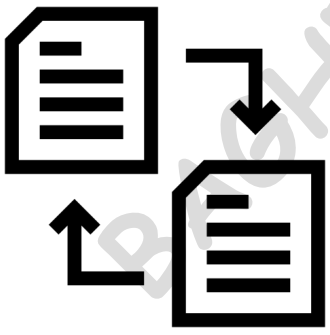
INTERNET AND WWW

NETWORK:

Definition: A computer network is a set of computers sharing resources located on or provided by network nodes.

- **Communication Protocols:** Computers use common communication protocols over digital interconnections to communicate with each other.
- **Interconnected Devices:** Networks are a collection of interconnected devices that can communicate and share resources.

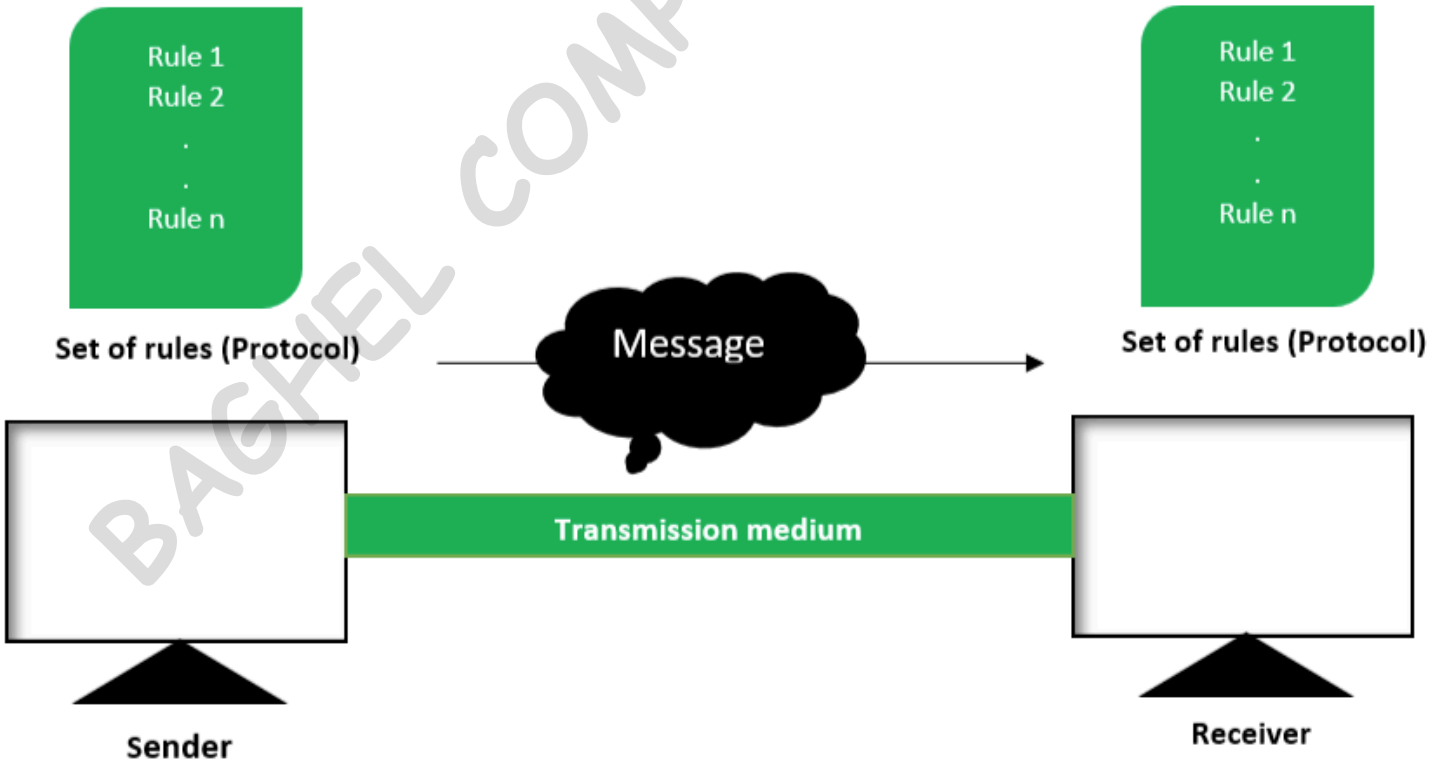


- **Data Exchange:** Networks allow computers to exchange data and collaborate, enabling users to access information and services.

Component in network

A network is a collection of five different components.

1. Message
2. Sender
3. Receiver
4. Transmission Medium
5. Set of rules (Protocol)

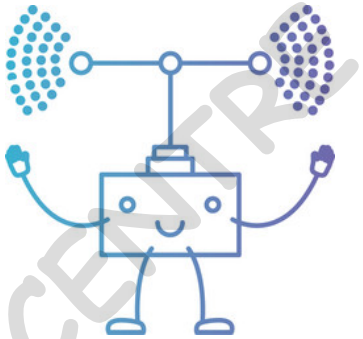


In computer networks we use protocol as a rules and regulation media for data transmission and computer as a sender and receiver.

Any computer network achieve these advantages,

- Make Communication
- Resource Utilization,
- Saving Cost And
- Time Saving.

Transmission media

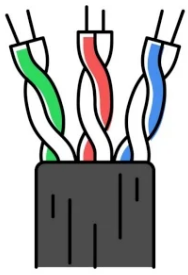


Transmission media are the pathways that carry data from one place to another in a network. They can be either guided, which means they use physical cables, or unguided, which means they don't need cables.

1. Guided Media:

Guided media use cables to transmit data. Examples include:

1.Twisted Pair Cable:



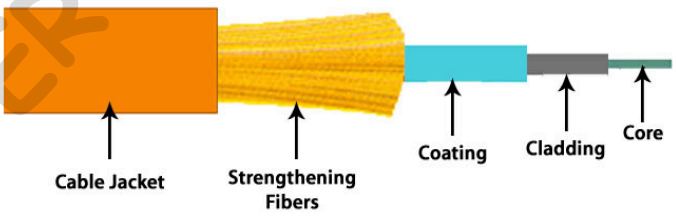
Two insulated copper wires twisted together, used for things like phone lines and some internet connections.

2.Coaxial Cable:

Consists of a central wire surrounded by insulation and a conductive shield, often used for cable TV and internet.

3.Fiber Optic Cable:

Uses thin strands of glass or plastic to transmit data using light signals, commonly used for long-distance communication.



2. Unguided Media:

Unguided media transmit data without cables.

1. Radio Transmission:

- Explanation: Radio waves carry data through the air. They're used for things like broadcasting music,

communication between devices like walkie-talkies, and Wi-Fi.

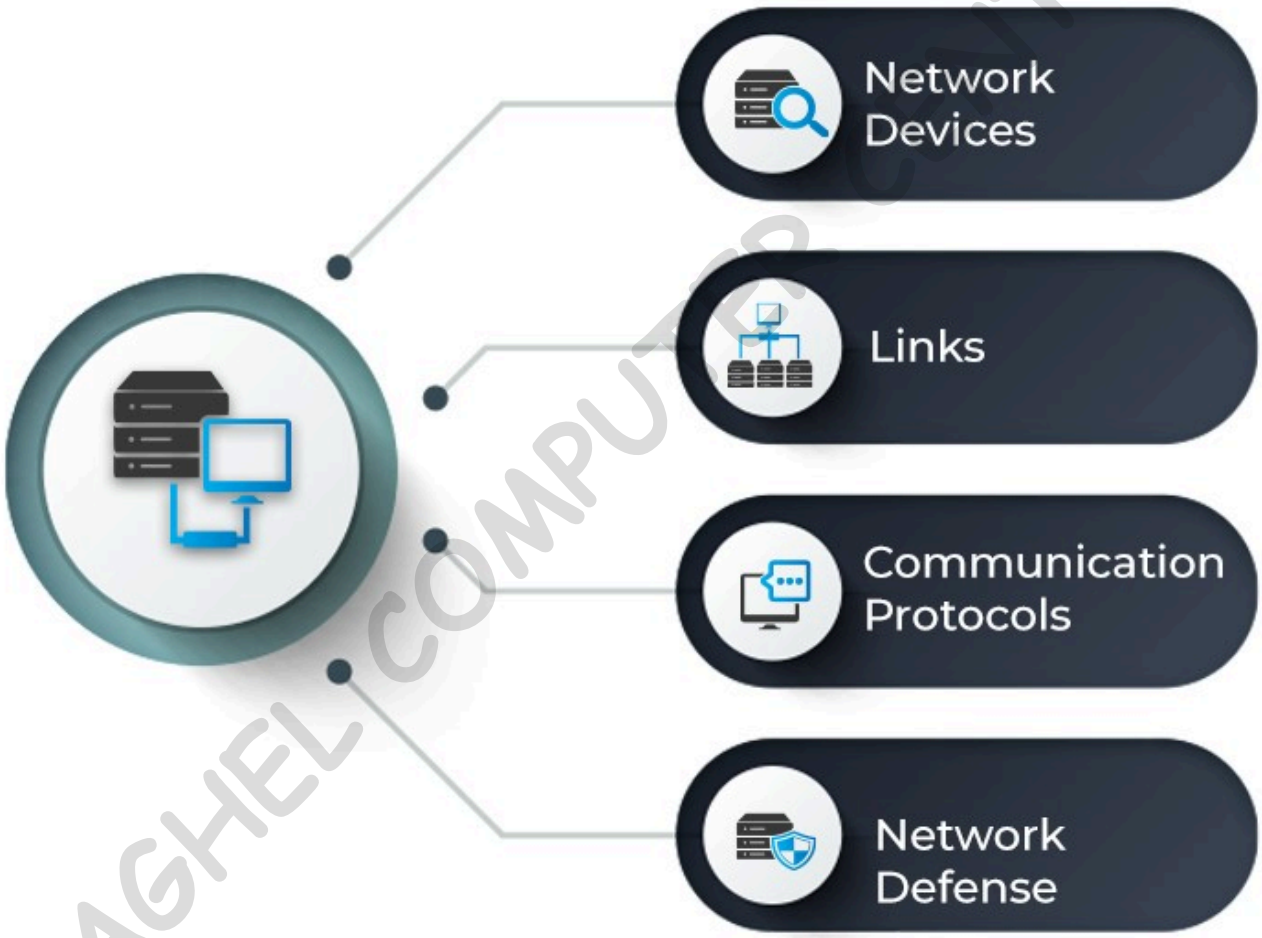
- Example: When you listen to the radio in your car or use your phone to connect to Wi-Fi, you're using radio transmission.

2. Microwave Transmission:

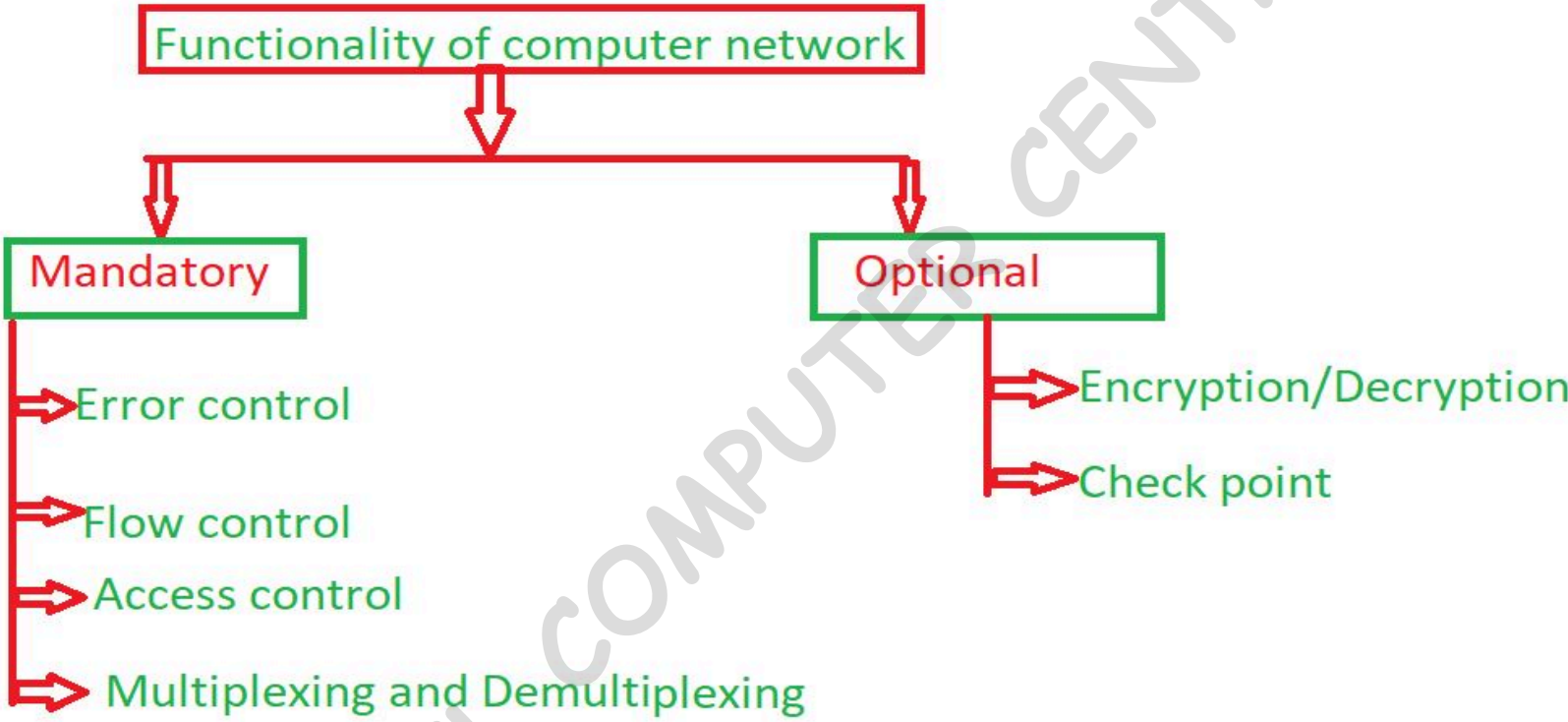
- Explanation: Microwaves are high-frequency waves that also carry data wirelessly. They're used for things like long-distance phone calls, satellite communication, and fast internet connections.

- Example: Satellite TV signals and fast internet connections often use microwave transmission to deliver data quickly over long distances.

Key component of a computer network



Functionality of a computer network

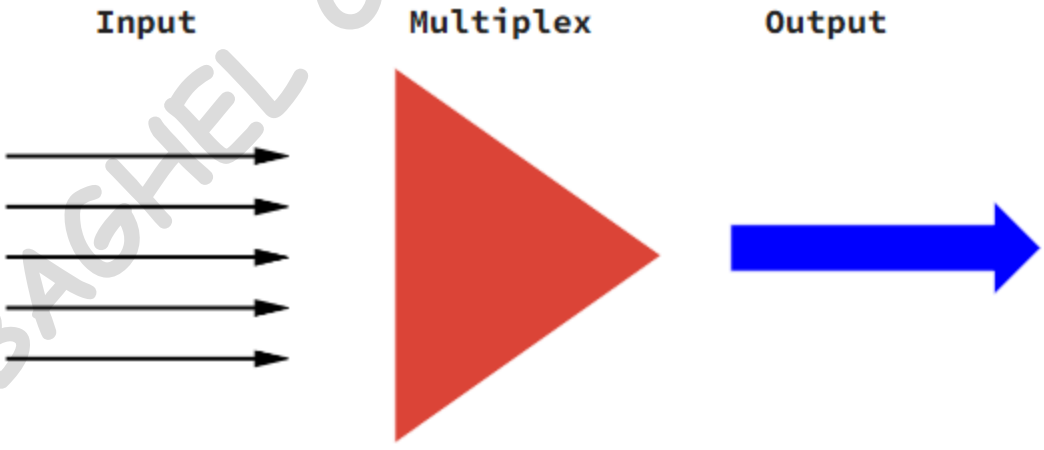


- **Error control:** minimizes data transmission errors.

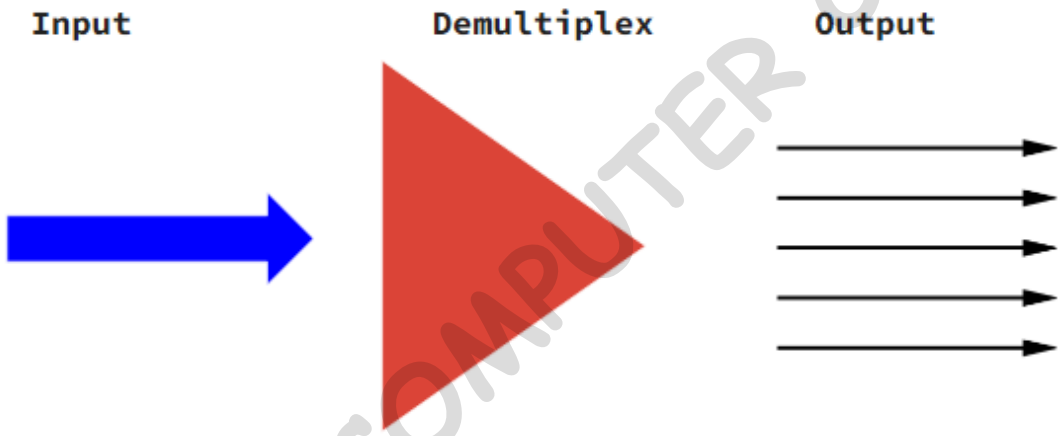
- **Flow control :** regulates data traffic.

- **Access control:** manages user permissions,

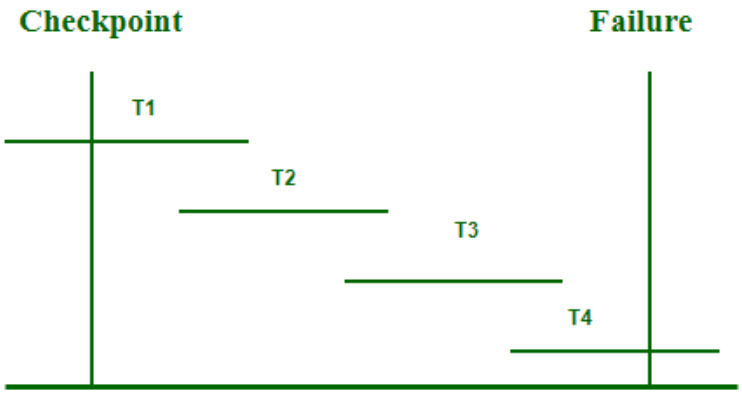
- **Multiplexing :** it is a combinational circuit that accepts **multiple input** of data but provide only **single output**.
  EX: Cable television companies transmit multiple channels of video and audio content over a single coaxial cable.



- **Demultiplexing :** it is a combinational circuit that accepts single input of data but provide multiple output.
  EX:At the user's television set, the composite signal needs to be separated back into individual channels for viewing.



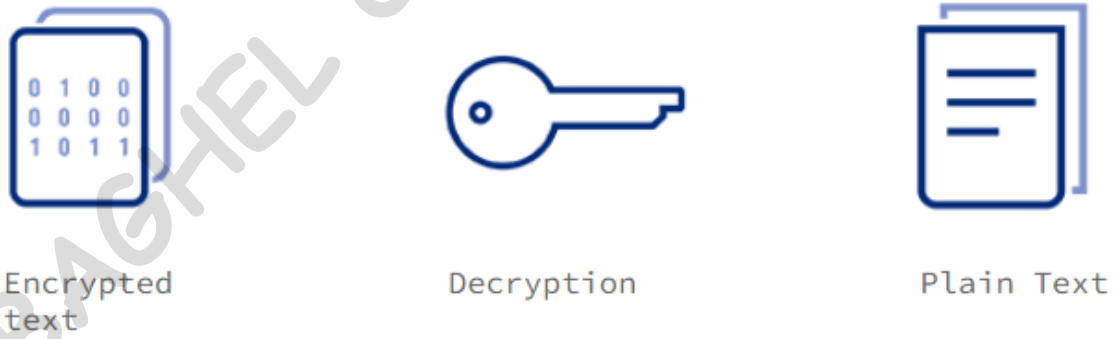
- checkpoints facilitate recovery points in computer networks.



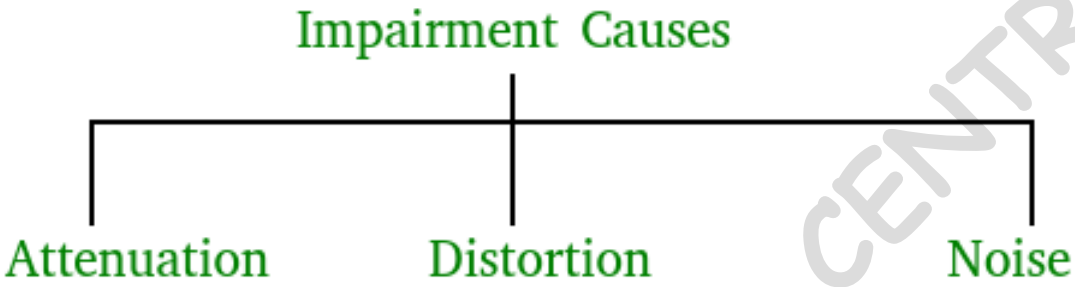
- **Encryption**

It is a process by which a readable message is converted to an unreadable form to prevent from unauthorized party

- **Decryption** : It is a process by which a unreadable message is converted to an readable format.

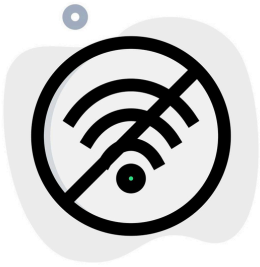


Impairment causes

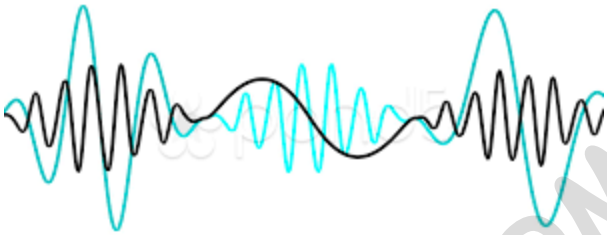


Impairment in communication systems refers to any factor that degrades the quality or performance of the signal being transmitted from the sender to the receiver. There are various causes of impairment in communication systems, including:

1. Attenuation: Signal loses strength and becomes weaker as it travels, just like how your voice gets quieter the further you move away from someone.



2. Distortion: Signal changes shape or gets messed up during transmission, similar to how a photo might get stretched or blurry when it's copied multiple times.

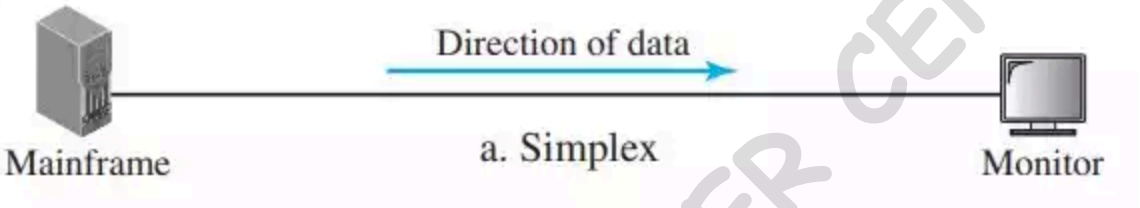


3. Noise: Unwanted background sounds or interference that disrupt the main signal, like static on a phone call or buzzing on a radio.

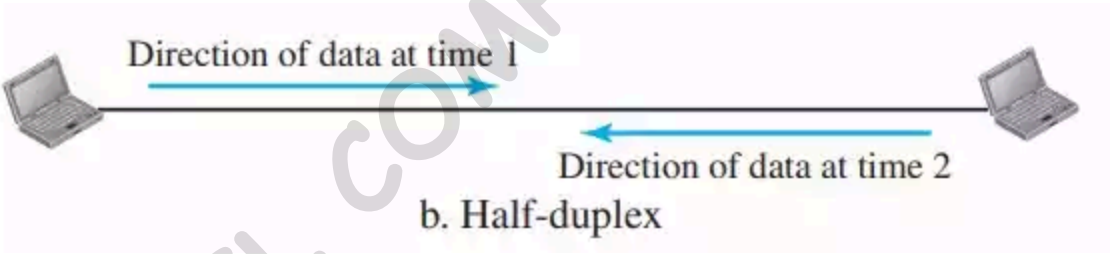
Transmission modes

Simplex:

Only the sender can transfer data at a time



Half duplex:



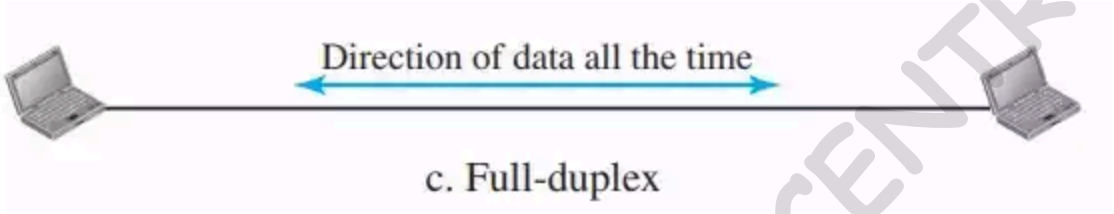
In this, at a time either the sender can send data or the receiver can send data

Ex: hub

Note: it is a broadcast device

It works on physical layer of OSI model.

Full duplex:



c. Full-duplex

In this, at a time both the sender and the receiver can send data at a same time.

Ex: switch

Note: it is a multicast device.

It works on Data Link layer of OSI model.

History of the internet:

1969: The internet began as a U.S. government project called ARPANET (Advanced Research Projects Agency Network), connecting computers for research purposes.

1980: The National Science Foundation developed NSFNET, linking supercomputer centers and universities, expanding internet access.

1989: Tim BernersLee created the World Wide Web (WWW), a network of internet sites allowing access to text, images, videos, and more.

1993 (INTERNET): Tim Berners Lee released the world's first web browser and editor, making the internet more accessible to users.

Note:-

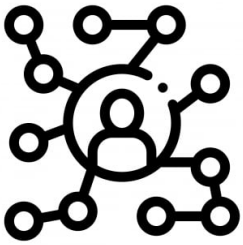
- **First web browser without graphical capabilities:** WorldWideWeb (later renamed Nexus) by Tim Berners-Lee (1990)

- **First graphical web browser:** NCSA Mosaic (1993)

1995: The first publicly available internet service in India was launched by **Videsh Sanchar Nigam Limited (VSNL) on 15 August 1995.**

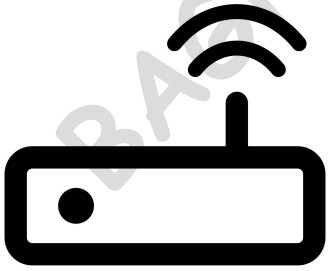
Internet

1. Definition: The internet is a global network connecting billions of devices worldwide in other words we can say that it is a network of networks.



2. Network Structure: It's made up of interconnected smaller networks using standardized protocols.

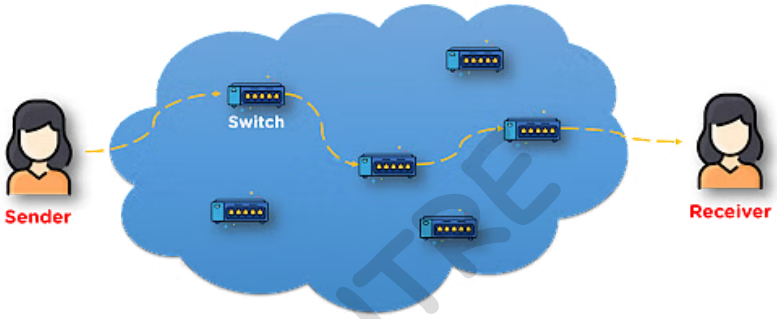
3. IP Addressing: Devices are identified by unique IP addresses for communication.



4. Routing: Data packets are routed through interconnected routers to reach their destinations.

5. Packet Switching:

Data is broken into packets for transmission and reassembled at the destination.



6. Infrastructure:

Backbone infrastructure like fiber optic cables and satellites support internet connectivity.

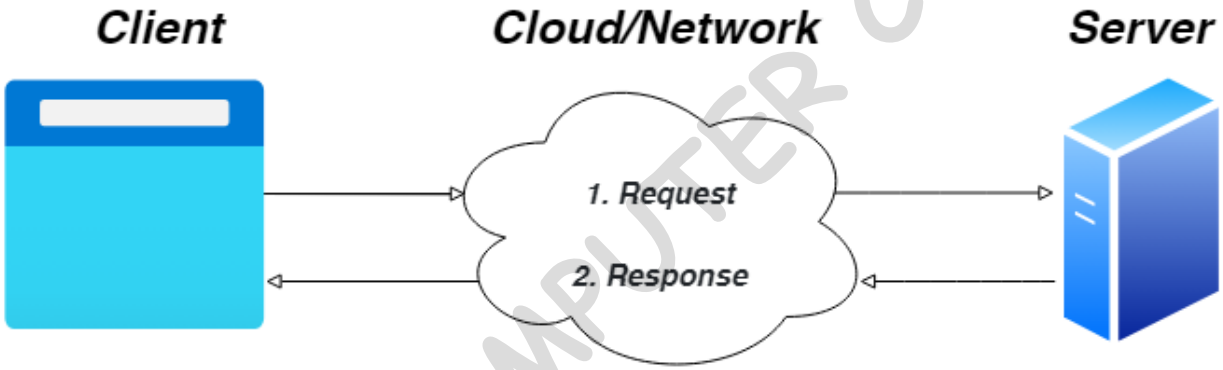
7. Access Technologies:

Various technologies like DSL, cable, fiber, and wireless enable user connections.

8. Internet Service Providers (ISPs):

Companies provide internet access to users and manage networks.

9. Client and Server: Devices on the internet typically act as either clients or servers. So, on the Internet, a **client** is like your web browser or app, and the **server** is like the computer that stores and delivers the website or service you requested.



10. Founders:

Other key figures include **Vint Cerf and Robert Kahn, who developed TCP/IP,** the fundamental communication protocol of the internet.


ROBERT KAHN


VINT CERF

WWW

1. Definition: The World Wide Web (WWW) is a system of **interconnected web pages and resources accessible** via the internet.

2.Founder Name: The World Wide Web (WWW) was proposed by **Tim Berners-Lee in 1989.** The first website went live on August 6, 1991.

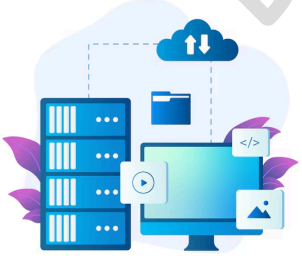
3. Hypertext Documents: Web pages contain text, images, and links, created using HTML (Hypertext Markup Language).

4. Hyperlinks: Links allow users to navigate between web pages by clicking on clickable elements.

5. URLs: Each web page has a unique address called a URL (Uniform Resource Locator) specifying its location on the web.

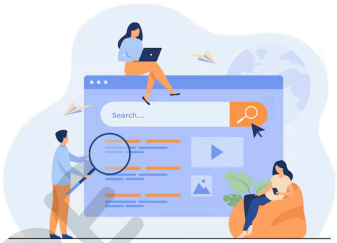
6. HTTP and HTTPS: Communication between web browsers and servers occurs using protocols like HTTP and HTTPS.

7. Web Browser: Software like Chrome, Firefox, or Safari is used to access and view web pages.



8. Web Server: Servers store and deliver web pages to users upon request.

9. Search Engines: Tools like Google or Bing help users find web pages by entering keywords.

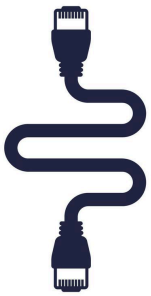


10. Web Development: Involves creating websites and applications using HTML, CSS, JavaScript, and other technologies.

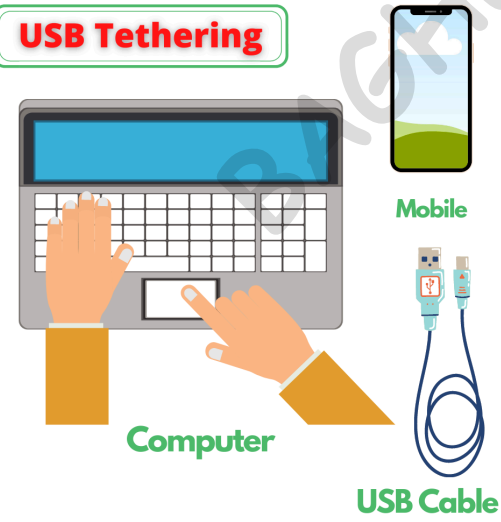
Modes of Connecting Internet

- **Hotspot:** Using a mobile device's cellular data to create a **wireless network.**

- **WiFi:** Connecting to a wireless network using a **WiFienabled device.**

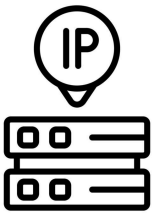


- **LAN Cable:** Establishing a **direct wired** connection using an Ethernet cable.



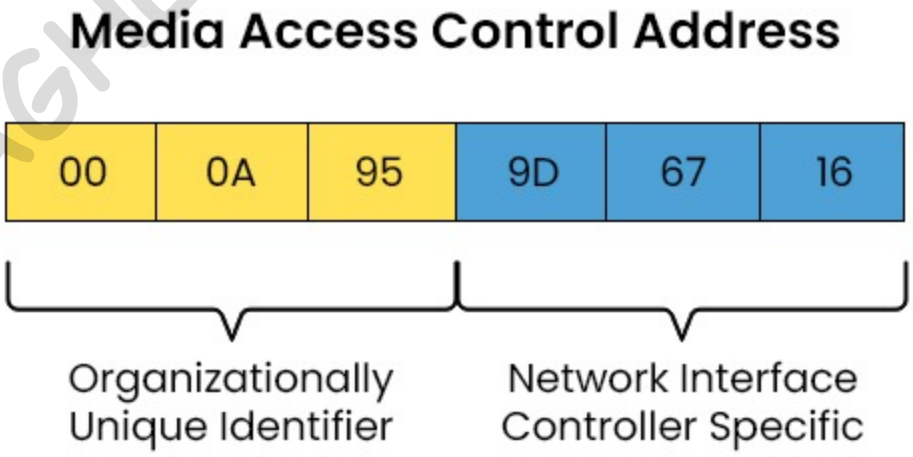
- **USB Tethering:** Sharing a mobile device's internet connection with another device via USB cable.

Identifying and uses of IP/MAC/IMEI of various devices:



- **IP Address:** Identifies a device on a network and enables communication over the internet or local network.

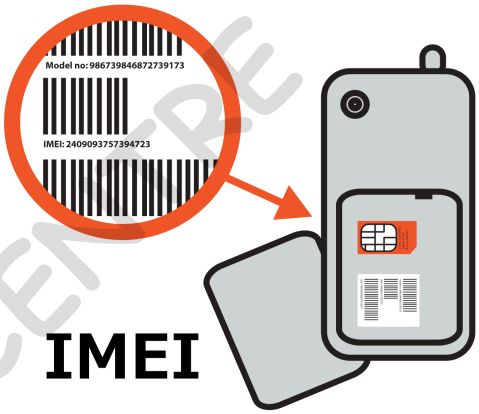
- **MAC Address:** A unique hardware identifier assigned to network interfaces, such as network cards or WiFi adapters.



- **IMEI (International Mobile Equipment Identity):**

  It has a **15 digit** number.

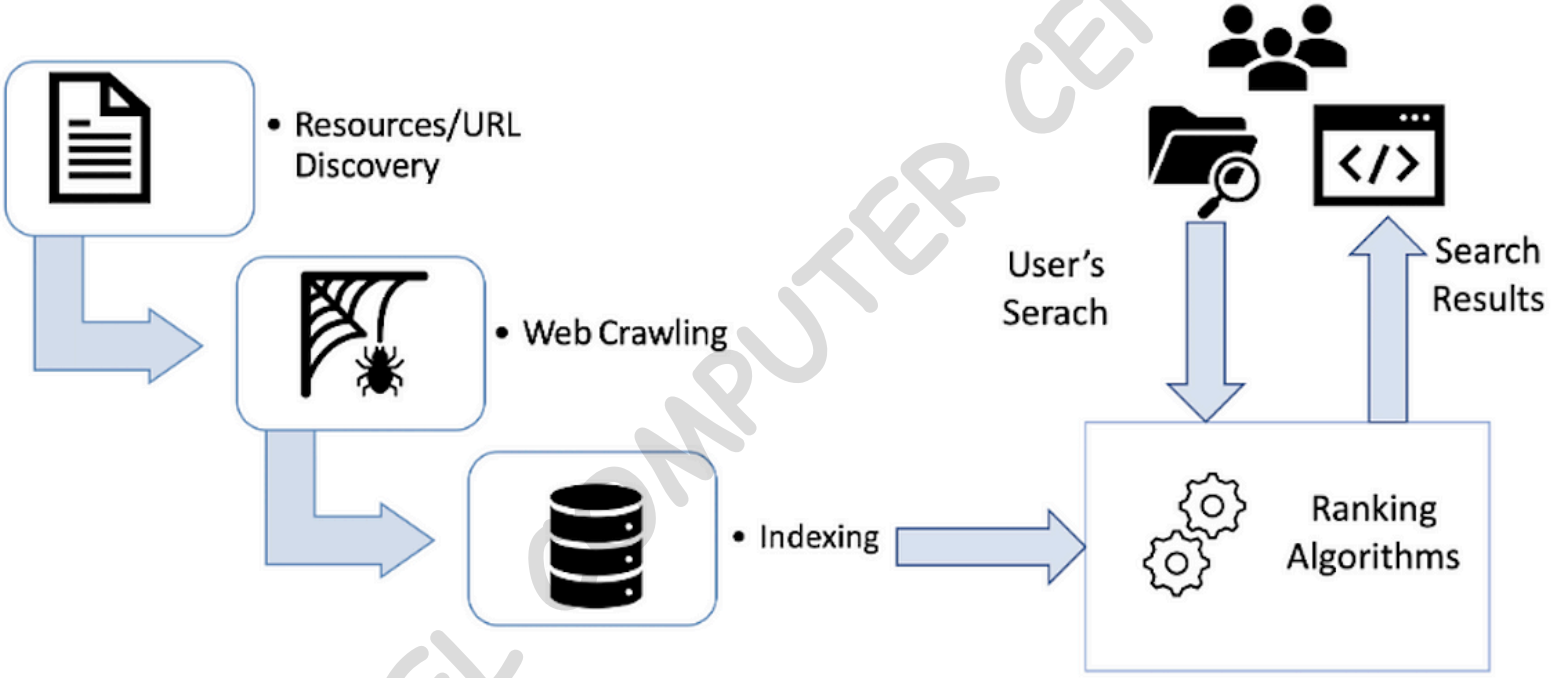
  A unique identifier assigned to mobile devices, primarily used to identify GSM, WCDMA, and LTE devices.



IMEI

Internet general term

Web crawler/ web indexing/ Search Algorithm



Web Crawler: It's a program that systematically browses the web, fetching web pages and following links.

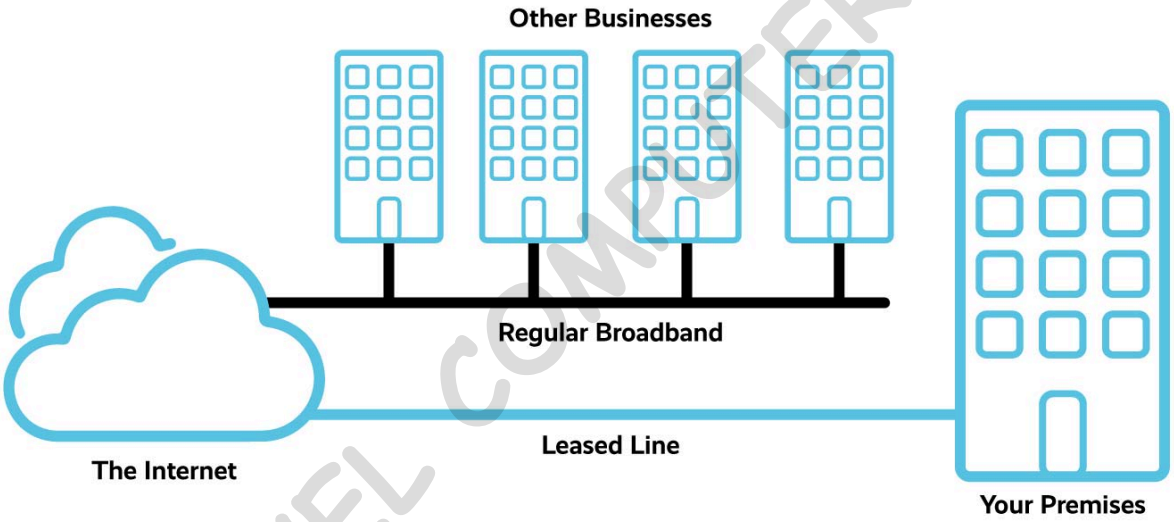
Web Indexing: It's the process of organizing and storing data obtained by web crawlers in a structured manner, making it searchable.

Search Algorithm: It's a set of rules used to retrieve relevant information from a dataset.

Relationship: Web crawlers gather the data, web indexing structures and organize it, and search algorithms determine the relevance of this indexed data to user queries, ultimately presenting the most relevant results to users.

LEASED LINES

A leased line is a private, high speed internet connection rented by a business from a telecom provider. It's like having a dedicated express lane for data transfer between two locations, ensuring fast and reliable connectivity without sharing bandwidth with others.

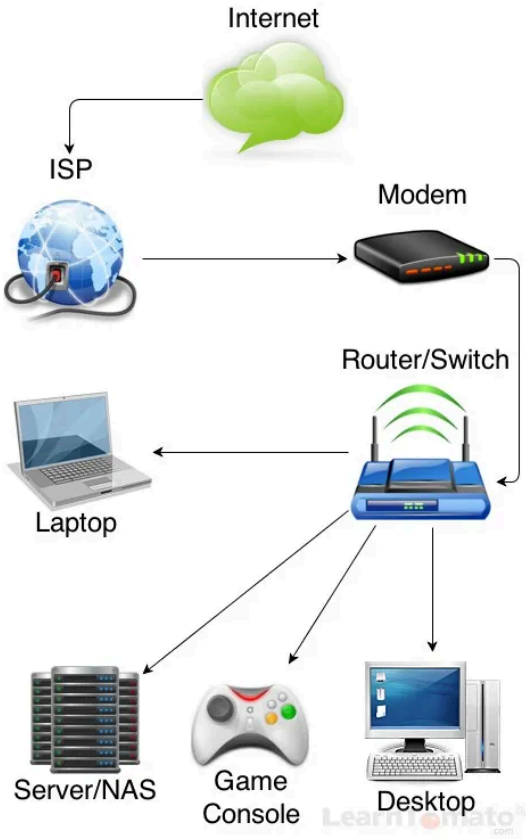


ISP

ISP stands for Internet Service Provider. They're the companies that give you access to the internet, offering different plans for connecting to the web, either through wired or wireless connections.

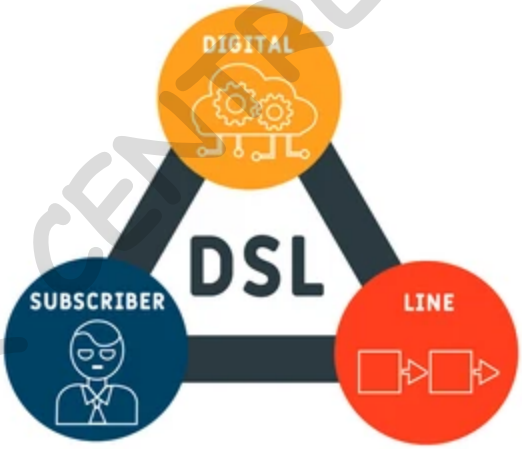
BROADBAND

Broadband means fast internet. It's like a speedy highway for data, letting you access websites, stream videos, and download files quickly. It's faster and more reliable than the older, slower dialup internet connections.



1. Digital Subscriber Line (DSL):

- Utilizes existing copper telephone lines.
- Splits the telephone line into separate channels for voice and data transmission.
- Offers high speed internet connectivity
- Commonly available in urban and suburban areas.



2. Dialup:

- Establishes connection via a standard telephone line and modem.
- Operates by dialing a phone number provided by the ISP.
- Found in remote or rural areas .
- Slower speeds.

URL EXTENTIONS

Some list of letter addressing system are.

.com - Commercial organization.

.org - Non profitable organization.

.gov - Government department.

.net - Networking organizations.

.co - Company.

.edu - Educational institutions.

.info - Informations.

Country code related letter addressing system some of :

.in- India.

.us- United States.

.ca- Canada.

.jp- Japan.

.uk- United Kingdom.

.pk- Pakistan.

Uniform Resource Locators (URL)

URL stands for Uniform Resource Locator. It's the address used to locate a resource, like a webpage or a file, on the internet. URLs are composed of several parts, including the protocol (such as "http://" or "https://"), the domain name (like "example.com"), and the specific path to the resource.

There are two types of url:-

Absolute URL's	Relative URL's
https://www.jetbrains.com/pycharm/	
https://www.jetbrains.com/go/	
https://www.jetbrains.com/idea/	

1. Absolute URL:

An absolute URL specifies the complete address of a resource, including the protocol and domain name.

Example: https://www.example.com/page.html

2. Relative URL:

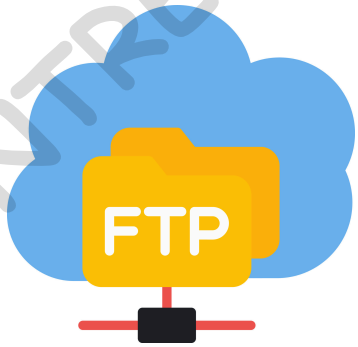
A relative URL specifies the location of a resource relative to the current location. It doesn't include the protocol or domain name, only the path to the resource.

Example: /images/picture.jpg

They are shorter and more flexible than absolute URLs because they don't require specifying the entire address, assuming the resource is located on the same server.

PROTOCOL

1. FTP (File Transfer Protocol):



- Used for transferring files between computers.
- Authentication required

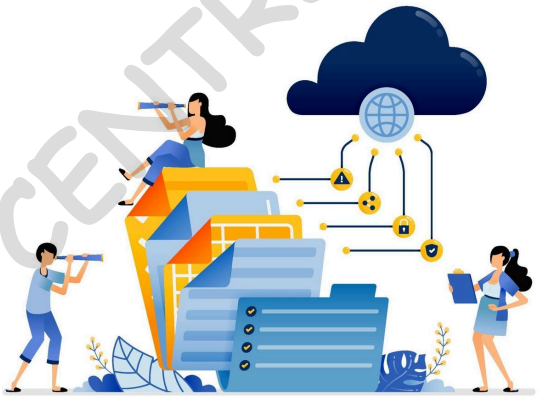
2. TFTP (Trivial File Transfer Protocol):

- Similar to FTP but simpler and often used for basic file transfers in local networks.
- Authentication not required.

3. Telnet: Allows remote access to computers or servers using a text based interface.

4. Gopher:

- An older protocol for organizing and accessing documents on the internet.
- Gopher is not a combination of TCP/IP, but rather it's built on top of TCP/IP.
- Gopher operates within the framework provided by TCP/IP

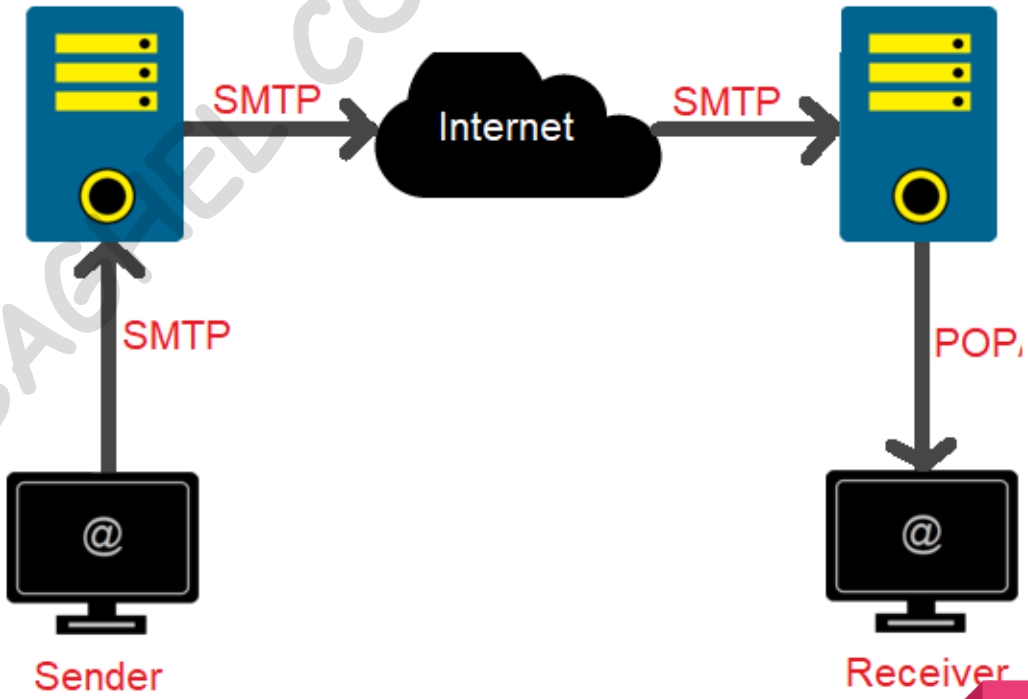


5. HTTP/HTTPS (Hypertext Transfer Protocol/Secure): Used for transferring web pages and ensuring secure communication over the internet.

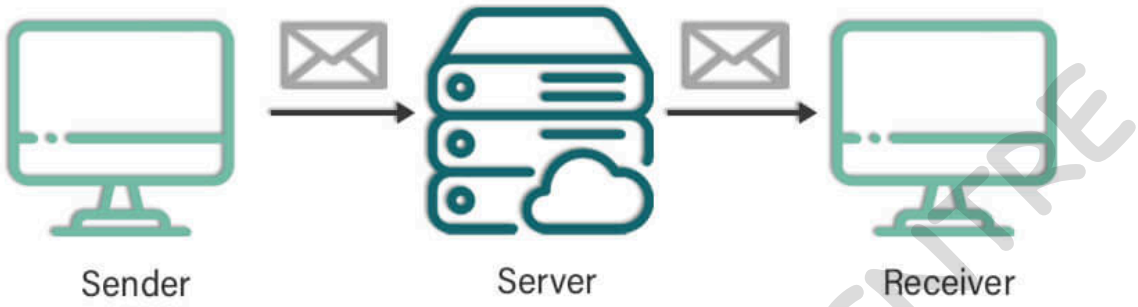
6. NNTP (Network News Transfer Protocol): Used for distributing and retrieving Usenet newsgroup articles.

7. SMTP (Simple Mail Transfer Protocol): Used for sending email messages between servers.

8. POP (Post Office Protocol): Allows email clients to retrieve messages from a mailserver.

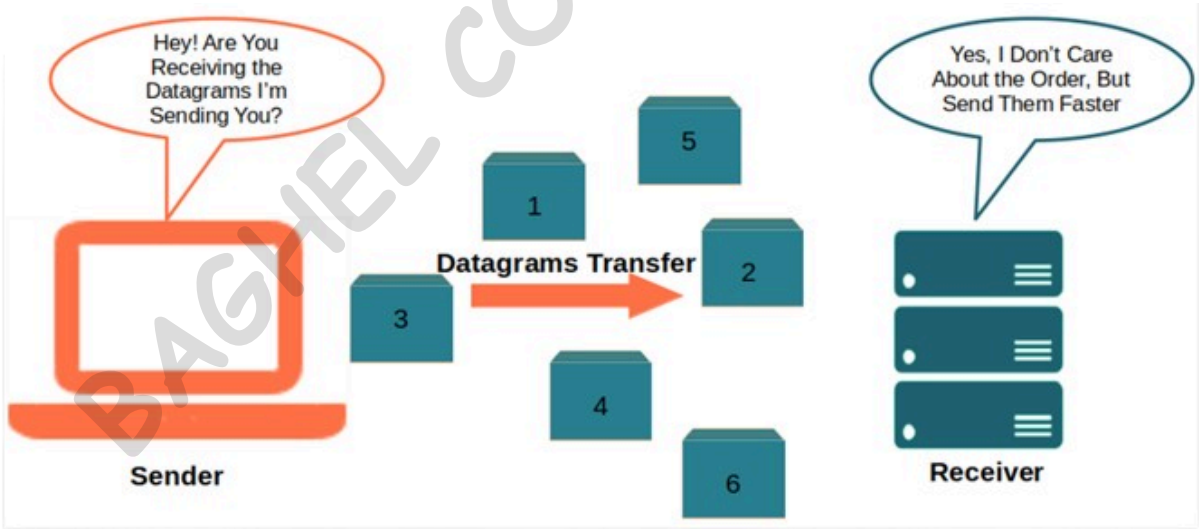


9. TCP (Transmission Control Protocol):



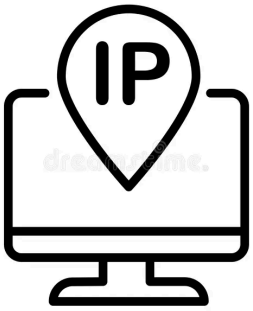
It ensures that data gets to its destination in order and without errors. Commonly used for things like websites and emails.

10. UDP (User Datagram Protocol):



It's faster and simpler but doesn't guarantee delivery or order. Used for things like streaming videos and online gaming where speed is more important than perfect delivery.

11.Internet Protocol (IP)



IP stands for Internet Protocol: It's a set of rules that governs how devices communicate over the internet.

Unique Identifier: Every device connected to the internet is assigned a unique numerical label called an IP address.

IPv4 and IPv6: There are two main versions of IP addresses:

→ IPv4 (e.g., 192.168.1.1)

➔ IPv6

(e.g.2001:0db8:85a3:0000:0000:8a2e:0370:7334)

IPv4 Format: IPv4 addresses consist of four sets of numbers separated by dots with each set ranging from 0 to 255.

IPv6 Format: IPv6 addresses are longer and use hexadecimal (0000-FFFF) numbers separated by colons

BIT/BYTE:

- IPV4: 32bit or 4 byte ,
- IPV6: 128 bit or 16 byte.

Octet:

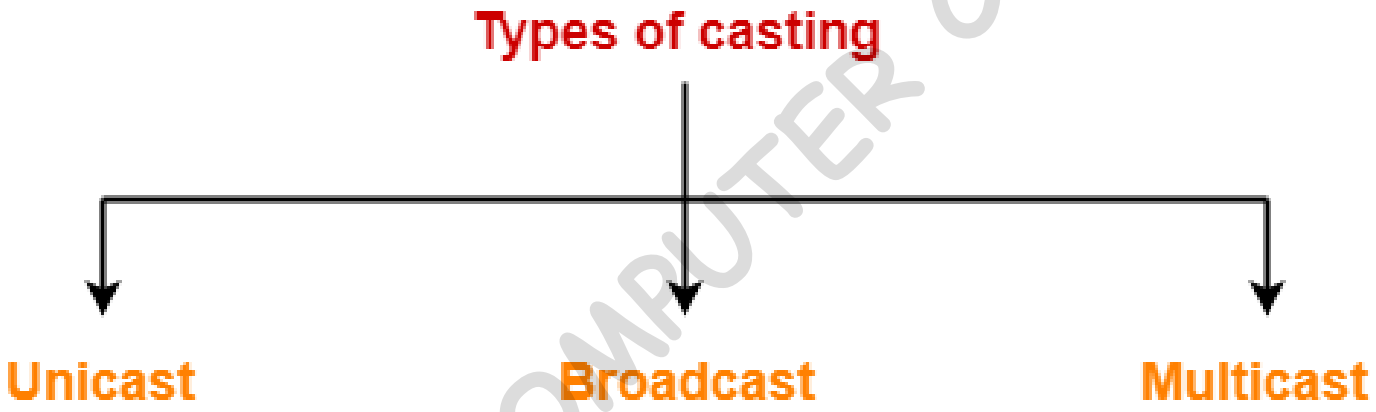
- IPV4 : 4 Octet
- IPV6 :16 Octet

Private and Public: IP addresses can be private (used within a local network) or public (routable on the internet).

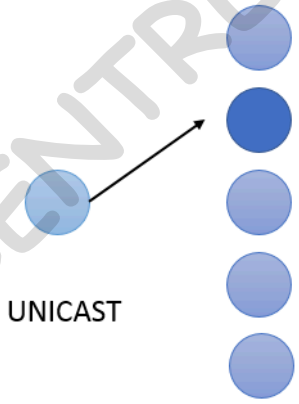
Essential for Internet Communication: IP addresses are fundamental for devices to communicate over the internet, enabling activities such as web browsing, email, video streaming, and online gaming.

Casting and its type

The term cast used here refers to the stream of packets (data) transmitted from clients to a recipient channel for establishing communication.



Unicast:



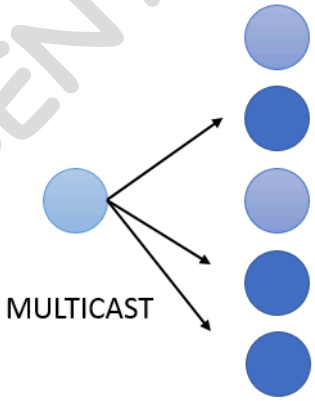
- *Meaning:* Unicast communication is a one-to-one communication model, where data is sent from one sender to one specific receiver.
- *Advantages:*
  - Targeted: Sends data directly to the right person or device.
  - Efficient: Saves internet space by sending only to the needed person instead of everyone.
  - Private: Keeps your data between you and the person you're talking to, so it's safe.

- **Reliable:** Makes sure your message gets through without any mixups or interruptions.

- *Disadvantages:*
  - **Scaling Issues:** Gets tricky in big networks because every chat needs special attention.
  - **Lots of Work:** Dealing with many individual chats can slow down the internet and make it harder to handle.
  - **Can't Talk to Everyone Together:** Unlike group chats, unicast can only talk to one person at a time, which might not be good for certain situations.
  - **Waiting Time:** Sometimes it takes longer to send messages, especially when there are many chats happening at once.

Multicast:

- *Meaning:* Multicast communication is a **one-to-many or many-to-many** communication model, where data is sent from one sender to multiple specific receivers.



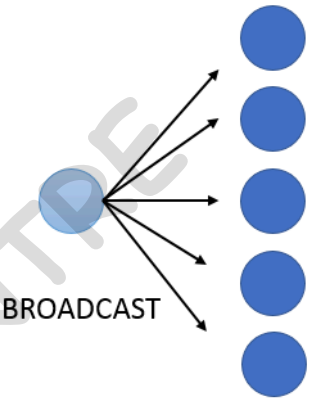
- *Advantages:*
  - **Efficient Broadcasting:** Sends data to many people at once, saving internet space.
  - **Works for Big Groups:** Good for large groups of people talking or sharing data.

- **Less Traffic:** Doesn't clog up the internet by sending data only to those who need it.

- ***Disadvantages:***
  - **More Complicated:** Can be harder to set up and manage compared to other ways of sending data.
  - **Not Always Supported:** Some devices and systems might not be able to use multicast, limiting its usefulness.
  - **Security Risks:** If not set up properly, multicast can be vulnerable to hackers or unauthorized access.

Broadcast:

- *Meaning:* Broadcast communication is a one-to-all communication model, where data is sent from one sender to all devices in the network.

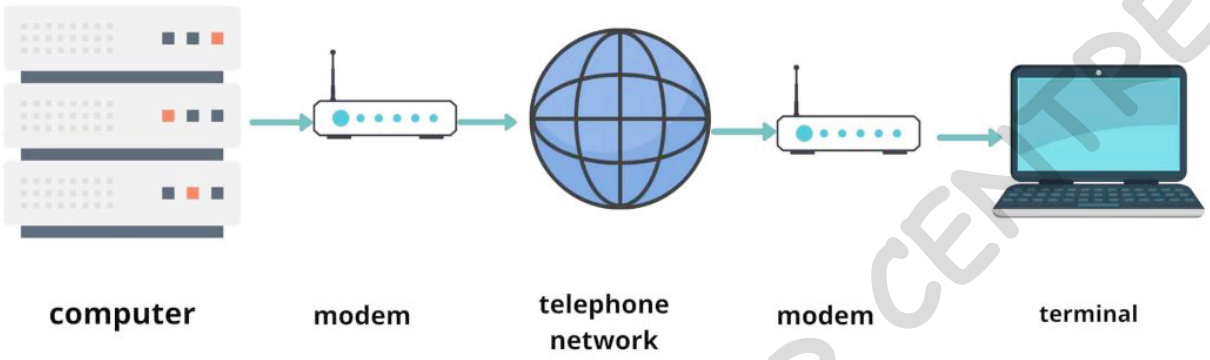


- *Advantages:*
  - Sends to Everyone at Once: Broadcast sends messages to all devices in the network simultaneously, which is fast and efficient.
  - Easy Setup: It's simple to use because you don't have to specify individual recipients.
  - Good for Groups: Useful when you need to share information with lots of devices at the same time.

- **Quick Information Sharing:** Handy for live events or emergencies where you need to get information out fast.

- *Disadvantages:*
  - **Can Block the Network:** Sending to everyone at once can slow down the network by flooding it with data.
  - **Security Risks:** Since everyone gets the message, sensitive info might be exposed to unintended recipients.
  - **Wastes Bandwidth:** Even devices that don't need the message still get it, which can waste internet resources.
  - **Lack of Control:** You can't choose who gets the message, so it might not be efficient or private.

MODEM

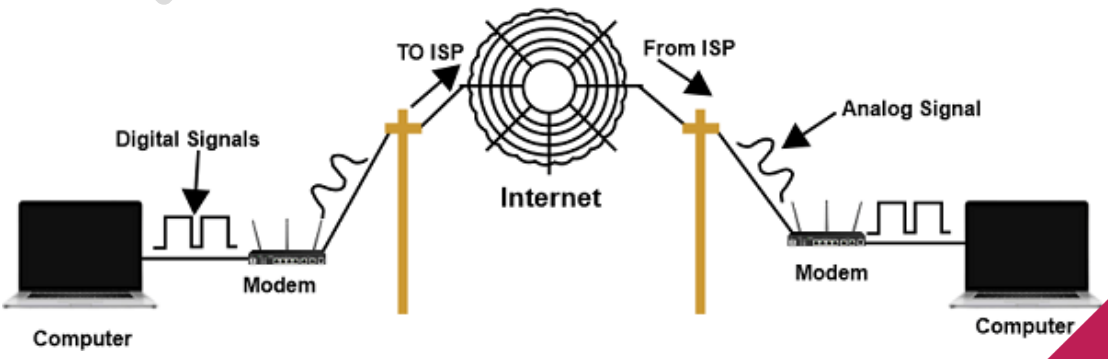


Definition: A modem (ModulatorDemodulator) is a device that converts digital signals into analog signals suitable for transmission over analog communication lines, and vice versa.

Functions:

Modulation: Converts digital data into analog signals for transmission.

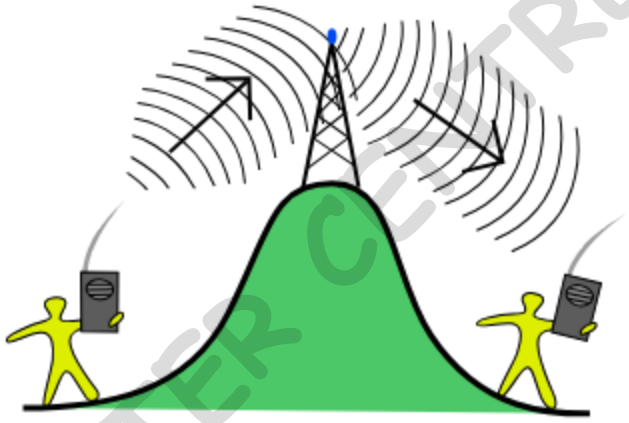
Demodulation: Converts received analog signals back into digital data.



Repeater:

Extends the range of a signal or data transmission.

Receives weak signals, amplifies them, and retransmits them.



Helps to overcome signal degradation over long distances.

Commonly used in wired and wireless networks to boost signal strength.

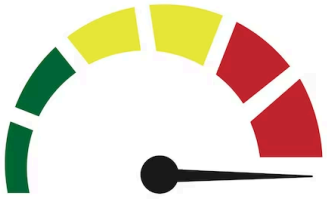
Does not process or modify the data, only strengthens the signal for transmission.

Types of network

LAN (Local Area Network):

Definition: LAN connects devices within a small area like a home, office, or school.

Advantages:

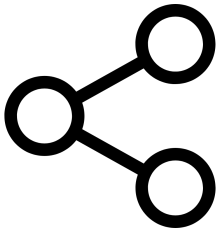


1. **High Speed:** Fast data transfer within a confined area.

2. **Low Cost:** Relatively inexpensive setup and maintenance.

3. **Ease of Maintenance:** Simple management due to smaller scale.

4. **High Security:** Control over access within the network.



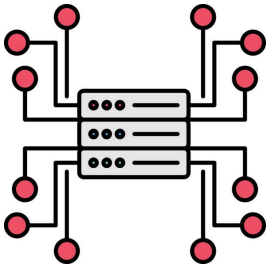
5. **Resource Sharing:** Sharing of devices like printers and files.

Disadvantages:

1. **Limited Range:** Coverage limited to a small area.

2. **Hardware Dependency:** Need for physical infrastructure.

3. **Network Congestion:** Possible slowdowns with many devices.

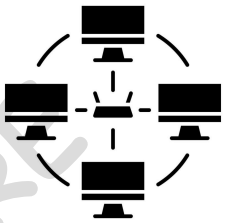


4. Vulnerability to Physical Damage: Susceptible to damage to cables or hardware.

5. Limited Scalability: Difficulty in expanding beyond a certain size.

MAN (Metropolitan Area Network):

Definition: MAN covers a larger area like a city, connecting multiple LANs.



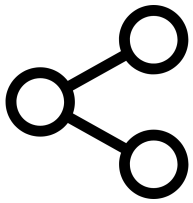
Advantages:

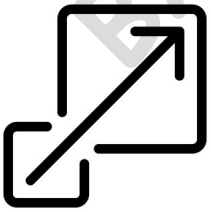
1. **Extended Coverage:** Connects multiple LANs across a city.

2. **Improved Communication:** Faster data transfer between locations.

3. **Cost Efficiency:** Shared resources among organizations.

4. **Resource Sharing:** Centralized sharing of services.





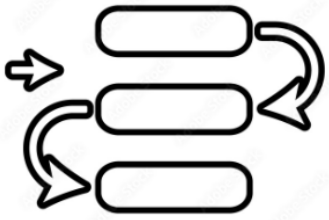
5. **Scalability:** Easy expansion across a city.

Disadvantages:

1. Complexity: More intricate setup and management.

2. Cost of Implementation: Higher initial investment.

3. Security Concerns: Increased risk with shared infrastructure.



4. Dependency on Service Providers: Reliance on external providers.

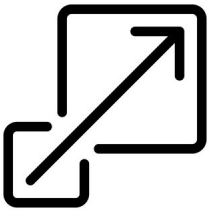
5. Limited Control: Less control over network infrastructure.

WAN (Wide Area Network):

Definition: WAN spans large distances, connecting LANs and MANs globally.

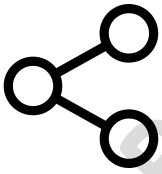
Advantages:

1. Global Connectivity: Worldwide network access.



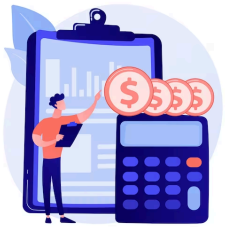
2. Scalability: Accommodates large scale networks.
3. Flexibility: Various connectivity options available.

4. Centralized Management: Easier oversight of dispersed networks.

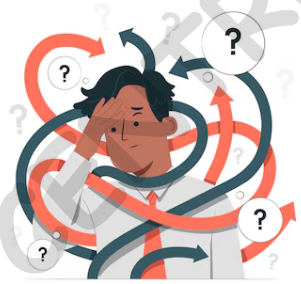


5. Resource Sharing: Efficient sharing of resources globally.

Disadvantages:

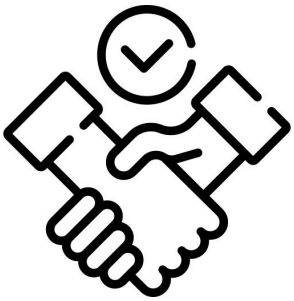


1. **Cost:** Expensive setup and maintenance.



2. **Complexity:** Higher level of technical expertise required.

3. **Security Risks:** Greater vulnerability to security threats.



4. **Reliability:** Potential for downtime and disruptions.

5. **Performance Variability:** Speed and reliability affected by distance and infrastructure quality.

Topology:

Topology refers to the physical or logical arrangement of nodes in a network and how they communicate with each other.

Types of Topology:

Bus

Bus topology is a network arrangement where all devices are connected to a single communication line or cable.

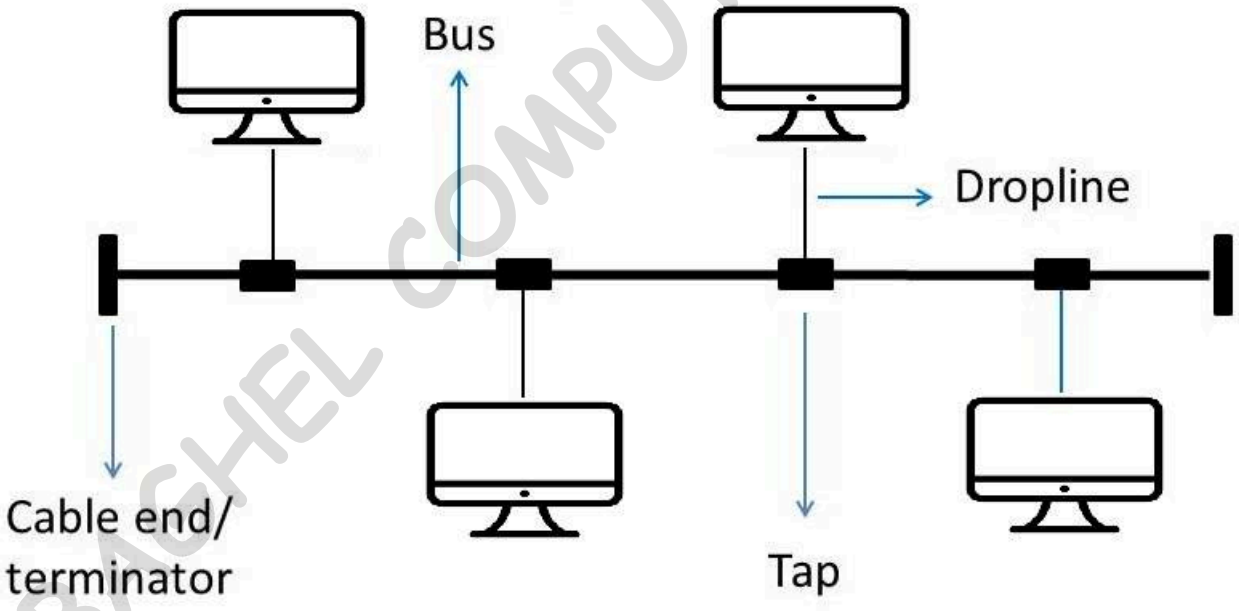
Data transmission occurs through this main cable, known as the "bus."

Each device on the network can send data onto the bus.

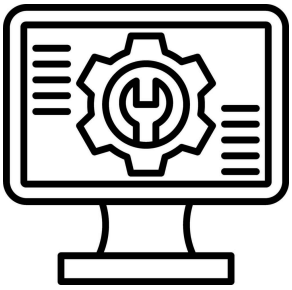
Bus topology is **bidirectional**

Data sent by one device is accessible to all other devices connected to the bus.

Devices have unique addresses, and only the intended recipient processes the data.

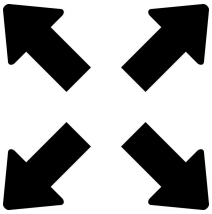


Advantages:



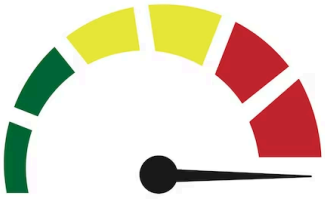
1. Easy Setup: Simple to install and understand.

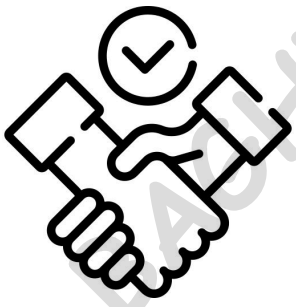
2. CostEffective: Saves money on cabling as it uses a single line.



3. Expandable: Adding new devices is straightforward.

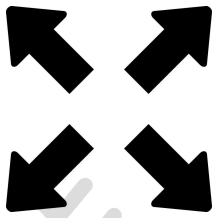
4. Fast Data Transfer: Data moves quickly between devices.



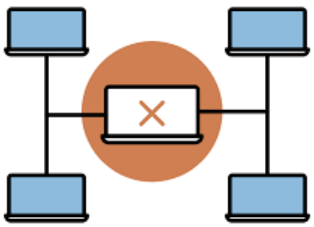


5. Reliable: Failure of one device doesn't shut down the whole network.

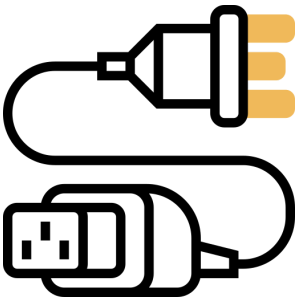
Disadvantages:



1. **Limited Size:** Doesn't work well for large networks.



2. **Single Point of Failure:** If the main cable breaks, the whole network goes down.



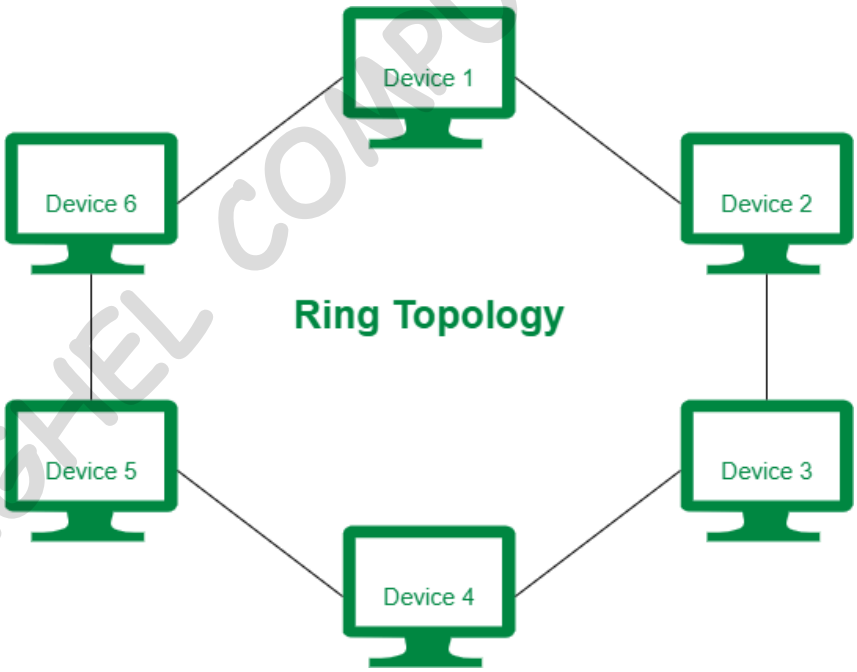
3. **Limited Cable Length:** Can't cover long distances without additional equipment.

4. **Security Risks:** Data is visible to all devices, raising security concerns.

5. **Slower with More Devices:** Performance drops as more devices join the network.

Ring

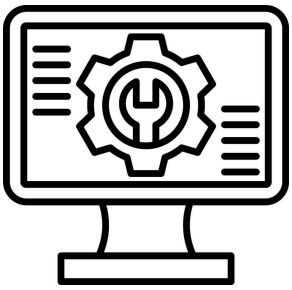
- **Closed Loop:** Devices are connected in a closed loop, forming a circular network structure.
- **Unidirectional Data Flow:** Data travels in one direction around the loop.
- **Each Device Directly Connected:** Each device is directly connected to two others, facilitating data transmission.



Advantages:

1. **Balanced Performance:** Every device gets equal chance to send data.

2. **Efficient Transmission:** Data moves efficiently around the loop.

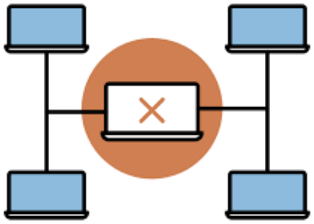


3. **Simple Setup:** It's easy to configure and understand.

4. **No Central Hub:** Doesn't rely on a central device, reducing failure risk.

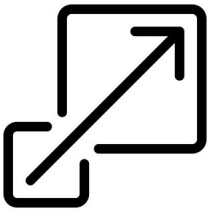
5. **CostEffective:** Requires less cabling compared to some topologies.

Disadvantages:



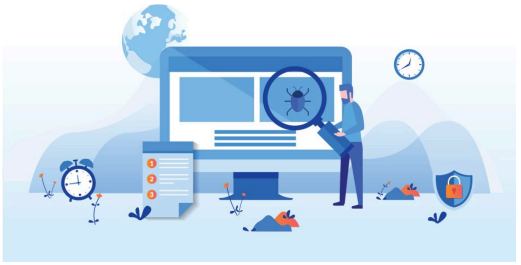
1. Single Point Failure: If one link breaks, the whole network can fail.

2. Difficult to Modify: Adding or removing devices can be tricky.



3. Limited Scalability: Expanding the network isn't straightforward.

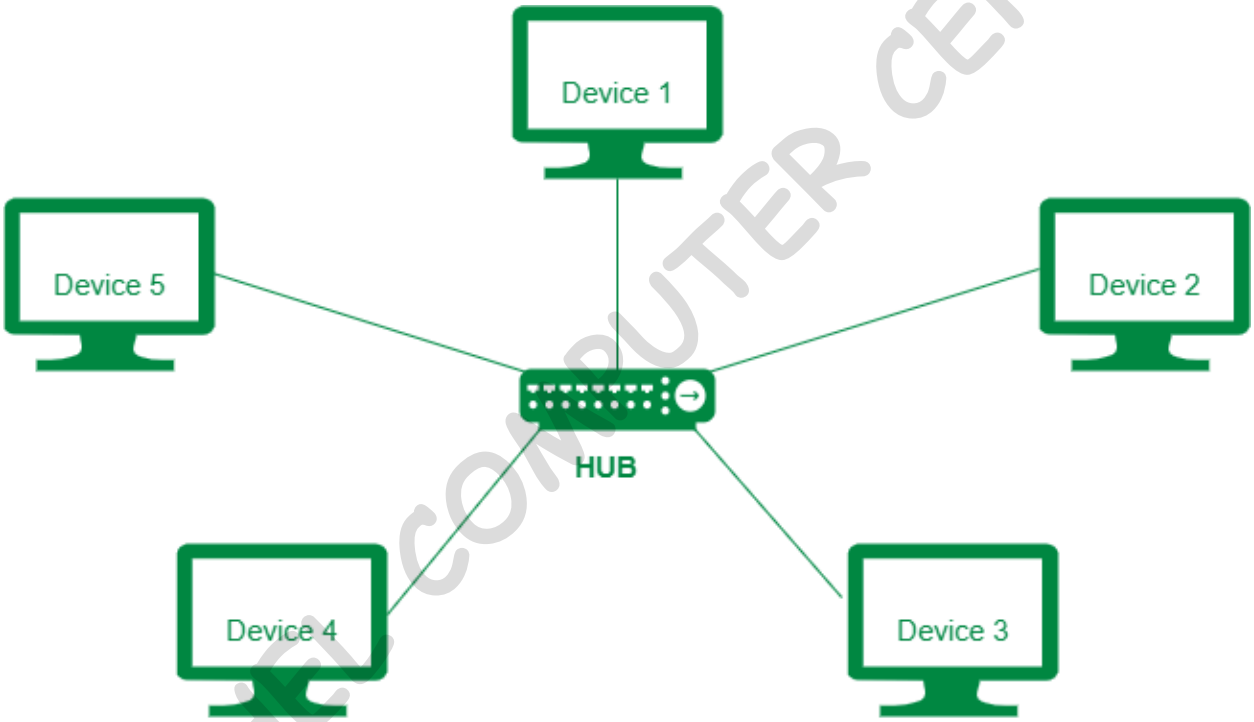
4. Performance Issues: Efficiency decreases with many devices.



5. Less Popular: Not as commonly used due to its limitations.

Star

Star topology is a network configuration where all devices are connected directly to a central hub or switch.

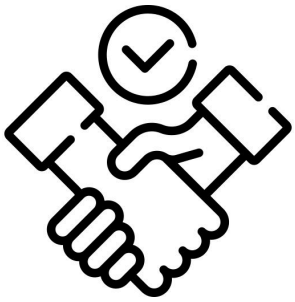


Advantages:

1. **Easy Management:** Simple to manage and troubleshoot because all devices connect to one central point.

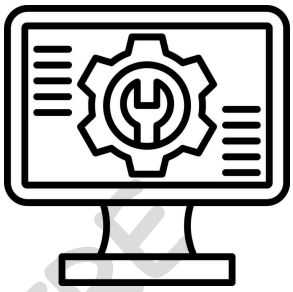
2. **Expandability:** Adding new devices is easy without disrupting the rest of the network.

3. **Reliability:** If one device fails, it doesn't affect others, ensuring consistent network performance.



4. **Efficient Performance:** Each device has its own connection, leading to faster data transfer.

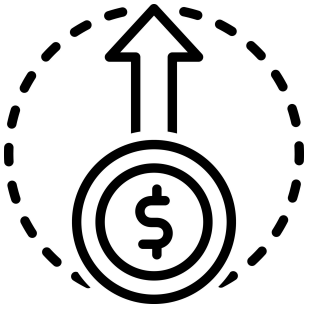
5. Simple Setup: Quick to set up and configure, suitable for networks of all sizes.

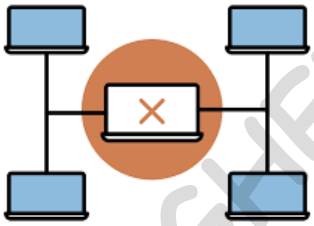


Disadvantages:

1. Hub Dependency: If the central hub fails, the whole network can go down.

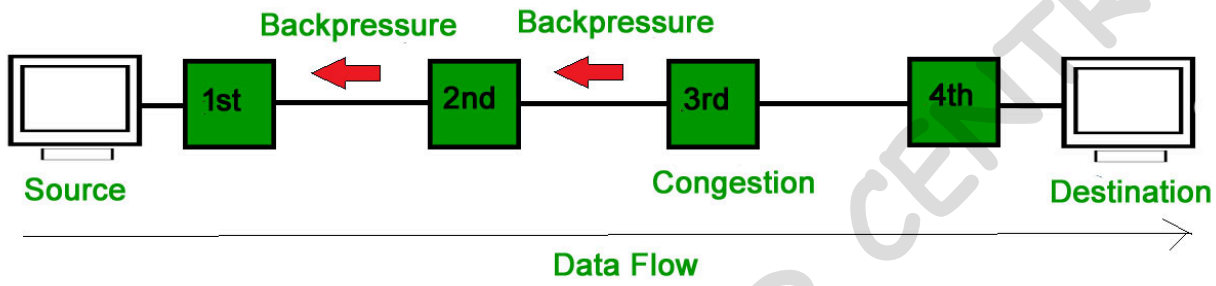
2. Costly: Requires extra equipment like hubs, potentially increasing costs.



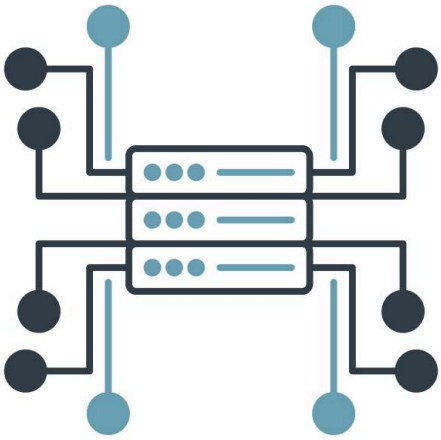


3. Limited Distance: Devices must be close to the central hub due to cable length limitations.

4. Possible Congestion: All data flows through the hub, leading to congestion and slower performance.

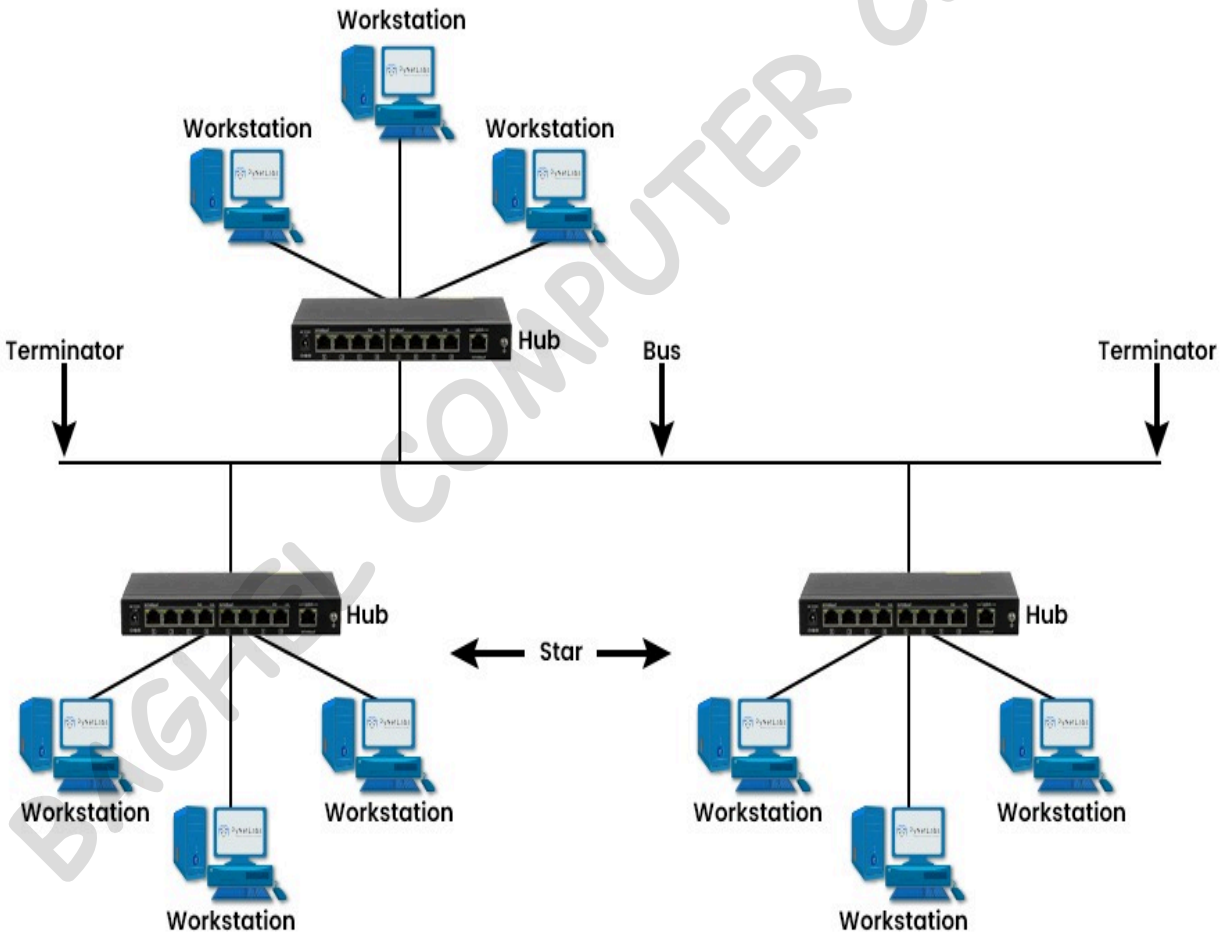


5. Complex Cabling: Needs more cables compared to other setups, which can be challenging to manage.



Tree

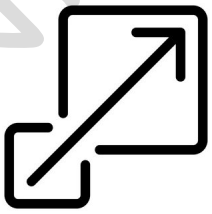
It is a combination of both bus and star topology.
Each node is connected to the central node through a single path.
This topology has a tree-like structure.

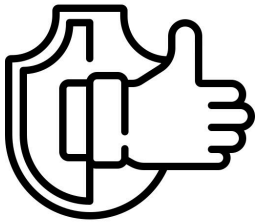


Advantages:

1. Easy Management: Organized like a tree, making it easy to understand and manage.

2. Scalability: Can grow easily by adding more branches or levels.





3. Reliability: If one branch fails, it usually doesn't affect the whole network.

4. Efficient Communication: Data flows directly along branches, avoiding congestion.

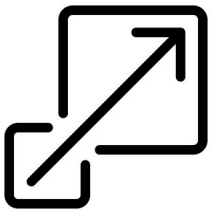
5. Central Control: Root node simplifies management tasks.

Disadvantages:

1. Complex Setup: Setting up can be harder due to the hierarchical structure.

2. Root Dependency: Network relies heavily on the root node; its failure can disrupt everything.

3. Scalability Challenges: Adding too much can slow down the network.



4. Costly Expansion: Needs extra equipment and cables.

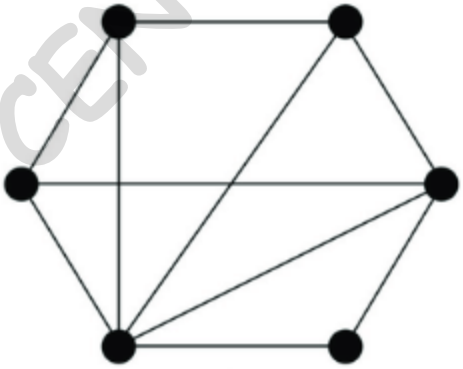
5. Maintenance Issues: Troubleshooting can be tough, especially in big networks.

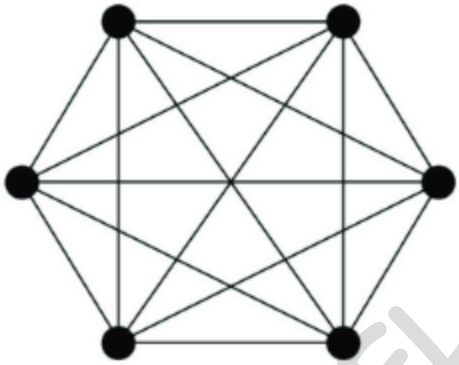
Mesh

Every node has a point to point connection to the other node.

There are two types of node

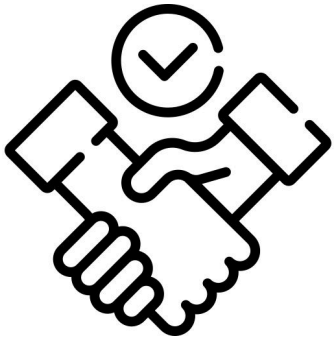
Partially Mesh: some of the nodes are not connected to each other.





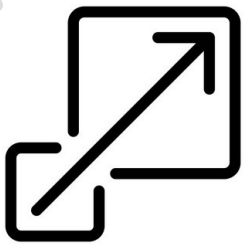
Fully Mesh: all the nodes are connected to each other.

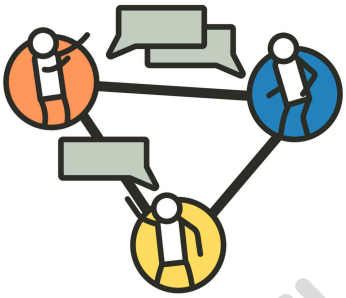
Advantages:



1. **Reliability:** If one connection fails, data can still travel through alternative paths.

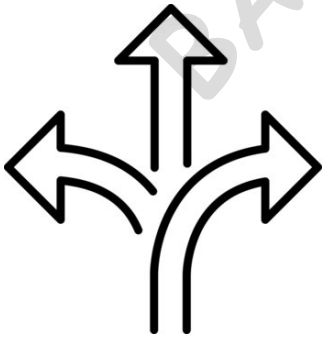
2. **Scalability:** Can easily grow by adding more devices without affecting performance.





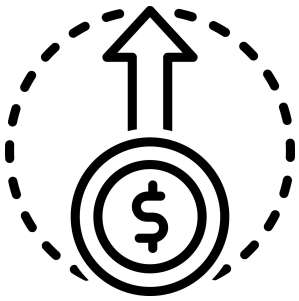
3. **Fast Communication:** Parallel data transmission allows for quicker and more efficient communication.

4. **Security:** Data can be sent securely through encrypted pathways.



5. **Flexibility:** Each device can connect directly to any other device, offering flexibility in data routing.

Disadvantages:

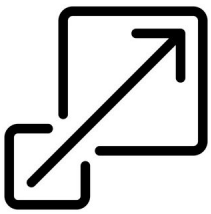


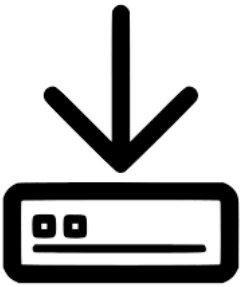
1. **Costly:** Requires a lot of cables and equipment, making it expensive to set up and maintain.

2. **Complexity:** Setting up and managing a mesh network can be complicated due to the many connections.

3. **Maintenance Challenges:** Troubleshooting and upkeep can be difficult because of the intricate structure.

4. **Scalability Limits:** Large mesh networks may suffer from congestion and increased traffic.





5.Heavy Load: All devices actively handle data, potentially slowing them down.