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Assignment 1: Study of Networking Devices and Components

1. Types of Computer Networks

1.1 Local Area Network (LAN)

- **Definition:**

A LAN is a network restricted to a small geographical area such as a single building, office, or campus.

- **Characteristics:**

- Covers a distance of up to a few kilometers.
- Data transfer speeds are very high (up to 10 Gbps or more).
- Ownership is private; usually managed by one person or organization.
- LANs use Ethernet cables, switches, and wireless access points.

- **Applications:**

- Connecting office computers for sharing printers and files.
- LAN gaming in internet cafés.
- Campus networks in schools/colleges.

- **Example:** The computer lab in a college where all PCs are connected to a single switch.

1.2 Metropolitan Area Network (MAN)

- **Definition:**

A MAN is larger than a LAN but smaller than a WAN. It typically spans a city or a group of nearby buildings.

- **Characteristics:**

- Covers areas ranging from 5 km to 50 km.
- Often uses **fiber optic cables** for high bandwidth.
- Managed by Internet Service Providers (ISPs) or telecom companies.

- **Applications:**

- Connecting multiple bank branches across a city.
- Linking hospitals, libraries, and universities within a metropolitan region.

- **Example:** The Mumbai city railway reservation network linking all ticket counters.

1.3 Wide Area Network (WAN)

- **Definition:**

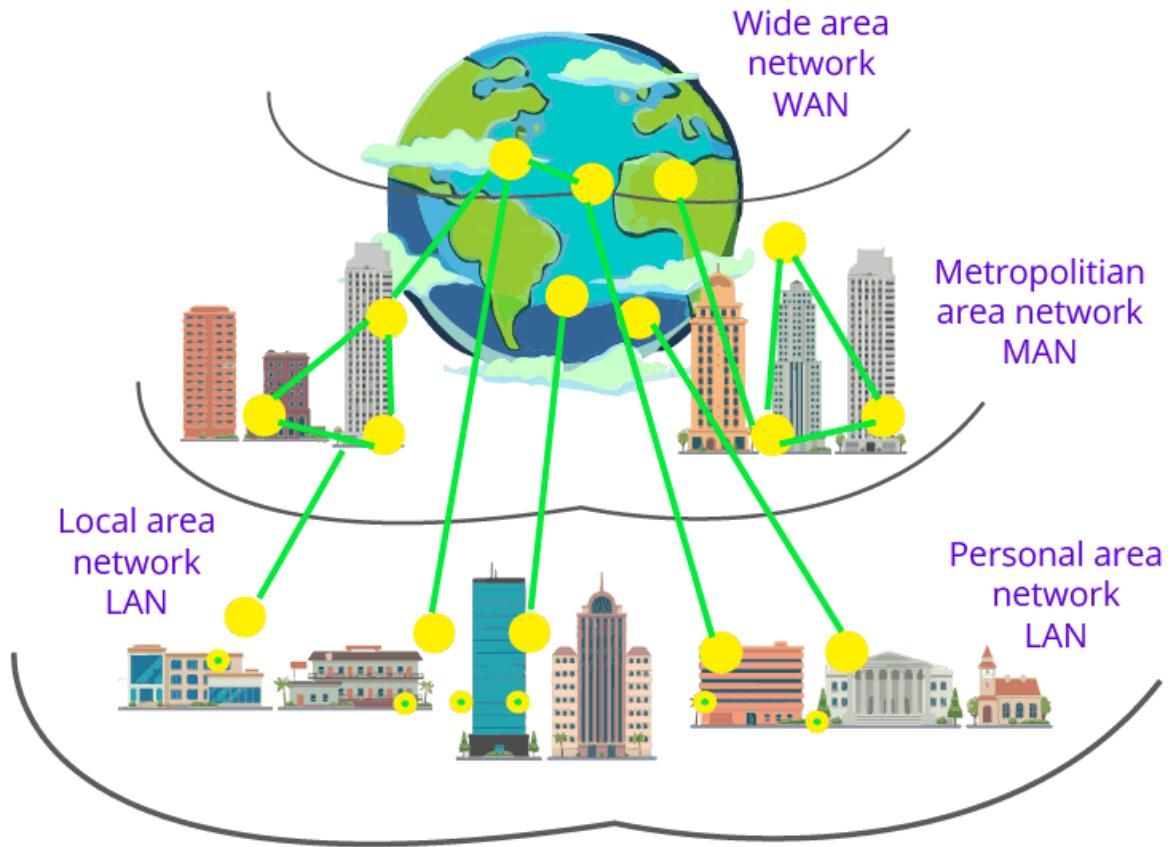
WAN is the largest type of network, covering states, countries, or even continents.

- **Characteristics:**

- Spans thousands of kilometers.
- Slower than LAN/MAN because of long-distance transmission.
- Uses **satellites, undersea fiber cables, and routers**.
- The **Internet** is the most famous WAN.

- **Applications:**

- Online banking across countries.
- Global businesses like Amazon or Google operating from multiple locations.
- **Example:** A multinational company's offices in India, USA, and Europe connected over WAN.



2. Networking Devices

2.1 Repeaters

- **Working Principle:**

When data travels through cables, the signal strength weakens (attenuation). Repeaters **receive weak signals, regenerate them,**

and retransmit them to extend the coverage.

- **Key Features:**

- Operates at the **Physical Layer** of the OSI model.
- Does not interpret data; only strengthens the signal.
- Cannot filter traffic.

- **Applications:**

- Extending the range of Wi-Fi signals.
- Used in long Ethernet cables to avoid signal loss.

- **Example:** A Wi-Fi range extender used in homes is a form of repeater.

2.2 Hubs

- **Working Principle:**

A hub is a **basic device** that connects multiple computers in a LAN. It **broadcasts data to all ports**, regardless of the intended recipient.

- **Key Features:**

- Works at the **Physical Layer**.
- Cannot differentiate between devices.
- Creates unnecessary traffic → **collision domain**.

- **Applications:**

- Rarely used now; replaced by switches.

- **Example:** If one computer sends a message, all others connected to the hub receive it, even if it was meant for only one system.

2.3 Switches

- **Working Principle:**

A switch is an **intelligent hub**. It uses **MAC addresses** to send data only to the intended device.

- **Key Features:**

- Works at the **Data Link Layer**.
- Reduces collisions and network congestion.
- Provides full-duplex communication (send + receive simultaneously).

- **Applications:**

- Backbone of modern LANs.
- Used in offices, schools, and data centers.

- **Example:** In a 10-computer office network, a switch ensures that if PC-1 sends a file to PC-3, only PC-3 receives it.

2.4 Routers

- **Working Principle:**

Routers connect **different networks** and forward data packets using **IP addresses**. They decide the **best path** for data delivery.

- **Key Features:**

- Works at the **Network Layer**.
- Supports NAT (Network Address Translation).
- Can provide security via **firewalls**.

- **Applications:**

- Connecting a home LAN to the Internet.

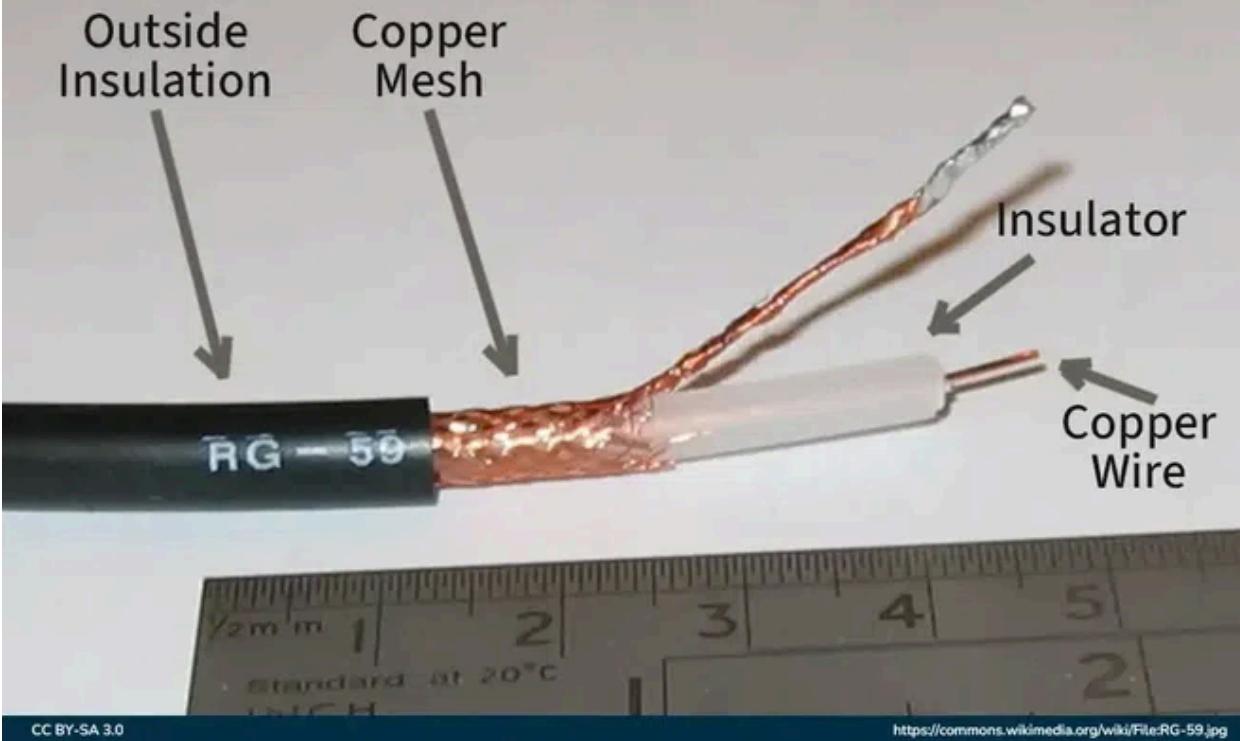
- Interconnecting company networks across different locations.
 - **Example:** Your home Wi-Fi router that connects all devices (mobiles, laptops, TV) to the internet.
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2.5 Cables

- **Definition:** Cables are the **physical medium** through which data signals travel in wired networks.
- **Types:**
 - **Twisted Pair Cable (UTP/STP)**
 - Two copper wires twisted together.
 - Cheap, widely used in LANs.
 - Example: Ethernet cables (Cat5, Cat6).
 - **Coaxial Cable**
 - Has a central copper conductor with insulation.
 - Used in old TV networks and some WANs.
 - **Fiber Optic Cable**
 - Uses light signals to transmit data.
 - Extremely high speed (up to Tbps).
 - Immune to electromagnetic interference.
 - Example: Internet backbone cables.
- **Applications:**
 - Twisted pair in office LANs.
 - Fiber optics in long-distance Internet connections.

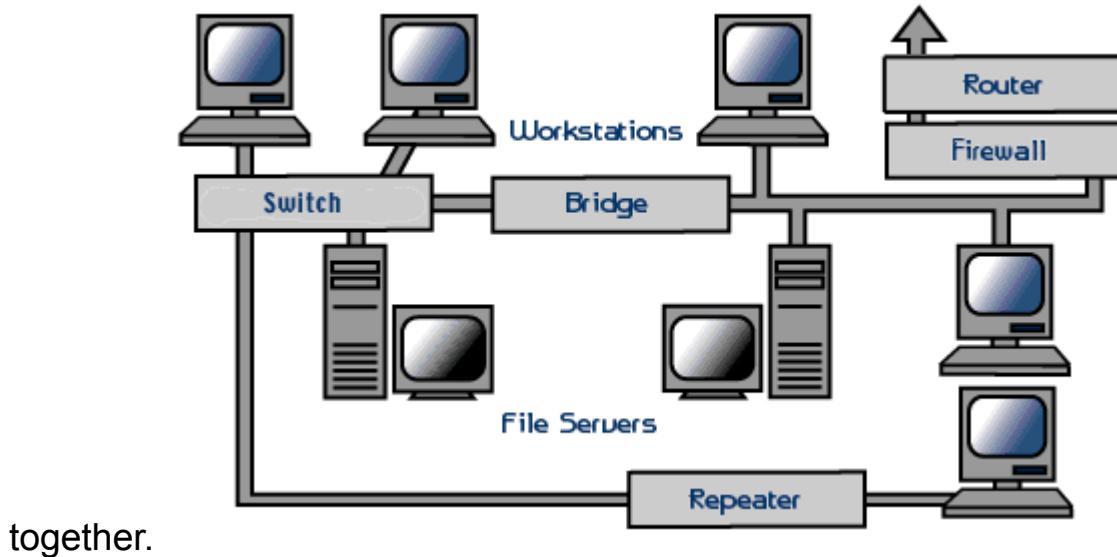
Coaxial Cable

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3. How These Work Together

- In a **LAN**, switches and routers connect computers with Ethernet cables.
- In a **MAN**, fiber optic cables with repeaters ensure connectivity between buildings.
- In a **WAN**, routers, satellites, and undersea cables link continents



4. Conclusion

Networking devices and components are the **building blocks of communication**.

- **Repeaters** extend signal range.
 - **Hubs** provide basic connectivity.
 - **Switches** improve efficiency within LANs.
 - **Routers** connect different networks intelligently.
 - **Cables** form the backbone of all wired communication.
- Together, LAN, MAN, and WAN ensure that data flows seamlessly from one device to another, whether in a single room or across the globe.