

Cloud Computing :- It is the use of remote servers on the internet to store, manage and process the data rather than local servers. By the help of cloud computing we can easily scale up and scale down as per our requirement.

⇒ Benefits of cloud computing:-

- Reduces investment
- Increased scalability
- Increased availability and reliability

⇒ features/characteristics of cloud computing

- O:- On demand self service
- B:- Broad network access
- R:- Resource pool
- E:- Rapid Elasticity
- M:- Measured service (Pay per use)

* These characteristics are given by National Institute of Science & Technology (NIST)

⇒ Applications of cloud computing :-

- Online storage • Photo & video editing s/w
- Presentation s/w (ex: slide rocket)
- finding way on Map
- Word processing application (ex:- white board)

Cloud Computing Service models:-

→ Infrastructure As A Service (IaaS) :-

or Hardware As A Service (HaaS) :-

In the IaaS model, the cloud provider

manages IT infrastructures such as

storage, server and networking resources

, and delivers them to the subscribers

, organization via virtual machine

accessible through the internet. IaaS

can have many benefits for organization, such as potentially making workloads faster, easier, more flexible

and more cost efficient.

Here the whole control is in the hands of the user how he/she wants to use that cloud services.

⇒ The choices that we can make are

as follows:-

- Operating System

- VM and storage

- IP address

- Provides Infrastructure

- Enhanced Scalability

- It is mainly used by the system administrators

- Platform as a Service (PaaS) :-

- PaaS is a complete development

and deployment environment in the cloud and resources that enable you to deliver everything from simple cloud based app, to sophisticated cloud enabled enterprise applications.

It is used by developers because we have provided with a platform, some tools, run time environment and some programming languages etc. And by the help of these tools, we can build and deploy our applications.

⇒ The options available in this model are

as follows:-

- UI, the access of OS virtual storage,

- physical storage are not available here

- Your application

- Run time environment

- Offers development and deployment tools

- VM and storage

- Flexible

- No need to purchase expensive hardware and software.

- Software As A Service (SaaS) :-

- Software as a service allows users to connect to and use cloud based after

- over the internet. Common examples are

email, calendaring, and office tools (such as Microsoft office 365). SaaS providers a complete software solution that you purchase on as pay as you go basis from a cloud service provider.

SaaS means, accessing software through the internet without downloads. User subscribe to applications hosted on remote servers, accessing them via web browsers. No maintenance or updates are required, making it a convenient and cost effective way to use the software.

⇒ features of SaaS model:-

- use us this model to save our cost and time
- It is faster and scalable
- It is cheaper and safe

Cloud Computing Deployment Models

→ Public cloud :-

- It is publicly available to all where everyone can access the same resource
- It is deployed globally
- Due to the global deployment, there is less security and privacy as compared to the private cloud.
- It is less expensive that why it is cost efficient.

→ XaaS (Everything and anything as a Service):-

As from the name we can understand that this model provides everything and anything as a service with

remote access, either the service are related to browser, desktop infrastructure etc. It will provide the service for anything with the remote access.

It provide multi tenant model. Here SLA (Service level agreement) is formed.

Multi tenant model means there is one owner which provides many virtual machine. It is cheaper than private.

→ Private cloud :-

- It is not publically available to all.
- It is deployed locally.
- It is more secure than public cloud.
- It is more expensive as compared to public cloud.
- It provides more customization as compared to public cloud.

It is a cloud computing environment dedicated to a single organization. Any cloud infrastructure had underlying compute resources like CPU and storage that you provision on demand through a self-service portal. In a private cloud all resources are isolated and the control of one organization.

→ Type of private cloud:-

1. On-Premise :- An on-premise private cloud is one that you can deploy on your own resources in an internal data center. You must purchase the resources

maintain and upgrade them and ensure security. Its management is expensive and requires heavy initial investment and ongoing expenses.

2. Off-Premise :- Off-premises software is a type of software that is not installed on a company's own servers. Instead from a third-party provider. Off-premises software can exist within cloud technology or as a SaaS model.

→ Hybrid cloud :-

It is the combination of both public and private cloud that is why it is known as hybrid cloud.

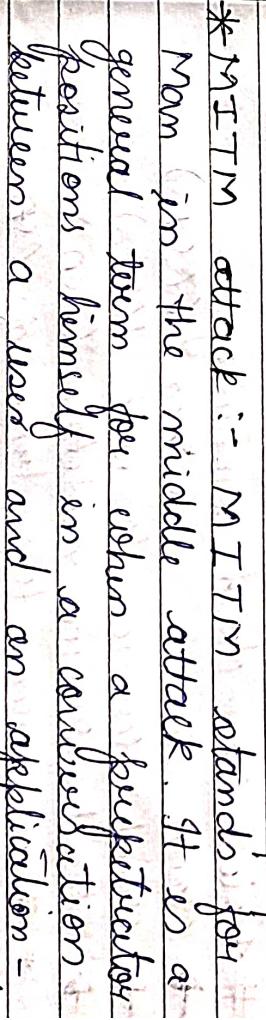
- It is used when we need to perform the critical activities (critical activities are those activities which we don't want to perform publicly but want full security and privacy).
- All the advantage of private and public cloud comes under this.

→ Community :-

A community cloud is a collaboration effort in which infrastructure is shared between

Several organization from a specific community with common concerns (Security, compliance, jurisdiction, etc). whether managed internally or by a third party and hosted internally or externally are some uses community cloud.

Virtualization :- Virtualization is a technology that you can use to create virtual representation of servers and other physical machine. Virtual software mimics the function of physical hardware to run multiple virtual machines simultaneously on a single physical machine.



* MITM attack :- MITM stands for Man in the middle attack. It is a general term for when a perpetrator positions himself in a communication between a user and an application either to eavesdrop on the communication or one of the following pattern, making it appear as if a normal exchange of information is underway.

⇒ Hypervisor :- Hypervisor is a software that you can use to run multiple virtual machines on a single physical machine. Every virtual machine has

its own operating system and application. The hypervisor allocates the underlying physical computing resources such as CPU and memory to individual VM as required.

* If your hypervisor is compromised then if it is called hypervisor tampering for virtualization.

* VM hopping :- It is a common attack mode in virtualization security attack. It means that an attacker attempts to gain access to other virtual device on the same hypervisor based on one virtual machine, and then attacks it.

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* Denial of Service attack (DoS attack):-

It is an attack meant to shut down a machine or network, making it inaccessible to its intended user. DoS attack attempts this by flooding the target with traffic, or sending it information that triggers a crash in both instances, the DoS attack depends legitimate users (i.e. employees, members, or account holders) of the service or resource they expected.

If it is an attack when the attacker increases the no. of request for a particular website or application due to which the site gets down.

Roles in cloud computing:-

- Cloud Service Provider (CSP)
- Cloud Service Consumer (CSC)
- Cloud Service Auditor (CSA)

* These are two types of CSP

- Internal
- External

→ Cloud broker:— It decides which service is given to whom and many more things

→ Cloud carrier:— It provides the networking services by the help of which CSC

met with brokers

Historical Development :-

→ 1950s, when large scale mainframes were made available to school and corporations.

→ 1970s, IBM released an OS called VM

that allowed admin on their system

870 mainframe system to have multiple virtual systems, on - VM on a single

physical node

→ 1990s, telecommunication companies started

offering virtualized private network (VPN)

→ Cloud computing is realized through the advent of Internet

→ 1960s, John McCarthy noted :

- Computation may someday be organized as a public utility.
- McCarthy's prediction foresaw the advent of grid computing in the early 1990's.
- One of the first companies to embrace the cloud was Salesforce.com.

• CRM services via the Internet:

→ Amazon Web Services (2002), Google Docs (2006), and Amazon's Elastic Compute

→ In 2007 Google and IBM partnered

with higher education to introduce cloud computing to academia.

► Microsoft entered the arena with the introduction of Windows Azure in Nov 2009

► few core technologies that played an important role in the realization of cloud computing:-

- Distributed system
- Virtualization
- Web 2.0

Flexibility offers a wide range of services & resources especially in user types

Quick setup and requires less time for implementation

Implementation minimal hardware and management

• Service - oriented computing

• utility computing

► These major milestones have led to Cloud computing:-

- mainframe computing
- cluster computing
- Grid computing

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=Advantages of Public cloud service provider

disadvantages	Public cloud	Private cloud.
cost	generally cost-effective can be more expensive due to use with pay-as-you-go model	& Reliability
		Redundancy

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Disaster recovery	Typically has robust disaster recovery options	Relies on the organization's own disaster recovery plans	and focus on their core competencies	Allows organization to focus on their core business
# Advantages of Private cloud over Public				

Advantages	Private cloud	Public cloud	Network	Cloud
Control and customization	full control over infrastructure and configuration	limited customization due to shared infrastructure	Dedicated network	Cloud network
Security and compliance	enhanced security and compliance and adherence	shared environment may wise security and compliance controls	Performance	Performance
Performance & Reliability	Dedicated resources for performance	Performance may be influenced by resource allocation	influenced by shared infrastructure	influenced by shared infrastructure
Data security	Provides control	Data may rende	over data location in diff. regions	affecting privacy

Disaster recovery	Typically has robust disaster recovery options	Relies on the organization's own disaster recovery plans	and privacy	Our data location and privacy
Focus on core competencies	Allows organization to focus on their core business	Requires more infrastructure management	and privacy	and privacy
Cost predictability	Cost Predictable cost without unexpected changes	Predictable cost based on usage	Our data location in diff. sections affecting privacy	Our data location in diff. sections affecting privacy
Advantages of Private cloud over Public	Private cloud	Public cloud	Our data location in diff. sections affecting privacy	Our data location in diff. sections affecting privacy

Advantages	Control and customization	Network performance	Cost predictability
Control and customization	full control over infrastructure and configuration	resources for improved performance	Predictable cost without unexpected changes
Customization	due to shared infrastructure	influenced by shared infrastructure	potentially less predictable.
Security and compliance	enhanced security and compliance adherence	Legacy system integration with existing legacy systems	May require additional effort for integration with legacy system
Performance & Reliability	Dedicated resources for consistent performance	Performance may be influenced by resource allocation	More control over resource allocation over underlying infrastructure
Data residency	Provides control	Data may reside	

- * SETI :- Search for extra terrestrial intelligence
- * Term cloud computing in 2000
- * load sharing (load distribution in servers)
- * Grid computing :- The main difference b/w grid computing and cloud computing is that there is no need of money in grid computing

Concurrent computing :- Concurrent computing refers to the simultaneous execution of multiple tasks or processes, allowing them to make progress independently and potentially interact with each other. It's a key concept in computer science, enabling efficient utilization of resources and supporting parallelism in system designs.

- * Open stack (NASA and Rackspace) in 2008
- * Rapid growth in 2010
- * Server less computing in 2015, FaaS (function as a service)
- * Edge computing in 2020 (position of computing on user end)

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- 3rd layer - Cloud computing
- 2nd layer - fog computing
- 1st layer - edge computing /雾 computing

No. of devices are more in layer 1 and it decreases as layers increases

- # Parallel computing :- Parallel computing refers to the process of breaking down larger problems into smaller, independent, often smaller parts that can be executed simultaneously by multiple processor communicating via shared memory, the

results of which are combined upon completion as part of an overall algorithm. In other words we can say that on server and on client is parallel computing.

Concurrent computing involves handling multiple tasks or processes concurrently often through the use of threads or processes, enabling efficient use of resources utilization and potentially improving system performance by allowing tasks to execute simultaneously. It's a fundamental concept in modern computing systems, essential for handling tasks in real-time distributed environment, and parallel processing.

Cluster Computing :- Cluster computing refers to the use of multiple interconnected computers, often referred to as nodes or servers, working together as a single system to perform computational tasks. These nodes are typically linked via a high-speed network and may share resources such as storage, memory, and processing power. Cluster computing enables distributed processing, allowing large-scale tasks to be divided among multiple nodes for parallel execution, thereby increasing computation speed and capacity. It's commonly used in scientific research, data analysis and high-performance computing application.

Suppose you have 4 computers or 4 cores in a computer (if can be more than 4) and if any of these computer stops then those 3 remaining computer will try to fix that computer which is not working until it get fixed those 3 computer will share the load.

03/02/2024

Automatic Computing :- Automatic computing refers to the process of performing computing tasks without direct human intervention. It involves the use of computer systems and software programs designed to execute predefined instruction or algorithm without requiring constant manual inputs or oversight. Automatic

computing systems are capable of processing data, performing calculations and executing tasks autonomously, based on predetermined rules or instructions. This concept underlies much of modern computing where tasks are automated to streamline processes, improve efficiency and reduce the need for human intervention.

Client Server architecture:- A network architecture where client request services from centralized server. It is a network model where client devices or application request services or resources from servers, which provides those services or resources in response to the clients requests. In this model client initiate communication & make request, while server

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wait for and respond to those request. This architecture enables distributed computing, allowing clients to access resources or services hosted on remote servers, and it's commonly used in various applications including web browsing, email, file sharing, and database management systems.

⇒ Client - Server architecture v/s cloud computing architecture

Latency

Latency depends on the distance between the client and the server

Aspect	Client - Server architecture	Cloud computing architecture
Definition	A network architecture distributed across the client model providing request service from centralized server	A network architecture on demand requesting services and receive responses over the internet
Resource owner	Resource are owned and managed by the organization	Cloud resource are owned and managed by a provider
Scalability	Scaling requires easily scalable	Scaling made by provisioning hardware often or deprovisioning resulting in more resources as cost and complexity needed

Accessibility	Accessibility depends on network connectivity to the specific server.	Data storage	Data is primarily stored on the cloud and is distributed across multiple servers, potentially across multiple locations, leading to data centers, concentration, improving redundancy and resilience.
Security	Organizations are responsible for server security and data protection.	Cloud providers implement security measures, but data security is a shared responsibility.	<p>Cloud providers implement security measures, but data security is a shared responsibility.</p> <ul style="list-style-type: none"> * Purpose of distributed system <ul style="list-style-type: none"> • to share resources • to utilize them better • true in the case of cloud computing
Application Deployment	Application deployment and updates are managed individually on each server.	<ul style="list-style-type: none"> * Properties :- heterogeneity, openness, scalability, transparency, consistency, continuous availability and independent failures. 	<ul style="list-style-type: none"> # Computer clusters - * is a group of linked computers working together closely thus on many platforms

many respects forming a single computer.

* The components of a cluster are connected to each other through fast local area network.

⇒ Types of cluster

- High availability cluster
- load Balancing cluster
- HPC Cluster

Comparison b/w Cluster, Grid & Cloud.

	Cluster	Grid	Cloud
On demand	X	✓	
Self service			
Broad N/w	✓	✓	✓
Access			
Resource pooling	✓	✓	✓
Rapid elasticity	X	✓	✓
Measured service	X	✓	✓

of service

Vision of cloud computing

- Cloud computing provides the facility to provision virtual hardware, runtime environment and service to a person having money.

- These all thing can be used as long as they are needed by the user, there is no requirement for the upfront commitment.

→ The whole collection of computing system

- is transformed into a collection of utilities, which can be provisioned and composed together to deploy system in hours.

Grid Computing :-

- Grid computing is a term referring to the combination of computer resources from multiple administrative domains to reach a common goal.
- Coordinator resources that are not subject to centralized control.
- Uses standard, open, general purpose protocol and interfaces.
- Delivers nontrivial (important) qualities of service.

rather than days, with no maintenance costs.

→ The long term vision of cloud computing is that IT services are traded as utilities in an open market without technological and legal barriers.

→ In the near future we can imagine that it will be possible to find the solution that matches with our requirement by simply entering our request in a global digital market that bodes with cloud computing services.

→ The existence of such market will enable the automation of the delivery process and its integration into its existing software system.

→ Due to the existence of a global platform for boding cloud service will also help service providers to potentially increase their money provider.

→ A cloud can also become a consumer,

of a competitor service in order to fulfill its promises to customers.