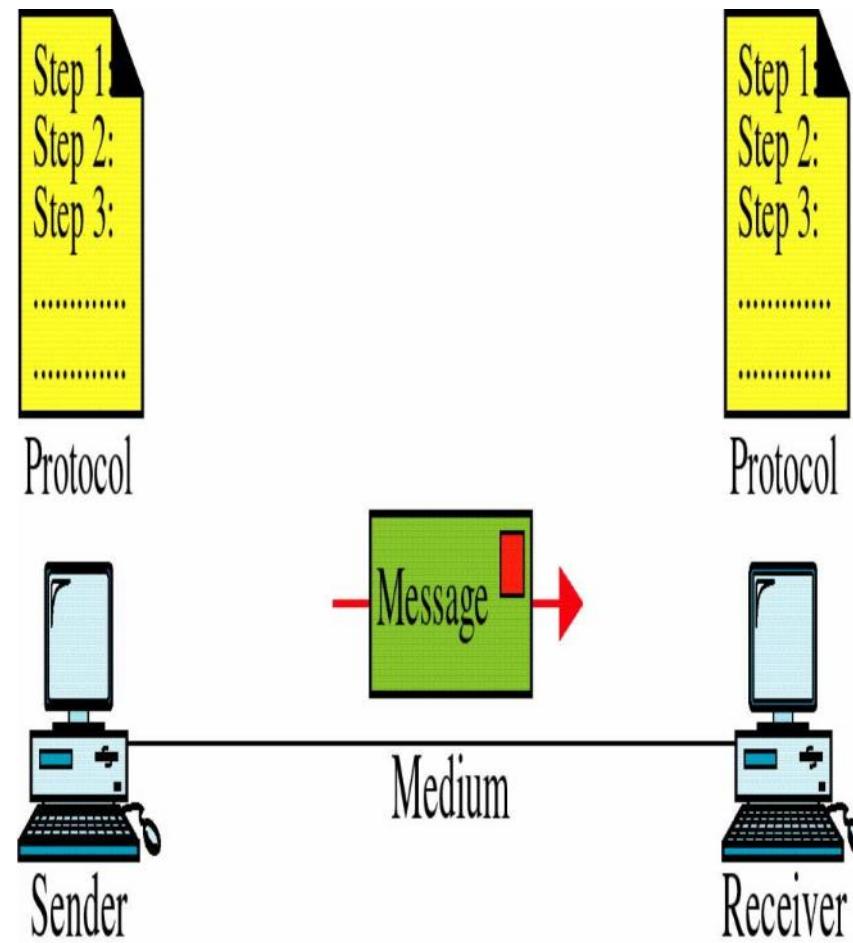


Module-1

Data communication Model

3

- **Message** : Is the information to be communicated. Popular forms of information include text, numbers, pictures, audio and video.
- **Sender**: Is the device that sends a message. It can be computer, workstation, telephone, video camera and so on.
- **Receiver**: Is the device that receives the message. It can be computer, workstation, telephone, video camera and so on.
- **Protocol**: Is a set of rules that both sender and receiver must agree.
- **Transmission Medium** : Is the physical path by which a message travels from sender to receiver.
 - Example : Twisted-pair cable, Coaxial cable, Fibre-optic, and radio waves



Network Criteria

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- The important network criteria are:
 1. **Performance:** Depends on number of factors, including number of users, type of transmission medium used, capabilities of hardware, and the efficiency of the software.
 - It can be measured in many ways:
 - **Transit time(ms)** – The amount of time required for a message to travel from one device to another.
 - **Response time(ms)** – Is the elapsed time between a request and a response.
 - **Throughput** – Number of packets transmitted per second.
 - **Delay(ms)**

Network Criteria

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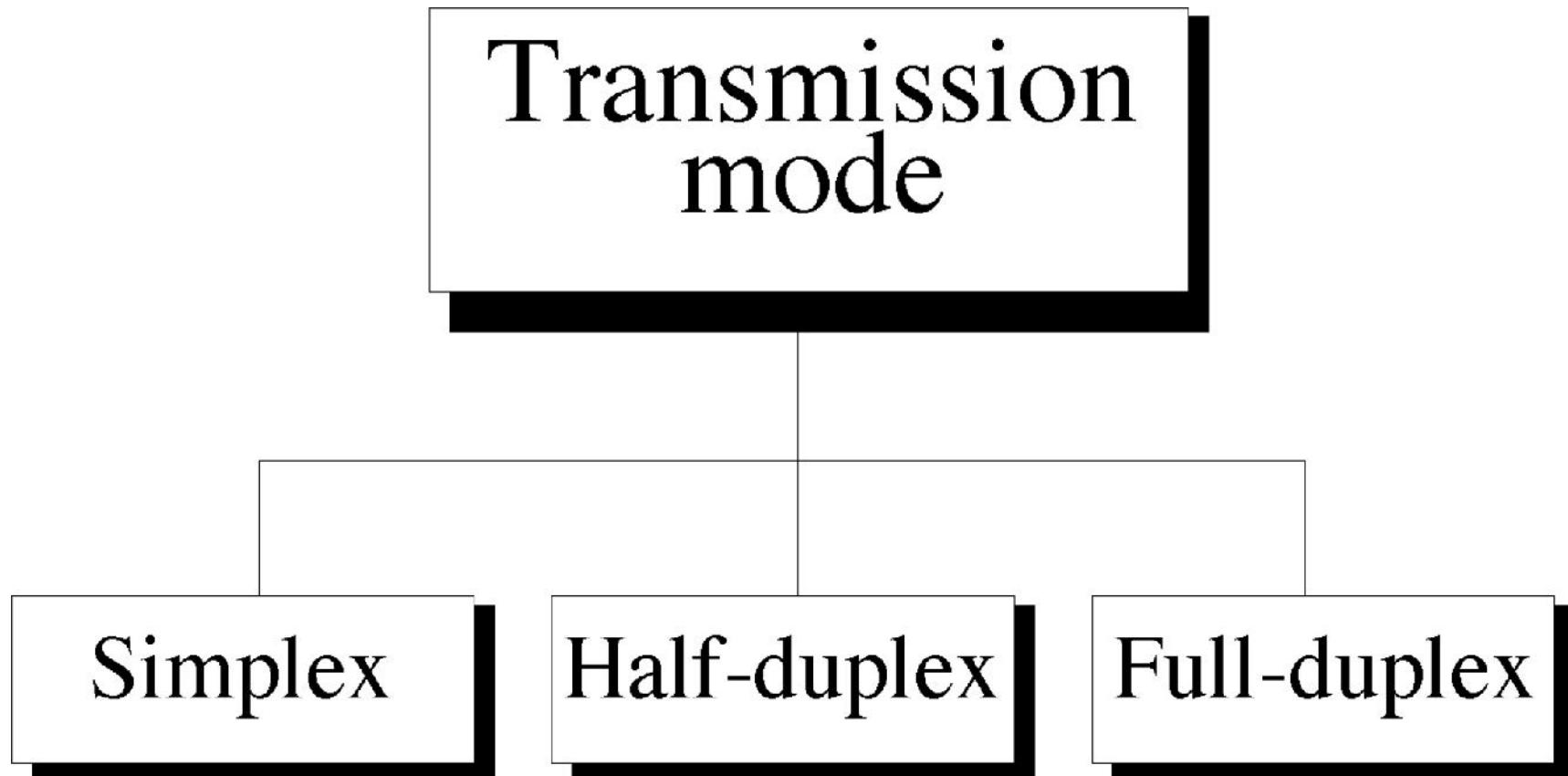
2. Reliability - Network reliability is measured by

- the frequency of failure,
- the time it takes a link to recover from failure, and
- the network robustness in a catastrophe.

3. Security – Protecting data from unauthorized access by means of implementing procedures and policies to recover from breaches and data losses.

Data Flow/ Transmission Mode

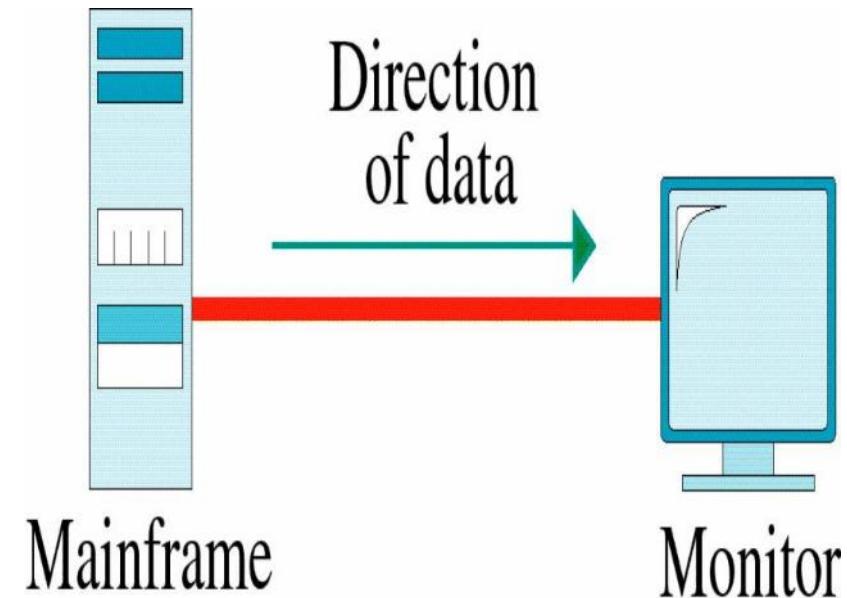
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Simplex

8

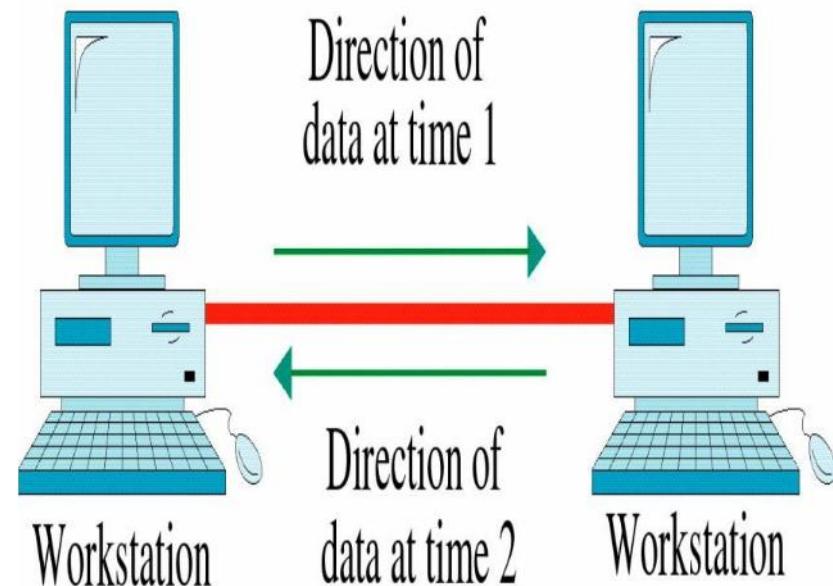
- In simplex mode, the communication is unidirectional.
- Only one of the two devices on a link can transmit; the other only can receive.
- The simplex mode can use the entire capacity of the channel to send data in one direction.
- Example: Keyboard and Monitors



Half-Duplex

9

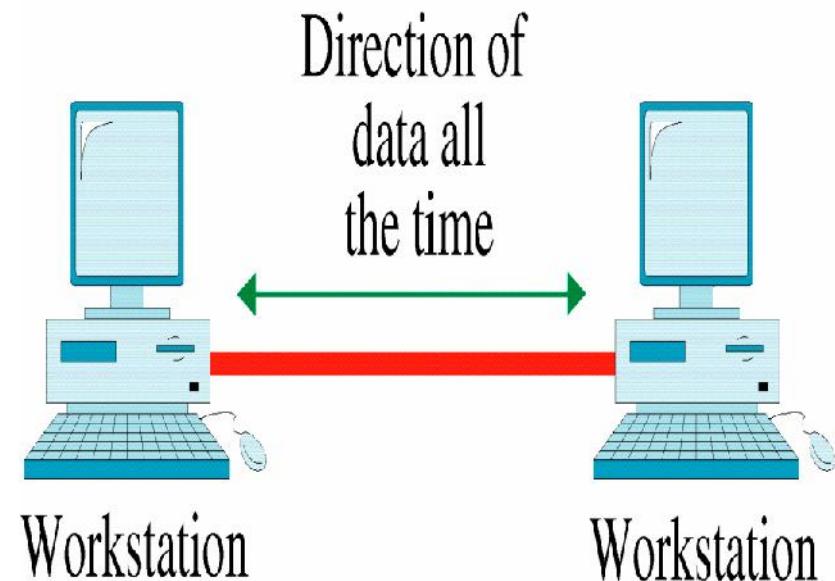
- In half-duplex mode, each station can transmit and receive, but not at the same time.
- When one device is sending, the other can only receive, and vice versa.
- Entire capacity of the channel can be utilized for each direction.
- Ex: Walkie-talkies



Full-Duplex/Duplex

10

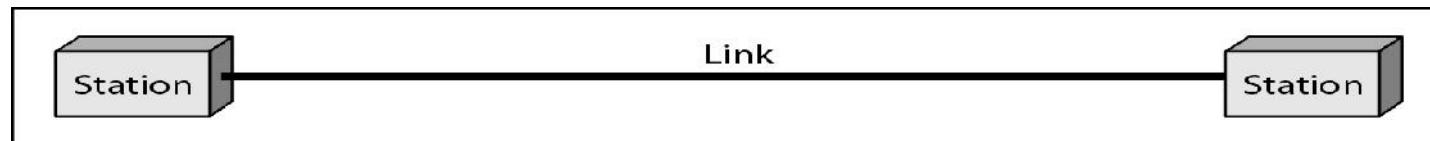
- In full-duplex mode, both stations can transmit and receive simultaneously.
- The capacity of the channel is divided in both directions.
- Example: Telephone network.



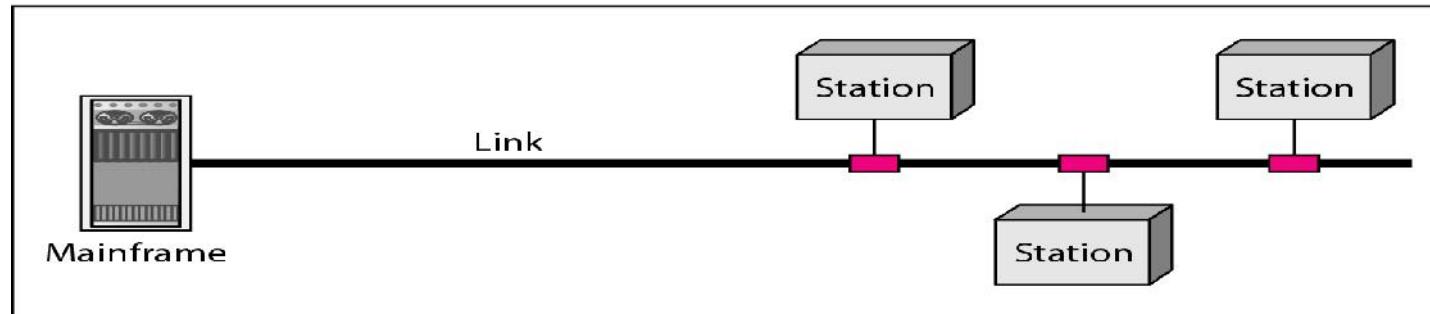
Type of Connection

11

- In a network devices are connected through links.
- Link - Is a communication pathway that transfers data from one device to another.



a. Point-to-point

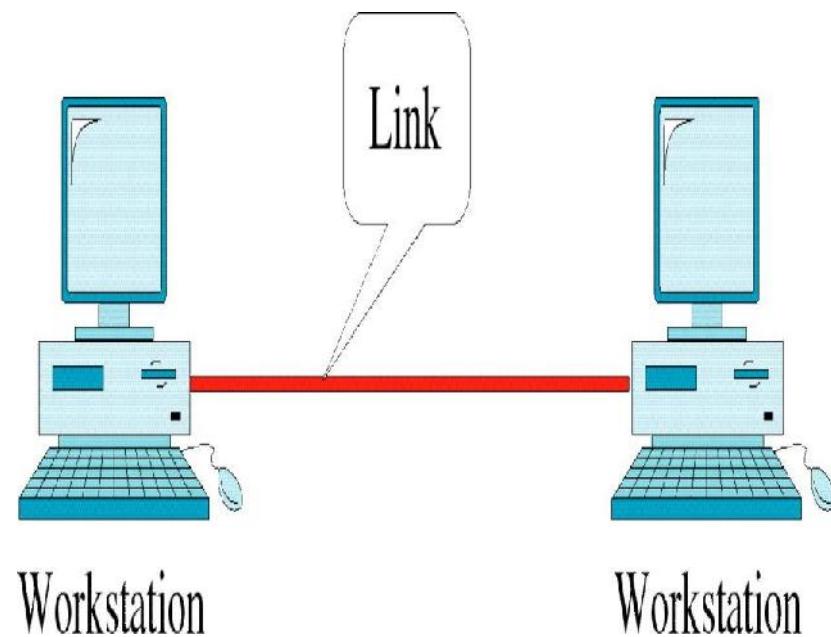


b. Multipoint

Point-to-Point

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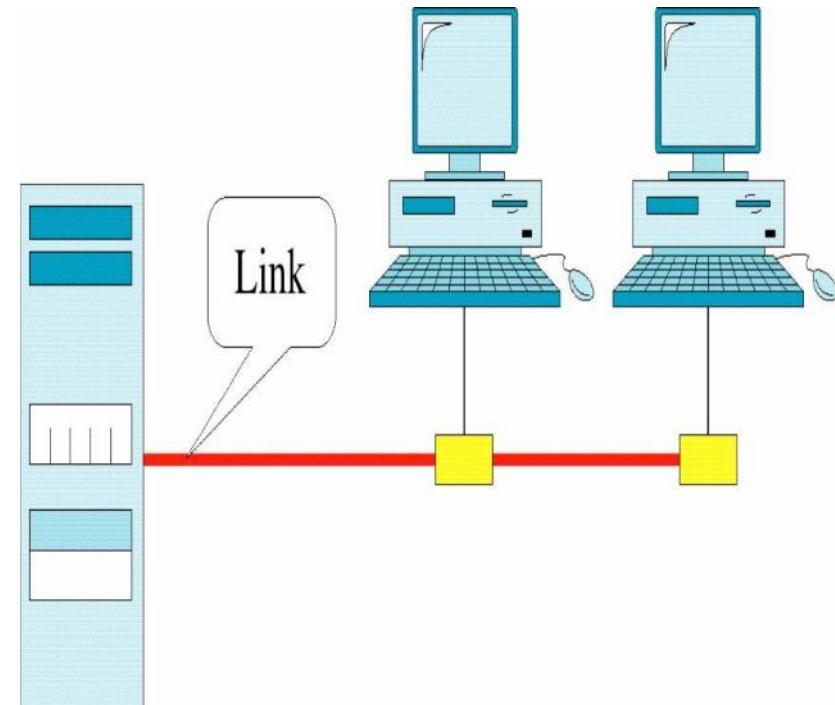
- A point-to-point connection provides a dedicated link between two devices.
- The entire capacity of the link is reserved by those two devices.
- Ex: TV Infrared Remote Control



Multipoint/ Multidrop

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- Also called multidrop connection.
- Two or more devices share a single link.
- The capacity of the channel is shared.



Network topology

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- A **topology** is a geometrical representation of relationships between all the links and devices(nodes) in a network.
- Topologies can be either **physical or logical**.
- **Physical topologies** describe how the cables are run.
- **Logical topologies** describe how the network messages travel.
- The basic four topologies are:
 - **Mesh**
 - **Star**
 - **Bus**
 - **Ring**
- Others: Tree and Hybrid

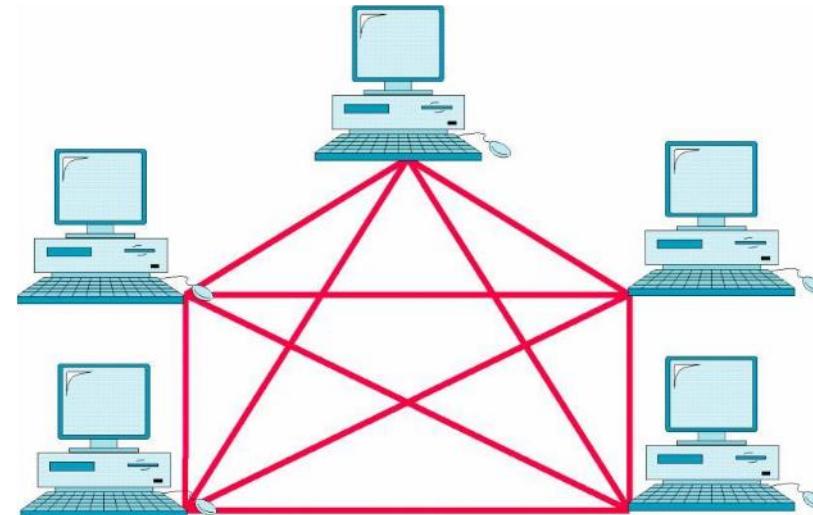
Mesh Topology

15

- Dedicated Point-to-point link.
- Link carries traffic only between the two devices it connects.
- For “n” nodes in a fully connected mesh topology with duplex mode, the number of links required = $n(n-1)/2$.
- No of I/O ports needed = $n-1$
- If $n=5$, then links needed=10.
- I/O ports = 4.

Advantages:

- 1) Eliminates traffic problem.
- 2) Robust.
- 3) Easy fault detection and isolation.
- 4) Privacy/Security - Prevents other user from gaining access to messages.



Disadvantages:

- 1) Number of cabling and I/O ports is high.
- 2) Reconfiguration is difficult.

Star Topology

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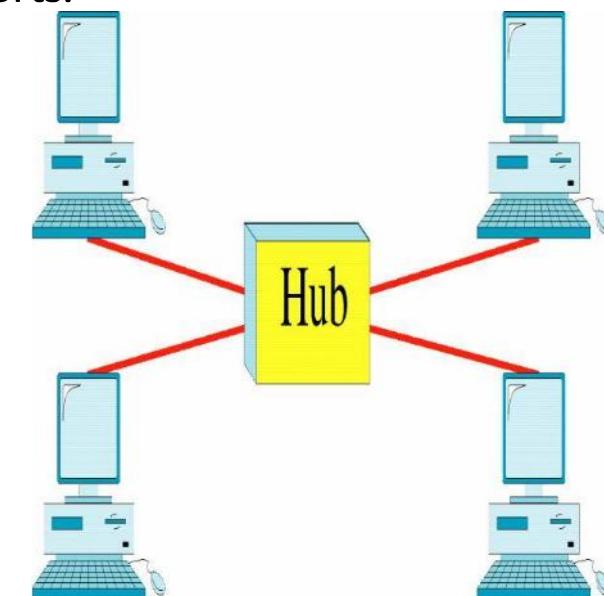
- Dedicated point-to-point link to the central controller called hub.
- Devices are not linked to one another.
- Unlike mesh, star does not allow direct communication between devices.
- Controller acts as an exchange.

Advantages:

- 1) Less expensive than mesh in terms of cabling and I/O ports.
- 2) Installation and reconfiguration is easy.
- 3) Robust.
- 4) Easy fault deduction and isolation.

Disadvantages:

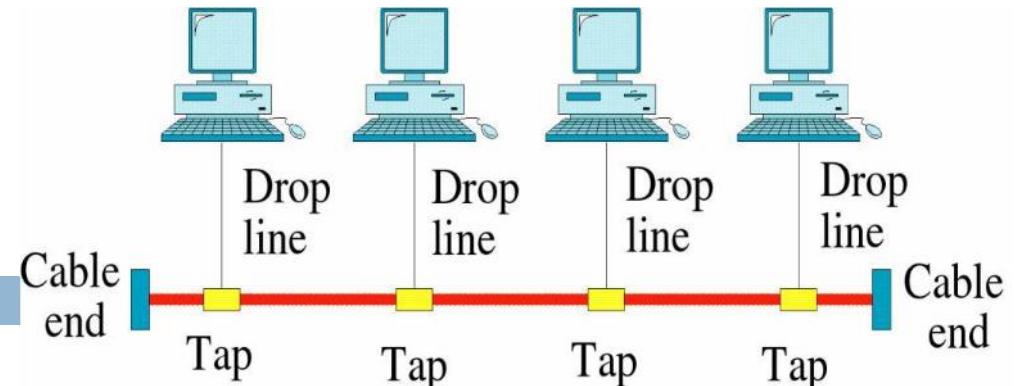
- 1) Dependency on hub.
- 2) Hub goes down then entire network is dead.



Bus Topology

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- Oldest topology.
- Provides multipoint connection.
- Uses long cable as a backbone.
- Devices are connected by using drop line and tap.



Advantages:

- 1) Easy installation.
- 2) Less number of cables than mesh and star.

Disadvantages:

- 1) Fault detection and isolation is difficult.
- 2) Reconfiguration is not possible - adding new devices are not possible. This limits the number of devices.
- 3) Adding new devices needs a replacement of main cable.
- 4) Bus goes down then the entire network is dead.

Ring Topology

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- Developed by IBM.
- Provides **point-to-point** connection.
- Each node is linked with the nodes **on either side of it**.
- Uses **token** passing mechanism.
- Each device incorporates “repeater” – Regenerates the bits and passes them along the ring.

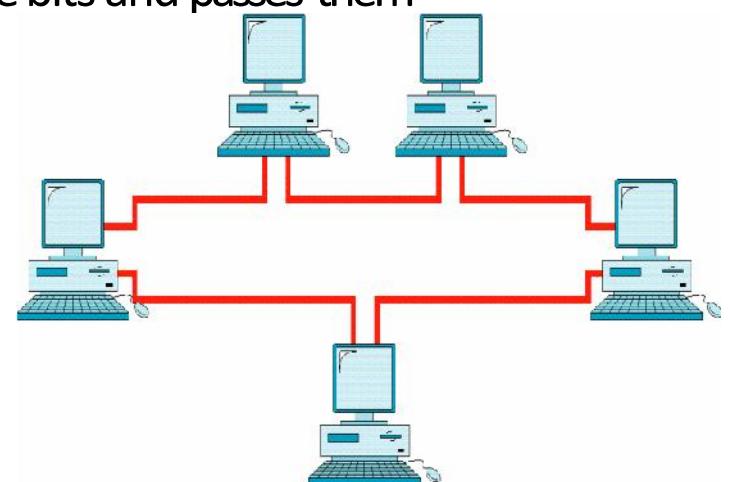
Advantages:

- 1) Easy to install and configure.
- 2) Easy fault detection and isolation.

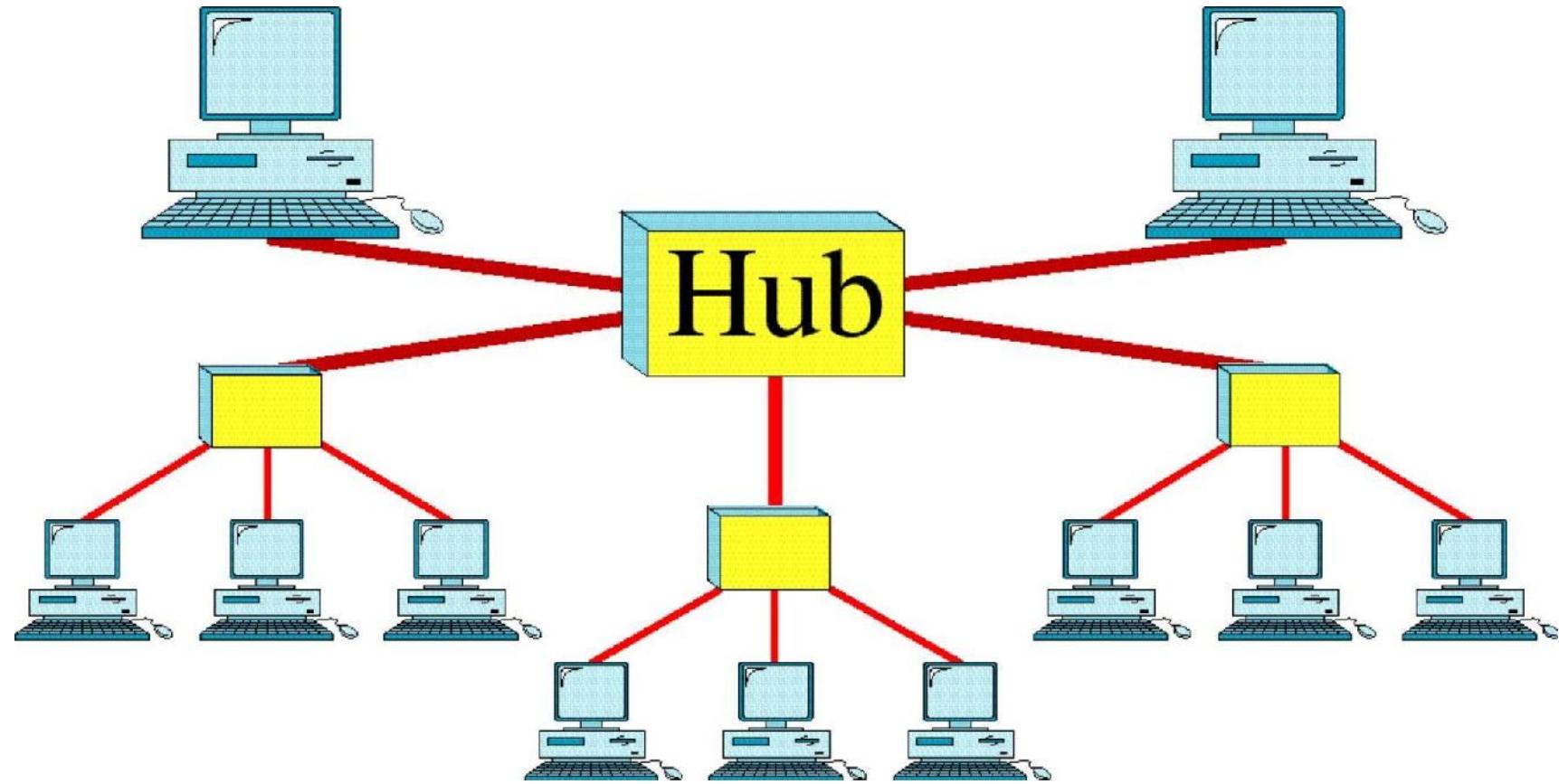
Disadvantages:

- 3) Unidirectional traffic with single ring.
- 4) Fault in the ring disable the entire network.

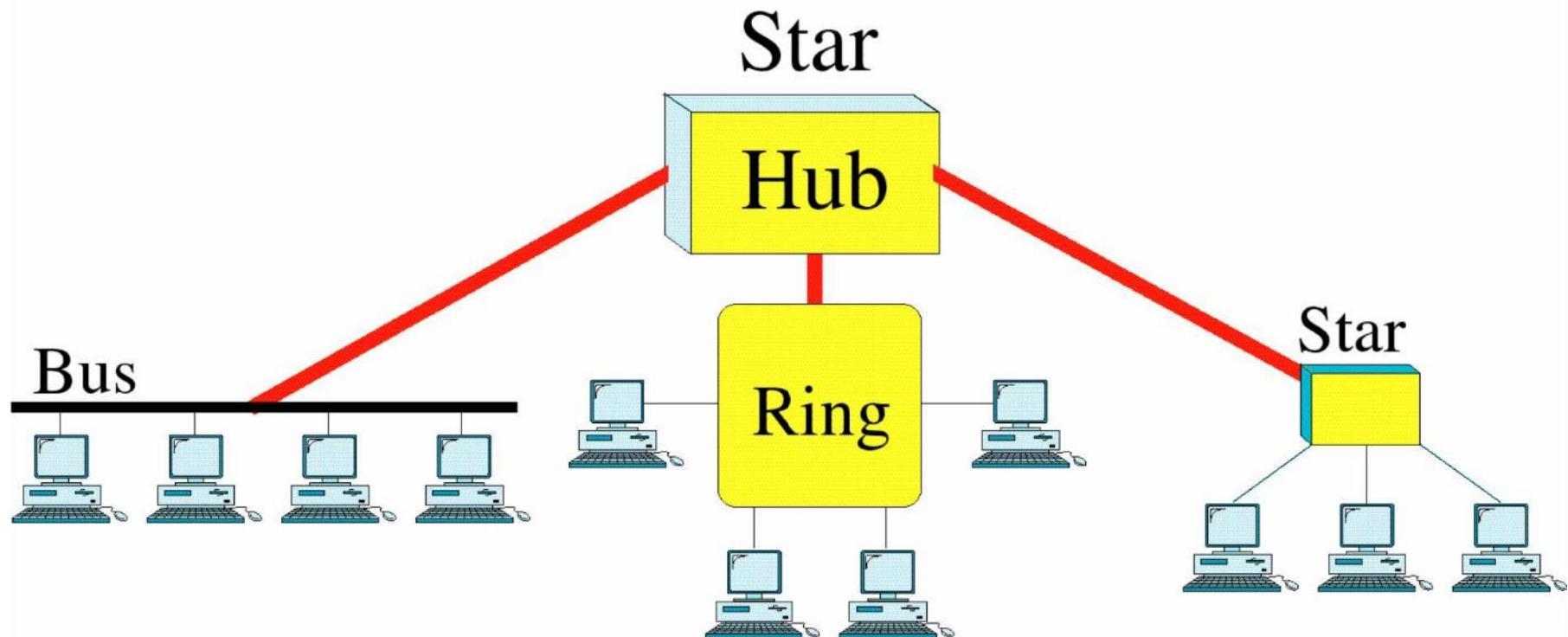
Note: These problems can be eliminated by using dual ring.



Tree Topology



Hybrid Topology



What is a Computer Network?

28

- A computer network is a system in which multiple computers are connected to each other to share information and resources.



Characteristics of a computer network:

- Share Resources from one computer to another.
- Create files and store them in one computer, access those files from the other computer(s) connected over the network.
- Connect a printer, scanner, or a fax machine to one computer within the network and let other computers of the network use the machines available over network.

Hardware's required to setup a computer network

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- Network Cables
- Distributors
- Routers
- Internal Network Cards
- External Network Cards



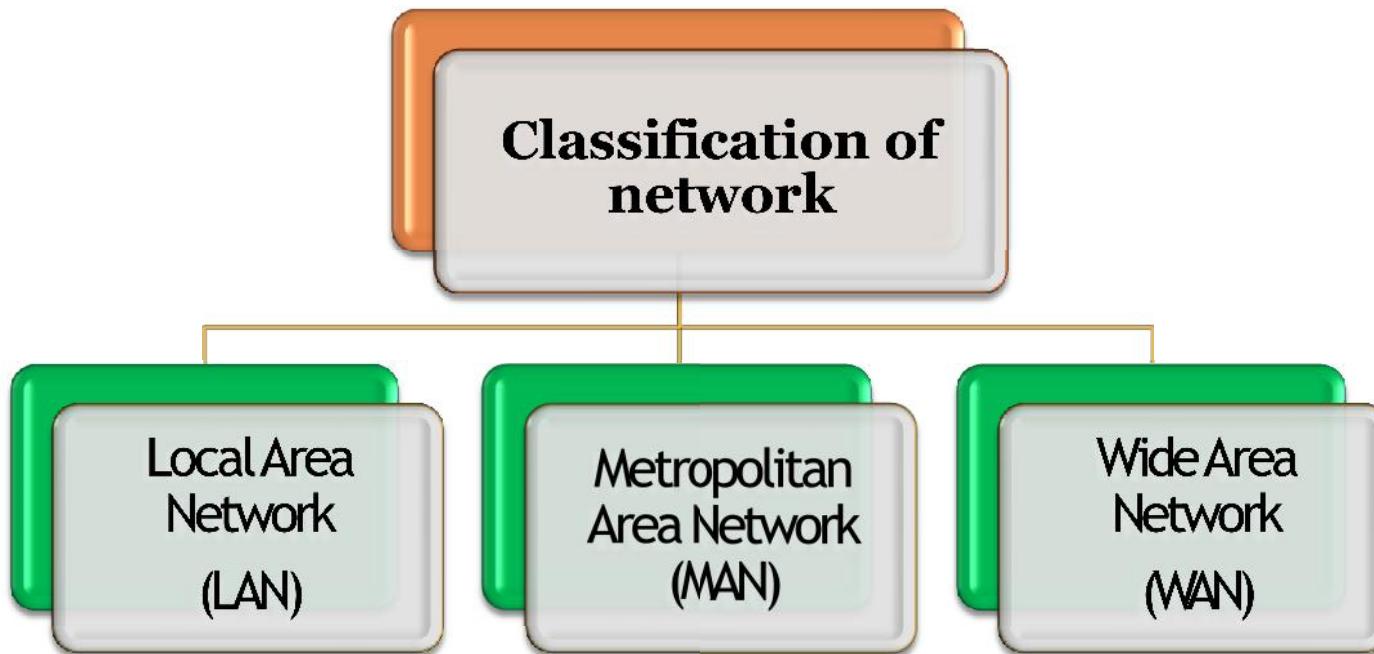
Devices Used in Network Computer Network

30

- Routers
- Gateways
- Repeaters
- Bridges
- Hub
- Modem

Categories of Networks

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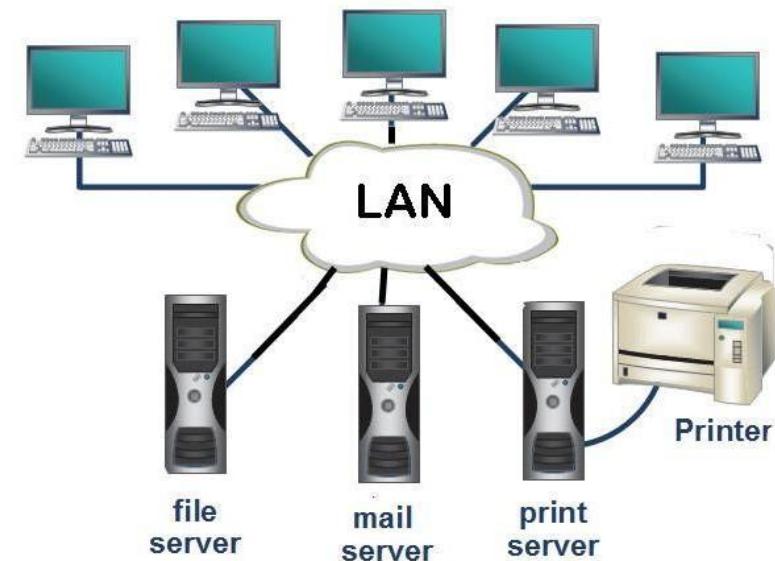


- The main difference among these classifications is their area of coverage.

Local Area Network(LAN)

34

- A LAN is a private network that connects computers and devices in a limited **geographically area** such as a home, school computer laboratory, office building.
- LAN's are used to share resources and to exchange information.
- Traditional LAN's run at 10-100Mbps.
- Common Topologies used are bus, ring and star.
- High data rates with less errors.



LAN

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Advantages

- Easy to share devices (printers, scanners, external drives)
- Easy to share data (homework, pictures)
- Cost of LAN Setup is low.

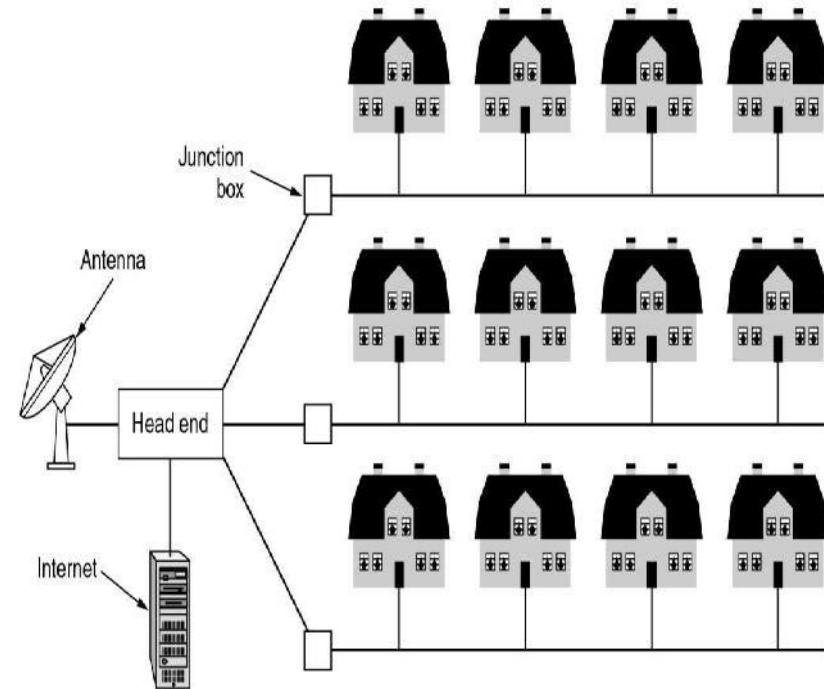
Disadvantages

- **Power** - a good LAN is required to be on all the times.
- **Security** - each computer and device become another point of entry for undesirables.
- if all computers running at once, can **reduce speed** for each.
- Area covered is **limited**

Metropolitan Area Network(MAN)

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- Covers a larger geographical area than is a LAN, ranging from several blocks of buildings to entire cities.
- It may be a single network as a cable TV network or it may be means of connecting a number of LANs into a larger network so that resources may be shared.
- MAN is wholly owned and operated by a private company or may be a service provided by a public company.



MAN

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Advantages

- Efficiency and shared access.
- All the computer-owning residents of the area have equal ability to go on line.

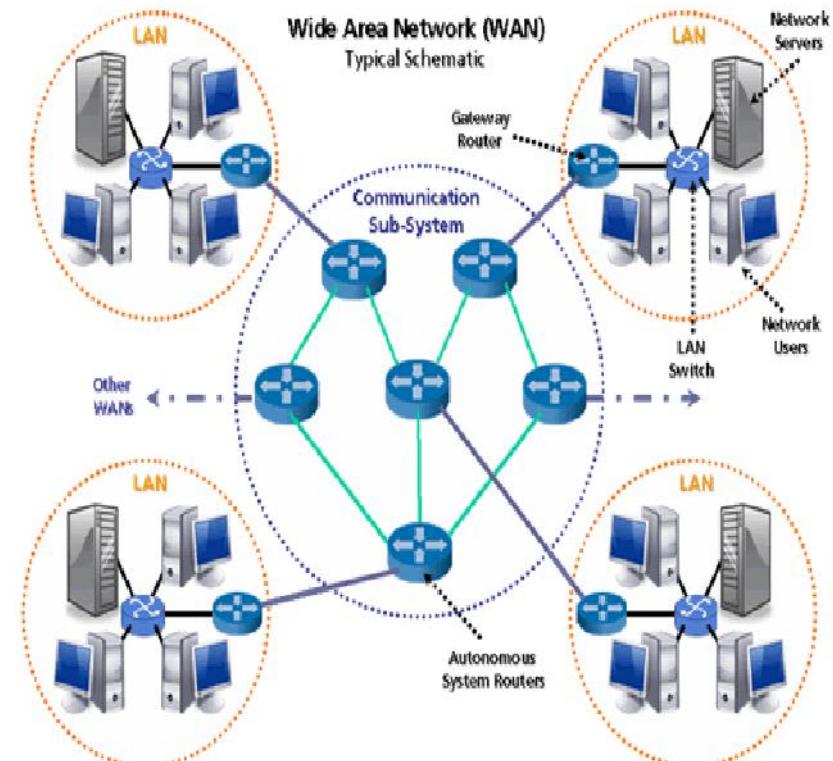
Disadvantages

- It can be costly (hardware, software, support, etc.)
- Security problems
- As the network consists of many computers over the span of a city, the connection can lag or become quite slow.

Wide Area Network(WAN)

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- Is the largest network of all network types.
- The internet is the largest WAN in the world.
- WAN generally covers large distances such as states, countries or continents.
- WAN is group of MANs or LANs or the mixture of both network.
- Types of WAN: EPN, VPN



Comparision

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BASIS	LAN	MAN	WAN
Full Form	Local Area Network	Metropolitan Area Network	Wide Area Network
Range	A communication network linking a number of stations in same local area. Range is 1 to 10 km	This network shares the characteristics of packet broadcasting networks. Range is 100 km	A communication network distinguished from a Local Area Network. Range is Beyond 100 km
Media Used	Uses guided media	Uses guided as well as unguided media	Uses unguided media
Speed	A high speed i.e. 100kbps to 100mbps	Optimized for a large geographical area than LAN.	Long distance communications, which may or may not be provided by public packet network.
Cost	cheaper	costly	expensive
Equipment needed	NIC, switch and hub	Modem and router	Microwave, radio, infra-red laser
protocols	Attached Resource computer network (ARCNET), Token ring	Frame relay and asynchronous transfer mode(ATM)	ATM, FDDI, SMDS

Network Standards

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- Standards provides **guidelines** to the manufacturers, vendors, government agencies and other providers to work regardless of manufacturer.
- It guarantees interoperability, compatibility, interconnectivity.
- It ensures that hardware and software produced by different vendors can work together.
- Standards are developed by **cooperation** among standards creation committees, forums, and government regulatory agencies.

Organizations For Communication Standards/ Standardization Bodies

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- a) International Standards Organization (ISO)
- b) International Telecommunications Union (ITU)
- c) American National Standards Institute (ANSI)
- d) Institute of Electrical and Electronics Engineers (IEEE)
- e) Electronic Industries Association (EIA)
- f) Internet Engineering Task Force (IETF)

Communication Protocols

55

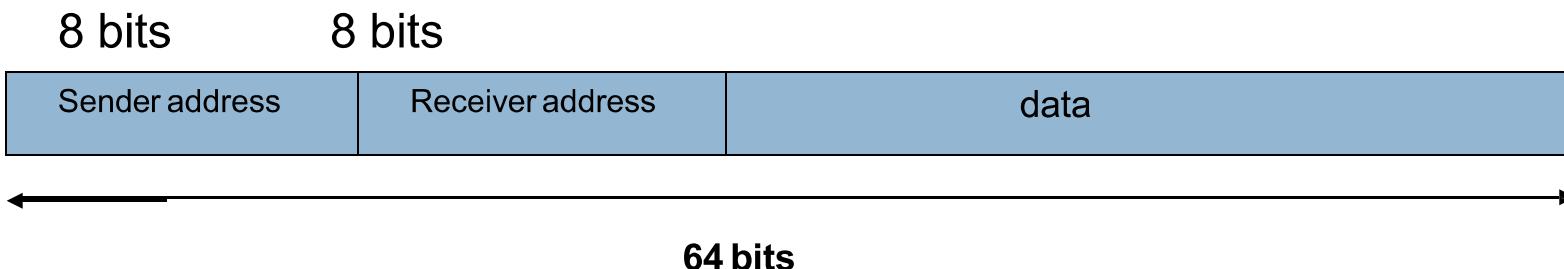
- Protocol is a **set of rules** that govern(manages) all aspect of **data communication** between computers on a network.
- These rules include **guidelines** that regulate the following characteristics of a network: access method, allowed physical topologies, types of cabling, and speed of data transfer.
- A protocol defines what, how, when it communicated.
- The **key elements** of a protocol are **syntax, semantics and timing**.
- **Protocols** are to computers what **language** is to humans. Since this article is in English, to understand it you must be able to read English. Similarly, for two devices on a network to successfully communicate, they **must both understand** the same **protocols**.

Elements of protocol

i) Syntax

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The **structure or format** of the data.



ii) Semantics

- Refers to the **meaning of each section of bits**.
 - how is a particular pattern to be interpreted, and what action is to be taken based on that interpretation.

iii) Timing

- When data to be sent**
- How fast it can be sent**

Eg. If a sender produces data at 100 Mbps but the receiver can process data at only 1 Mbps, the transmission will overload the receiver and data will be largely lost.

Commonly Used Protocol

Protocol	Remarks
Point To Point (PPP)	Used to manage network communication over a modem
Transfer/Transmission Control Protocol (TCP/IP)	Internet backbone protocol. The most widely used protocol.
Internetwork package exchange (IPX)	Standard protocol for Novell NOS
NetBIOS extended user interface (NetBEUI)	Microsoft protocol that doesn't support routing to other network. Running only Windows-based clients.
File transfer Protocol (FTP)	Used to send and received file from a remote host
Simple mail Transfer protocol (SMTP)	Used to send Email over a network
Hyper text transfer protocol (HTTP)	Used for Internet to send document that encoded in HTML
Apple Talk	Protocol suite to network Macintosh computer and a peer-to-peer network protocol
OSI Model	A way of illustrating how information travels