STUDY OF NETWORK COMPONENTS 19Z510 – COMPUTER NETWORKS LABORATORY

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**DEPARTMENT** **OF** **COMPUTER** **SCIENCE** **ENGINEERING** **PSG** **COLLEGE** **OF** **TECHNOLOGY**

(Autonomous Institution)

**COIMBATORE** **– 641** **004**

**Experiment** **I** **– Study** **of** **Network** **Components**

# Computer Network:

A computer network consists of interconnected computing devices designed to communicate and share resources. These connections can be established through either wired or wireless means. Wired connections use physical cables (like Ethernet cables) to link devices, ensuring reliable and often faster data transmission. Wireless connections, on the other hand, rely on radio waves or infrared signals to transmit data between devices without the need for physical cables, providing flexibility and mobility within the network. Both types of connections enable devices such as computers, smartphones, servers, and other networked devices to exchange information and access shared resources, facilitating efficient communication and collaboration in various environments, from homes and offices to large-scale enterprises and the internet itself.

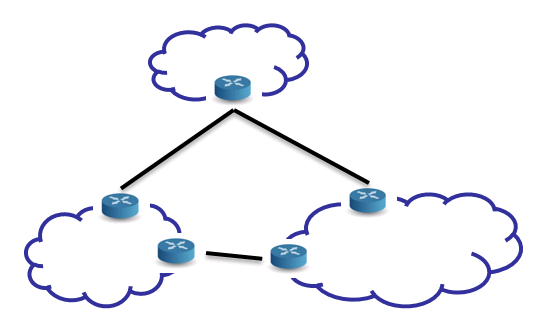


# Building Blocks of Network:

* **Node**:
  + Nodes are devices in a network.

# Link:

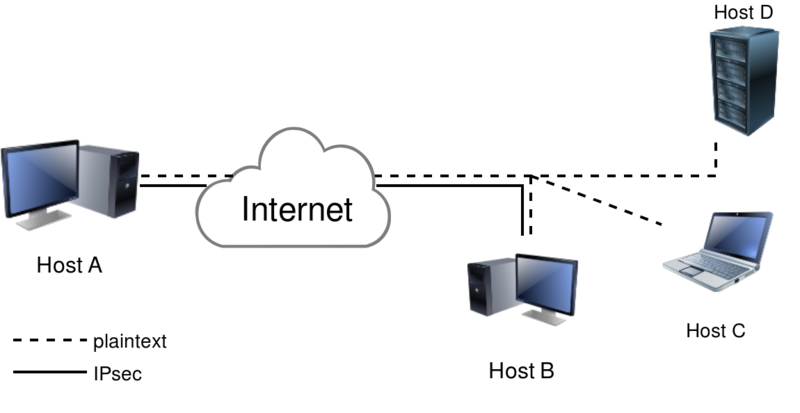
* + Connection between the nodes by cables or optical fibers.



# Other Networking Components:

**Host**:

* A host is any computer or device connected to a network.
* Hosts can offer services, access services, or does both.

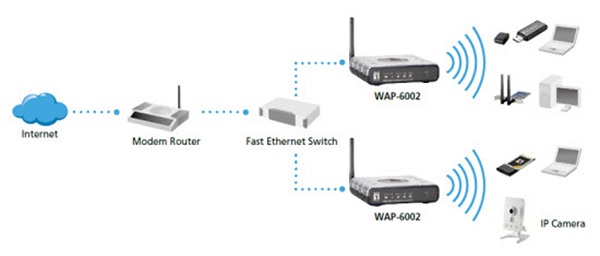


# Client and Server:

* In a computer network, a client is a computer or program that utilizes a service from another computer, called a server

# Access Point:

* A device that allows wireless devices to connect to a wired network using Wi-Fi. Access points extend the range of a network and can manage multiple wireless devices.



# Basic Hardware Components:

All networks are made up of basic hardware building blocks to interconnect network nodes, such as Network Interface Cards (NICs), Bridges, Hubs, Switches, and Routers.

# Network Interface Card:

* + A hardware component that enables a computer to connect to a network.
  + NICs can be for wired connections (Ethernet) or wireless (Wi- Fi).
  + They have unique MAC addresses used for network communication.



# Repeater:

* + A device that receives a network signal, amplifies or regenerates it, and retransmits it to extend the range of the network.
  + Repeaters are used to cover larger areas in both wired and wireless networks.

**Hub**:

* + A basic network device that connects multiple Ethernet devices, making them acts as a single network segment.
  + Hubs broadcast incoming data packets to all ports, regardless of the destination, which can lead to inefficiencies and collisions.



# Switch:

* + A network device that connects devices and uses MAC addresses to forward data only to the intended recipient port.
  + This reduces collisions and improves network efficiency compared to hubs.

# Network Bridge:

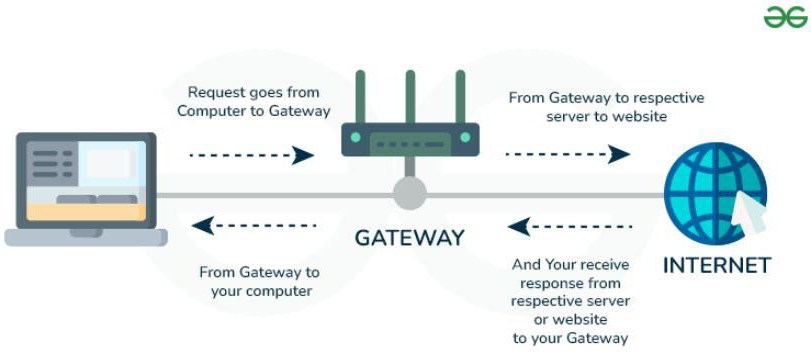
* + A network bridge is a device that connects and filters traffic between two or more network segments, effectively creating a single, aggregate network.

# Router:

* + A device that forwards data packets between different networks, directing the data along the most efficient routes.
  + Routers operate at the network layer and can connect different network types, such as a home network to the internet.

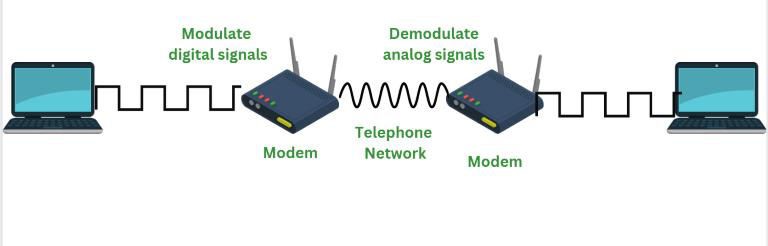
# Gateway:

* + A network node that connects different networks, often with different protocols, and provides translation between them.
  + Gateways can operate at various layers of the OSI model and are essential for communication between different network architectures.



# Modem:

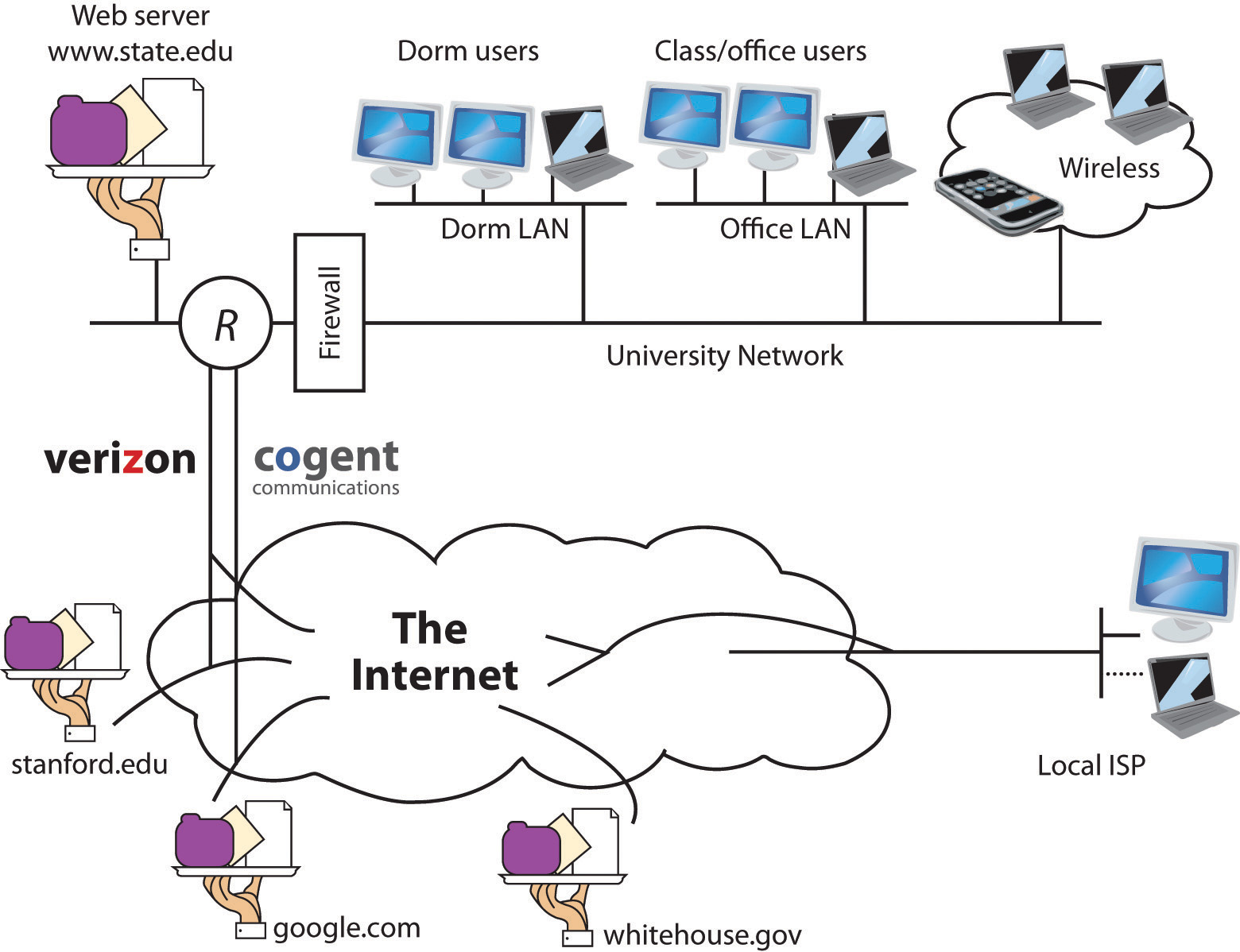
* + A device that modulates digital data from a computer into an analog signal for transmission over telephone lines and demodulates incoming analog signals back into digital data.
  + Modems are essential for connecting to internet services provided over traditional phone lines.

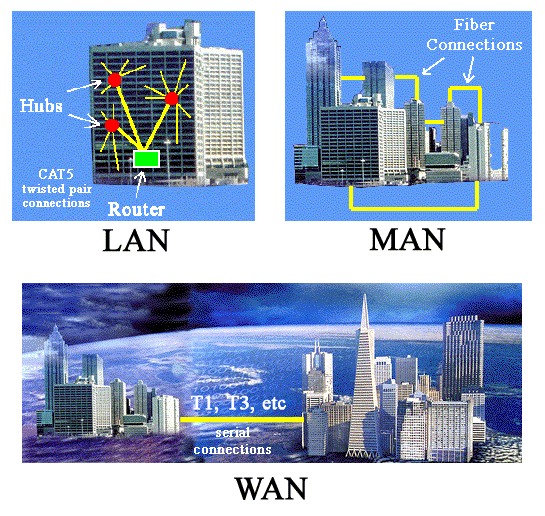


# Port:

* + A port is a virtual point where network connections start and end.
  + Ports are software-based and managed by a computer's operating system.
  + Each port is associated with a specific process or service.

# Types of Network:

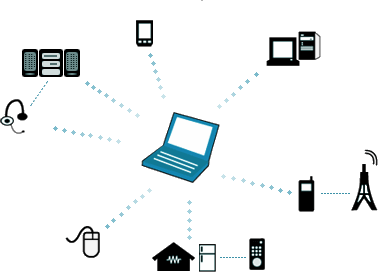
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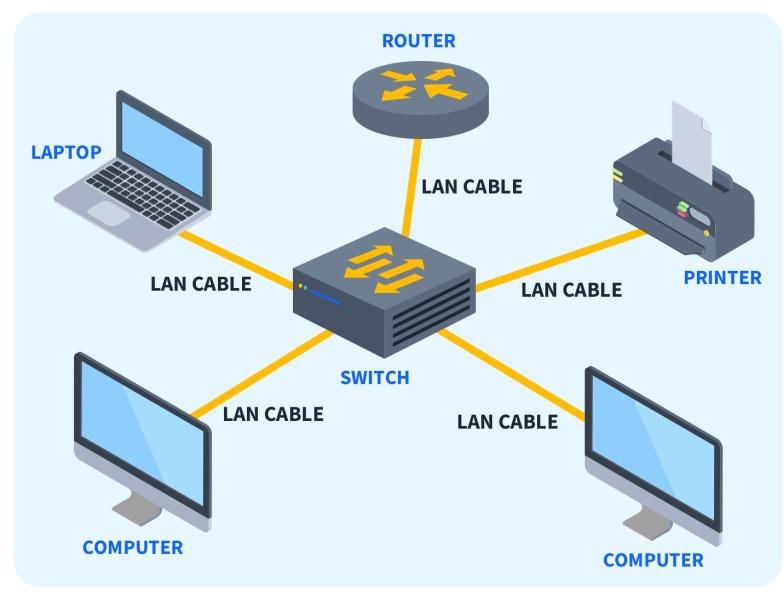
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**Personal** **Area** **Network:**

* A PAN is a small network used for communication between personal devices such as smart-phones, laptops, tablets, and wearable within a short range, typically within a few meters.
* Bluetooth and USB are common technologies used in PANs, which are ideal for connecting devices in close proximity for personal use.

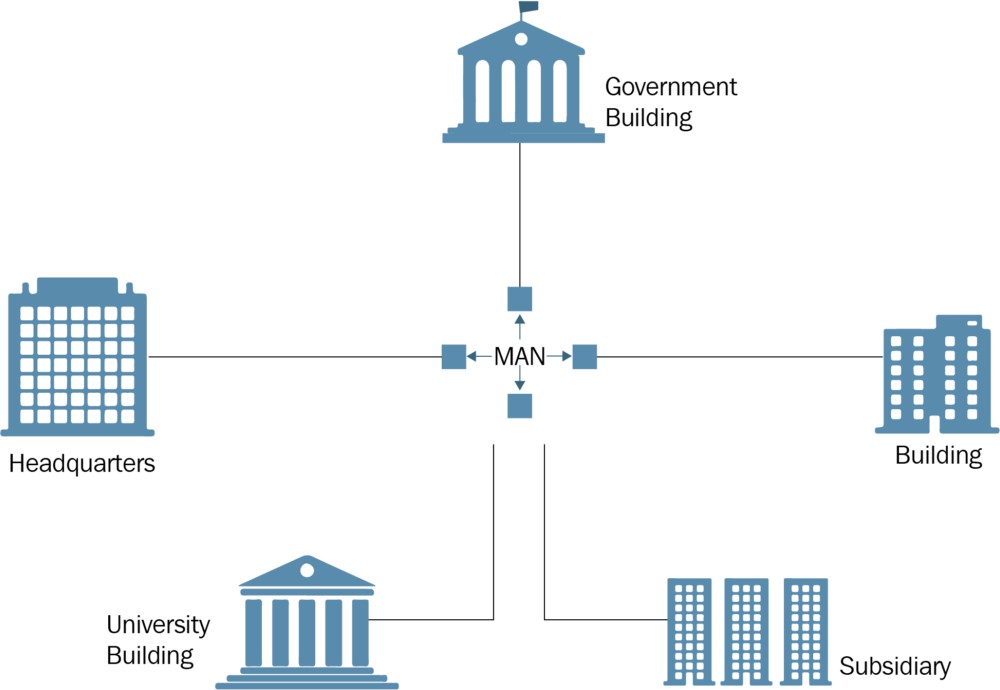


# Local Area Network:

* A LAN is a network that connects computers and devices within a limited area, such as a home, office, or campus.
* LANs enable high-speed data transfer and resource sharing, such as printers and files, among connected devices. Ethernet and Wi- Fi are commonly used technologies in LANs.

# Metropolitan Area Network:

* A MAN covers a larger geographic area than a LAN, typically spanning a city or a large campus.
* It connects multiple LANs within the specified region to create a cohesive network.
* MANs are used by organizations with multiple locations in the same area and often use high-speed connections like fiber optics.

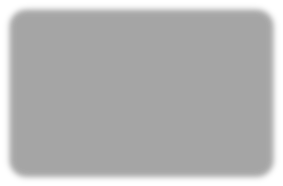
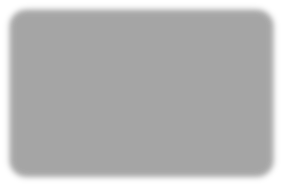
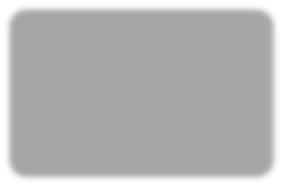
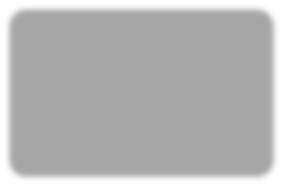


# Wide Area Network:

* A WAN spans a large geographical area, often a country or even the globe, connecting multiple LANs and MANs.
* The Internet is the largest example of a WAN, which allows data exchange and communication across vast distances.
* WANs utilize various transmission technologies, including leased lines, satellite links, and public networks, to maintain connectivity over long distances.

# Classification of Network Architecture:

* The architecture of a network is a logical design that determines how the devices in the network communicate.



Network

Architecture

Peer to Peer

Client-

Server

Hybrid

# Peer to Peer Architecture:

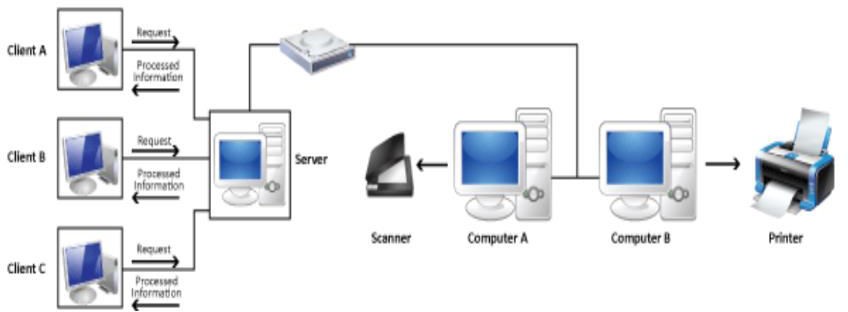
* In a peer-to-peer architecture, each device (peer) in the network has equal status and can act both as a client and a server.
* Peers share resources directly with each other without relying on a centralized server.
* This architecture is commonly used for file sharing, and it is decentralized, which can improve fault tolerance and scalability.

# Client-Server Architecture:

* In client-server architecture, servers provide resources, services, or data, and clients request and use these resources.
* Servers manage and store data centrally, while clients rely on the server for processing requests and accessing shared resources.
* This model is efficient for managing resources and provides better security and centralized control.

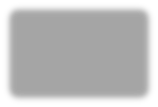
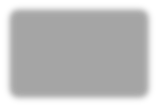
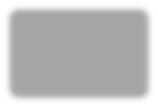
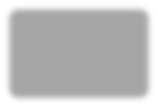
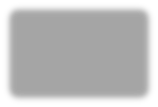
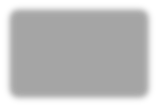
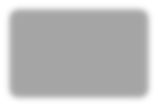
# Hybrid Architecture:

* Hybrid architecture combines elements of both client-server and peer-to-peer architectures.
* It leverages the centralized control and resource management of the client-server model, while also incorporating the direct sharing capabilities and decentralization of the P2P model.
* This approach provides flexibility, scalability, and improved resource utilization for various applications.



# Network Topology:

* The pattern of interconnection of nodes in a network is called the topology.
* This layout also determines the manner in which information is exchanged within the network.



Network

Topology

Bus

Star

Ring

Mesh

Tree

Hybrid

# Bus Topology:

* In bus topology, all devices are connected to a single central cable, known as the bus or backbone.
* Data sent from a device is broadcast to all devices on the network, but only the intended recipient accepts and processes the message.
* It is simple and cost-effective but can suffer from collisions and is difficult to troubleshoot and scale.

# Star Topology:

* In star topology, all devices are connected to a central hub or switch. The central hub acts as a repeater for data flow.
* It is easy to install and manage, and if one device fails, it does not affect the rest of the network.
* However, if the central hub fails, the entire network is affected.

# Ring Topology:

* In ring topology, each device is connected to exactly two other devices, forming a circular pathway for signals.
* Data travels in one direction (or both, in a dual ring) to reach its destination.
* It can be efficient for handling large volumes of data but a failure in any single connection can disrupt the entire network.

# Mesh Topology:

* In mesh topology, each device is connected to every other device in the network.
* This provides high redundancy and reliability, as there are multiple paths for data to travel.
* It is very robust but can be expensive and complex to install and maintain due to the large number of connections.

# Tree Topology:

* Tree topology is a hierarchical network structure that combines characteristics of star and bus topologies.
* Devices are grouped in star-configured groups connected to a central bus backbone.
* It allows for easy expansion and hierarchical management but relies heavily on the bus backbone, making it a single point of failure.

# Hybrid Topology:

* Hybrid topology combines two or more different types of topologies to form a more versatile and scalable network structure.
* For example, a combination of star and mesh topologies can leverage the benefits of both.
* This type of topology can be tailored to specific needs and is flexible but can also be complex and costly to implement.

# Network Transmission Medium:

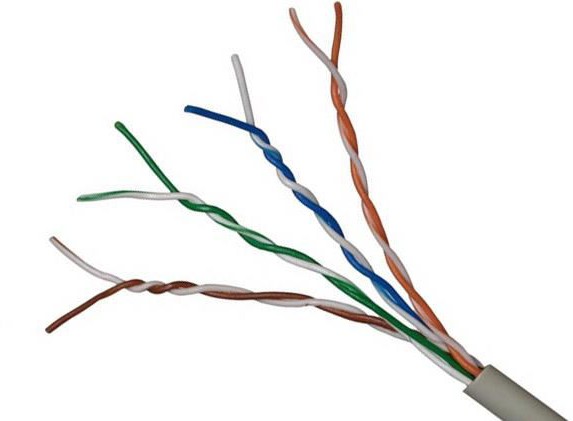
* A network transmission medium is the physical pathway or channel through which data is transmitted from one network device to another.
* It is the conduit that carries the signals used for communication in a network.

# Guided Transmission Medium:

* Guided media are those that provide a conduit from one device to another.

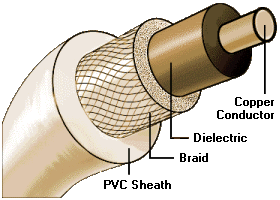
# Twisted Pair Cable:

* + A twisted pair consists of two conductors (normally copper), each with its own plastic insulation, twisted together.
  + One of the wires is used to carry signals to the receiver, and the other is used only as a ground reference.
  + **Shielded**: Consists of pairs of insulated copper wires twisted together with an additional outer layer of insulation for protection against electromagnetic interference.
  + **Unshielded**: Similar to shielded twisted pair but lacks the outer shielding, making it more susceptible to interference but cost- effective.
  + The most common UTP connector is RJ45 (RJ stands for registered jack)



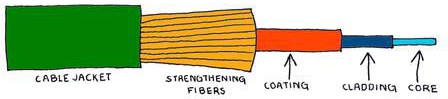
# Coaxial Cable:

* + Coaxial cable, or coax, supports higher frequency signals compared to twisted-pair cable.
  + It consists of a central core conductor, typically solid or stranded copper wire, surrounded by an insulating sheath.
  + This core is further enclosed in an outer conductor made of metal foil, braid, or a combination of both.
  + **Baseband:** Used for digital transmission where the entire bandwidth is used by a single signal. It's commonly used in Ethernet networks.
  + **Broadband:** Supports multiple channels of data transmission simultaneously, each using a different frequency range within the cable.
  + The most common type of connector used today is the Bayone- Neill-Concelman (BNC)connector..



# Fiber Optic Cable:

* + Utilizes light signals to transmit data over long distances with high speed and low attenuation.
  + It is immune to electromagnetic interference and suitable for high-bandwidth applications like telecommunications and networking.
  + Subscriber-channel connector, straight-tip connector and MT- RJ are the most common connectors used.



# Unguided Transmission Media:

* Unguided media transport electromagnetic waves without using a physical conductor.
* Signals are normally broadcast through free space and thus are available to anyone who has a device capable of receiving them.
* Unguided signals can travel from the source to destination in several ways:

# Ground propagation

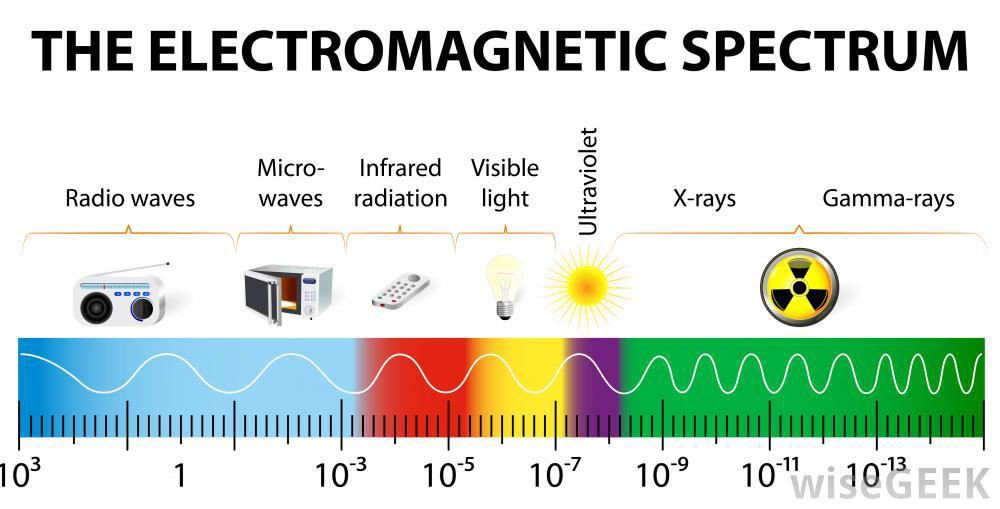
* + - In ground propagation, radio waves travel through the lowest portion of the atmosphere, hugging the Earth.

# Sky propagation

* + - In sky propagation, higher-frequency radio waves radiate upward into the ionosphere (the layer of atmosphere where particles exist as ions) where they are reflected back to Earth.

# Line-of-sight propagation

* + - In line-of-sight propagation, very high-frequency signals are transmitted in straight lines directly from antenna to antenna.
* **Radio-waves** (30 Hz to 300 GHz):
  + Uses radio frequencies for wireless communication, suitable for long-distance transmissions but susceptible to interference and attenuation over long distances.
  + AM/FM radio, television broadcasts, and wireless communication.
* **Microwaves** (1 GHz to 300 GHz):
  + Uses high-frequency radio waves for point-to-point communication, often used in satellite communication and wireless networking due to its high bandwidth and low attenuation.
  + Satellite communication, radar, and point-to-point communication links.
* **Infrared** (300 GHz to 400 THz):
  + Utilizes infrared light for short-range communication, such as remote controls and wireless data transfer between devices.
  + It is limited by line-of-sight requirements and can be affected by environmental factors like sunlight.
  + Remote controls, short-range communication, and certain types of data transfer between devices.



# Think and Answer

1. What kind of network is generally used in our college laboratories? Local Area Network(LAN)
2. What kind of network do you use in your home or in day-to-day life? Personal Area Network and Wireless Local Area Network
3. What are the nodes do you find in our labs? Computers, Servers, switches etc
4. How do you think nodes are connected in our college labs? Ethernet Cables
5. What kind of network architecture is used in our department labs? Client-Server architecture
6. What kind of topology is used in our department labs? Star Topology