Internet Architecture —

Internet Architecture explains how data is structured, seat and controlled across network.

There are different models. Each model is designed to solve specific problems, and often, networks use a mix of models.

Every model has its own advantages and trade-offs in terms of —

- Scalability
- Performance
- Security
- Manageability

1. Peer-to-Peer (P2P) Architecture —

In a P2P network each device (or node) acts as both a client and a server. This means devices can connect directly to each other to share files, processing power, or bandwidth, without needing a central server.

P2P networks can be :-

- Fully Decentralized no central server, or
- Partially centralized a central server helps coordinate, but doesn't store data.

Real-World Example —

BitTorrent is a common P2P system :

- Users who have file (called seeders) upload it.
- Others download parts of the file from many source at once, making it fast and efficient.

This architecture enables direct sharing, reduces server load and improves file availability.

2. Client - Server Architecture -

The Client - Server model is common internet setup where clients (user devices) send requests and servers respond with the needed data or services.

In this model:

- Clients are devices like phones or computers.
- Servers are powerful systems that store data and handle requests from many clients.

Example -

- You open your browser and type weatherexample.com.
- Your browser (the client) sends a request to the server hosting that website.
- The server processes the request and sends back the weather data.
- Your browser displays it on the screen.

A key part of this model is the tier system, which separates server functions into layers.

The client-server model is used in websites, email-systems, online banking and many more internet services.

Notes
- Single - Tier Architecture -
  - In this setup, the client, server and database are all on the same machine.
  - It is simple but not ideal for large-scale apps because it lacks scalability and security.

- **Two - Tier Architecture —**

This model separates the system into —
- Client handles the user interface or presentation.
- Server handles the database and data processing.

It's commonly used in desktop applications, where the client connects directly to the server (usually database) to run queries and access data.

Three - Tier Architecture —

This model splits the system into 3 layers —
- Client (Presentation layer) — Handle the user interface.
- Application Server (logic layer) — Processes business logic.
- Database Server (Data layer) — Stores and manages data.

Each layer is separate, which improves flexibility, scalability and maintenance.

- **N - Tier Architecture —**

In N - Tier, there are more than 3 layers, with each tier handling a specific task, such as authentication, business rules or data processing.
- Used in large web application
- Offers high scalability, modularity and distributed deployment.

Note — While tiered architectures improve performance, security and flexibility, they also add complexity. Each tier must be properly configured, secured and efficiently connected to prevent delays and vulnerabilities.

3. Hybrid Architecture —

- A Hybrid Architecture combines features of both Client-Server and Peer-to-Peer (P2P) models.
- A central server handles authentication, session control and coordination.
- Once connected, actual data transfer (like videos or files) happen directly b/w devices using P2P.

Example —

In a video conferencing app:
- You log-in — the central server verifies your username and controls the meeting setup.
- Once the meeting starts, audio and video data is sent directly b/w participants, reducing lags and easing server load.

This model combines the control and security of client-server with speed and efficiency of P2P communication.

4. Cloud Architecture —

Cloud Architecture is a type of computing setup where infrastructure like servers, storages and applications is hosted by third-party providers (eg AWS, Azure). It follows a virtualized client-server model and gives users on-demand access to resources over the internet without managing the hardware behind it.

Example —

Apps like Google Drive or Dropbox follow the SaaS model, where users access software online while the cloud provider handles the hardware.

5. Software - Defined Networking (SDN) -

SDN is mordern networking model that separates the -

- Control Plane - decides where traffic should go.
- Data Plane - actually forwards the traffic.

Traditionally, both planes were inside the same network device (like routers). But in SDN the control panel is centralized in a software-based controller, while network devices just follow its instruction.

This setup make network -

- Programmable
- Easier to manage
- More flexible

Example -

Large companies or cloud providers use SDN to -
- Dynamically manage traffic
- Allocate bandwidth based on real-time needs.

SDN gives full control over the network from one central point, improving efficiency and automation.