

Internet technology from networks to streaming servers

Chapter 2: Basic Networking Issues

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The contents of this presentation have been prepared from the study book of the course, Internet Technology from networks to streaming servers.

Why should I read this chapter?



- After knowing the importance of the internet , you should begining to learn how you can swim in the big networking ocean .
- This chapter covers different kinds of the network classifications:
 1. Classification based on Transmission media
 2. Classification based on Geography
 3. Classification based on Topology

Learning Objectives



- **After you have read this chapter, you should be able to:**

1. Define the Network.
2. Compare the Intermediate devices.
3. Compare the differences between bridges and routers.
4. Explain The kinds of network.
5. Classified network based on transmission media.
6. Classified network based on geography.
7. Classified network based on topology.
8. Distinguish between the internet protocols.

What is a Network?

- A Network is defined as a group of computers and associated devices that are connected by communications facilities.

Networks: Terms

Some of the most important terms:

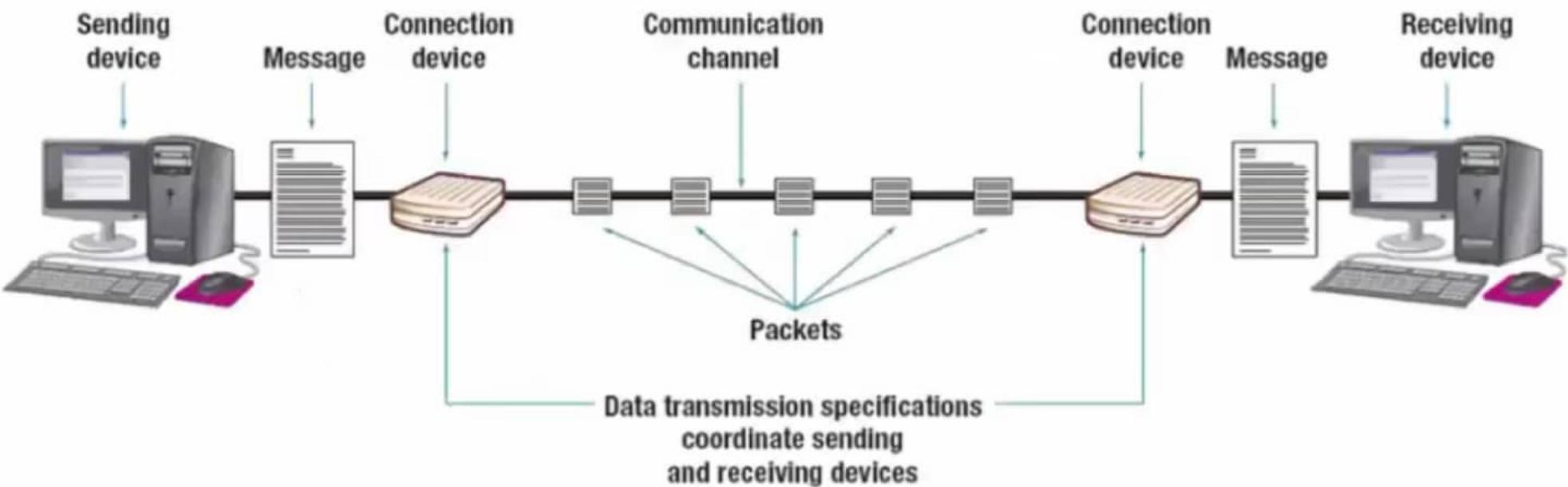
- **Node:** any device connected to a network such as computer, printer or storage device.
- **Client:** a node that requests and uses resources available from other nodes.
- **Server:** a node that share resources with other nodes.
- **Directory server:** specialized server that manage resources such as users accounts.
- **Host:** any computer system that can be accessed over a network.
- **Switch:** Central node that coordinates the flow of data by sending messages directly between sender and receiver nodes.

Applications of Networks

- Resource Sharing
- Information sharing
- Communication
- Remote computing
- Distributed processing

How computers send data?

- The basic requirements that the computer need for sending/receiving data through the internet are:
 1. Communication Channel
 2. Connection method
 3. Protocol
 4. Address



The four basic elements of a communication system

Communication Channels

- Computer channels carry data from one computer to another.
- Two categories of communication channels:
 1. Physical connection
 2. Wireless connection

Communication Channels: Physical connection

Physical connections use a solid medium (wire or cable) to connect sending and receiving devices.

These connections include:

- **Twisted-pair cable:** used in telephone lines and Ethernet cables.
- **Coaxial cable:** a single solid-copper core.
- **Fiber-optic cable:** transmits data as pulses of light through tiny tubes of glass.



Communication Channels: Wireless connection

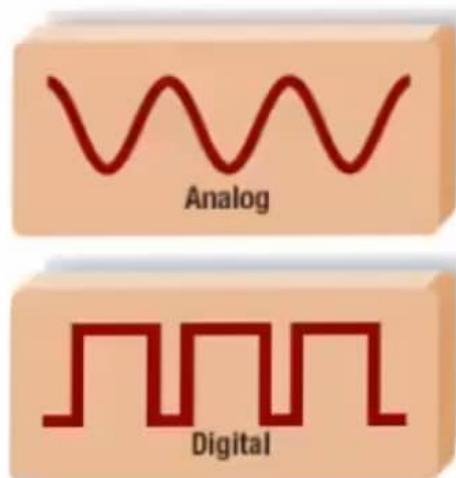
Wireless connection doesn't use solid substance to connect sending and receiving devices. They move data through the air.

These connections include:

- **Bluetooth**
- **Wi-Fi (wireless fidelity)**
- **Microwave**
- **Infrared**
- **WiMax (Worldwide Interoperability for Microwave Access)**
- **Cellular**
- **Satellite**
 - **Uplink** is a term relating to sending data to a satellite.
 - **Downlink** refers to receiving data from a satellite.
 - Important application: **GPS (Global positioning system)**.

Connection Devices

- Telephones send and receive **analogue signals**.
- Computers uses **digital signals**.
- To convert the digital signals to analog signals and vice versa, you need a **modem**.



Connection Devices: Modem

- Modem is short for **modulator-demodulator**.
- **Modulation:** converting signals from digital to analog.
- **Demodulation:** converting signals from analog to digital.
- The modem enables digital microcomputers to communicate across different media including telephone wires, cable lines and radio waves.
- The speed of transmitting data called **transfer rate**.



- **Transfer rate** is measured in millions of bits.
- The higher the speed, the faster you can send and receive information.

Unit	Speed
Kbps	thousand bits per second
Mbps	million bits per second
Gbps	billion bits per second
Tbps	Trillion bits per second

Three types of modems:

1. DSL
2. Cable
3. Wireless



- A **DSL** modem (**Digital Subscriber Line**) provides high-speed connection using standard phone lines.
- A **cable** modem uses the same coaxial cable as the television.
- A **wireless** modem is also known as a **WWAN** (wireless wide area network) modem. Almost all computers today have built-in wireless modems.



Connection Devices: Connection Service

- The old dial-up services have been replaced by higher-speed connection services including:
 - Digital subscriber line (DSL)
 - Cable service
 - Fiber-optic service
 - Satellite connection services
 - cellular services (3G and 4G)



Intermediate Devices

- An intermediate device can be converted data into signals and transform data from analog into digital signals and back.
- Computers, repeaters, bridges routers, LAN Switches, and gateways .wireless access points, and network' interface cards (NIC) are all communication devices

Intermediate Devices

❑ Workstation:

Computer connected to a network Called clients Contains a network interface card (NIC).

❑ network interface card (NIC) :

- Is a piece of hardware that must be attached to every computer for it to connect to a network.
 - NIC card is given a unique hardware address and it never changes.
 - NIC comes with different drivers for different types of operating systems
-
- **Note :** A driver is the software that allows the operating system to communicate with the network interface card.

Intermediate Devices

❑ File Server :

- 1) High Capacity
- 2) Large hard drive
- 3) Contains a network operating system

❑ Repeaters :

are used to regenerate the signals.

❑ Bridges :

- is a device that is used to connect two similar local area networks.
- Using bridges is advantageous because they do not replicate noise.
- The main disadvantage to bridges is that they can't connect dissimilar network types or perform intelligent path selection.

Bridges



Intermediate Devices

❑ **Switches :**

- are used to connect two dissimilar networks.
- **The difference between switches and bridges:**
 1. switches can connect two networks with dissimilar bandwidth.
 2. They operate at the hardware level, which makes them operate at higher speeds compared to bridges.

Intermediate Devices

❑ Hubs :

- are devices used to link several computers together.
 - They repeat any signal that comes in on one port and copy it to the other ports.
-
- **There are two types of hubs:**
 1. **Passive hubs :**
 - simply Connect all ports together electrically and are not powered.
 2. **Active hubs :**
 - use electronics to amplify and clean up the signal before it's broadcast to the other ports.
 - Can be remotely managed on the networks.

Intermediate Devices

❑ Routers :

- are highly intelligent devices that connect multiple networks.
- determine the best path for sending data.

• The differences between bridges and routers:

1. The router finds the best path and transmits the data to the destination.
2. a bridge can use only one path between two networks , a router can transmit data through multiple paths.
3. A bridge shuts down all paths except one by spanning tree protocol.
4. Bridges are faster than routers because they do not perform complex functions as routers do.

Intermediate Devices

□ **Gateways :**

- Can convert data used by one protocol to a format that is compatible with a different protocol.
- Gateways can be implemented as a hardware , software or combination of both.



How many kinds of Networks?

- ❖ **networks can be classified in different ways:**
 1. Based on transmission media: Wired and Wireless.
 2. Based on network geography: LAN and WAN (and MAN).
 3. Based on Network topology: Physical topology (connectivity) and logical Topology (the transfer of data in a network).

Classification of Network Based on Transmission Media

❖ **Communications Media :**

- To transfer data from one computer to another requires some type of link through which the data can be transmitted
- This link is known as the communications channel
- The main categories of transmission media are guided medium and unguided medium

Guided Transmission Media (Physical Media)

- ❖ Guided Transmission Media (Physical Media) waves are guided along a solid medium path

- ❑ **Twisted Pair cables :**

- Twisted pair looks like telephone wire and consists of insulated strands of copper wire twisted together
- There are two versions of twisted pair cable:
 1. Shielded Twisted Pair (STP) is commonly used in Token Ring networks.
 2. Unshielded Twisted Pair (UTP) is used in Ethernet networks , Transmission rates vary between 10-100-1000-10000 Mbps.

Guided Transmission Media (Physical Media)

- **Transmission characteristics :**
 - Common in building for digital signaling used at speed of 10's Mb/s (CAT3) and 100Mb/s (CAT5) over 100s meters.
 - limited in distance, bandwidth, and data rate.



Figure 2.2: Twisted Pair cable



Guided Transmission Media (Physical Media)

Coaxial cables :

1. **Thinnet** : looks like regular TV cable.
 - It is about $\frac{1}{4}$ inch in diameter and is very flexible and easy to work with.
 2. **Thicknet** :
 - is about $\frac{1}{2}$ inch in diameter and not very flexible.
 - is older and not very common anymore except as a backbone within and between buildings. Coax transmits at 10 Mbps..
- **Applications:**
 - TV distribution (cable TV); long distance telephone transmission; and Local area networks

Guided Transmission Media (Physical Media)

- Transmission characteristics:
 - Can transmit analog and digital signals.
 - Usable spectrum for analog signaling is about 400 Mhz.
 - Amplifier needed for analog signals for less than 1 Km and less distance for higher frequency.
 - Repeater needed for digital signals every Km or less.
- distance: 10's Km.



Figure 2.3: Coaxial cable



Guided Transmission Media (Physical Media)

❖ **Fiber-optic cables:**

- the transmission of information as light pulses along a glass or plastic wire or fiber (threads)
- (made from thin, flexible glass tubing; it is lighter than metal wires and it is fragile and expensive)
- Applications:
 - Relatively new transmission medium used by telephone companies in place of long-distance trunk lines.
 - Also used by private companies in implementing local data communications networks.

Guided Transmission Media (Physical Media)

- Transmission characteristics:
 - greater capacity (bandwidth of up to 2 Gbps).
 - lower attenuation.
 - immunity to environmental interference.
 - highly secure due to tap difficulty and lack of signal radiation



Figure 2.4: Fiber-optic cable



Unguided Transmission Media

- Wireless transmission media refers to the methods of carrying data through the air or space using infrared, radio, or microwave signals



Classification of Network based on Geography

- Geography Networks are frequently classified according to the geographical boundaries spanned by the network itself.
- LAN, WAN, and MAN are the basic types of classification, of which LAN and WAN are frequently used.

□ LAN :

- A local area network (LAN) is a computer network covering a small geographic area.
- like a home, office, or group of buildings.

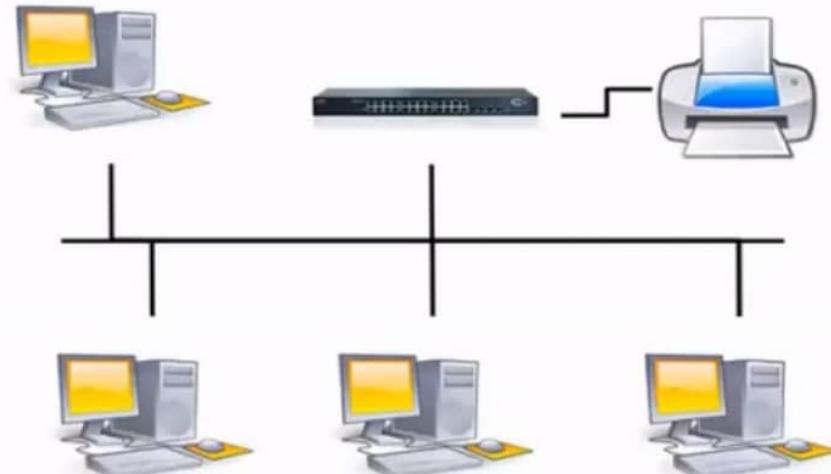


Figure 2.5 : local area network

PAN (Personal Area Network)



Piconet



LAN (Local Area Network)



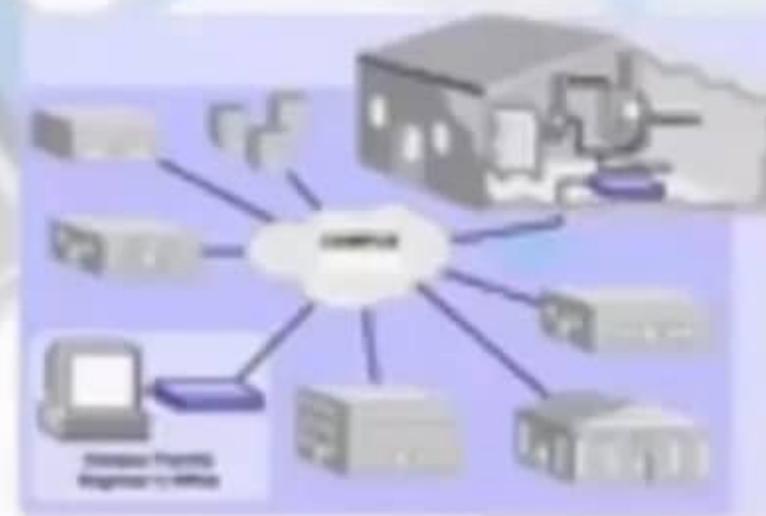
LAN in your Home



LAN in Office

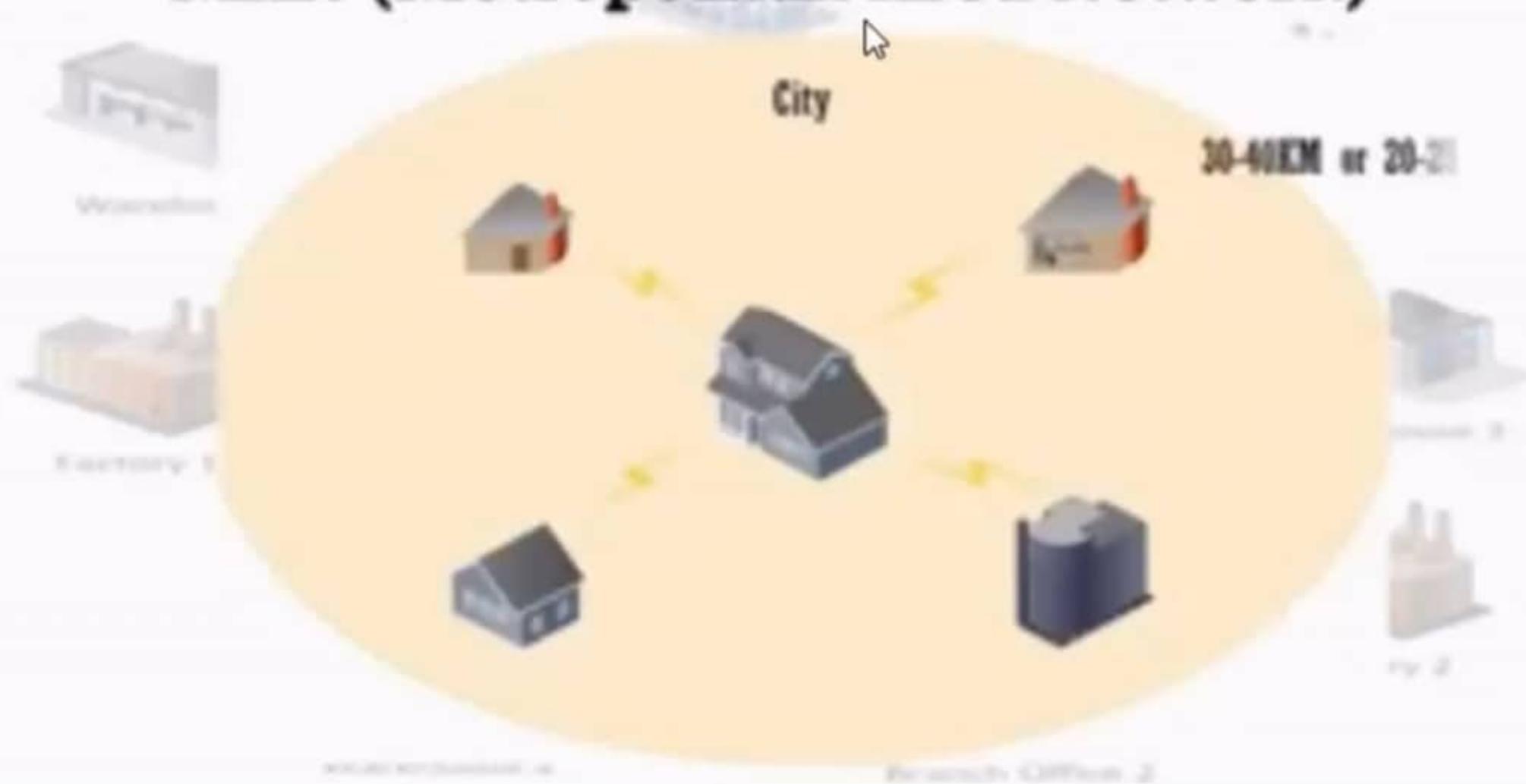


LAN in Building



LAN in Campus

MAN (Metropolitan Area Network)



WAN (Wide Area Network)



Q. Which of the following is the fastest media of data transfer

- a. Co-axial Cable
- b. Untwisted Wire
- c. Telephone Lines
- d. Fibre Optic



Q. A computer communication technology that provides a way to interconnect multiple computer across short distance is

- a. LAN
- b. MAN
- c. WAN
- d. Wireless network

Computer Network

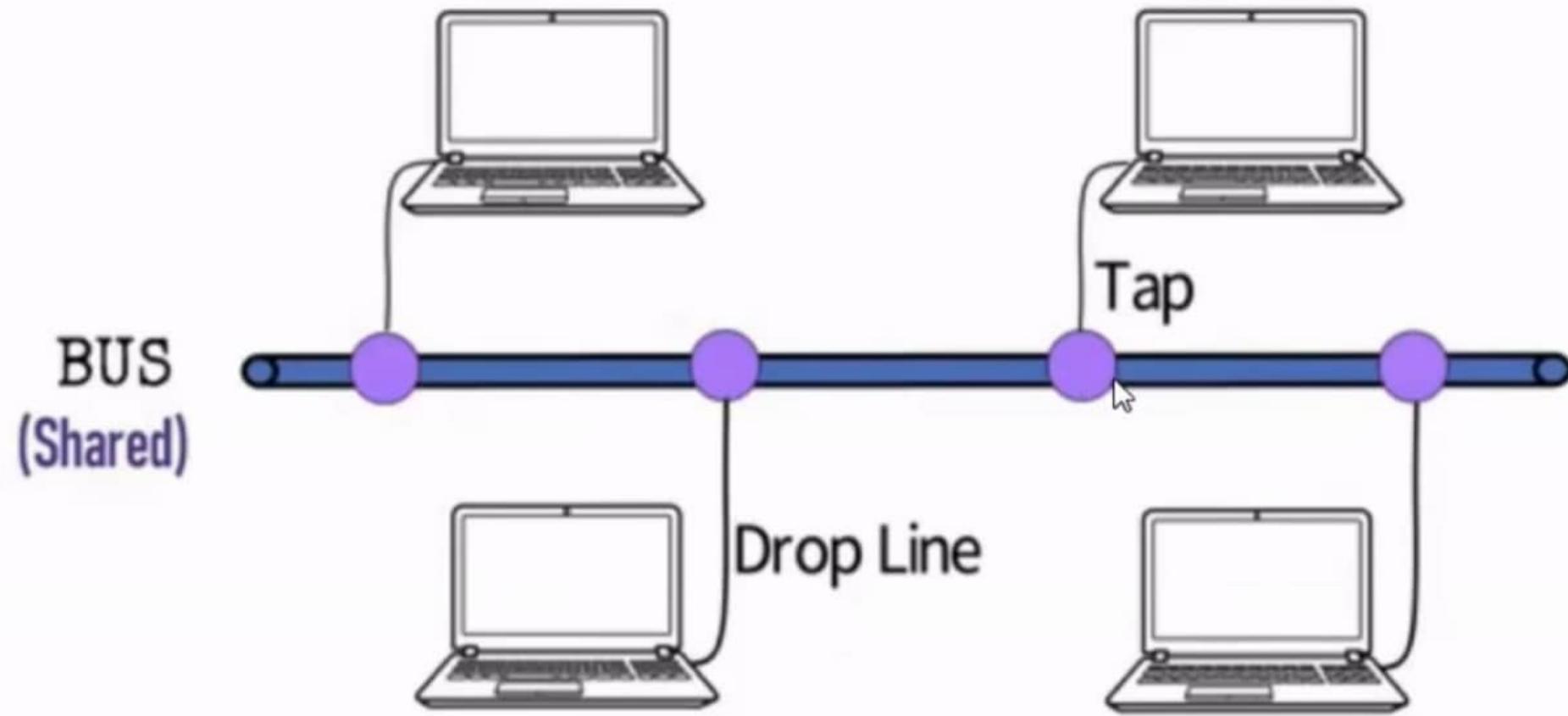


Local Area Network



- 👉 Star Topology
- 👉 Bus Topology
- 👉 Ring Topology
- 👉 Mesh Topology
- 👉 Hybrid Topology

Bus Topology



Advantages

Less cabling



Easy to install

Less expensive

Disadvantages

Limited computers

Little fault tolerance



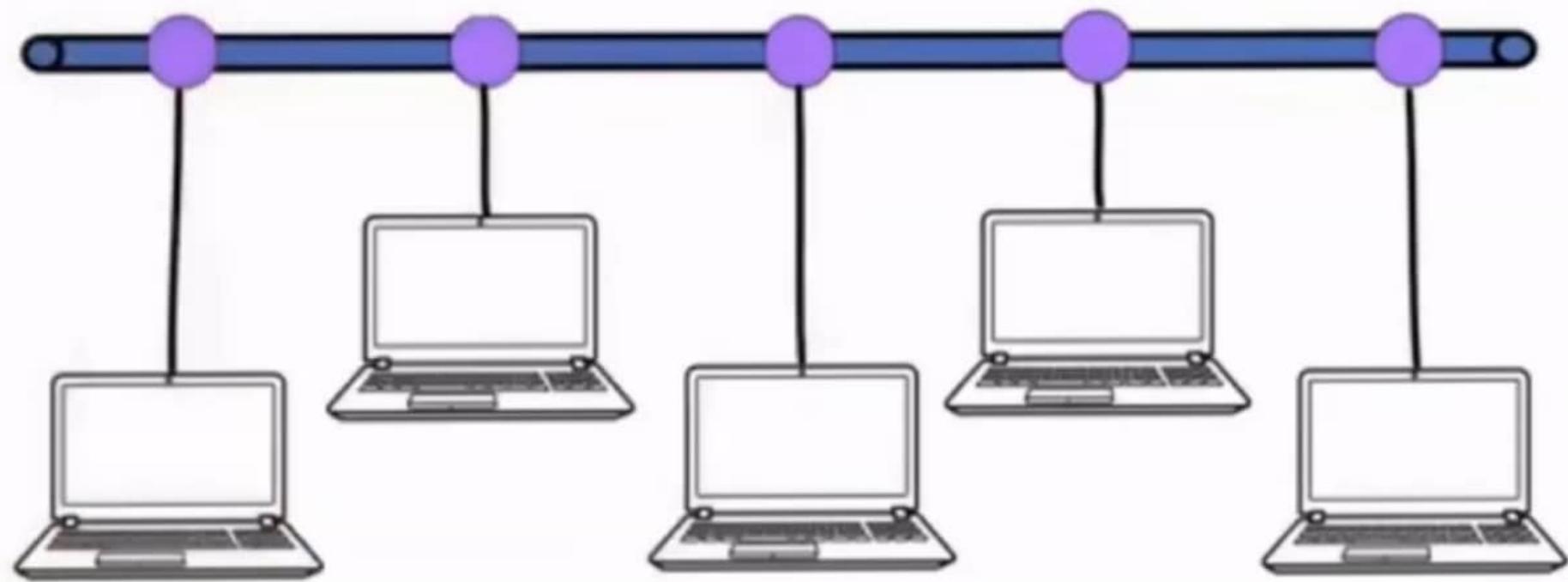
Security risk



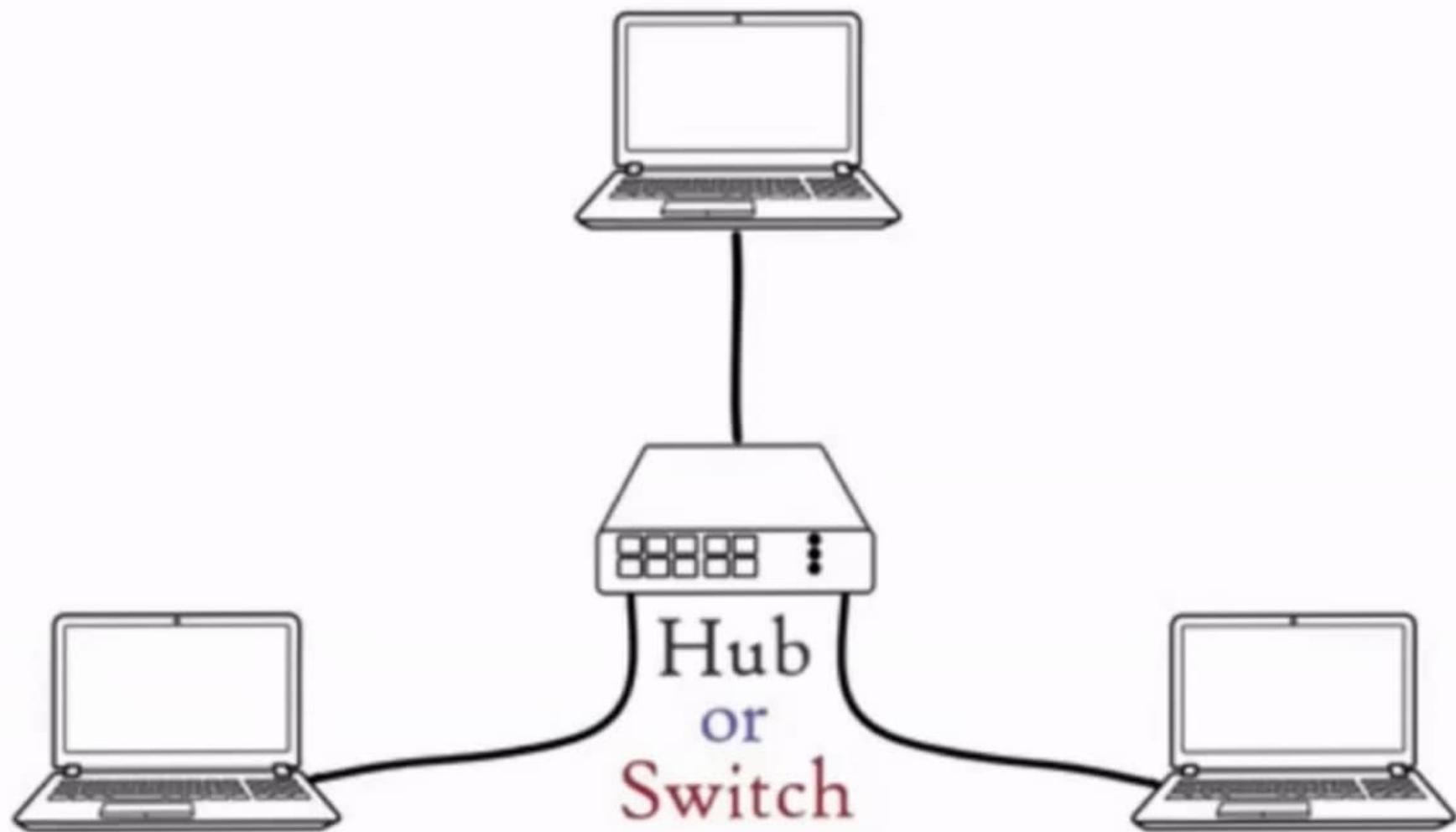


Slow network

↑ Data collisions



Star Topology



Advantages

Less expensive

Easy to reconfigure

Good fault tolerance



Easy fault detection

Disadvantages

-Whole network paralyze if the central device fails

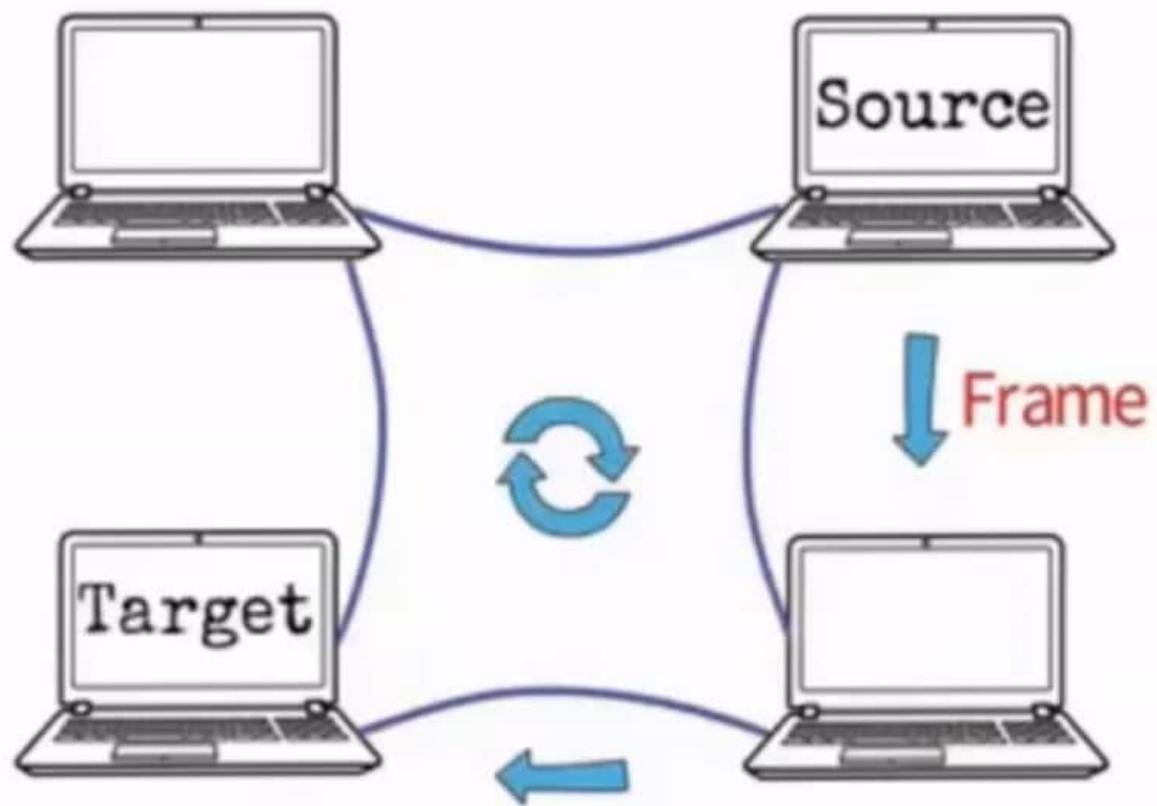
-Limited computers count

Example

High Speed LANs



Ring Topology





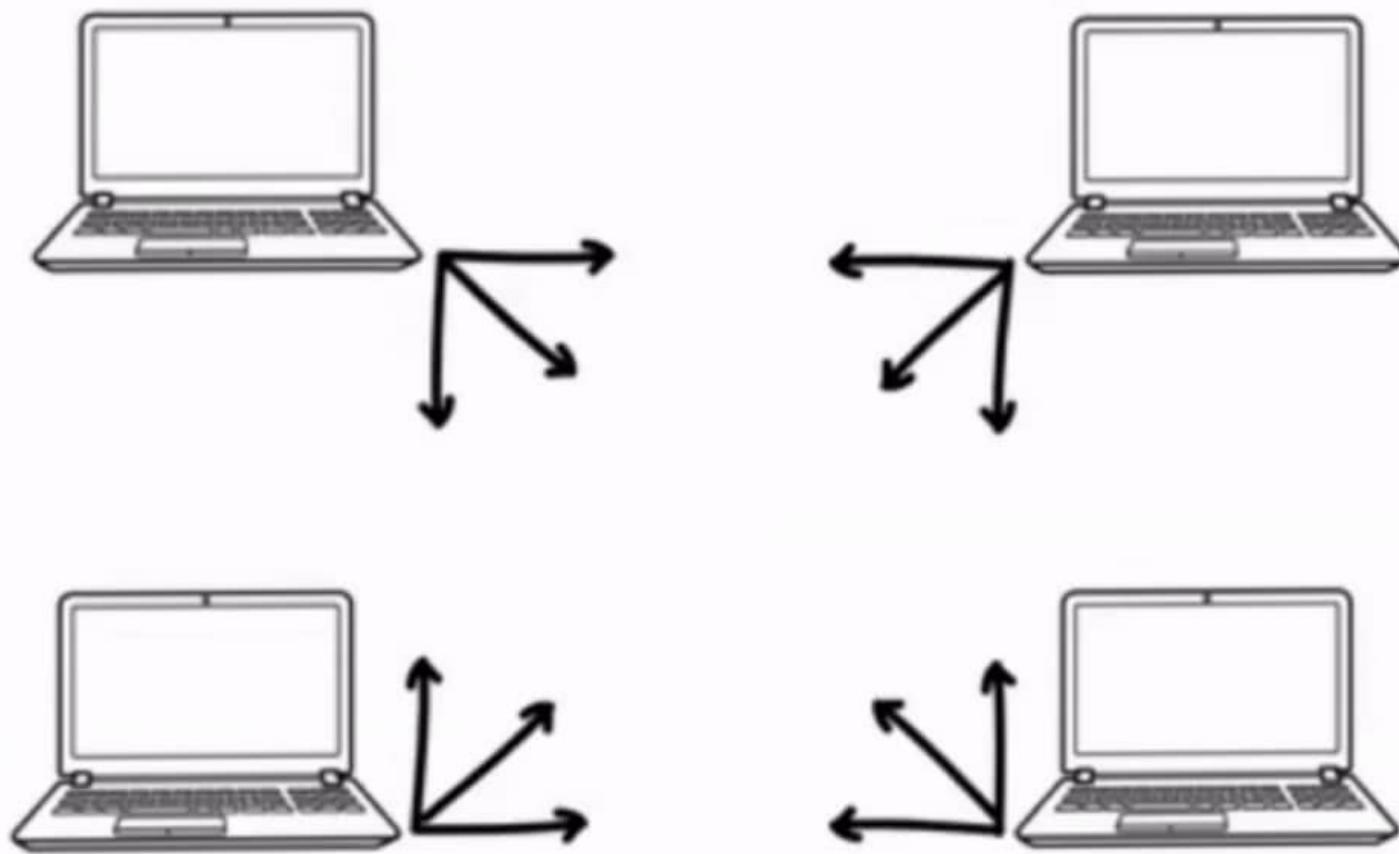
Advantages

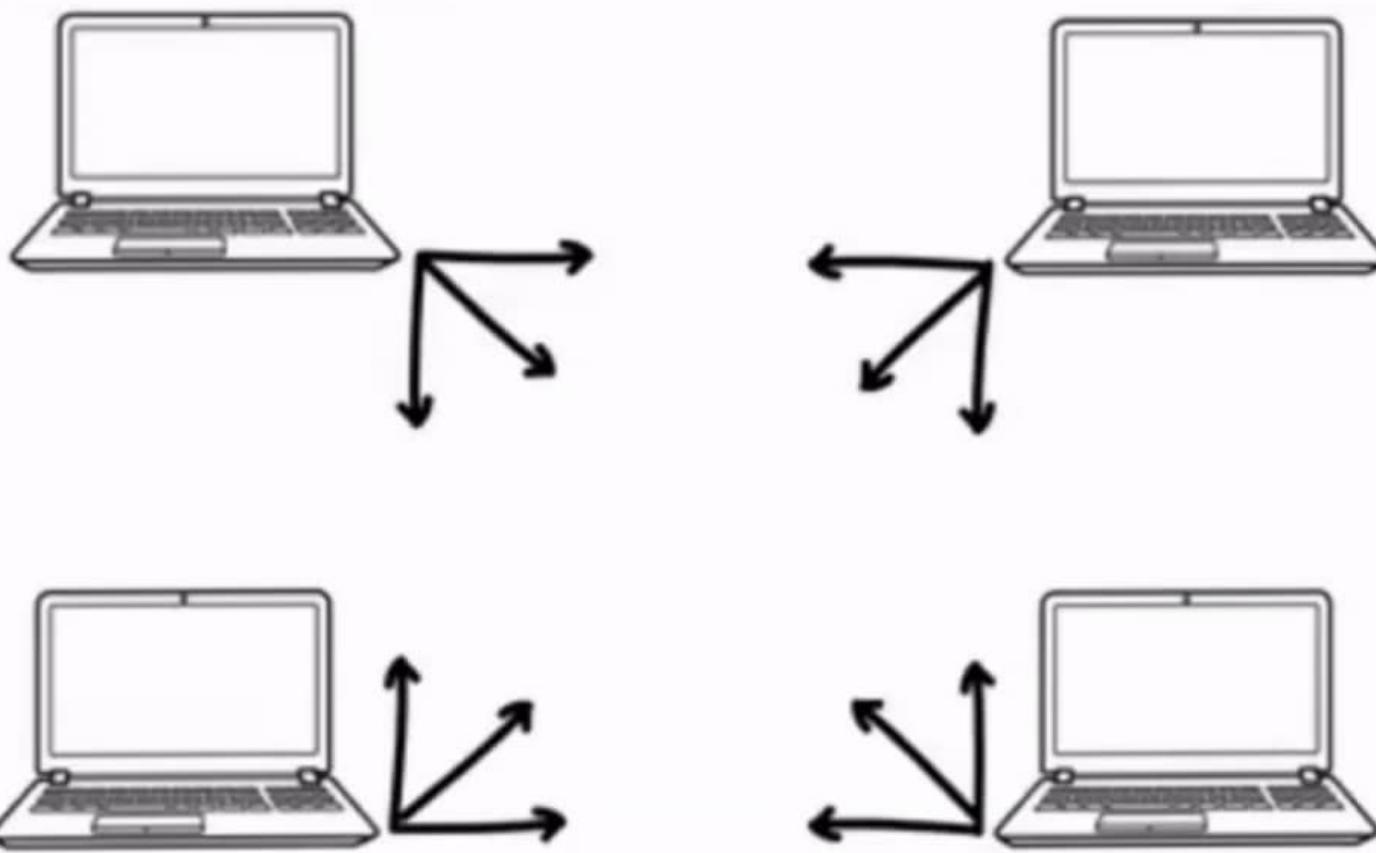
Easy installation

Less cabling



Mesh Topology





$$n(\text{devices}) = 4$$

$$n(\text{links per device}) = 4 - 1 = 3$$

$$n(\text{total links}) = 4(4 - 1) = 12 = \text{Simplex Links}$$



Advantages

No traffic problems
Privacy and Security



Disadvantages

Difficult installation
Expensive



More cables → large space



Classification of Network based on Geography

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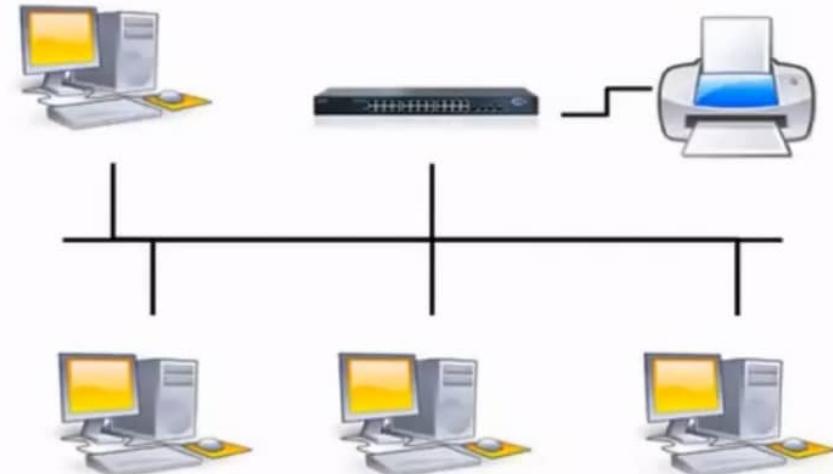


Figure 2.5 : local area network

Classification of Network based on Geography

□ MAN :

- A Metropolitan Area Network (MAN) is a network that encompasses a city or town.
- It is usually multiple point-to-point fiber-optic connections put together by a communications company and leased to their customers.

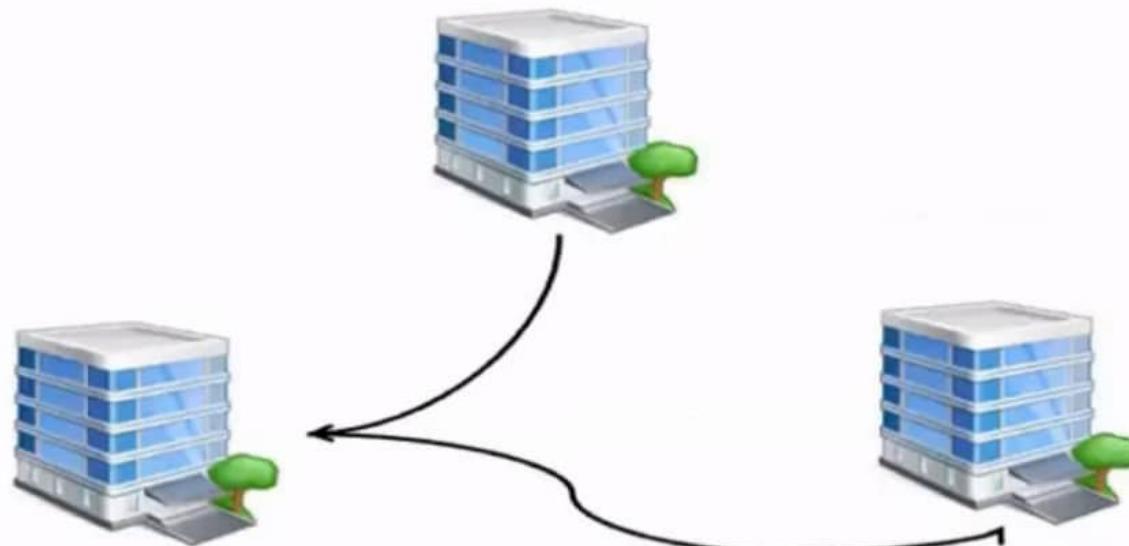


Figure 2.6 Metropolitan area network

Classification of Network based on Geography

❑ WAN :

- A Wide Area Network (WAN) is a computer network that covers a large geographical area.
- WANs are used to connect LANs and other types of networks together.
- The largest and most well-known example of a WAN is the Internet.

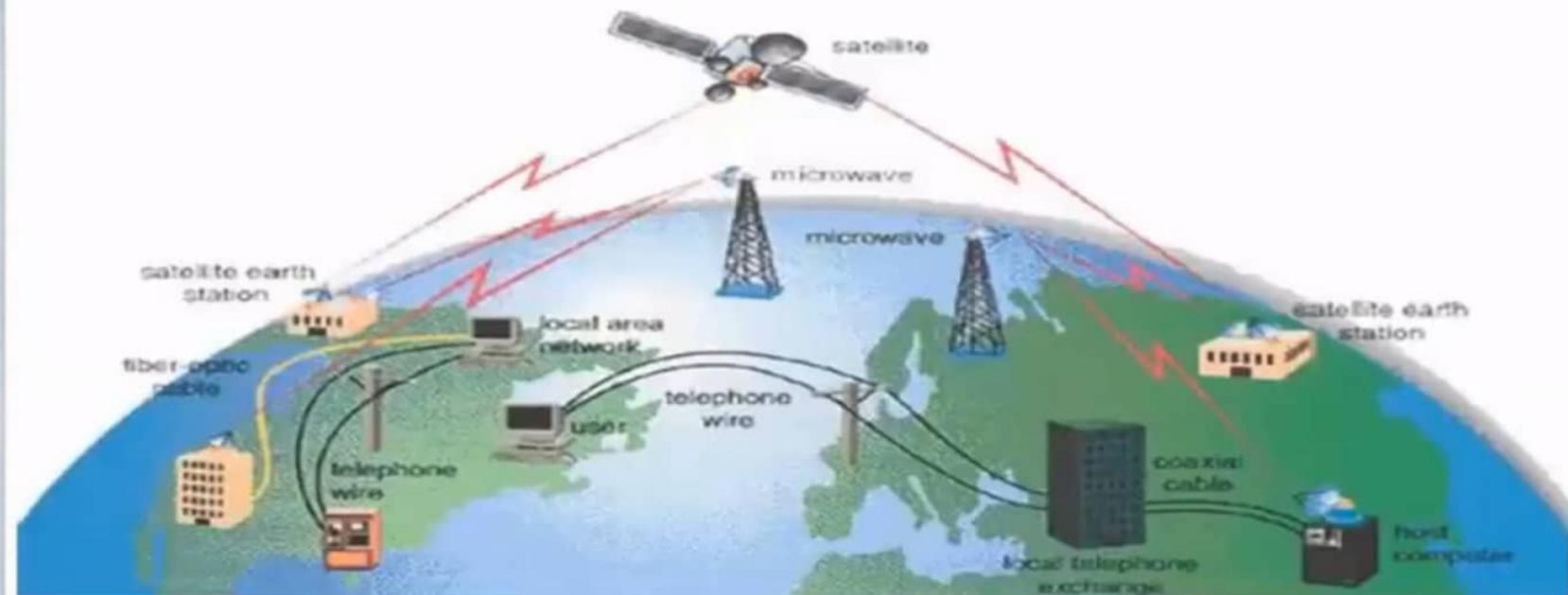


Figure 2.7 Wide Area Network



Classification of Network Based on topology

- refers to the way computers and peripherals are configured to form networks.
- **Types of Network Topologies:**
 1. can be either Physical Topology (describe how the cables are run).
 2. or logical Topology (describe how the network messages travel).



Physical Topology (connectivity)

- Physical Topology accounts the physical structure of a network that carries devices, cable installations and locations.
- Types of Physical Topology:
 - There are many types such as bus , star, ring ...etc.

Types of Physical Topology

❑ Bus Topology:

- is the simplest physical topology.
- It consists of a single cable that runs to every workstation.
- Covers the shortest amount of distance.
- Each computer shares the same data and address path.

• logical bus topology:

- messages pass through a single cable.
- Each workstation checks to see if the message is addressed to itself.
- If the address of the message matches the workstation's adds, the network adapter copies the message to the card's on-board memory.

Types of Physical Topology

- Disadvantages:

1. difficult to add a workstation.
2. very expensive to maintain.
3. If the cable is broken all systems would collapse.

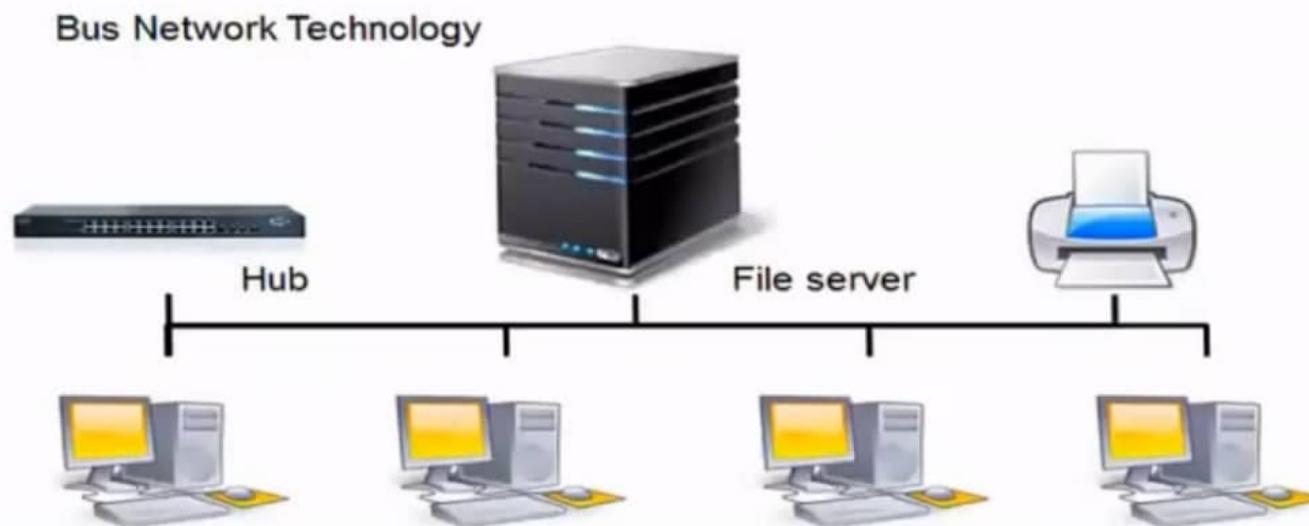


Figure 2.8 Bus Network Technology

Types of Physical Topology

□ Star Topology:

- is the most common network topology.
- each node is connected to a central device called a hub. making it very easy to add a new workstation.
- The hub takes a signal that comes from any node and Passes it to all the other nodes in the network.
- Advantages:
 1. Cheap.
 2. easy to install and reconfigure.

Types of Physical Topology

- Disadvantages:

1. More expensive to install than bus networks.
2. If the hub fails, all other attached computers/devices lose network access

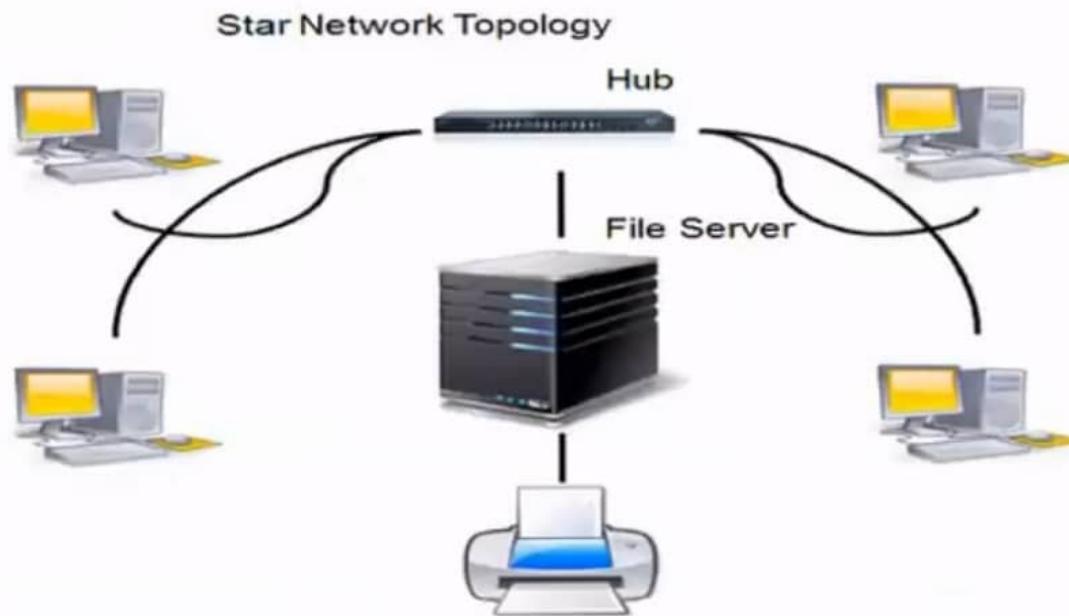


Figure 2.9: Star topology

Types of Physical Topology

❑ Ring Topology:

- Ring Topology Similar to a bus network but the end of the network in a ring topology comes back around to the first node .
- This leads to a unidirectional path where each workstation reads a message, then regenerates it and hands it to its neighbor on a different network cable.
- Disadvantages:

1. Adding computers consistently degrades network performance.
2. network will go down if one entity is removed from the ring.
3. The hardware involved was fairly expensive.

Types of Physical Topology

Ring Network Topology

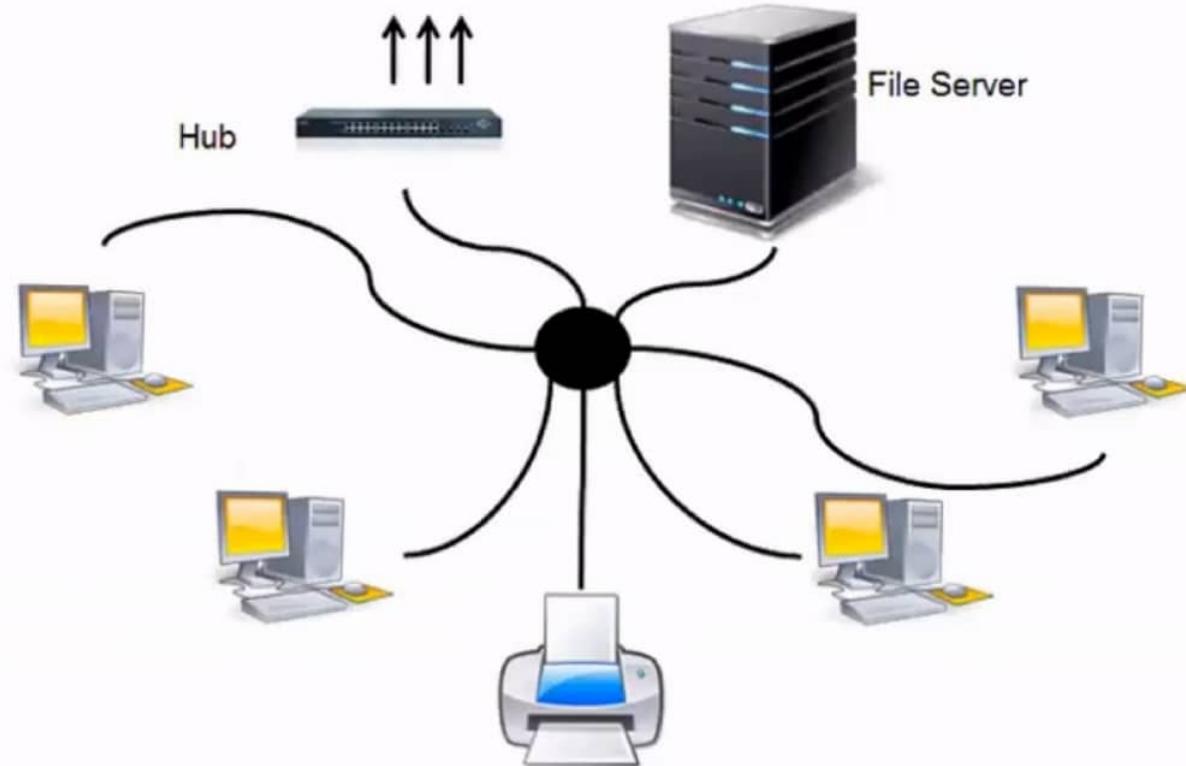


Figure2 .10 Ring Topology



Logical Network topologies(management method)

- is referred to the way that used to transfer data in network.
- Networks can also be classified into different types according to the roles that the networked computers play.

peer-to-peer:

- network is composed of two or more self-sufficient computers.
- Each computer handles all functions, logging in, storage, providing an interface

Logical Network topologies(management method)

- **Advantages:**

1. great for small, simple, and inexpensive networks.
2. every computer is an equal in the network
3. resources are shared in the network.
4. no assigned role for any particular computer and each one usually runs similar software.

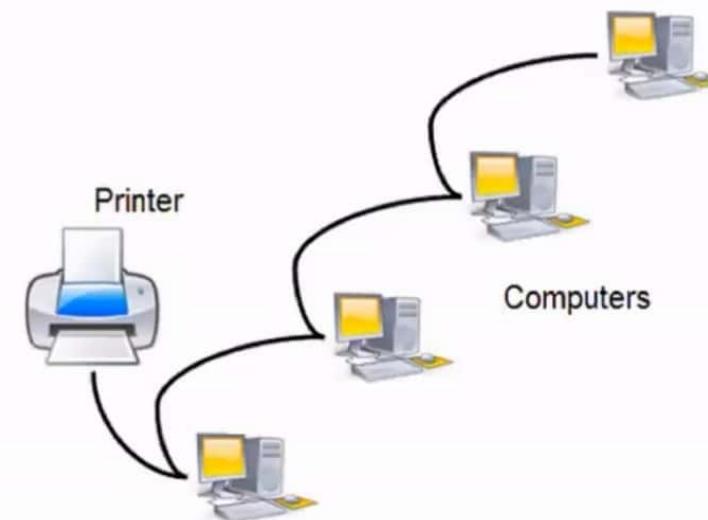


Figure 2.11 Peer-to-Peer



Logical Network topologies(management method)

□ Client -Server:

- The simplest client-server network is composed of a server and one or more clients.
- The server provides a service that the client computer needs.
- Clients connect to the server across the network in order to access the service

Server-based network

- A dedicated server is one that services the network by storing data, applications, resources, and also provides access to resources required by the client.
- These servers can control the network's security from one centralized location or share it with other specially configured servers.



Figure 2.12: Server-based network

Client-based network

- Computer networks using distributed services provide those services to client computers, but not from a centralized server.
- The services are running on more than one computer and some or all of the functions provided by the service are provided by more than one server.



Figure 2.13: Client-based network



Network And Communications Protocols

- To communicate over the Internet, the computers must use a common language or a protocol to govern the exchange of messages and have a way to address one another.

Protocol :

Is set of rules and procedures for transmitting data between two or more devices.

Services & Protocols

❑ Internet Standards :

- Standards cover interoperability of systems on the Internet through defining protocols

❑ Service :

- is a protocol used by two or more computers to interact with each other.
 - e.g. email, FTP, HTTP, ... all the useful services that are built on TCP/IP.
- a service is associated with an IP port number.
 - e.g. the HMI service uses port 80.



Features determined by the protocol are:

- A common set of rules.
- Define how to interpret signals.
- Identify individual computers.
- Initiate and end networked communication.
- Manage information exchange cross network medium.
- Check errors of data sent across network.



Examples of Communications protocols

DNS :

- "Domain Name Service".
- the service computers on the Internet use to look up names like "www.yahoo.com" to find their IP addresses.

NNTP :

- The Network News Transfer Protocol is used to transfer Usenet news across the Net.



Examples of Communications protocols

❑ HTTP:

- Hypertext Transfer Protocol.
- Used to get documents from one computer to another.
- HTTP usually uses port 80, but it's not uncommon for certain Web servers use port 8000, port 8080, or some other port.

❑ HTTPS:

- works exactly the same was as HTTP, but, first, the two computers agree on a way to encrypt the Information so that nobody else can understand what they are saying to each other.

❑ FTP:

- “File transfer protocol”.
- move a named file form one computer to another (does not encrypt the password).

Examples of Communications protocols

❑ ARP:

- “Address Resolution Protocol”.
- Used to map an IP address to its MAC address.

❑ SCP:

- “Secure Copy”.
- like the UNIX CP command, but over the Internet.
- Encrypted, so this is safe (unlike FTP).

❑ ICMP:

- “Internet Control Message Protocol”.
- Used to control the flow of data in the network, for reporting error.
- Contains “Ping” (packet Internet groper) troubleshooting tool.





Examples of Communications protocols

Finger:

- Ask a host if it knows about a particular username.

Telnet, SSH:

- Establish a command line interface to a login on the server newer service that encrypts the password and session data.

SMTP:

- “Simple Internet Mail Transfer Protocol”.
- Send/forward Internet email.



Examples of Communications protocols

❑ POP:

- “Post Office Protocol”.
- Copies mail from server to local PC.

❑ IMAP:

- “Internet Mail Access Protocol”.
- An alternative to POP where the email remains up on the server.
- it is not copied down.

❑ IGMP:

- “Internet Group Message Protocol ”.
- Used when one host needs to send data to many destination hosts.
 - This process is called **Multicasting**.
 - Example Streaming (audio and video) : data is sent without waiting for an acknowledgement that the data packets were delivered.



concept check

- What is the Network?
- What are the differences between bridges and routers?
- How the ring topology works?
- Why the internet should be use protocols?
- What is the service?
- Which protocol used with error messages?
- What are the characteristics of HTTPS?