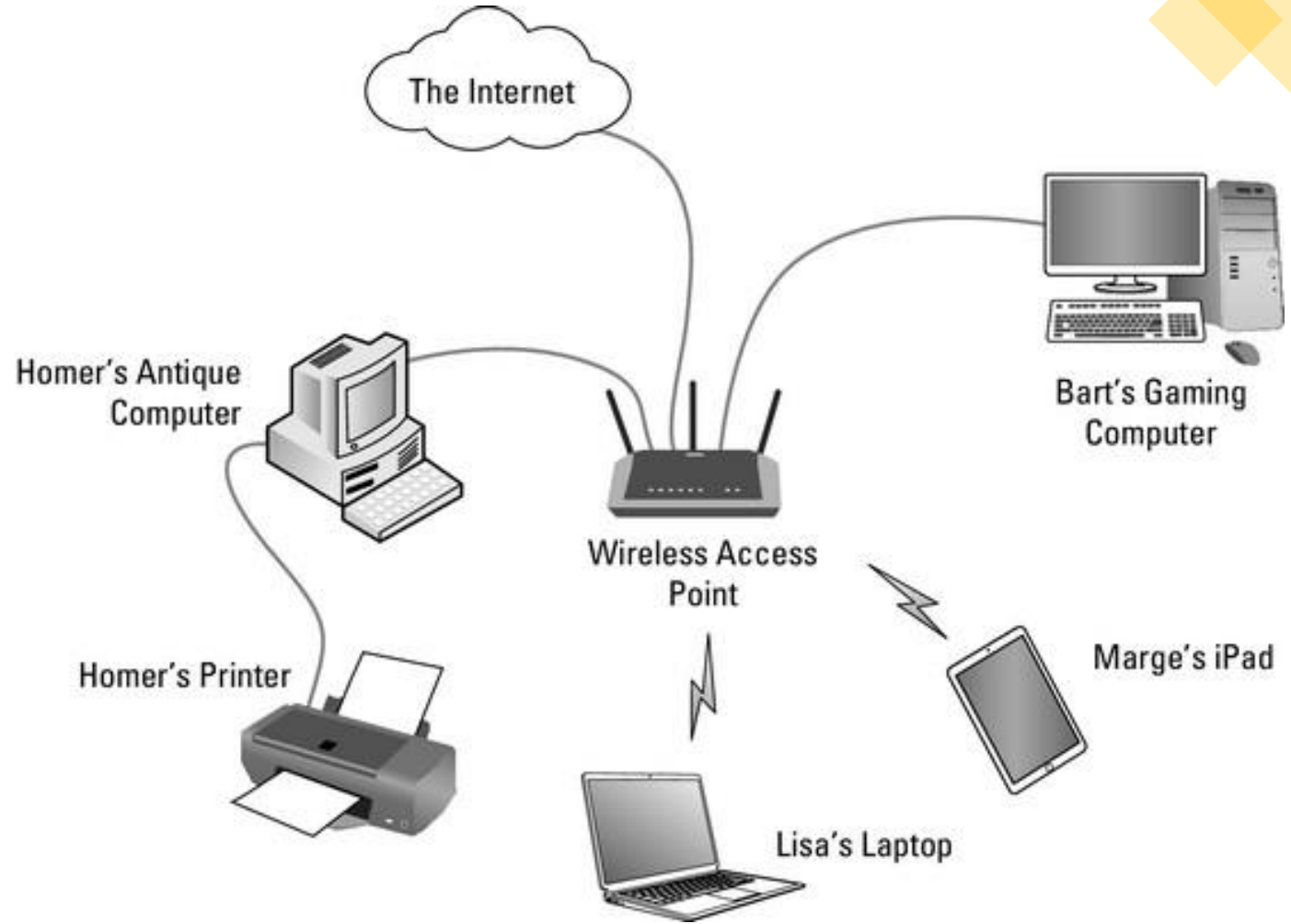


# Introduction to Networking

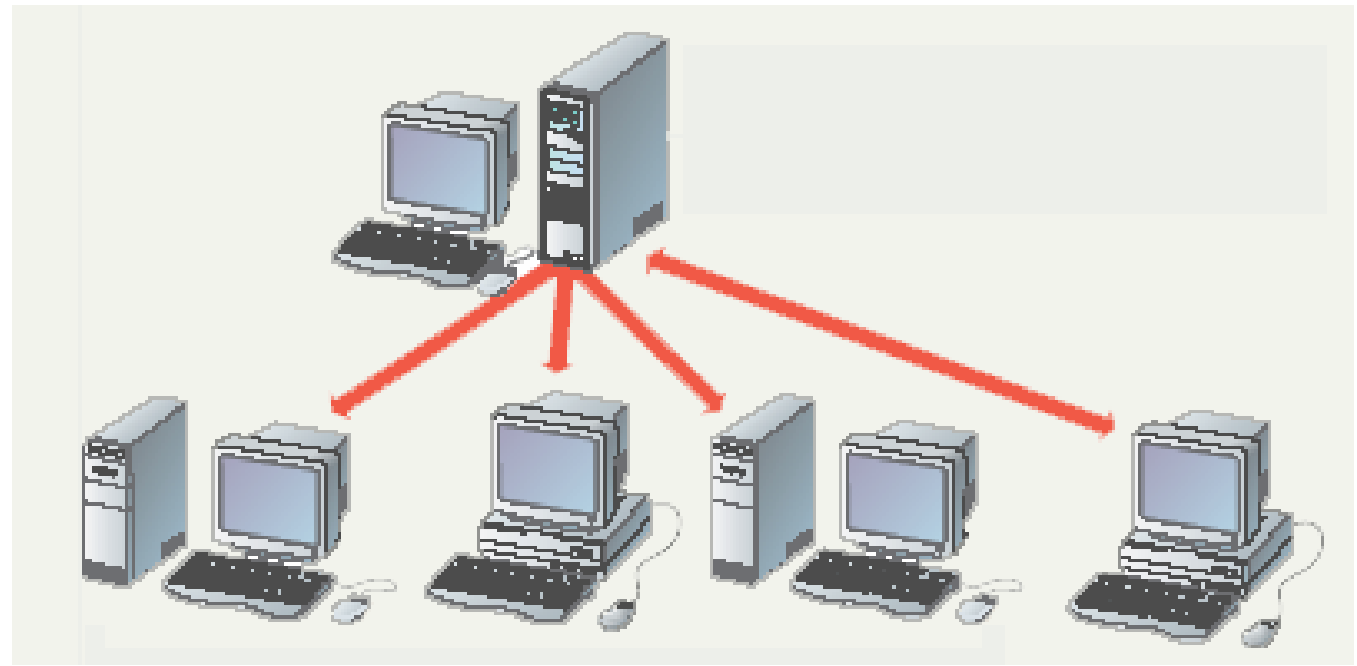
# Definition

- The interconnection of two or more devices that exchange data.
- It is done to enable the devices to communicate and share available resources.
- Often connected by wires. A wireless network uses radio waves.
- Devices/ computers on a network are known as hosts.
- These network devices can be printers, routers, hubs, switches, bridges, etc.



# Usage of Network

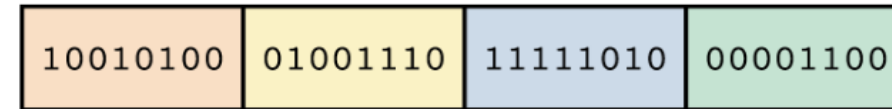
- Simultaneous access to data
  - Data files are shared
    - Access can be limited
  - Shared files stored on a server
  - Software can be shared
    - Site licenses, network versions, application servers
- Shared peripheral device
  - Printers and faxes are common shares
- Personal Communications
  - Email, conferencing (audio, video), Voice over Internet Protocol (VoIP)
- Easier Data Backup



# Network Address and DNS

- IP address

- Public vs Private
- IPV6 and IPV4



148 . 78 . 250 . 12

FE80:0000:0000:0000:0202:B3FF:FE1E:8329

- Domain Name System

- Translate hostname to IP address
- liit.ac.in — Country as per ISO code

Uniform Resource Locator

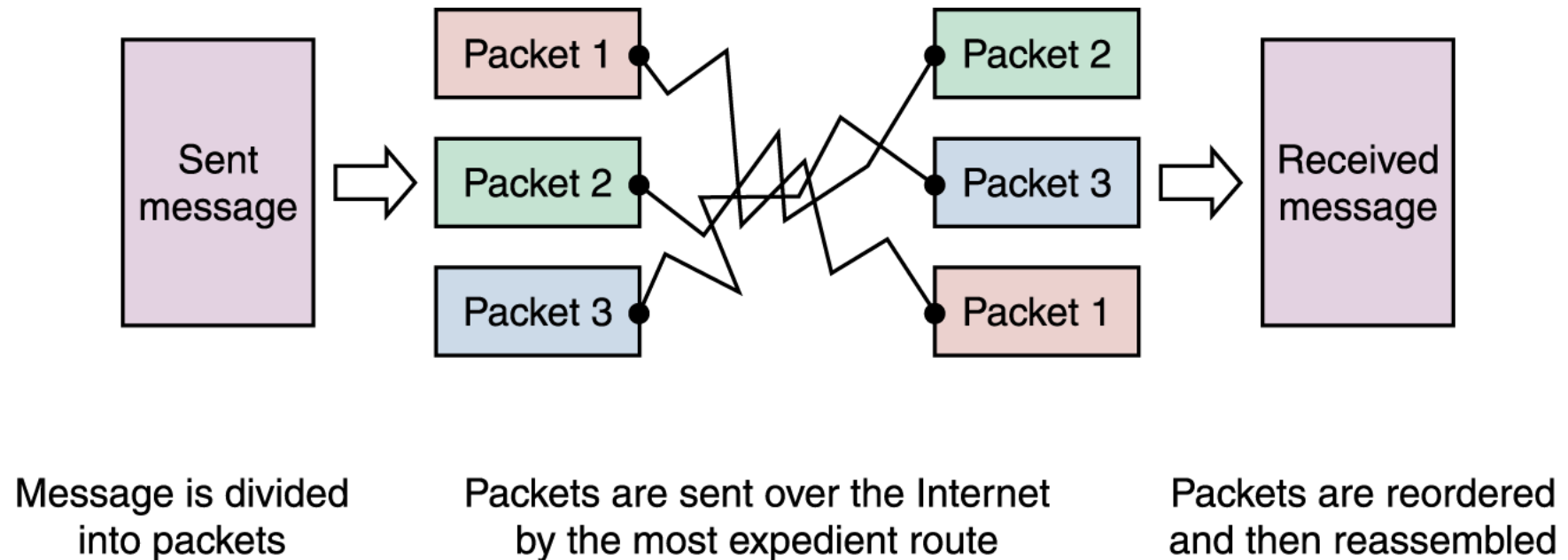
Top-level domain name..  
"ac" - academia

## Commands

- tracert www. google.com
- Ifconfig / ipconfig
- netstat
- ping

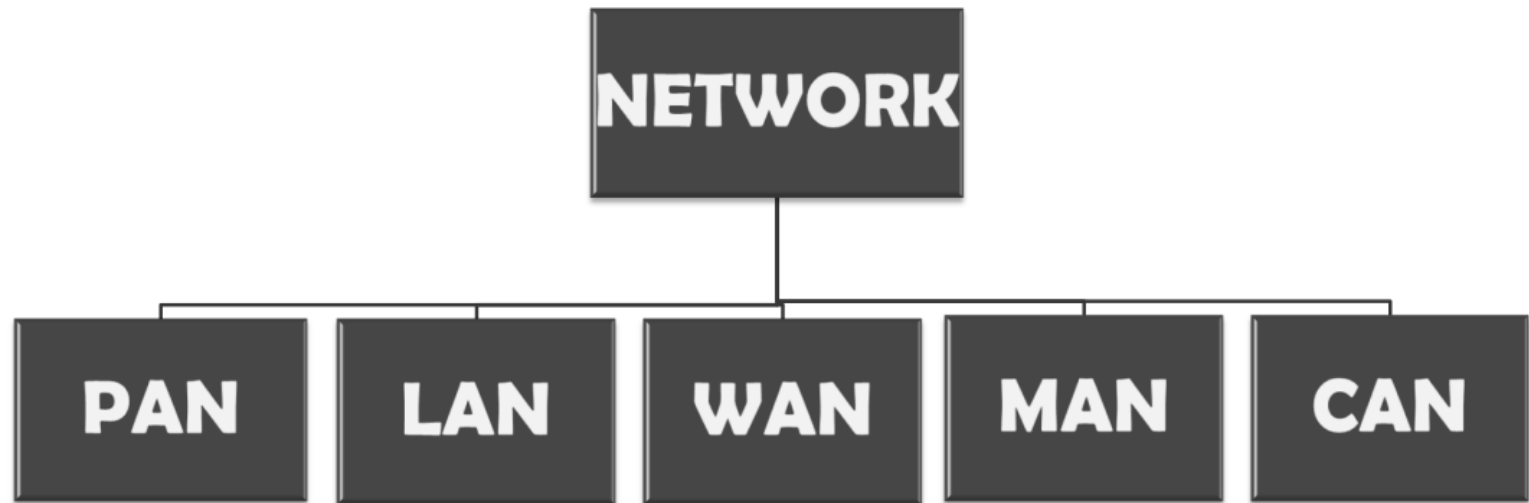
# Packet Switching

- To improve the efficiency of transferring information over a shared communication line, messages are divided into fixed-sized, numbered packets
- Network devices called routers are used to direct packets between networks



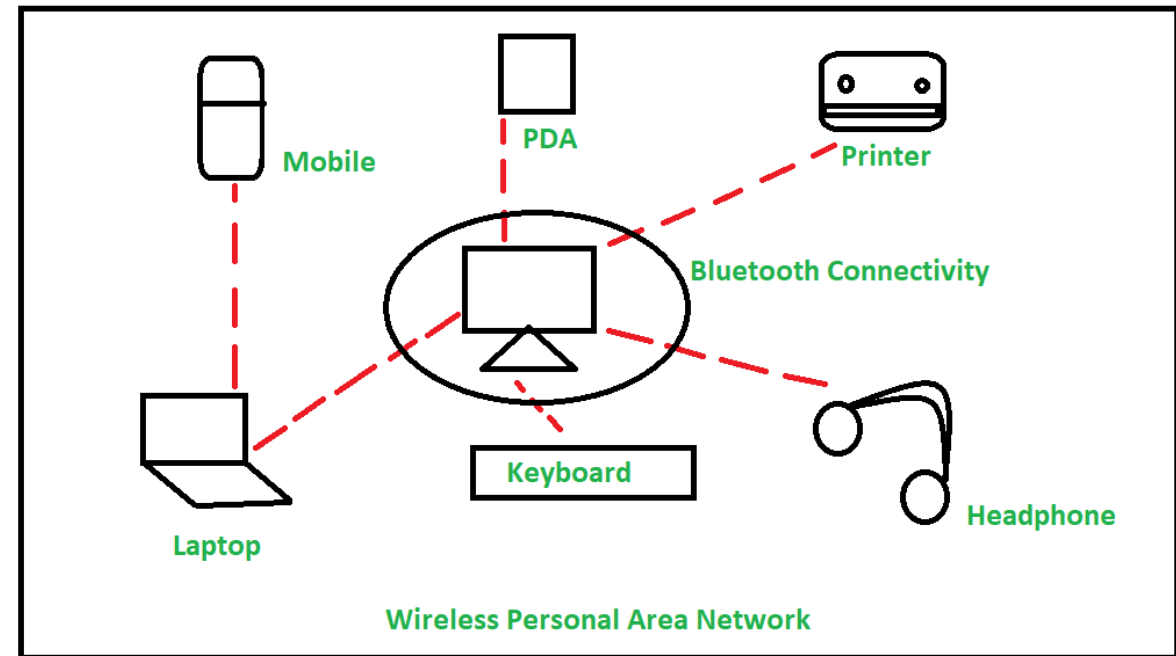
# Types of Network (by their geography)

- Personal Area Network (PAN)
- Local Area Network (LAN)
- Campus Area Network (CAN)
- Metropolitan Area Network (MAN)
- Wide Area Network (WAN)



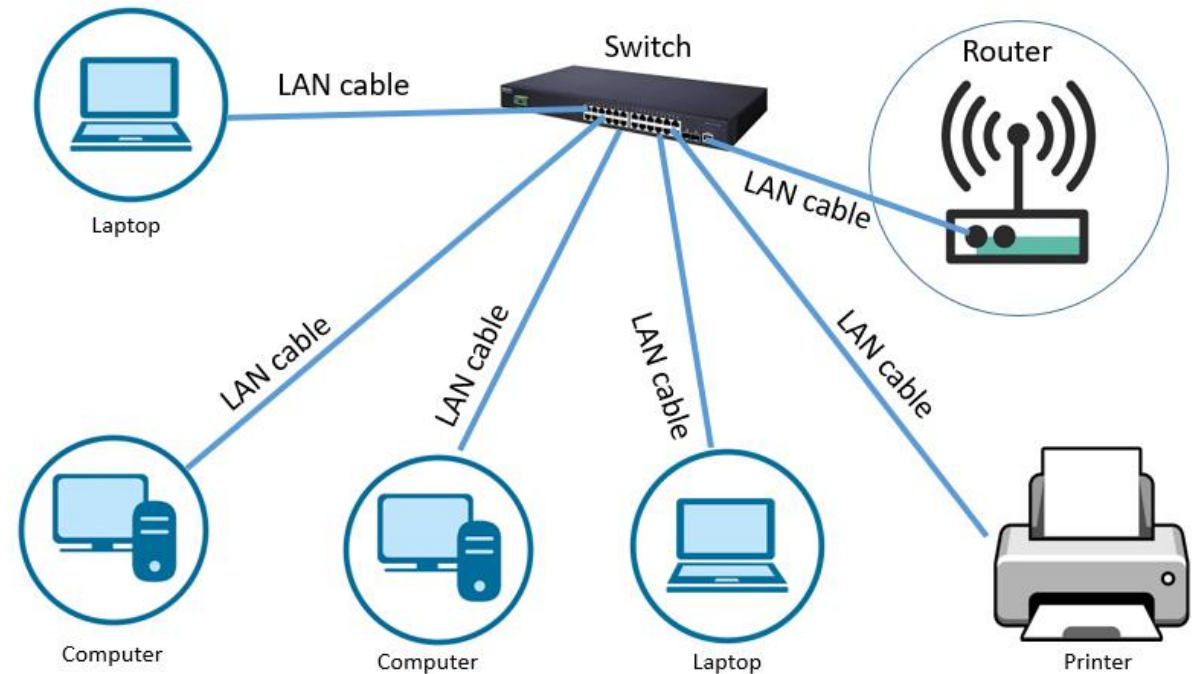
# Personal Area Network (PAN)

- Small scale network (around an individual person).
- Consists of a mobile computer, a cell phone or personal digital assistant.
- The PANs can be constructed using wireless or cables.
- Can also be used for communication amongst the personal devices or for connecting to a higher-level network and the Internet (an uplink) where one "master" device takes up the role as internet router.



# Local Area Network (LAN)

- LAN is a network which is designed to operate over a small physical area such as an office, factory or a group of buildings.
- LANs are easy to design and troubleshoot
- Exchange of information and sharing of resources becomes easy because of LAN.
- In LAN, all machines are connected to a single cable.
- It is usually a privately owned network.

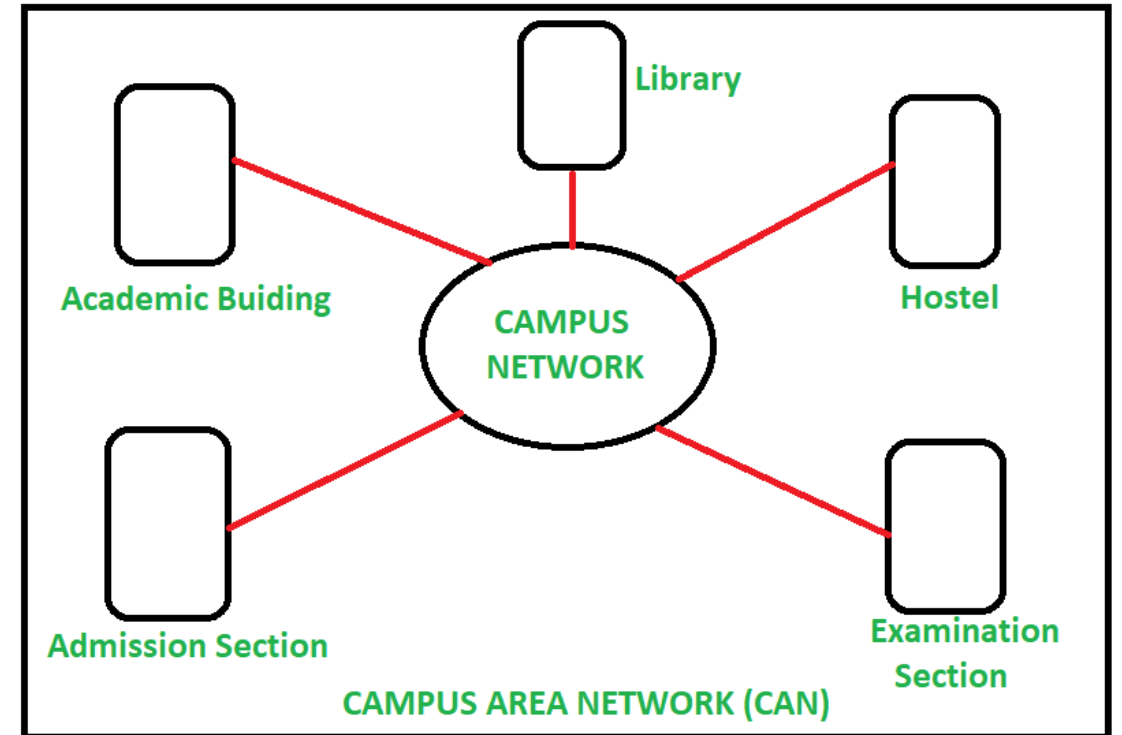


## Local Area Network



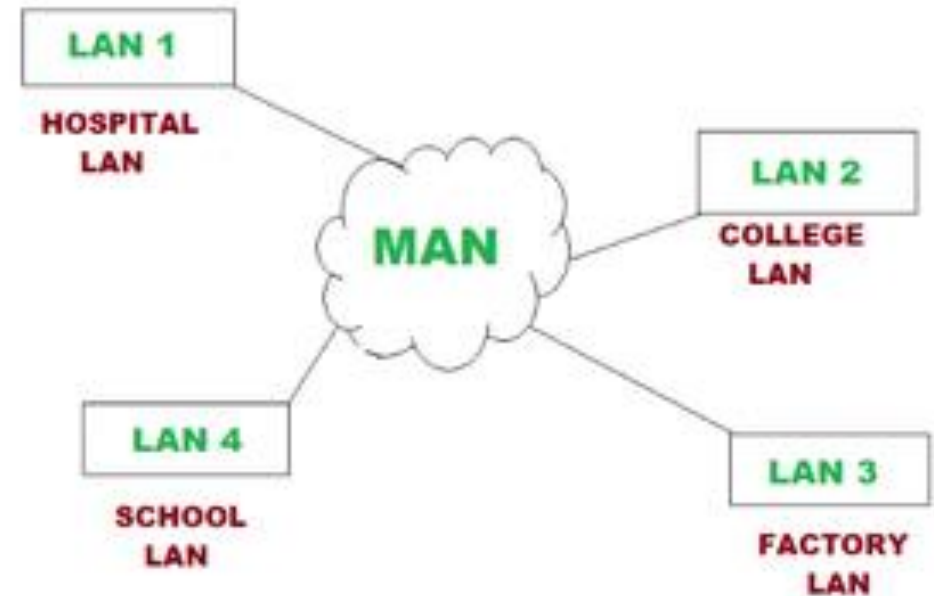
# Campus Area Network (CAN)

- Larger than LANs, but smaller than metropolitan area networks these types of networks are typically seen in universities, large school districts or small businesses.
- They can be spread across several buildings that are fairly close to each other so users can share resources.
- Network equipments such as switches, routers and the transmission media i.e. optical fibre etc are almost entirely owned by the campus owner.



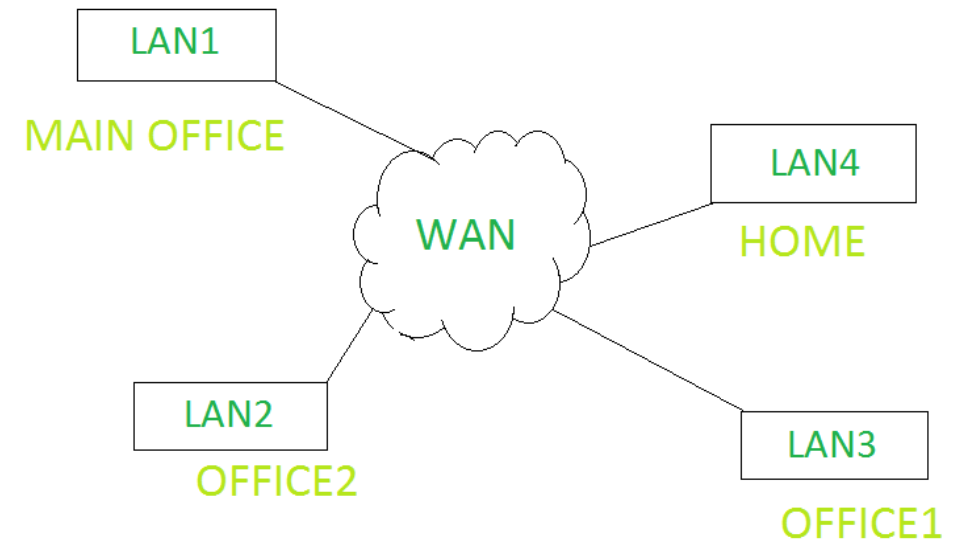
# Metropolitan Area Network (MAN)

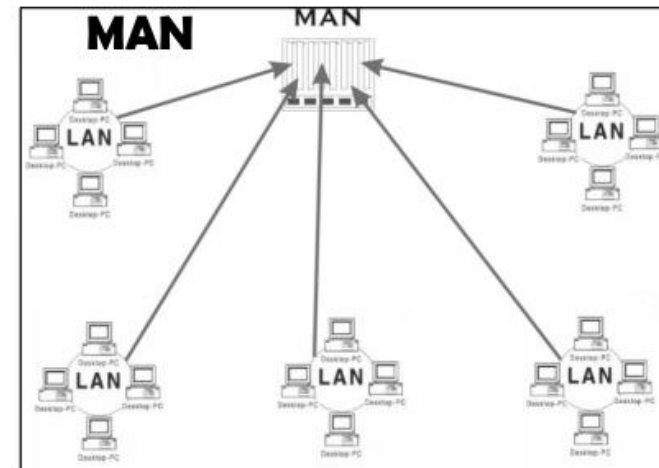
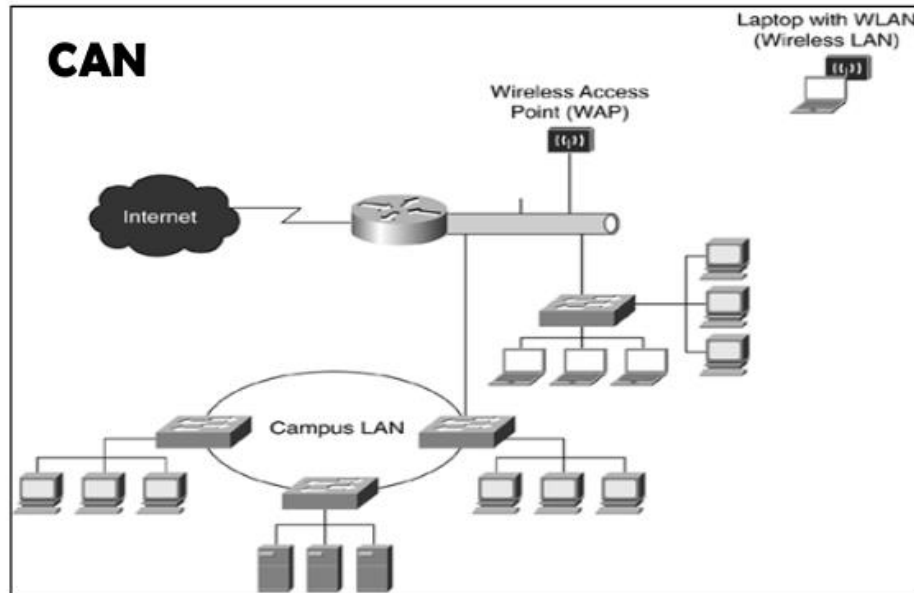
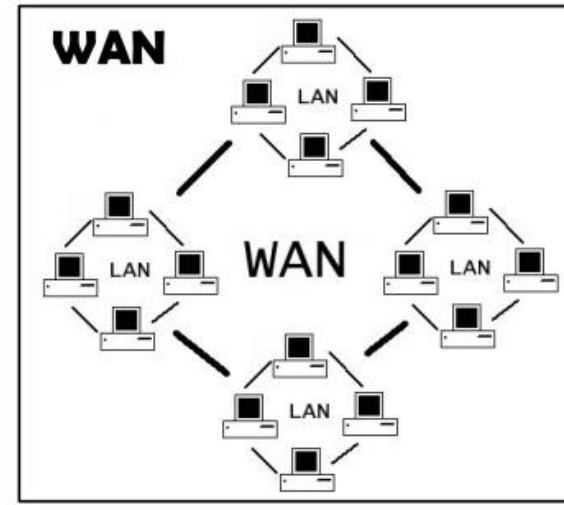
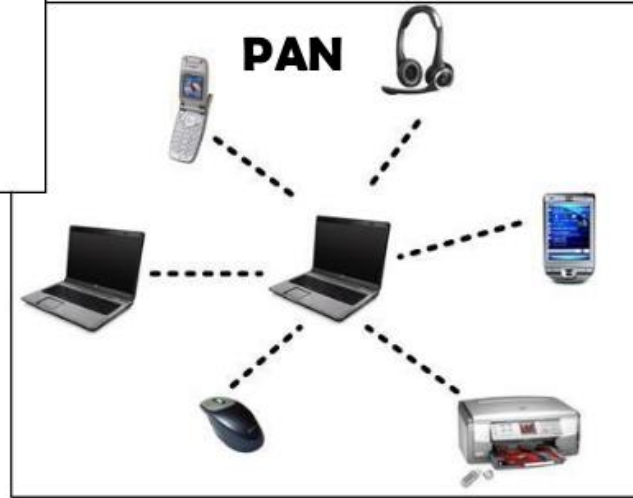
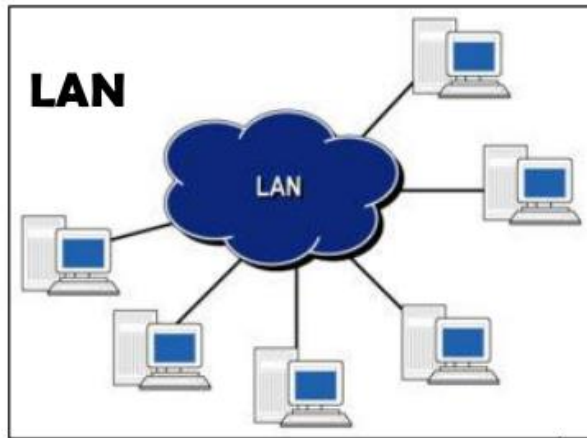
- A MAN is larger than a LAN but smaller than or equal in size to a WAN.
- MANs are typically owned and managed by a single entity.
- This could be an ISP or telecommunication company that sells its services to end-users in that metropolitan area.
- For all intents and purposes, a MAN has the same characteristics as a WAN with distance constraints.



# Wide Area Network (WAN)

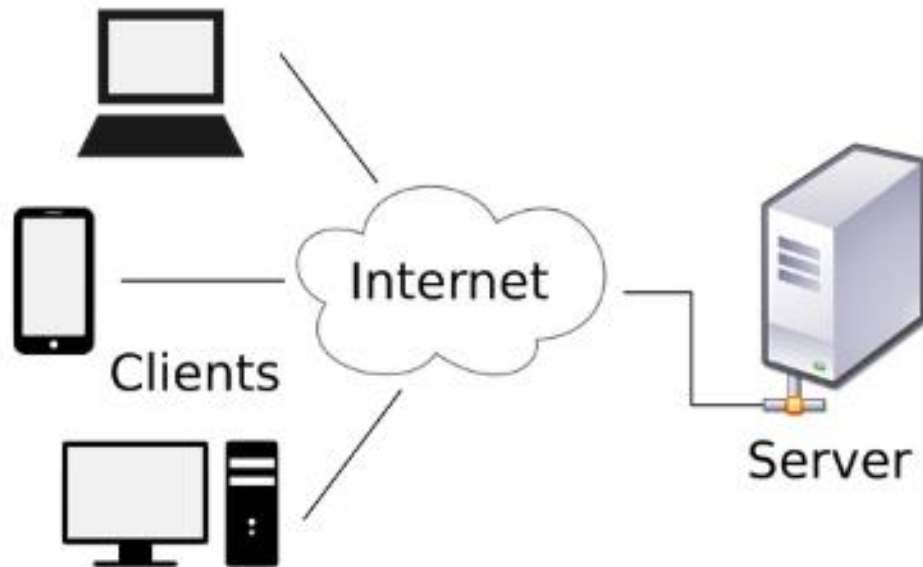
- A Wide Area Network exist over a large area.
- Data travels through telephone or cable lines.
- Usually requires a Modem.
- The Internet is a WAN.



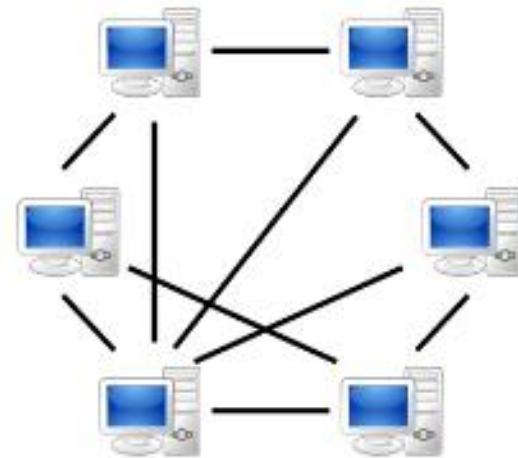


# How Networks Are Structured?

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**Client-Server**



**Peer-to-Peer**

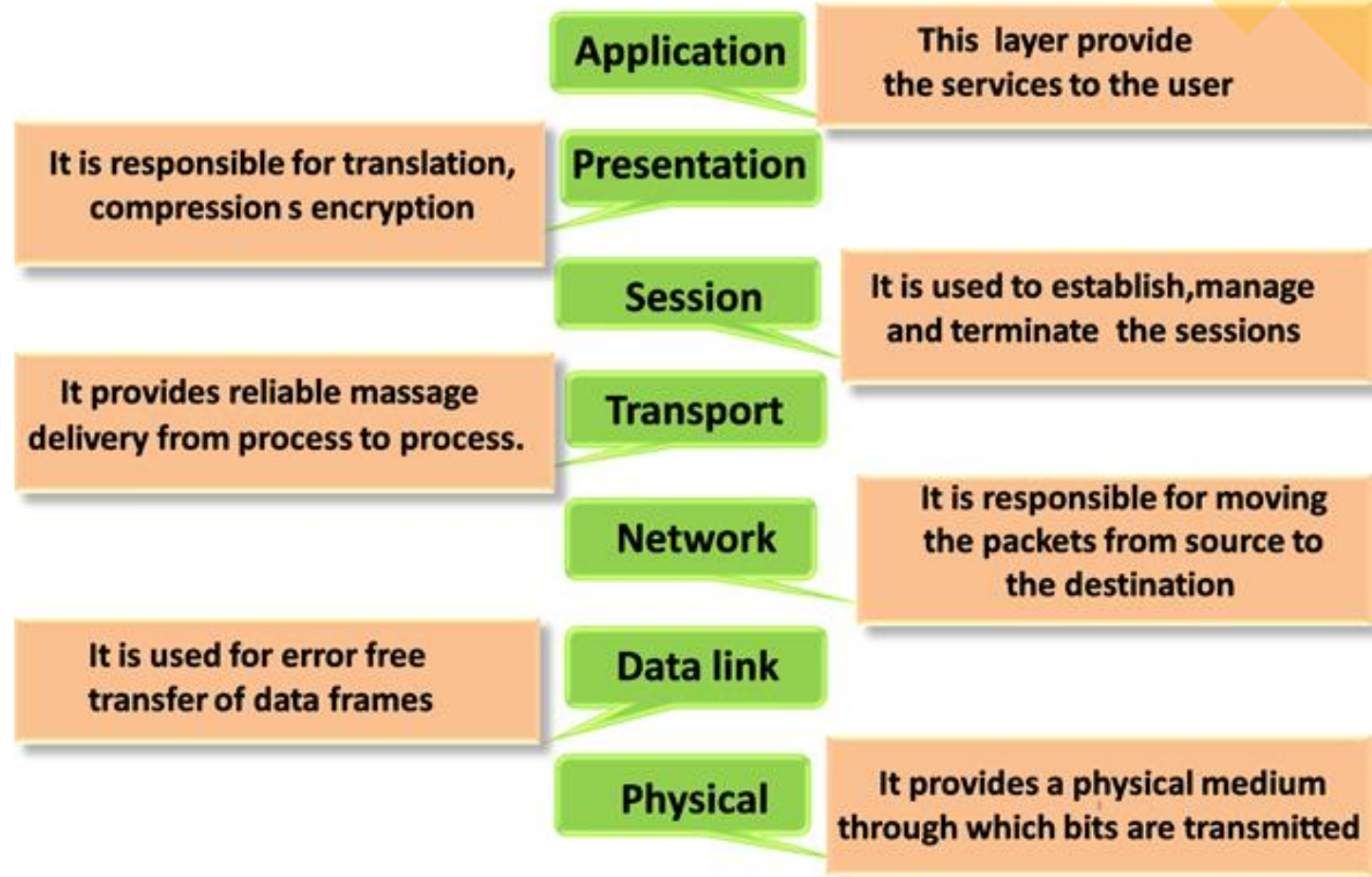
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# Computer Network Models

- In a layered approach, networking concept is divided into several layers, and each layer is assigned a particular task.
- To divide the design into small pieces.
- Each lower layer adds its services to the higher layer to provide a full set of services to manage communications and run the applications.
- It provides modularity and clear interfaces, i.e., provides interaction between subsystems.
- There are set of rules that a layer uses to exchange the information with peer entity. These rules mainly concern about both the contents and order of the messages used.

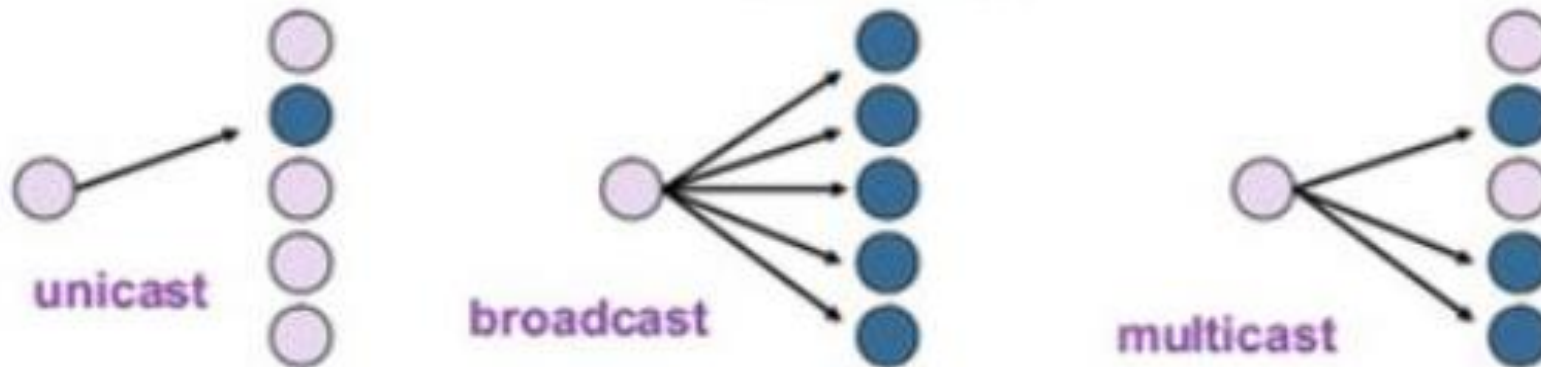
# OSI Model

- **Open System Interconnection** is a reference model that describes how information from a software application in one computer moves through a physical medium to the software application in another computer.
- OSI consists of seven layers, and each layer performs a particular network function.



# Communication Protocols

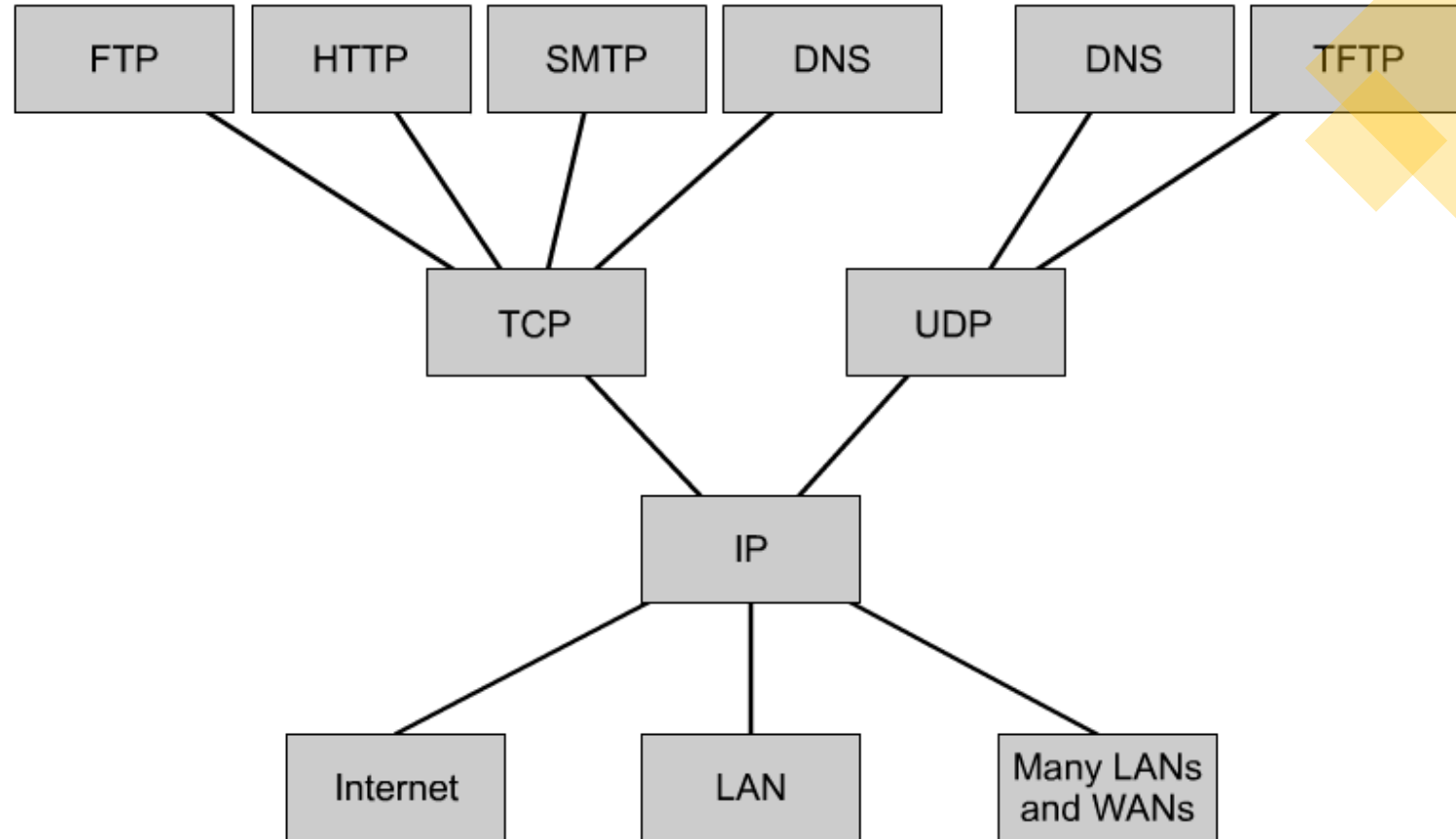
- A protocol is a formal description of a set of rules and conventions that govern a particular aspect of how devices on a network communicate. Protocols determine the format, timing, sequencing, and error control in data communication.
- Unicast – single destination
- Multicast – same message to a group
- Broadcast – all hosts need to receive the message





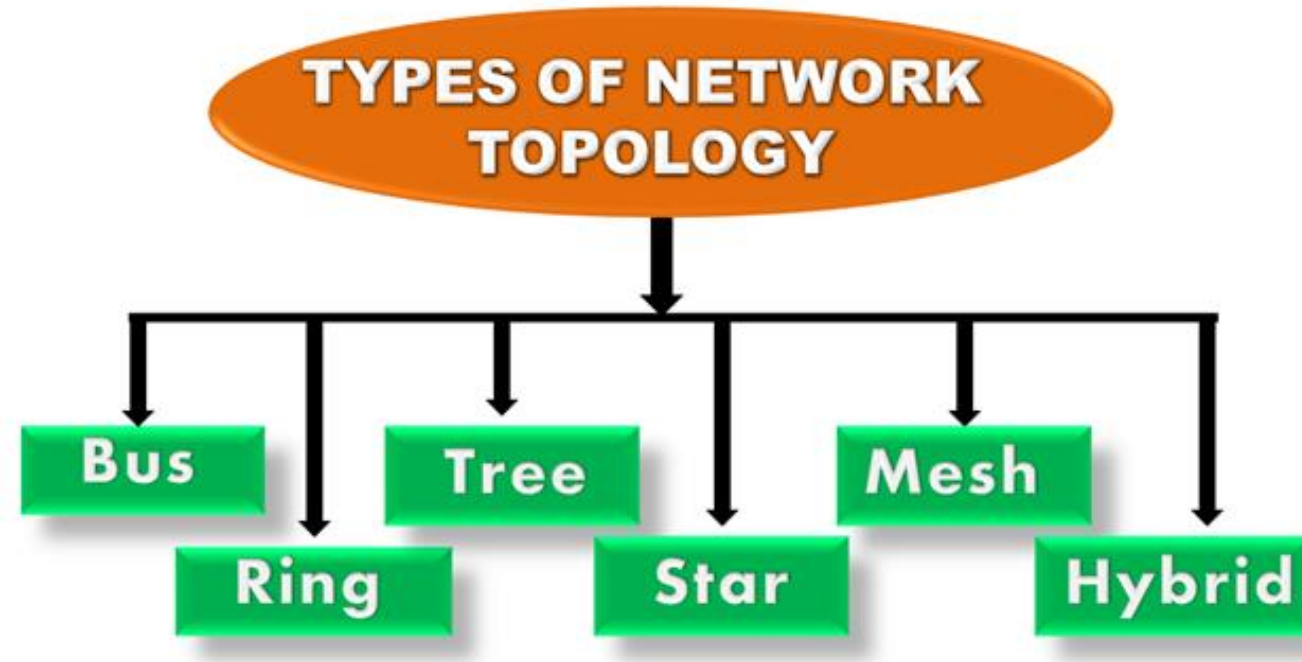
# IP, TCP, UDP

- Application Layer protocols
- Transport Layer protocol
  - TCP: communicating over a network. TCP/IP is the most common protocol
  - UDP: substitute communication protocol to TCP

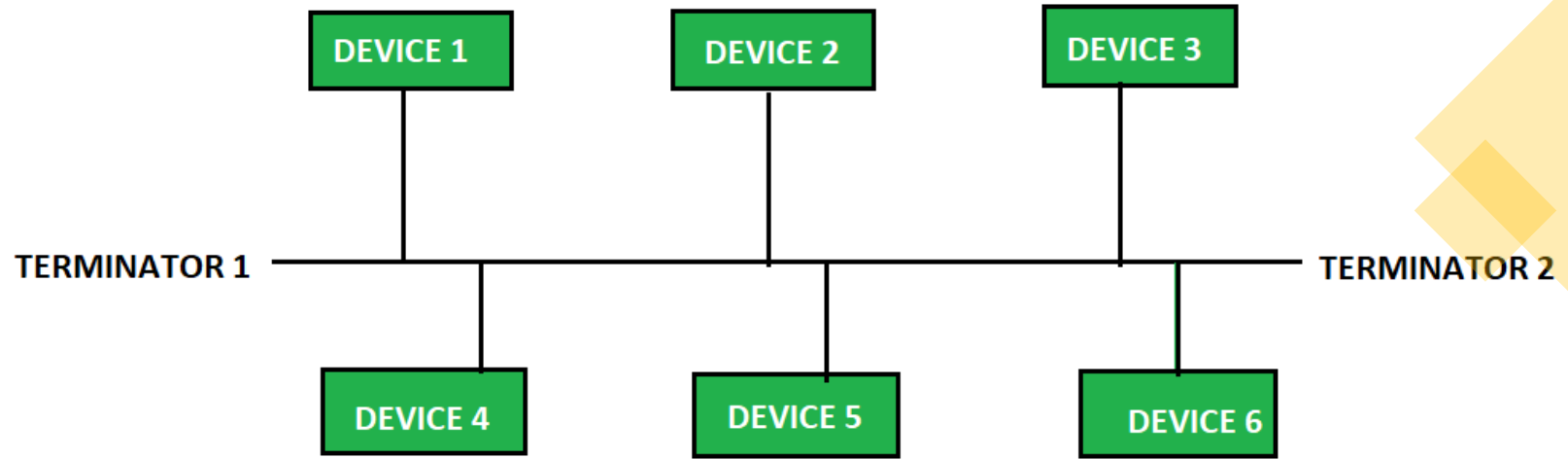


# Network Topologies

- Network topology defines the structure of the network.
- Logical layout of wires and equipment
- Choice affects
  - Network performance
  - Network size
  - Network collision detection
- Several different types

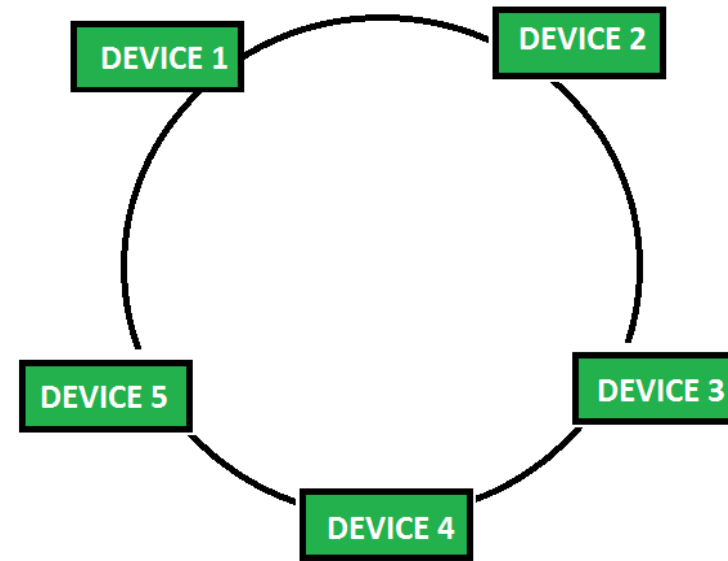


# Bus Topology



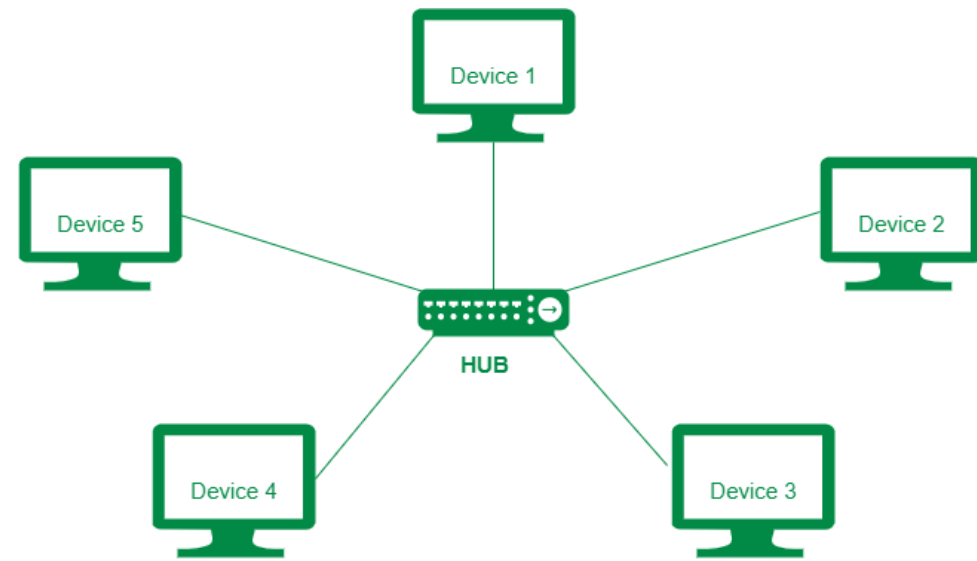
- All devices are connected to a central cable, called bus or backbone.
- There are terminators at each end of the bus that stops the signal.
- Simple and low-cost
- Only one computer can send messages at a time.
- A fault or break in the bus cable stops all transmission, even between devices on the same side of the problem.

# Ring Topology



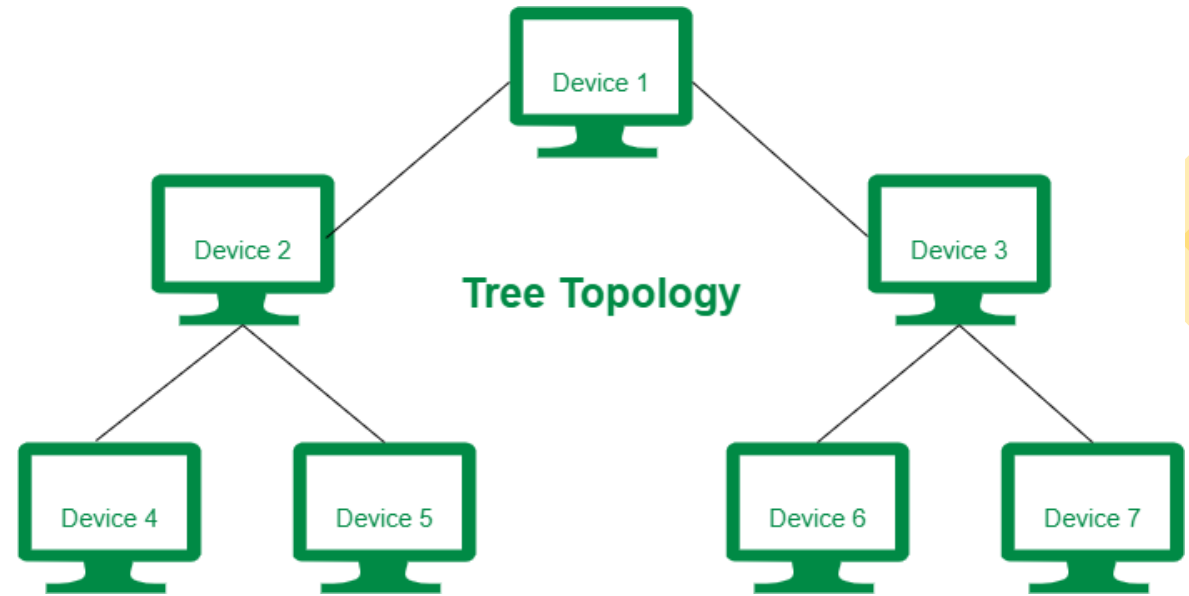
- All devices are connected to one another in the shape of a closed loop.
- Each device incorporates a repeater.
- Typical way to send data:
  - Token passing
  - only the computer who gets the token can send data
- Avoids the collisions that are possible in the bus topology.
- A break in the ring (such as station disabled) can disable the entire network.
- Unidirectional traffic.

# Star Topology



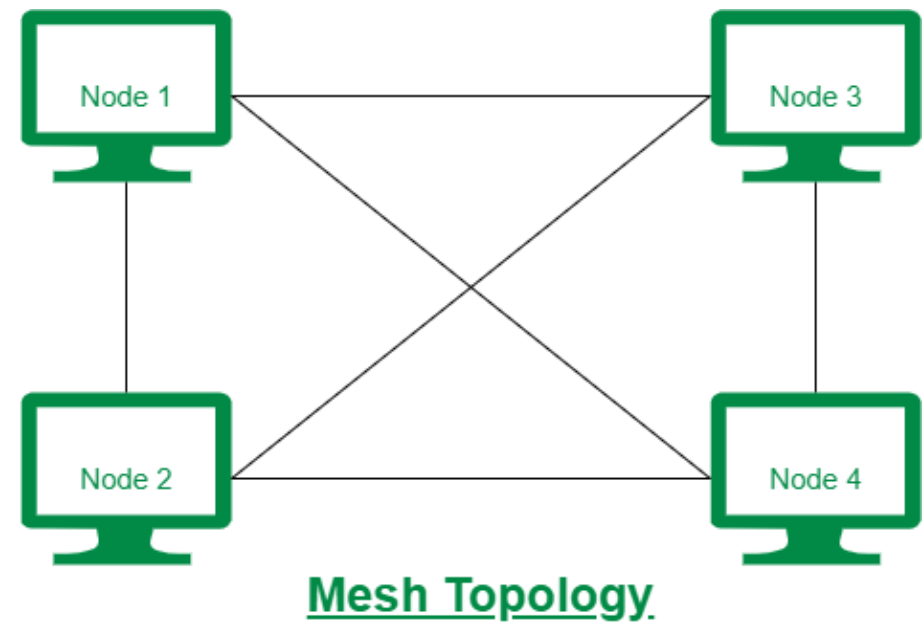
- All devices are connected to a central hub.
- One cable can not crash network. All other links remain active.
- All signals transmission through the hub; if down, entire network down.
- More cabling, hence higher cost.
- Depending on the intelligence of hub, two or more computers may send message at the same time.

# Tree/Hierarchical Topology



- All the devices are connected like the branches which are connected with the tree.
- Combination of a Bus and Star network topology.
- As the leaf nodes can add one or more nodes in the hierarchical chain, it provides high scalability.
- The other nodes in a network are not affected, if one of their nodes get damaged.
- Presence of large number of nodes makes network performance slow.
- If the computer in first level is erroneous, next level computer will also go under problems.

# Mesh Topology



- Each host has its connections to all other hosts.
- Mesh topology is implemented to provide as much protection as possible from interruption of service.
- It is robust, if one link becomes unusable, it does not incapacitate (affect) the entire system.
- A large amount of cabling required.
- Installation and reconfiguration are difficult and expensive.

# Transmission media

- Carry a flow of information.
- Links that connect nodes
- Choice impacts
  - Speed
  - Security
  - Size

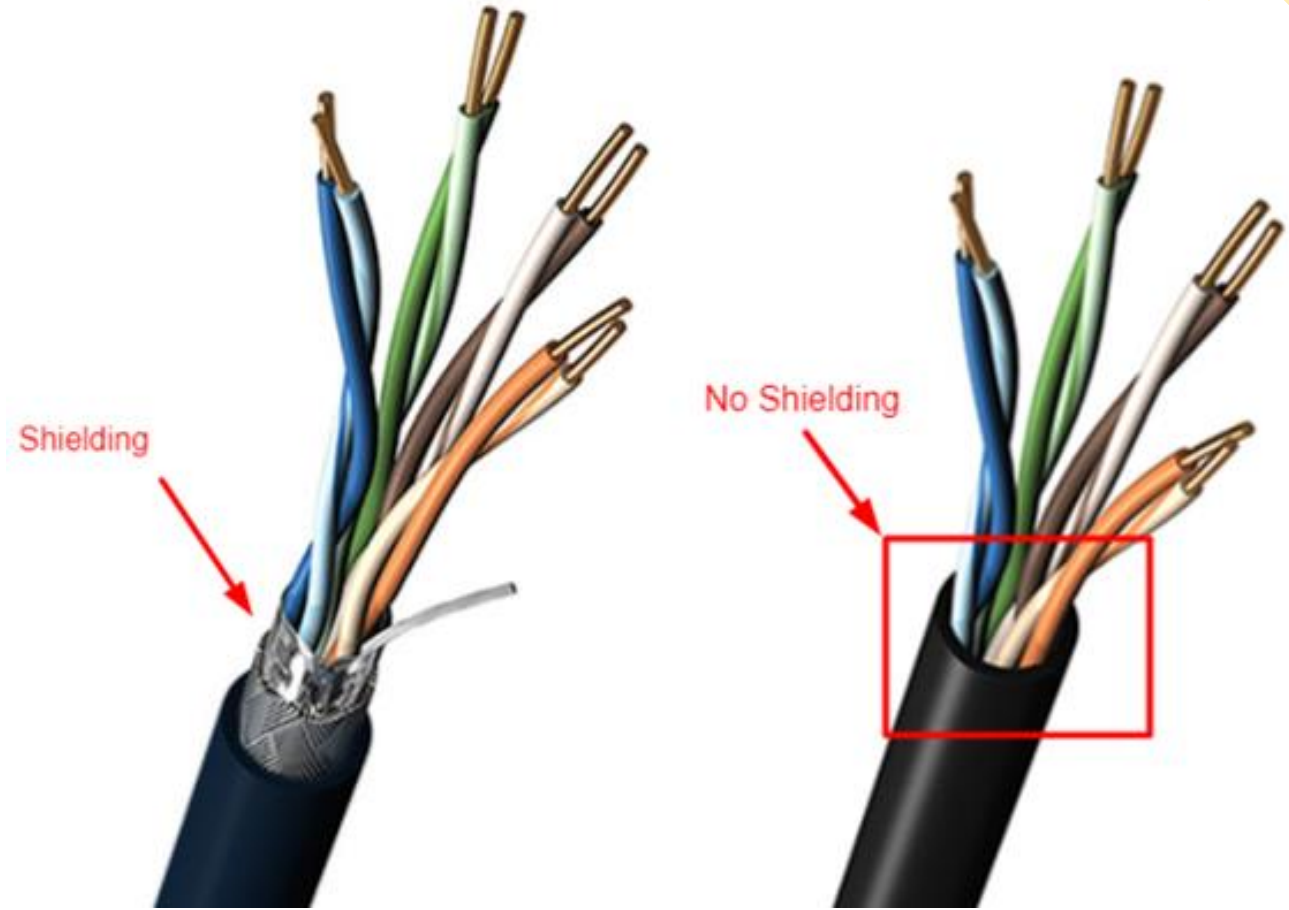
Two main categories:

- Guided — wires, cables
  - Twisted-Pair cables
  - Coaxial cables
  - Fiber-optic cables
- Unguided — wireless transmission, e.g. radio, microwave, infrared, sound, sonar



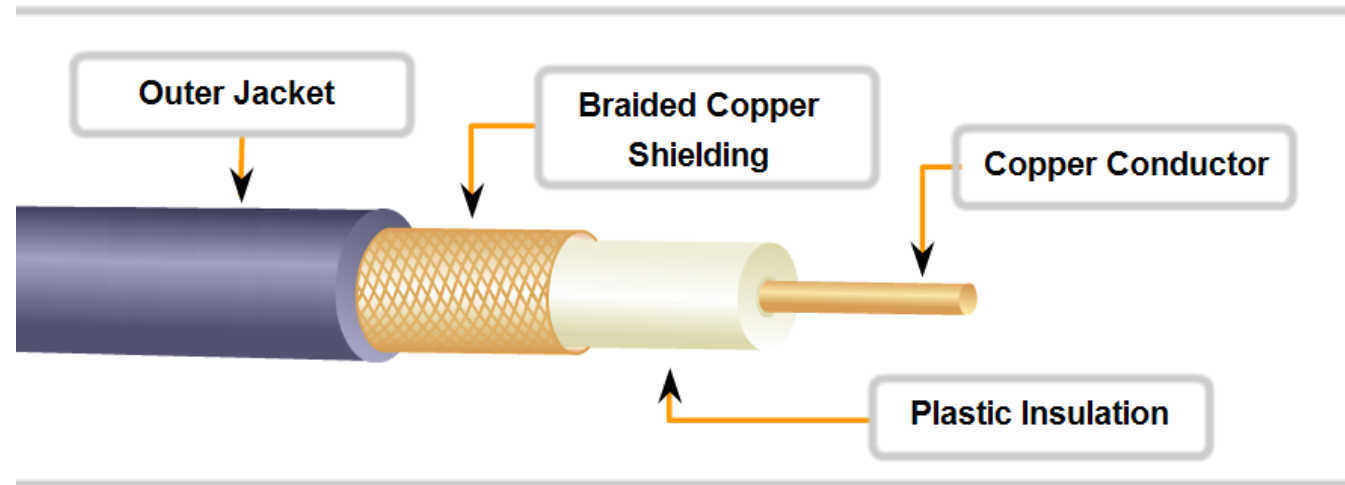
# Twisted-Pair Cables

- Two conductors that are generally made up of copper and each conductor has insulation.
- One of the conductors is used to carry the signal and the other is used as a ground reference only.
- Most common LAN cable.
- Four pairs of copper cable twisted
- May be shielded from inside.
- Speeds range from 1 Mbps to 1,000 Mbps



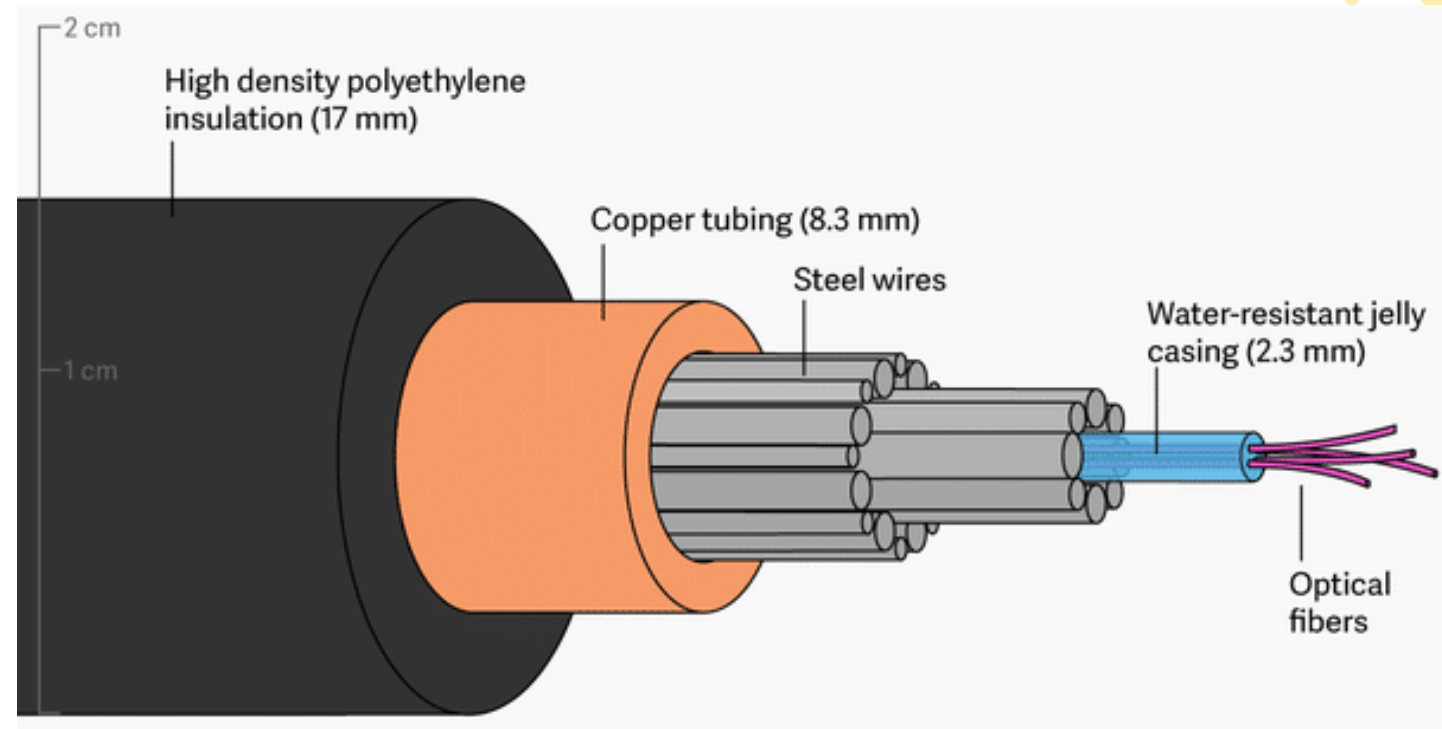
# Coaxial Cables

- Surrounding the copper conductor is a layer of flexible insulation.
- Copper braid or metallic foil acts both as the second wire in the circuit and as a shield for the inner conductor.
- Shield can help reduce the amount of outside interference.
- It can be run longer distances than Twisted pair Cables.
- Speed: 10-100Mbps
- Cost: Inexpensive



# Fiber-Optic Cables

- Glass fiber carrying light pulses.
- Based on the Total Internal Reflection of Light.
- High-speed point-to-point transmission 10-100's Gbps
- low error rate:
  - repeaters spaced far apart
  - immune to electromagnetic noise



# Wireless Media

- Data transmitted through the air
- Carry electromagnetic signals that represent the binary digits of data communications using radio or microwave frequencies.
- LANs use radio waves
- WANs use microwave signals
- Easy to setup
- Difficult to secure
- Bluetooth, Zigbee, WiFi – various standards 1G.. 5G, Others.