

Cloud Computing UNIT-3

- ⇒ Cloud Architecture, Layers
- ⇒ Anatomy of the Cloud
- ⇒ Network Connectivity in Cloud Computing
- ⇒ Applications on the Cloud
- ⇒ Managing the Cloud
- ⇒ Migrating Application to Cloud
- ⇒ Phases of Cloud Migration
- ⇒ Approaches for Cloud Migration.

Cloud Architecture

- ⇒ Every technology has a structure called architecture that explains how it works. The cloud also has an architecture that describes how it functions.
- The cloud depends entirely on the internet to work.
- ⇒ The cloud architecture has four layers that show how users access and use the cloud.

① Layer 1 : User/ client Layer :-

- ⇒ This is the lowest layer of cloud architecture. It includes users or clients who connect to the cloud.
- ⇒ Users can use devices like:

① Thin client :- Needs help from another system to work properly.

Example:- A basic computer in an office that cannot run software on its own. It connects to a server to access programs and files.

② Thick client :- works on its own, like a regular computer.

Example:- A work computer with installed softwares like Excel, Photoshop, AutoCAD that runs locally without needing a server.

③ Mobile phones or Tablets :-

These are handheld devices (like your smartphone or iPad) that can access the internet and cloud applications.

Example:- Using apps like YouTube or Google Drive on your phone.

④ Layer 2 :- Network Layer :-

This layer allows users to connect to the cloud. The connection is usually the internet (for public clouds) or a Local area network (LAN) (for private clouds).

Example:- for public cloud :- you use Google Drive or Amazon Services, which are available world wide. You don't know where the cloud's data center is located, it is hidden.

Example for private cloud:-

A Company may use its own cloud only within its office building or Organization.

⇒ A good network (like fast Internet) is needed to use cloud Services smoothly.

⇒ If your internet is slow or stops working, it's not cloud providers fault. For example, you use youtube or Gmail, if your internet is slow, it's not youtube's fault.

③ Layer-3: Cloud Management Layer:-

This layer has Software that manages and controls cloud operations.

Cloud Operating Systems:-

These are Special Software that connects the user (you) to the cloud resources like Servers, Storage and data.

Example:- Like windows connects you to files and programs on your computer, cloud OS connects you to cloud resources.

Management Software:-

These tools help in managing cloud resources:

Scheduling:- Deciding when and how tasks should run

Optimizing:- Using resources like Servers and storage efficiently.

Organizing workloads:- Managing tasks and work happening in the cloud.

⇒ This layer directly affects SLAs (Service-Level Agreements). SLAs are agreements between the cloud provider and the User.

They guarantee things like performance, Speed, Availability

The cloud will work fast

Services will be available without delay

The cloud will be accessible when needed.

⇒ If something goes wrong (e.g. delay or service issue) the cloud provider must pay a penalty for breaking the agreement.

public cloud Examples: Amazon web services, Microsoft Azure.

private cloud Examples: OpenStack, Eucalyptus

④ Layer 4: Hardware Resource Layer

- This layer includes the hardware resources that power the cloud.
- Data Centers: Large buildings full of servers and hardware where cloud data is stored and processed
- public cloud: The data center is managed by the cloud provider
- private cloud: The data center can belong to the organization using it.
- This layer is the most critical for SLAs because it ensures that resources (like server or storage) are delivered quickly and reliably.
- If there is a delay or failure, the provider must pay a penalty as per the SLA.
- Data centers are connected with high-speed networks and use efficient systems to transfer data.
- Sometimes, multiple clouds share the same data center, or a single cloud may use several data centers.

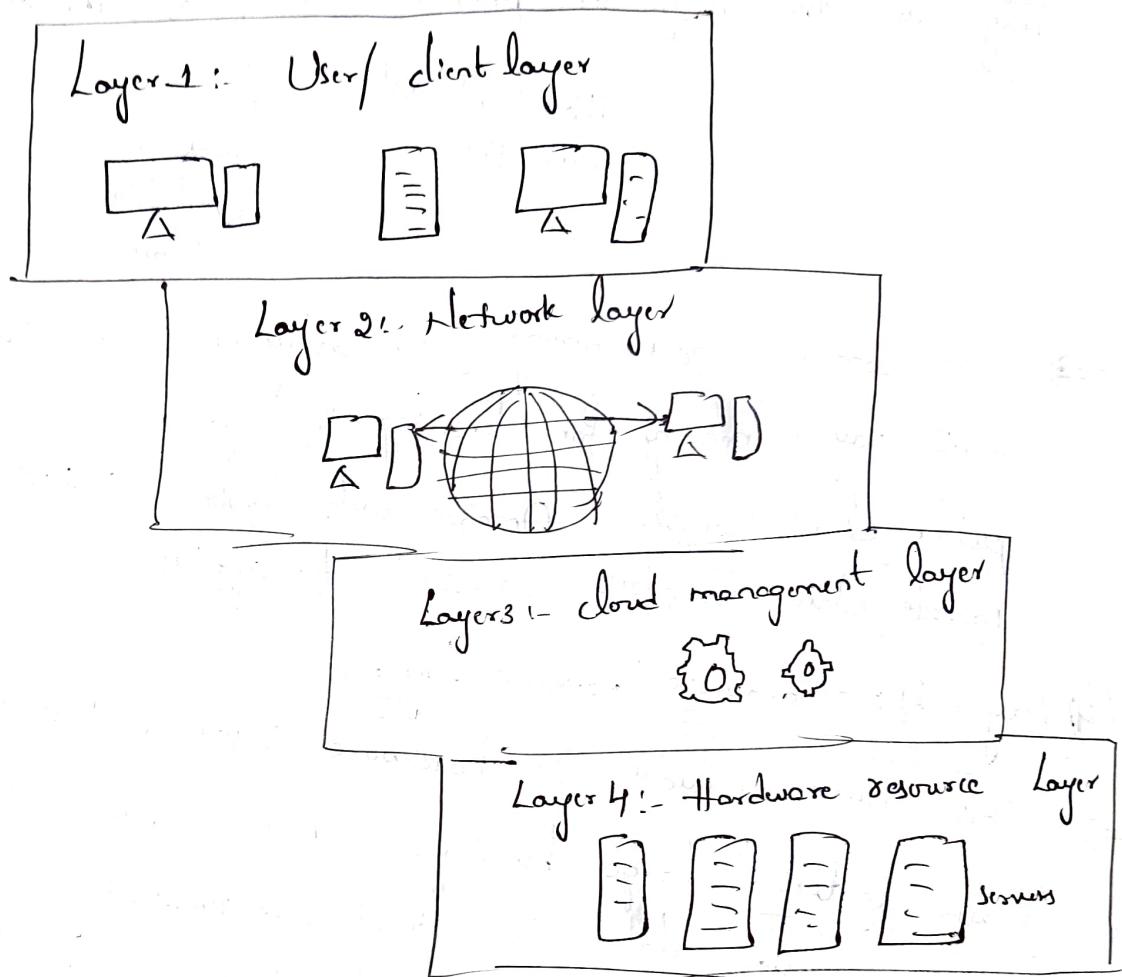


fig cloud Architecture

Anatomy of the cloud

→ cloud anatomy means the basic parts that makeup the cloud.

5 Basic parts of cloud Anatomy

① Application:

→ This is the top layer where your apps (Software) run.
Example: Apps like Google Docs, Zoom, Gmail that you use on the cloud

② Platform:

→ This is the middle part that helps apps run properly.
It connects the apps to the hardware.
Example: Operating System like windows or Linux.

③ Infrastructure:

This is the power that makes the cloud work.

It has 3 main things

processing power
(computer to do the work)

Storage
(to Save files and data)

Network
(to Send data across the internet)

Example: Big Servers in the cloud store your photos and process your Google Searches.

④ Virtualization:

This means Creating Virtual Systems from real physical machines.
A single physical machine can act like many virtual machines.

Example: One big Server can be divided into smaller virtual servers that work like separate computers.

5) Physical Hardware:

This is the real hardware like servers and storage devices that keeps the cloud running.

Example: Big computers and storage machines placed in data centers.

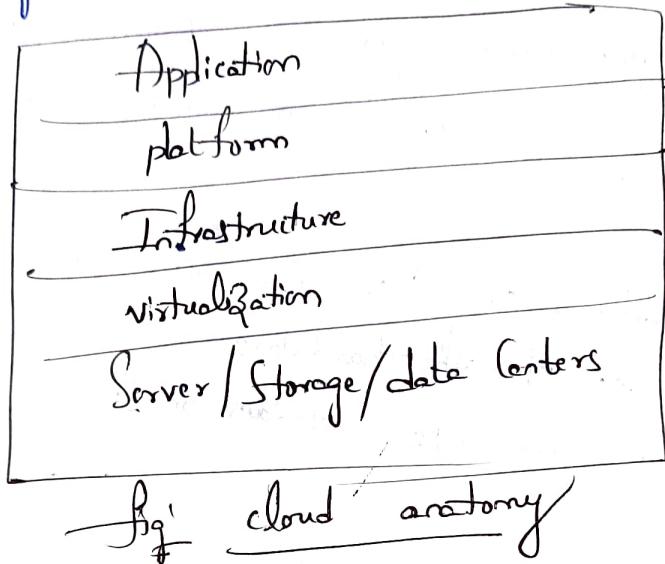


Fig: Cloud anatomy

Google Drive Example:

- you upload a document (Application)
- the document is processed using Google's software (Platform)
- it is sent over the internet and saved on cloud servers (Infrastructure)
- the server is divided into smaller virtual servers to store files from many users (Virtualization)
- these servers are part of the real hardware (Physical hardware) in Google data centers.

This single example shows how all the parts work together in one service.

Network Connectivity In Cloud Computing

- ⇒ cloud computing lets us share things like servers and storage using networks. These resources are connected through the internet so people can run applications and get results. The speed and quality of the network are very important for cloud computing to work smoothly.
- ⇒ there are different types of cloud setups, and how the network is connected plays a big role in how people access the cloud. The two main types of connections are public cloud and private cloud.

① Public Cloud Access:-

- public clouds connects to users through the internet. Some providers also offer VPNs (Virtual Private Networks) for safer connections.
- Security is a common problem in public clouds because they are open to everyone on the internet. To keep data safe, providers use encrypted tunnels (like secure pathways), but this can slow down the connection.
- To speed things up, better paths can be chosen. For example, using a shorter route between the cloud and the user can make the connection faster.
- Since public clouds rely on the internet (which is managed by many companies called ISPs), it's important to choose the best path to send data quickly.

② Private Cloud Access:-

- private clouds are part of a company's own network, so they are more secure and easier to control.

- ⇒ They might use ~~internet~~ internal networks or VPNs for connecting users.
- ⇒ If the company already has a good network, moving to a private cloud won't cause any big changes or slow down performance.

Public Intra-cloud Networking:

- ⇒ In public clouds, resources (like servers) may be far apart but are connected through the internet. The connections between resources are managed by the cloud provider, so users don't see or control them.
- ⇒ Security and access to resources are important. The cloud provider promises certain performance levels, which are defined in agreements called SLAs (Service Level Agreements).

Private Intracloud Networking:

- ⇒ In private clouds, the company connects its own data centers. These connections are used to handle internal applications.
- ⇒ If the company's applications are built in small parts (following a method called SoA), the data has to move between these parts and the users. This increases the need for strong connections.
- ⇒ The connections between users and resources are within the application itself, affecting performance.
- ⇒ The way the application is built and the network setup impacts speed and reliability.

(5)

New Facets (challenges) in Private Networks

- Before, Companies had their applications on their own Servers. Now, many companies are moving these to the cloud using Services like SaaS (Software as a Service) means Companies ^{rent} Software over the Internet instead of installing it in their office.
- ⇒ Old networks were designed for office Servers, not cloud based tools. If network (internet connection) fails, people won't be able to use critical tools like Email, ERP (Enterprise Resource Planning) for managing Company operations. This means businesses can't work if they lose access to these tools. So Networks must be like electricity, if the network goes down, work stops.
- Companies need networks that can handle old style tools (stored in the office) and new style tools (stored in the cloud).
- ### Path for internet Traffic
- Older networks used only a few internet gateways (access points that connect users to internet). Fewer gateways mean slower connections to cloud based tools for users.
- ⇒ Adding more gateways in different locations will help users access cloud applications faster.
- ⇒ Some tools like video calls, use a lot of internet data. This requires a well planned network.
- ⇒ Companies should plan how to connect users to cloud services efficiently, choosing shortest and faster paths.

Applications on the cloud

Applications are what make a computer useful. Overtime, different types of applications have been developed:

① Stand-alone Applications:

- These run on a single computer and do not need a network to work. They use only the resources of the machine they are installed on.
- These applications are independent and do not need data or processing power from other systems.

Example:- A basic calculator app installed on your computer.

② Web Applications:

As user needs grew, applications were created that could be accessed by other people over a network.

- These are called web applications and work using the client-server model.

Server:- A powerful machine where the web application is installed.

Client:- A user's computer or device that connects to the server through the internet.

Example:- Email services like Gmail or social media platforms like Facebook.

While web applications became very popular, they had some limitations.

- ① not elastic- If too many people tried to use the application at the same time, it would stop working or slow down because it couldn't handle extra pressure.
- ② not multitenant- Each user needed their own separate system or copy of the application.

③ Couldn't measure Services for Users.

Users couldn't pay only for the amount of Service they used

④ Worked on only one Specific platform.

The application could only run on one type of System or Software.

For example, an app might only work on windows computers and not on Mac or Linux Systems.

⑤ Didn't offer flexibility like pay-as-you-go options.

→ Users had to pay for the full Service, even if they didn't use it much.

Applications on the cloud

→ Cloud applications are similar to web applications but are designed to overcome the limitations of traditional web apps. They are often provided as Software as a Service (SaaS) and have unique features that make them better.

Features of cloud Applications.

① Multitenancy:-

→ One application can serve many users at the same time. Each user feels like they have their own private version of the app, even though the software is shared.

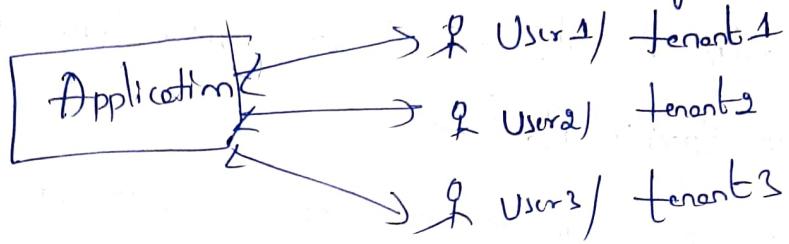
→ changes made for one user do not affect others.

Example: Online banking apps where many users access the same app, but their accounts and data remain separate

② Elasticity:-

→ the system can automatically handle changes in user demand. For example, if there are many users at one time, the cloud provides more resources, when demand reduces, it uses fewer resources

→ This ensures smooth performance even during busy times.



③ Heterogeneous cloud platform:

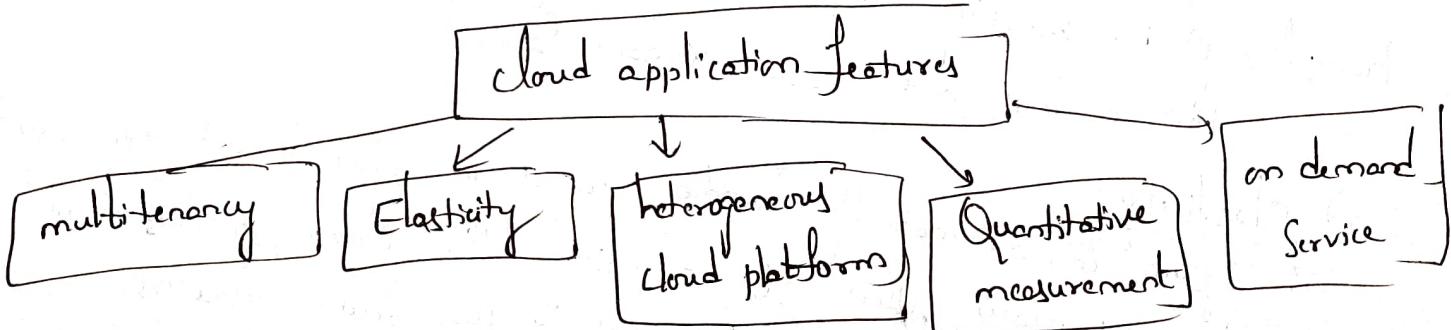
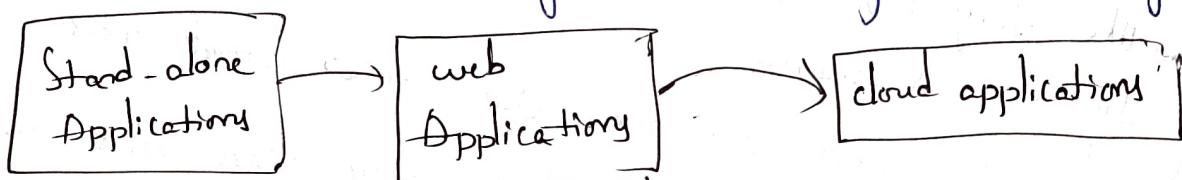
The cloud can support different types of applications. Developers can create and deploy apps easily. Users can access these apps through a web browser on any devices, regardless of the Operating System.

④ Quantitative measurement:

→ Cloud services are measurable. Users are charged based on what they use. This "pay-per-use" model is similar to how we pay for electricity or water bills.

⑤ On-demand Service:

→ Users can access services whenever they need them, without restrictions. They can use the service on any device, at any time, from anywhere.



Managing the cloud (cloud management)

⇒ Cloud management means taking care of the cloud to ensure it works well and provides good quality Service (QoS). It's very important because the cloud's success depends on how it's managed. Cloud management has two main parts:

functions of cloud management

- ① managing the cloud infrastructure (the physical and technical systems that run the cloud)
- ② managing the applications (the programs that run on the cloud)

① managing the cloud infrastructure - (Infrastructure management)

→ The cloud infrastructure is like the backbone of the cloud. If it's not well managed, the whole cloud system may fail, and users won't get the promised service quality. Good infrastructure management focuses on:

Resource management - this means managing resources like servers, storage, and bandwidth. Tasks include:

Scheduling

Deciding which task gets resources and when.

provisioning

providing resources as needed

Load Balancing

Ensuring no server is overloaded.

If resources are not managed properly,

- Performance gets worse, and users may face slow or interrupted services.
- Functionality (basic features) may stop working.
- Costs can increase, making the cloud expensive for users and less profitable for providers.

Efficient management focuses on

- ① performance :- Always keep the Systems running well.
 - ② Costs :- managing the cloud at lower cost to attract more users
 - ③ Energy Efficiency :- Use less power by techniques like Server Consolidation, which combines workloads onto fewer servers.
- Infrastructure management is especially important in IaaS (Infrastructure as a Service) where resources are shared by multiple users.

② Managing the Cloud Application (Application management)

Companies move their apps to the cloud to become faster and meet changing needs. But cloud apps are complex because they rely on:

→ cloud storage and databases

→ third-party tools like email or messaging services.

challenges of managing cloud applications:

- Ensuring apps always work (availability and uptime)
- monitoring the cloud infrastructure to support the apps
- managing policies like security, governance, and audits

Solutions for managing cloud apps:

- Use tools that monitor app performance and fix issues automatically, like increasing capability or adding resources
- Collect data to analyze and make improvements.

Migrating Application to cloud

⇒ Cloud migration means moving your Software and data from your current System to a cloud based System.

phases of cloud migration:

① Evaluation (check your current Setup)

- Look at what you have now - your Software, Storage, Costs.
- check if its safe and worth moving to the cloud.

② Migration Strategy (plan the move)

- you can move everything at once (hotplug) or move one part at a time (fission)

③ Prototyping (Do a Small Test)

- Test a small part of your system on the cloud to make sure everything works.

④ Provisioning (Setup the cloud)

- prepare the cloud by installing your Software and copying your data.
- Make sure everything connects and works smoothly.

⑤ Testing (Final checks)

- After moving, check if the system works well. Test if it can handle many users, problems, or heavy work.

Approaches for cloud migration:-

There are four main ways to move to the cloud:

① migrate Existing Applications

- Update and rearchitect current applications to run on the cloud

② Start from Scratch:

- Build entirely new applications designed specifically for the cloud.

③ Separate Company

→ Create a new team or company dedicated to cloud operations
for better focus

④ Buy an Existing

→ Acquire a cloud company to quickly enter the cloud market
and leverage their setup.

cloud vendor

Companies that

Provide
Cloud Services