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Computer Network:

Computer Network can be defined as a collection of autonomous computers interconnected by a single technology. A collection of interconnected devices that communicate and share resources like files, internet access and printers. These connections can be Wired or Wireless.

 # Fact:

Neither the Internet nor the World Wide Web is a computer Network.

The internet is not a single network but a network of networks.

Web is a distributed system that runs on top of the Internet.

Types of Networks:

1. **LANs**

Local Area Networks are privately owned networks within a single building or campus of upto a few kilometers in size. Widely used to connect personal compu. in company offices to share resources. LANs are distinguished from other kinds of networks by the following characteristics:

i) LANs are restricted in size –

It covers a known area of 30-50m or 100-300 m (Wi-Fi) and up to 100m (Wired).

ii) Transmission Technology -
. LANs use a transmission technology
consisting of a cable to which all
machines are attached. Traditional LANs
run at speeds of 10 MBPS to 100 MBPS,
have low delays and make very few errors.
Newer LANs operate at up to 10 Gbps.

2. PAN
Personal Area Network is a small network
designed for personal devices to communicate
within a very short range (1 to 10 meters).
It connects devices like
- Smartphones & laptops
- Smartwatches & Fitness Trackers
- Wireless Headphones & Bluetooth Speakers.

PANs are of 2 types:
→ Wired PAN - Uses USB or other cables.
→ Wireless PAN - Uses Bluetooth, Wi-Fi

3. MAN
Metropolitan Area Network is a network
that spans a city or a large campus,
typically having range 10 to 100 kms.
It is larger than LAN but smaller than
WAN. Commonly used by large organizations
to connect multiple LANs within a
specified geographical area. It uses fiber-
optic cables, wireless connections or leased
telecommunication lines to provide high-speed
data transfer & internet access.

Example: Cable television Network.

4. WAN

Wide Area Network connects multiple LANs or MANs across large distances, ranging from 100 km to Worldwide. It uses fiber optics, satellites or leased telecom lines to enable communication between cities, countries or even continents. WAN is slower than LAN/MAN but enables global communication.

Examples: The Internet
Bank Networks connecting ATMs nationwide

Goals of Computer Network:

- Resource Sharing - Sharing files, printers
- Communication - Allowing messages, video calls, etc.
- Reliability - Ensuring data is accessible & backedup
- Scalability - Can easily add more devices
- Security - Protecting data from unauthorised access.
- Cost Efficiency - Reducing hardware costs by sharing resources.

Components of a Computer Network:

1. Hardware Components:-
- Nodes (Devices)
- Network Interface Card (NIC)
- Switches
- Routers
- Modem

- Cables and Wireless Media

2. Software Components
- Network Operating System (NOS)
- Protocols
- Firewalls and Security softwares.

These components work together to ensure seamless data transfer, connectivity and security in a network.

Computer Network Architecture:
Network Architecture refers to the design and structure of a network that defines how devices communicate, manage data from and ensure security. It includes both - physical & logical layouts of a network.

Types of Network Architecture:
1. Peer - to - Peer (P2P) Architecture
In a point-to-point network, all computers are directly linked together without a central server. They share equal responsibilities and resources.
Best suited for small networks like home or offices.
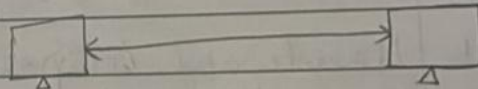
Advantages -
- Simple & Cost-effective
- No need for a dedicated server.
- Easy to set-up
- If 1 device stops working, no effect on others.

Disadvantages:
- Not scalable for large setups.
- Security and data management can be difficult.
- No data backup without server.

2. Client - Server Architecture:
Also known as 'Request - Response' Architecture.
In this model, a central server manages
resources and communication for multiple
clients. Used in large organizations, web
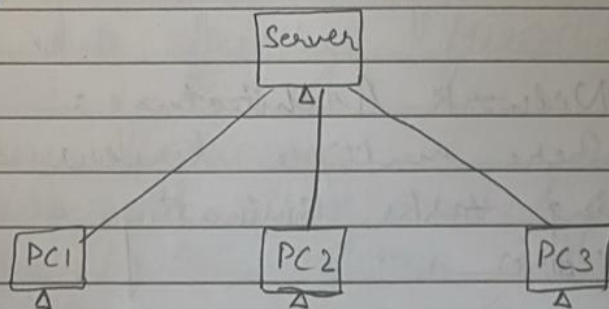applications and enterprise networks.
Example - A bank server managing multiple
            customer requests.

Advantages:
- Centralized data management. (Easy back-up)
- High security and control
- Scalable for large networks.
- Increased speed of resource sharing.

Disadvantages:
- Requires a dedicated server, which can be
  expensive.
- If the server fails, network will be disrupted

Types of Network Architecture based on Design:

1. Centralized Network Architecture:
A single central server controls all network operations and manages data processing. Clients depend on the central system for resources and services.

Key Features
- Single point of control
- High security and easy management
- Efficient for structured environments like banking systems.

Example -
- Mainframe - based banking networks.
- Traditional data centers.

Advantages
- Centralized security
- Easy maintenance

Disadvantages
If central server fails, whole network is affected.

2. Distributed Network Architecture:
A network where multiple servers or nodes share processing tasks, eliminating a single point of failure.

Key Features:
- Data is spread across multiple systems
- Load balancing for better performance.
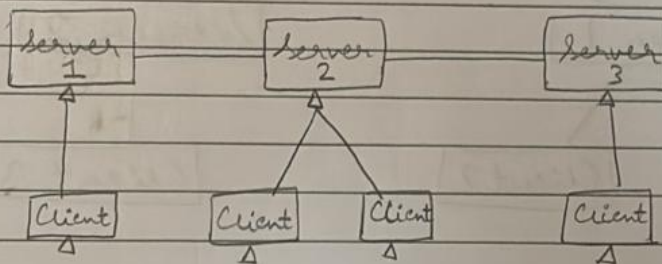- Used in cloud computing and block chain technology.

Example-
- Google Cloud Services
- Blockchain networks (eg: Bitcoin, Ethereum)

Advantages:
More reliable and scalable

Disadvantages:
Requires complex setup and management.

3. Hybrid Network Architecture
A combination of Centralized and Distributed models, offering flexibility and efficiency.

Key Features
- Uses both client-server & peer-to-peer methods.
- Can switch between centralized & distributed processing based on demand.
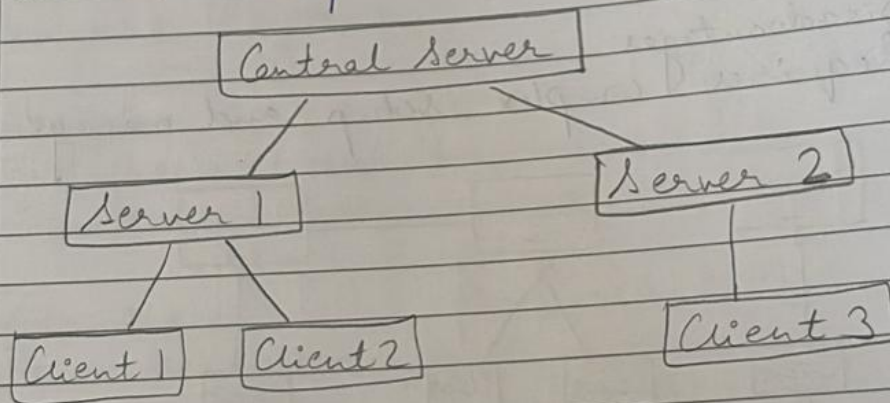- Common in large enterprises & smart cities.

Example:
- Corporate networks using both cloud & local servers.
- Smart Grid Systems.

Advantages:
- Flexible
- Scalable
- Efficient

Disadvantages
Can be complex to manage

\# The choice of network architecture depends on security, scalability and fault tolerance. While centralized networks offers control, distributed architectures provide reliability, and hybrid models combines the best of both.