Cloud Computing

UNIT-1:

- Computing Paradigms
- Cloud Computing Fundaments
- Cloud Computing Architecture & Management

High Performance Computing (HPC)

→ uses Powerful Processors
→ uses Supercomputers for complex tasks.
→ using Powerful Computers

Cluster Computing

→ Group of nearby computers.
→ High-Speed Processing.

Distributed Computing

→ A System where many computers work together to
- to solve a problem
- but appear to the user as a Single System

→ Resource Sharing - CPU, memory
→ Scalability - Easily add more computers

ex: - ATM networks
- Online banking
- Google Search.

→ It is a model where many computers work together on 1 Problem

⇒ Distributed Computing is the foundation of CC

Grid Computing

→ Computers in different locations connected to work as one big System.

Uses: - Scientific research

Bio Computing

→ Combines biology + IT
→ DNA used for computation.

ex: DNA computing.

→ Use
drug design

Mobile Computing

→ Computing through mobile devices
- via wireless networks

ex: - UPI apps
- whatsApp

→ Anywhere access

Network Computing

→ Sharing resources via n/w (LAN/WAN/Internet)

ex: Email, file Sharing

*NIST Defn of CC

→ CC is a model for enabling convenient, on-demand n/w access that can be rapidly provisioned & released with minimal mgmt effort or Provider interaction.

Essential characteristics → 5 essential characteristics

1. On-demand Self-Service
2. Measured Service
3. Rapidly Provisioned
4. Rapid elasticity
5. Measured Service

*Need for CC

1. Cost Saving:
   - No need to buy costly h/w or s/w
   - Pay only for what you use.
2. Scalability:
   - increase or decrease resources anytime,
3. Accessibility:
   - Use services from anywhere with internet.
4. Faster Deployment:
   - Apps can be deployed in minutes.
5. Data Backup & Recovery:
   - cloud keeps multiple copies of data.
6. Flexibility

*Principles of CC → foundation

→ the principles of CC are the basic ideas & rules that guide how cc works.

→ These principles make the cloud:
- Scalable (can grow easily)
- Reliable (works continuously)
- Efficient (uses resources wisely)
- Cost efficient (Pay only for use)

1. Virtualization
2. Resource Pooling
3. Scalability & Elasticity
5. Broad N/w access
6. Measured Service
7. Multi-Tenancy
8. Security & Privacy,
9. Automation.

Additional Supporting Principles

1. Abstraction [users don't see or understand h/w, they only use services]
2. Reliability [data is stored in multiple servers for backup.]
3. Availability [services are available 24x7]
4. Interoperability [diff cloud systems can work together via APIs]

Ex: Google Drive follows all principles:
- Virtualized storage
- On demand use
- Shared resources
- Pay-as-you-go model
- Access from any device.

5- Essential characteristics (OBRRM)

→ On-demand self-service
→ Broad n/w access
→ Resource pooling (Multi-tenancy)
→ Rapid elasticity
→ Measured service.

→ CC is a technology
- It delivers computing resources
- Servers, storage, databases, s/w over the internet (cloud) on Pay-as-you-go bases

① On-demand Self-Service

→ We can get any resource, whenever we want.
- like Server, s/w storage.
→ Creating a new Google Drive folder anytime

② Broad N/w Access

→ Cloud services can be accessed at anywhere & anytime.
→ we need internet.
→ We can use from any device like mbl, laptop...
ex: We can open Gmail on mbl, laptop or tablet from any place.

③. Resource Pooling (multi-tenancy)

→ Many users share cloud resource.

→ It works like a water tank
  ← shared by many houses

→ Cloud provider manages everything.

ex: Gmail

④. Rapid Elasticity

→ We can increase or decrease automatically based on need.

→ It expands like a rubber band.

ex: During sales, apps increases servers

⑤. Measured Service

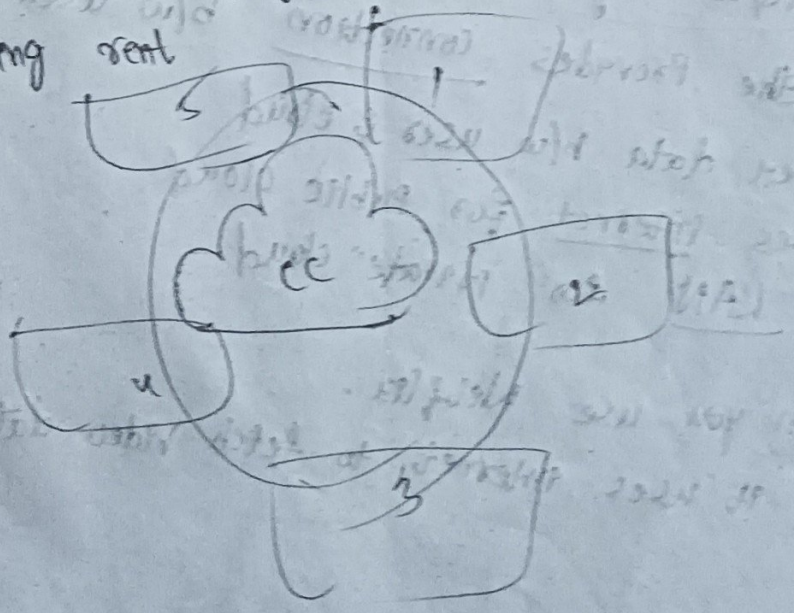
→ It follows Pay-as-you-go model.

→ We just pay for what we use

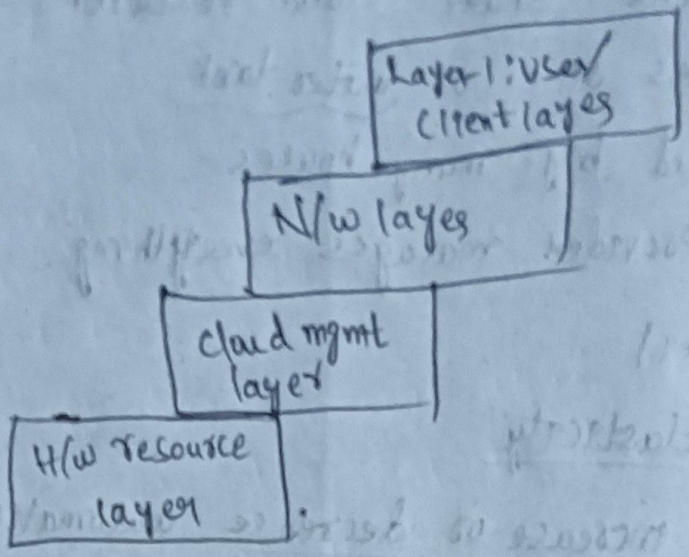
→ It tracks how much you use & charges

ex: electricity bill

- ₹ Instead of buying a new house
- ₹ Taking rent



CC Architecture



Layer-1: (Client Layer)

→ lowest layer in cloud architecture.
→ All the users belong to this layer.
→ users interact with the cloud.

(Users sends a request → Cloud receives → Processess it)

Clients:
- users — web browsers
- mobile
- laptops

⇒ You open Gmail (You are client)

Layer-2: (N/w Layer)

→ It ~~is~~ the Provides connection b/w user & cloud
→ Transfer data b/w user & cloud
→ It uses internet for Public cloud
→ uses LAN for private cloud

ex: when you use Netflix.
- it uses internet to fetch video data

Layer-3: Cloud Management Layer

→ this layer manages & controls all cloud operations
→ It includes: Resource allocation, Monitoring, load balancing, security...
→ It is like brain of the cloud.

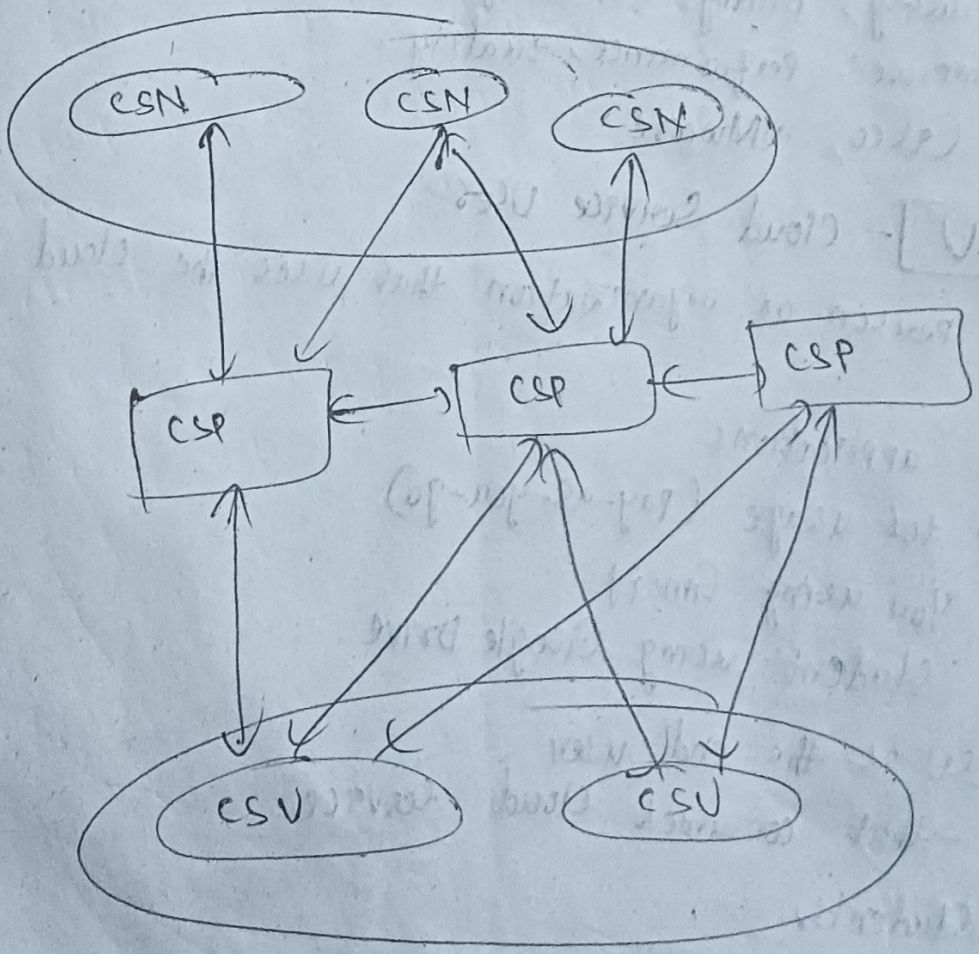
ex: Aws Cloudblatch

Layer-4: Hardware Resource Layer

→ Bottom layer in the architecture
→ this layer contains the physical hardware used by the cloud.
→ It includes: Servers, Storage, Power supply

ex: Google's Data center.

Data Centers



@ Actors in @Cloud / cloud Ecosystem

1. CSP (Cloud Service Provider)

→ the company that provides cloud services

→ Role:
- Owns data centers
- Provide storage
- maintains server, security
- offers IaaS, PaaS, SaaS.

Ex: AWS, Microsoft Azure, Google cloud, IBM cloud

⇒ A CSP is the organization that provides cloud services
- such as servers, storage, S/w

2. CSN (Cloud Service N/w) or Partner.

→ A third-Party company that supports CSP
- by providing tools, services

Role:
- Provides additional services
- security, billing, monitoring
- Improves performance, quality.

ex: Cisco, VMware

3. CSU - Cloud Service User

→ the person or organization that uses the cloud service.

Role:
- uses applications
- Pays for usage (Pay-as-you-go)

ex: - You using Gmail
- Student using Google Drive.

⇒ A CSU is the end user
- that consumes cloud service.

ex: Students.

Requirements for Cloud Services

→ the cloud services / service offering models require certain features to be exhibited
- in order to be considered as services.

1. **Multitenancy:** - essential characteristic of cloud systems
- It is ~~expected~~ expected that multitenancy be supported at various levels of a cloud Infrastructure.

ex: At appln level, multitenancy is a feature
- that allows a single instance of an appln & leverages the economy of scale
- to satisfy several users at the same time

2. **Service life cycle mgmt:**
- cloud services are paid as per usage, & can be started & ended at any time,
- ∴ It is required that a CS (cloud service) support automatic service provisioning,

3. **Security:** Security of each individual service needs to be protected on the mul

4. Responsiveness

5. Intelligent Service deployment

6. Portability

7. Interoperability

8. Regulatory aspects

9. Environmental Sustainability

10. Service reliability, Service availability & Quality assurance

11. Service access

12. Flexibility

13. Accounting & charging

14. Massive data processing

1. Multiple users can

Interoperability : Different clouds / systems can work together

Regulatory Aspects : Follow laws

Environmental Sustainability :
Eco-friendly data centers, renewable energy

Service Access ; Anywhere, anytime access via internet, APIS

Flexibility : Scale-up / down
Pay-as-you-go usage

Accounting & Charging : Transparent billing & cost tracking for usage

Massive Data Processing ; Handle Big data, AI, IOT

Intelligent Service Deployment ; Smart, automated deployment using AI / ML

Portability ; Move apps / data easily across different clouds

Responsiven

* Cluster Computing

Classification of cluster

1. Open cluster: IPs are needed by every node & these are accessed only through the internet or web. This type of cluster causes enhanced security concerns.
2. Close cluster: the nodes are hidden behind the gateway node, and they provide increased protection. they need fewer IP addresses & are good for computational tasks.

Advantages

→ High performance
→ Easy to manage
→ Scalable (resources can be added)
→ Expandability
→ Availability
→ Flexibility (It can be upgraded to superior specification)

Disadvantages

→ High cost
→ Problem in finding fault (difficult to find which component has a fault)
→ More space is needed.

Applications

→ Weather forecasting
→ image rendering
→ e-commerce appln
→ data mining, aerodynamics, astrophysics
→ Complex computational problems can be solved.
→ Earthquake Simulation

Quantum Computing → fast

→ It uses qubit ⇒ exists on both 1 & 0's states

→ Regular Computers make use of bits ⇒ exists only one ON/OFF
If ON – works (process) uses logic gates
OFF – No work done

→ qubit can do which bit can't do

→ QC has 2 properties:

1. Quantum Superposition – at a time QC can exist on 2 states
2. Quantum Entanglement – If 1 do anything 2 can do same

Adv

→ Speed is fast
→ Parallel processing of info
→ cryptography
→ Chemistry.

Dis

→ Noise & decoherence
→ Scalability
→ Error Correction
- difficult to detect, correct
→ lack of robust quantum algo
→ High cost
→ high power consumption

Automated algo^m available

Optical Computing

→ Also known as Optoelectronic computing & Photonic Computing

→ uses photons to process info

→ Photons have higher bandwidth than electrons
(bandwidth → more speed of travelling; electrons → used in convent comp^r sy

→ Speed of computation depends on 2 factors:
- how fast

Adv:

- Low heating
- Can tackle complex computations very quickly
- Increased computation speed.
- Higher bandwath
  → low data loss transmission
- Free from electrical short circuits.

Dis:

→ high cost
→ Size is very bulky
→ Integrating optical gates is complex.
→ Interence can be caused by dust or any imperfections.

Nano Computer

→ A nano computer refers to a computing device which utilizes nanotechnology principles for its construction & operation.
→ It is very small in size.
→ these are much smaller than any other type of computer.
  - bcz their parts and circuits are made at the nano level
  - using nanotechnology.
→ Nanotechonology: It is the science of manipulating matter at the atomic or molecular level
  - to produce macroscopic devices.