

COMPUTER NETWORKS



JINI N K

THE INDIAN PUBLIC SCHOOL®

Unit II: Computer Networks

- Evolution of networking: introduction to computer networks, evolution of networking (ARPANET, NSFNET, INTERNET)
- Data communication terminologies: concept of communication, components of data communication (sender, receiver, message, communication media, protocols), measuring capacity of communication media (bandwidth, data transfer rate), IP address, switching techniques (Circuit switching, Packet switching)
- Transmission media: Wired communication media (Twisted pair cable, Co-axial cable, Fiber-optic cable), Wireless media (Radio waves, Micro waves, Infrared waves)
- Network devices (Modem, Ethernet card, RJ45, Repeater, Hub, Switch, Router, Gateway, WIFI card)
- Network topologies and Network types: types of networks (PAN, LAN, MAN, WAN), networking topologies (Bus, Star, Tree)
- Network protocol: HTTP, FTP, PPP, SMTP, TCP/IP, POP3, HTTPS, TELNET, VoIP
- Introduction to web services: WWW, Hyper Text Markup Language (HTML), Extensible Markup Language (XML), domain names, URL, website, web browser, web servers, web hosting

COMPUTER NETWORKS

- A collection of interconnected computers and other devices
- Communicates with each other
- Share hardware and software resources.



ADVANTAGES

- Share resources
- Share software
- Share storage
- Improve communications

DISADVANTAGES

- Complex to run
- Costlier
- Depends on the server
- File security
- Network management

EVOLUTION OF NETWORKING

ARPANET:

- The First Network was “**ARPANET**”. It was developed by U.S Department of Defense .
- It stands for “**Advanced Research Projects Agency Network**”.

NSFnet:

- In mid 80's another federal agency called **NSF**(National Science Foundation) created new High capacity network called NSFnet.
- NSFnet strictly used for academic and engineering research.

EVOLUTION OF NETWORKING

- 1 1969 - First network came into existence
- 2 ARPANET – Advanced Research Project Agency Network
- 3 MID 80'S - NSFNET (National Science Foundation Network)

ARPANET +NSFNET + PRIVATE NETWORKS = INTERNET

DATA COMMUNICATION TERMINOLOGIES

1. Data Channel:

Channel is the medium used to carry information or data from one point to another.

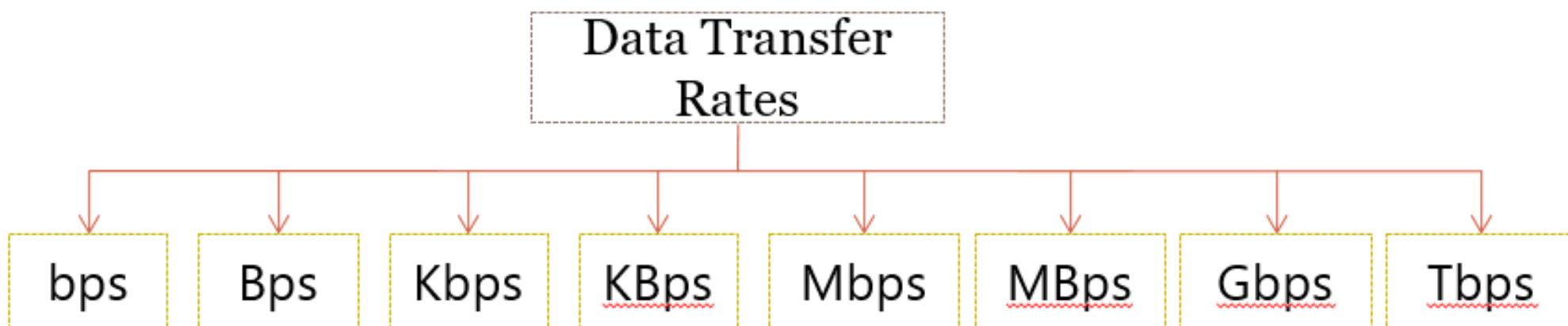
2. Baud:

It is a unit used to measure the speed of signaling or data transfer , equals to the number of pulses or **bits per second(bps)**.

3. Data Transfer Rates:

The amount of data transferred per second by the communication channel from one point to another is known as “Data Transfer Rates”. It is measured by bps or Bps or baud.

The following are some of the **terms used in data transfer**:



- (i) **bps** – It denotes "**bits per second**".
- (ii) **Bps** – It denotes "**Bytes per second**" ($1\text{Bps} = 1000 \text{ bps}$)
- (iii) **Kbps** – It denotes "**Kilo bits per second**" ($1\text{Kbps} = 125 \text{ Bps}$)
- (iv) **KBps** - It denotes "**Kilo Bytes per second**".
- (v) **Mbps** – It denotes "**Mega bits per second**".
- (vi) **MBps**- It denotes "**Mega Bytes per second**".
- (vii) **Gbps** – It denotes "**Giga bits per second**".
- (viii) **Tbps** – It denotes "**Tera bits per second**".

4. Bandwidth:

- It measures how much data can be sent over a specific connection in a given amount of time.
- High bandwidth channels are called **broad band channels** and Low bandwidth channels are called **narrow band channels**.
- In analog system frequency is measured by **hertz(Hz)** and digital system it is measured by "**bps(bits per second)**". **The terms used in bandwidth.**
 - (i) **kHz**- A “kilohertz” represents **thousand cycles per second**.
 - (ii) **MHz** – A “Megahertz” represents thousand **KHz**.
 - (iii) **GHz** – A “Gigahertz“ represents thousand **MHz**.
 - (iv) **THz**- A “Terahertz“ represents thousand **GHz**.

COMPONENTS OF A COMPUTER NETWORKS

(i) Hosts/Nodes -

Computers that are attached to the network

PC, laptop, smartphones...

(ii) Servers -

A computer that facilitates

- sharing of data
- software
- hardware resources
- Communication among hosts

(iii) Clients -

Host computer that requests for services from a server

(iv) Network Hardware -

NIC

- Network Interface Card
- Also called as Network Interface Unit (NIU) or Terminal Access Point (TAP)
- Has a unique physical address called MAC address of 6 bytes assigned by manufacturer

Hub, Switch, Router

- Network connectivity devices

(v) Communication channel -

Hosts in a network interact with other hosts and server(s)

Wired Communication channels

Devices connected through “Guided Media”(network cables)

Eg. Twisted-pair cables, coaxial cables, fibre-optic cables

Wireless Communication channels

Devices connected through “Unguided Media”

Eg. Microwaves, radio waves, satellites, infrared waves, laser...

(vi) Software -

Makes networking possible

Network Protocols

→ Set of rules for network connectivity

Network operating system

→ Specialized OS to handle networking tasks

(vii) Network Services -

→ Applications that provide different functionalities

 → DNS – Domain Name System

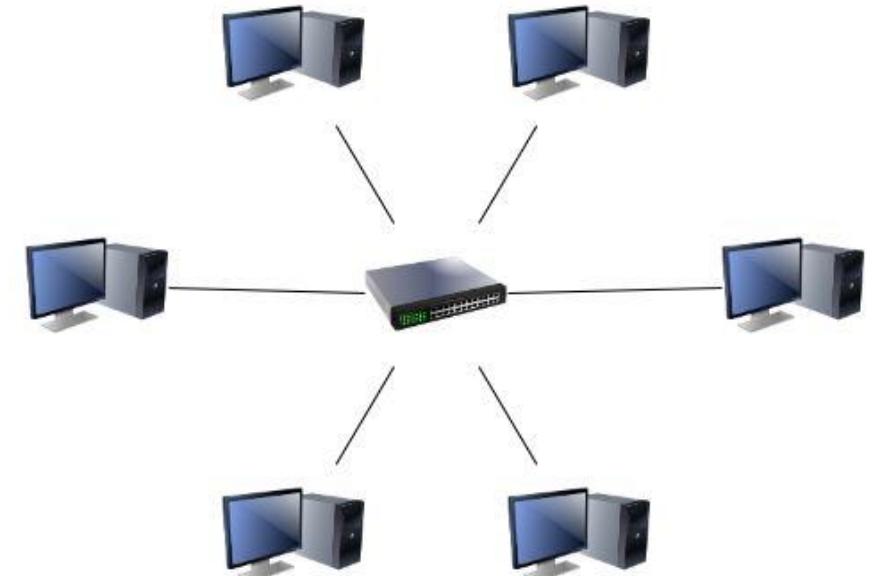
 → File sharing

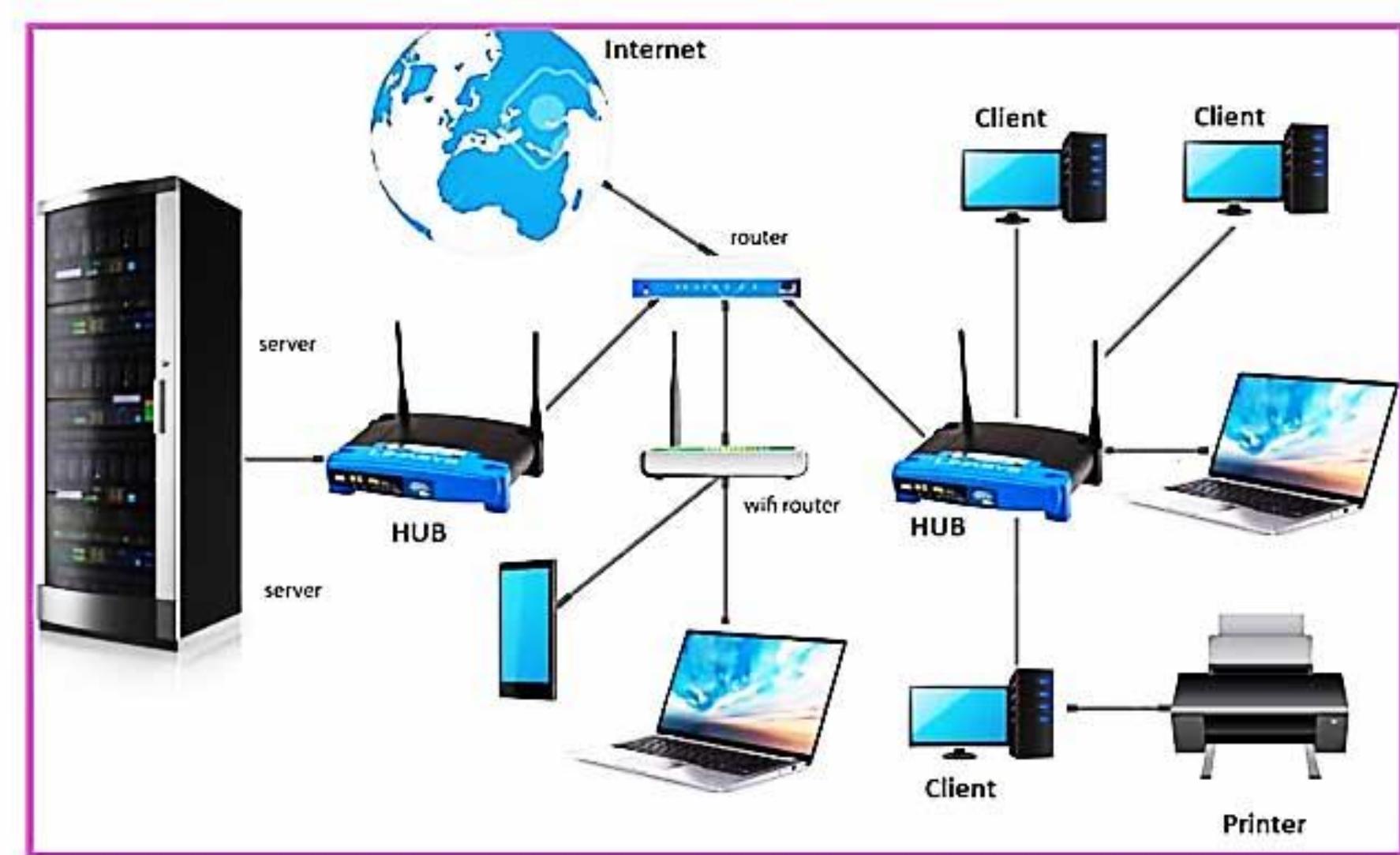
 → VoIP – Voice over Internet Protocol

TYPES OF NETWORKS - Geographical spread

LAN

- Local Area Network
- Small computer networks
- Confined to a localized area upto 1 km
- Eg. Office, building, schools, colleges or a factory
- LAN using unguided media - WLAN

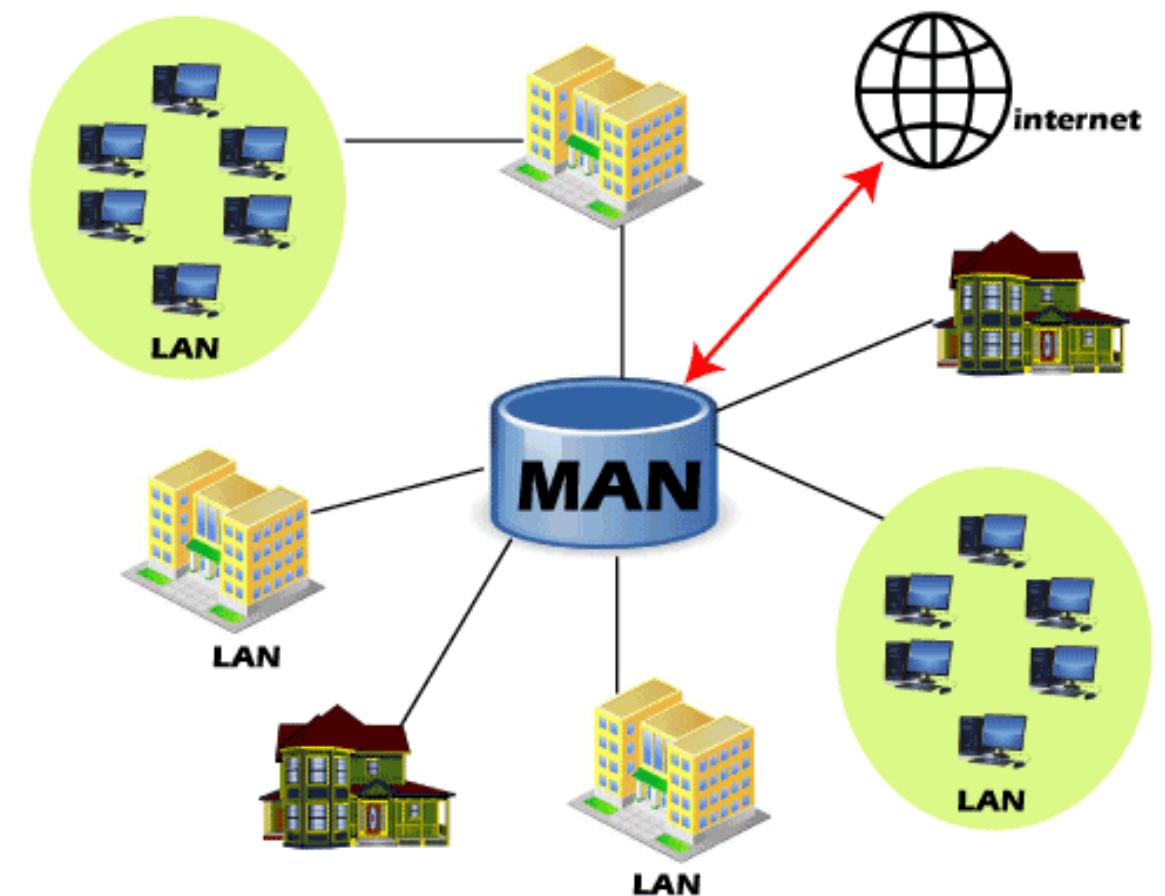




MAN

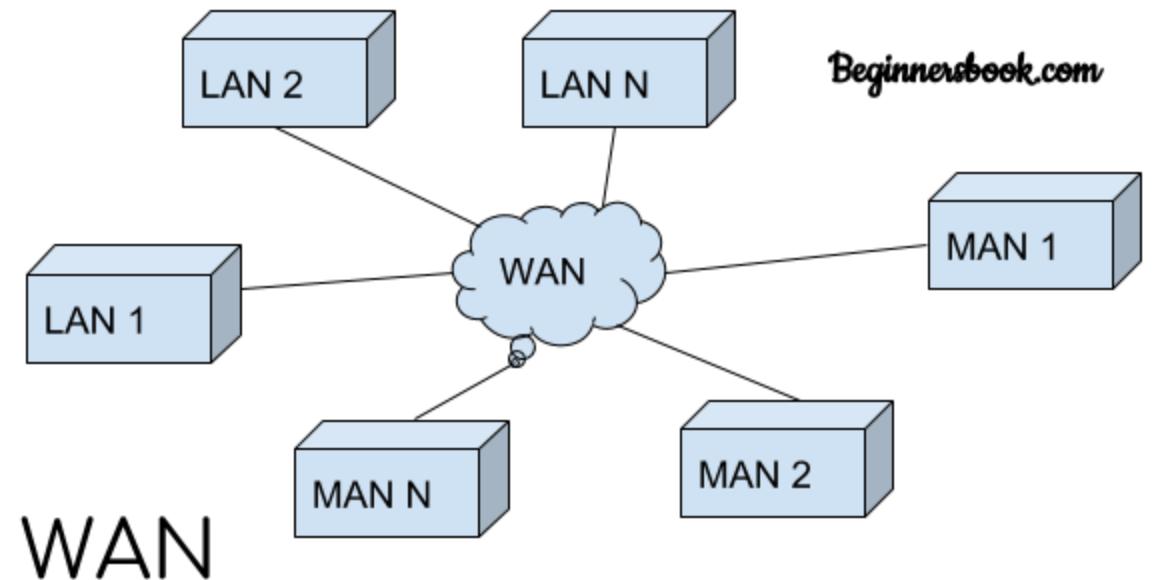
- Metropolitan Area Network
- Spans several buildings in the same city or town (30 to 40 km)
- MAN is larger than LAN but smaller than WAN

MAN (Metropolitan Area Network)



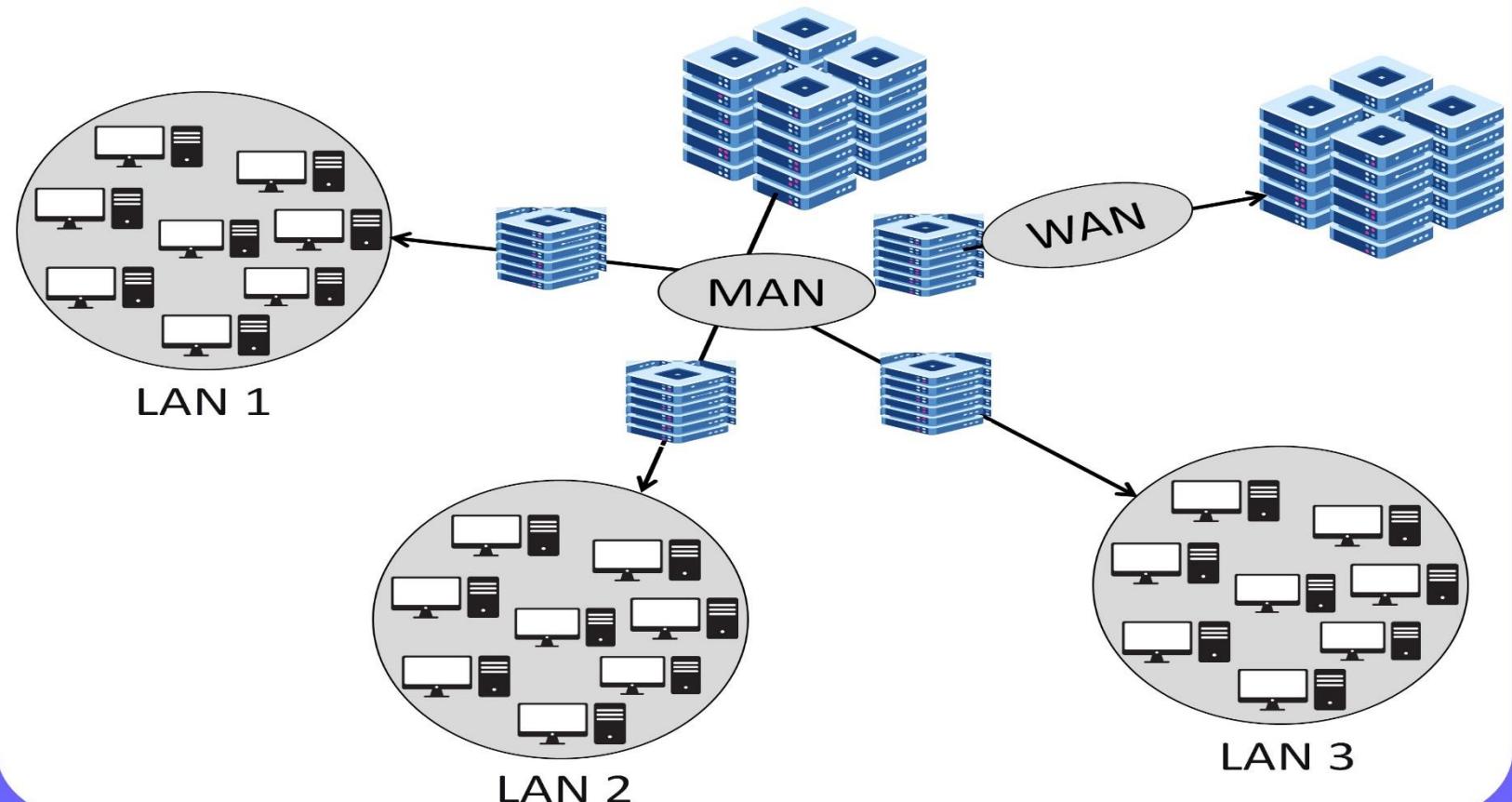
WAN

- Wide Area Network
- Spans over a large geographical area such as; a state, a country, a continent, Planet.
- 100KM – 1000 KM
- Internet is the largest WAN



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LAN, MAN AND WAN



PAN

- Personal Area Network
- Covers a very small area, ranges 1meters - 10 meters or 30 feet
- Wired USB connectivity or Wireless like Bluetooth or Infrared



COMPARISON OF NETWORKS

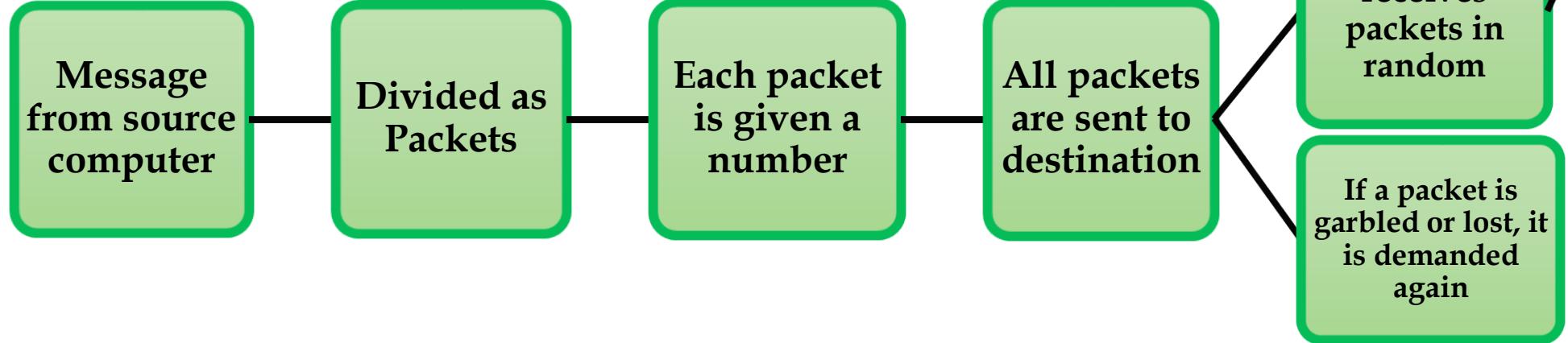
Parameter	PAN	LAN	MAN	WAN
Area covered	Small area (up to 10 m radius)	A building or campus (up to 10 km)	A city (up to 100 km radius)	Entire country, continent or globe
Networking cost	Negligible	Inexpensive	Expensive	Very expensive
Transmission speed	High speed	High speed	Moderate speed	Low speed
Error rate	Lowest	Lowest	Moderate	Highest
Network devices used	WLAN, USB Dongle	LAN/WLAN, Hub/ Switch, Repeater, Modem	Router, Gateway	Router, Gateway
Technology/media used	Infrared, Bluetooth	Ethernet, Wi-Fi	Optical fibre, Radio-wave, Microwave	Microwave Satellite

INTERNET

- World wide network of computers
- Super network
- Made up of many networks interconnected by peering points
- Allows exchange of information
- Internet protocols - TCP/IP



HOW DOES INTERNET WORK?



The communication protocol used by Internet is TCP/IP

TCP - Transmission Control Protocol

Responsible for dividing messages into packets and reassembling the same at the destination

IP - Internet Protocol

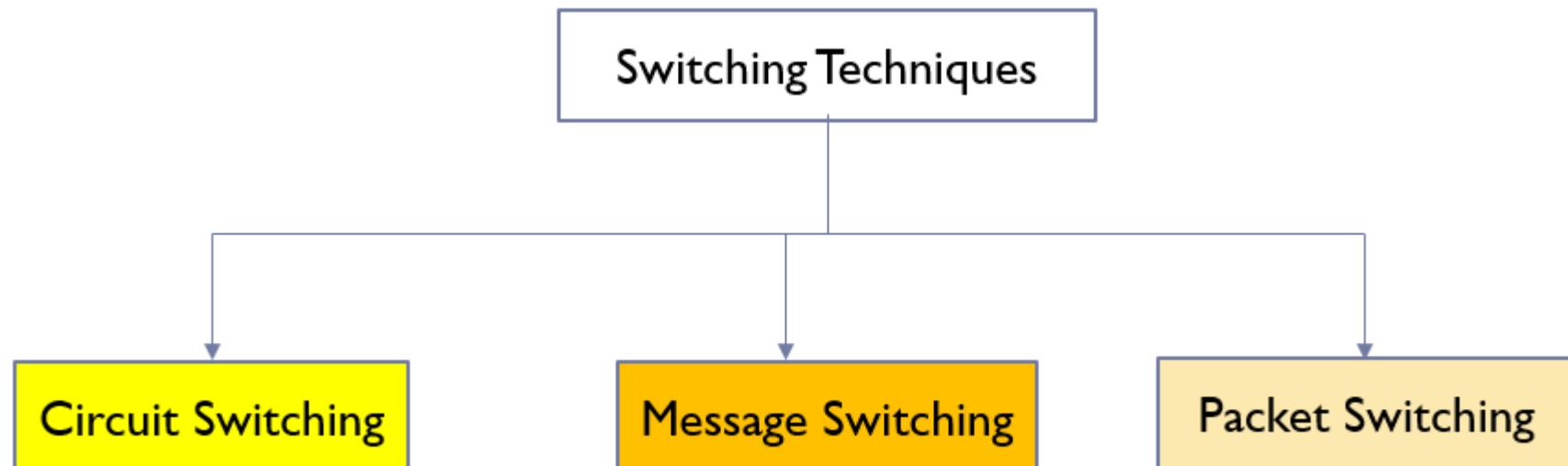
Responsible for handling the address of destination computer so that each packet is routed to its proper destination

INTERSPACE

- Client/server software program
- Allows multiple users communicate online
- Uses real time audio, video and text chat in 3D environments
- Interspace is an application environment whereas internet is a protocol environment

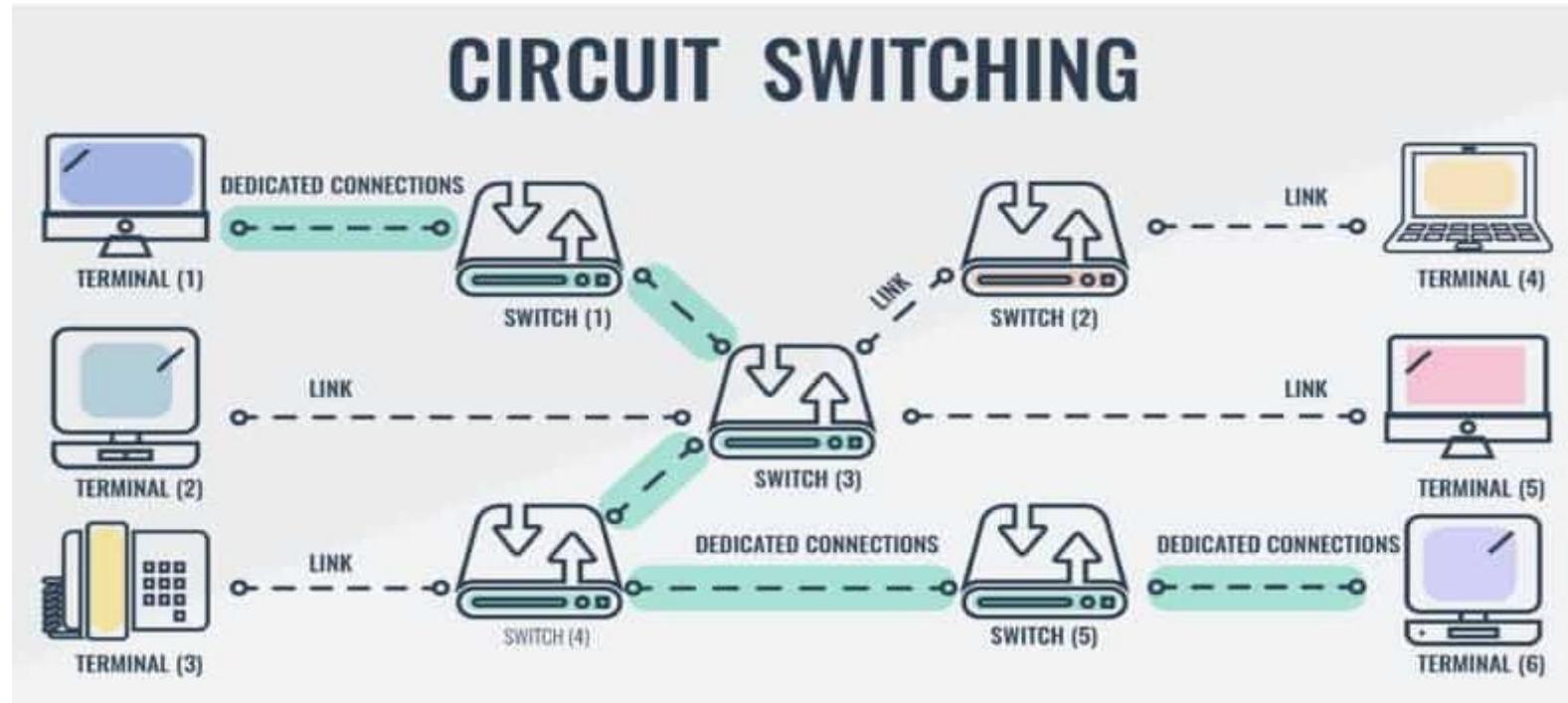
SWITCHING TECHNIQUES

- Used for data transmission across networks
- Technique used is switching technique



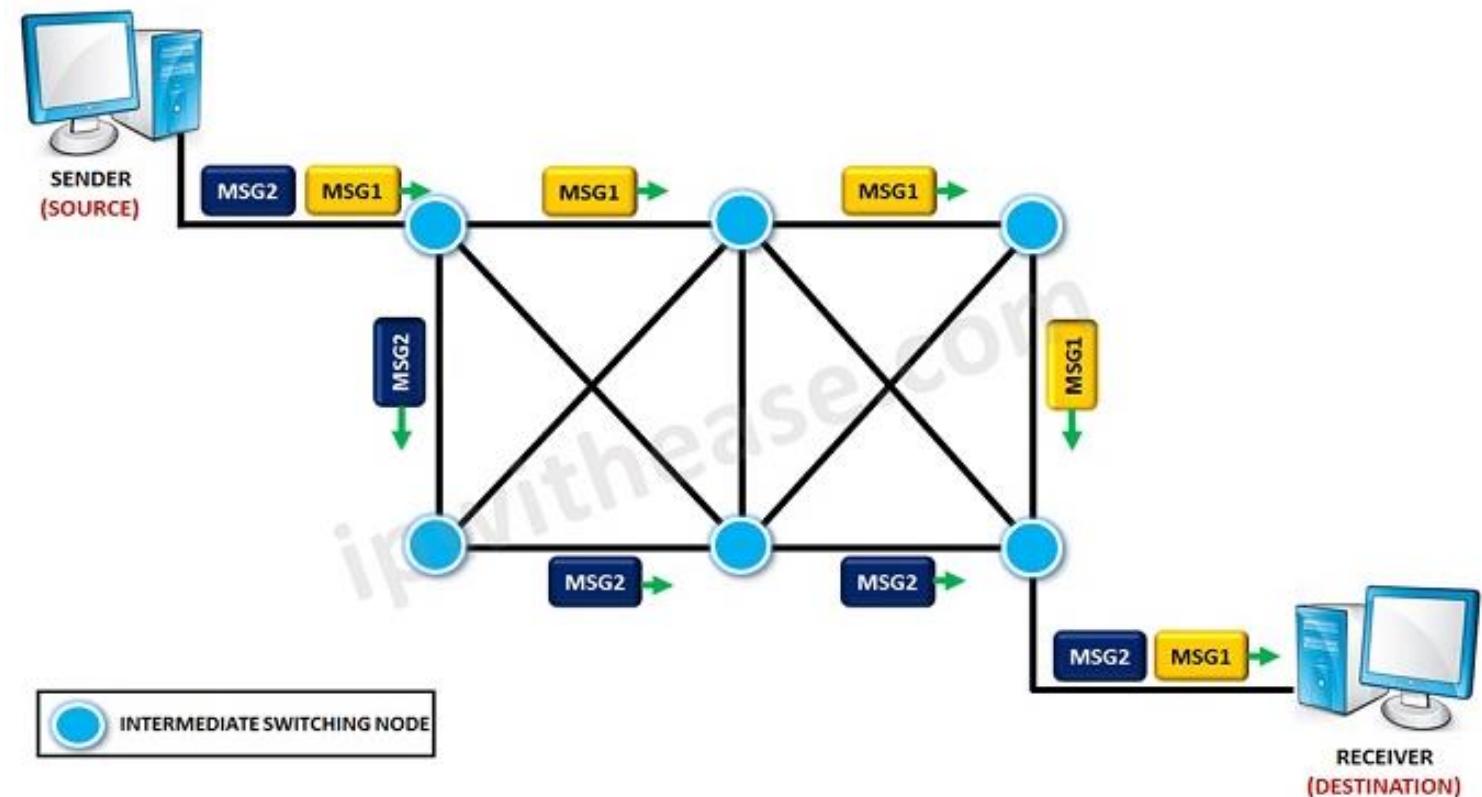
CIRCUIT SWITCHING

- A complete physical connection is established between the sender and receiver
- Sets up an end to end path between computers before sending the data



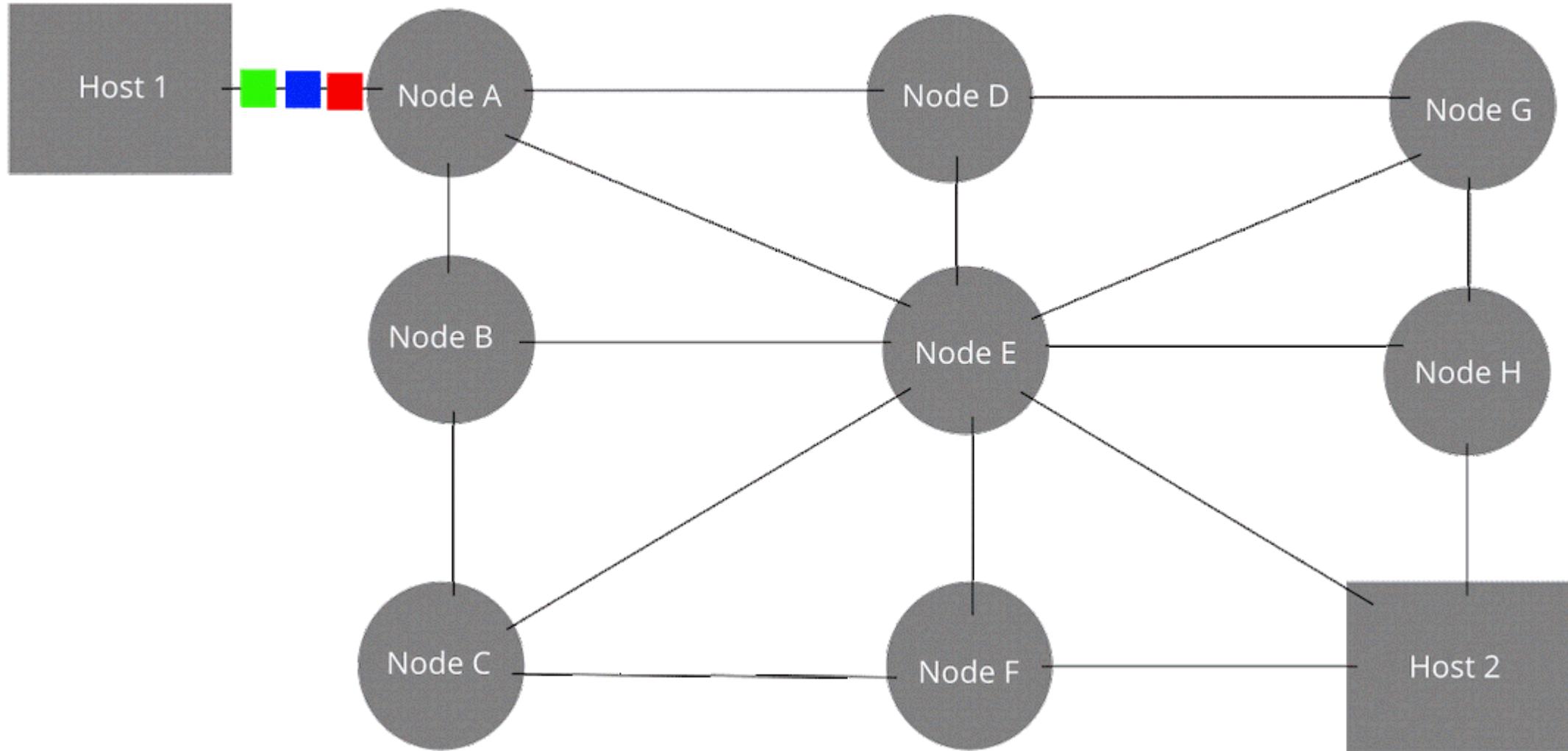
MESSAGE SWITCHING

- Uses store and forward working principle
- Stores first, forward later, one jump at a time
- Travels across different intermediate hops or switching offices



PACKET SWITCHING

The original message is **Green, Blue, Red.**

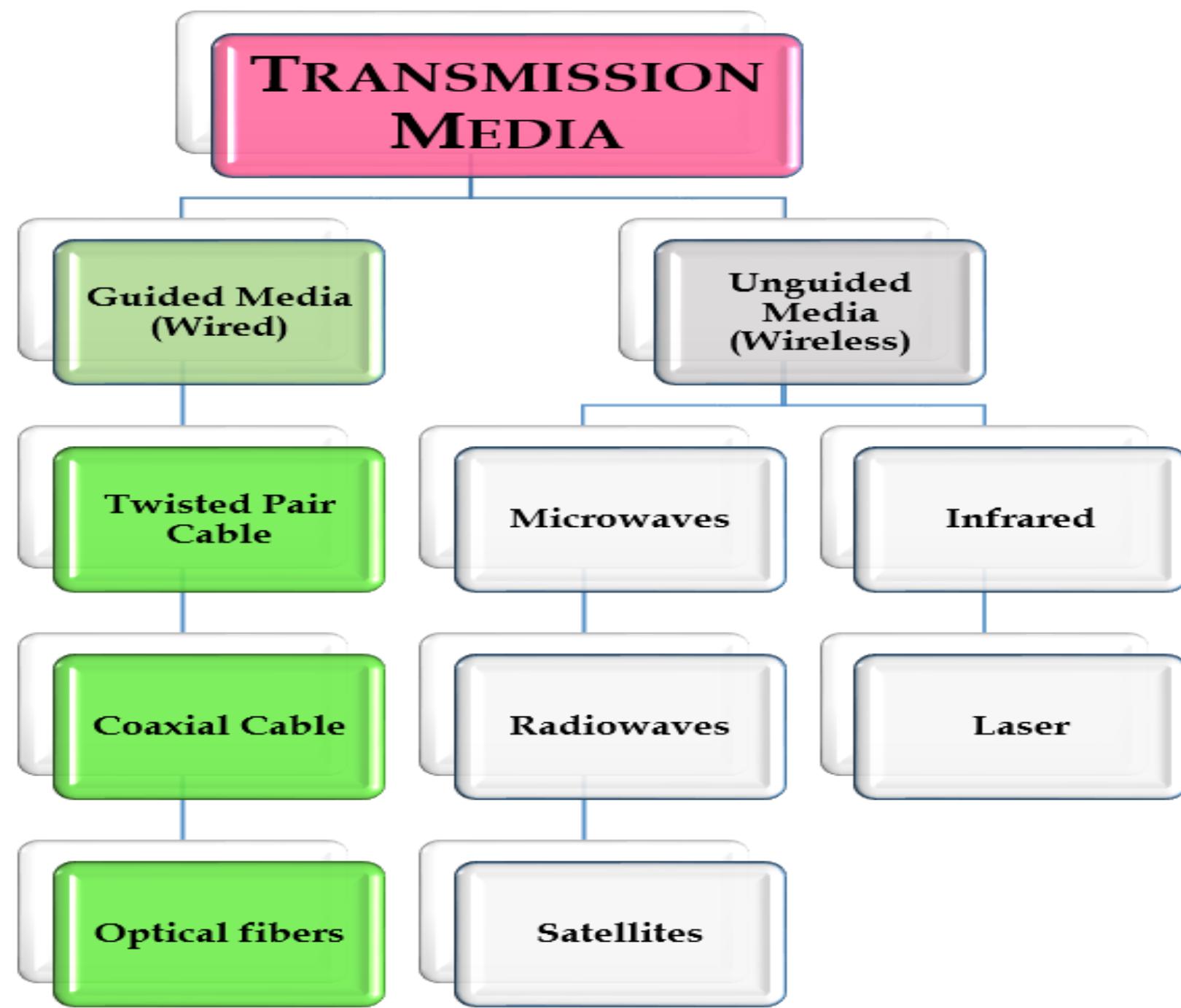


PACKET SWITCHING

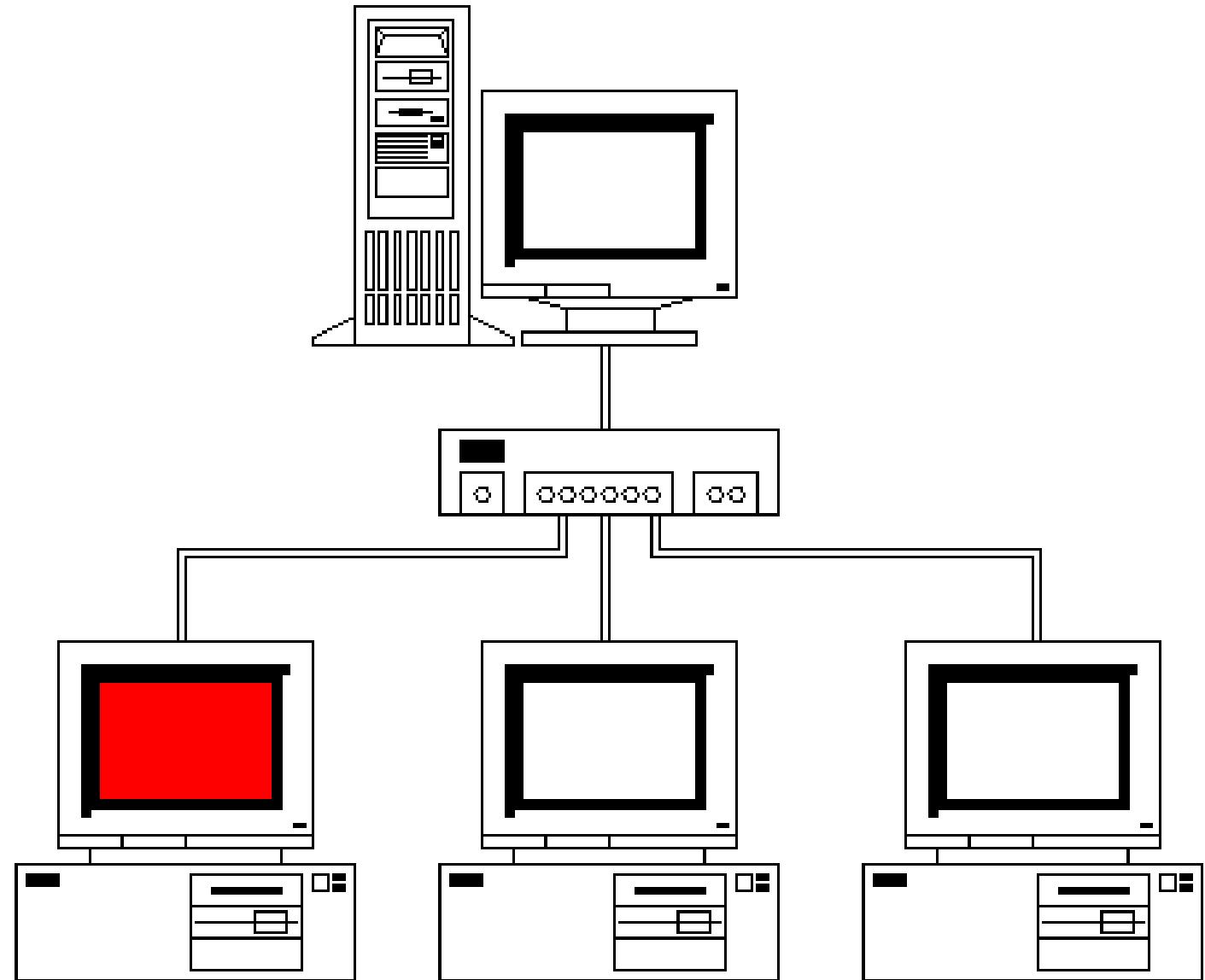
- The internet is a packet switched network
- Message is broken into individual chunks called as packets
- Each packet is sent individually
- Each packet will have source and destination IP address with sequence number
- Sequence numbers will help the receiver to
 - Reorder the packets
 - Detect missing packets
 - Send acknowledgements

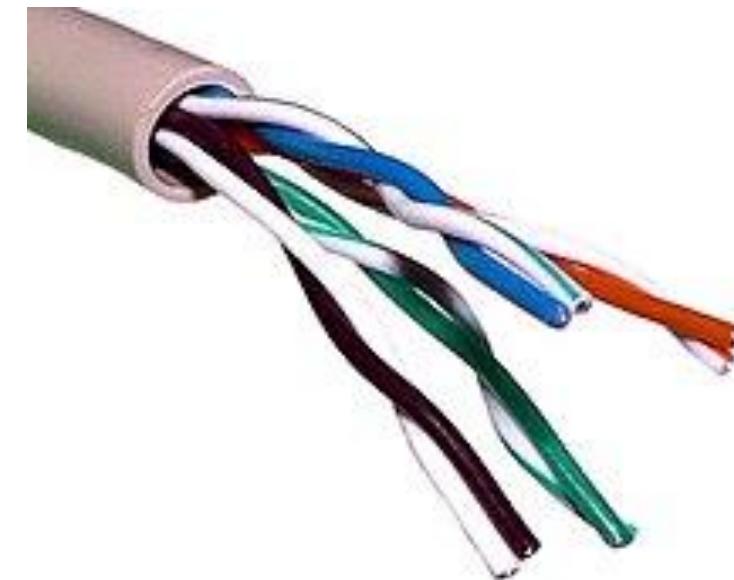
CIRCUIT SWITCHING VS PACKET SWITCHING

Circuit Switching	Packet Switching
Physical path between source and destination	No physical path
All packets use same path	Packets travel independently
Reserve the entire bandwidth in advance	Does not reserve
Bandwidth Wastage	No Bandwidth wastage
No store and forward transmission	Supports store and forward transmission



GUIDED MEDIA





TWISTED PAIR CABLE

- Twisted Pair cable consists of four insulated pairs of wires twisted around each other
- Twisting of wires reduces crosstalk
- **Crosstalk** is the bleeding of a signal from one wire to another which can corrupt signal and cause network errors
- Used in telecommunication and Ethernet network

TWISTED PAIR CABLE

ADVANTAGES

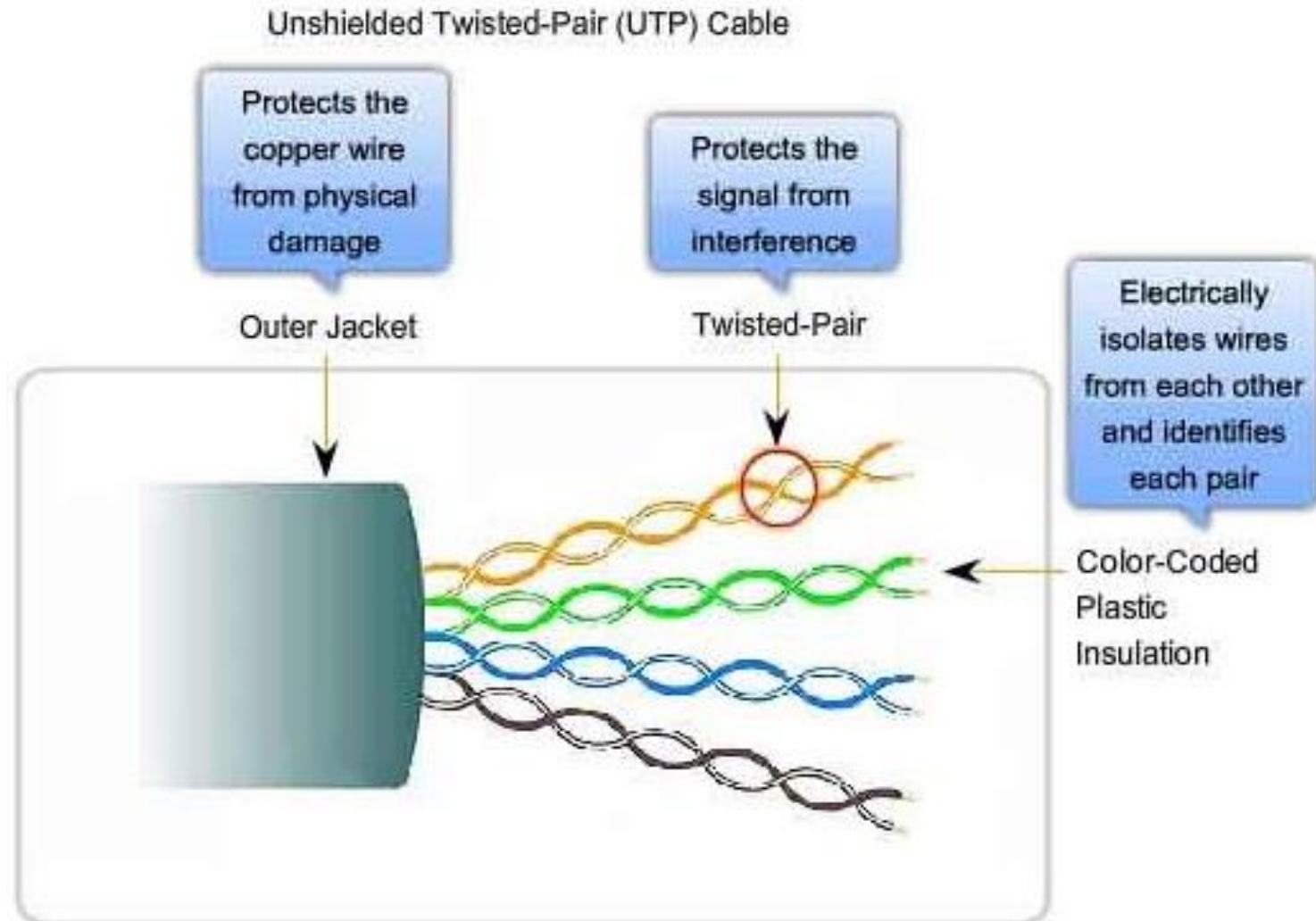
- Simple, easy to install and maintain
- Physically flexible
- Low weight
- Can be easily connected
- Very inexpensive

DISADVANTAGES

- Incapable to carry signal over long distances without a repeater (> 100)
- Has low bandwidth capabilities
- Unsuitable for broadband applications

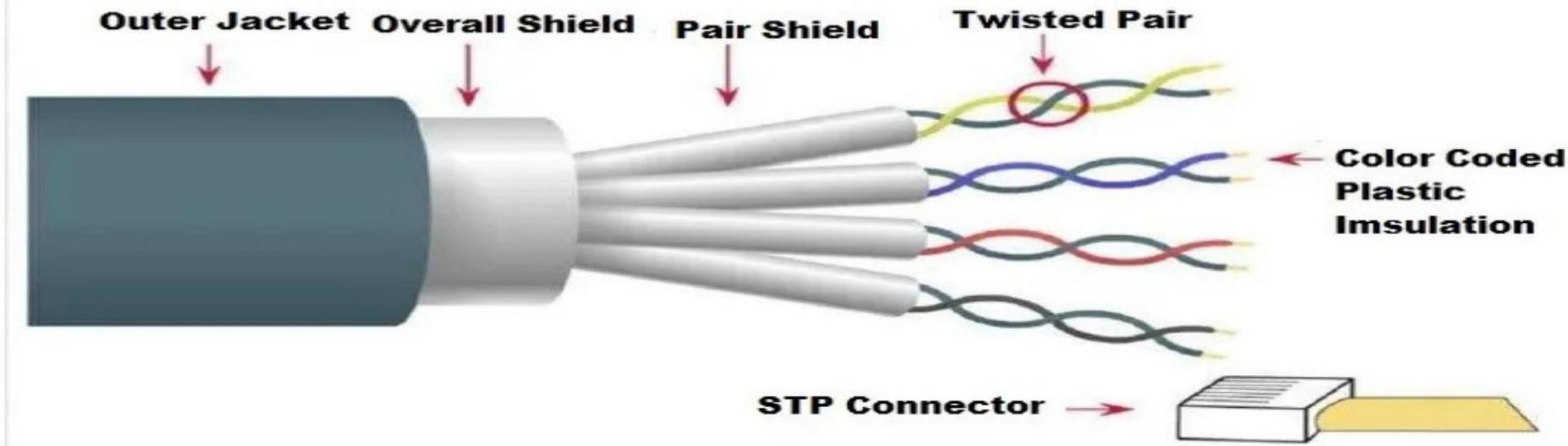
UNSHIELDED TWISTED PAIR CABLE UTP

- Used for variety of electronic communications



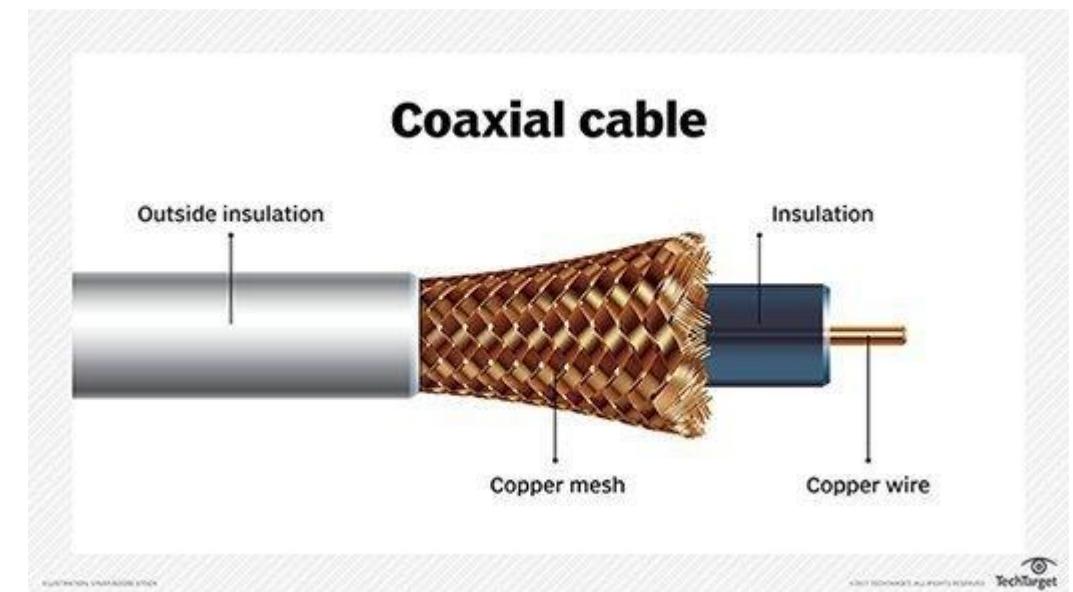


SHIELDED TWISTED PAIR CABLE STP



- Shielded individual pair of wires
- Maximum length can be 100 m
- Gives greater protection from interference and crosstalk due to shielding
- Heavier and costlier than UTP

COAXIAL CABLE



- Consists of a solid wire core surrounded by one or more foil or wire shields
- Each separated by plastic insulator
- Inner core carries the signal and the shield provides the ground
- Suitable for high speed communication
- Most common in cable TV transmission

COAXIAL CABLE

ADVANTAGES

- Data transmission is better than twisted pair cable
- Used for shared cable network
- Used for broadband transmission
- Offer higher bandwidths upto 400 Mbps

DISADVANTAGES

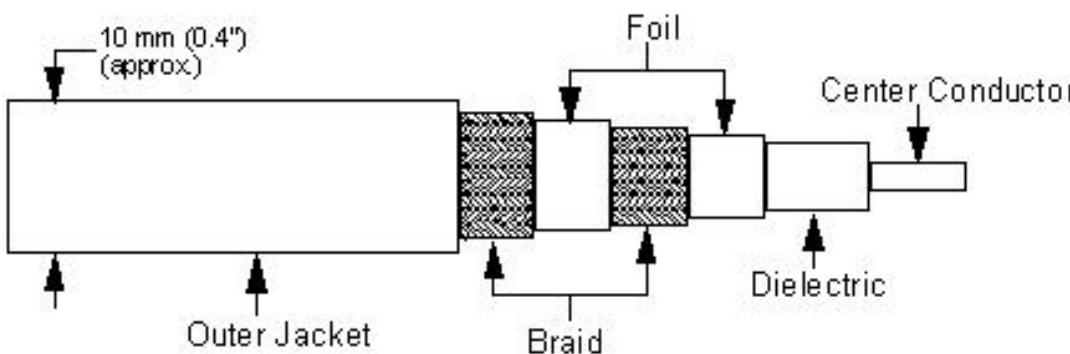
- Expensive compared to twisted pair cable
- Not compatible with twisted pair cable

TYPES OF COAXIAL CABLE

THICKNET

- Thicker than thinnet
- Segments can be upto 500 m long (while joining nodes)

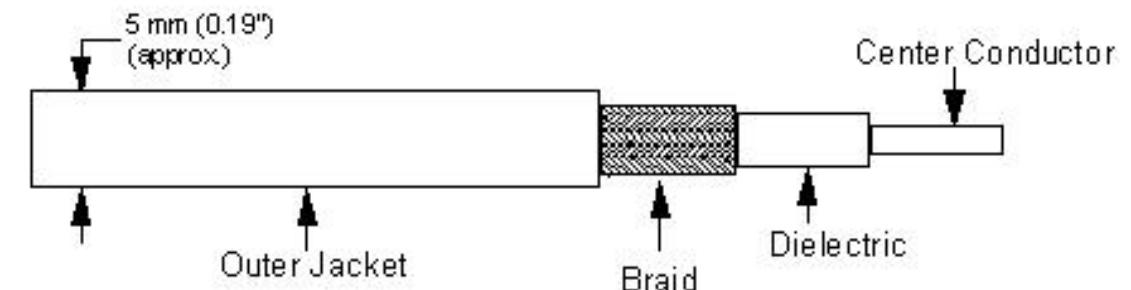
Thicknet Coaxial Cable



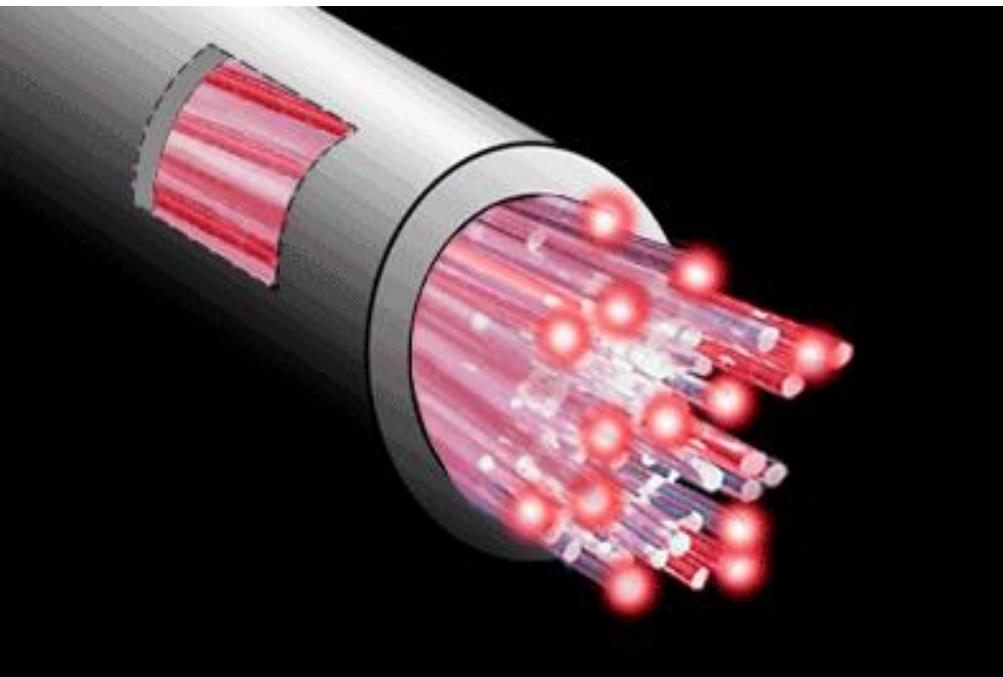
THINNET

- Thinner
- Segment length can be upto 185 m

Thinnet Coaxial Cable

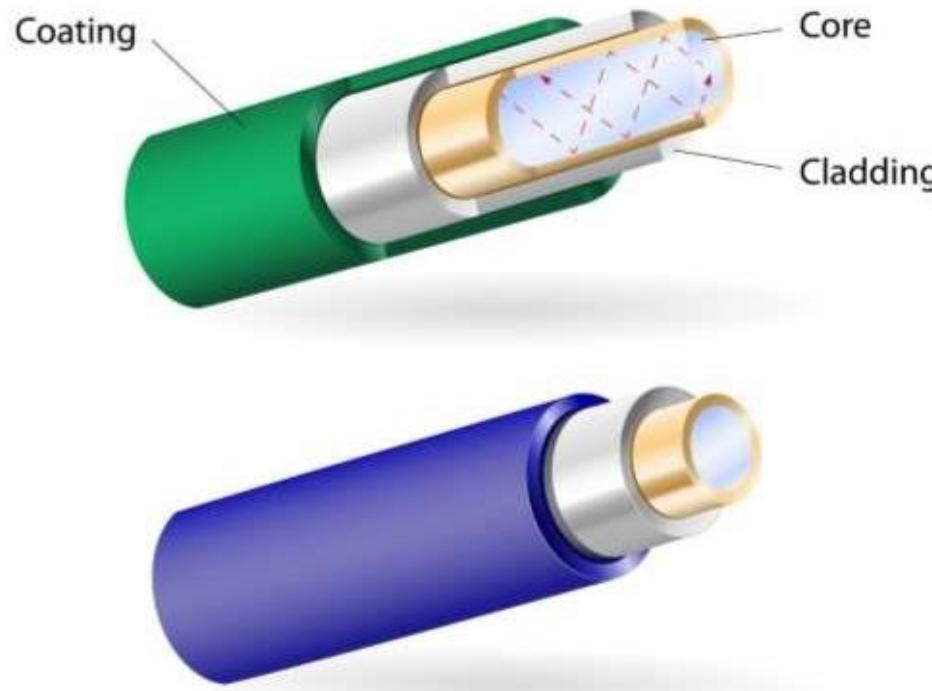


OPTICAL FIBERS



- Optical fibres consist of thin strands of glass or glass like material which carry light.
- Uses LEDs or LDs
- The data to be transmitted is modulated onto the light beam using frequency modulation techniques
- The signals at the receiving end are demodulated
- The bandwidth is very high

OPTICAL FIBERS



The fiber cable consists of three pieces

- (i) The core** – the glass or plastic through which the light travels
- (ii) The cladding** – covering of the core that reflects light back to the core
- (iii) Protective coating** – protects the fiber cable from hostile environment

OPTICAL FIBERS

ADVANTAGES

- Immune to electrical and magnetic interference
- Highly suitable for harsh industrial environments
- Guarantees secure transmission
- Very high transmission capacity
- Used for broadband transmission

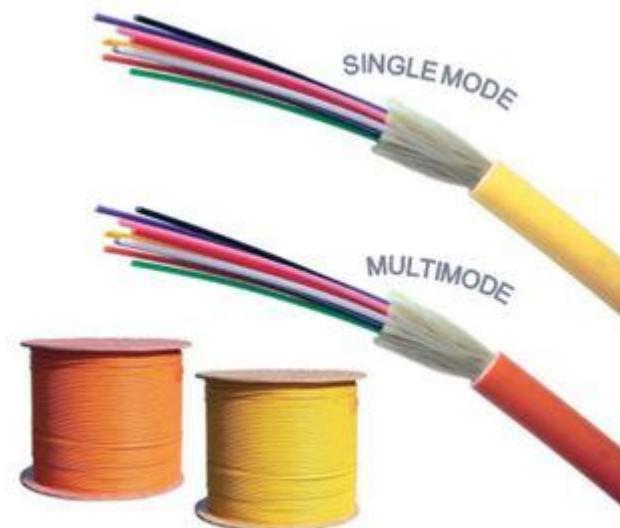
DISADVANTAGES

- Installation problem because cables are fragile
- Connecting two fibers together is a difficult process
- Connection losses
- More difficult to solder
- Most expensive of all the cables

TYPES OF FIBER OPTIC CABLES

SINGLE MODE

- Supports a segment length upto 5 km
- Bandwidth upto 10 Gbps



MULTIMODE

- Supports a segment length upto 1 km
- Bandwidth upto 100 Gbps

GUIDED MEDIA COMPARED

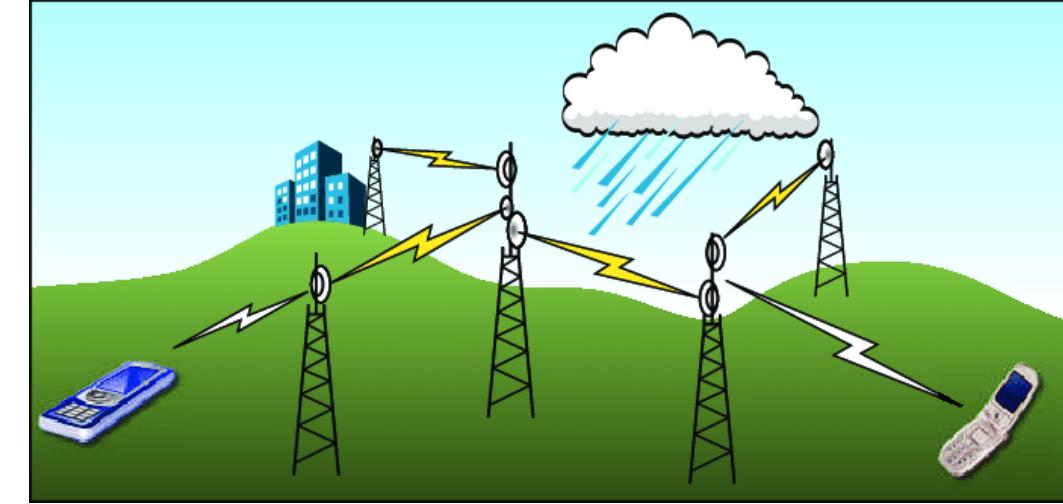
Type	Sub Type	Max segment length	Bandwidth supported	Installation	Cost	Interference
Twisted Pair Cable	UTP	100 m	40 Gbps	Easy	Cheapest	High
	STP	100 m	500 Mbps	Moderate	Moderate	Moderate
Coaxial Cable	Thinnet	185 m	10 Mbps	Easy	Cheap	Moderate
	Thicknet	500 m	10 Mbps	Hard	Moderate	Low
Fiber Optic Cable	Singlenode	2 km	100 Mbps	Very hard	Expensive	None
	Multinode	100 km	2 Gbps	Very hard	Expensive	None

UNGUIDED MEDIA





MICROWAVE



- The microwave transmission is a line of sight transmission.
- Similar to radio and television signals
- Used for long distance communication
- Consists of a transmitter, receiver and the atmosphere
- Two directional parabolic antennas are mounted on towers, buildings or hills to send and receive signals through air.
- Higher the tower, greater is the range

MICROWAVE

ADVANTAGES

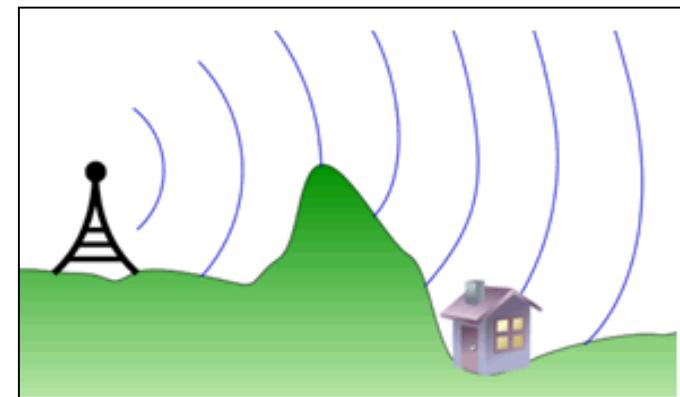
- Cheaper (no cables or repeaters)
- Ease of communication over difficult terrain
- Ability to communicate over oceans

DISADVANTAGES

- Insecure communication
- Antenna propagation issue (reduces signal strength)
- Susceptible to weather effects
- Bandwidth is limited
- Cost of design, implementation and maintenance is high

RADIO WAVE

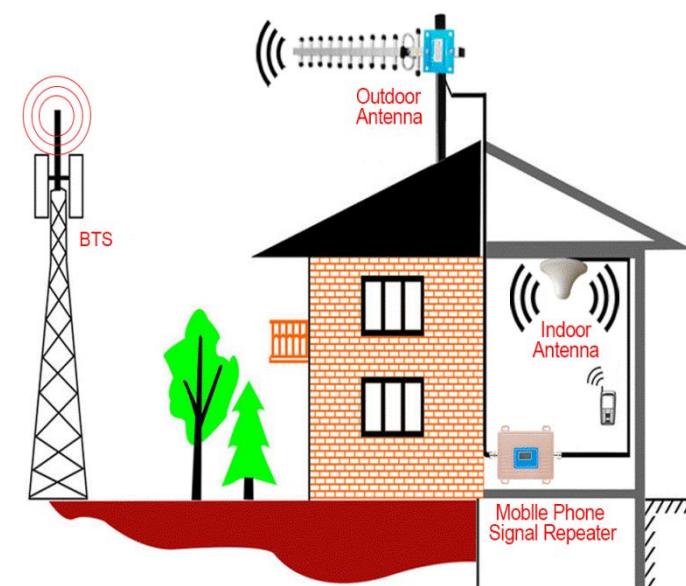
- Use radio frequencies. Uses transmitter and receiver
- Both the transmitter and receiver use antennas to radiate and fetch radio signals.
- Radio waves are omnidirectional, i.e., the signals are propagated in all the directions.
- Radio waves cover a large area, and they can penetrate the walls, bricks, woods.
- It provides a higher transmission rate.
- Examples: An FM radio, television, cordless phones.



RADIO WAVE

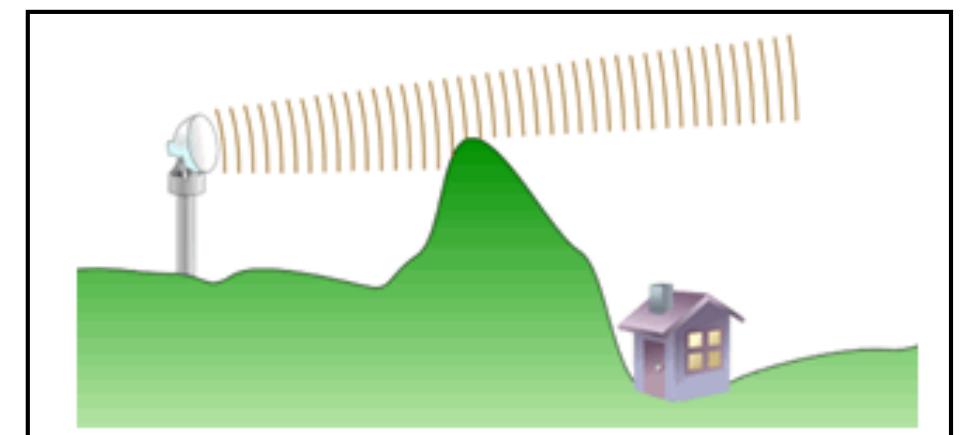
ADVANTAGES

- Offers mobility
- Cheaper (no cables or repeaters)
- Ease of communication over difficult terrain



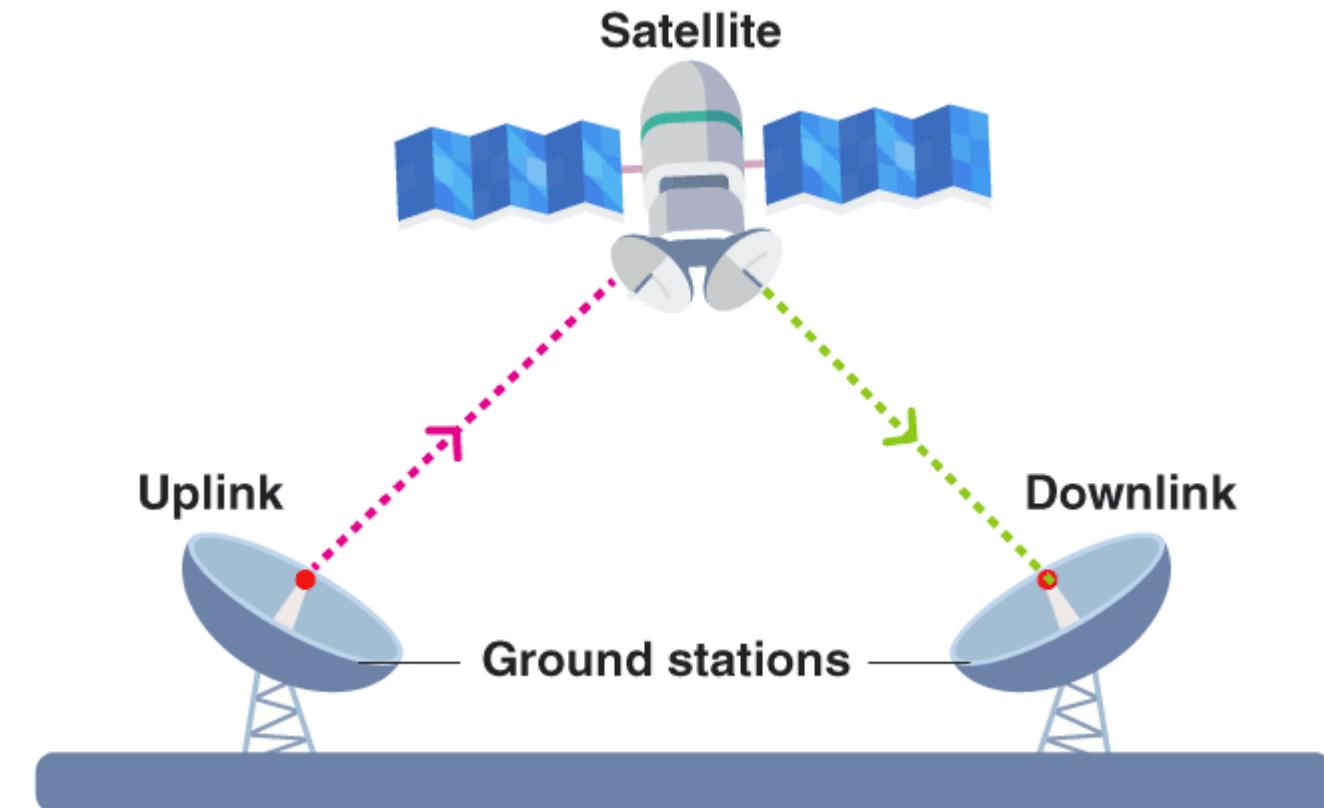
DISADVANTAGES

- Insecure
- Susceptible to weather effects



SATELLITE (SATELLITE MICROWAVE)

- Satellite is a special type of microwave transmission medium
- It provides various types of services such as transmitting fax, voice data, video, email and other internet applications.



SATELLITE

ADVANTAGES

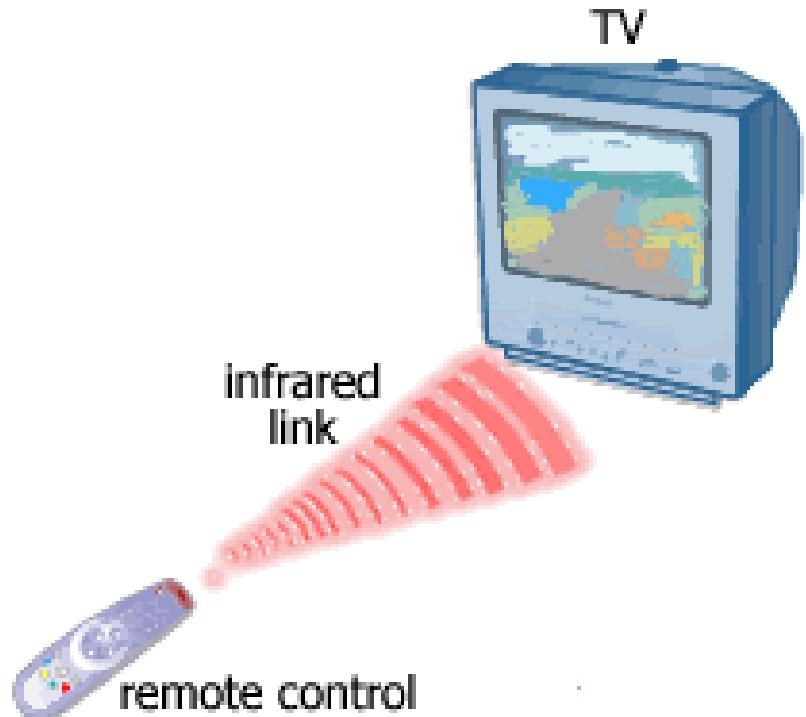
- Quite large area is covered
- No intercontinental cables required
- Heavy usage of intercontinental traffic
- Covers large areas of the Earth
- Particularly used for sparsely populated areas

DISADVANTAGES

- Technological limitations preventing the deployment of large, high gain antennas on the satellite platform
- Over-crowding of available bandwidths
- High investment and insurance cost
- High atmospheric losses above 30GHz limit carrier frequencies

INFRARED

- Uses infrared light to send data
- Short range communication(approx. 5 meters) using wireless signals.
- The data is transmitted through air and can propagate in the open space
- It can propagate throughout a room, but will not penetrate walls.
- Secured transmission



INFRARED

ADVANTAGES

- Secure medium of transmitting data
- Cheap mode of transmission

DISADVANTAGES

- Can work only for short distance
- Cannot penetrate walls
- Affected by distance, noise and heat

NETWORK TOPOLOGIES

The pattern of interconnection of nodes in a network - Topology

Factors to be considered while choosing a topology:

Cost

Flexibility

Reliability

Types of Topologies

Star

Bus

Ring or Circular

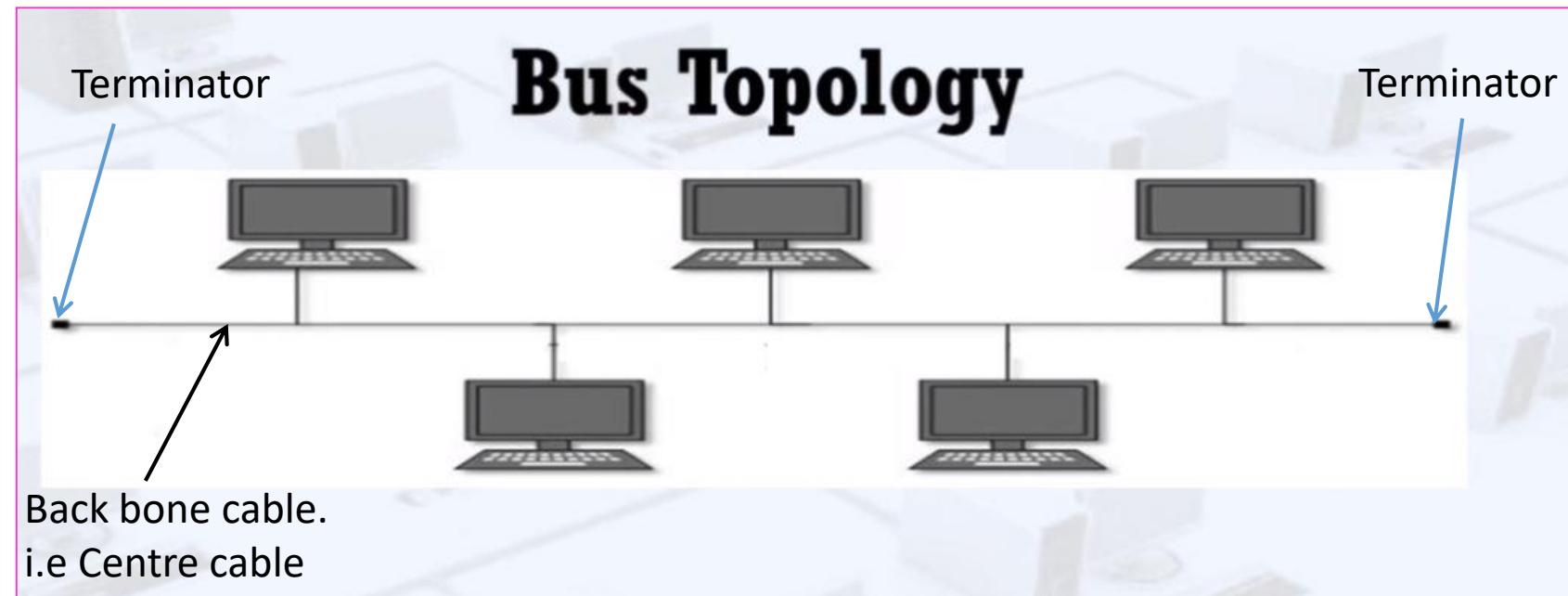
Tree

Mesh

Fully connected

THE BUS OR LINEAR TOPOLOGY

- Uses a common single length of transmission medium(coaxial cable) called backbone to connect all the workstations.
- The bus has terminators at either end which absorb the signal, removing it from the bus



Bus Topology

ADVANTAGES

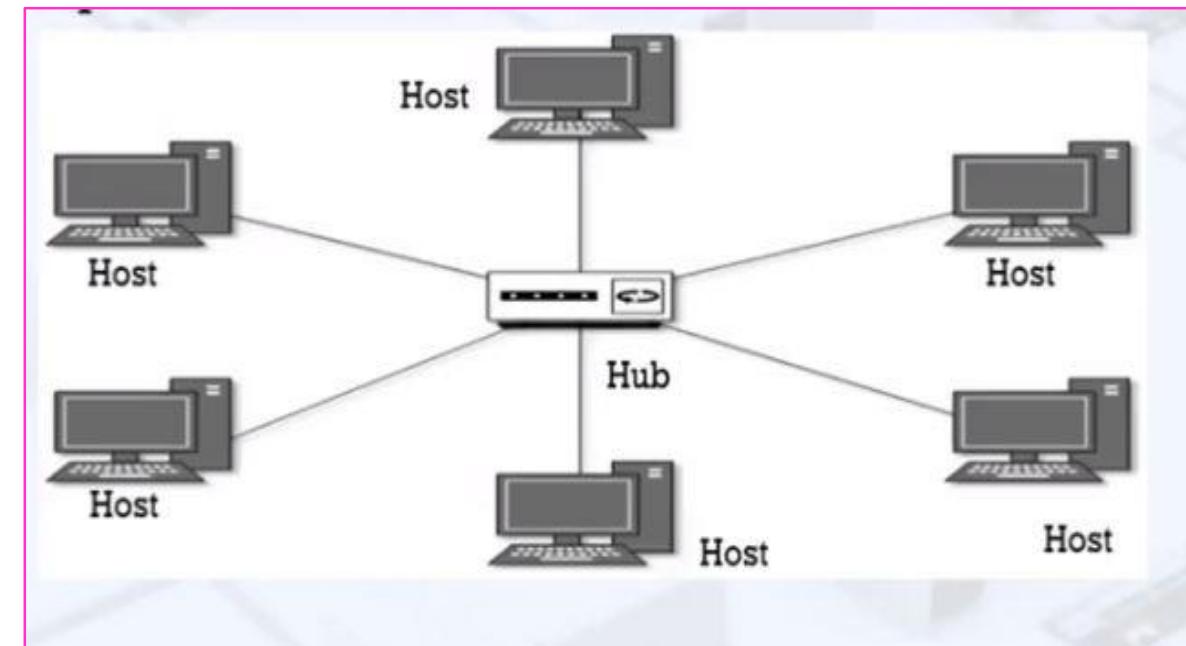
- Short cable length
- Simple and easy to maintain wiring layout
- Less installation cost
- Resilient architecture
- Easy to extend

DISADVANTAGES

- Fault diagnosis is difficult
- Fault isolation is difficult
- Repeater configuration
- Nodes must be intelligent

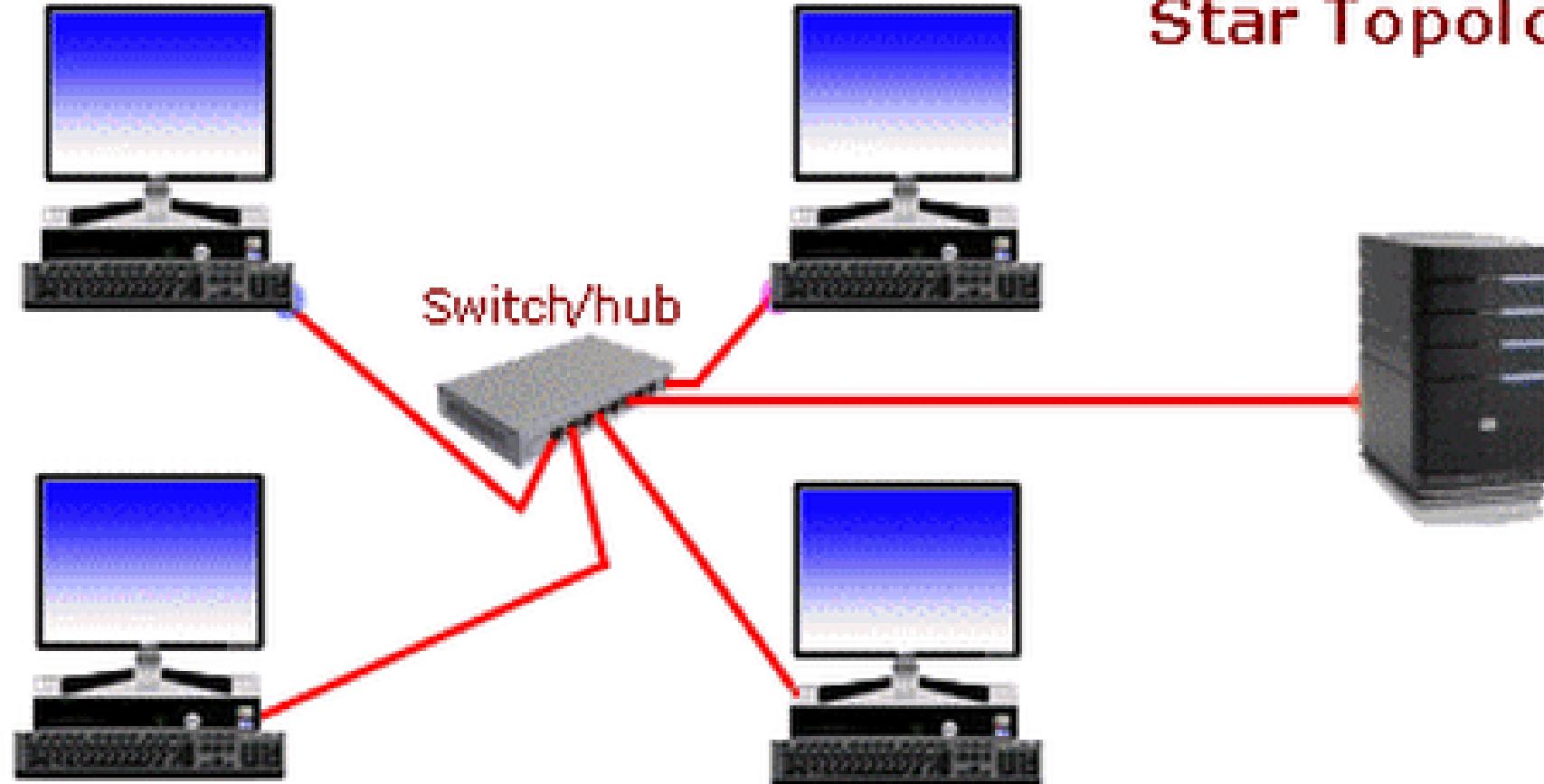
THE STAR TOPOLOGY

- Each node (computer) is directly connected to a central device like HUB or Switch.
- Data passes through Hub or switch before it reaches the destination.



THE STAR TOPOLOGY

Star Topology



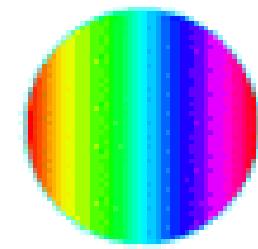
STAR TOPOLOGY

ADVANTAGES

- Ease of service
- One device per connection
- Centralized control/problem diagnosis
- Simple access protocol

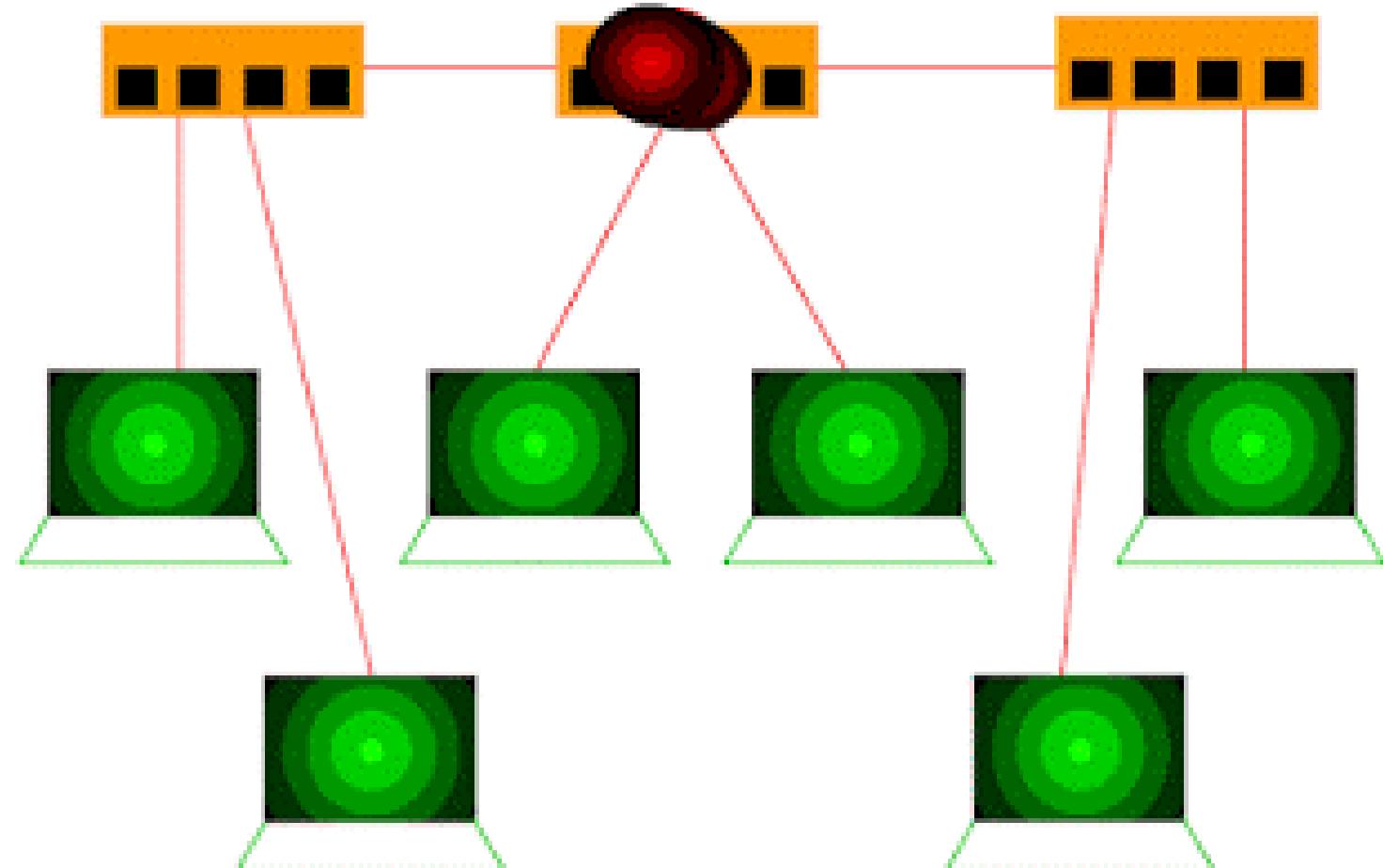
DISADVANTAGES

- Long cable length
- Difficult to expand
- Central node dependency



THE TREE TOPOLOGY

- Uses combination of bus and star topologies
- Best suitable for applications having hierarchical flow of data



TREE TOPOLOGY

ADVANTAGES

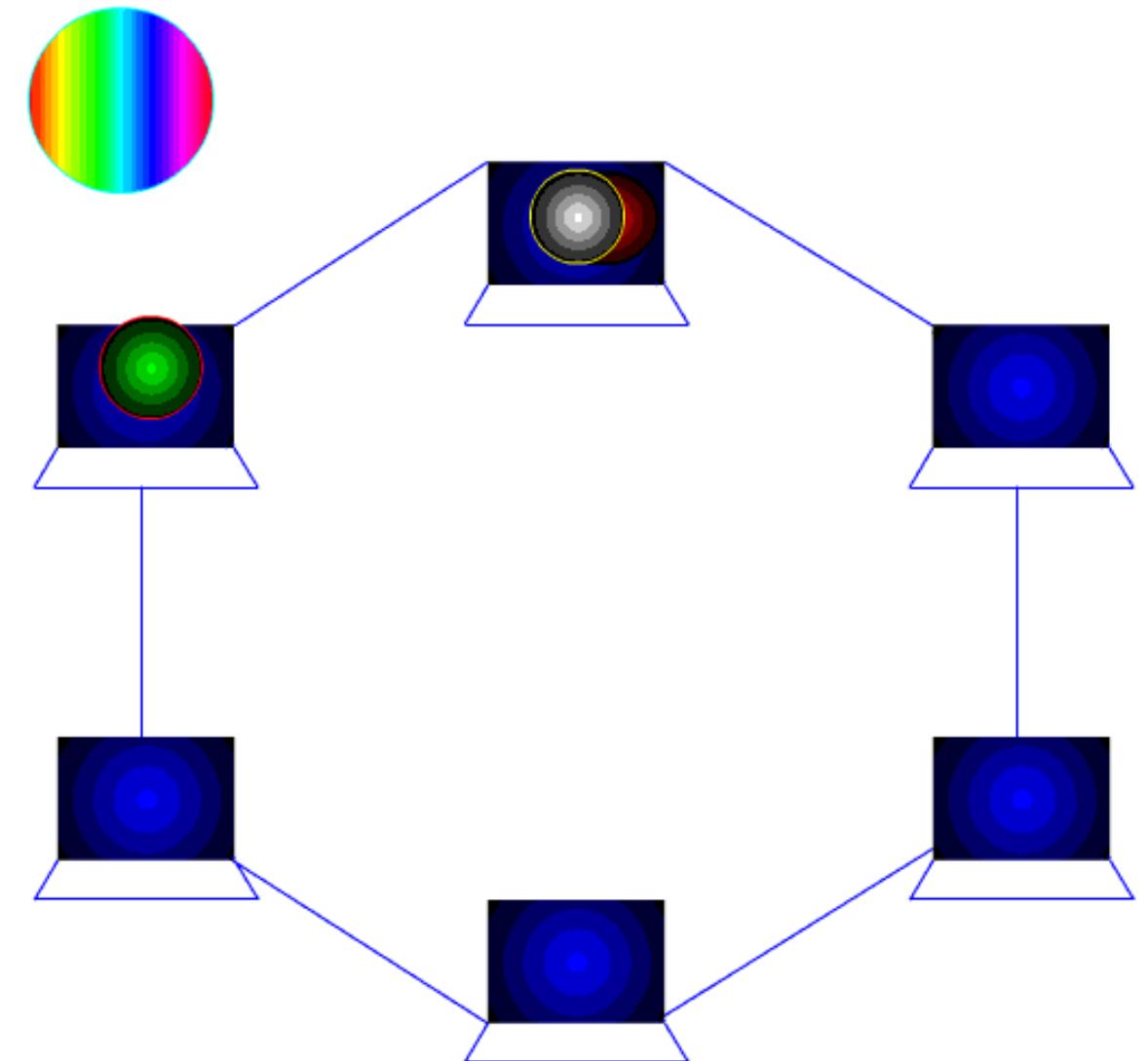
- Point to point wiring for individual segments
- Supported by several hardware and software vendors
- Flexible and scalable

DISADVANTAGES

- Overall length of each segment is limited by the type of cabling
- If backbone line breaks, entire segment goes down
- More difficult to configure and wire than other topologies

THE RING TOPOLOGY

- All the nodes are connected to each-other in such a way that they make a closed loop.
- Data is transmitted in only one direction.



RING TOPOLOGY

ADVANTAGES

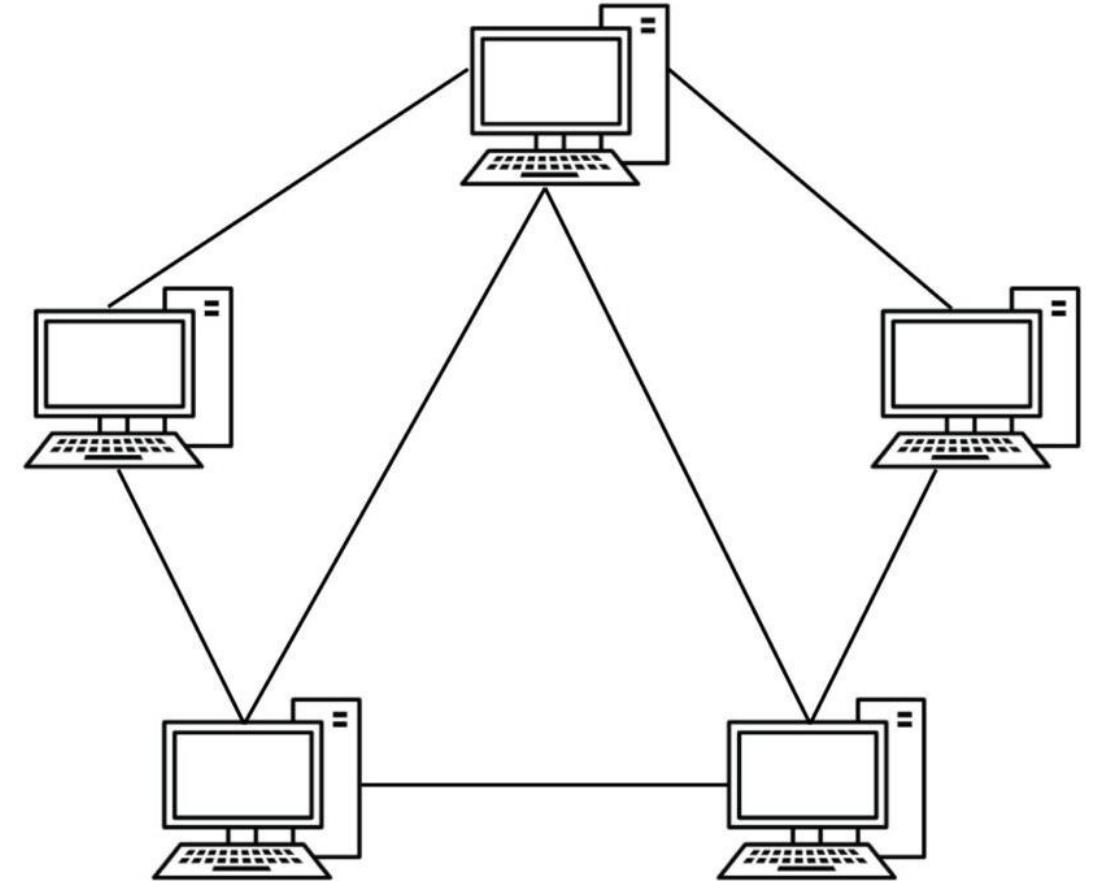
- Short cable length
- No wiring closet space required
- Suitable for optical fiber cable

DISADVANTAGES

- Slower than Star topology
- Node failure causes network failure
- Difficult to diagnose faults
- Network reconfiguration is difficult

MESH TOPOLOGY

- Each computer is interconnected to more than one node
- There is a point to point link between each dedicated node



MESH TOPOLOGY

ADVANTAGES

- Eliminates traffic problem
- Robust: provides security and privacy
- Fault diagnosis is easy
- Can be expanded and modified

DISADVANTAGES

- Installation and configuration is difficult
- Cabling cost is high
- Bulk wiring is required
- High maintenance

MESH TOPOLOGY

ADVANTAGES

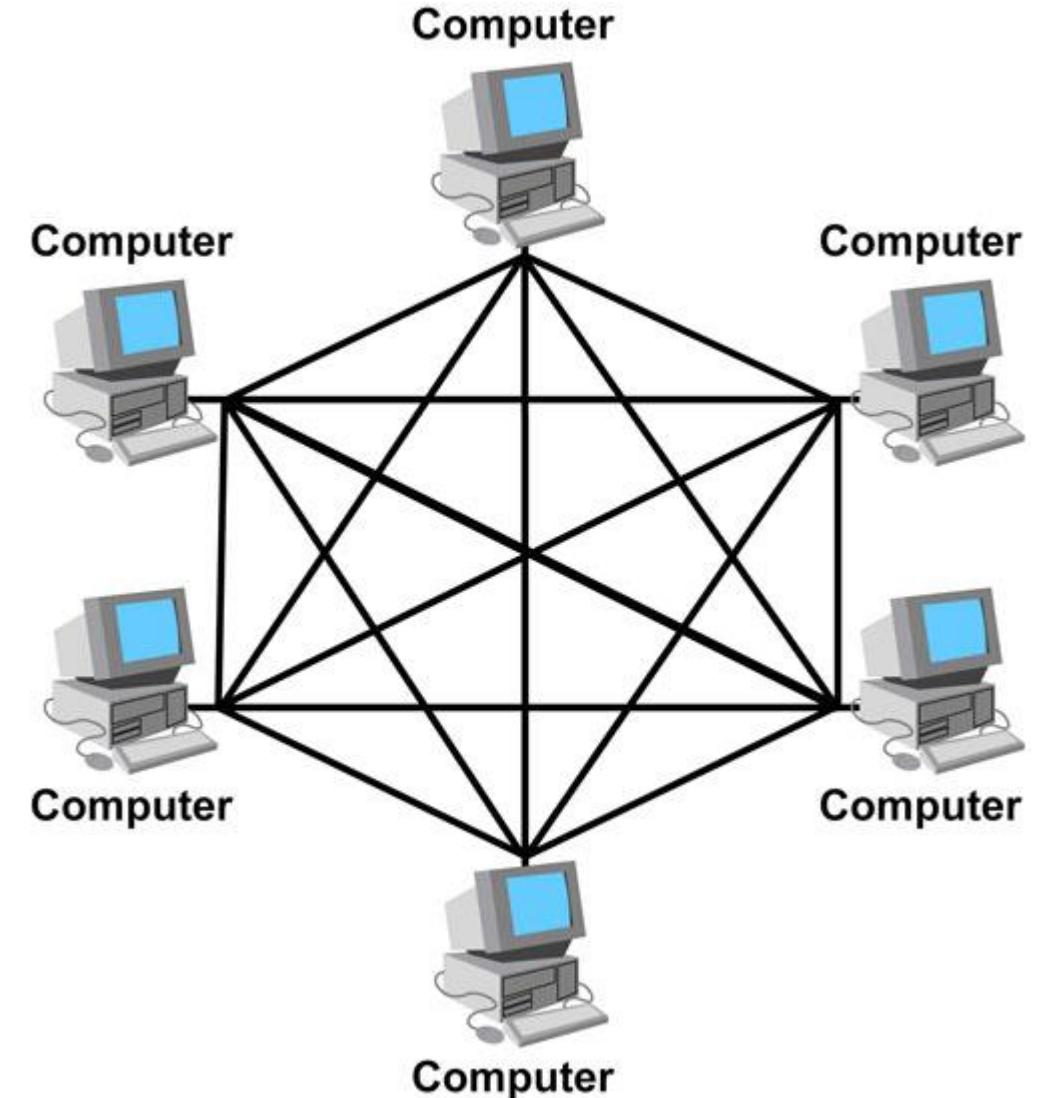
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FULLY CONNECTED

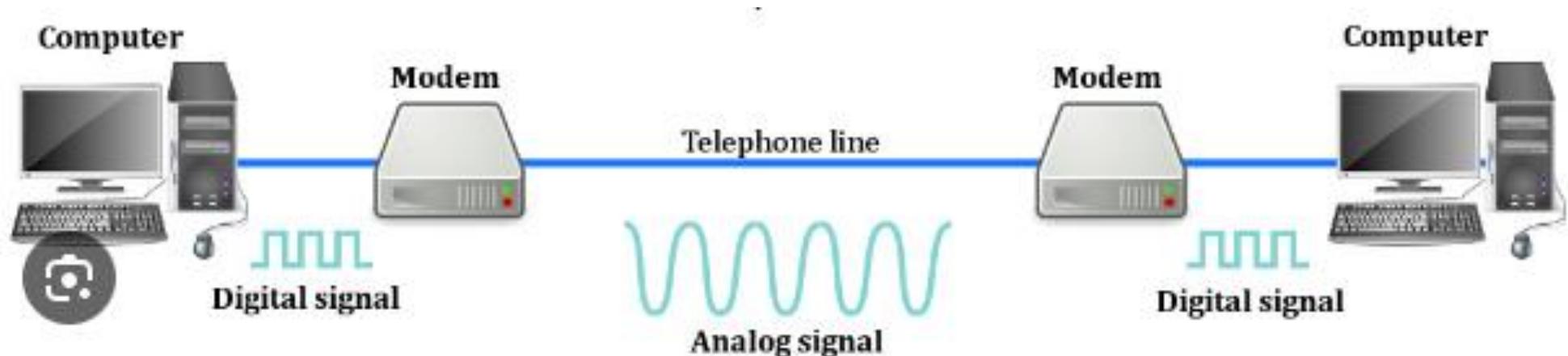
- Each computer is interconnected with each other
- Fully connected
- There is a point to point link between each dedicated node
- Direct link between each hosts



NETWORK DEVICES

MODEM

- Modulator Demodulator
- Allows to connect and communicate with other computers via telephone lines
- Modulation – Sending data – Digital to analog
- Demodulation – Received analog data to digital data



INTERNAL MODEMS



EXTERNAL MODEMS



INTERNAL MODEMS – Fixed within the computer

EXTERNAL MODEMS – Connected externally to a computer

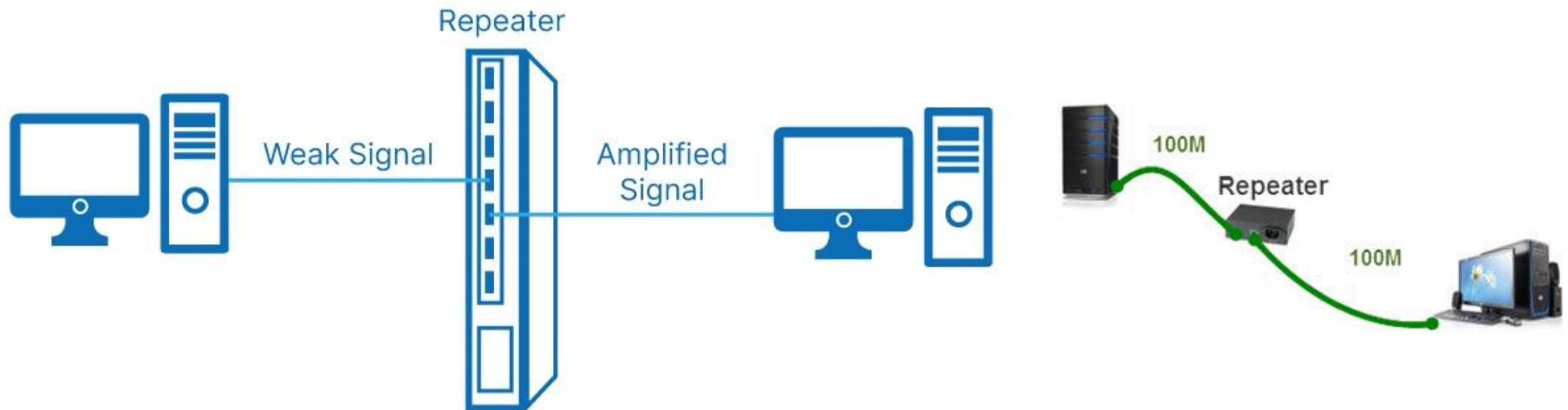
RJ-45

- Registered Jack
- Eight-wire connector
- Used to connect computers in Ethernet LANs
- Ethernet uses either a bus or star topology and supports data transfer rates upto 10 Mbps



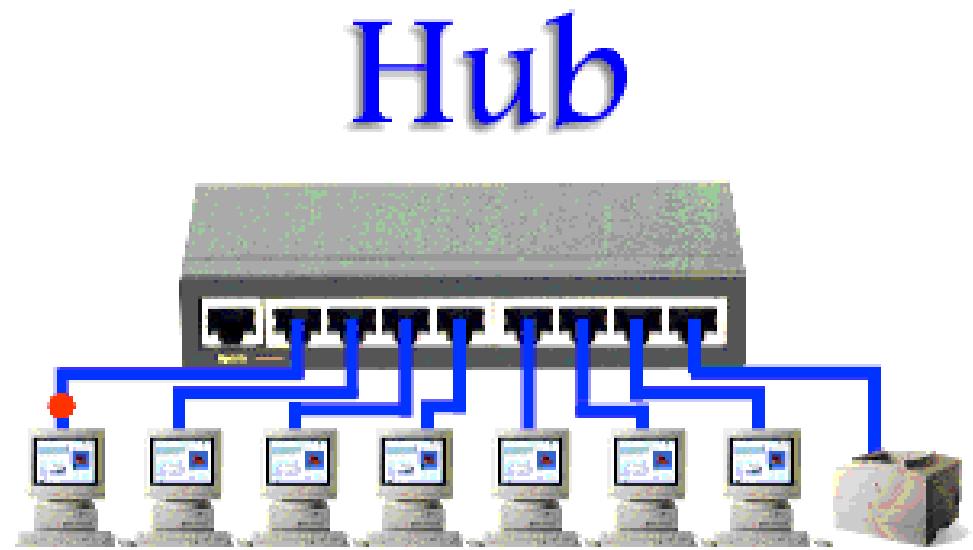
REPEATER

- Amplifies and restores signals for long-distance transmission
- Used when the network cable exceeds 100 metres
- Two kinds – Amplifier and Signal repeater



HUB

- Has multiple ports
- Used to connect multiple computers
- Unintelligent network device
- Simply transfers data from one port to another
- Can both send and receive data, one task at a time



ACTIVE HUBS

- Regenerate or amplify the signal before they are retransmitted

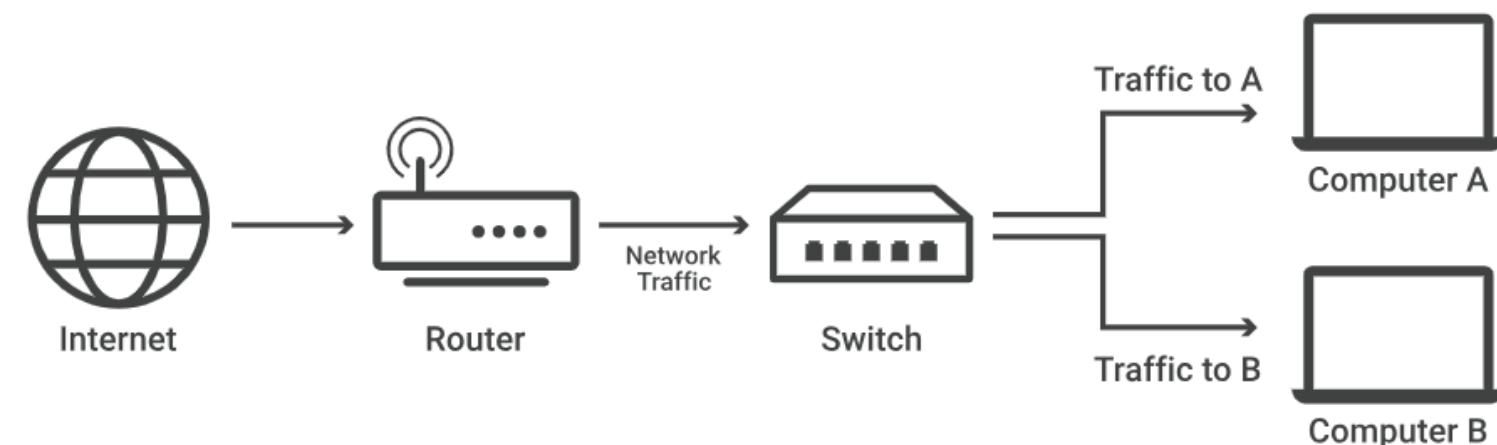
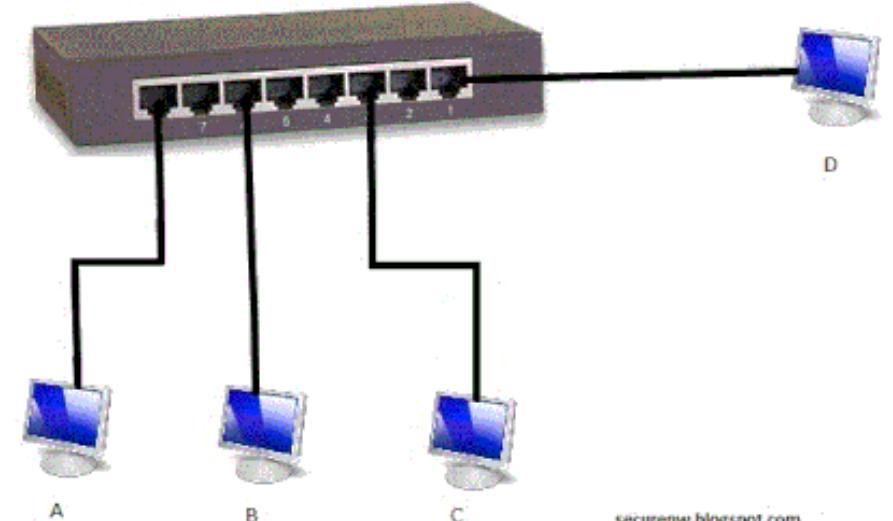
PASSIVE HUBS

- Allow the signal to pass from one computer to another without any change

SWITCH

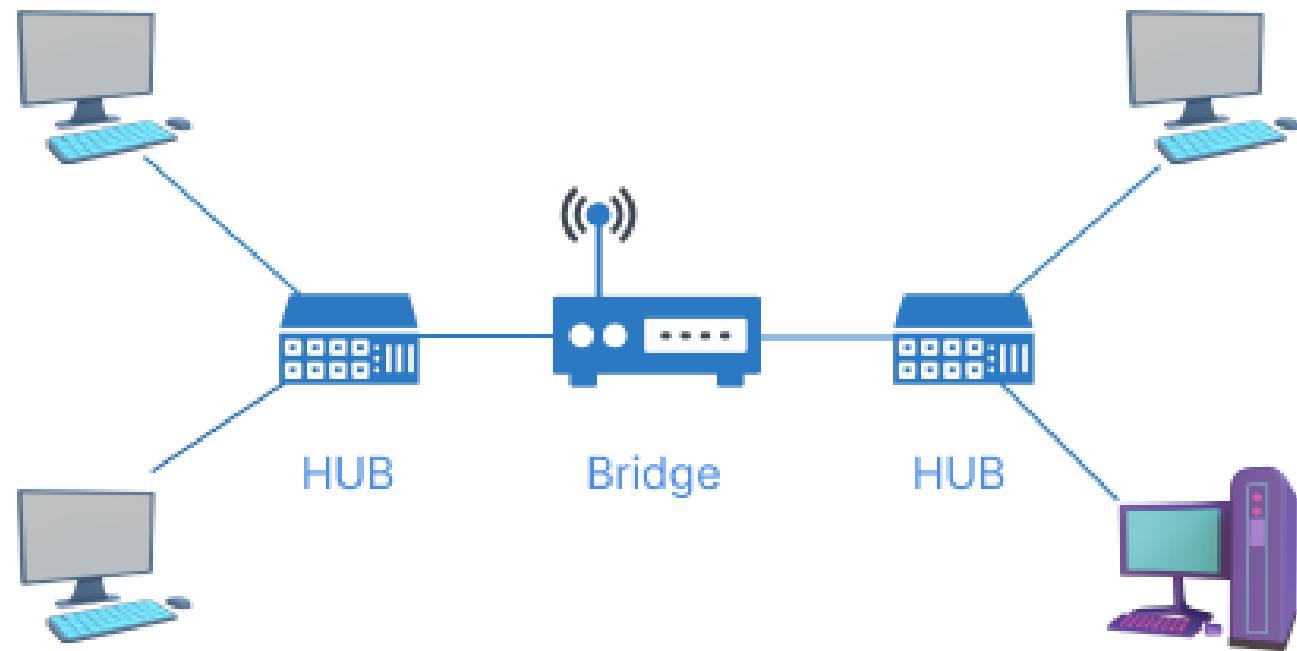
- Intelligent multiport device
- Interconnects computers or devices
- Filters and forwards data packets
- Used to segment networks into different subnetworks called subnets or LAN segments
- Prevents traffic overloading in a network

Switch With Port Mirroring
Port Number 1 is Destination Port or SPAN



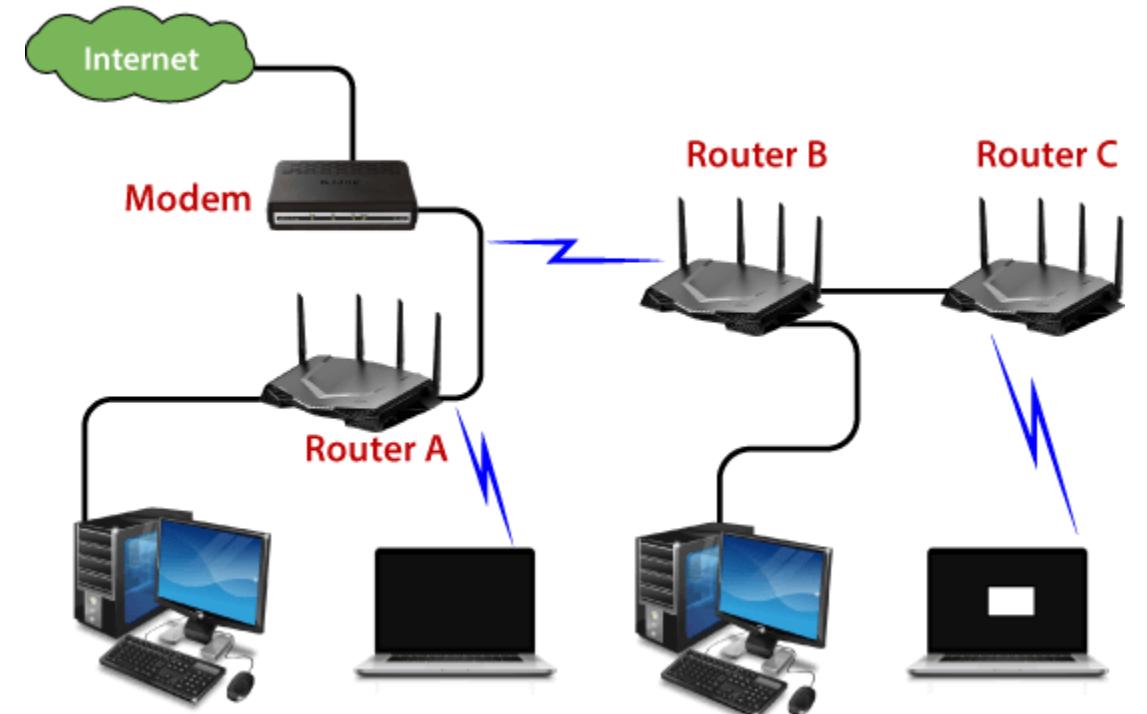
BRIDGE

- Intelligent device
- Used to connect multiple LANs together with a larger LAN
- Can handle networks that follow the same protocols



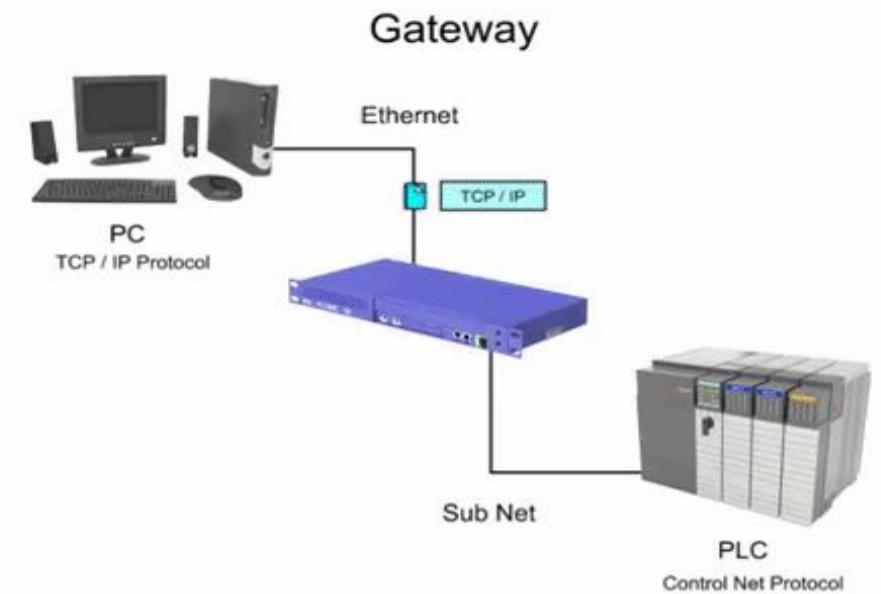
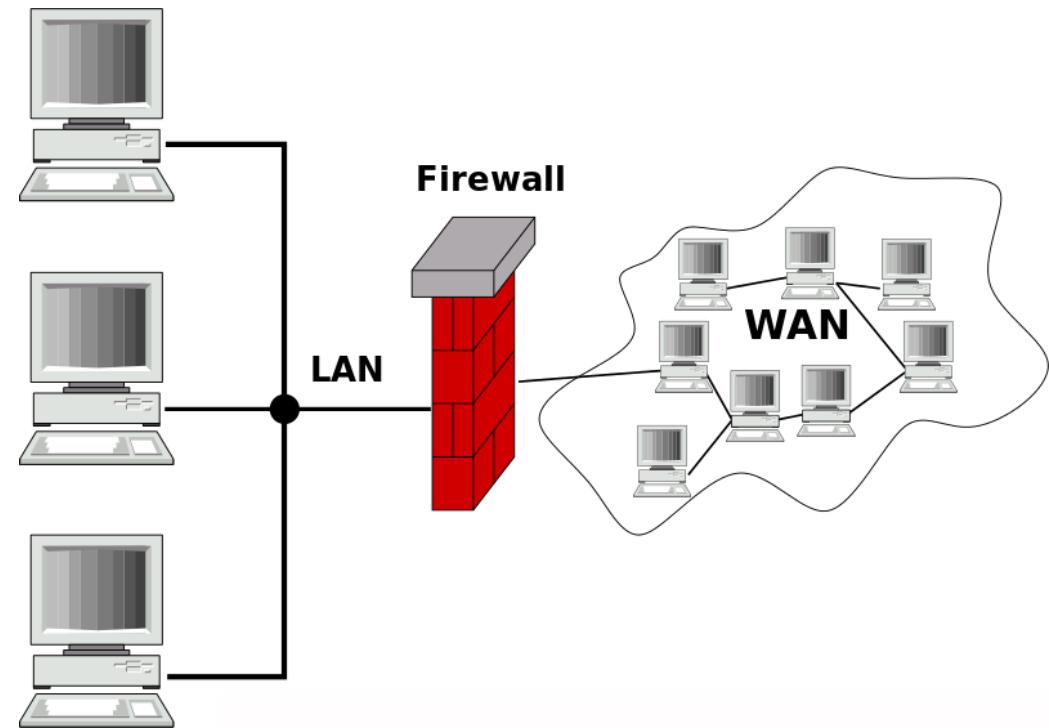
ROUTER

- Forwards data from one network to another
- Works like a bridge but can handle different protocols
- Packet travels in the most efficient path



GATEWAY

- Connects dissimilar networks
- Establishes an intelligent connection
- Connects different types of networks that uses different protocols
- Acts as a proxy server and a firewall



Wi Fi CARD

- Wireless Fidelity card
- Enables internet connection through the wireless connection network
- Internal or external Local Area Network Adaptor
- Comes with a built-in wireless radio and antenna



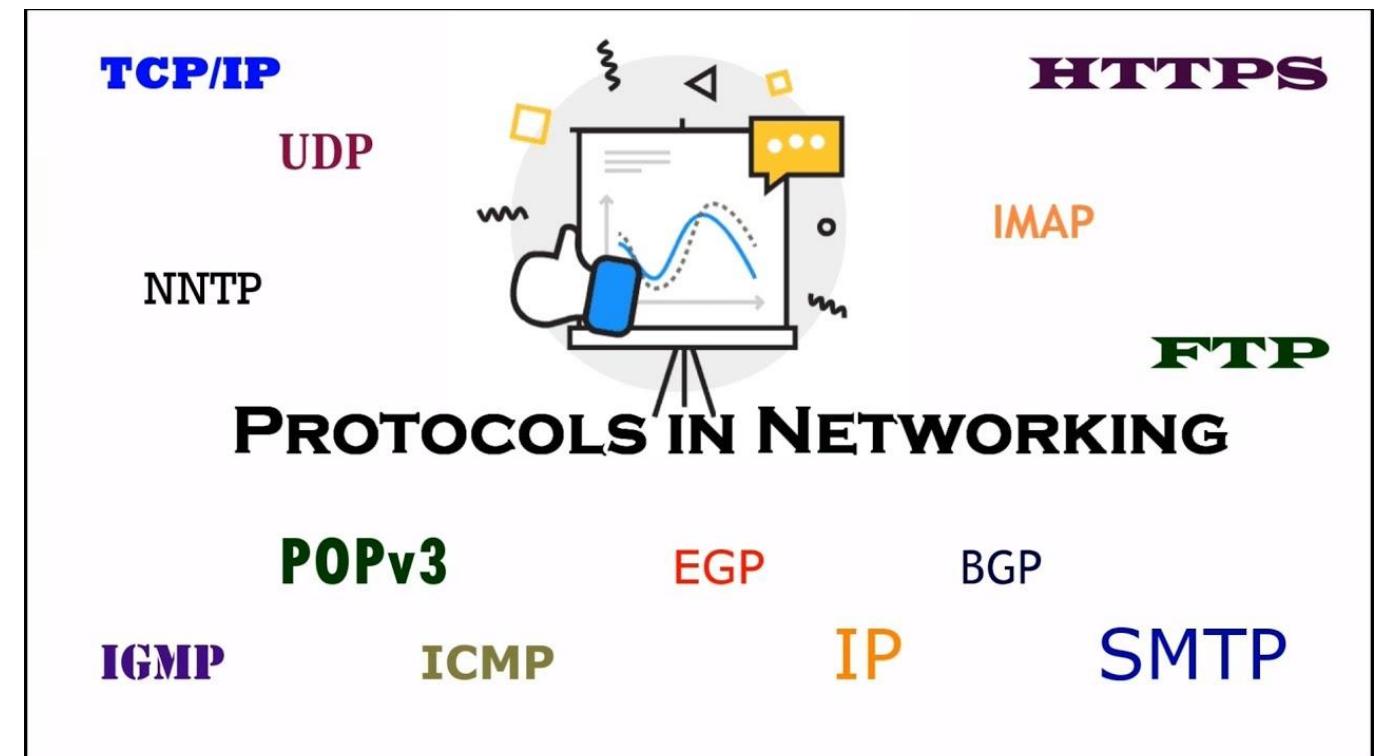
CHOOSE? WHEN?

TWISTED PAIR CABLE	COAXIAL CABLE	FIBER OPTICS	RADIO WAVES	MICROWAVE	INFRARED
Low cost	Long distance telephone transmission	Greater data capacity required	Long distances	Line of sight transmission	No licensing
Easy installation	Television signal transmission	Lower attenuation	Signals penetrate walls, buildings	Cheaper than other unguided media	Cannons penetrate walls
No high speed data requirements	Short distance computer system links required	Secure transmission	Omnidirectional transmission	Long distance telephone service	Secure transmission
Transmission over a short range	LANs are to be formed among some computers	Cost does not matter	Health hazards involved	Requires repeaters every 30 miles	-
Analog transmission – amplifier required for every 5 to 6 km	Analog transmission – amplifier required for every 5 to 6 km	Greater repeater spacing	Insecure communication	Insecure communication	-
Digital transmission – Repeaters required over 100 m	Digital transmission – Repeaters required over 100 m	Repeater required every 10 km	Ease of communication over difficult terrains	Ease of communication over difficult terrains	-

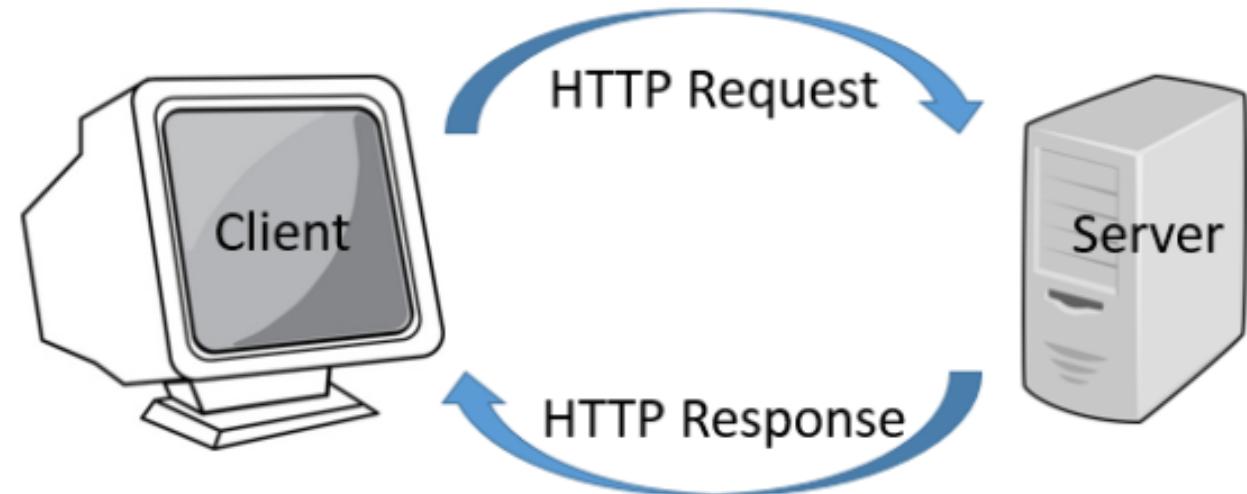
NETWORK PROTOCOLS

PROTOCOL

A network protocol is an accepted set of rules that govern data communication between different devices in the network



HTTP



- Hyper Text Transfer Protocol
- Application level protocol
- Set of rules for transferring hypertext (text, graphics, image, sound, video etc.) on WWW
- Consists of two distinct items
- The set of requests from browsers to servers
- The set of responses going back to the other way

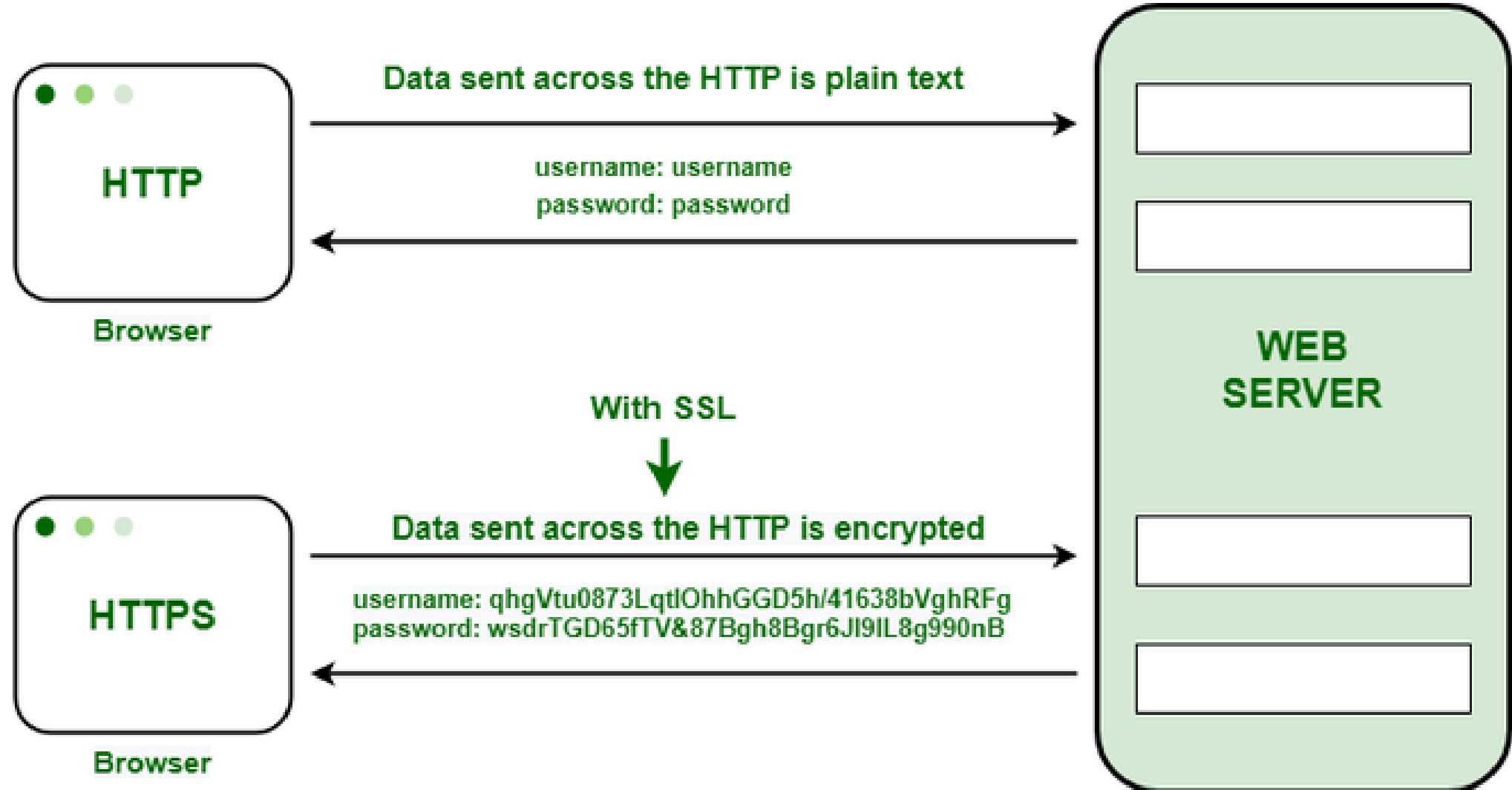


HTTPS

- Hyper Text Transfer Protocol Secure
- Uses SSL/TLS protocol for encryption and authentication.
- Sends the data in encrypted form to make secure transmission
- Used to transmit sensitive data
- Should have https protocol in the URL and a padlock sign in the address bar before sharing sensitive data
- SSL/TLS – Secure Socket Layer/Transport Layer Security Protocol

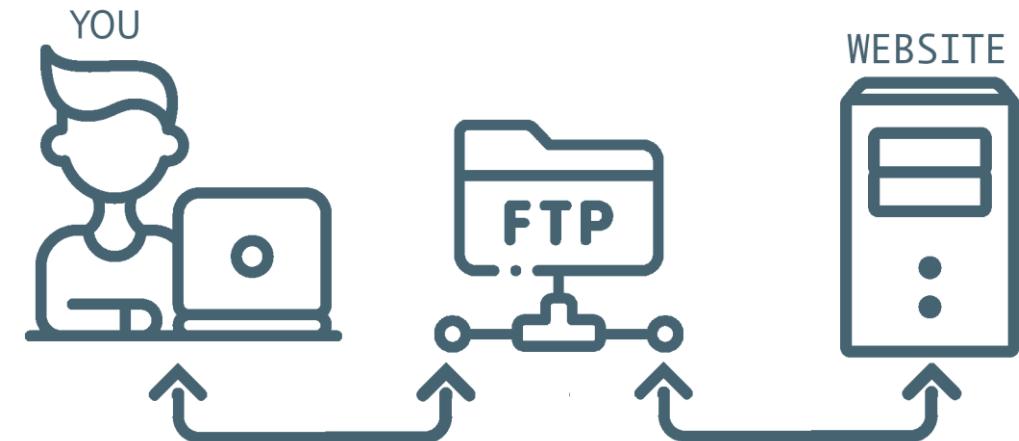


HTTP vs HTTPS



FTP

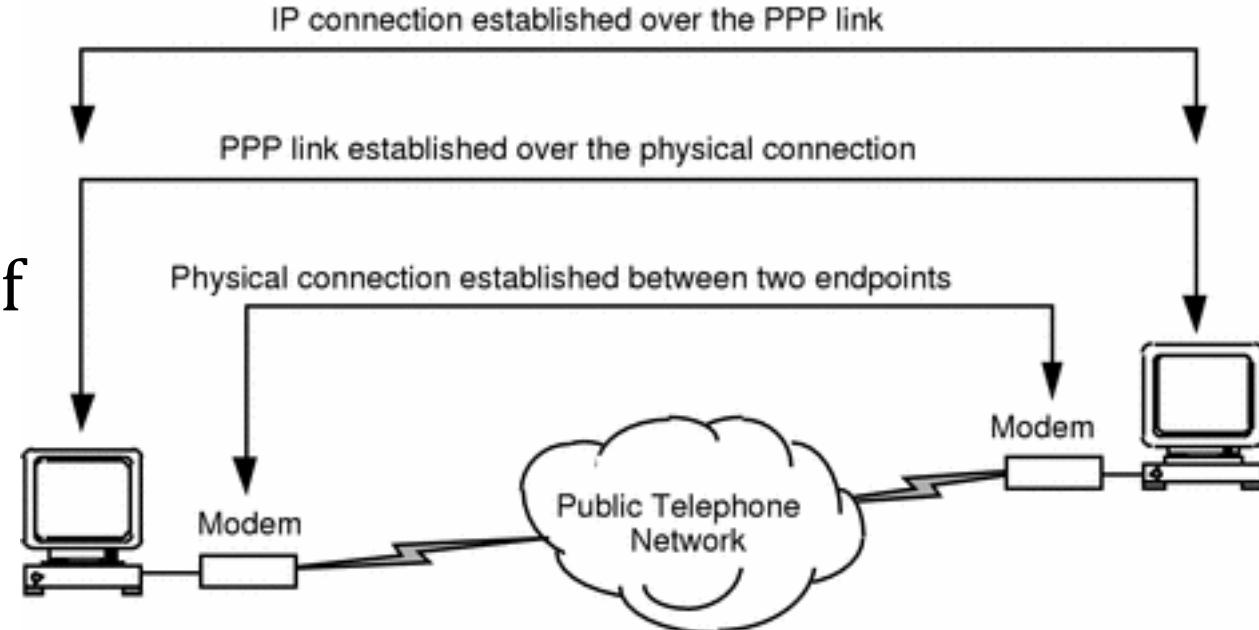
- File Transfer Protocol
- Standard protocol for the exchange of files over internet(download, upload, transfer)
- Transfers data reliably and efficiently
- It is also the name of a program or command
- Works as a client/server process
- It encourages indirect or implicit(via programs) use of remote computers



Download File
Upload Files
Delete Files
Rename File
...etc...

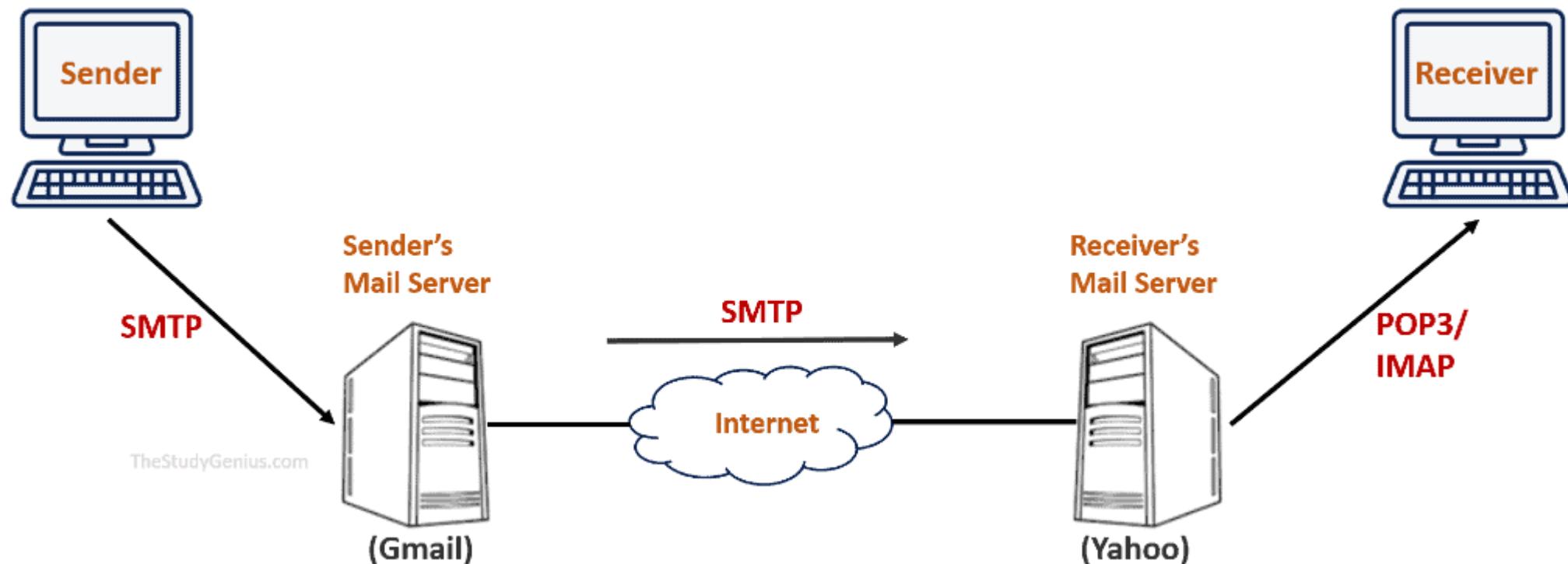
PPP

- Point To Point Protocol
- Internet standard for transmission of IP packets over serial lines
- Establishes a direct connection between two networking nodes
- IPCP – IP Control Protocols permits the transport of IP packets over a PPP link
- NCP – Network Control Protocol used for traffic transportation
- LCP – Link Control Protocol for link establishment



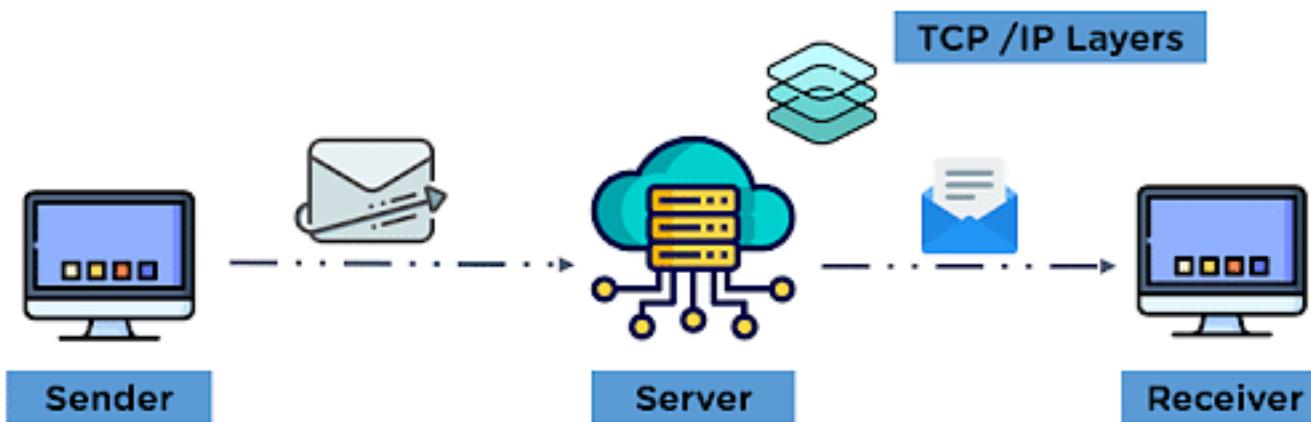
SMTP

- Simple Mail Transfer Protocol
- Used to send email
- Can only be used to send email, not to receive
- Used by the Mail Transfer Agent (MTA) to deliver the sent email to the recipient's mail server



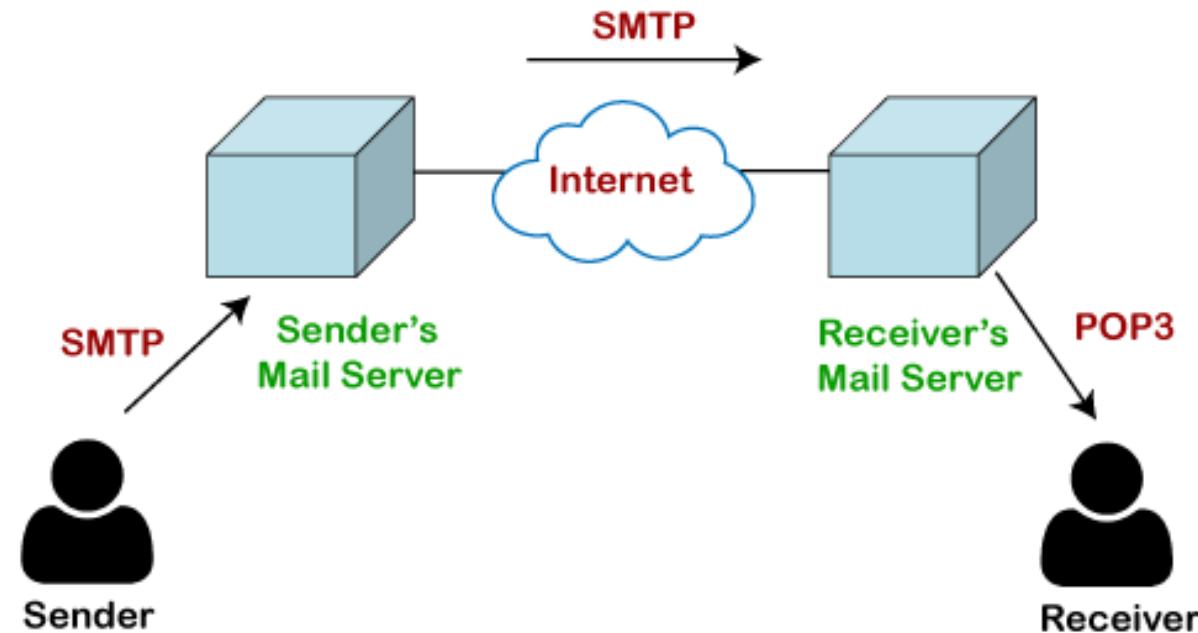
TCP/IP

- Transmission Control Protocol/ Internet Protocol
- Basic communication protocol of the Internet
- At the sending end, TCP divides the whole message into smaller units known as segment, and each segment contains a sequence number which is required for reordering the frames to form an original message.
- At the receiving end, TCP collects all the segments and reorders them based on sequence numbers.
- IP deliver the packets at the destination by the IP address



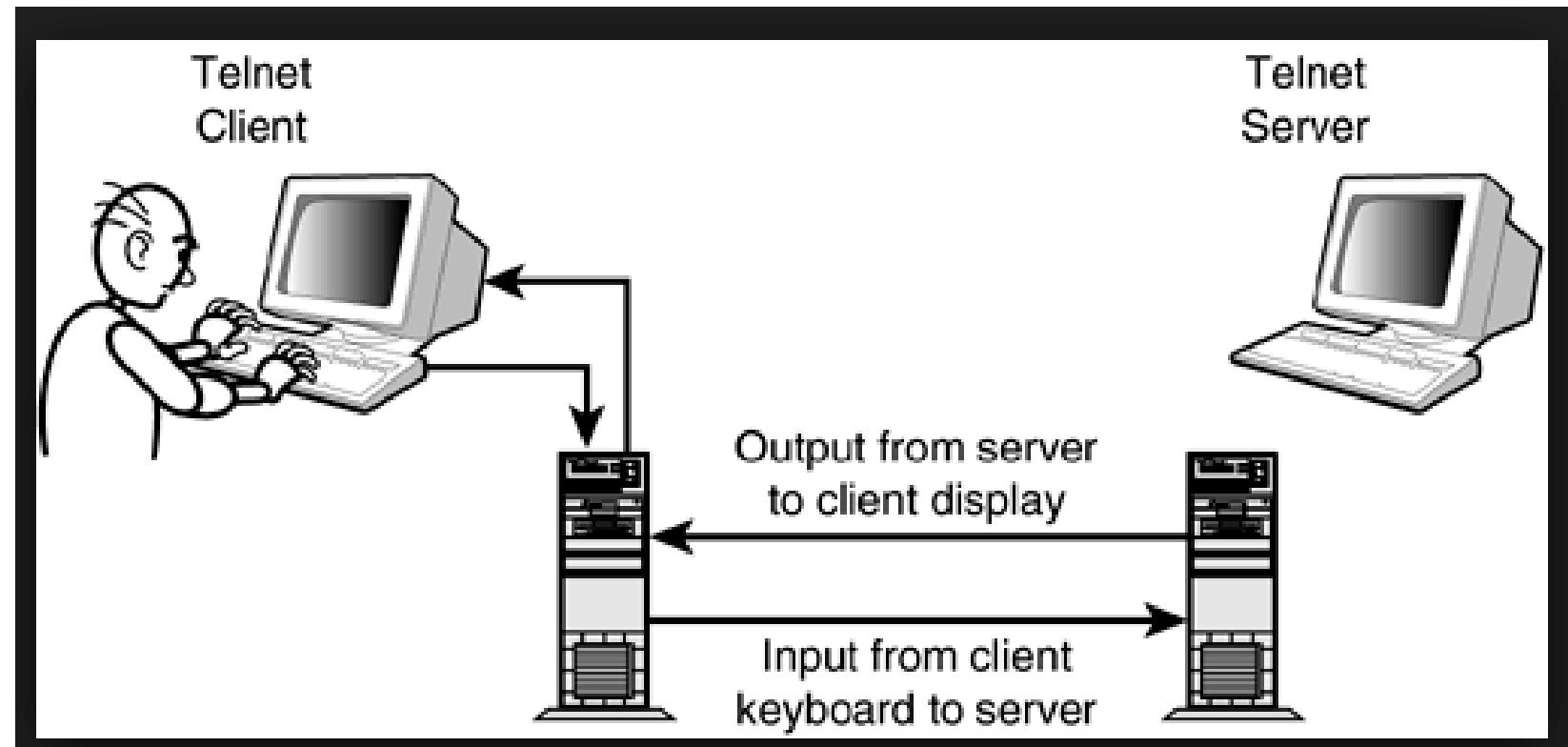
POP3

- Post Office Protocol 3
- Simple standardized way for users to access mailboxes and download messages to their computers
- Used to receive mails
- Once downloaded, can use without internet connection



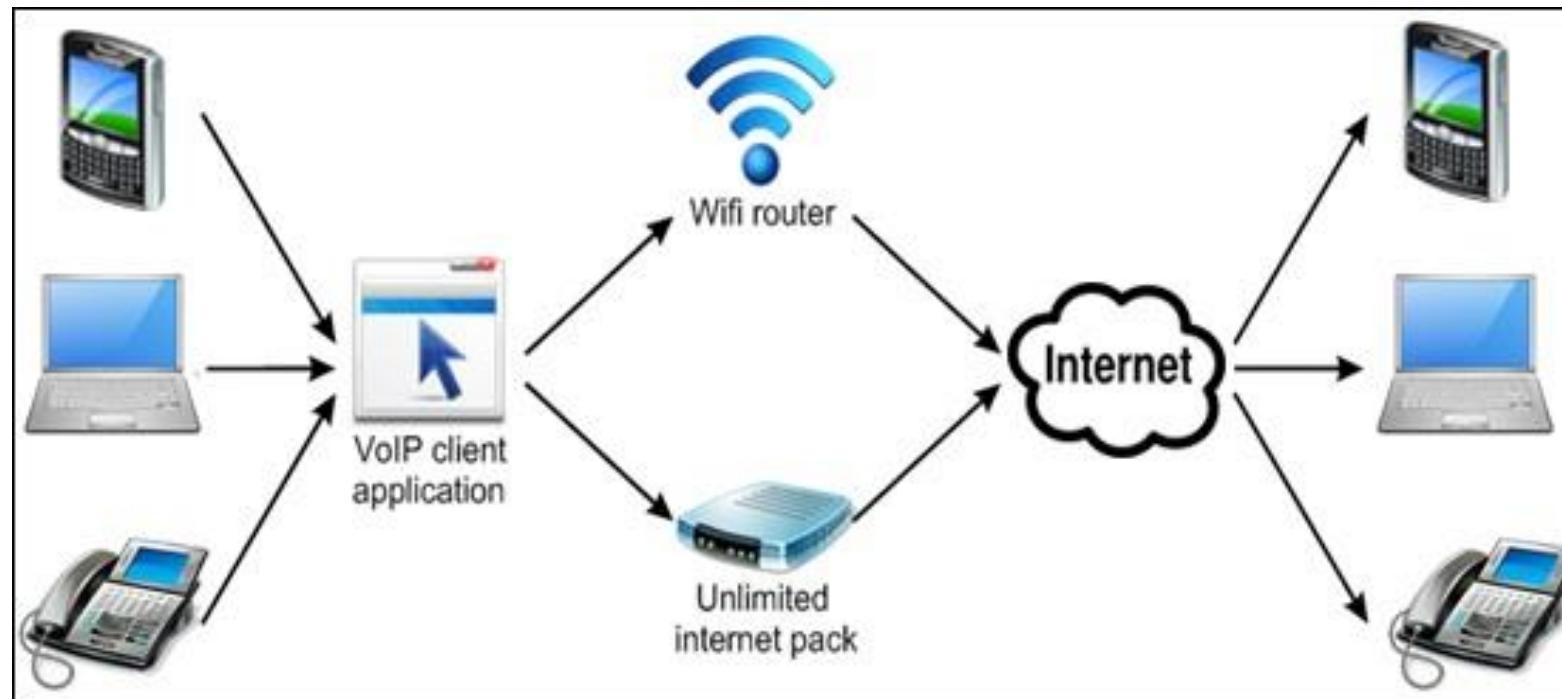
TELNET

- Internet utility that lets you log onto remote computer systems



VoIP

- Voice Over Internet Protocol
- Enables voice communication over the internet
- Compress the voice into data packets and transmits
- Use packet switching networks



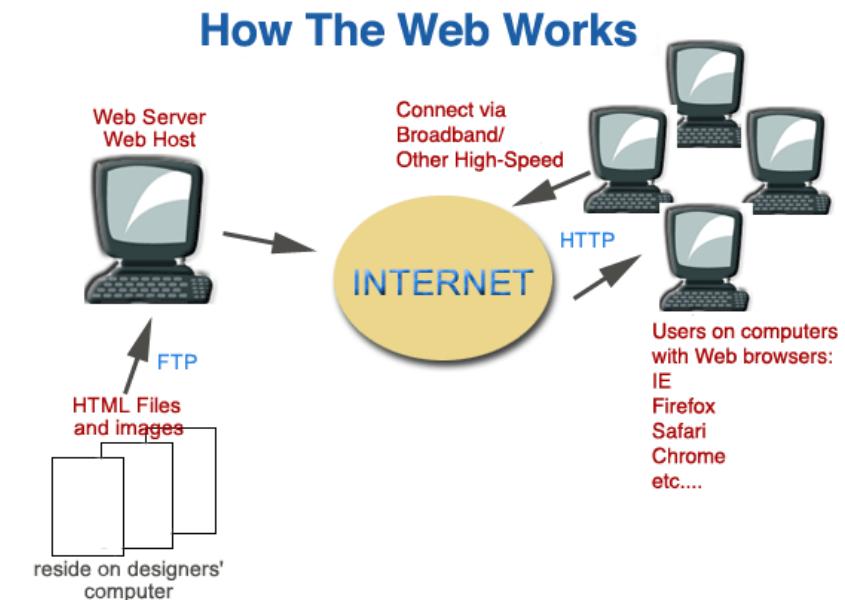
INTRODUCTION TO WEB SERVICES

WWW

- World Wide Web
- Set of protocols that allows to access any documents on the net through URL (Uniform Resource Locator)
- A small part of internet

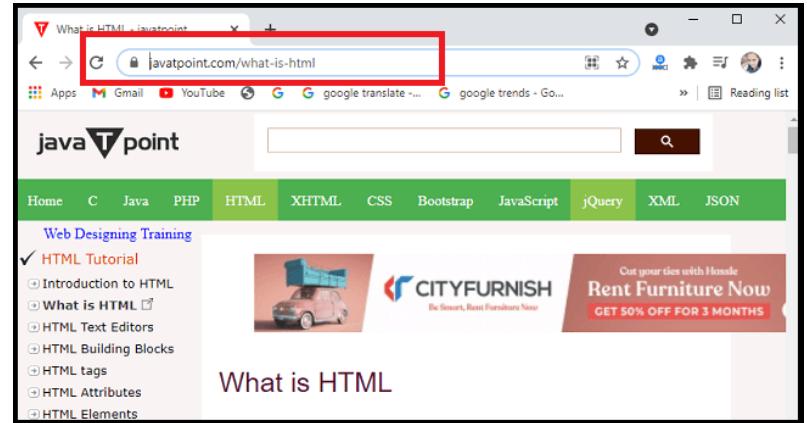
WWW ATTRIBUTES

- User-friendly
- Multimedia Documents
- Hypertext and Hyperlinks
- Interactive
- Frames



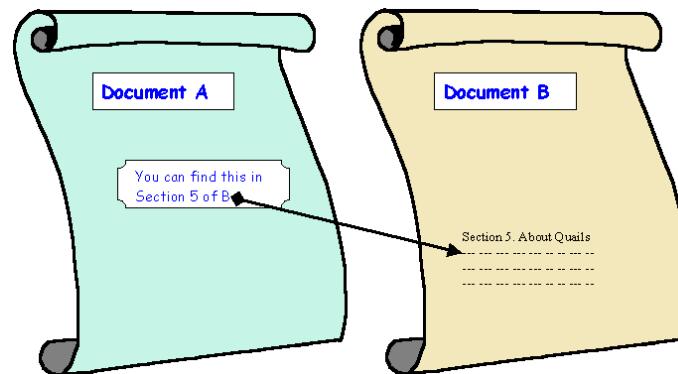
WEB PAGE

- A document on the internet that contain text plus multimedia elements



HYPertext

- A document that incorporates text, graphic images, audio and video



HYPERLINKS

- a hyperlink is an icon, graphic, or text that links to another file or object.



HTML

- Hyper Text Markup Language
- Tells the browser how to display text, pictures and links on the screen
- Language to design the layout of a document and to specify the hyperlinks

HTML Page Structure

```
<!DOCTYPE html>           ← Tells version of HTML
<html>                  ← HTML Root Element
<head>                  ← Used to contain page HTML metadata
    <title>Page Title</title>   ← Title of HTML page
</head>

<body>                  ← Hold content of HTML
    <h2>Heading Content</h2>   ← HTML heading tag
    <p>Paragraph Content</p>   ← HTML paragraph tag
</body>

</html>
```

XML

- eXtensible Markup Language
- A markup language for documents containing structured information (heading, sub heading, plain text, tables, data etc.)
- Provides a facility to define tags and the structural relationships between them

```
<?xml version="1.0"?>
- <birds>
  - <owl id="1201">
    <species>Bubo bubo</species>
    <name>Eagle Owl</name>
    <region>Eurasia</region>
  </owl>
  - <owl id="1202">
    <species>Strix occidentalis</species>
    <name>Spotted Owl</name>
    <region>North America</region>
  </owl>
</birds>
```

DIFFERENCE BETWEEN HTML & XML

XML (Extensible Markup Language)	HTML (Hypertext Markup Language)
It stores and transports data.	It displays data.
It uses user-defined tags.	It uses predefined tags.
It contains structural data.	It doesn't contain any structural data.
It can distinguish uppercase and lowercase letters (case sensitive).	It can't distinguish uppercase and lowercase letters (case insensitive).
It maintains spacing, tabs, newlines, and any other whitespace formatting.	It doesn't maintain whitespace.
It needs to have an end-tag.	It doesn't need an end-tag.
It needs structure or nesting.	It doesn't need structure.

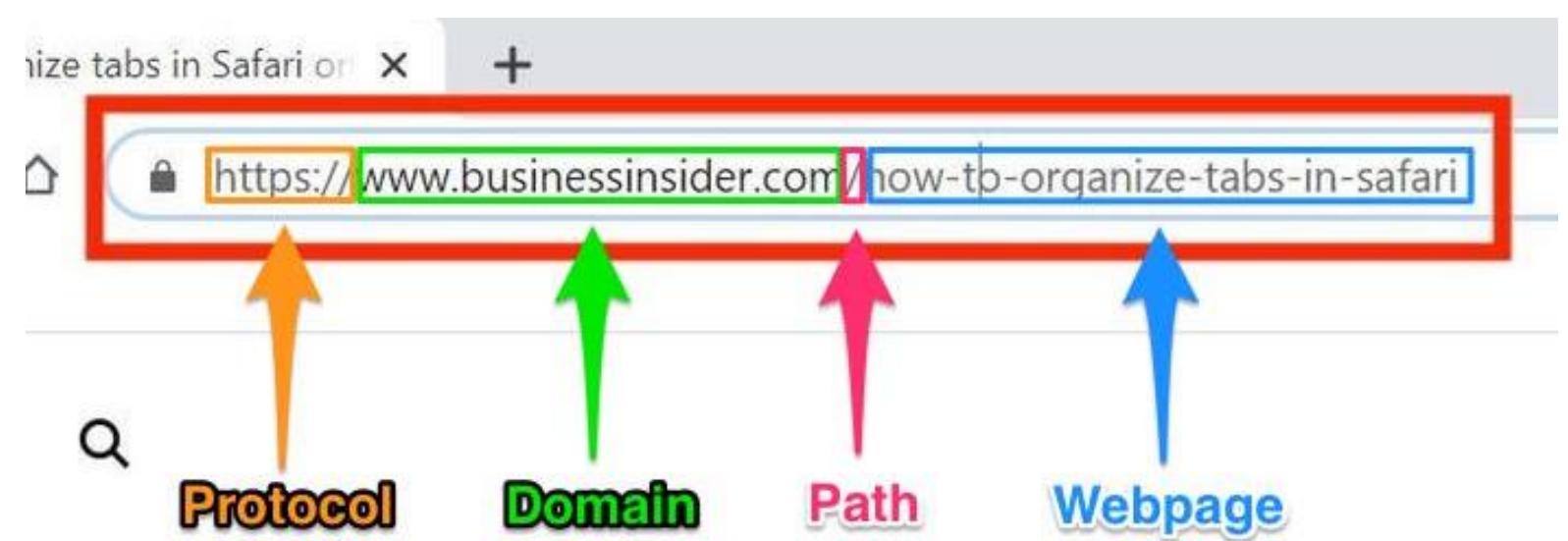
URL

- Uniform Resource Locator
- Used to locate resource on the internet
- Also known as web address



type://address/path

**Basic Structure
of URL**



How to organize tabs in a C

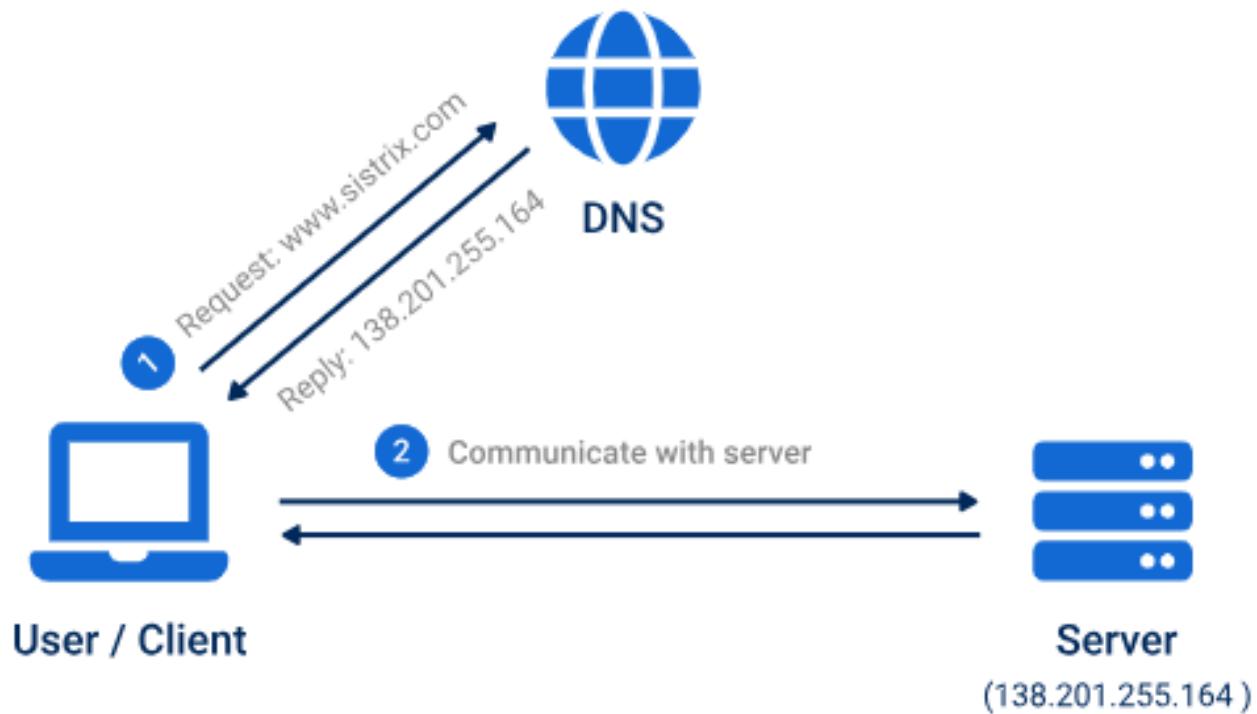
DOMAIN NAMES

- The name or address of the server on the internet



DOMAIN NAME SYSTEM

- The characters based naming scheme by which servers are identified
- DNS is the phone book of the internet

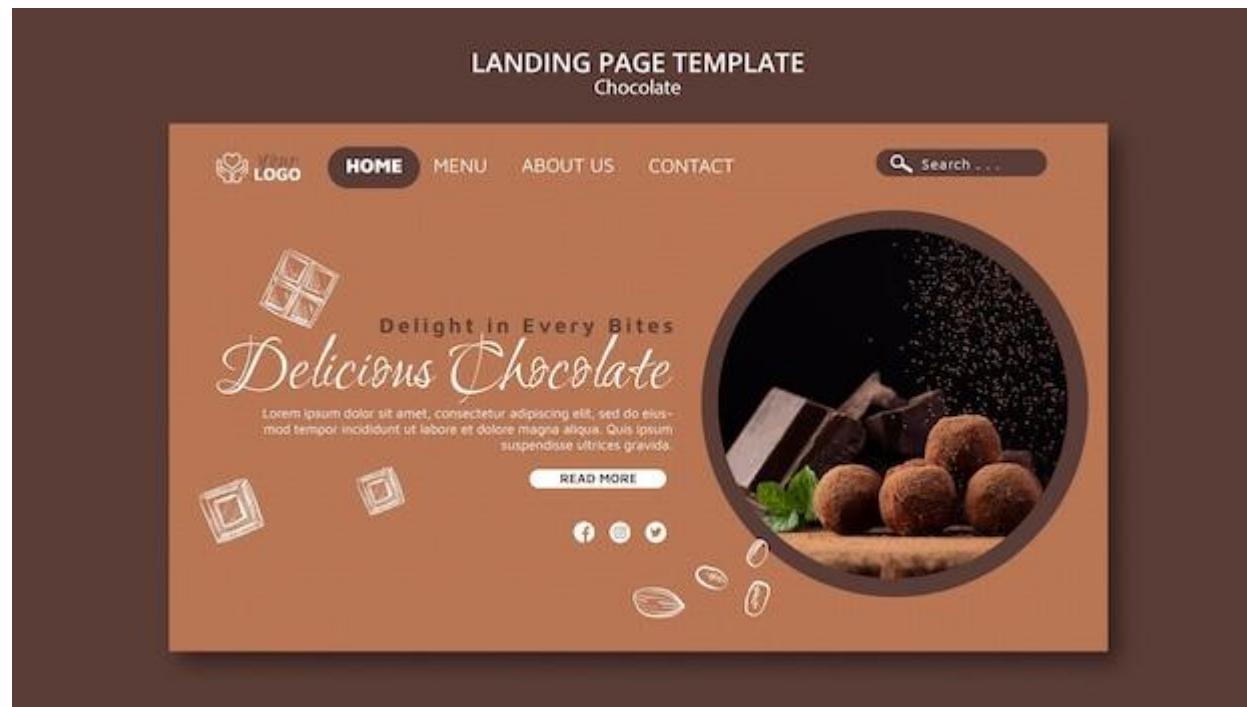


COMMON DOMAINS

DOMAIN ID	AFFILIATION	REMARKS
com	Commercial	For Commercial firms
edu	Education	For educational firms
gov	Government	For government organizations/bodies
mil	Military	For Military
net	Network resources	For ISPs/networks
org	Non-profit organizations	For NGOs and other non-profit
co	Company	For listed companies
biz	Business	For business
tv	Television	For television companies and channels

WEBSITE

- Collection of web pages and related content
- Identified by a common domain name
- Published on at least one web server
- Location on a net server



WEB BROWSER

- A WWW client that navigates through the WWW and displays web pages



Google
Chrome



Apple
Safari



Microsoft
Edge



Mozilla
Firefox



Opera



Internet
Explorer



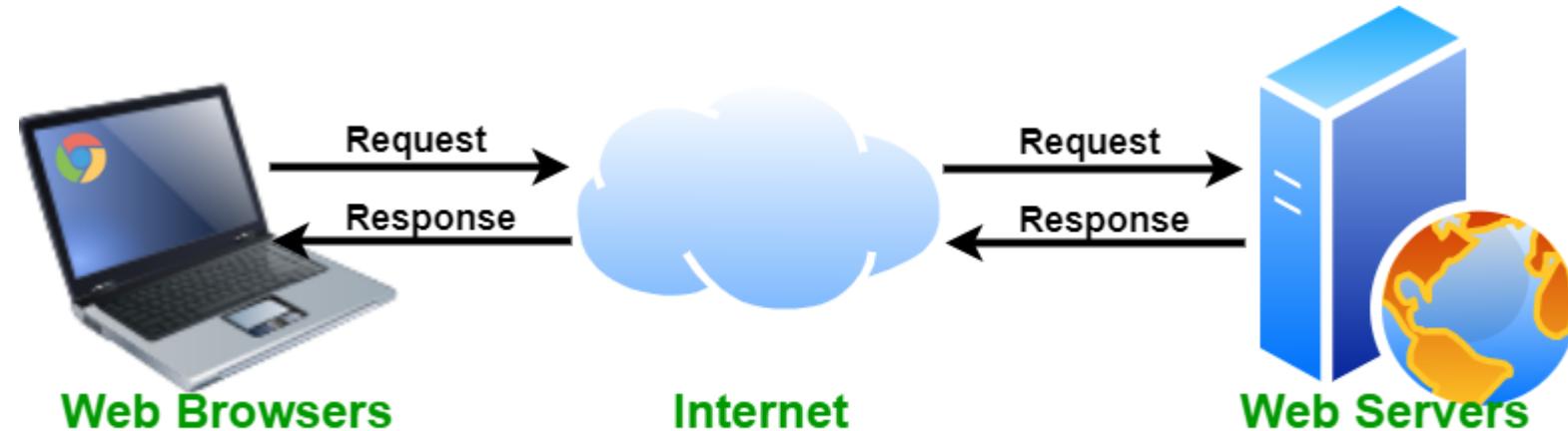
Brave
Browser



Tor
Browser

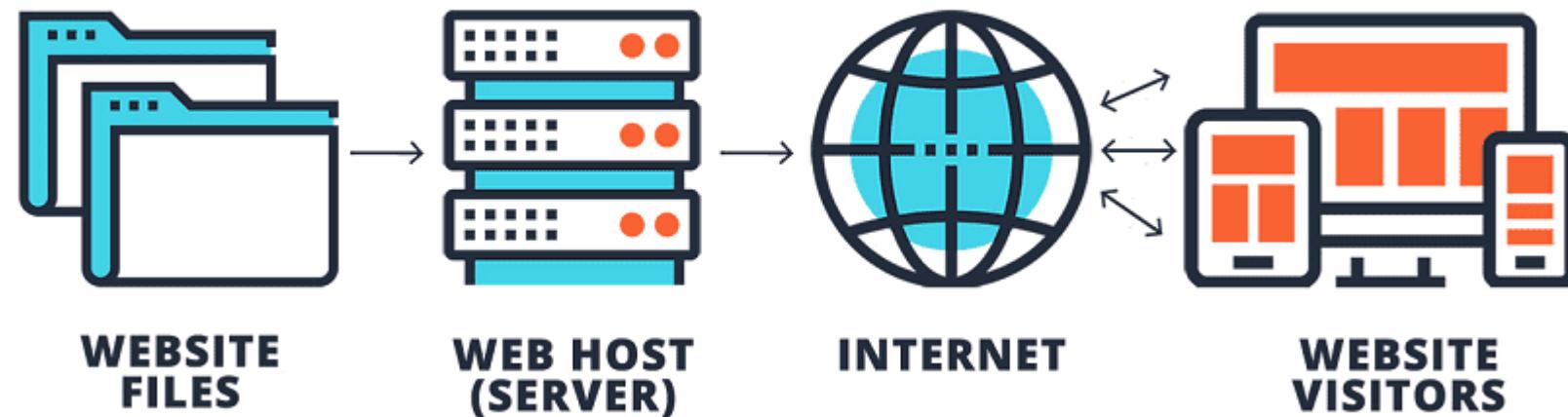
WEB SERVERS

- A WWW server that responds to the requests made by web browser



WEB HOSTING

Hosting web-server application on a computer system through which electronic content on the Internet is readily available to any web browser client.



IDENTIFYING NODES

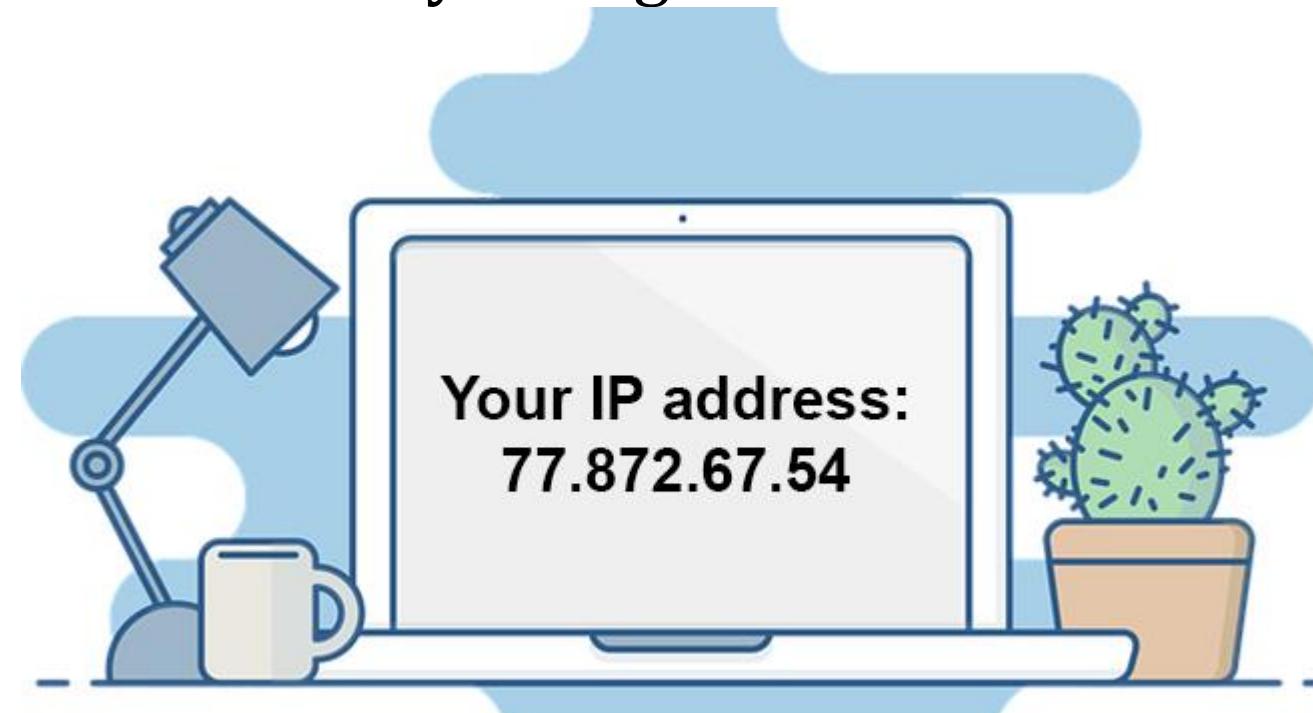
IP address

MAC address

- IP address is used to transport data from one network to another network using the TCP/IP protocol
- MAC address is used to deliver the data to the right device within the network

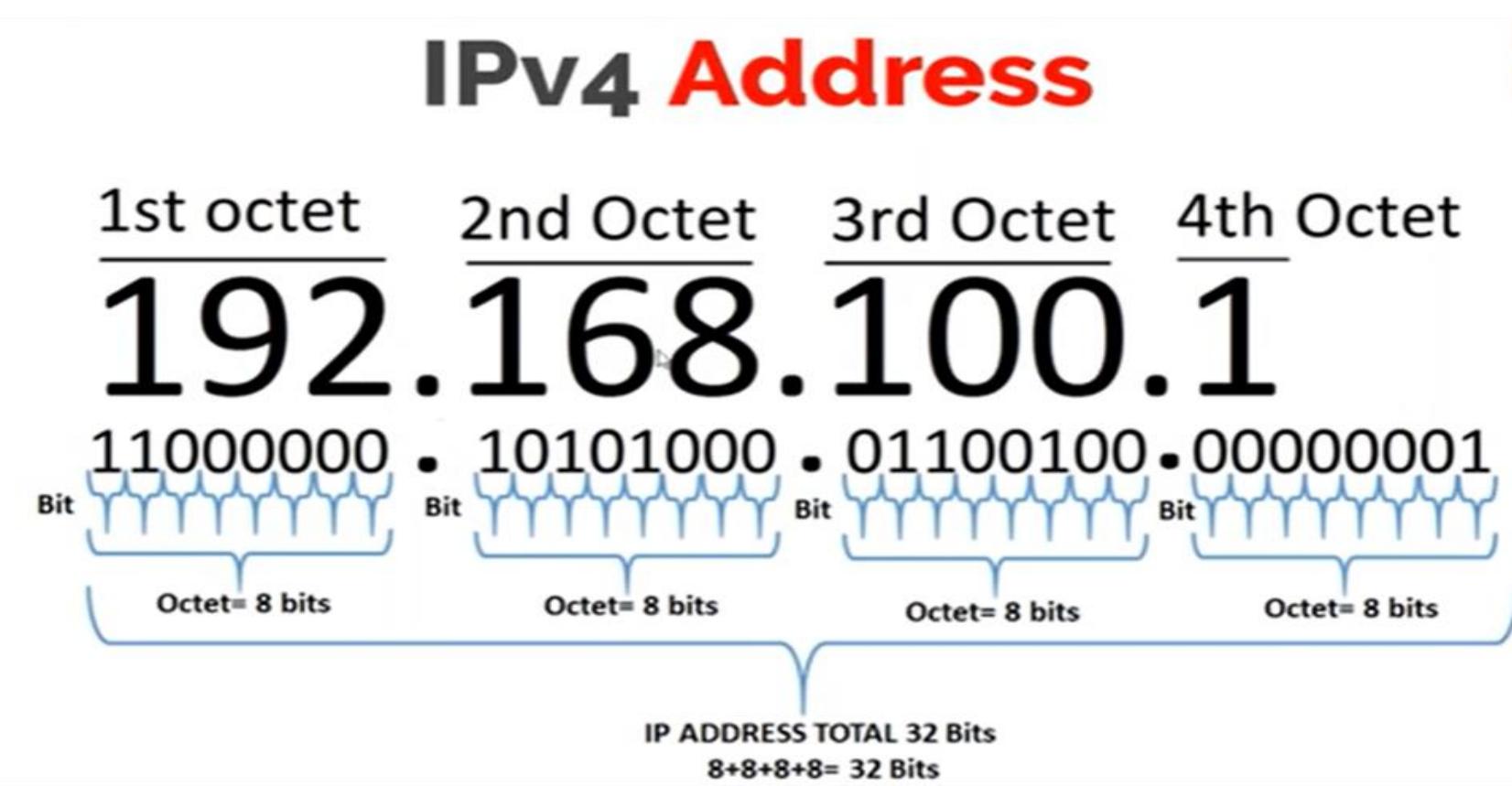
IP ADDRESS

- Unique numerical identifier for every device or network that connects to the internet
- Logical address that may change



IPv4 ADDRESS

- Internet protocol version 4
- 4-byte (32 bit) address



IPV6 ADDRESS

- 16- byte (128 bit) address

2001 : 0DC8: E004 : 0001 : 0000 : 0000 : 0000 : F00A

16 bits : 16 bits

128 Bits

MAC ADDRESS

- Physical address assigned to each NIC card
- MAC address cannot be changed
- 48 bit address



IP ADDRESS VS MAC ADDRESS

IP ADDRESS	MAC ADDRESS
Internet Protocol	Media Access Control
Logical address	Physical address
Provided by the Internet Server	Provided by Manufacturer
Can be changed by ISP	Cannot be changed



JINI N K