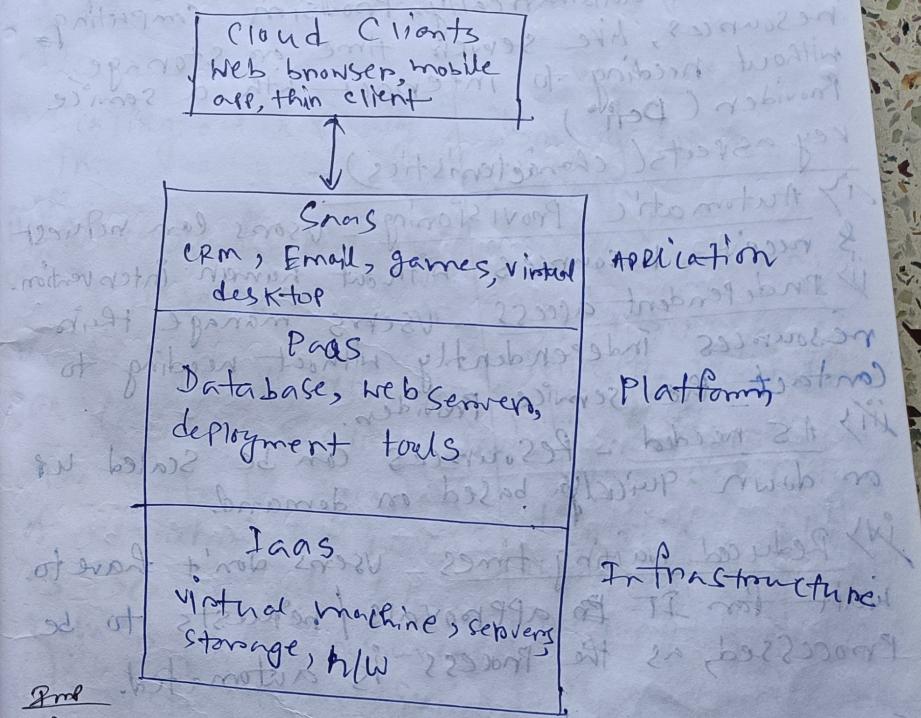
iv) Community

Adv - i) Cost effective, ii) Better security than public cloud, iii) Shared responsibilities & costs, iv) Customizable for group needs.

Disadv - i) Limited scalability, ii) Governance challenges, iii) Costly than public, iv) Slow adoption & updates.

Service models - They are the models on which the cloud computing is based. They are 3 types.

i) IaaS, ii) PaaS, iii) SaaS. (Done Pm)



Qn) Rakesh wants to build an application (web) using html, database etc. Which type of service he needs? → He needs data base, web servers etc. So, PaaS.

• Benefits / Characteristics (What are the characteristics of c.c.)
 And
 1) What are the benefits of c.c. (Done priv)

• what do you mean by on demand self services?

one can logon to a website at any time & anywhere.

ii) In i.e., on demand self service means, an user can automatically provision computing resources, like server time or storage without needing to interact with a service provider (Defn.)

key aspects (characteristics) -

i) Automatic Provisioning - users can request & receive resources without human intervention.

ii) Independent access - users manage their resources independently without needing to contact the service provider.

iii) As needed - resources can be scaled up or down quickly based on demand.

iv) Reduced waiting times - users don't have to wait for IT Bo approvals / requests to be processed, as the process is automated.

Chap-3

Pg = 26 - 44 (Book from which we need to study)

Topic
Scaling

Scaling, from an IT resource perspective means the ability of the IT resource to handle increased or decreased usage

demands. There are 2 types of scaling; horizontal & vertical.

i) Horizontal - Scaling out & Scaling in

= Scaling up & Scaling down

impl. \sqrt{x} &
Horizontal

i) Scaling out & Scaling in.

ii) Allocating & Releasing of IT resources that is of the same type is referred to as horizontal scaling.

The horizontal allocation of resources is referred to as scaling out & the releasing of resources is referred to as scaling in.

It's a common form of scaling within the cloud environment.

vertical

ii) Scaling up & Scaling down

when an existing IT resource is replaced by another with higher or lower capacity, then it's called vertical scaling. The replacing of an IT resource with another that has a higher capacity is referred to as scaling up & the replacing of the IT resource with another that has a lower capacity is referred to as scaling down.

It is less common in cloud environment.
Why?

- Vertical Scaling is less common in cloud environment.

Why?

V.S. is less common in cloud env. as it's often more expensive, can lead to downtime during upgrades, & has inherent limitation due to physical hardware constraints.

Here are more causes -

i) Hardware limitations - Can't scale beyond physical server capacity.

ii) Downtime required - Often needs rebooting the servers to scale up.

iii) Higher cost - Bigger instances are more expensive than multiple smaller ones.

iv) Single point of failure - one large server going down affects everything.

v) Less flexible - Harder to adapt the changing loads (Compared to horizontal scaling)

v) Not cloud-native - Doesn't fit well with distributed, Scalable Cloud architectures. ②

23/4/25

Virtualization

Virtualization is a large umbrella of technologies & concepts that are meant to provide an abstract environment - whether it's virtual hardware / operating system - to run applications. It is one of the fundamental components of Cloud Computing, especially in case of infrastructure based services.

Virtualization technologies have gained a renewed interest by the community. Reasons

i) Increase Performance & Computing Capacity

Nowadays super computers can provide immense computing powers that can accommodate the execution of tools for 100's of machines.

ii) Underutilize of hardware / Software resources

H/W & S/W underutilization is occurring due to -

• Increase Performance / Computing Capacity

2) Effect of limited / sporadic use of resources.

(3) Computers today are so powerful that in most of the cases only a fraction of their capacity is used by an application / system.) //

3) Lack of space

The continuous need for additional capacity like storage / computing power makes data centers grow quickly. [Companies like Google / Microsoft expand their infrastruct. by building data centers that are able to host thousands of nodes.] //

4) Greening initiatives - It aims to reduce energy consumption & env. impact by running multiple virtual machines on fewer physical servers. This improves resource efficiency, lowers power & cooling needs & reduces e-waste, supporting sustainable & eco-friendly operations.

5) Rise of administrative cost

Virtualization can raise admin costs because it needs skilled staff & special tools. [Managing many virtual systems can be more complex.] //

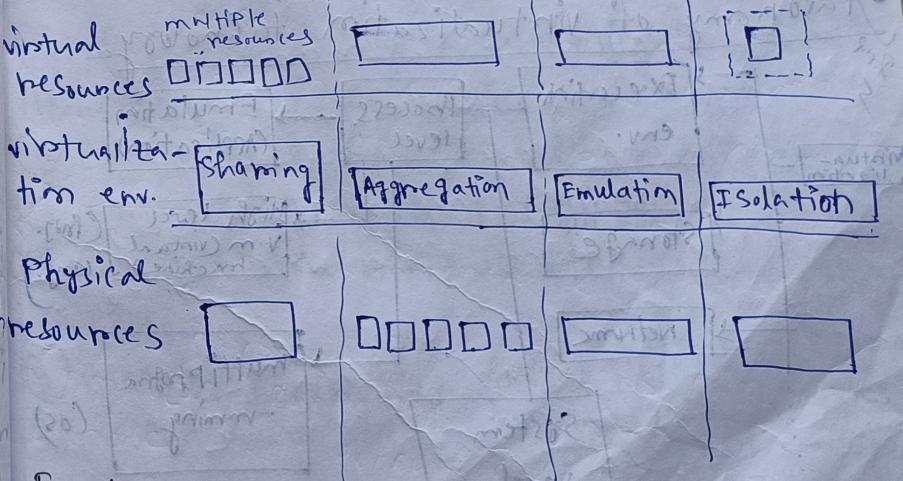
Characteristics of virtual environment

i) Increase security - virtual env's increase security by keeping systems separate, making backups easy & controlling access better.

ii) Manage execution - sharing

Sharing of resources, aggregation of resources, emulation, isolation.

• simulate - Executing the plan from real to virtual env.



• Emulation - Guests are executed within an env. that is controlled by the virtualization layers which is a program that allows for controlling & tuning the env. that is exposed to guest. which

[For instance, a complete diff. env. with respect to the host can be emulated for allowing the execution of guest requirement requiring specific characteristics that are not present in the physical machine.] //

• Isolation

Virtualization allows guest whether their applications/others entities with a complete separate env. in which they are executed.

Secondly it provides separation b/w the host & the guest.

• Taxonomy of virtualization technology

