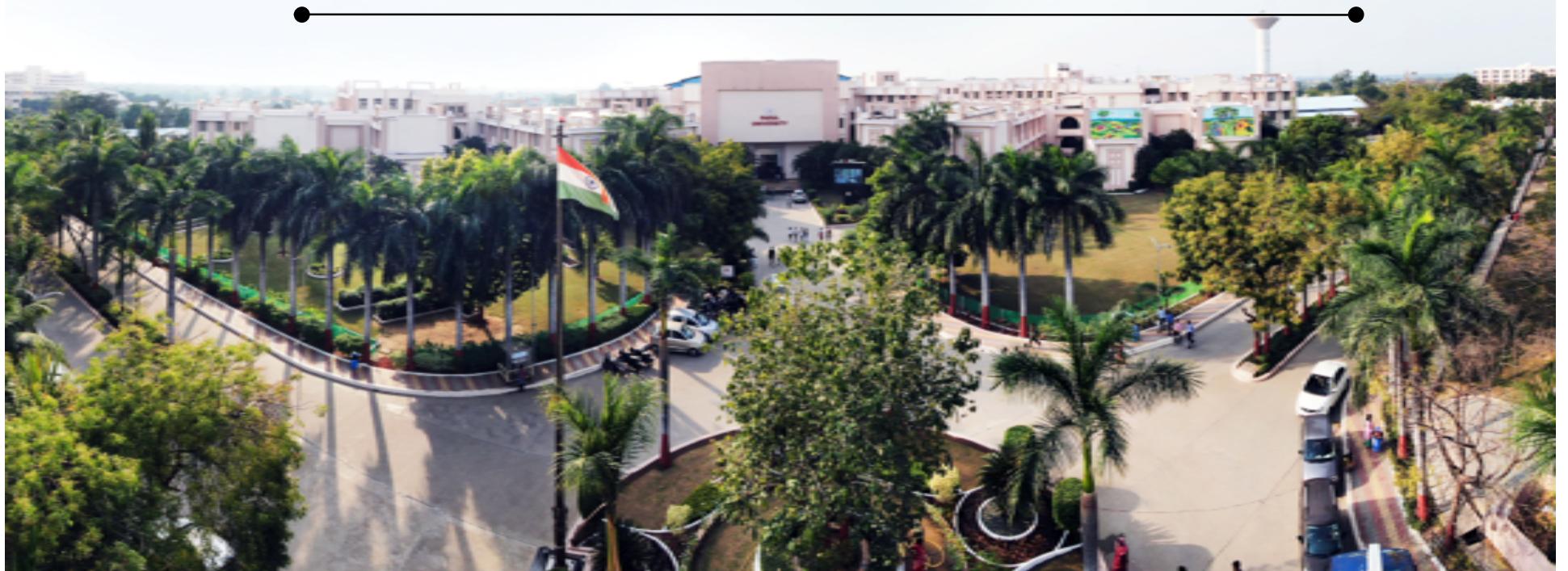




Subject: Fundamental of Computer Science

Unit-6 COMPUTER NETWORKS AND INTERNET





1. Basic of Computer Network

A **computer network** is a system where multiple computers and digital devices are interconnected to exchange data, share resources, and communicate efficiently.

The need for networks arises from **resource sharing, communication, reliability, cost-effectiveness and distributing computing**.

Network classification is commonly done based on geographical area coverage, leading to three major categories:

1. **LAN (Local Area Network)**
2. **MAN (Metropolitan Area Network)**
3. **WAN (Wide Area Network)**



1. Basic of Computer Network

LAN (Local Area Network)

A LAN is a network that covers a small geographical area, such as home, office, school, laboratory or college campus. (Up to 1 KM)

Characteristics

- 1. High Data Transfer Speed** : 100 Mbps To 10 Gbps
- 2. Low Latency** : Minimal Delay
- 3. Easy Maintenance** : Fewer Devices and simple configurations
- 4. Private Ownership** : Owned, operated, and maintained by single organization
- 5. Secure Environment** : Easier to implement and access control.



1. Basic of Computer Network

MAN (Metropolitan Area Network)

A MAN spans a **city / metropolitan region**, connecting multiple LANs (10 To 50 KM)

Characteristics

- 1. Medium Speed** : Faster than WAN, slower than LAN 10 To 1000 Mbps
- 2. Public / Private Ownership** : Often maintained by telecom companies or ISPs
- 3. Used for connecting multiple LANs** : Universities, government offices, corporate branches across cities.
- 4. High-Capacity Backbone** : Uses fiber-optic cables and microwave links.
- 5. Supports Large-Scale Communication** : Ideal for large campuses or city-wide infrastructure.



1. Basic of Computer Network

WAN (Wide Area Network)

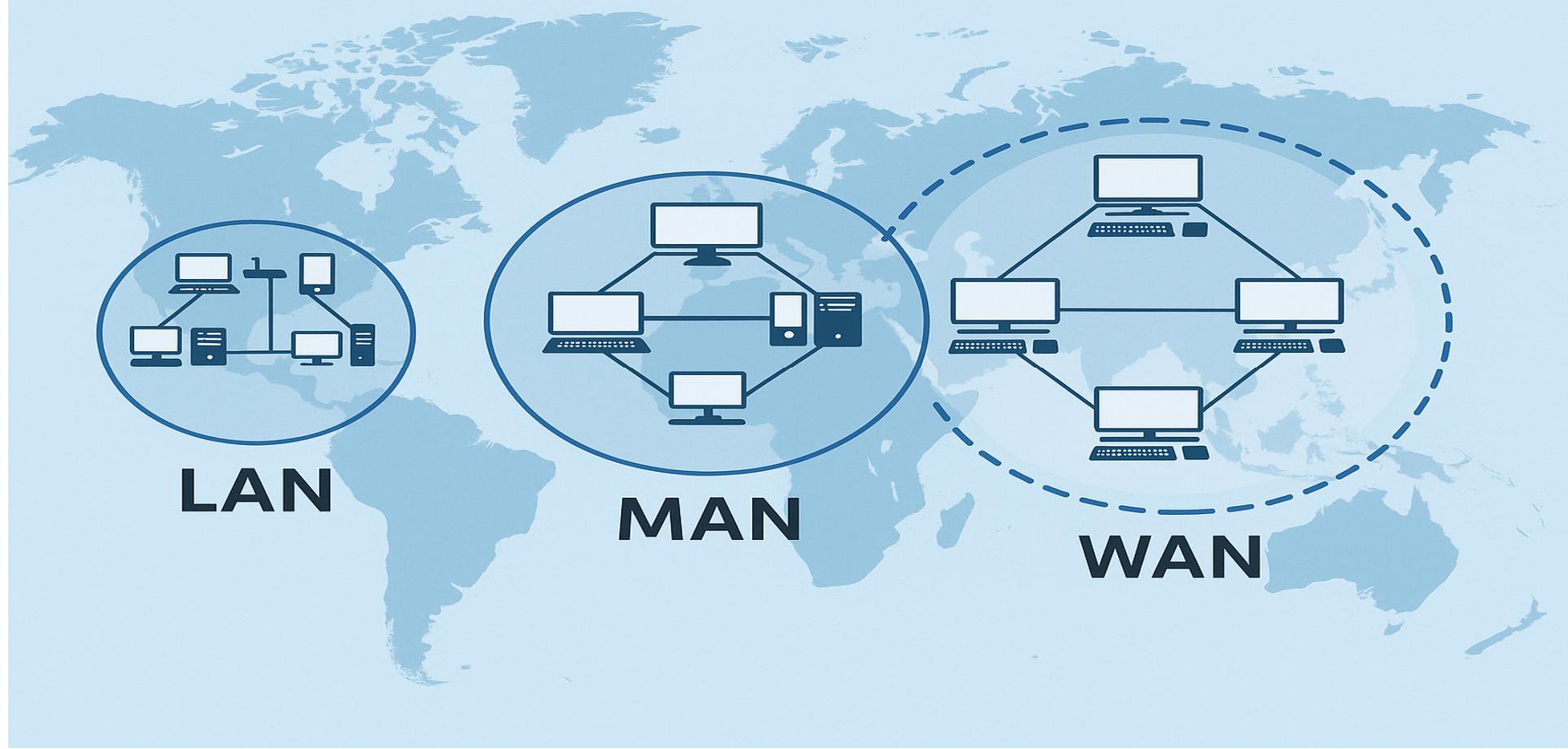
A WAN covers a very large geographical area (Cities, States, Countries) or even entire continents. (100 KM to thousands of KM)

Characteristics

- 1. Largest Network Type** : Extends globally (Internet)
- 2. Lower Speeds compared to LAN / MAN** : Due to long distances and multiple routing hops
- 3. Shared Ownership** : Uses public telecom networks, satellites, underwater cables.
- 4. High Latency** : Significant delay in signal transmission across large distances.
- 5. Complex Infrastructure** : Utilizes routers, leased lines, satellites.



1. Basic of Computer Network

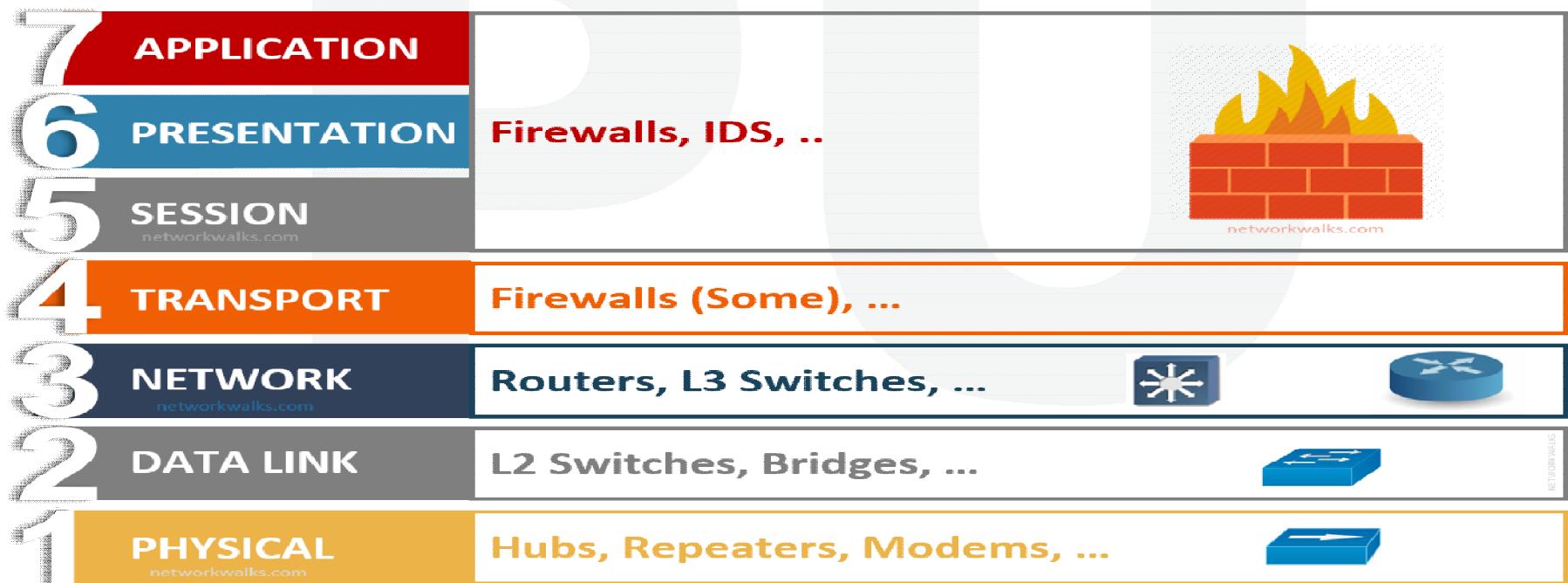




2. Network Devices

Computer networks rely on specialized hardware devices to connect, manage, and transport data.

Among these, routers, switches and modems are fundamental components.





2. Network Devices

1. Switches

A switch is a networking device **used to connect computers and devices within a LAN.**

It operates at the Data Link Layer (Layer 2) of OSI Reference Model and uses **MAC address** to forward frames.

Key Features

- Frame forwarding using MAC address** : Switch builds address table to forward data only to intended device.
- Reduces network collisions** : Each port has its own collision domain
- Full duplex communication** : Data can flow both way simultaneously
- Supports VLAN** : Enables network segmentation for security and efficiency.



2. Network Devices

2. Router

A router is a device that **connects multiple network together** and forward packets **based on their IP addresses**.

It operates at the Network Layer (Layer 3) of OSI Reference Model.

Key Features

- Routes packets between networks** : Connecting home network to Internet.
- Assign IP Addresses** : Automatically & Manually assign IP address
- Firewall and Security functions** : Blocks unauthorized access Support filtering, port control and intrusion detection.
- Supports Routing Protocols** : RIP (Routing Information Protocol), OSPF (Open Shortest Path First) BGP (Border Gateway Protocol).



2. Network Devices

3. Modems

A modem (**MOdulator - DEModulator**) converts:

Digital Signals from computer -> To **Analog Signals** (vice-versa)

Modems enable internet connectivity by linking your device / network to an ISP (Internet Service Provider)

Nowadays Modem is been replaced by ROUTER.

Key Features

- Conversion of signals** : Digital to Analog and again Analog to Digital.
- Establish Internet Communication** : Older times used to get connected to Internet
- Various Types available**: DSL (Digital Subscriber Line), Dial-up, Cable Modem, USB (Dongles)



2. Network Devices





3. Introduction To Internet

Internet

The **Internet** is a global system of interconnected computer networks that uses **TCP/IP** (Transmission Control Protocol / Internet Protocol) Protocol to communicate and exchange data.

It allows users worldwide to **access, share, and transfer information seamlessly**.

Key Characteristics

1. Global Connectivity (Public and Private Networks)
2. Decentralized System (No single person owns)
3. Standard Protocols (TCP and more protocols)
4. Accessibility (email, website, social media, cloud)



3. Introduction To Internet

Components of Internet

Clients (Various Devices), Servers, Protocols, ISP (Internet Service Provider), DNS (Domain Name System)

Major Services of Internet

1. Email
2. World Wide Web (WWW)
3. File Transfer Protocol (FTP)
4. Video Streaming
5. Online Gaming
6. Cloud Computing



4. Search Engines

Search Engine

A search engine is a online tool that helps user **find information** on the Internet by indexing and ranking web pages based on relevance.

Example

Google, Bing, Yahoo, DuckDuckGo, Baidu



4. Search Engines

How Search Engine Works

- Crawling** (Visit and Scan Pages to map keyword matching)
- Indexing** (Content found is analyzed and stored in massive database)
- Ranking** (Algorithm evaluate on record found on content quality)
- Retrieval** (Most relevant to be displayed to user as output)



4. Search Engines

Importance of Search Engine

1. Helps in information discovery and research
2. Drives online business visibility
3. Provides instant access to millions of resources
4. Aids navigation and content filtering across the web



5. Basics of Cloud Computing and IoT

Cloud computing is the delivery of computer services - such as **servers, storage, databases, networking, software and analytics** over the Internet known as “Cloud” instead of using local hardware or personal computer.

Key Characteristics

- 1. On-demand self-service**: User can access resources whenever needed
- 2. Broad network access** : Services are accessible from anywhere
- 3. Resource Pooling** : Server and storage are shared among multiple users.
- 4. Rapid Elasticity** : Resources can be scaled up or down as needed.
- 5. Measured service** : User pays only for what they use



5. Basics of Cloud Computing and IoT

Cloud Service Model

1. IaaS (**I**nfrastructure as a **S**ervice)
2. PaaS (**P**latform as a **S**ervice)
3. SaaS (**S**oftware as a **S**ervice)

IaaS : Provides virtualized computing resources like servers, storage, and networks.

PaaS : Offers hardware and software tools for application development

SaaS : Provides ready-to-use software over the Internet

Example

IaaS : AWS, Google Compute Engine

PaaS : Google App Engine, Microsoft Azure

SaaS : Gmail, Google Docs



5. Basics of Cloud Computing and IoT

Advantages of Cloud Computing

- 1. Cost Efficient** : Reduces hardware and maintenance cost
- 2. Scalable and Flexible** : Quickly adjust to workload demands
- 3. Accessible Anywhere** : Available quickly and globally
- 4. Automatic Updates** : Provider handle software and security updates
- 5. Disaster Recovery** : Cloud backups prevents data lost



5. Basics of Cloud Computing and IoT

The Internet of Things (IoT) is a network of **interconnected physical devices** (like sensors, vehicles, appliances, and machines) that **collect and exchange data over the Internet without requiring human intervention**.

IoT connects “**Things**” (devices) to Internet, enabling **automation, monitoring and control**.

Key Component of IoT

- 1. Sensors** : Devices collect data from the environment (temperature, motion etc)
- 2. Connectivity** : Transfer data using WiFi, Bluetooth, Cellular (4G/5G)
- 3. Data Processing** : Data is processed locally or in cloud to extract meaningful insights
- 4. User Interface** : Allow user to monitor and control devices



5. Basics of Cloud Computing and IoT

Application of IoT

1. **Smart Homes** : Automated Lights, AC, Security system
2. **Healthcare** : Remote patient monitoring, wearable devices
3. **Agriculture** : Smart irrigation, soil monitoring, crop analytics
4. **Transportation** : Smart traffic controlling, autonomous vehicle
5. **Industrial Automation** : Machine health monitoring, energy optimization
6. **Smart Cities** : Waste Management, street lighting

Advantages of IoT

- **Automation** : Reduces human effort
- **Efficiency** : Enhances productivity and resource usage
- **Real-time monitoring** : Continues tracking of processes
- **Data-driven Insights** : Helps in decision-making and forecasting
- **Convenience** : Improves lifestyle, quality and comfort