UNIT 2

CONCEPT OF NETWORK AND DATA COMMUNICATION

2 ELEMENTS OF COMMUNICATION SYSTEM

- Data communications are the exchange of data between two devices through some form of transmission medium such as wire cable or wireless medium
- The communicating devices must be part of a communication system made up of a combination of hardware and software
- There are 3 basic elements of communication system
  - Transmitter (Sender)
  - Communication Channel (Medium)
  - Receiver

3 ELEMENTS OF COMMUNICATION SYSTEM

4 ELEMENTS OF COMMUNICATION SYSTEM

- The transmitter's function is to process the message signal into a form suitable for transmission over the communication channel which is also known as modulation
- The communication channel's function is to provide a pathway between sender and receiver
- The Receiver's function is to process the received signal to recover the original message

5 CONCEPT OF COMMUNICATION SYSTEM

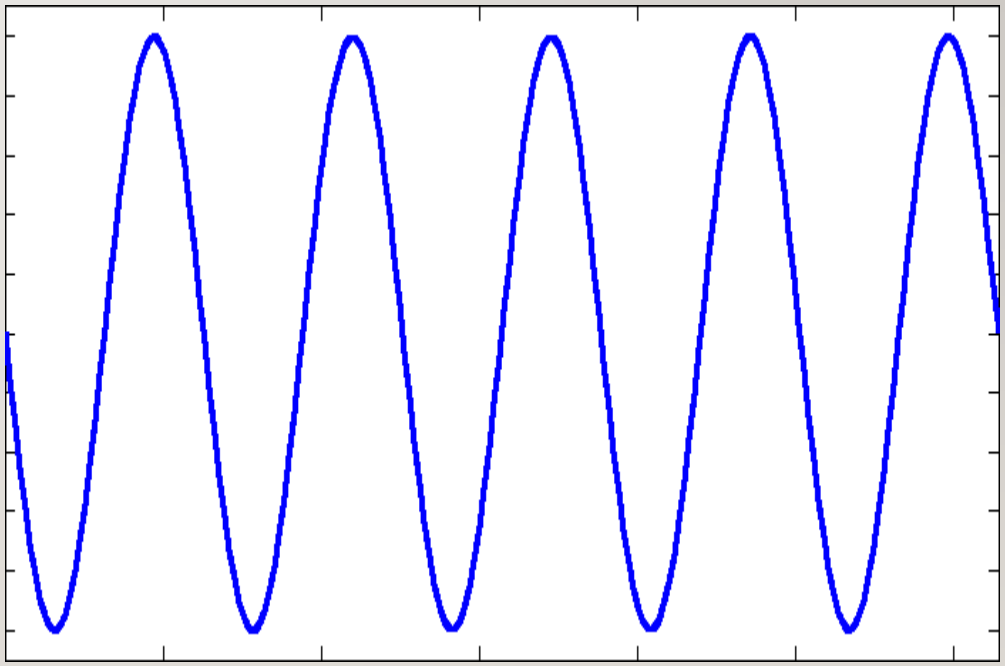
Signal

- A signal is a medium for transmitting data or information
- Signal can be of two types:
  - Analog
    - It carries data in analog form
  - Digital
    - It carries data in digital form

6 ANALOG SIGNAL

- Analog signal is continuous and can be represented in sine waves such as human voice, music, television transmission signal etc
- In analog signal the amplitudes and frequency may vary
- Any information can be converted into an analog signal such signal is a measured response to changes in physical phenomena

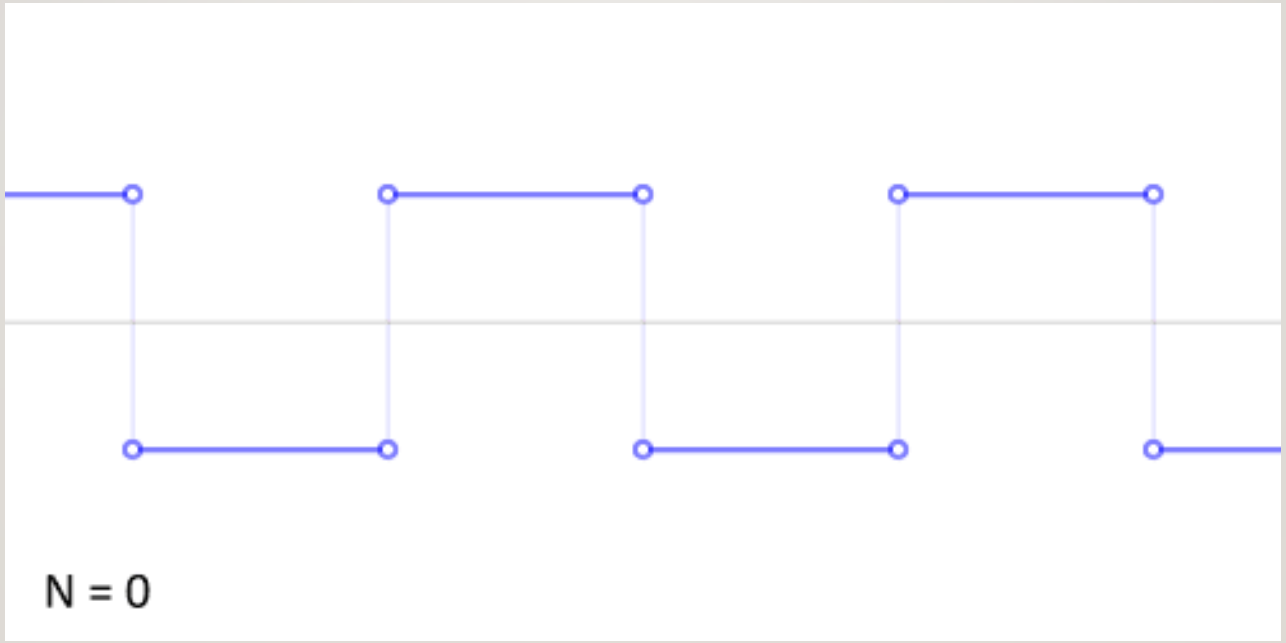
7 ANALOG SIGNAL



8 DIGITAL SIGNAL

- A digital signal is a physical signal that is a representation of a sequence of discrete values
- It describes any system based on discontinuous data or events
- Modern computers are digital machines because they can distinguish between just two values in basic i.e. 0 (low) and 1 (high)
- Data transmission between computer peripherals and inner parts of computer is digital transmission

9 DIGITAL SIGNAL

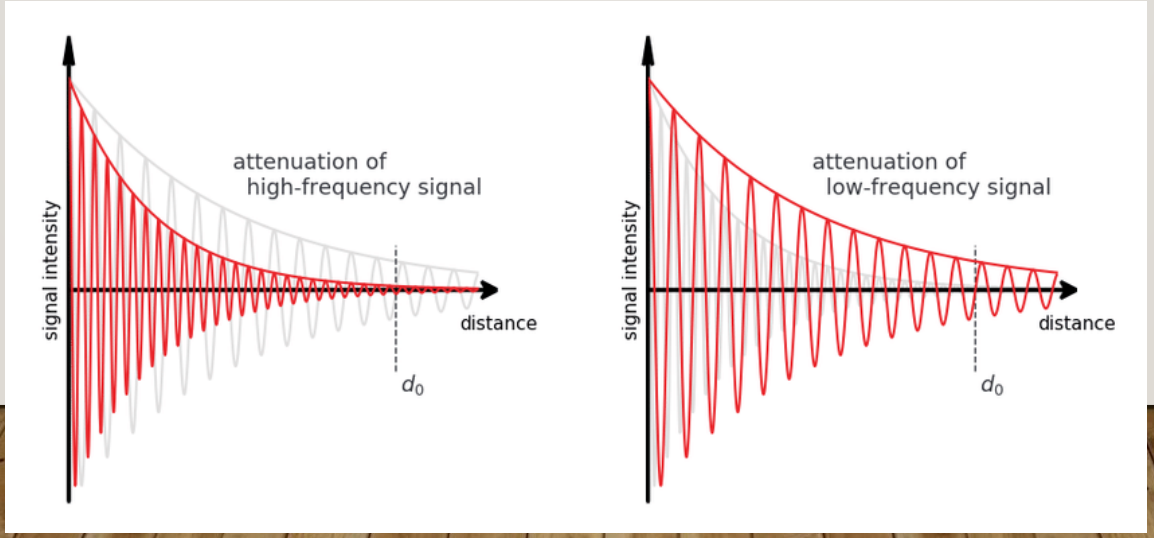


10 CAUSES OF SIGNAL IMPAIRMENTS

- Those imperfections in transmission medium are called signal impairments
- It means the sent and received messages are not same
- Causes of signal impairments
  - Attenuation
  - Distortion
  - Noise

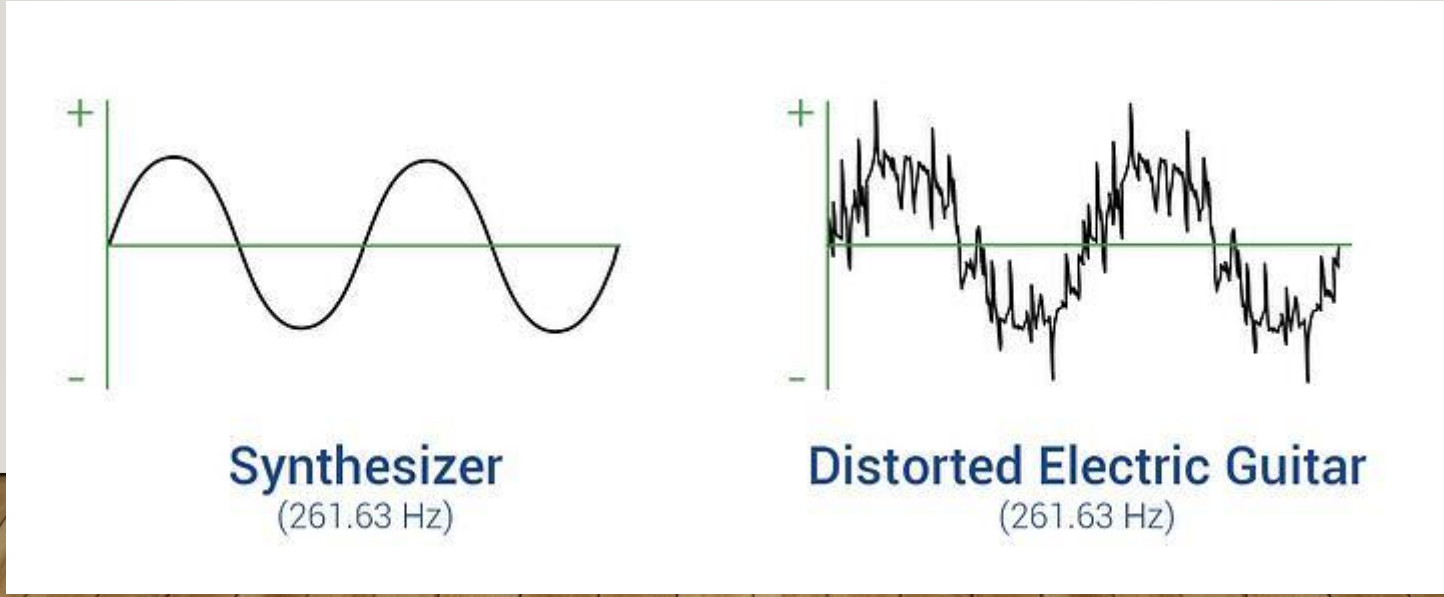
11 ATTENUATION

- Attenuation is the reduction in the strength of analog or digital signal as it is transmitted over a communication medium
- It is loss of energy of signal as it travels
- Repeaters and amplifiers are used to regenerate the signals



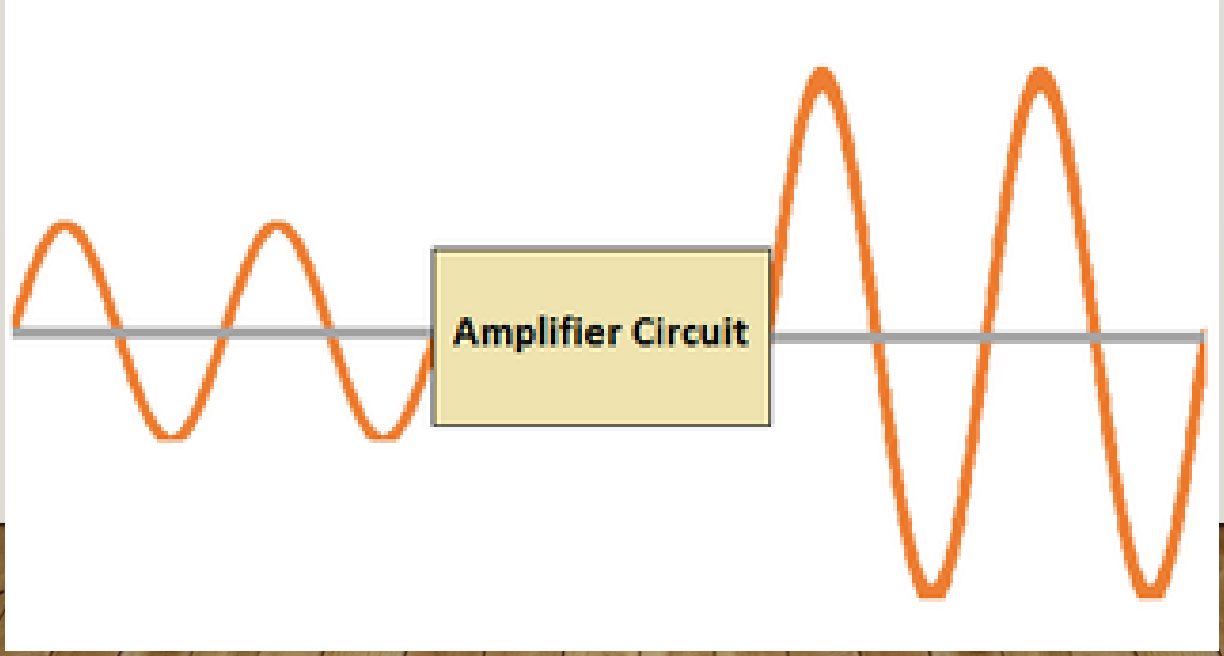
12 DISTORTION

- Distortion means that the signal changes its form or shape
- Signal frequencies are composite signals.
- Distortion occurs in these composite signals



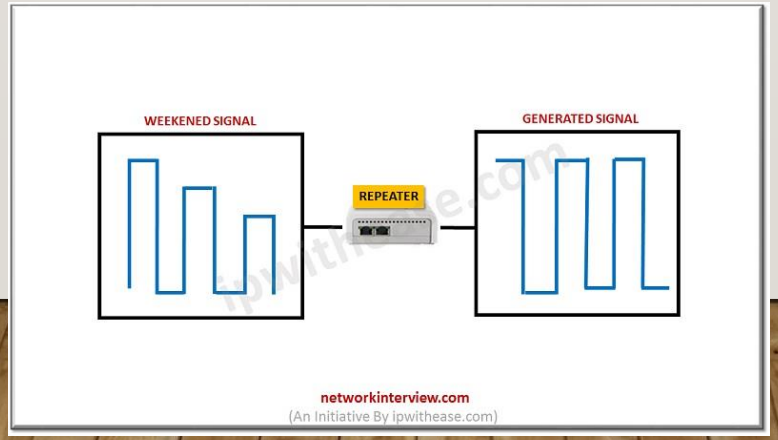
13 AMPLIFICATION

- Amplification is the process to strengthen the amplitude of the signals using an electronic circuit
- Amplifier is used to amplify the signal



14 REPEATER

- Repeater extends the range of communication system by re-generating the signal allowing it to travel further
- Signals can carry information within a fixed distance
- After travelling certain distance, the signal becomes corrupted or weak
- Repeaters re-generate original signals and extend the length of travel



15 TRANSMISSION IMPAIRMENTS TERMINOLOGY

- Jitter
  - Jitter is a variance in latency, or the time delay between when a signal is transmitted and when it is received. This variance is measured in milliseconds (ms) and is described as the disruption in the normal sequence of sending data packets.

16 TRANSMISSION IMPAIRMENTS TERMINOLOGY

- Singing
  - Singing occurs as a result of transmitted signals being coupled into a return path and fed back to the respective sources. It is the same as echo.

17 TRANSMISSION IMPAIRMENTS TERMINOLOGY

- Echo
  - Echo occurs when some portion of the signal is returned back with enough delay (typically >30ms).
  - They can be Talker echo and Listener echo
  - Talker echo: go-to-return crosstalk
  - Listener echo: multiple reflection in path

18 TRANSMISSION IMPAIRMENTS TERMINOLOGY

- Crosstalk
  - It is the effect of one wire on the other in which one wire acts as sending antenna and other acts as the receiving antenna.
  - It is unwanted coupling between signals and affects both wires parallel to each other.

19 TRANSMISSION IMPAIRMENTS TERMINOLOGY

- Attenuation
  - Attenuation means a loss of energy. The strength of a signal falls off with distance over any transmission medium.
  - For guided media, this reduction in strength or attenuation is generally logarithmic and is thus typically expressed as a constant number of decibels per unit distance.

TRANSMISSION IMPAIRMENTS TERMINOLOGY

- Distortion
  - It means changes in the form or shape of the signal.
  - This is generally seen in composite signals made up with different frequencies. Each frequency component has its own propagation speed travelling through a medium.
  - That's why it delay in arriving at the final destination Every component arrive at different time which leads to distortion.

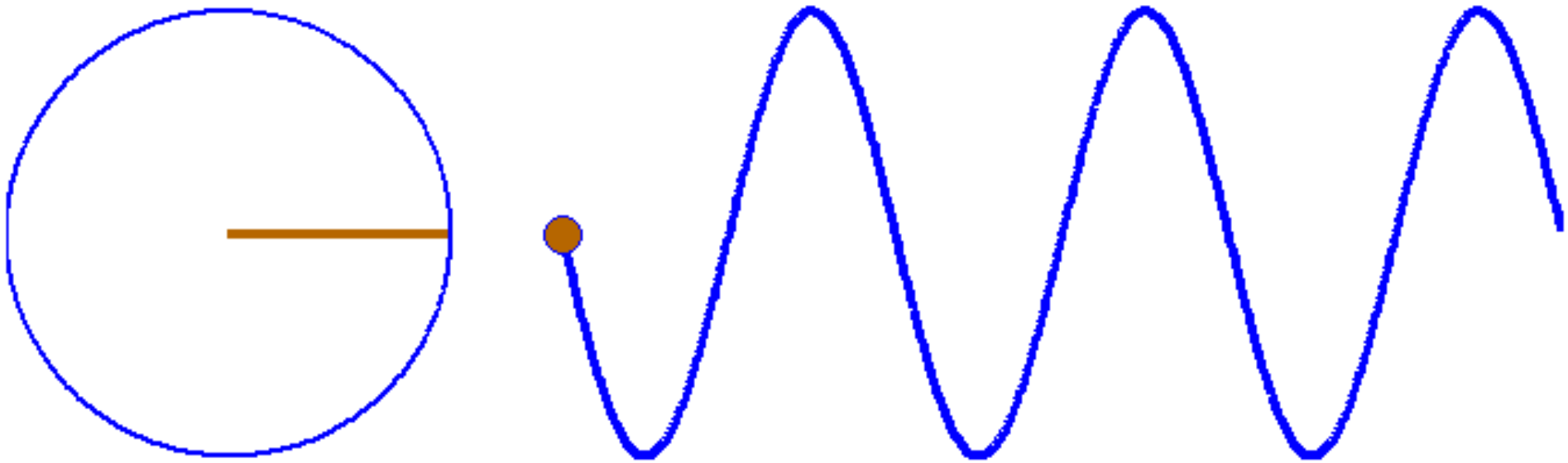
TRANSMISSION IMPAIRMENTS TERMINOLOGY

- Noise
  - The random or unwanted signal that mixes up with the original signal is called noise. There are several types of noise such as induced noise, crosstalk noise, thermal noise and impulse noise which may corrupt the signal.
  - Induced noise comes from sources such as motors and appliances. These devices act as sending antenna and transmission medium act as receiving antenna. Thermal noise is movement of electrons in wire which creates an extra signal. Crosstalk noise is when one wire affects the other wire. Impulse noise is a signal with high energy that comes from lightning or power lines

22 TRANSMISSION IMPAIRMENTS TERMINOLOGY

- Bandwidth
  - Bandwidth describes the maximum data transfer rate of a network or Internet connection. It measures how much data can be sent over a specific connection in a given amount of time.
  - Rate of data transmission over communication channel
  - It is measured in cycles per second or hertz.

23 MESSAGE SIGNAL



24 MODULATION

- Original message signal can't be transmitted over longer distance because
  - message signal has low frequency
  - low frequency signal have low strength
  - weak signal can't travel for long distance
  - message signal is weak signal

25 MODULATION

- Modulation is the process of changing or encoding the carrier wave in accordance to message signal
- It is the process of superimposing a message signal with a carrier signal is called modulation.
- Some modulation technique change the height of the signal, some changes the timing and some changes phase of the signal

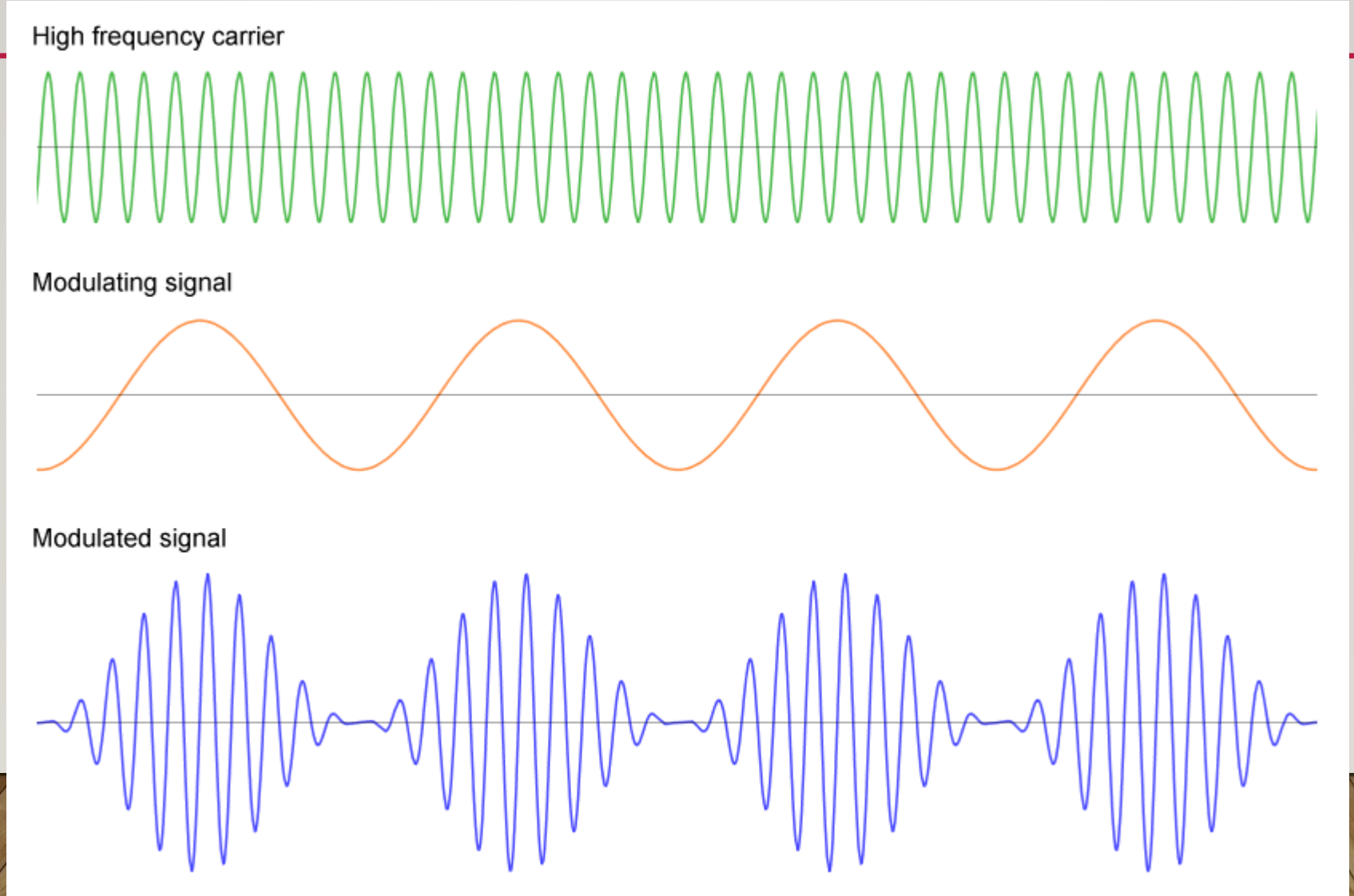
26 MODULATION

- There are 3 types of modulation
  - Amplitude modulation (AM)
  - Frequency modulation (FM)
  - Phase modulation (PM)

27 AMPLITUDE MODULATION

- The process of changing the amplitude of carrier signal in accordance to message signal.
- The other characteristics of carrier signal i.e. phase and frequency remains unchanged or constant
- AM transmission is not very good for high quality transmission

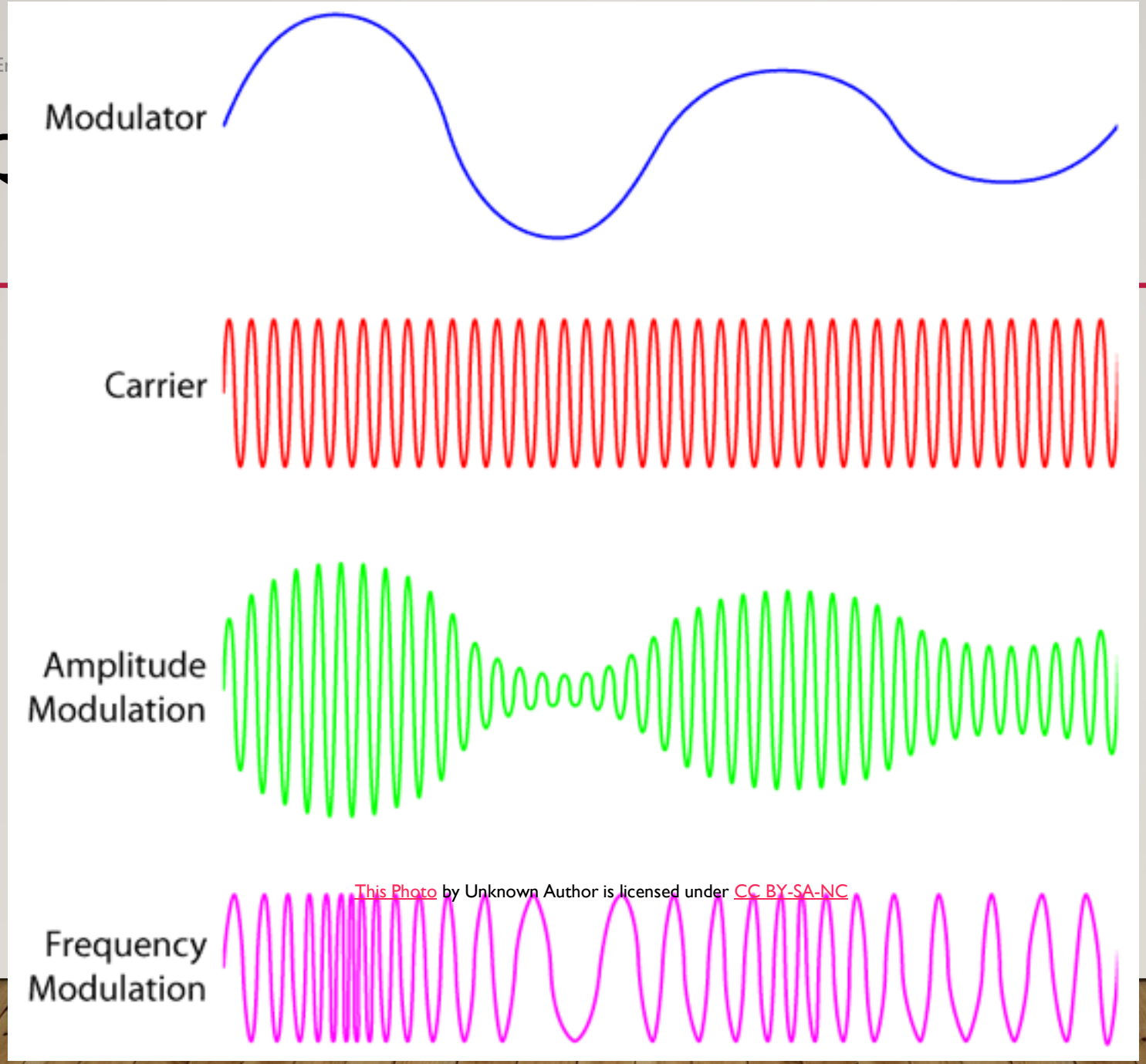
28 AMPLITUDE MODULATION



29 FREQUENCY MODULATION

- The process of changing the frequency of carrier signal in accordance to message signal.
- The other characteristics of carrier signal i.e. phase and amplitude remains unchanged or constant
- FM has less amount of noise and gives best encoding method as far as quality is concerned

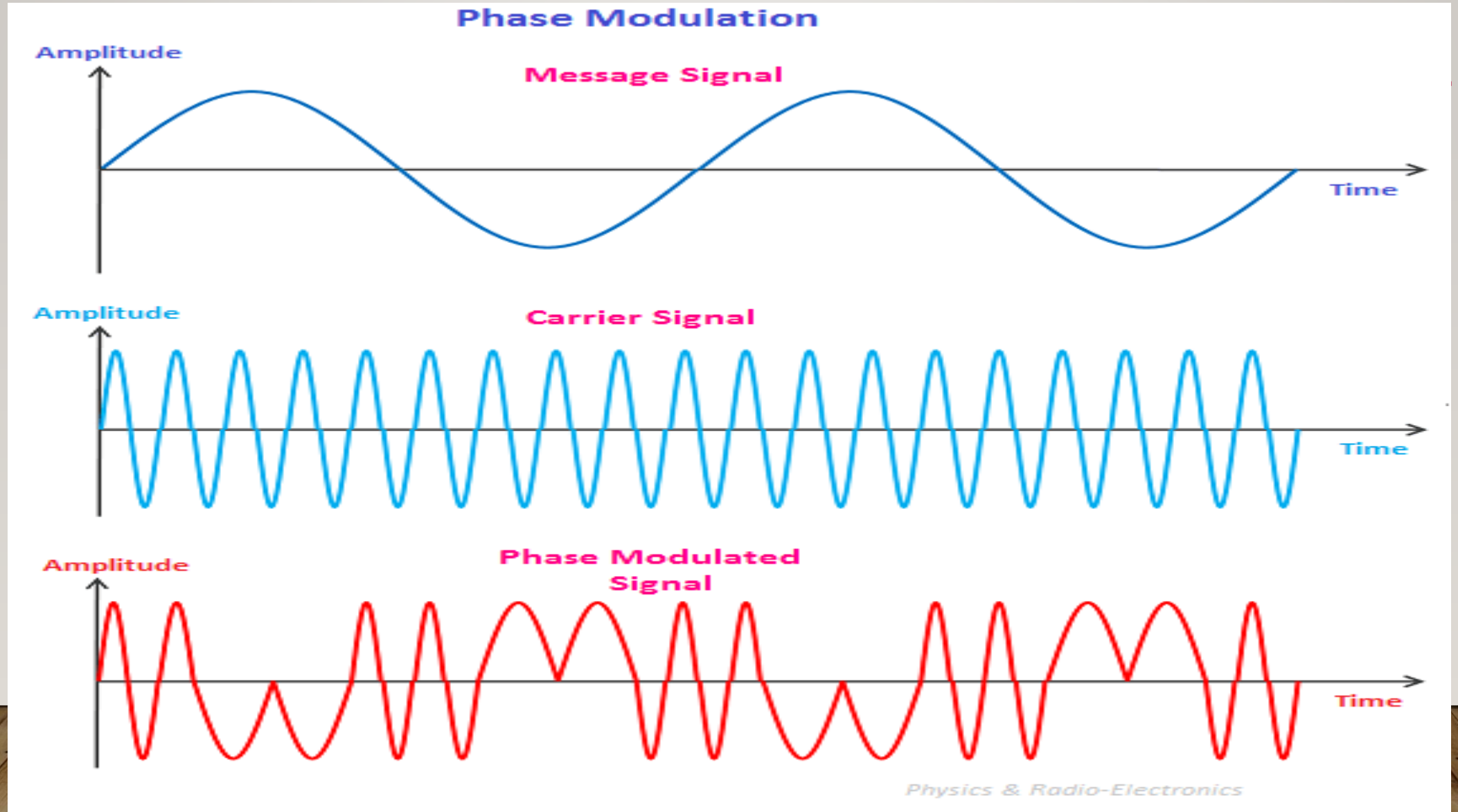
30 FREQ



31 PHASE MODULATION

- The process of changing the phase of carrier signal in accordance to message signal.
- The other characteristics of carrier signal i.e. frequency and amplitude remains unchanged or constant
- PM is also the basis for many forms of digital modulation based around phase shift keying (PSK)

32 PHASE MODULATION

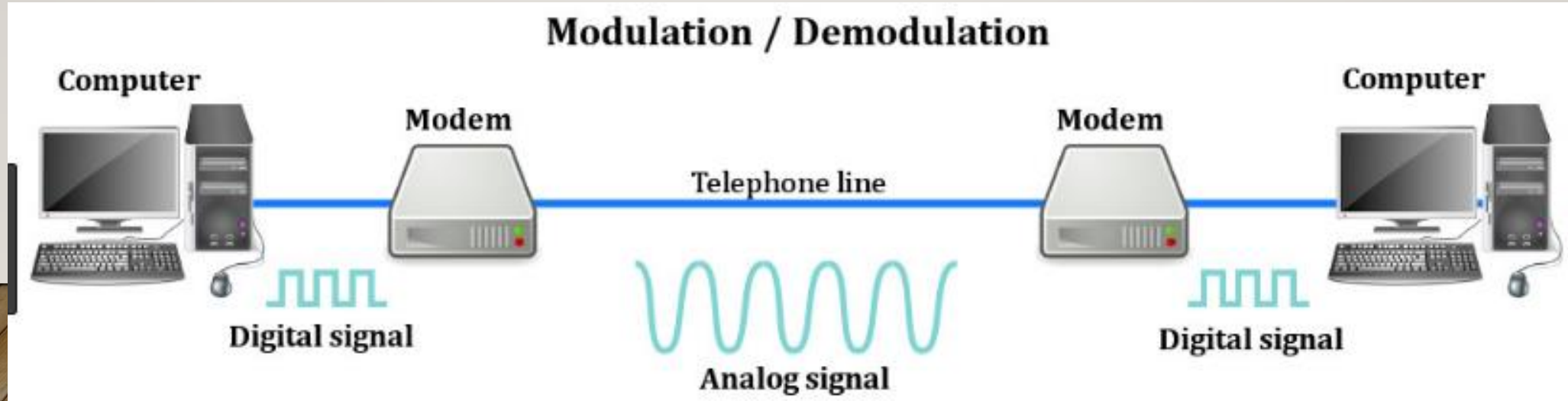


33 DE-MODULATION

- Demodulation is the process of regenerating the original message signal from the received modulated signal
- It is the reverse process of modulation
- It is done at the receiver end
- The device which modulates and demodulates signal is called modem in computer

34 DE-MODULATION

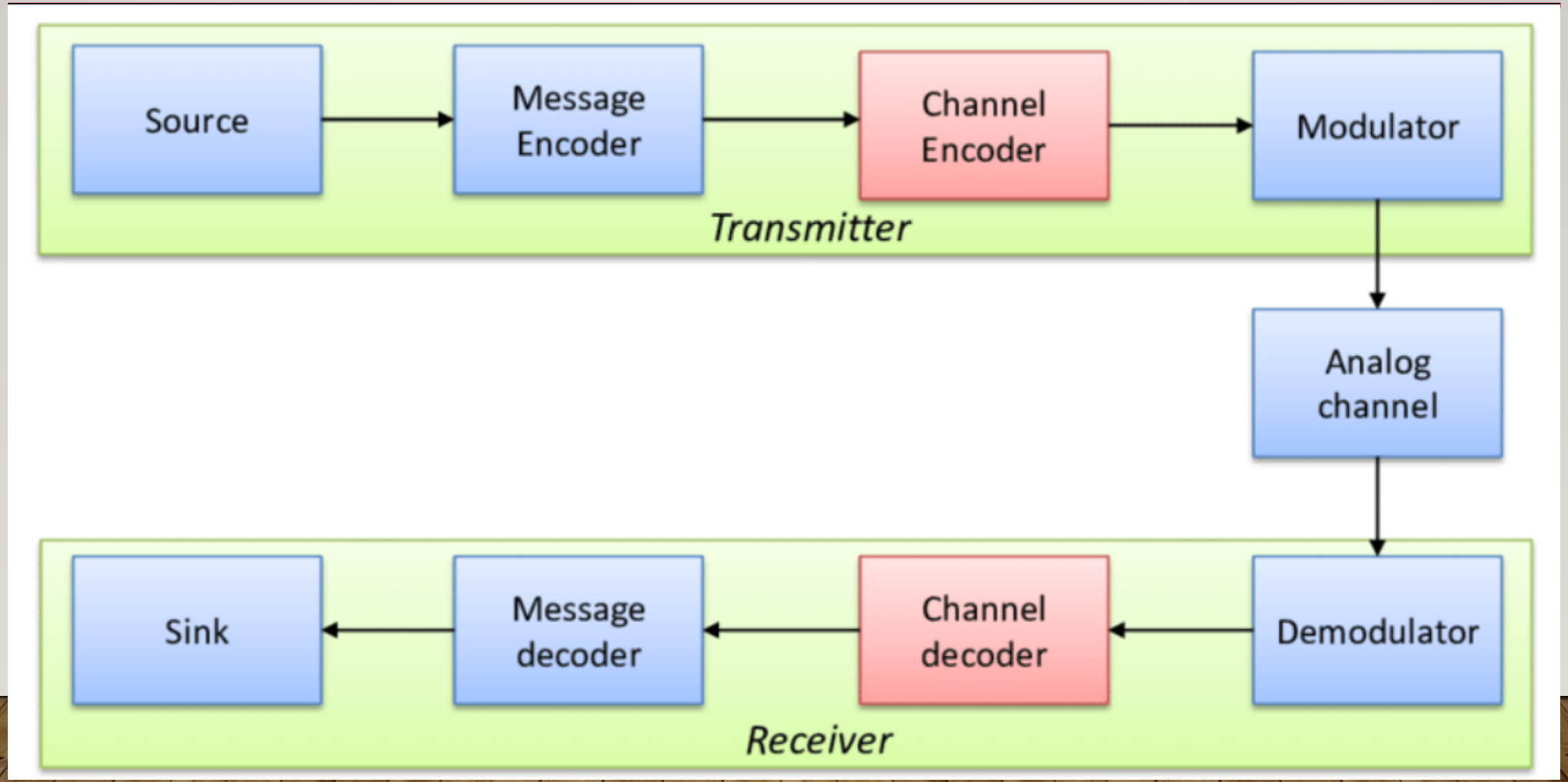
- Conversion of digital signal into analog signal is called modulation
- and conversion of analog signal to digital signal is called de-modulation



35 COMMUNICATION SYSTEM MODEL

- It is a system model that describes a communication exchanges between two stations, transmitter & receiver.
- It carries information from source node to destination node through communication channel
- Channel can be wired (ethernet, co-axial, optical fiber) or wireless (wi-fi, Bluetooth, infrared, radio waves)

36 COMMUNICATION SYSTEM MODEL



37 ELEMENTS OF COMMUNICATION

- There are 5 elements of data communication
  - Message
  - Sender
  - Receiver
  - Medium/channel
  - Protocol

38 ELEMENTS OF COMMUNICATION

- Message:
  - The message is data or information to be communicated and it is the form of text, number, picture, audio and video.
- Sender:
  - The sender device sends the messages to the receiver and it can be computer, workstation or any networking devices.
- Receiver:
  - The receiver device receives the messages from the medium and it can be computer, workstation or any networking devices.

39 ELEMENTS OF COMMUNICATION

- Transmission medium:
  - The transmission medium is physical connection in which a message can travel from sender to receiver and vice versa.
  - The medium can be wired and wireless.
- Protocols:
  - A protocol is a set of common rules that manages the data communications. Without protocol two devices can be connected but not be communicated but not be communicated. It represents an agreement among the different communication devices in a network.

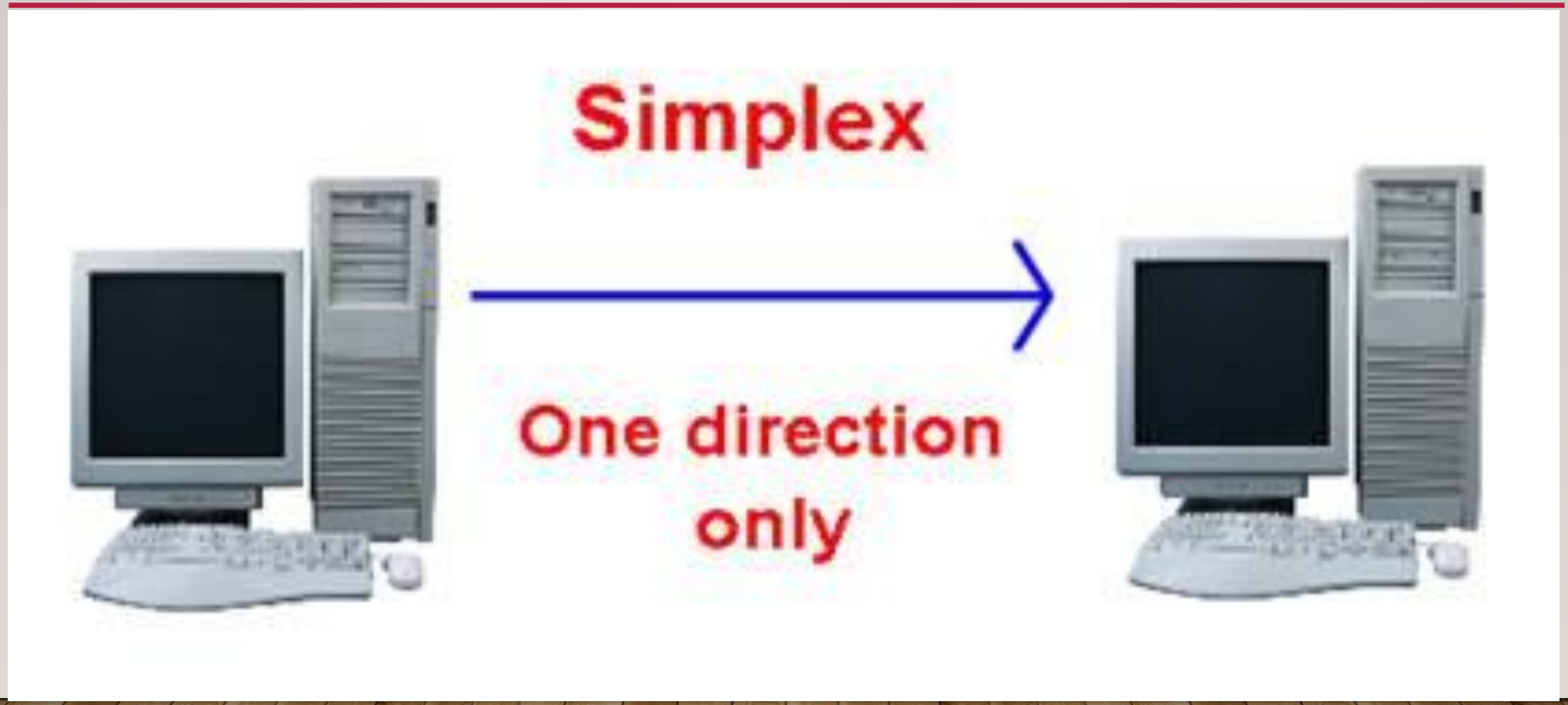
MODES OF COMMUNICATION

- Communication mode refers to the mechanism of transferring of data between two devices connected over a network
- It is also called transmission mode
- There are 3 modes of communication
  - Simplex mode
  - Half-duplex mode
  - Full-duplex mode

41 MODES OF COMMUNICATION

- Simplex mode:
  - In this mode the sender can only send data and receiver can only receive data
  - It is unidirectional mode of communication
  - Simplex mode can use the entire capacity of the channel to send data in one direction
  - Such as Keyboard and traditional monitors are examples of simplex mode communications

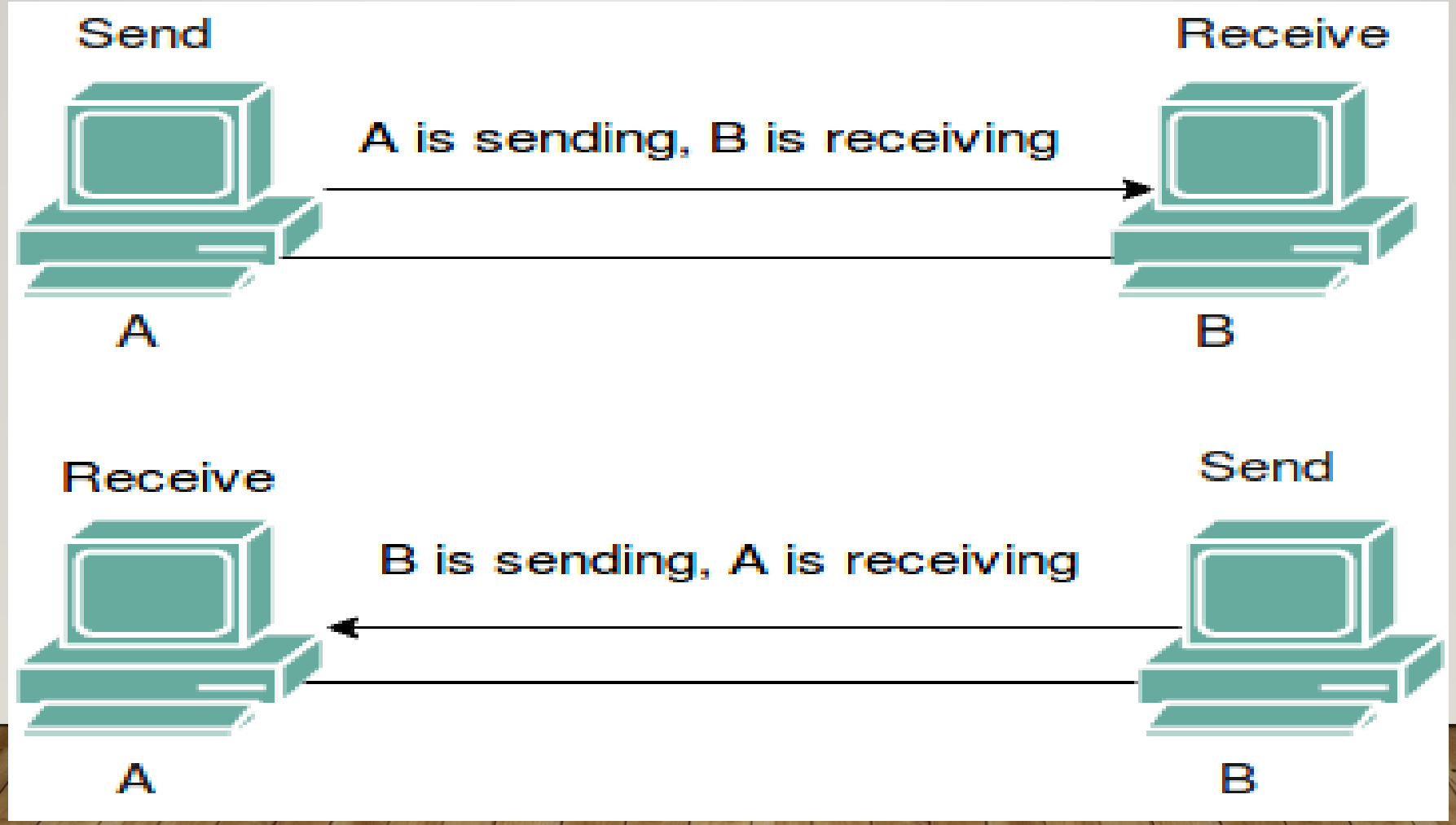
42 MODES OF COMMUNICATION



MODES OF COMMUNICATION

- Half-duplex mode:
  - In half-duplex mode, each station can both send and receive data but not at the same time.
  - In each transmission, one station becomes sender and other receiver and vice versa
  - Entire capacity of channel can be utilized for each transmission
  - e.g. Walkie-talkie communication

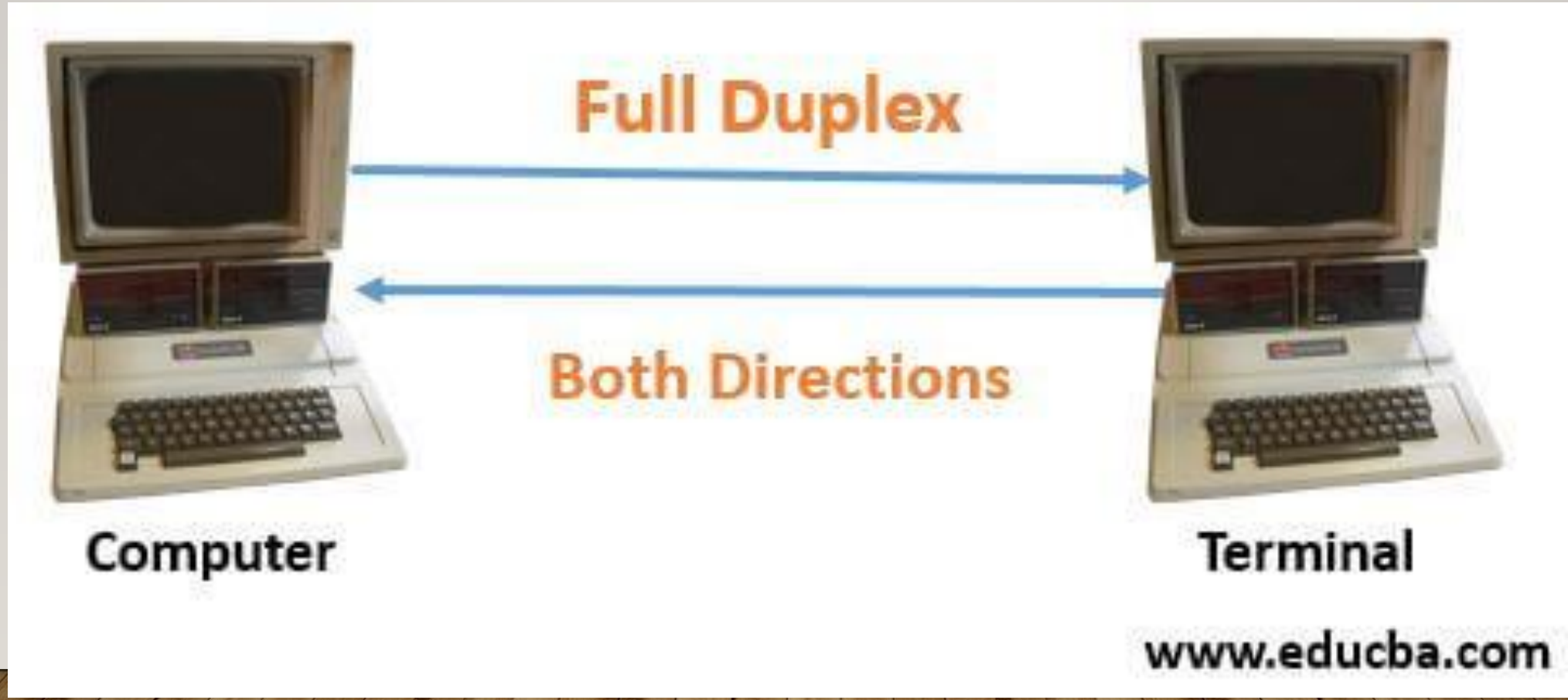
44 MODES OF COMMUNICATION



45 MODES OF COMMUNICATION

- Full-duplex mode:
  - In full-duplex mode, both stations can send and receive data in parallel or simultaneously
  - It is bi-directional mode of communication
  - Both stations acts as sender and receiver at the same time
  - e.g. telephone communication, networks

46 MODES OF COMMUNICATION



47 TYPES OF NETWORK

- There are mainly 3 types of network
  - Local Area Network (LAN)
  - Metropolitan Area Network (MAN)
  - Wide Area Network (WAN)

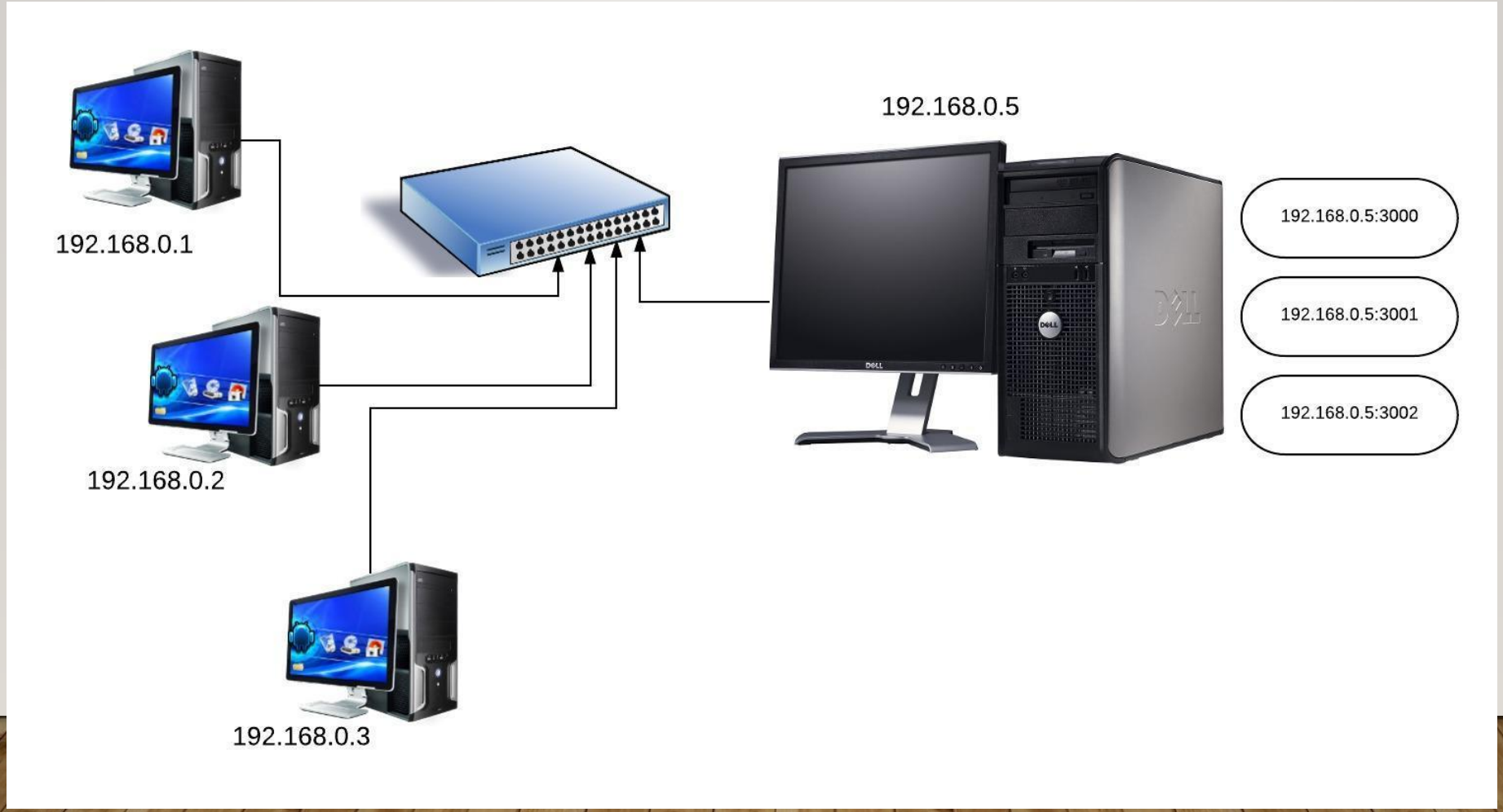
TYPES OF NETWORK

- Local Area Network (LAN)
  - LAN is privately owned and links the devices of small geographical area such as office building, campus etc.
  - LANs are designed to allow resources to be shared between personal computers or workstations
  - Resources can be hardware (like printer, scanner) or software (like application programs, data)

TYPES OF NETWORK

- Local Area Network (LAN)
  - Early LANs had data rates up to 4 to 16 Mbps range
  - Nowadays the speeds are 100 to 1000 Mbps
  - Wireless LAN also known as WLAN can be created by using wireless communication like wi-fi or Bluetooth

50 TYPES OF NETWORK



51 TYPES OF NETWORK

- Advantages of LAN
  - Resource Sharing: provides resource sharing such as printers, scanners, modems, hard disks to network
  - Easy and Cheap Communication: Data and messages can be easily shared to the network
  - Centralized Data: Data & applications can be stored in single server and shared among network
  - Data Security: It is easy to manage data in central server

52 TYPES OF NETWORK

- Dis-advantages of LAN
  - High setup cost: Initial setup cost is high because special server software is required along with networking devices like switch, hub, ethernet cables etc.
  - Data Security Threat: Unauthorized user can have access to centralized data if not properly monitored
  - Maintenance Cost: Network administrator is required to maintain and manage hardware & software failures
  - Covers Limited Area: It is restricted to small geographical area like single office, building or campus.

TYPES OF NETWORK

- Metropolitan Area Network (MAN)
  - It is network of size between LAN and WAN
  - It covers the area inside a town or city
  - It is designed to cover network that expands over metropolitan area
  - e.g. telephone network, ADSL network, TV network

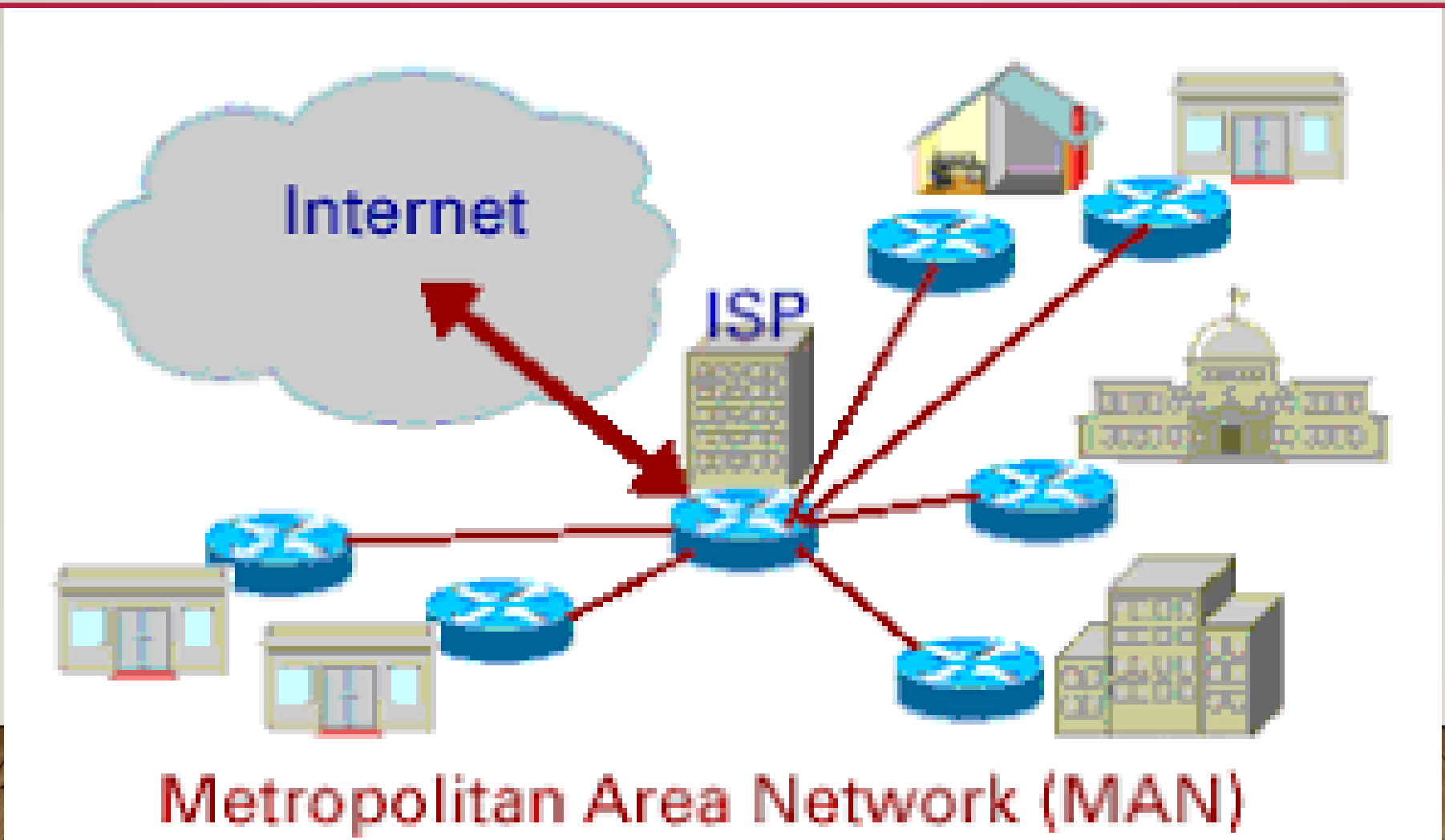
54 TYPES OF NETWORK

- Advantages of MAN
  - High speed network: provides high speed network compared to WAN
  - High Security: provides high security than WAN
  - Low cost: Low setup and maintenance cost than WAN

55 TYPES OF NETWORK

- Dis-advantages of MAN
  - Difference in Speed: introduces variations in internet speed
  - Security Threat: may arise threat to data security
  - Maintenance: More complex maintenance than in LAN

56 TYPES OF NETWORK



57 TYPES OF NETWORK

- Wide Area Network (WAN)
  - It provides long distance transmission of data over large geographic area
  - It is complex and giant network of network
  - It connect LANs, MANs from spread all over the world
  - It provides internet access

58 TYPES OF NETWORK

- Advantages of WAN
  - Large network: It covers large geographic area
  - Data sharing: allows data sharing all over the world
  - High bandwidth: higher bandwidth compared to LAN and MAN
  - Centralized data: data are centralized and can get updated via network

59 TYPES OF NETWORK

- Dis-advantages of WAN
  - Security threat: Unsecured public network
  - Hardware software requirements: needs firewall and antivirus software to protect data
  - High setup cost: very expensive to setup
  - Troubleshoot problem: difficult to fix problem
  - Maintenance: requires high tech skilled manpower, supervisor and technicians

TRANSMISSION MEDIA

- Transmission media refers to the wires cables and other means through which data travels from its source to destination.
- They are often called as communication media.
- There are two types of media:
- Bounded (guided or wired)
  - Twisted pair cable, coaxial cable, fiber optics cable
- Unbounded (unguided or wireless)
  - Microwave, satellite communication, infrared technology

GUIDED VS UNGUIDED MEDIUM

GUIDED MEDIUM

- The signal is directed and contained by the physical medium
- It is called wired communication or bounded media
- Signal energy propagates through wires
- eg. twisted pair cable, coaxial cable, optical fiber etc

UNGUIDED MEDIUM

- The signal has no specific direction to travel, signal travels in electromagnetic wave form
- It is called wireless communication or unbounded media
- Signal energy propagates through air or space
- eg. Radio waves, microwaves, infrared, wi-fi, Bluetooth etc

62 TWISTED PAIR CABLE

- It is the oldest and still most common transmission media. It contains a pair of cables twisted with each other.
- The most common application of the twisted pair is in the telephone and in LAN. Twisted pair can only run few hundred meters without amplification, for longer distance, repeaters are used which re-amplifies the signals.
- Twisted pairs are cheaper, lighter, thinner, flexible and easier to install.
- The twisted pair cable is connected with the help of RJ-45 connector (for LAN) and RJ-11 connector (for telephone).

63 TWISTED PAIR CABLE

- Twisted pair cable can be Unshielded Twisted Pair (UTP) and Shielded Twisted Pair (STP).
- Unshielded Twisted Pair (UTP)
  - It is most common twisted pair and does not contain an extra covering. It cannot carry data signal for longer distance compared to STP. It is cheaper.
- Shielded Twisted Pair (STP)
  - It is rarely used. It contains an extra metal foil outside plastic cover of each pair. It can carry data signal for longer distance. It is expensive.

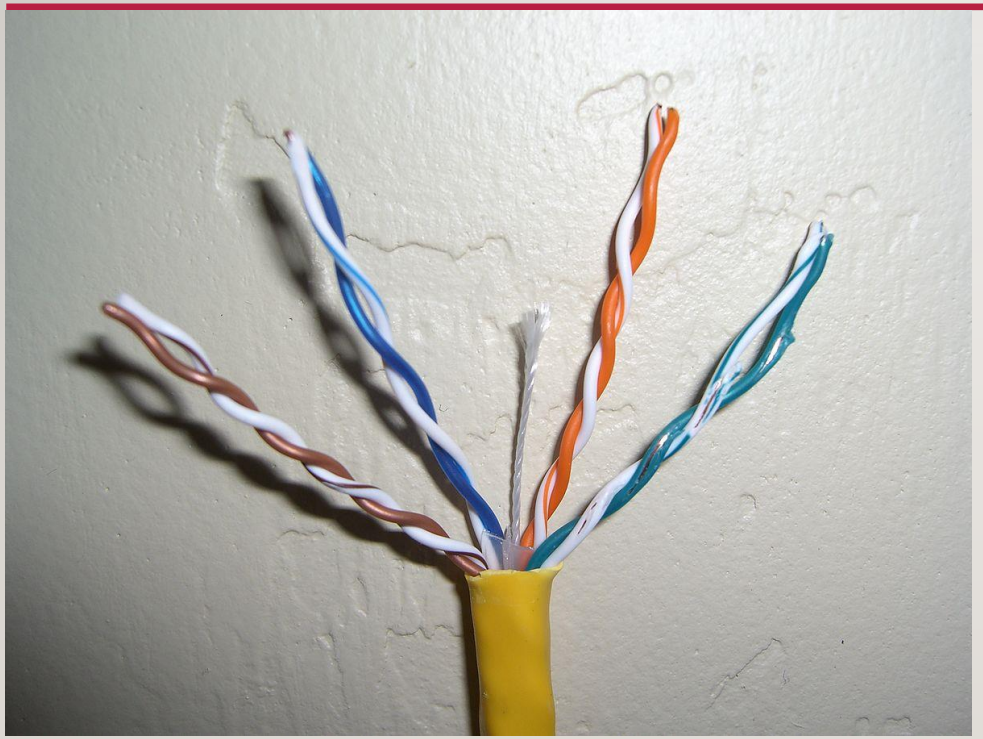
64 TWISTED PAIR CABLE

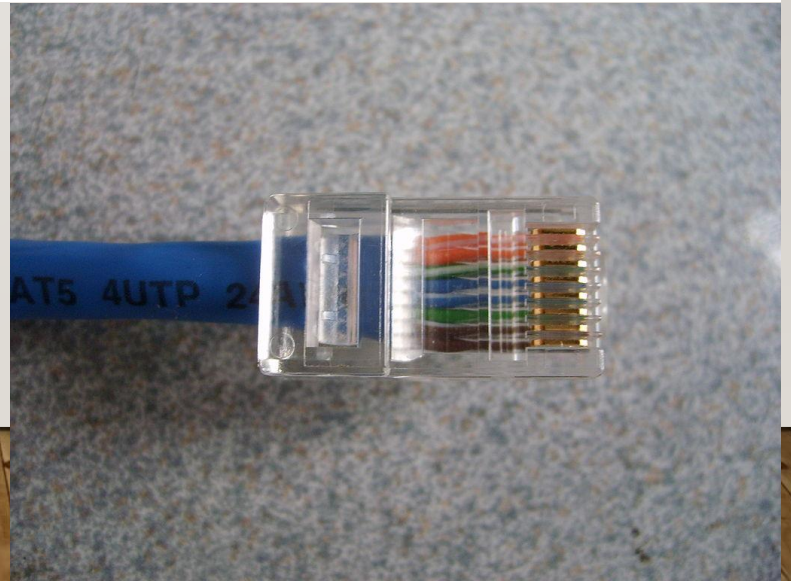
UTP Categories	Data Rate	Max. Length	Frequency
CAT 1	Up to 1 Mbps		
CAT 2	Up to 4 Mbps		
CAT 3	Up to 10 Mbps	100 m	16 MHz
CAT 4	Up to 16 Mbps	100 m	
CAT 5	Up to 100 Mbps	100 m	100 MHz
CAT 5e	Up to 1 Gbps	100 m	100 MHz
CAT 6	Up to 10 Gbps	100 m	>250 MHz
CAT 6a	Up to 10 Gbps	100 m	500 MHz
CAT 7	Up to 10 Gbps	100 m	600 MHz

65 TWISTED PAIR CABLE

- Advantages
  - It is lighter, cheaper and more flexible.
  - It can transmit data at a higher bandwidth for short distance.
- Disadvantages
  - It cannot be used for long distance transmission.
  - It is slower than optical fibers.
  - Data transmitted through UTP can be affected by electrical and magnetic field.

66 TWISTED PAIR CABLE





67 UTP VS STP

UTP

- Electromagnetic interference and noise is more
- It offers speed of about 10 to 1000 Mbps
- It is widely used for data transmission within short distance and is very popular for home network
- Cost of UTP is less than STP

STP

- It reduces electrical noise within cable and from outside of cable
- It offers speed of about 10 to 100 Mbps
- STP is widely used for enterprise network over long distance
- STP is costlier than UTP

68 COAXIAL CABLE

- Coaxial cable carries data signal of higher frequency and at a faster speed than twisted pair cable.
- It is mostly used for television transmission.
- It supports multiplexing. i.e. carrying multiple frequencies at the same time from single medium. It has large bandwidth.
- Coaxial cable has a single copper conductor at its center and a plastic layer provides insulation between the conductor and meshed aluminum shield. All these are finally surrounded by insulation layer.

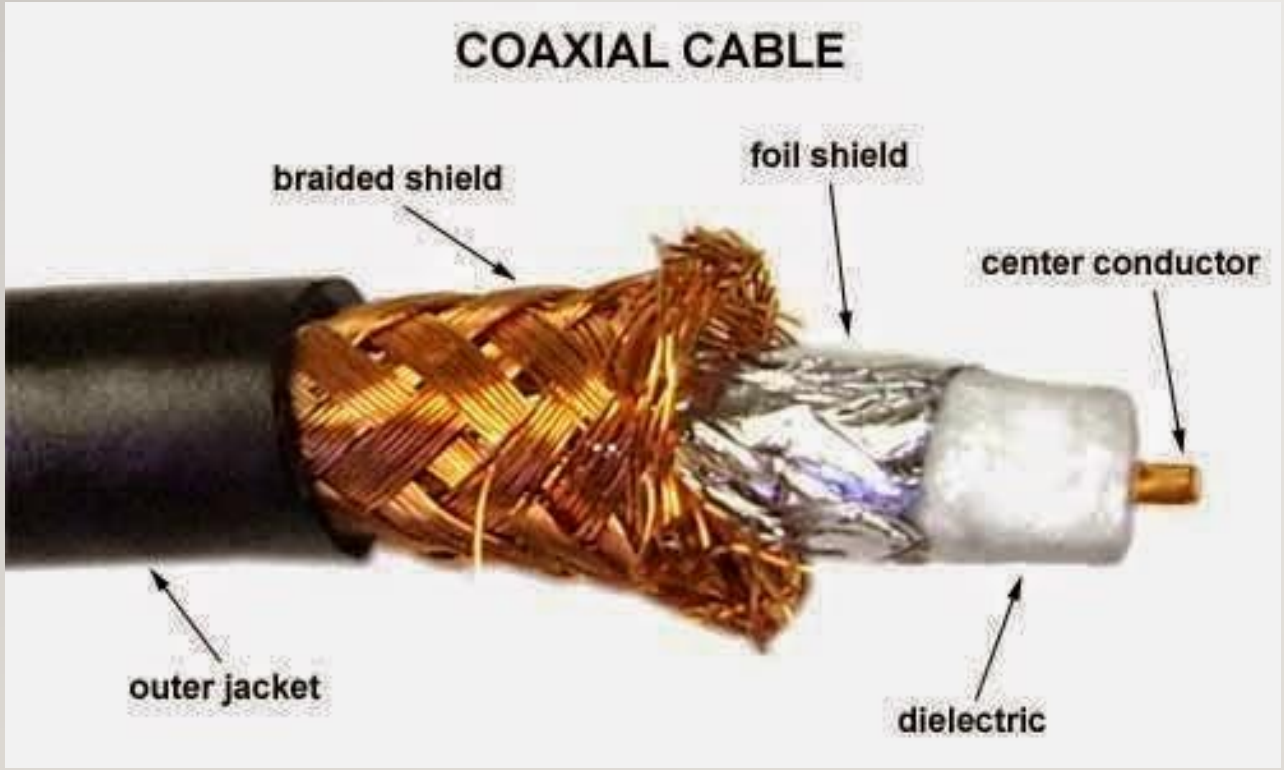
69 COAXIAL CABLE

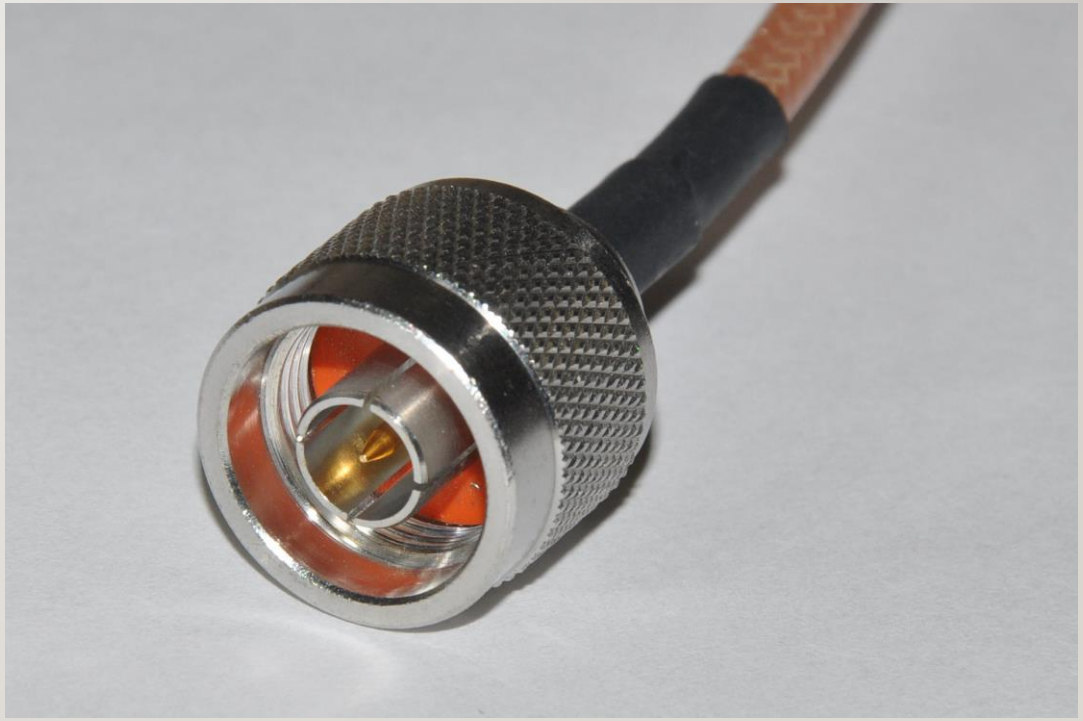
- The BNC (Bayonet-Neill-Concelman) connector is required for connecting this cable. There are two types of coaxial cables:
- Thin coax (thin-net):
  - also known as 10base2 cable having speed 10 mbps up to 200 meters.
- Thick coax (thick-net):
  - also known as 10base5 cable having speed 10 mbps up to 500 meters.

70 COAXIAL CABLE

- Advantages
  - It provides faster data transmission than the twisted pair cable.
  - It can transmit data over medium range distance.
  - It is easier to install, modify and manage the network.
- Disadvantages
  - It is expensive than twisted pair cable.
  - It is also not appropriate for long distance transmission.
  - It is mostly used for television broadcasting than computer network.

71 COAXIAL CABLE





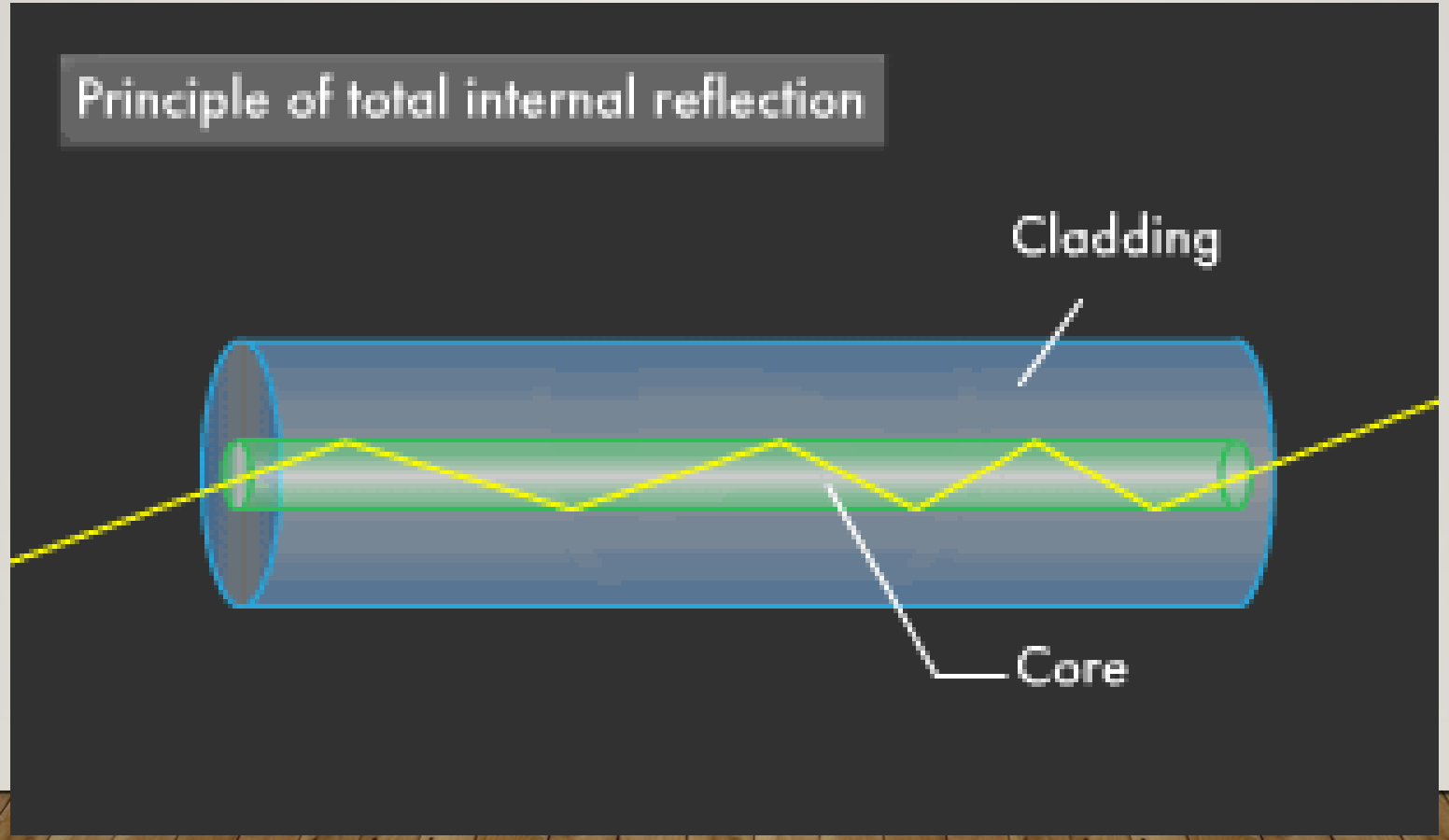
72 OPTICAL FIBER CABLE

- A fiber optic cable is made of glass or plastic and transmits signals in the form of light.
- A thin hair like fiber is capable of transmitting data at the speed of 2 billions bits per second.
- It has enormous bandwidth and carry signals for extremely long distance.
- It uses light pulses to carry data. So the signals are not affected by electromagnetic interference making the data transmission secure.

73 OPTICAL FIBER CABLE

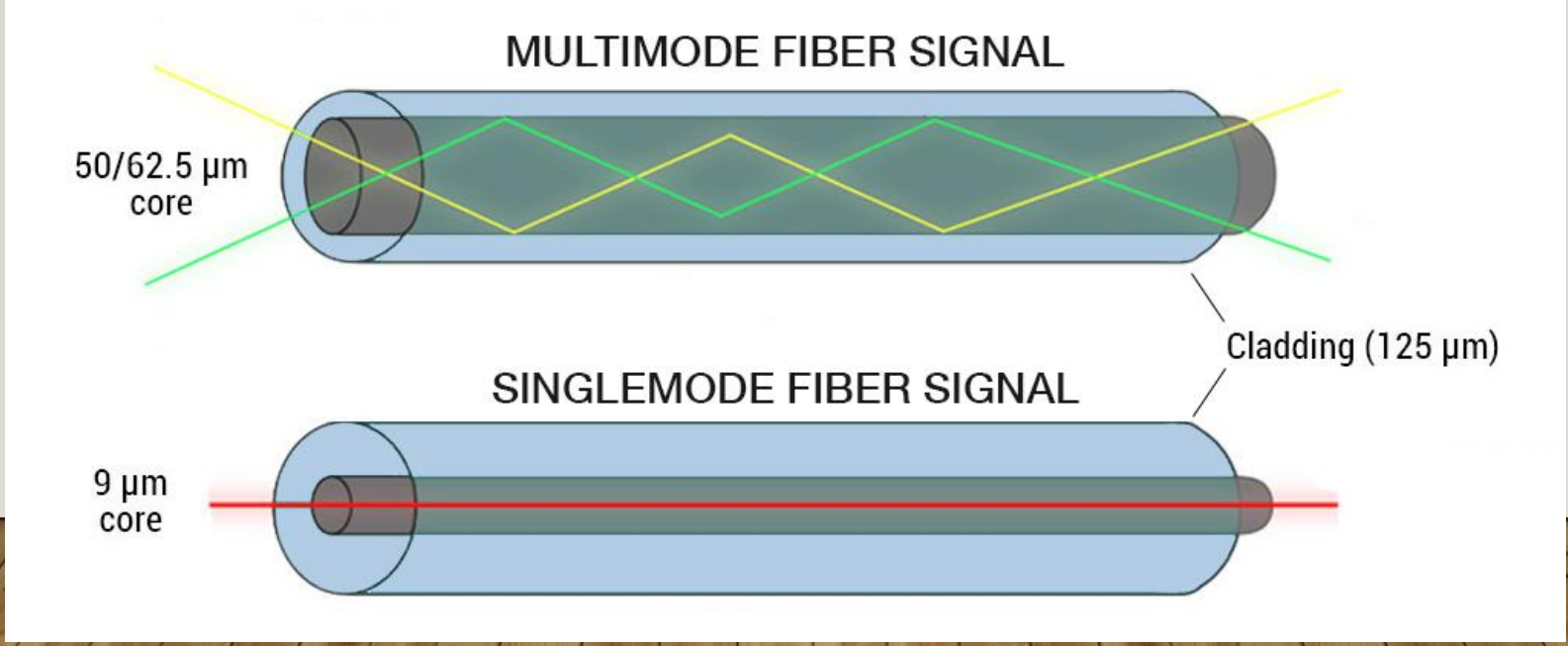
- Light Emitting Diodes (LEDs) at one end converts electrical pulses into light pulses and transmits it along the fiber from one end whereas at the other end light sensor or detectors are used to receive the light signals, convert them back into electrical signals.
- It is used for services like telecommunication, video conferencing and internet nowadays.

74 OPTICAL FIBER CABLE



75 OPTICAL FIBER CABLE

- Optical fiber can be categorized into two types:
  - Single-mode fiber: carries only one signal
  - Multi-mode fiber: carries multiple signals



76 OPTICAL FIBER CABLE

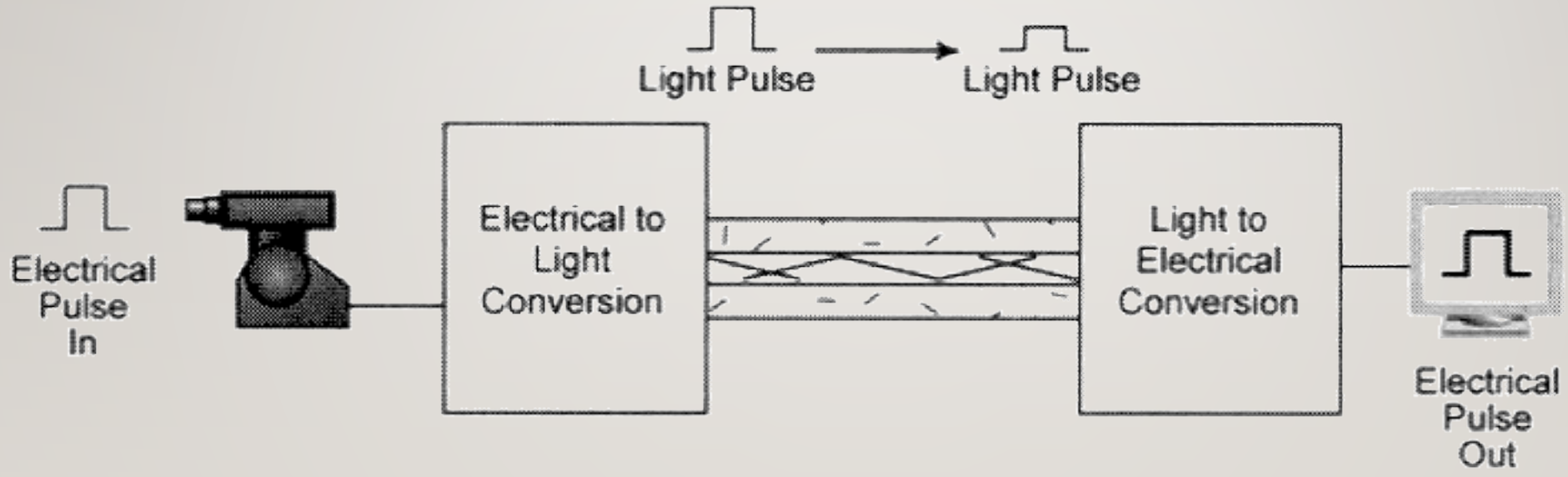
Advantages

- It provides fastest data transmission than other.
- It can transmit data for long distance.
- It provides error free and highly secured data transmission.
- It can transmit multiple data at the same time.

Disadvantages

- It is highly expensive and difficult to install.
- It is difficult to bend and may result fiber breakage.
- Skilled technical manpower is required.

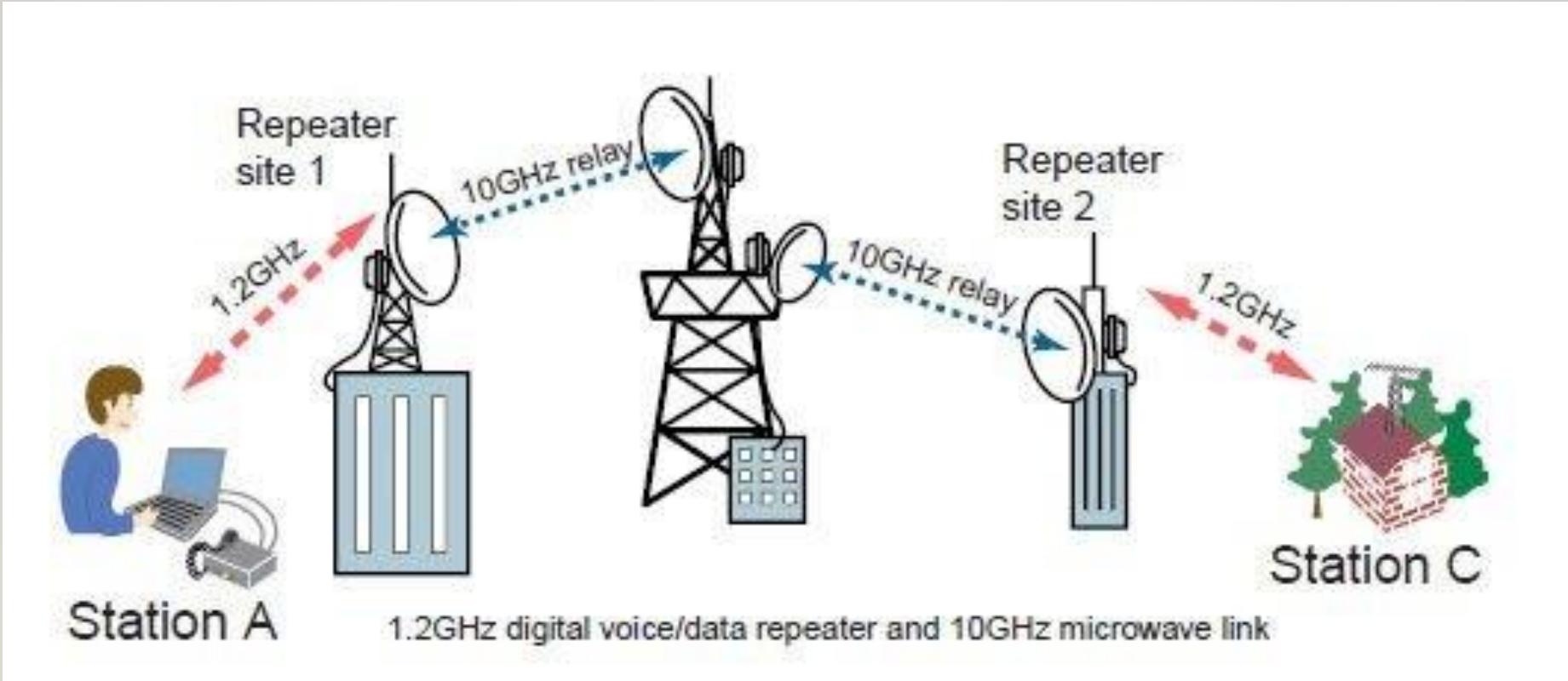
77 OPTICAL FIBER CABLE



78 MICROWAVE SYSTEM

- It uses very high frequency radio signals to transmit data through air medium.
- The transmitter and receiver should be in line of sight because the radio signal cannot bend.
- Long distance communication is not possible. So repeaters are used at intervals of 25 to 30 km.
- The repeating tower receives weak signal, amplifies the signal and sends it to next tower.
- The commercial radio frequency (RF) used are 2 to 60 GHz.

79 MICROWAVE SYSTEM



80 MICROWAVE SYSTEM

Advantages

- It has high bandwidth than infrared wave.
- The quality of data transmission is better than infrared wave.

Disadvantages

- It cannot bend and pass obstacles so requires line of sight for data transmission.
- It does not cover very large space because of earth's curvature

81 SATELLITE COMMUNICATION

- It is the most common worldwide communication system.
- It uses satellite as a repeater. The transmitter and receiver are located in ground stations.
- Transmitter transmits microwave signal to satellite. The satellite amplifies the weak signal and transmits it back to the receiver making it possible to communicate for longer distance.

82 SATELLITE COMMUNICATION

83 SATELLITE COMMUNICATION

Advantages

- It covers larger geographical area of earth.
- It has higher bandwidth than microwave and infrared.

Disadvantages

- It is very expensive for installation and for maintenance.
- It has signal propagation delay. i.e. slow communication.

84 INFRARED SIGNAL

- Infrared waves have frequencies from 300 GHz to 400 THz
- It can be used for short distance and smaller area.
- It is mainly used in wireless remote control, wireless LAN(WLAN), wireless mouse and keyboard.
- Wi-fi, Bluetooth etc uses these technology to communicate.

85 INFRARED SIGNAL

86 INFRARED SIGNAL

Advantages

- It is cheaper and easy to install.
- It enables mobile computing.

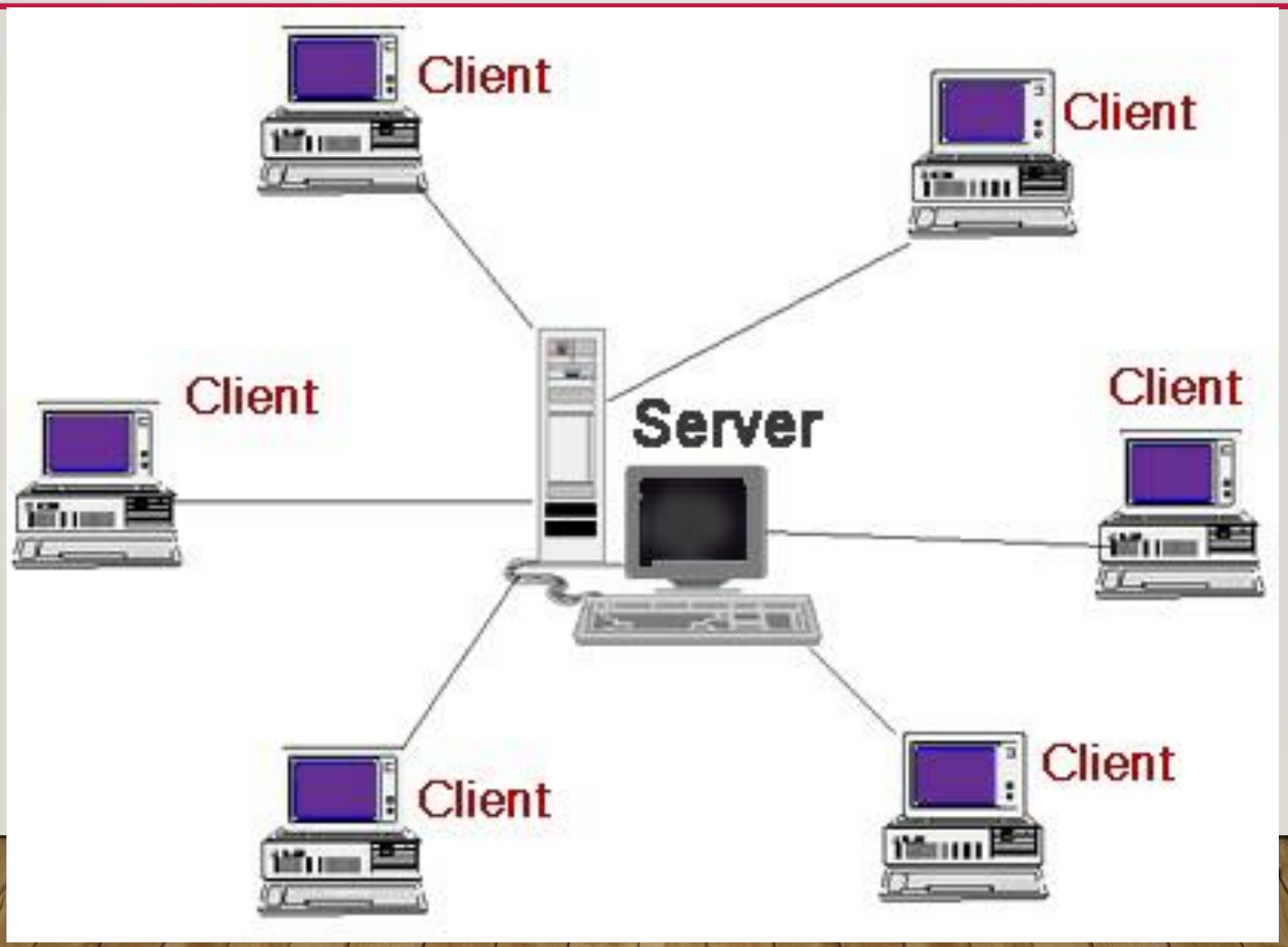
Disadvantages

- Data transfer rate is slower than that in wired media.
- The quality of data transmission is poor.

87 CLIENT SERVER ARCHITECTURE

- In this architecture, one dedicated server which is responsible for providing services to multiple clients
- Central servers are powerful computers that receives client requests, handles them and provides the services to the clients

88 CLIENT SERVER ARCHITECTURE



89 CLIENT SERVER ARCHITECTURE

Features

- Consists powerful server and other clients
- All data and information are stored in the server
- Security and network management are done by the server
- Client requests server and server replies with services

90 CLIENT SERVER ARCHITECTURE

Advantages

- Back up of data is easier as all data are stored in one computer called server
- Dedicated server improves overall performance
- Security is better
- Resources can be easily shared
- Data information management can be easy

91 CLIENT SERVER ARCHITECTURE

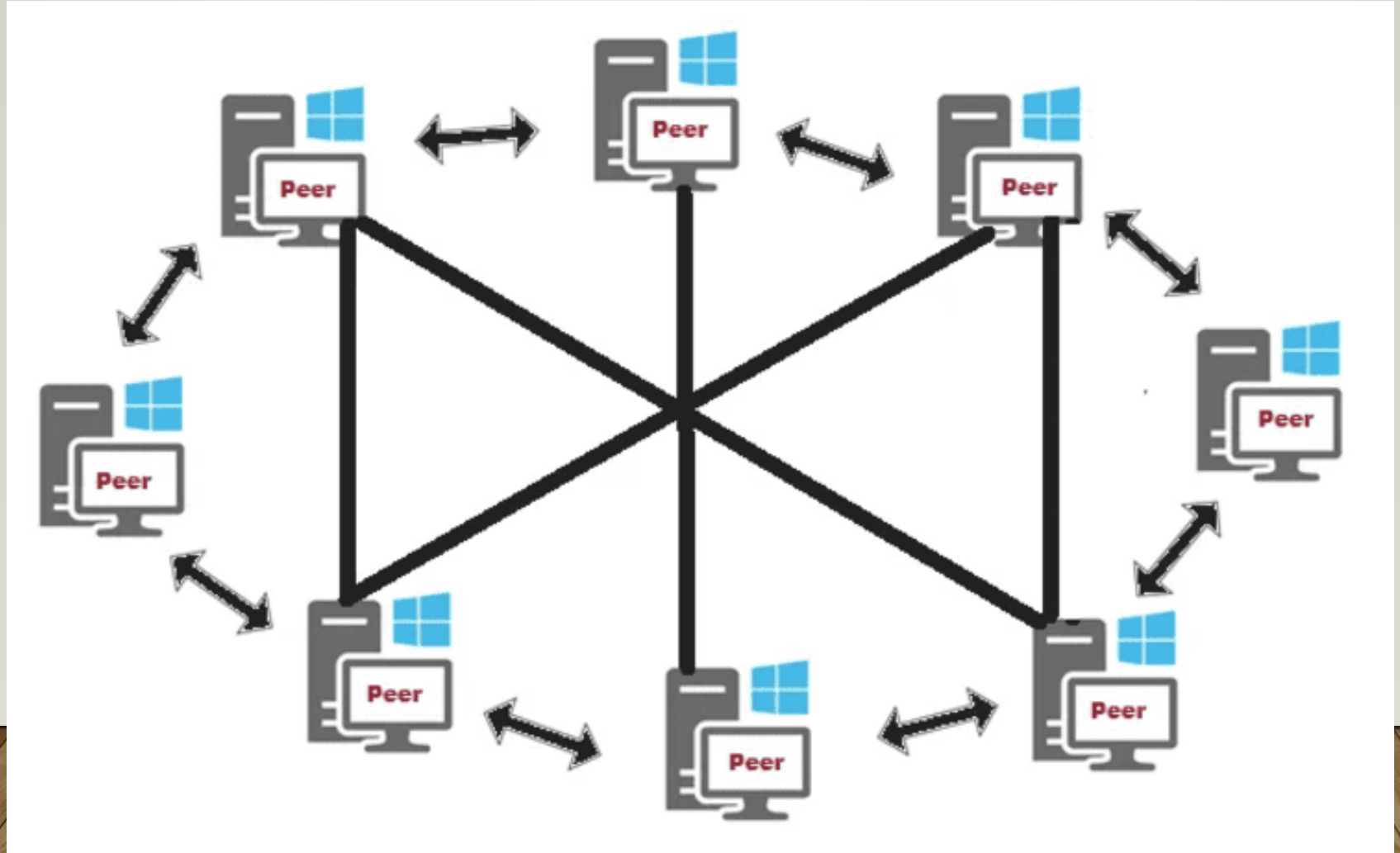
Disadvantages

- Expensive due to dedicated server
- server must have Network Operating System to provide services and cost of NOS is high
- Requires dedicated network administrator
- When server goes down entire network/system will be down
- Skilled technical manpower required

92 PEER TO PEER ARCHITECTURE

- All connected computer have equal roles and responsibility
- Each computer can act as client as well as server
- All nodes have same abilities, use resources available equally
- No hierarchy

93 PEER TO PEER ARCHITECTURE



94 PEER TO PEER ARCHITECTURE

Features

- All computers have equal roles and responsibilities
- No central dependency among nodes
- Each computer can work as client and server
- No need of dedicated server
- Each computer utilizes resources

95 PEER TO PEER ARCHITECTURE

Advantages

- Less costly because there is no need of dedicated server
- problem in one computer does not affect others
- Easy to setup and maintain

96 PEER TO PEER ARCHITECTURE

Disadvantages

- Low security because data is distributed among computers
- Back up of data is more difficult
- security and maintenance becomes difficult with growing number of nodes

97 CLIENT SERVER VS PEER-TO-PEER ARCHITECTURE

CLIENT SERVER

- Focuses on information sharing
- Centralized server is used to store data
- More stable and scalable
- Much more secure and easy to implement authentication
- Client requests and Server responses with reply

PEER TO PEER

- Focuses on connectivity
- Each peer has its own data
- Less stable if number of peers are increased
- Less secured and difficult to implement authentication
- Each node acts as both clients and servers

BASIC TERMS IN COMPUTER NETWORK

- IP Address
  - It is a unique address that identifies a device on the internet or a local area network.
  - IP stands for Internet Protocol which is set of rules for format of data to be sent via internet or network.
  - 4 set of unique 8-bit numbers assigned to a device
  - eg. 11000000 10101000 00000001 00001111
  - i.e. 192.168.1.15

99 BASIC TERMS IN COMPUTER NETWORK

- IP Address
  - There are two IP versions: IPv4 and IPv6
  - IPv4 is older version which has space over 4 billion IP address
  - IPv6 is the newest version which can provide upto trillions of IP address
  - IPv6 : fe80::f57b:ac78:af79:22ae%12
  - IPv4 : 192.168.123.6

100 BASIC TERMS IN COMPUTER NETWORK

- IP Address
  - IPv4 uses 32 bit address which can assign 2^{32} devices uniquely
  - IPv6 uses 128 bit address which can assign 2^{128} devices uniquely
  - IPv6 address is 1028 times faster than IPv4
  - IPv6 can fulfill future demands of computer networking

101 BASIC TERMS IN COMPUTER NETWORK

- Subnet Mask
  - It is logical sub division of IP address. It helps to identify network address and host address
  - It is 32 bit number (written in "dotted-decimal")
  - It is used to create and design sub networks
  - e.g. 255.255.255.0

102 BASIC TERMS IN COMPUTER NETWORK

- Subnet Mask
  - The practice of dividing a network into two or more networks is called subnetting
  - Subnetting increases routing efficiency which enhance security and reduces size of broadcast domain
  - Subnet are of two types: default subnet and custom subnet

103 BASIC TERMS IN COMPUTER NETWORK

- Gateway
  - It is used to connect devices of different network. If any device in local network wants to send data to device on another network, it first sends its packets to the gateway.
  - Router, firewall acts as gateway.
  - It is a connecting device between two networks

104 BASIC TERMS IN COMPUTER NETWORK

- Mac Address
  - Mac stands for Media Access Control. It is a unique identifier of the device provided by the manufacturer to piece of NIC.
  - It consists of six sets of two Hexadecimal numbers 48 bit address separated by colon.
  - It is also known as physical address of the device
  - e.g. 00:1B:44:11:3A:B7

105 BASIC TERMS IN COMPUTER NETWORK

- Mac Address
  - Mac addresses are permanent but in some case they can be changed
  - There are two types of Mac IDs
    - Universally Administered Address (UAA)
    - Locally Administered Address (LAA)

106 BASIC TERMS IN COMPUTER NETWORK

- Universally Administered Address
  - Most commonly used Mac address
  - assigned to the network adapter when it is manufactured
  - first 3 octets define manufacture and later 3 octets identify individual adapter

107 BASIC TERMS IN COMPUTER NETWORK

- Locally Administered Address
  - It is an address that changes adapter's Mac address
  - Allows to change adapter's Mac address
  - Network adapter uses LAA as Mac address

108 BASIC TERMS IN COMPUTER NETWORK

- Internet
  - Internet is the largest global giant computer network
  - It is globally connected computer network system.
  - It provides worldwide communication and access to resources through various private, public, business, academic and government networks.

109 BASIC TERMS IN COMPUTER NETWORK

Internet

- The Internet is a global system of interconnected computer networks that use the standard Internet Protocol Suite (TCP/IP) to serve billions of users worldwide.
- It is a network of networks that consists of millions of private, public, academic, business and government networks.
- Internet can be used in online communication, software sharing, exchange of views, posting product promotions, sending/receiving e-mails, online journals/magazines, online shopping, audio/video conferencing etc.

BASIC TERMS IN COMPUTER NETWORK

History of Internet

- The development of internet started when the US Defense Department set up the ARPANET (Advanced Research Project Agency Network) also known as ARPA to establish failure proof communication network for defense department of US.
- This architecture was later adopted by educational institute for exchange of views among research scholars and then it was set open to public since 1994.

BASIC TERMS IN COMPUTER NETWORK

Intranet

- It is secure and private network owned by any organization to share data application resources using IP protocol.
- Internet is public network but intranet is private

112 BASIC TERMS IN COMPUTER NETWORK

Extranet

- It is a part of intranet that is accessible to some people from the organization. It is a controlled private network allowing customers, partners, vendors to gain information
- It is restricted to selected users through user ID, password and other authentication mechanisms.

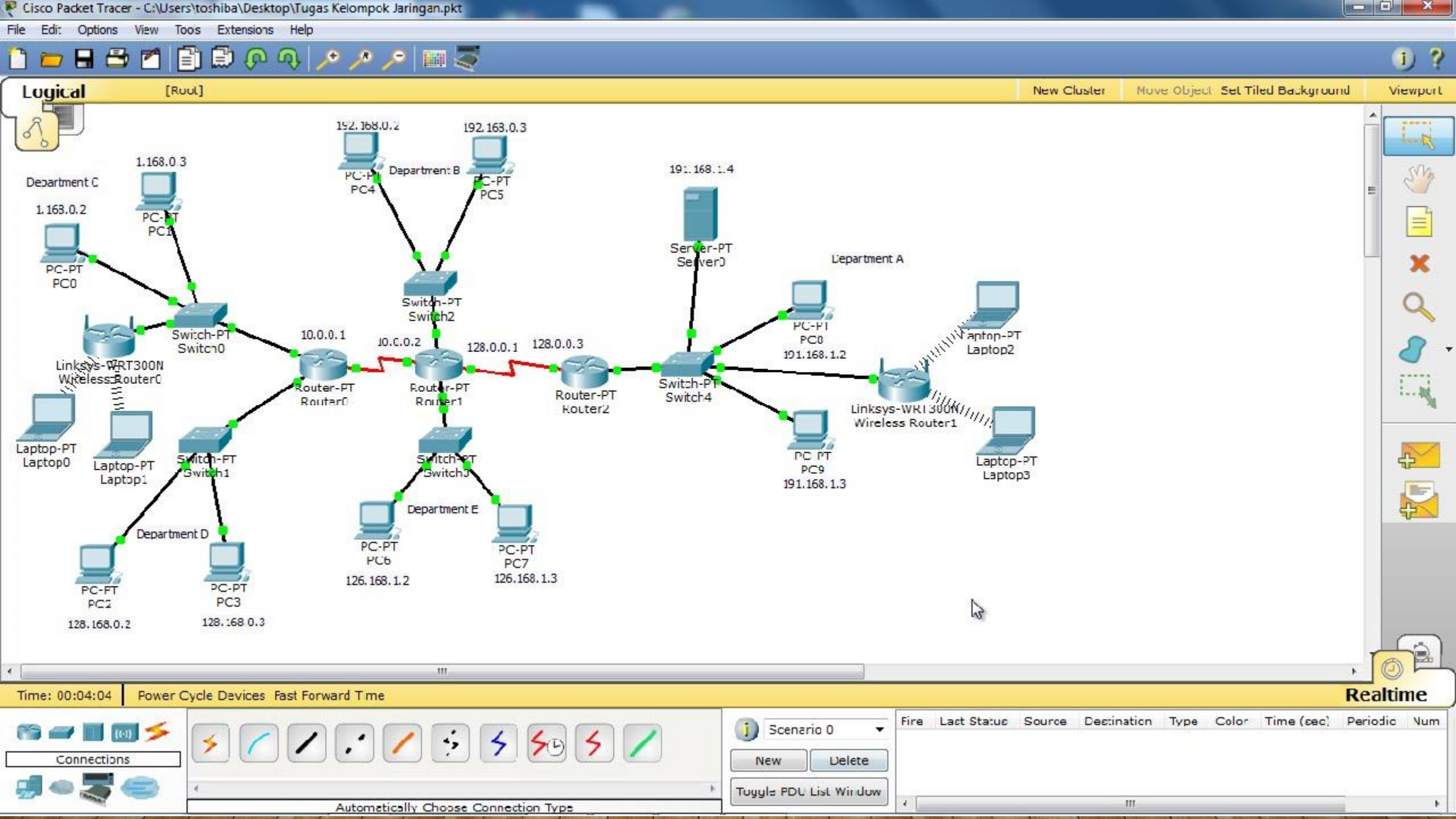
113 PACKET TRACER

- Packet Tracer is a comprehensive networking teaching and learning tool that offers a unique combination of realistic simulation and visualization experiences
- It will help students and teachers collaborate, solve problem and learn concept

114 PACKET TRACER

Advantages

- Provides realistic simulation and visualization learning environment
- Enables multiuser, real time collaboration and competition for dynamic learning
- Enables authoring and localization
- Empowers students to explore concepts conduct experiments and understand network
- Allows to design, build, configure and troubleshoot network


Cisco Packet Tracer - C:\Users\toshiba\Desktop\Tugas Kelompok Jaringan.pkt
File Edit Options View Tools Extensions Help
Logical
[Root]
New Cluster
Move Object
Set Tiled Background
Viewport
192.168.0.2
192.163.0.3
Department C
1.168.0.3
Department B
PC-PT PC4
PC-PT PC5
1.163.0.2
PC-PT PC1
PC-PT PC0
Switch-PT Switch2
Server-PT Server0
191.168.1.4
Department A
Switch-PT Switch0
10.0.0.1
10.0.0.2
128.0.0.1
128.0.0.3
PC-PT PC0
191.168.1.2
Laptop-PT Laptop2
Linksys-WRT300N Wireless Router0
Router-PT Router0
Router-PT Router1
Router-PT Router2
Switch-PT Switch4
Linksys-WRT300N Wireless Router1
Laptop-PT Laptop0
Laptop-PT Laptop1
Switch-PT Switch1
Switch-PT Switch3
PC-PT PC9
191.168.1.3
Laptop-PT Laptop3
Department E
Department D
PC-PT PC6
126.168.1.2
PC-PT PC7
126.168.1.3
PC-PT PC2
128.168.0.2
PC-PT PC3
128.168.0.3
Time: 00:04:04
Power Cycle Devices
Fast Forward Time
Realtime
Connections
Automatically Choose Connection Type
Scenario 0
New
Delete
Toggle PDU List Window
Fire
Last Status
Source
Destination
Type
Color
Time (sec)
Periodic
Num

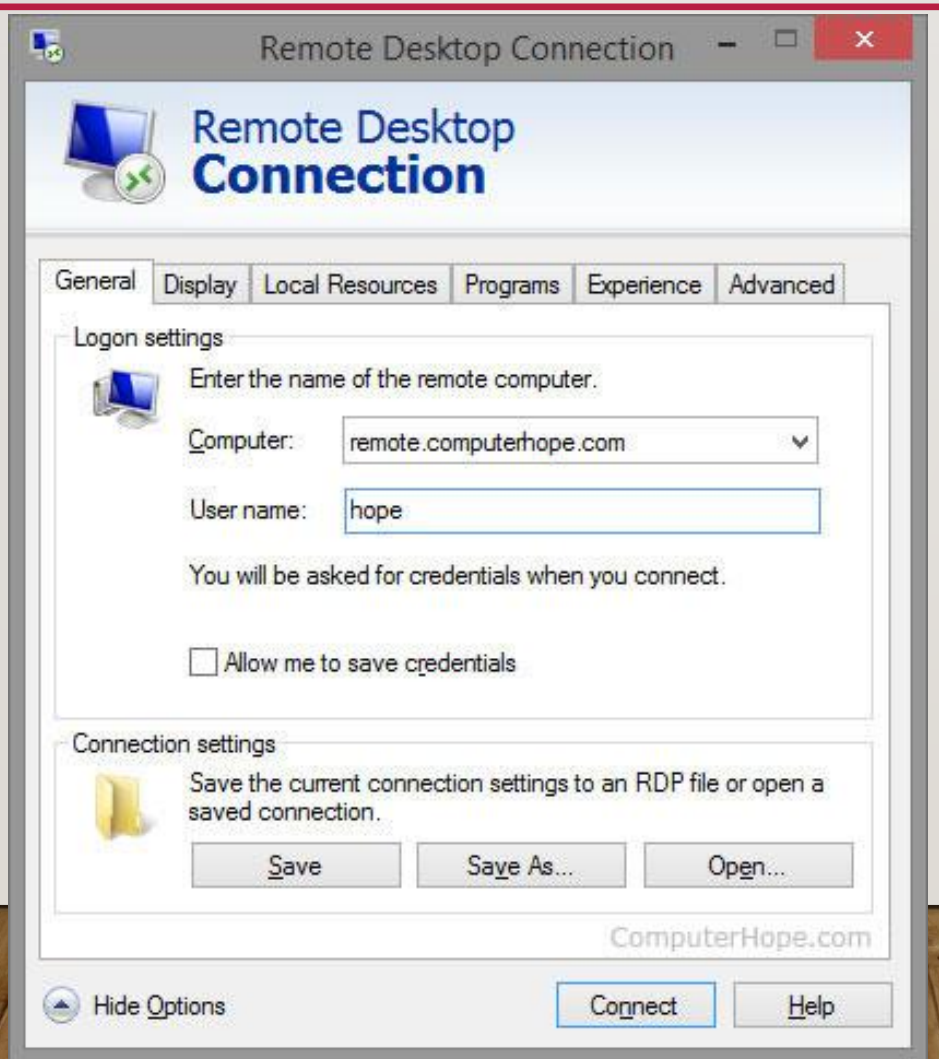
116 REMOTE DESKTOP LOGIN

- It allows a user terminal to connect remote host computer through a network and interact as if the user is interacting the computer directly
- Remote desktop connection allows us to use remote computer virtually
- Once connected, we get access to all resources connected to that host computer

117 REMOTE DESKTOP LOGIN

- It is very useful when we need to access remote computer and access them
- Most recent versions of windows OS supports Remote Desktop Connection
- Other third party software like TeamViewer, AnyDesk also provide such type of features

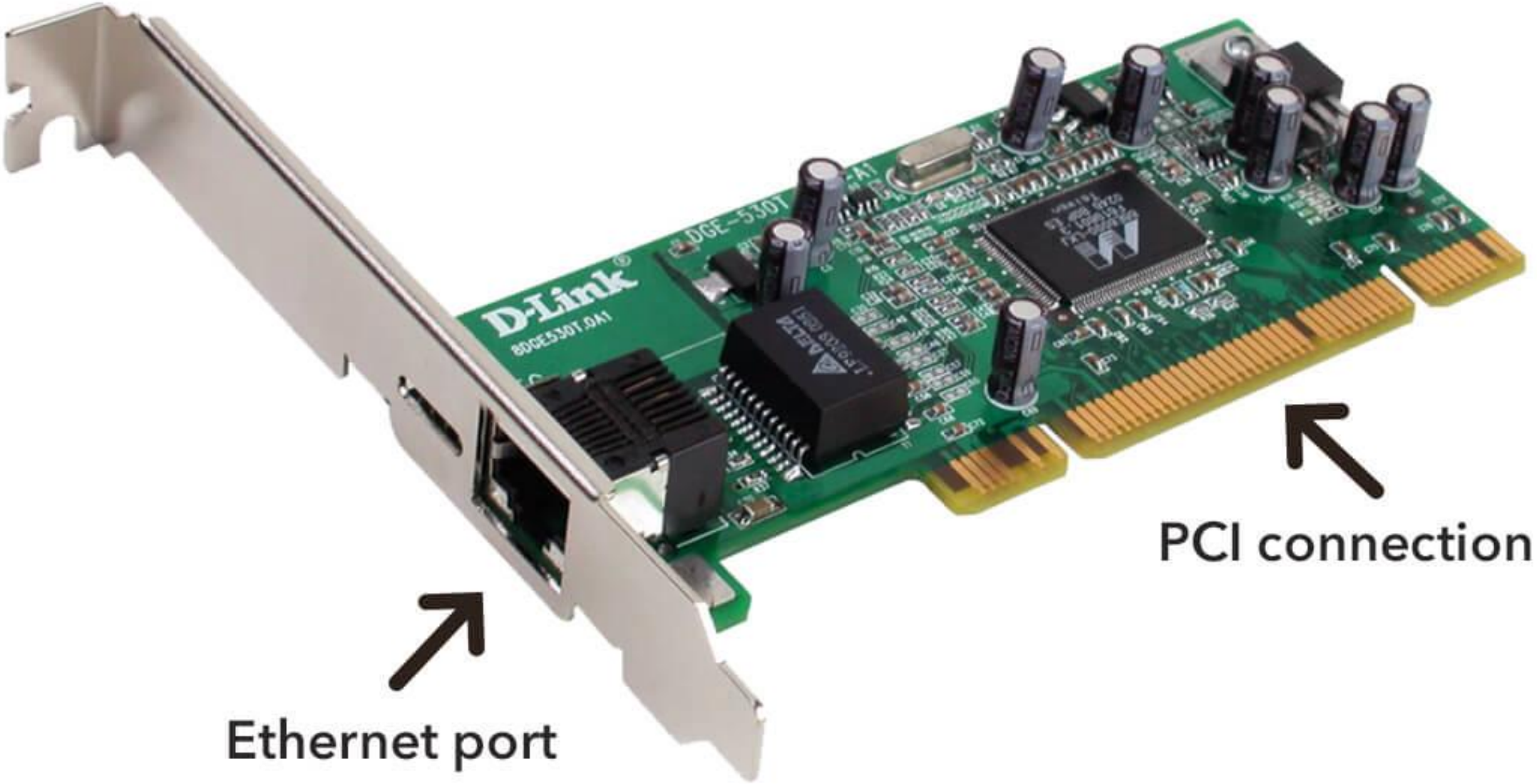
118 REMOTE DESKTOP CONNECTION



119 NETWORK CONNECTING DEVICES

- **Network Interface card (NIC)**
- Network Interface Card is a device that connects computer with network cable.
- It is a circuit board installed in a computer that provides dedicated network connection
- NIC card co-ordinates the transfer of information between the computer and the network.
- Modern NIC offer advanced features such as interrupt and DMA interfaces, supports multiple receive and transmit queues etc.
- Each NIC is assigned a unique MAC (Media Access Control) or physical address.
- It is also known as network adapter.

Gigabit Ethernet NIC

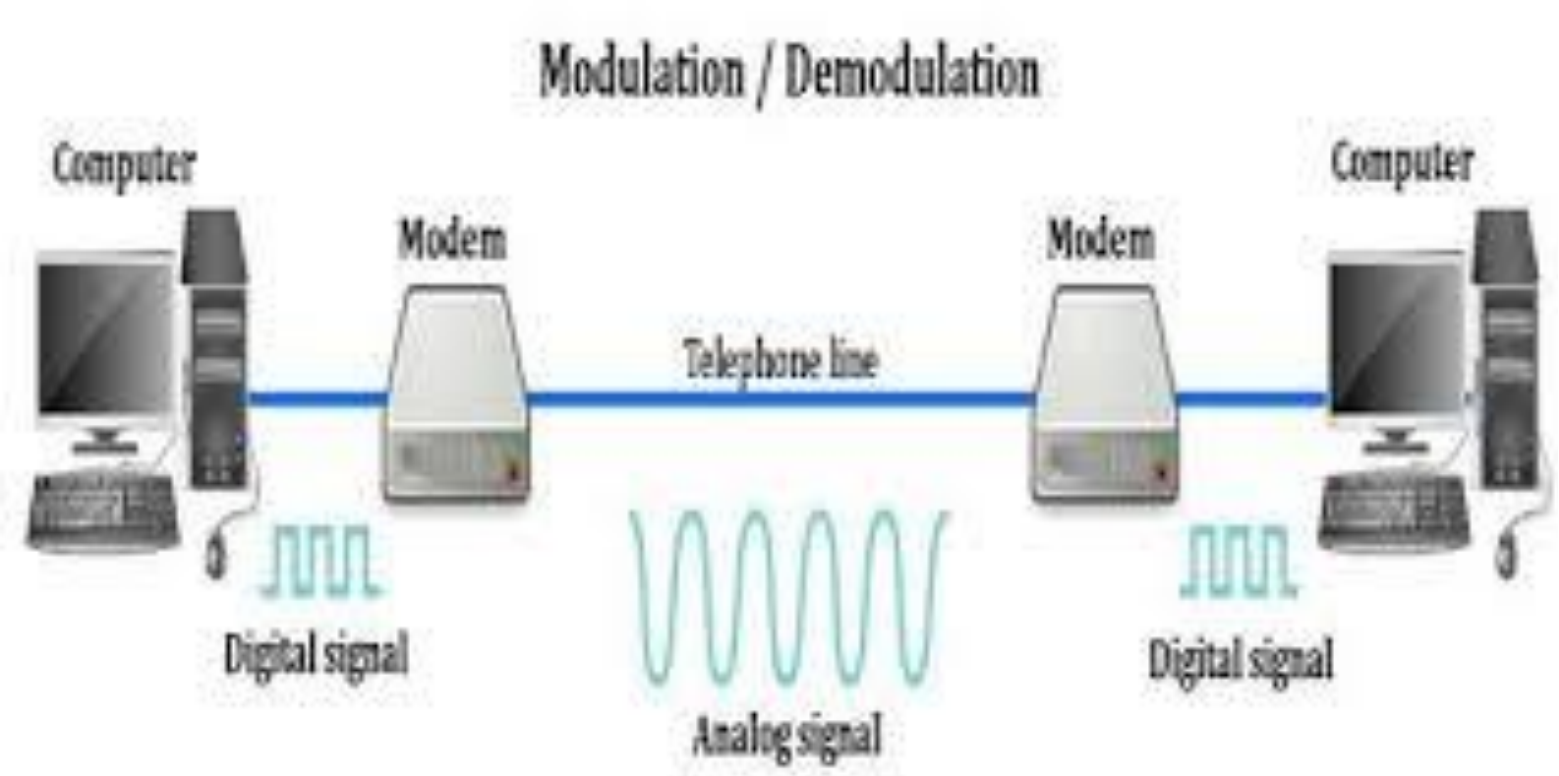


TechTerms.com

121 NETWORK CONNECTING DEVICES

- **Modem**
- Modem stands for Modulator and Demodulator.
- It converts binary codes into analog signal which can be further transferred via telephone network or cable.
- Modulation is the process of converting Digital binary data to analog data and Demodulation is the reverse process i.e. converting analog data into digital binary data.
- Modem can be internal or external.
- Modems have just two ports: one that connects to the outside world and an Ethernet jack that connects to a computer or a router

122 NETWORK CONNECTING DEVICES



123 NETWORK CONNECTING DEVICES

- **Hub**
- Hub is a multi-port network connecting device that connects multiple computers to a server in a LAN.
- It works on layer 1 (i.e. physical layer) of OSI (Open System Interconnection) model.
- It accepts data, amplifies it and retransmits data to whole network. It doesn't directs the signal to the actual destination, rather it broadcasts to all the computers connected to it. So, it creates an unwanted data traffic in network.


DC-IN
Up-LINK
5
4
3
2
1

125 NETWORK CONNECTING DEVICES

- **Switch**
- Switch is also a multiport network connecting device that connects multiple computers.
- It is also known as an intelligent hub. When the switch receives a data packet, It creates a direct connection between sender and receiver and forwards the data packet to the destination computer only.
- It works on layer two (i.e. Data link layer) of OSI model.
- It works on full duplex mode.
- It has capability for inspecting address of the data packets and directly switch the source port to destination port.


TP-LINK
TL-SG1024D
24-Port Gigabit Switch
Power
Link
Act
1000Mbps
1 3 5 7 9 11 13 15 17 19 21 23
2 4 6 8 10 12 14 16 18 20 22 24

127 NETWORK CONNECTING DEVICES

- **Router**
- Router is a hardware and software device which is highly intelligent and protocol sensitive linking device generally used to connect two different networks, LANs with WAN.
- It also helps to filter data, route the packets and isolate network.
- It works up to layer 3 (i.e. network layer) of OSI model.
- It keeps tracks of IP addresses, MAC addresses and determines the best path for sending data.

128 NETWORK CONNECTING DEVICES

129 NETWORK TOPOLOGIES

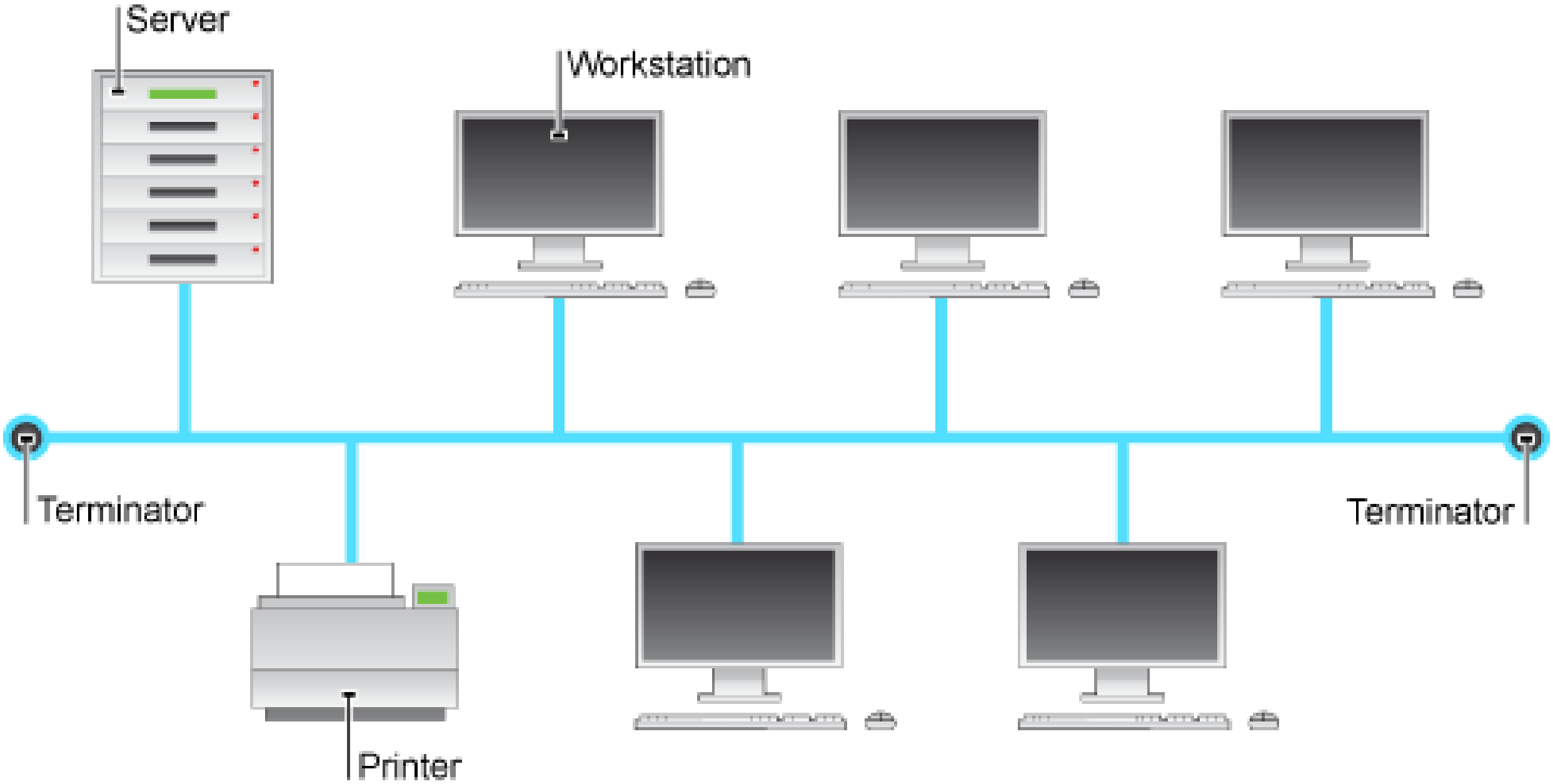
- Network Topology is the schematic description of a network arrangement, connecting various nodes (sender and receiver) through lines of connection.
- Network topology refers to the physical or logical layout of a network.
- It defines the way different nodes are placed and interconnected with each other. Alternately, network topology may describe how the data is transferred between the nodes.

NETWORK TOPOLOGIES

- There are two types of network topologies:
  - physical and logical.
  - Physical topology emphasizes the physical layout of the connected devices and nodes, while the logical topology focuses on the pattern of data transfer between network nodes.

131 NETWORK TOPOLOGIES

- BUS Topology
- Bus topology is a network type in which every computer and network device is connected to single cable.
- When it has exactly two endpoints, then it is called Linear Bus topology.
- Features of Bus Topology
- It transmits data only in one direction.
- Every device is connected to a single cable


Server
Workstation
Terminator
Terminator
Printer

NETWORK TOPOLOGIES

- Advantages of Bus Topology
- It is cost effective.
- Cable required is least compared to other network topology.
- Used in small networks.
- It is easy to understand.
- Easy to expand joining two cables together.

NETWORK TOPOLOGIES

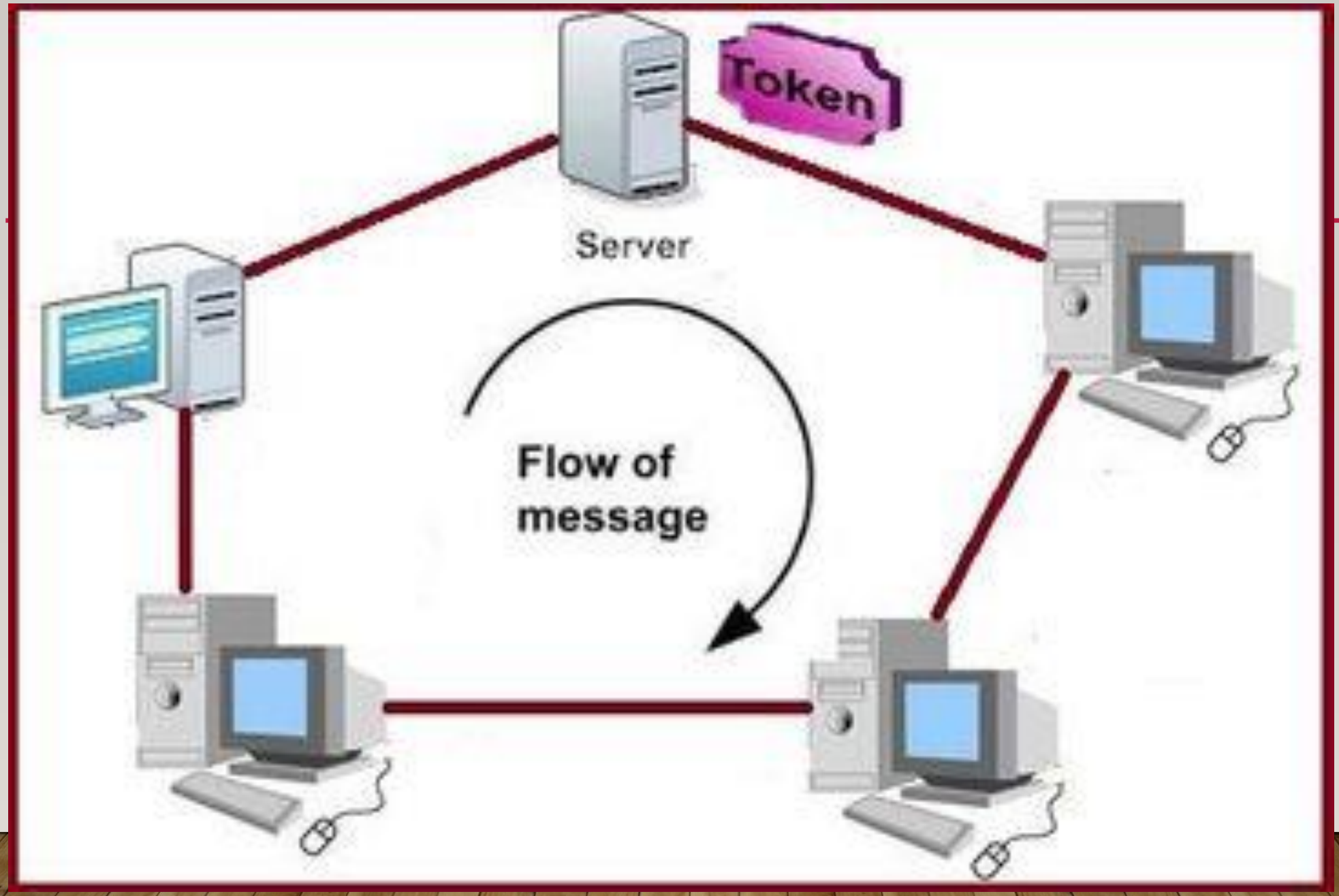
- Disdvantages of Bus Topology
- Cables fails then whole network fails.
- If network traffic is heavy or nodes are more the performance of the network decreases.
- Cable has a limited length.
- It is slower than the ring topology.

NETWORK TOPOLOGIES

- RING Topology
- It is called ring topology because it forms a ring as each computer is connected to another computer, with the last one connected to the first. Exactly two neighbors for each device.
- A number of repeaters are used for Ring topology with large number of nodes, because if someone wants to send some data to the last node in the ring topology with 100 nodes, then the data will have to pass through 99 nodes to reach the 100th node. Hence to prevent data loss repeaters are used in the network.

NETWORK TOPOLOGIES

- RING Topology
- The transmission is unidirectional, but it can be made bidirectional by having 2 connections between each Network Node, it is called Dual Ring Topology.
- In Dual Ring Topology, two ring networks are formed, and data flow is in opposite direction in them. Also, if one ring fails, the second ring can act as a backup, to keep the network up.
- Data is transferred in a sequential manner that is bit by bit. Data transmitted, has to pass through each node of the network, till the destination node.


Token
Server
Flow of
message

NETWORK TOPOLOGIES

- Advantages of RING Topology
- Transmitting network is not affected by high traffic or by adding more nodes, as only the nodes having tokens can transmit data.
- Cheap to install and expand

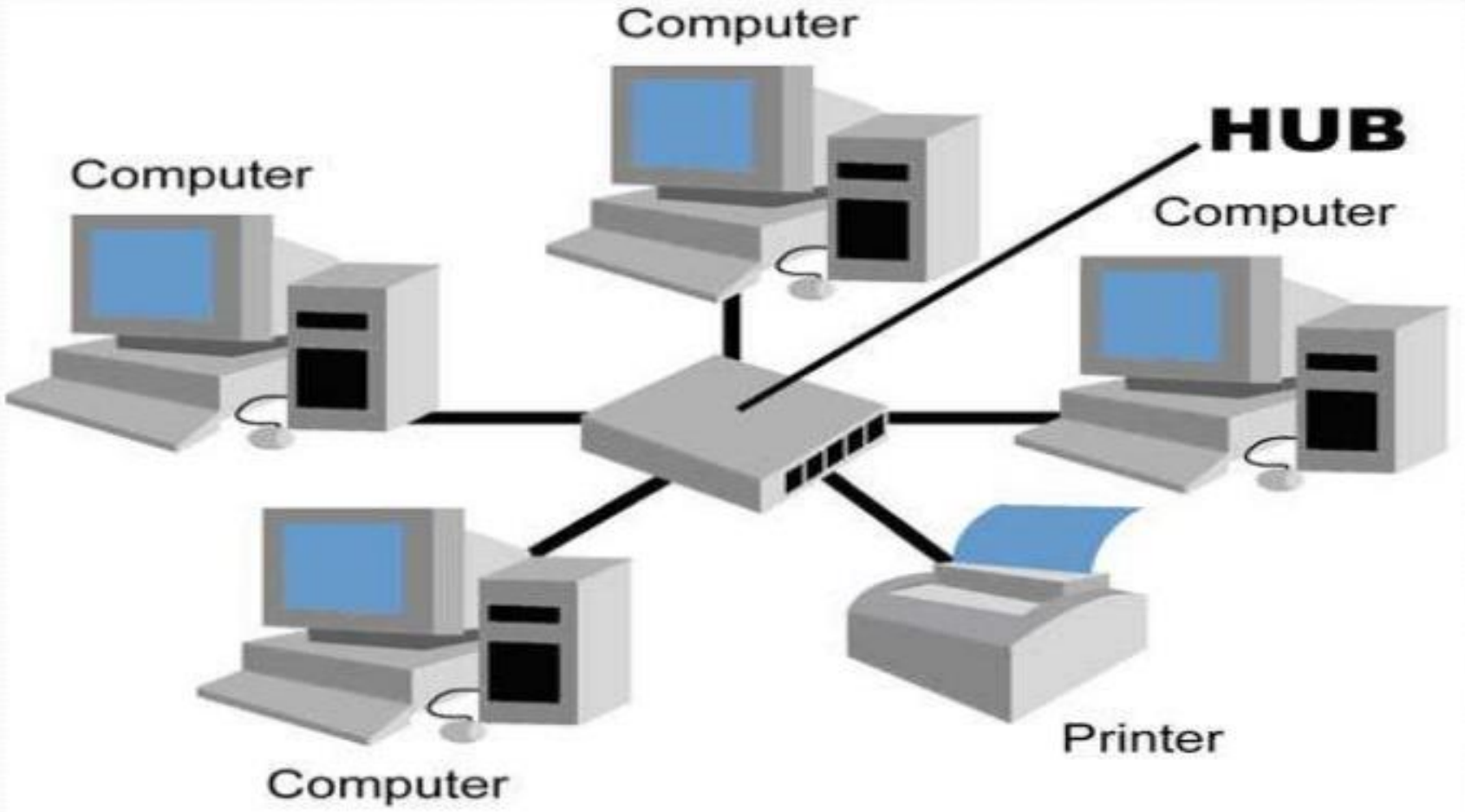
NETWORK TOPOLOGIES

- Disadvantages of RING Topology
- Troubleshooting is difficult in ring topology.
- Adding or deleting the computers disturbs the network activity.
- Failure of one computer disturbs the whole network.

NETWORK TOPOLOGIES

- STAR Topology
- In this type of topology all the computers are connected to a single hub through a cable. This hub is the central node and all others nodes are connected to the central node.
- Every node has its own dedicated connection to the hub.
- Hub acts as a repeater for data flow.
- Can be used with twisted pair, Optical Fiber or coaxial cable.

Star Topology



142 NETWORK TOPOLOGIES

- Advantages of Star Topology
- Fast performance with few nodes and low network traffic.
- Hub can be upgraded easily.
- Easy to troubleshoot.
- Easy to setup and modify.
- Only that node is affected which has failed, rest of the nodes can work smoothly.

NETWORK TOPOLOGIES

- Disadvantages of Star Topology
- Cost of installation is high.
- Expensive to use.
- If the hub fails then the whole network is stopped because all the nodes depend on the hub.
- Performance is based on the hub that is it depends on its capacity

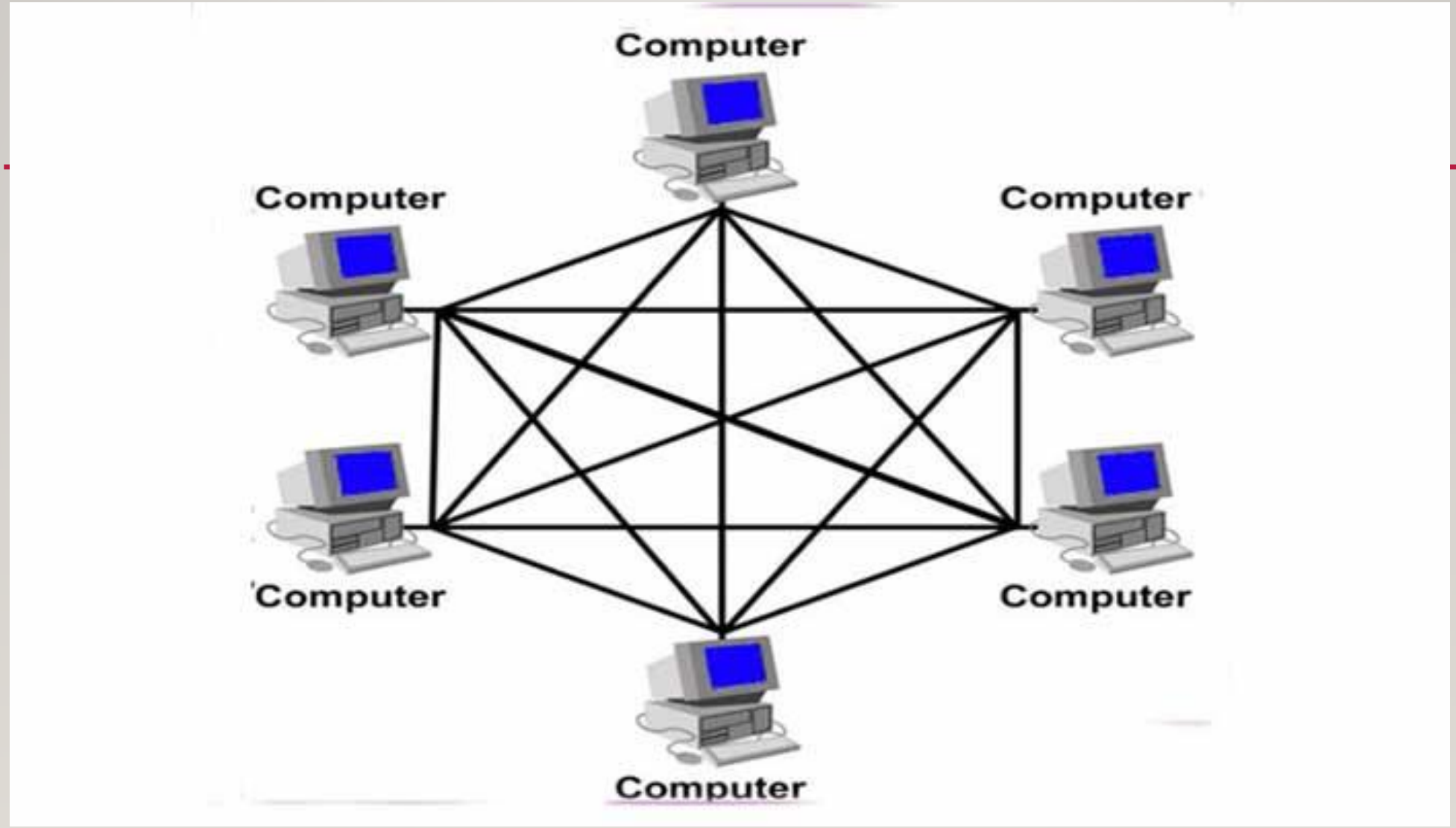
NETWORK TOPOLOGIES

• Mesh Topology

- Mesh technology is an arrangement of the network in which computers are interconnected with each other through various redundant connections.
- There are multiple paths from one computer to another computer.
- It does not contain the switch, hub or any central computer which acts as a central point of communication.
- The Internet is an example of the mesh topology.

145 NETWORK TOPOLOGIES

- Mesh Topology
- Mesh topology is mainly used for WAN implementations where communication failures are a critical concern.
- Mesh topology is mainly used for wireless networks.
- Mesh topology can be formed by using the formula:
  Number of cables = (n*(n-1))/2;
- Where n is the number of nodes that represents the network.


Computer
Computer
Computer
'Computer
Computer
Computer

NETWORK TOPOLOGIES

- Advantages of Mesh Topology
- Dedicated lines ensures low data traffic and high availability
- It is robust. If one link becomes unstable, we do have other alternatives
- Privacy and security is guaranteed than in others
- Fault tolerance and easy to identify and troubleshoot

NETWORK TOPOLOGIES

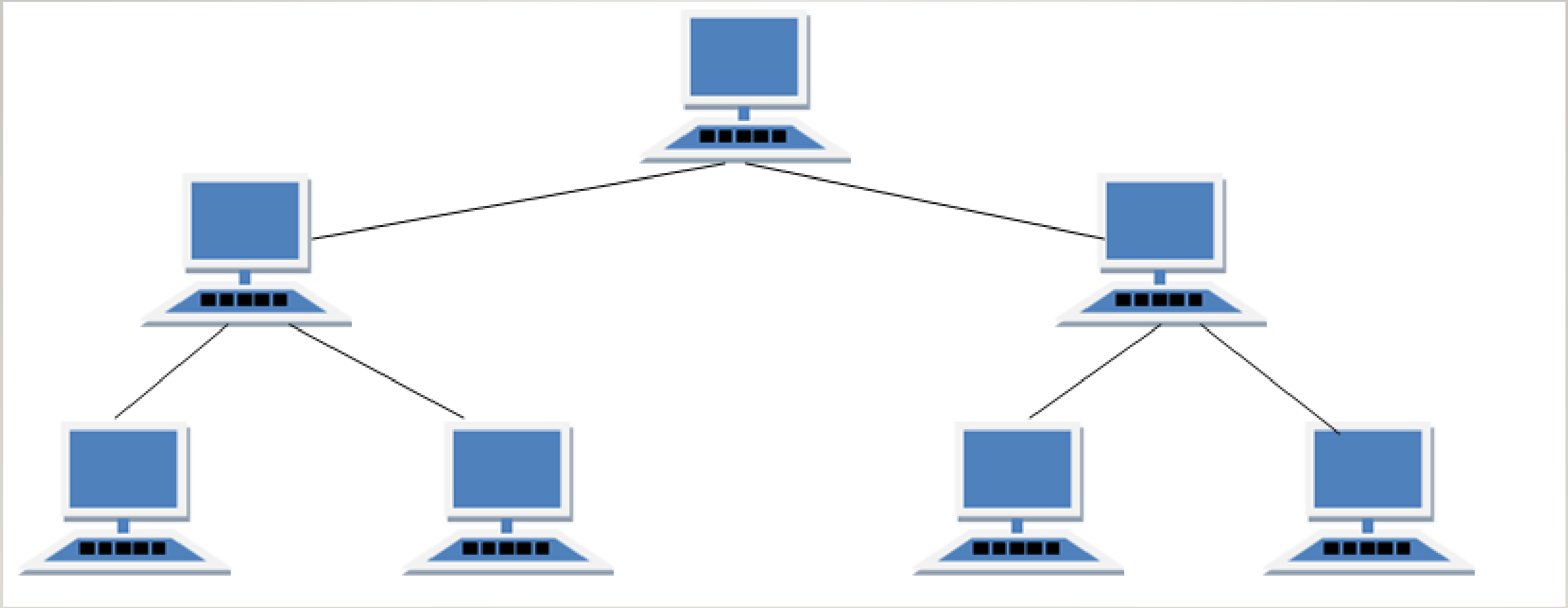
- Disadvantages of Mesh Topology
- Need more cables and ports
- No. of wires and links may exceed the available space
- More expensive because of wires and hardware requirements (I/O ports, cables)
- Difficult to monitor and manage

NETWORK TOPOLOGIES

• Tree Topology

- Tree topology combines the characteristics of bus topology and star topology.
- A tree topology is a type of structure in which all the computers are connected with each other in hierarchical fashion.
- The top-most node in tree topology is known as a root node, and all other nodes are the descendants of the root node.
- There is only one path exists between two nodes for the data transmission. Thus, it forms a parent-child hierarchy.

150



151 NETWORK TOPOLOGIES

- Advantages of Tree Topology
- It is scalable because more nodes can be added in the hierarchical structure.
- Other branches don't get affected if one fails
- Easier to maintain and troubleshooting
- Suitable for large organization

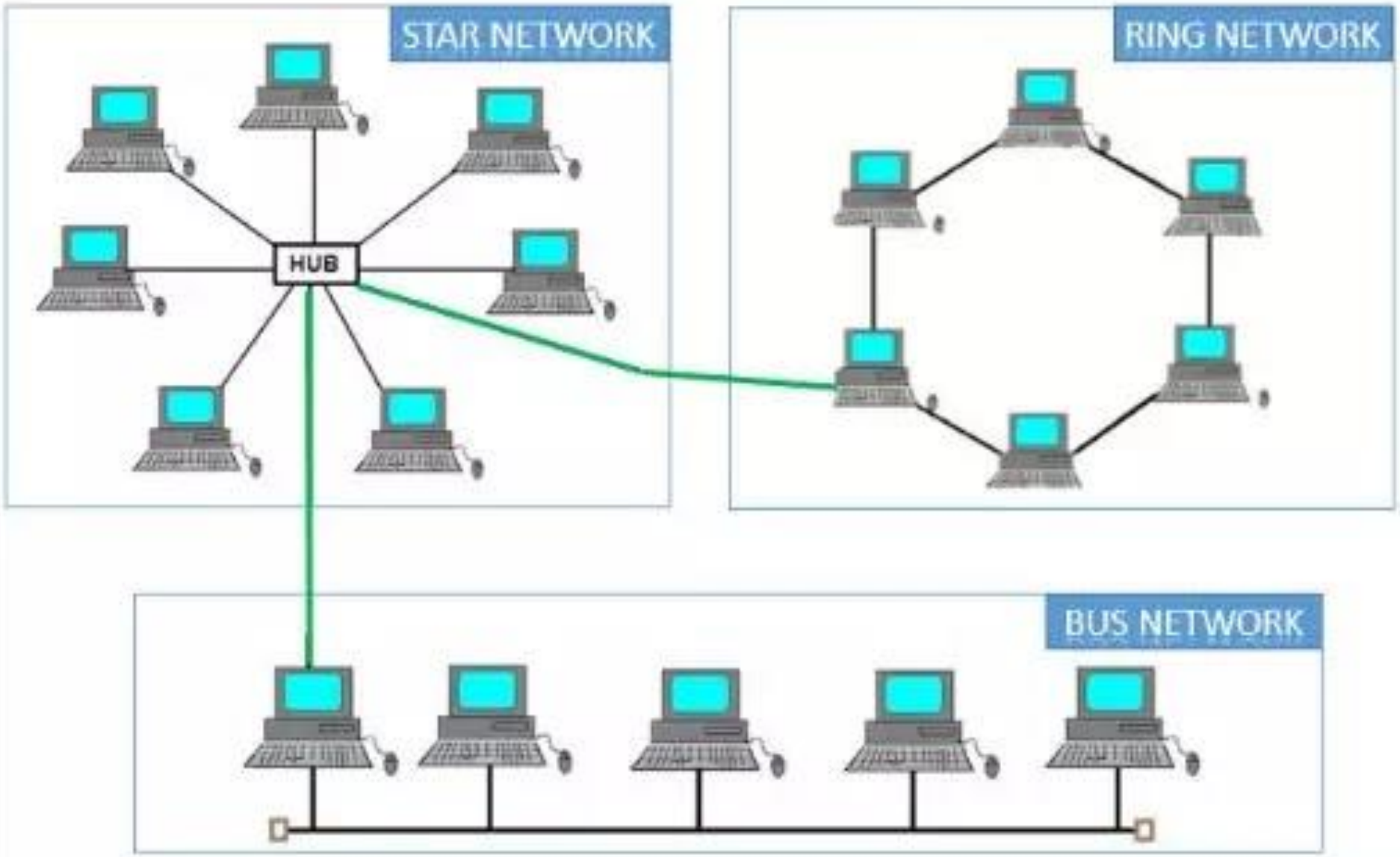
152 NETWORK TOPOLOGIES

- Disadvantages of Tree Topology
- More number of cables needed
- If root node fails, entire network fails
- Maintenance becomes difficult if more number of nodes are increased

NETWORK TOPOLOGIES

- Hybrid Topology
- It uses two or more differing network topologies. i.e. mix of more than one topologies
- It inherits merits and demerits of all incorporating technologies.
- Most of the networks in WAN are Hybrid topology

HYBRID TOPOLOGY



155 NETWORK TOPOLOGIES

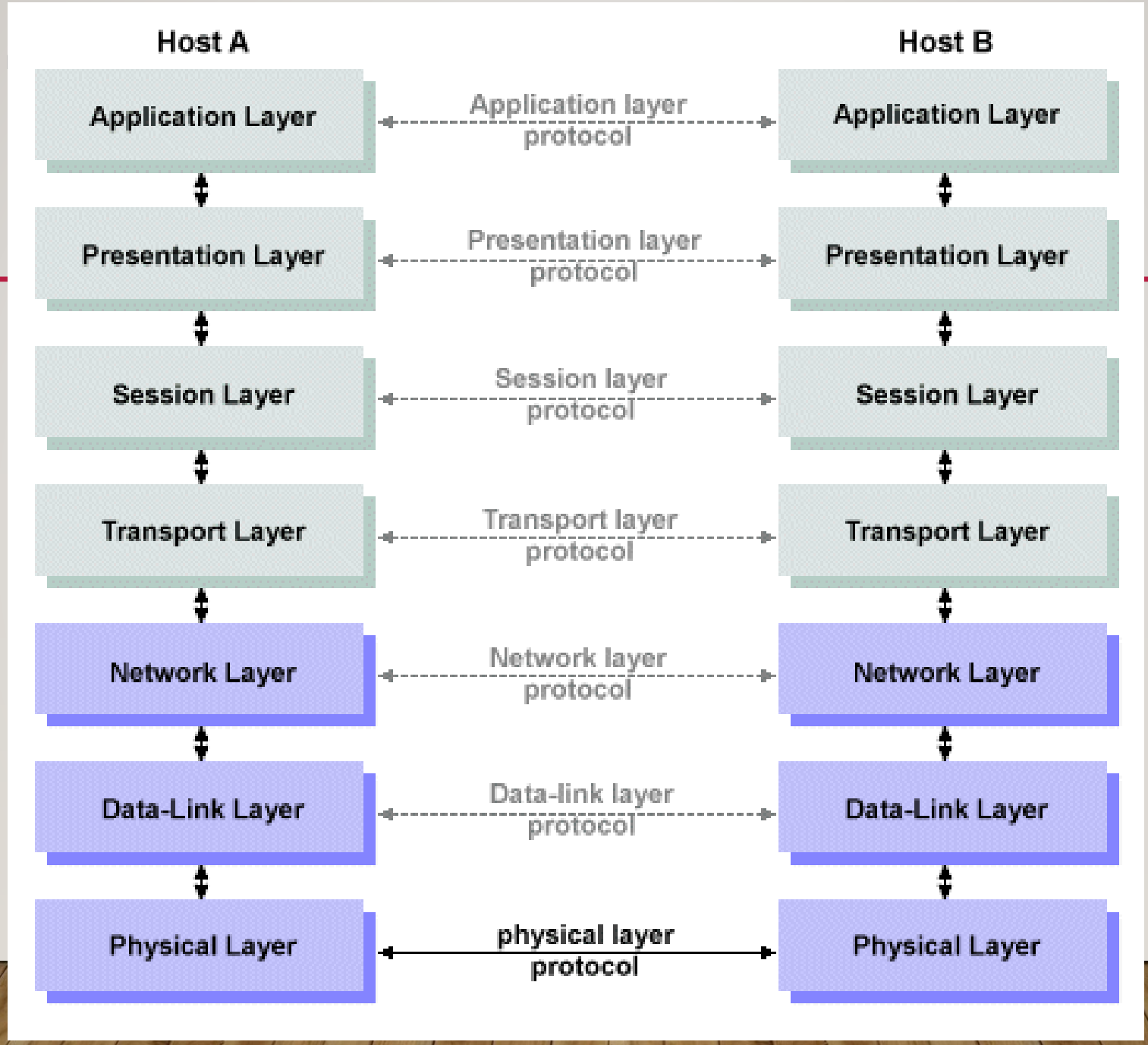
- Advantages of Hybrid Topology
- Combines the benefits of different topologies
- It can be modified easily as per requirements
- Extremely flexible and reliable
- Handles large volume of traffic
- Used to create large network

156 NETWORK TOPOLOGIES

- Disadvantages of Hybrid Topology
- It is expensive
- Very complex to design
- Difficult to installation and manage
- Time consuming

157 OSI REFERENCE MODEL

- Open System Interconnection (OSI) model includes a set of protocols that attempt to define and standardize the data communication process.
- The protocols were defined by the International Organization for Standardization (ISO).
- It is a concept that describes how data communications should take place.
- Each lower layer provides services to upper layers and vice versa.
- It divides the communication process into seven groups, called layers. They are:


Host A
Host B
Application Layer
Application layer protocol
Application Layer
Presentation Layer
Presentation layer protocol
Presentation Layer
Session Layer
Session layer protocol
Session Layer
Transport Layer
Transport layer protocol
Transport Layer
Network Layer
Network layer protocol
Network Layer
Data-Link Layer
Data-link layer protocol
Data-Link Layer
Physical Layer
physical layer protocol
Physical Layer

OSI REFERENCE MODEL

1. Application layer

- It allows applications to directly access the network services.
- It serves as the interface between the user and network that directly support user applications.
- It is completely user oriented layer. Some of its functions are file transfer, accessing remote file, database, e-mail etc.

OSI REFERENCE MODEL

2. Presentation layer

- It is responsible for data translation (formatting, compression and encryption) process.
- It converts readable format into unreadable format. Encryption and decryption of data is done in this layer.
- It is concerned with the syntax and semantics of the information.

OSI REFERENCE MODEL

3. Session layer

- It is responsible for establishing, maintaining and terminating a connection called a session.
- A session is a period in which data can be exchanged between computers.
- It controls the synchronization between two devices.

OSI REFERENCE MODEL

4. Transport layer

- It is responsible for control flow ensuring message packet delivery without error.
- Messages are packaged to form data packets at sender side for efficient transmission and assigned a tracking number so they can be re assembled in proper order.
- It performs error handling and ensures all data is received in the proper sequence.
- The data is retransmitted if there are errors.

OSI REFERENCE MODEL

5. Network layer

- It is primarily concerned with addressing and routing.
- Logical address (IP address) are translated into the physical address (MAC address) for transmitting data at network.
- The route from source to destination is determined at network layer.

OSI REFERENCE MODEL

6. Data Link layer

- It defines how the signal will be placed on or taken off from the NIC (Network Interface Card).
- Data frames are broken down into individual bits that can be translated into electronic signals and sent over the network.
- Corrupted data is also identified and corrected at this layer.

OSI REFERENCE MODEL

7. Physical layer

- It is responsible for transmitting raw bits from one node to another over communication channel.
- It defines the characteristics of electronic signals, type of cables, connectors, length of cables etc.
- It transmits the binary data (bits) as electrical or optical signals depending on the medium.

THANK YOU

END OF CHAPTER 2