Noida Institute of Engineering and Technology, Greater Noida

Introduction of Computer Networks & Physical Layer

Unit:1

Physical Layer

Course Details
B Tech 6th Sem

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I Sanjay Kumar Nayak ,Assistant Professor in Computer Science & Engineering .My total teaching experience is 17 years in NIET Greater Noida. I have completed My B.Tech and M.Tech from UPTU (AKTU).

Sanjay Kumar Nayak

CSE

Department

Evaluation Scheme

EVALUATION SCHEME
SEMESTER-VI

Sl. No.	Subject Codes	Subject Name	Periods			Evaluation Scheme				End Semester		Total	Credit
			L	T	P	CT	TA	TOTAL	PS	TE	PE		
1	ACSE0601	Advanced Java Programming	3	0	0	30	20	50		100		150	3
2	ACSE0602	Computer Networks	3	1	0	30	20	50		100		150	4
3	ACSE0603	Software Engineering	3	0	0	30	20	50		100		150	3
4		Departmental Elective -III	3	0	0	30	20	50		100		150	3
5		Departmental Elective -IV	3	0	0	30	20	50		100		150	3
6		Open Elective-I	3	0	0	30	20	50		100		150	3
7	ACSE0651	Advanced Java Programming Lab	0	0	2				25		25	50	1
8	ACSE0652	Computer Networks Lab	0	0	2				25		25	50	1
9	ACSE0653	Software Engineering Lab	0	0	2				25		25	50	1
10	ACSE0659	Mini Project	0	0	2				50			50	1
11	ANC0602 / ANC0601	Essence of Indian Traditional Knowledge / Constitution of India, Law and Engineering	2	0	0	30	20	50		50		100	
12		MOOCs (For B.Tech. Hons. Degree)											
		GRAND TOTAL										**1100**	**23**

Syllabus

Course Code	ACSE0602	L T P	Credits
Course Title	COMPUTER NETWORKS	3 1 0	4

Course objective:
Objective of this course is to develop an understanding of computer networking basics, different components of computer networks, various protocols, modern technologies and their applications.

Pre-requisites: Basic knowledge of Computer system and their interconnection, operating system, Digital logic and design and hands on experience of programming languages.

Course Contents / Syllabus

UNIT-I	Introduction	8 Hours

Goals and applications of networks, Categories of networks, Organization of the Internet, ISP, The OSI reference model, TCP/IP protocol suite, Network devices and components, Mode of communications

Physical Layer: Network topology design, Types of connections, LAN, MAN and MAN Transmission media, Signal transmission and encoding, Network performance and transmission impairments, Switching techniques and multiplexing, IEEE standards.

UNIT-II	Data Link layer	8 Hours

Framing, Error Detection and Correction, Flow control (Elementary Data Link Protocols, Sliding Window protocols). Medium Access Control and Local Area Networks: Channel allocation, Multiple access protocols, LAN standards, Link layer switches & bridges.

UNIT-III	Network Layer	8 Hours

Point-to-point networks, Logical addressing, Basic internetworking (IP, CIDR, ARP, RARP, DHCP, ICMP), IPv4, Routing, forwarding and delivery, Static and dynamic routing, Routing algorithms and protocols, Congestion control algorithms, IPv6.

UNIT-IV	Transport Layer	8 Hours

Process-to-process delivery, Transport layer protocols (UDP and TCP), Connection management, Flow control and retransmission, Window management, TCP Congestion control, Quality of service.

UNIT-V	Application Layer	8 Hours

Domain Name System, World Wide Web and Hyper Text Transfer Protocol, Electronic mail, File Transfer Protocol, Remote login, Network management, Data compression, VPN, Cryptography – basic concepts, Firewalls.

Syllabus

Unit	Topic
I	**Introduction:** Goals and applications of networks, Categories of networks, Organization of the Internet, ISP, The OSI reference model, TCP/IP protocol suite, Network devices and components. Mode of communication Physical Layer: Network topology design, Types of connections, LAN, MAN, and WAN Transmission media, Signal transmission and encoding, Network performance and transmission impairments, Switching techniques and multiplexing, IEEE standards.

Branch wise Applications

- Resource Sharing
- Server-Client model:
- Communication Medium:
- Access to remote information
- Person-to-person communication
- Electronic commerce
- Cloud-based Applications
- AI and Expert System
- Neural Networks and parallel programming
- Decision support and office automation systems etc.

Course Objective

To develop an understanding of

- **To understand computer networking basics.**
- To understand different components of computer networks.
- To study and understand various protocols.
- The standard models for the layered approach to communication between autonomous machines in a network.
- To study and understand the main characteristics of data transmission across various physical link types.

Course Outcome

At the end of the course, the student will be able

CO 1	Build an understanding of the fundamental concepts and Layered Architecture of computer networking.	K2, K6
CO 2	Understand the basic concepts of link layer properties to detect error and develop the solution for error control and flow control.	K2, K6
CO 3	Design, calculate, and apply subnet masks and addresses to fulfil networking requirements and calculate distance among routers in subnet.	K3, K4, K6
CO 4	Understand the duties of transport layer, Session layer with connection management of TCP protocol.	K2, K4
CO 5	Discuss the different protocols used at application layer.	K2

Program Outcome

1. Engineering knowledge
2. Problem analysis
3. Design/development of solutions
4. Conduct investigations of complex problems
5. Modern tool usage
6. The engineer and society
7. Environment and sustainability
8. Ethics
9. Individual and team work
10. Communication
11. Project management and finance
12. Life-long learning

CO-PO Mapping

The highlighted text shows the mapping of course outcome with PO mapping of this unit

						Computer Networks (KCS-603)			Year of Study: 2021-22			
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
C602.1	3	2	3	2	1	1					2	3
C602.2	3	3	2	2	3	2		1			1	3
C602.3	3	2	1		1	2		1	2		1	3
C602.4	2	2	1		1			1	1		1	3
C602.5	2	2	2		1						1	3

Program Specific Outcomes

- **PSO1:** Work as a software developer, database administrator, tester or networking engineer for providing solutions to the real world and industrial problems.
- **PSO2:**Apply core subjects of information technology related to data structure and algorithm, software engineering, web technology, operating system, database and networking to solve complex IT problems.
- **PSO3:** Practice multi-disciplinary and modern computing techniques by lifelong learning to establish innovative career.
- **PSO4:** Work in a team or individual to manage projects with ethical concern to be a successful employee or employer in IT industry.

CO-PSO Mapping

The highlighted text shows the mapping of course outcome with PSO mapping of this unit

CO	PSO1	PSO2	PSO3	PSO4
C603.1	3	3	2	1
C603.2	3	3	2	1
C603.3	3	3	2	1
C603.4	3	3	1	1
C603.5	3	3	1	1

Program Educational Objectives

- **PEO1:** able to apply sound knowledge in the field of information technology to fulfill the needs of IT industry.
- **PEO2:** able to design innovative and interdisciplinary systems through latest digital technologies.
- **PEO3:** able to inculcate professional and social ethics, team work and leadership for serving the society.
- **PEO4:** able to inculcate lifelong learning in the field of computing for successful career in organizations and R&D sectors.

Result Analysis

- Computer Networks Result of 2022-23: 96.97%
- Average Marks: 54.33

End Semester Question Paper Template

B TECH

(SEM-V) THEORY EXAMINATION 20__-20__

OBJECT ORIENTED SYSTEM DESIGN

Time: 3 Hours **Total Marks: 100**

Note: 1. Attempt all Sections. If require any missing data; then choose suitably.

SECTION A

1. Attempt all questions in brief. **2 x 10 = 20**

Q.No.	Question	Marks	CO
1		2	
2		2	
. .		. .	
10		2	

End Semester Question Paper Templates

SECTION B

2. Attempt any three of the following: 3 x 10 = 30

Q.No.	Question	Marks	CO
1		10	
2		10	
.		.	
5		10	

SECTION C

3. Attempt any one part of the following: 1 x 10 = 10

Q.No.	Question	Marks	CO
1		10	
2		10	

End Semester Question Paper Templates

4. Attempt any one part of the following: 1 x 10 = 10

Q.No.	Question	Marks	CO
1		10	
2		10	

5. Attempt any one part of the following: 1 x 10 = 10

Q.No.	Question	Marks	CO
1		10	
2		10	

6. Attempt any one part of the following: 1 x 10 = 10

Q.No.	Question	Marks	CO
1		10	
2		10	

End Semester Question Paper Templates

7. Attempt any one part of the following: 1 x 10 = 10

Q.No.	Question	Marks	CO
1		10	
2		10	

Prerequisite

- The student should have knowledge of
  - Networking
  - Layout of computer
  - Hardware
- The basic knowledge of C

Brief Introduction to Subject

- Computer network is a group of devices connected with each other through a transmission medium such as wires, cables etc.

- These devices can be computers, printers, scanners, Fax machines etc.

- The purpose of having computer network is to send and receive data stored in other devices over the network.

Communication (CO1)

Topic Objective

- The student will get an insight of communications, networking
- Medium used for transmission
- Various topologies used
- The LAN, WAN and MAN concept

Communication (CO1)

- For communication we share the information
- Data refers to any information
- Data communication
  - exchange of data between two devices by some transmission medium.
- Effectiveness of data communication depends on
  - Delivery
  - Accuracy
  - Timeliness
  - Jitter

Computer Networks (CO1)

- A computer network is an interconnection of two or more computers that are able to exchange information
- Network is a set of devices connected by communication link
- The computer may be connected via any data communication link
- Computers can be personal or main frames
- The computer network may be located anywhere in the world and its size can vary
- Generally follow a client server model.

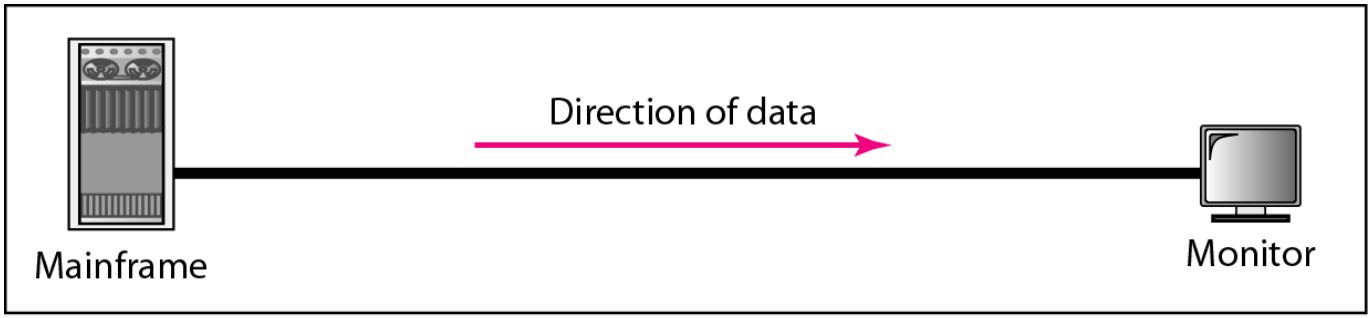
Computer network Communication(CO1)

- Components
  - Message – information to be communicated
  - Sender – a device that sends the data
  - Receiver – a device that receives the data
  - Transmission medium – physical path by which message transmits
  - Protocol – a set of rules that govern data communications
- We transmits information or data by two types of signals
  - Analog – telephones and radios
  - Digital - computers

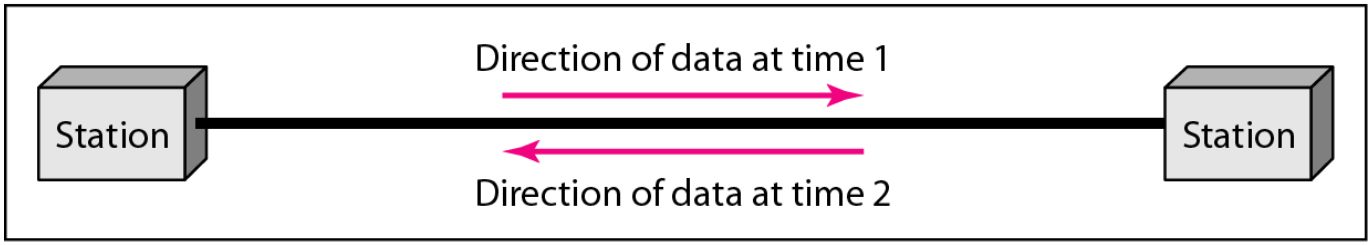
Data representation

- Text
  - Bit pattern, sequence of bits
  - set of bits – code, process is coding
- Numbers
  - Number system
- Images
  - Matrix of pixels
  - Size of the pixel depends on resolution
- Audio
  - Continuous
- Video
  - Continuous / combination of images

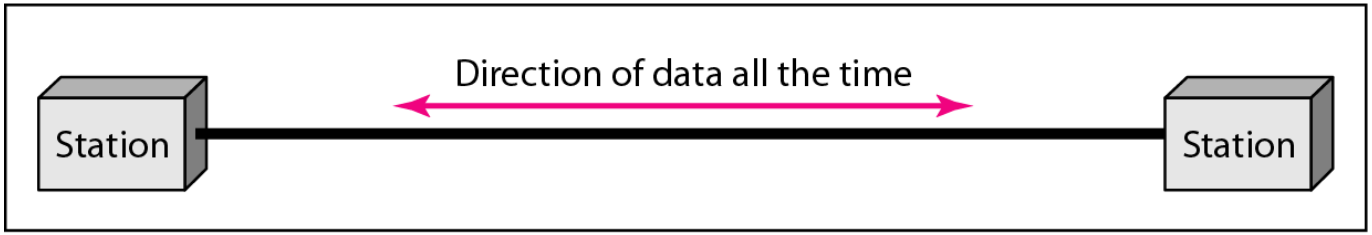
Modes of transmission(CO1)



a. Simplex



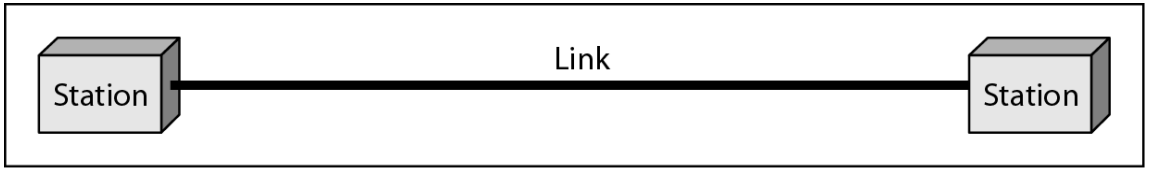
b. Half-duplex



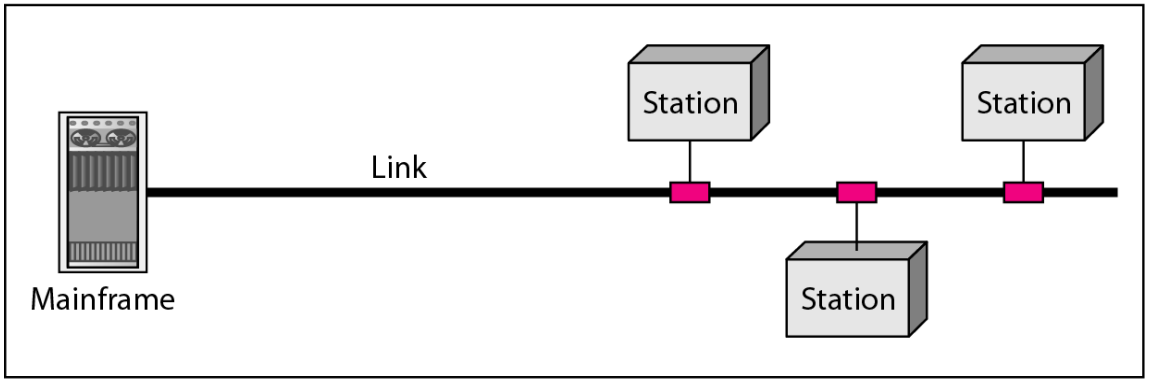
c. Full-duplex

Computer networks

- A network is a set of devices (often referred to as nodes) connected by communication links. A node can be a computer, printer, or any other device capable of sending and/or receiving data generated by other nodes on the network.
- Types of connections



a. Point-to-point



b. Multipoint

Computer networks

- Distributed Processing
  - Most networks use distributed processing, in which a task is divided among multiple computers.
  - Instead of one single large machine being responsible for all aspects of a process, separate computer (usually a personal computer or workstation) handle a subset.

Computer networks

- Network Criteria
  - Performance
    - Transmit time is the amount of time required for a message to travel from one device to another.
    - Response time is the elapsed time between an inquiry and a response.
    - depends on
      - the number of users,
      - the type of transmission medium,
      - the capabilities of the connected hardware,
      - and the efficiency of the software.
    - evaluated by two networking metrics: throughput and delay.

Computer networks

- Network Criteria
  - Reliability
    - the frequency of failure,
    - the time it takes a link to recover from a failure.
  - Security
    - protecting data from unauthorized access,
    - protecting data from damage and development,
    - and implementing policies and procedures for recovery from breaches and data losses.

Computer networks

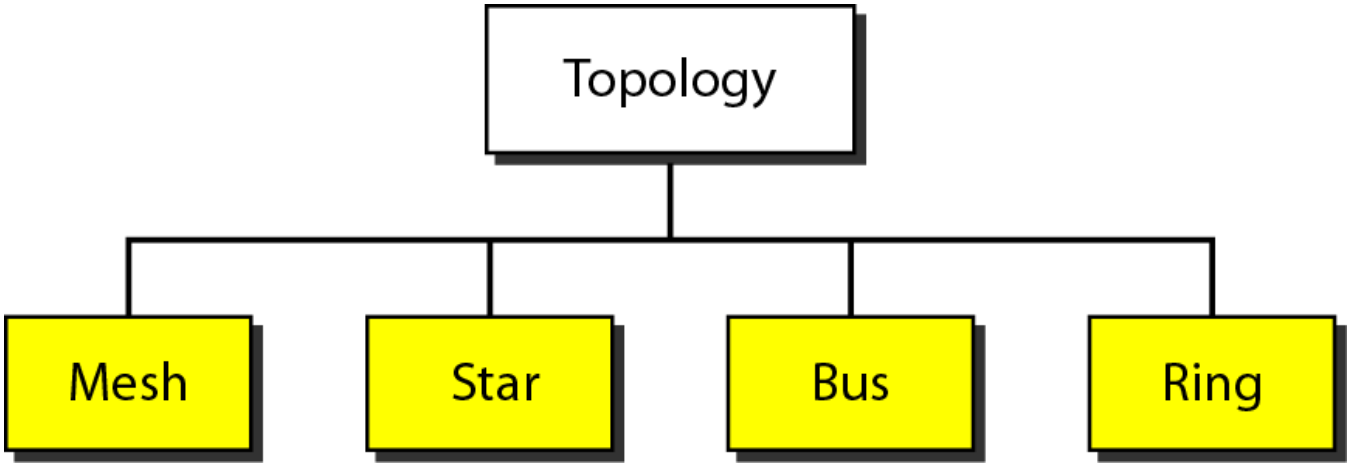
- Goals of networking
  - Resource sharing
  - High reliability
  - Saving Money
  - Interprocess Communication
  - Flexible access
  - Distribution of Process
  - Peer to Peer communication (equal)
  - Centralized communication (one)

Computer networks

- Applications of networking
  - Accessing Remote Database
  - Virtual Access Communication Facility
  - Marketing & Sales
  - Financial Services
  - Manufacturing
  - E-messages
  - Direct Services
  - Teleconferencing
  - Cable TV

Topology(CO1)

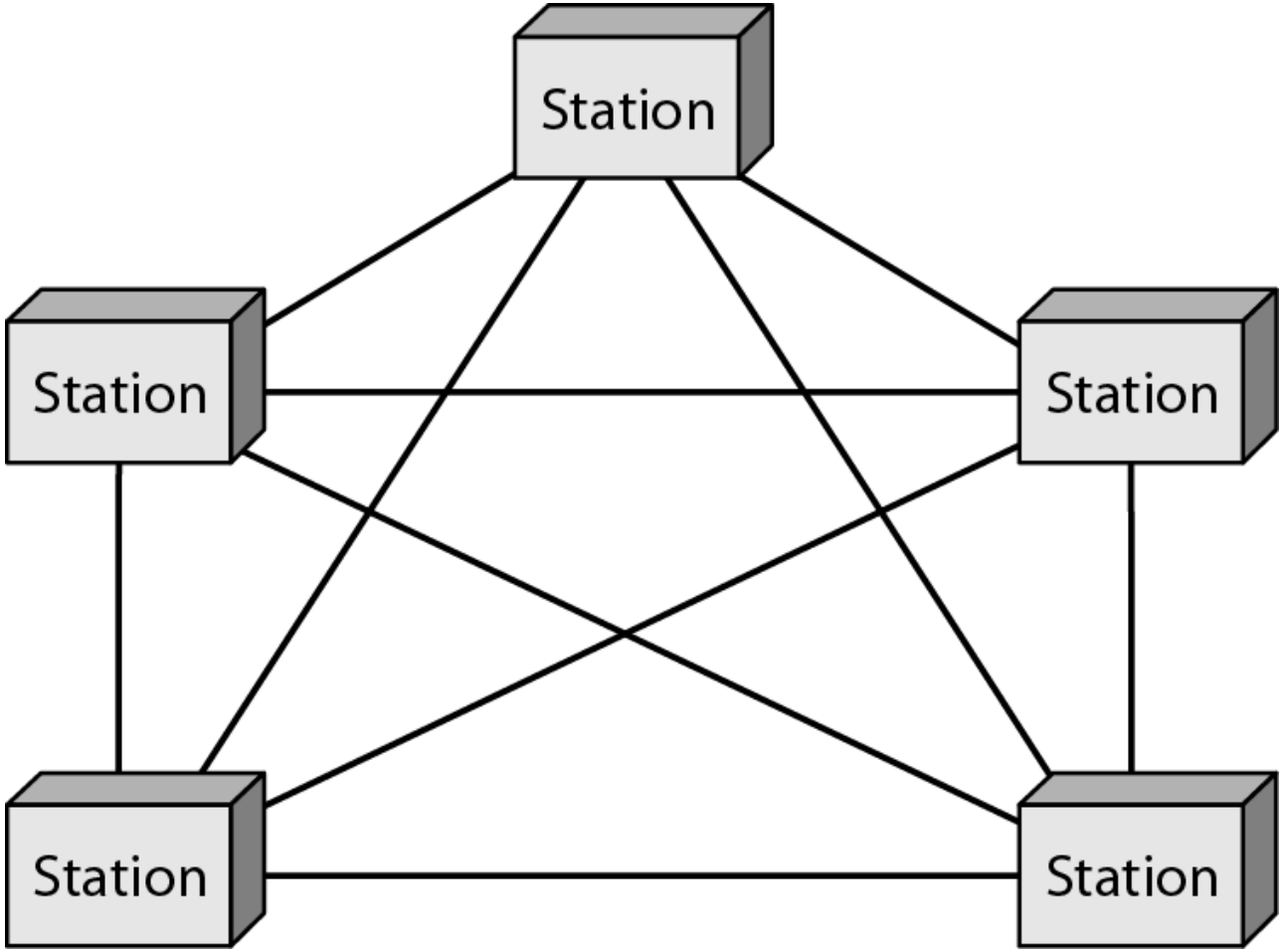
- Categories of topology



Topology(CO1)

- Mesh Topology
  - every device has a dedicated point-to-point link to every other device.
  - the number of physical links in a fully connected mesh network with n nodes = n(n - 1)/2
  - Advantages
    - carry its own data load
    - Robust
    - privacy or security
    - fault identification and fault isolation easy
  - Disadvantages
    - amount of cabling and the number of I/O ports required
    - installation and reconnection are difficult
    - sheer bulk of the wiring
    - expensive

Topology (CO1)

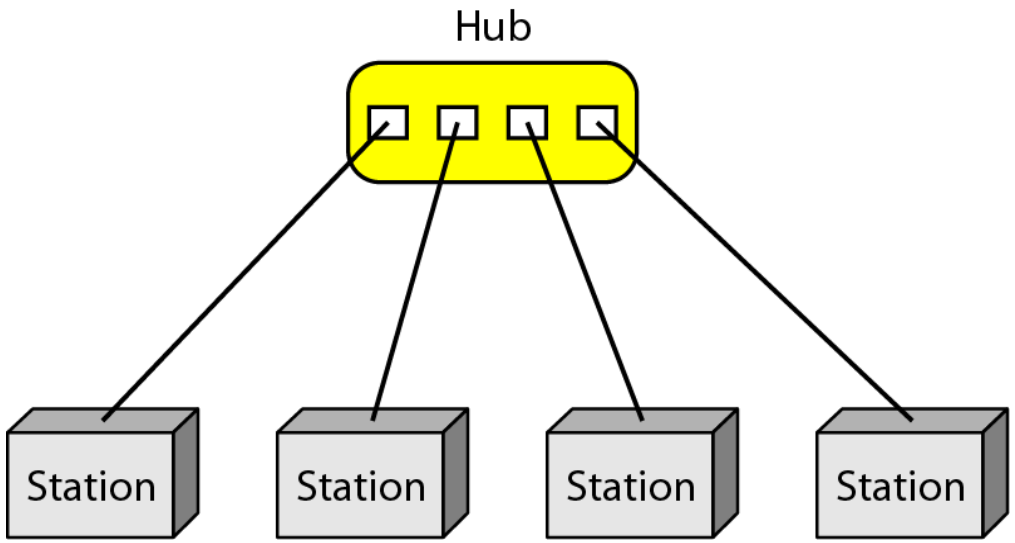


Mesh Topology

Topology (CO1)

- Star Topology
  - each device has a dedicated point-to-point link only to a central controller, usually called a hub. The devices are not directly linked to one another
  - Advantages
    - less expensive
    - easy to install and reconfigure
    - less cabling
    - Robustness
    - easy fault identification and fault isolation
  - Disadvantages
    - dependency of the whole topology on one single point, the hub
    - often more cabling is required

Topology (CO1)

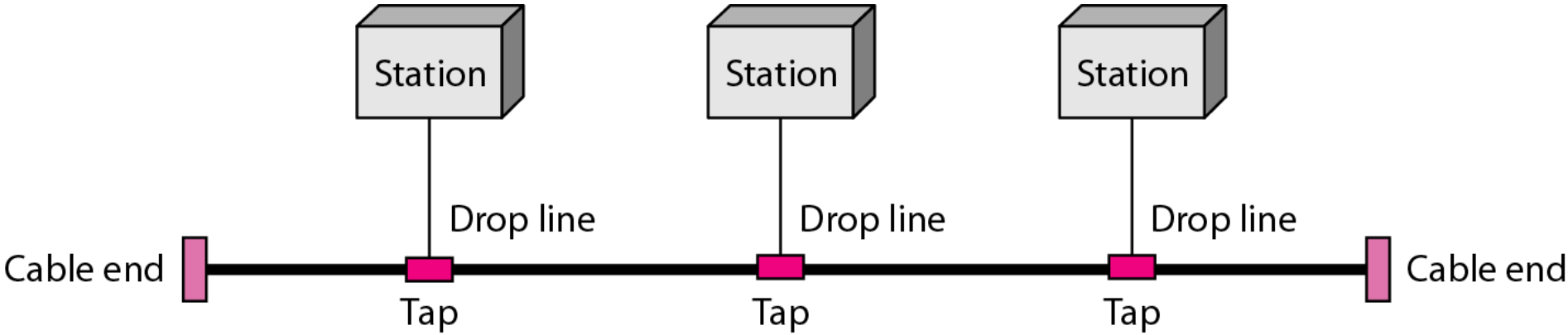


Star Topology

Topology (CO1)

- Bus Topology
  - Multipoint
  - One long cable acts as a backbone to link all the devices in a network
  - Nodes are connected to the bus cable by drop lines and taps.
  - A drop line is a connection running between the device and the main cable
  - Advantages
    - ease of installation
    - less cabling than mesh or star topologies
  - Disadvantages
    - difficult reconnection and fault isolation
    - difficult to add new devices
    - a fault or break in the bus cable stops all transmission

Topology (CO1)

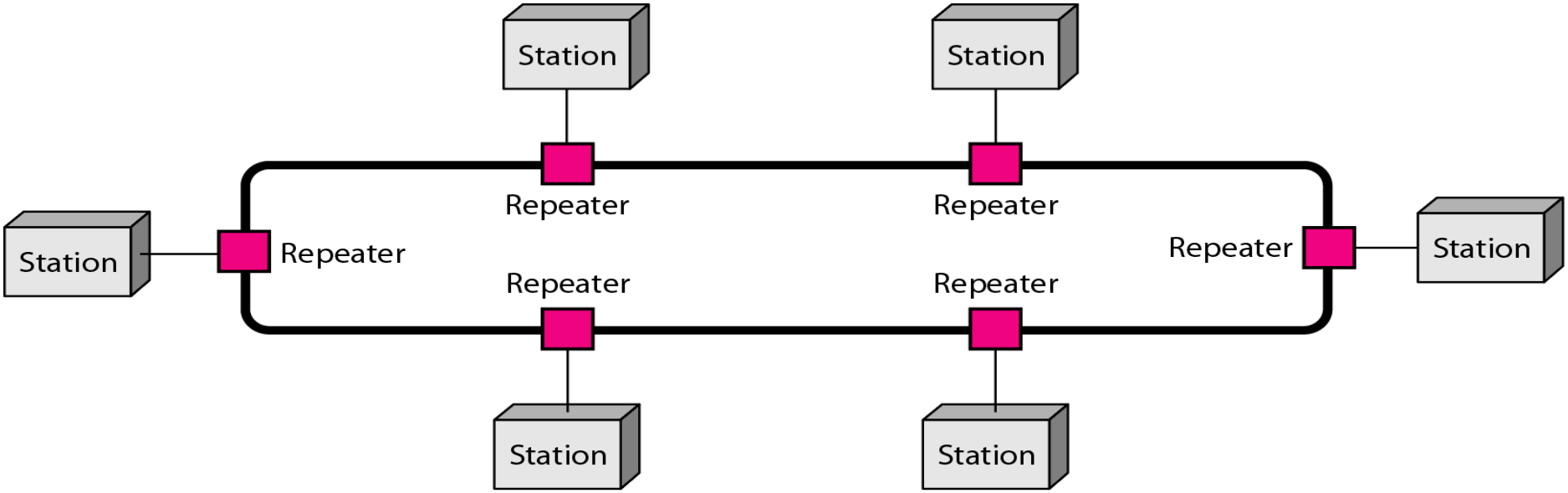


Bus Topology

Topology (CO1)

- Ring topology
  - each device has a dedicated point-to-point connection with only the two devices on either side of it.
  - A signal is passed along the ring in one direction, from device to device, until it reaches its destination.
  - Each device in the ring incorporates a repeater.
  - When a device receives a signal intended for another device, its repeater regenerates the bits and passes them along
  - Advantages
    - easy to install and reconfigure
    - To add or delete a device requires changing only two connections
    - fault isolation is simplified
  - Disadvantages
    - constraints are media and traffic considerations (maximum ring length and number of devices)
    - unidirectional traffic can be a disadvantage
    - a break in the ring can disable the entire network

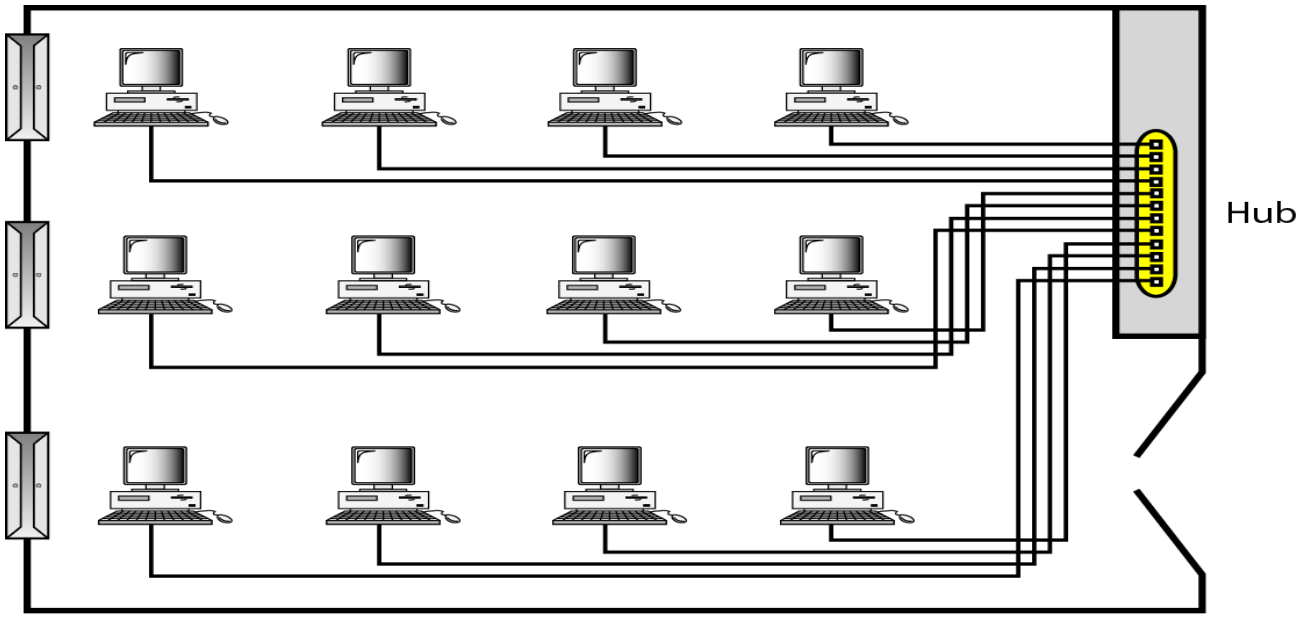
Topology (CO1)



Ring topology

Types of Networks (CO1)

- LAN
  - A local area network (LAN) is usually privately owned and links the devices in a single office, building, or campus
  - resources can be shared
  - In addition to size, LANs are distinguished from other types of networks by their transmission media and topology

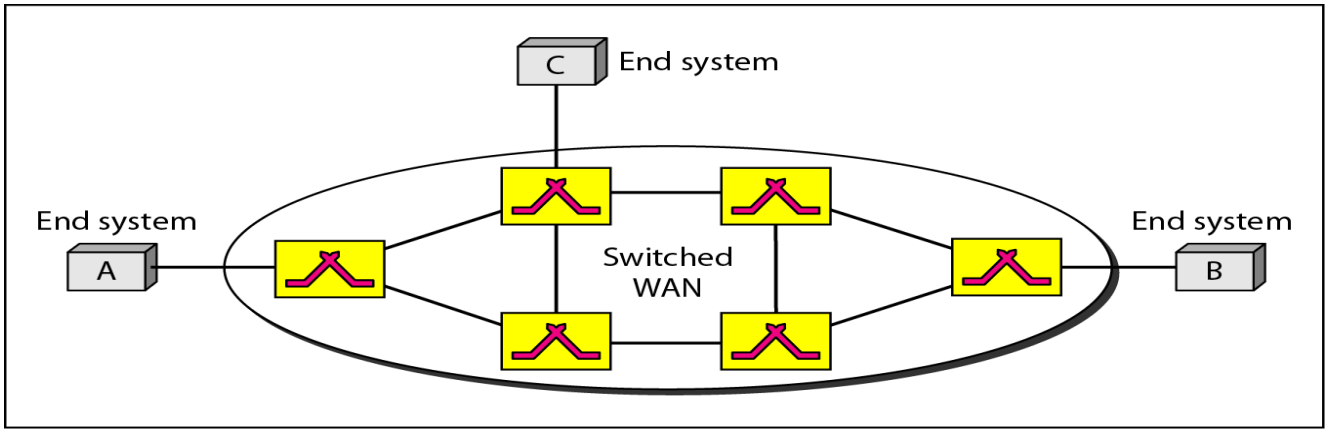


Types of Networks (CO1)

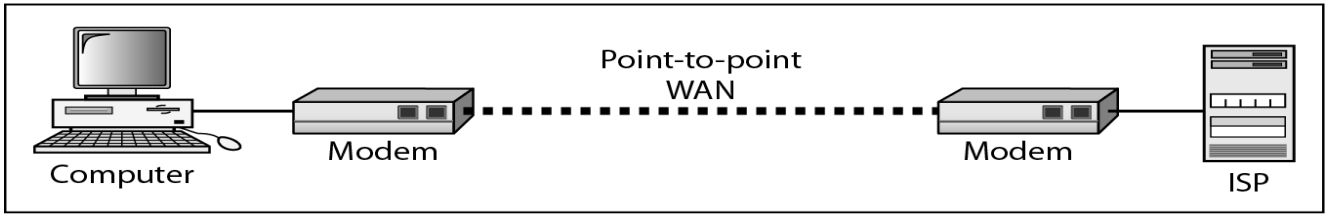
- MAN
  - A metropolitan area network (MAN) is a network with a size between a LAN and a WAN. It normally covers the area inside a town or a city.
  - It is designed for customers who need a high-speed connectivity, normally to the Internet, and have endpoints spread over a city or part of city

Types of Networks (CO1)

- WAN
  - A wide area network (WAN) provides long-distance transmission of data, image, audio, and video information over large geographic areas that may comprise a country, a continent, or even the whole world



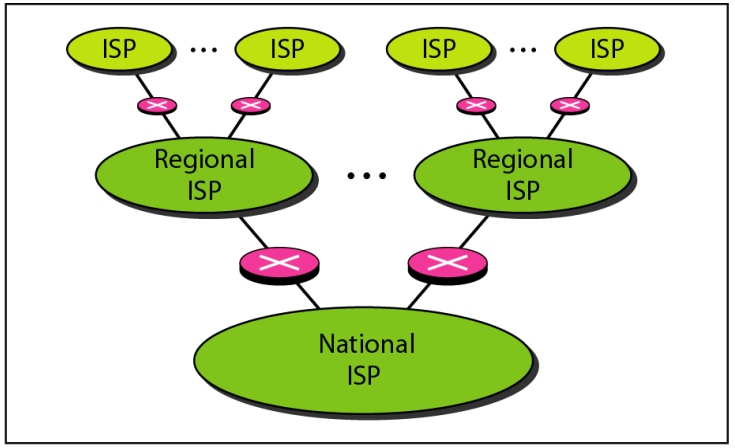
a. Switched WAN



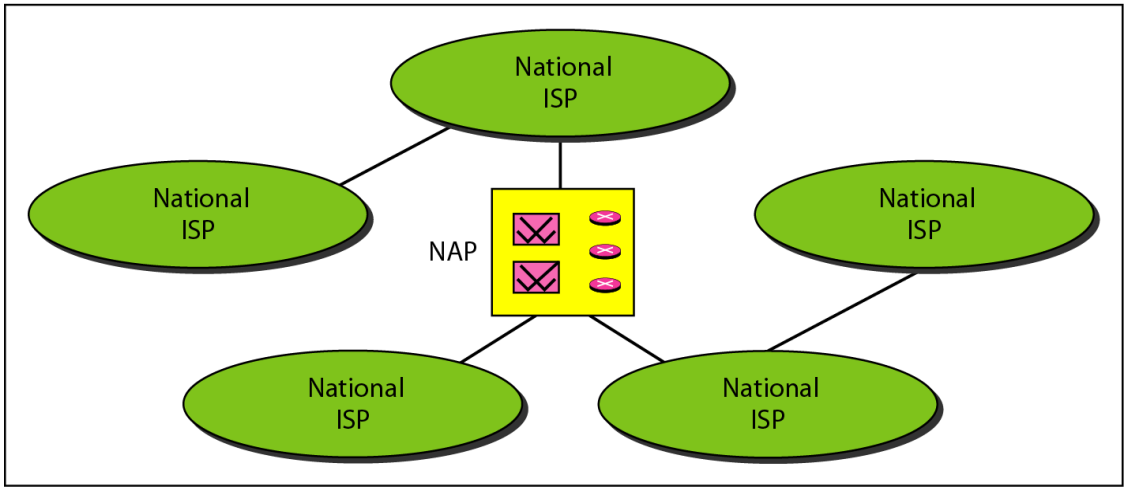
b. Point-to-point WAN

Internet(CO1)

- When two or more networks are connected, they become an internetwork, or internet.



a. Structure of a national ISP



b. Interconnection of national ISPs

Physical layer (CO1)

Topic Objective

- To understand the Physical Layer
- Various transmission medium and
- Switching methods

Recap of previous topic

- The layered architecture of OSI and TCP/IP model
- Comparison of both the models

OSI & TCP/IP models (CO1)

Topic Objective

- To understand the OSI and TCP/IP models
- Differences between two and the protocols supported

Recap of previous topic

- The basic networking layout and topology were studied
- Data flow mode supported

OSI Reference model(CO1)

- ISO OSI Reference model
- Standardization of protocols used in various layers
- Developed in 1983 revised in 1995
- layers based on
  - A layer should be created where a different abstraction is needed
  - Each layer should perform a well-defined function
  - The function of each layer should be according to internationally standardized protocols
  - The layer boundaries should be chosen to minimize the information flow across the interfaces
  - The number of layers should be large enough for necessary functions required and small enough not to become unwieldy

Layered architecture(CO1)

- Peer to peer process
- Interfaces
- Protocols
- Header and trailer
- Encapsulation
- Seven layers
  - Physical
  - Data link
  - Network
  - Transport
  - Session
  - Presentation
  - Application

OSI Model(CO1)

- Physical layer - coordinates the functions required to carry a bit stream over a physical medium
  - Physical characteristics of interfaces and medium
  - Representation of bits
  - Data rate
  - Synchronization of bits
  - Line configuration
  - Physical topology
  - Transmission mode
- Data Link Layer - transforms the physical layer, a raw transmission facility, to a reliable link
  - Framing
  - Physical addressing
  - Flow control
  - Error control
  - Access control

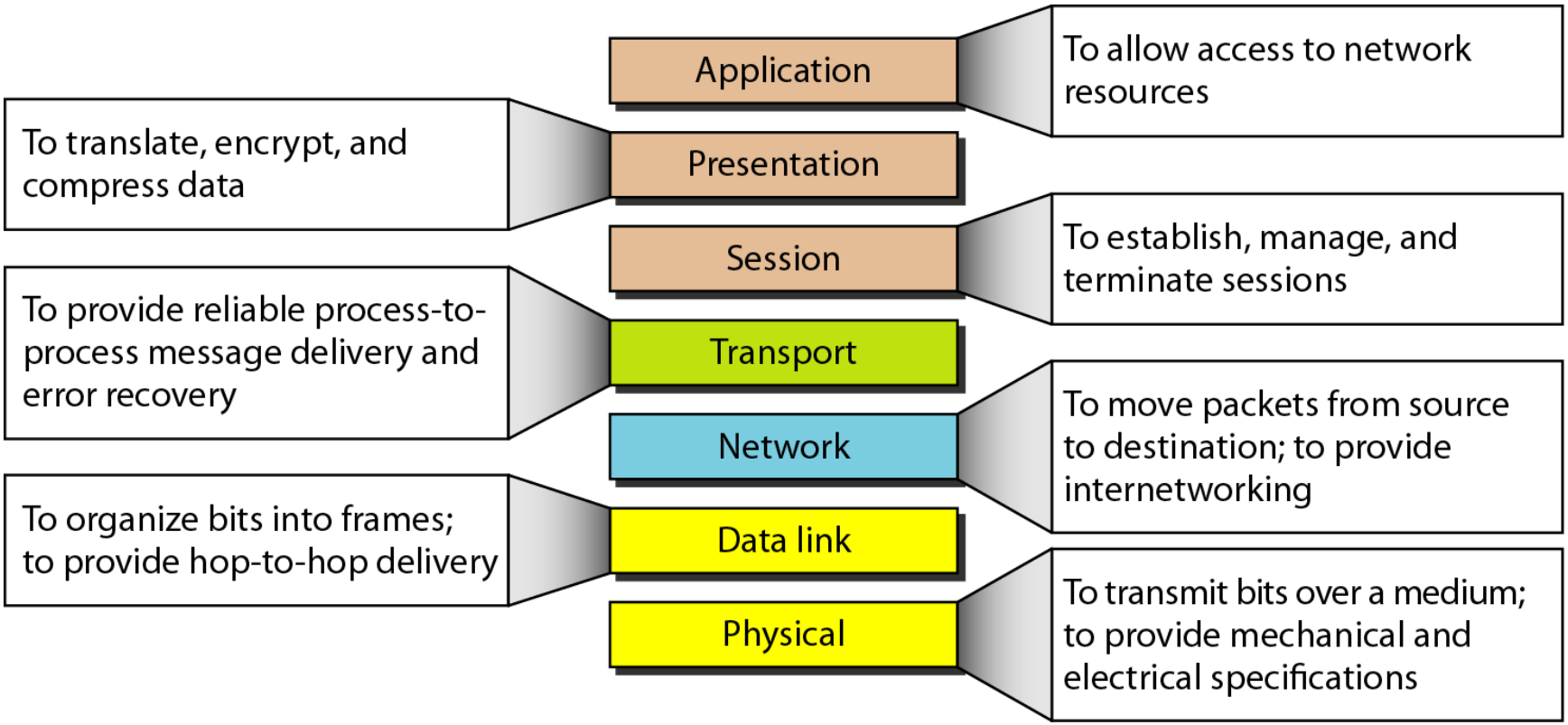
OSI Model(CO1)

- Network Layer - responsible for the source-to-destination delivery of a packet, possibly across multiple networks
  - Logical addressing
  - Routing
- Transport Layer - process-to-process delivery of the entire message
  - Service-point addressing
  - Segmentation and reassembly
  - Connection control
  - Flow control
  - Error control
- Session Layer - establishes, maintains, and synchronizes the interaction among communicating systems
  - Dialog control
  - Synchronization

OSI Model(CO1)

- Presentation Layer - concerned with the syntax and semantics of the information exchanged between two systems
  - Translation
  - Encryption
  - Compression
- Application Layer - enables the user to access the network
  - Network virtual terminal
  - File transfer, access, and management
  - Mail services
  - Directory services

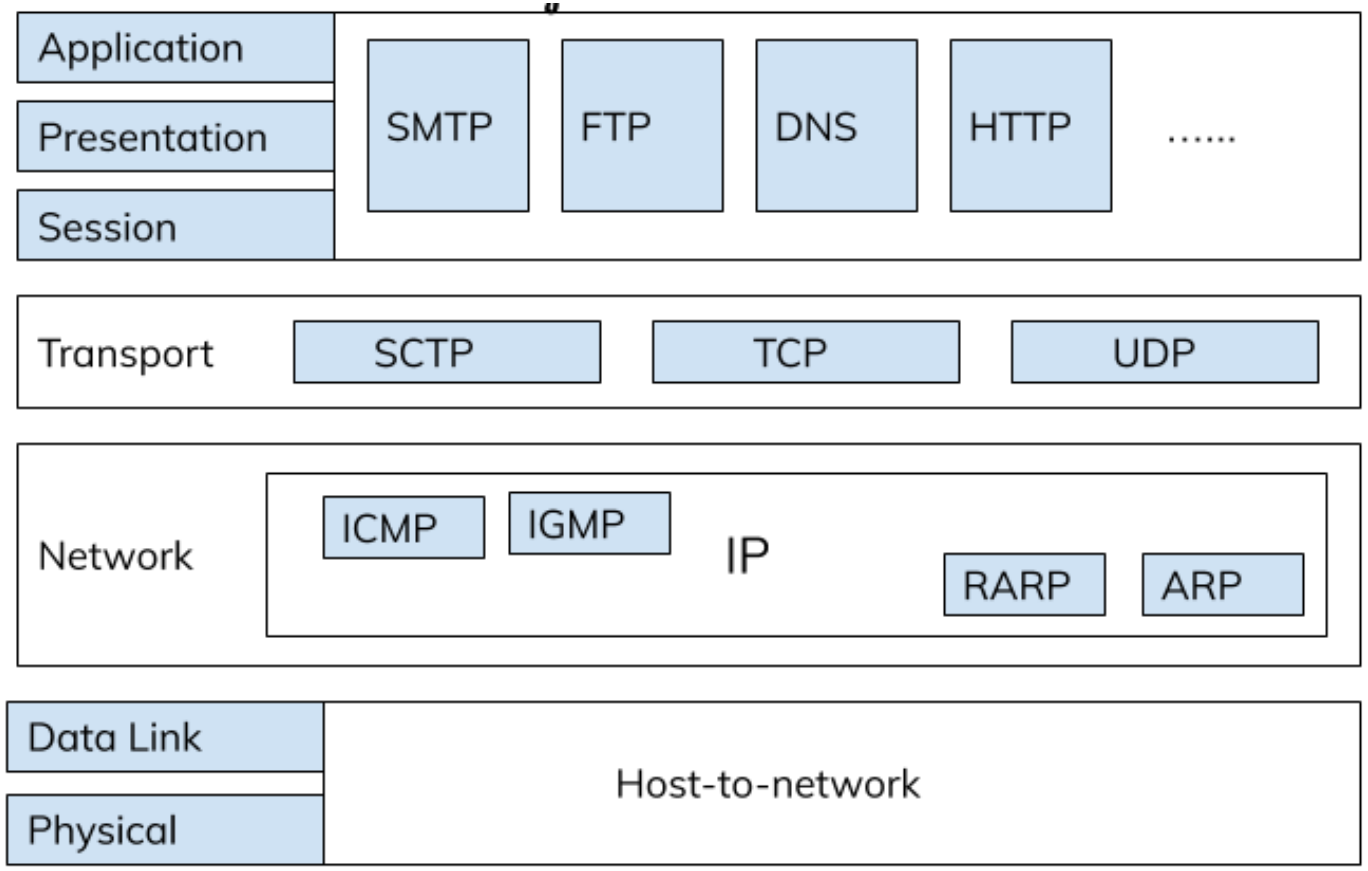
OSI Model(CO1)



TCP/IP model(CO3)

- Prior to OSI Model
- Basically had 4 layers
  - Host –to-network
  - Internet
  - Transport
  - Application
- TCP/IP is a hierarchical protocol made up of interactive modules, each of which provides a specific functionality
- TCP/IP protocol suite contain relatively independent protocols that can be mixed and matched depending on the needs of the system

TCP/IP Model(CO3)



Comparison between OSI and TCP/IP(CO1)

TCP/IP	OSI
TCP refers to Transmission Control Protocol.	OSI refers to Open Systems Interconnection.
TCP/IP has 4 layers.	OSI has 7 layers.
TCP/IP is more reliable	OSI is less reliable
TCP/IP does not have very strict boundaries.	OSI has strict boundaries
TCP/IP follow a horizontal approach.	OSI follows a vertical approach.
TCP/IP uses both session and presentation layer in the application layer itself.	OSI uses different session and presentation layers.
TCP/IP developed protocols then model.	OSI developed model then protocol.

Comparison between OSI and TCP/IP

TCP/IP	OSI
TCP does not clearly distinguish between service, protocols and interfaces	OSI has explicit distinction between these.
Specific protocols	protocols are better hidden
Protocol based model	Protocols can be replaced as technology changes
Description of the protocols	General model
Protocols do not fit in the function	Protocols do not fit in the function

Physical layer

Addressing

- Physical addressing
- Logical addressing
- Port Address
- Specific address

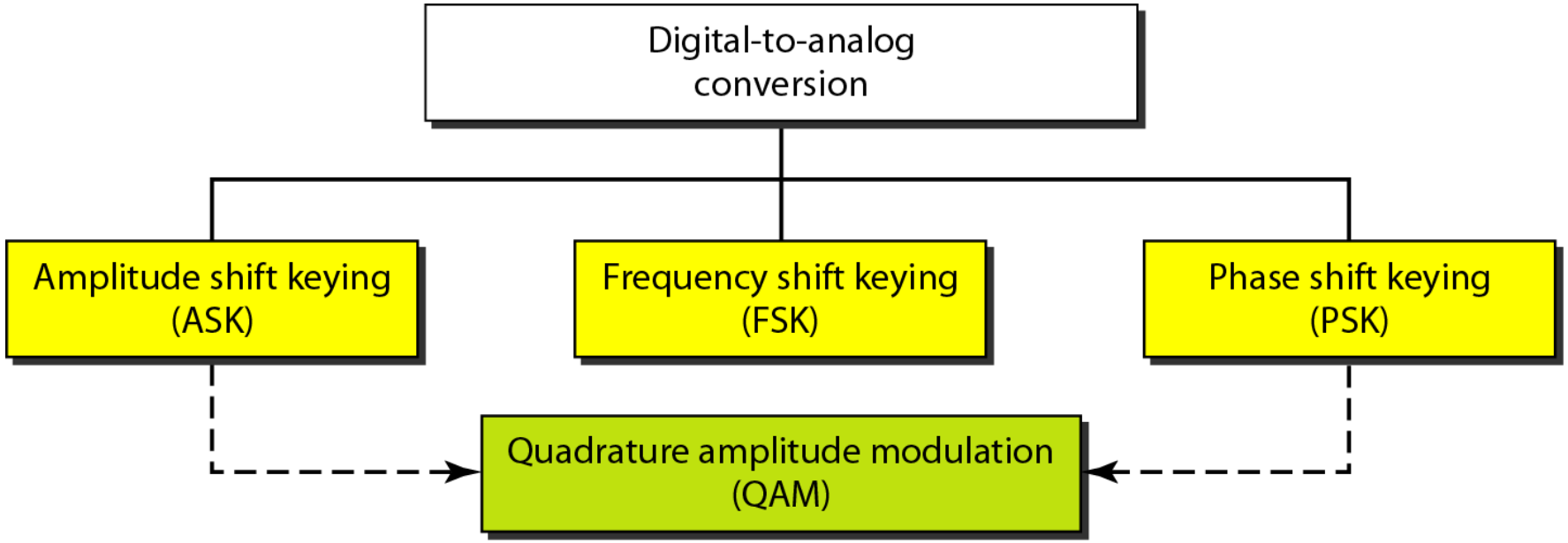
Physical Layer(CO1)

- Analog data and digital data
  - Continuous values and discrete values
- Analog and digital signals
  - Infinite number of values and limited number of values
- Periodic and non periodic signals
  - Repeat a pattern
- Data communications uses periodic analog signals
  - Sine wave
    - Peak amplitude
    - Period and Frequency (f=1/t)
    - Phase
    - Wavelength
    - Time and frequency domain
    - Composite signals
    - Bandwidth

Digital to Analog

- *Digital-to-analog conversion is the process of changing one of the characteristics of an analog signal based on the information in digital data.*
- Digital data needs to be carried on an analog signal.
- A carrier signal (frequency f_c) performs the function of transporting the digital data in an analog waveform.
- The analog carrier signal is manipulated to uniquely identify the digital data being carried.

Digital to Analog conversion(CO2)



Digital Data

- PERIODIC ANALOG SIGNALS
  - A simple periodic analog signal, a sine wave.
  - A composite periodic analog signal is composed of multiple sine waves.
- The three parameters: the peak amplitude, the frequency, and the phase
- Time and Frequency Domains
- Bandwidth
- Bitrate
- Bit length

Transmission impairment

- Causes
  - Attenuation – loss of energy
  - Distortion– change in shape & form of signal
  - Noise – extra signal

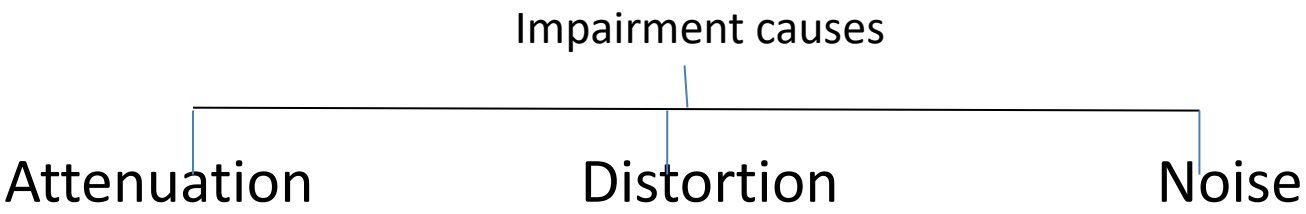
Data Rate(CO2)

- A very important consideration in data communications is how fast we can send data, in bits per second, over a channel. Data rate depends on three factors:
- 1. The bandwidth available
- 2. The level of the signals we use
- 3. The quality of the channel (the level of noise)

- Noiseless Channel: Nyquist Bit Rate
- Noisy Channel: Shannon Capacity
- Using Both Limits

Physical Layer

- Digital signals
  - 0 and 1
  - For no. of levels (L) require $\log_2$ L bits
  - Bit rate – no. of bits send per second(bps)
  - Bit length
- Transmitted by
  - Baseband transmission
  - Broadband transmission (using modulation)
- TRANSMISSION IMPAIRMENT



Physical Layer

- Data rate limit
  - The bandwidth available
  - The levels of signals that we use
  - The quality of channel
  - To calculate data rate
    - Nyquist for noiseless channel
    - Shannon for noisy channel
  - Performance
    - Bandwidth
      - In hertz and bits per second
    - Throughput
    - Latency
      - Propagation time + transmission time +queuing time + processing time
      - Jitter

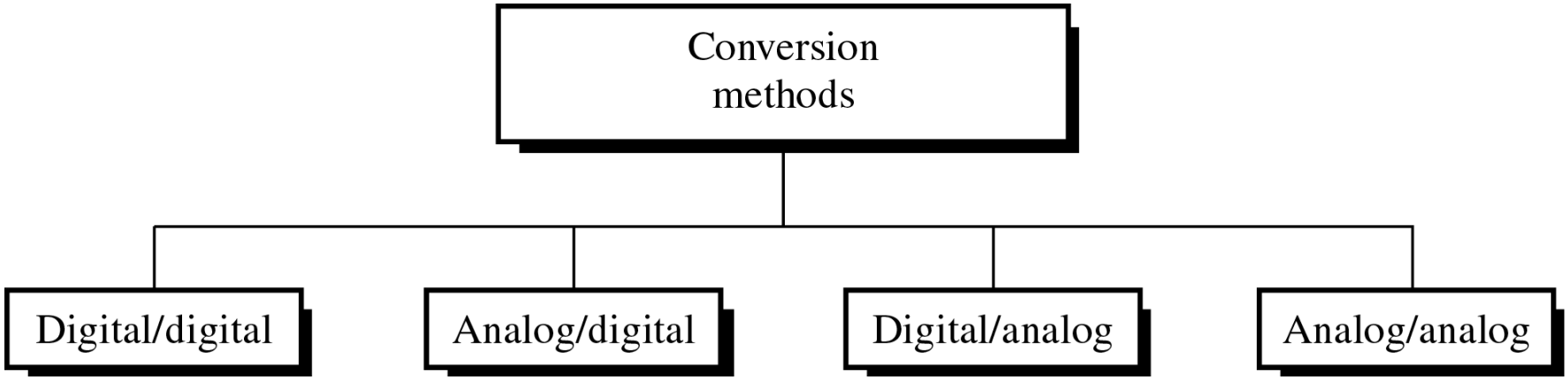
Physical Layer

- Conversion from digital to analog
  - ASK
  - FSK
  - PSK
  - QAM

- Bandwidth utilization
  - Multiplexing
  - Spreading
  - three basic multiplexing techniques:
    - frequency-division multiplexing,
    - wavelength-division multiplexing,
    - time-division multiplexing

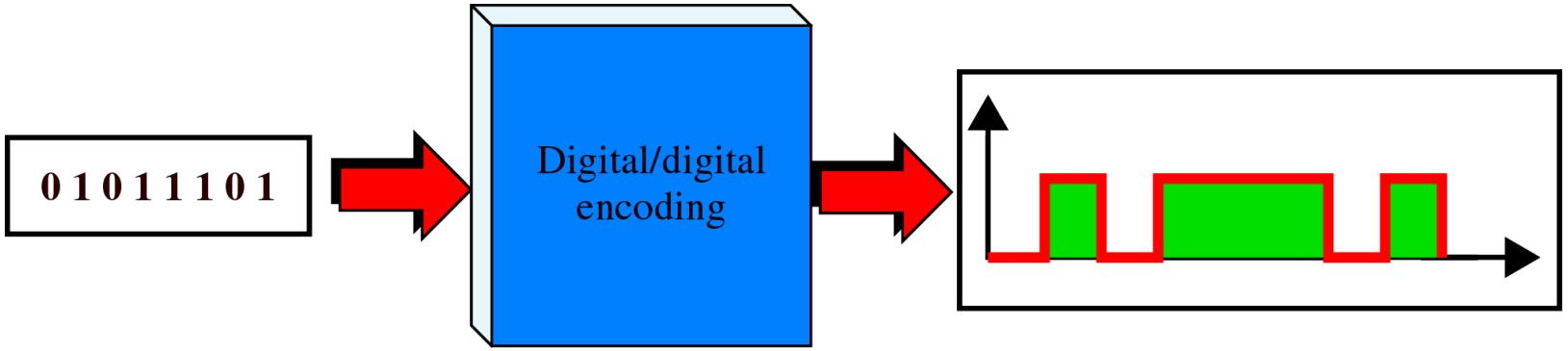
Encoding

Different Conversion Schemes



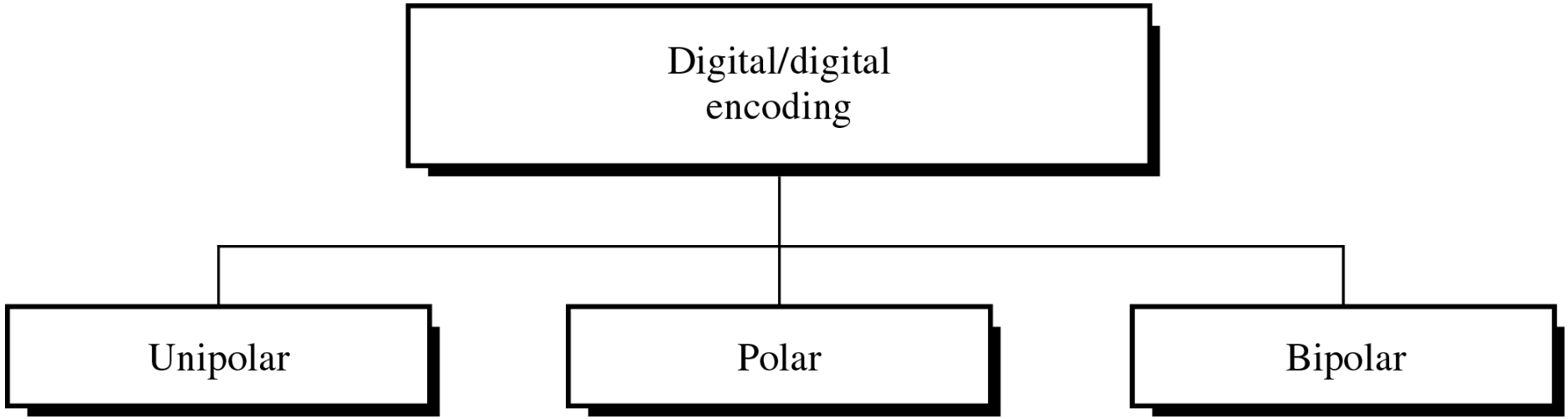
Encoding

Digital to Digital Encoding



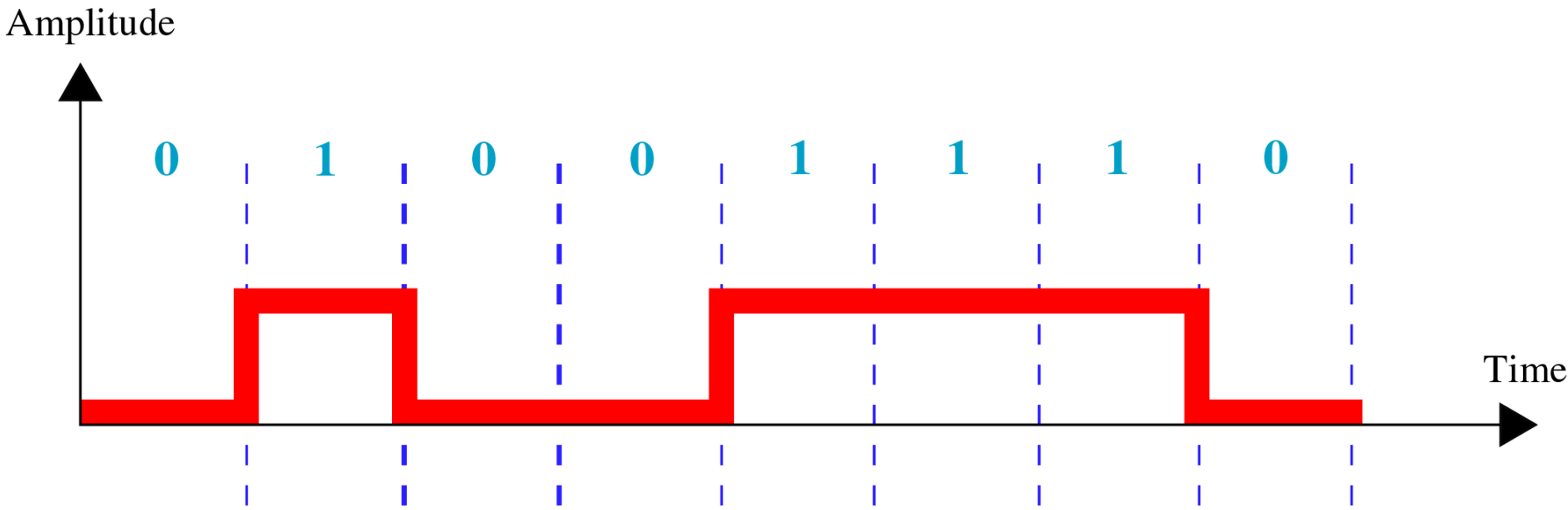
Encoding

Types of Digital to Digital Encoding



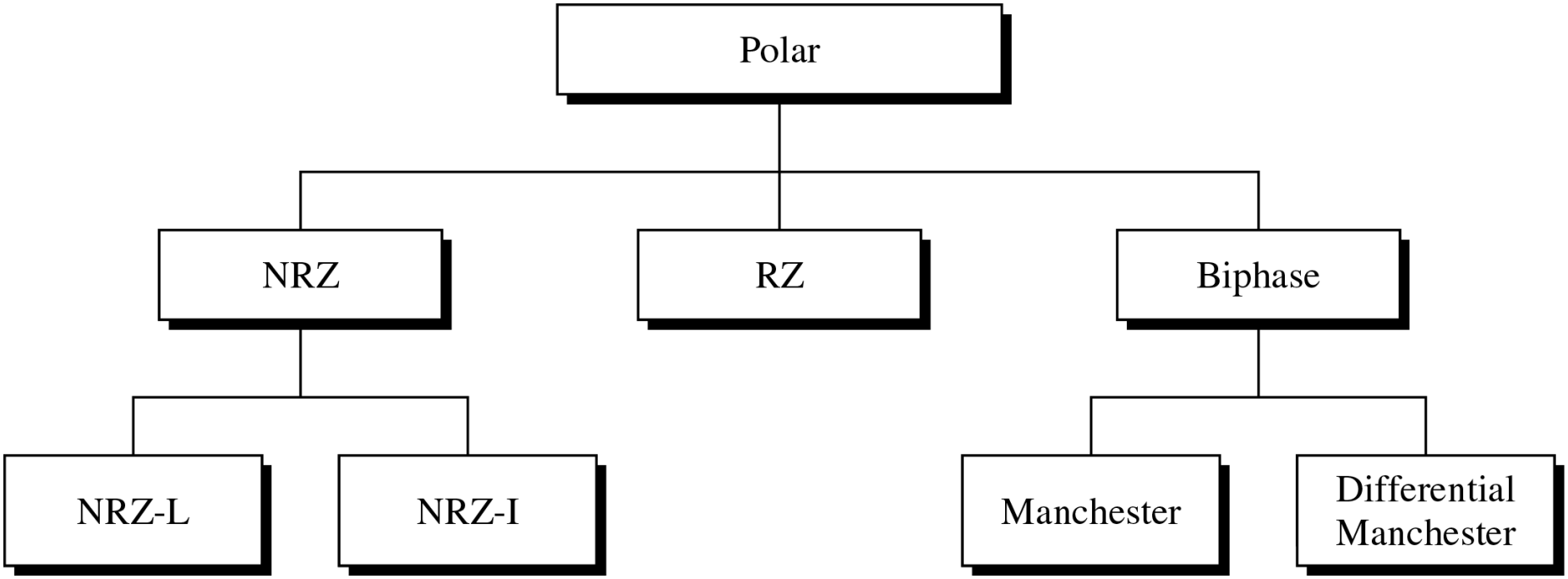
Encoding

Unipolar Encoding



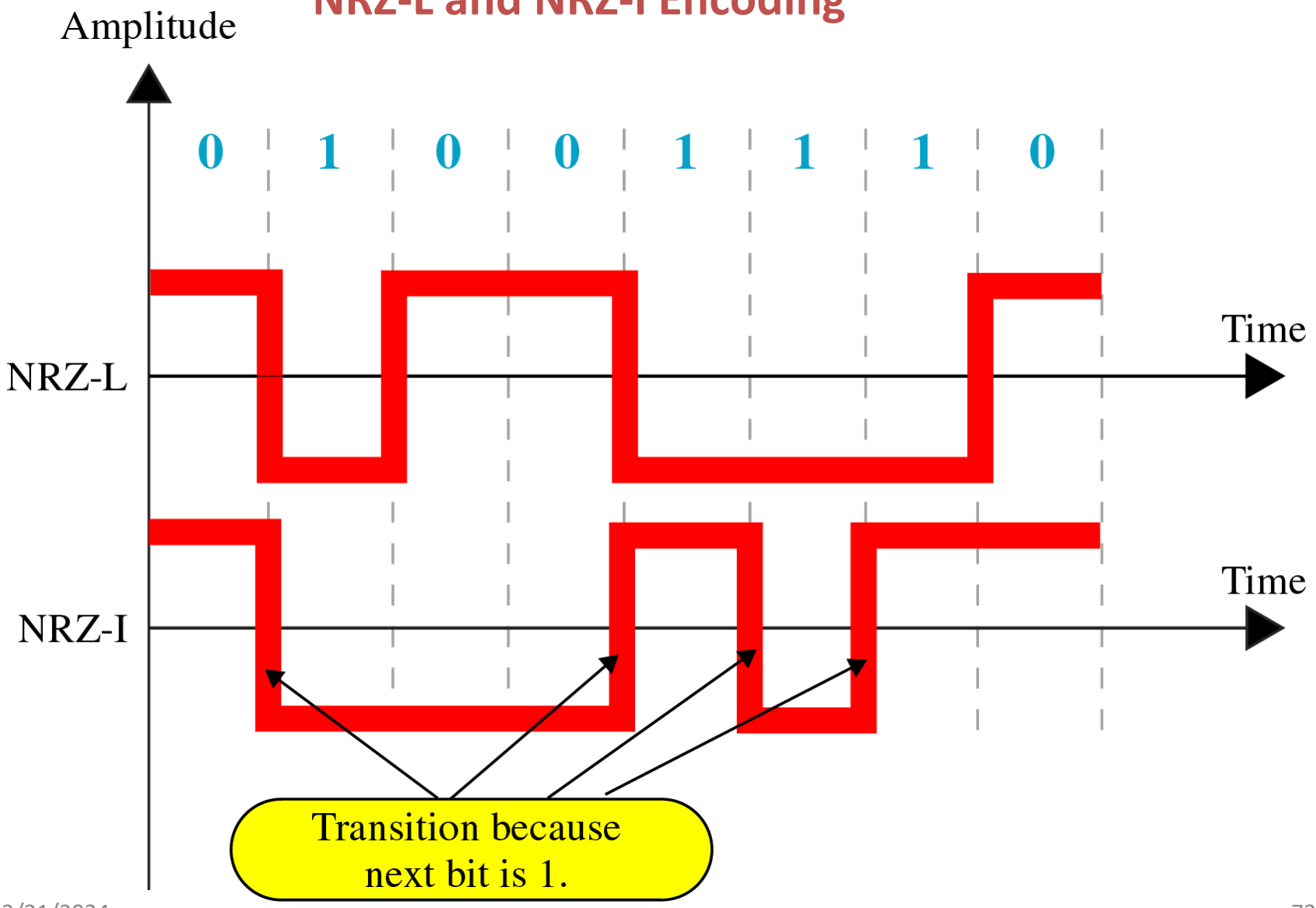
Encoding

Types of Polar Encoding



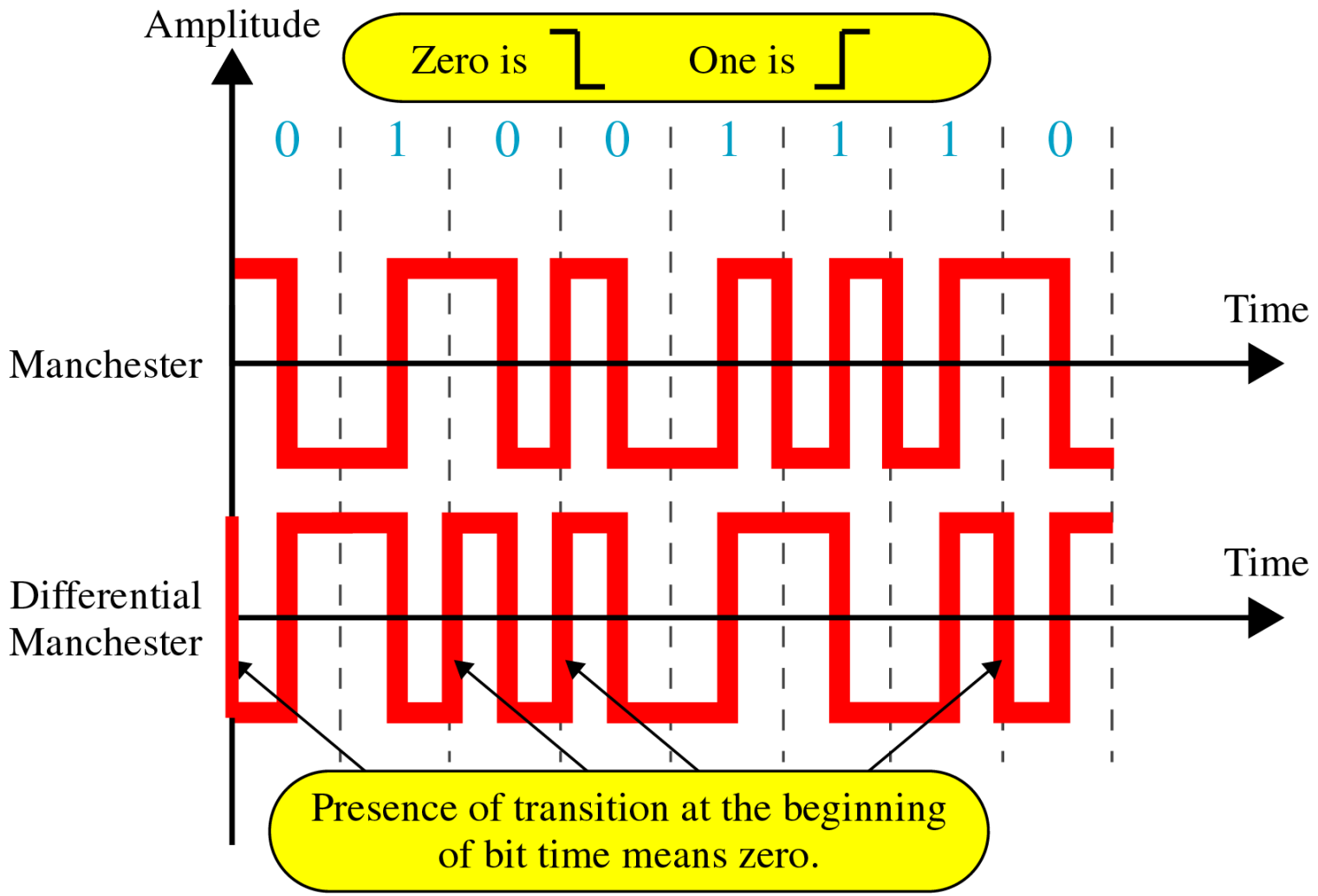
Encoding

NRZ-L and NRZ-I Encoding

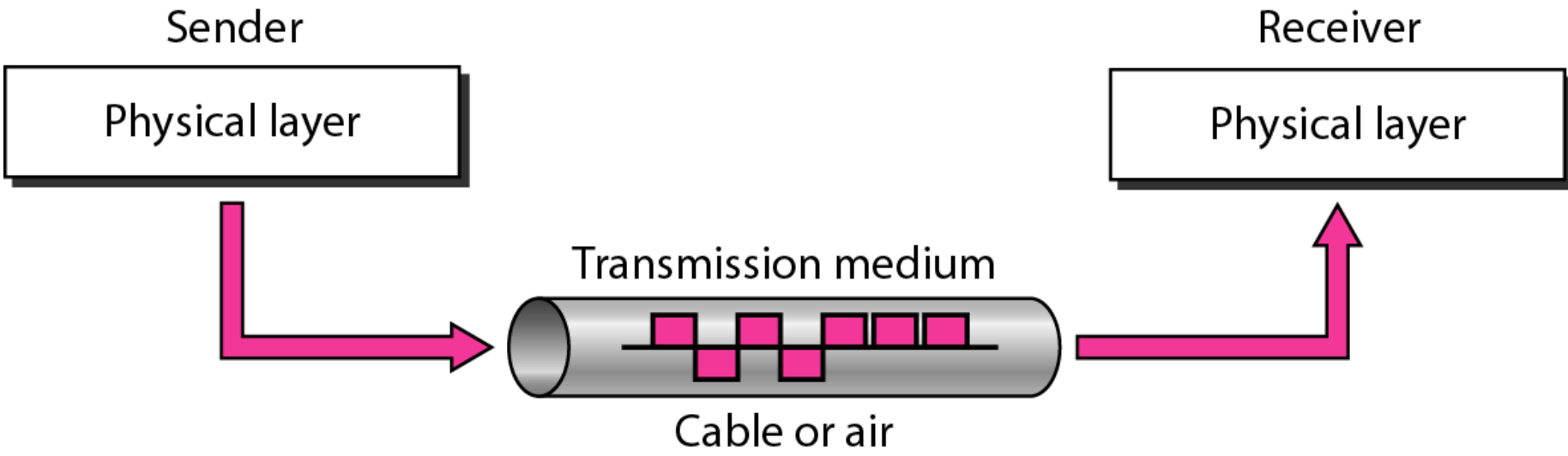


Encoding

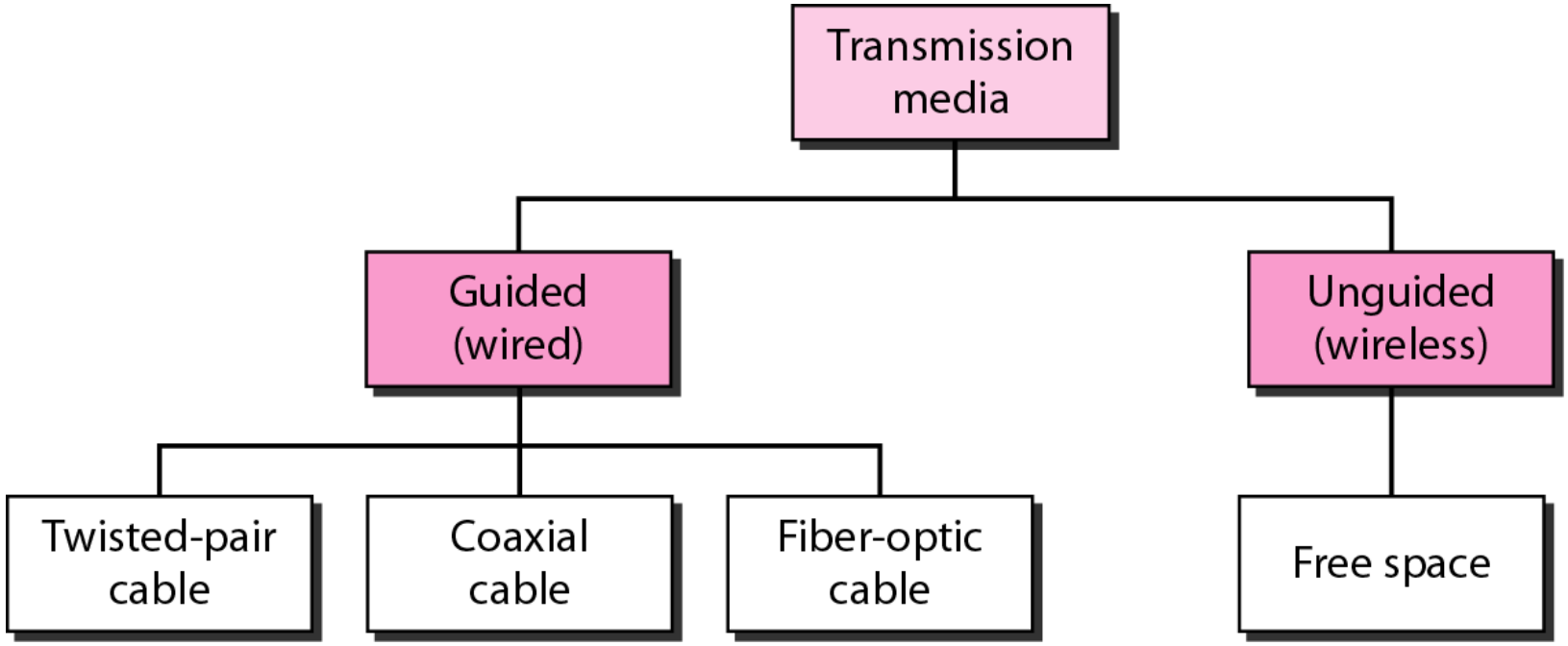
Manchester and Diff. Manchester Encoding



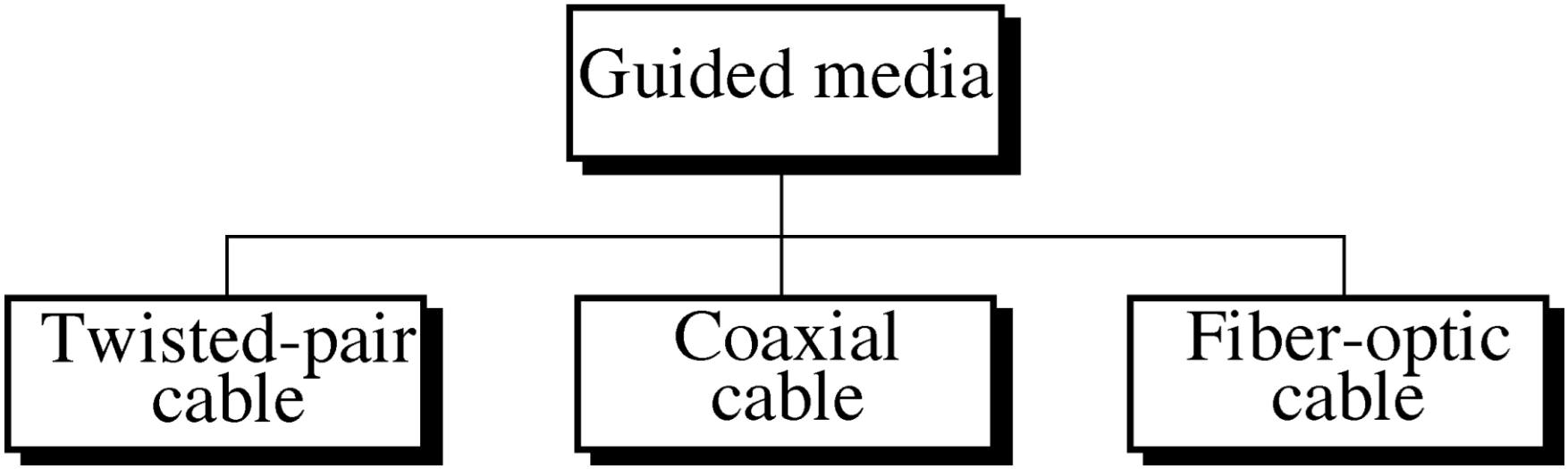
Transmission medium(CO2)



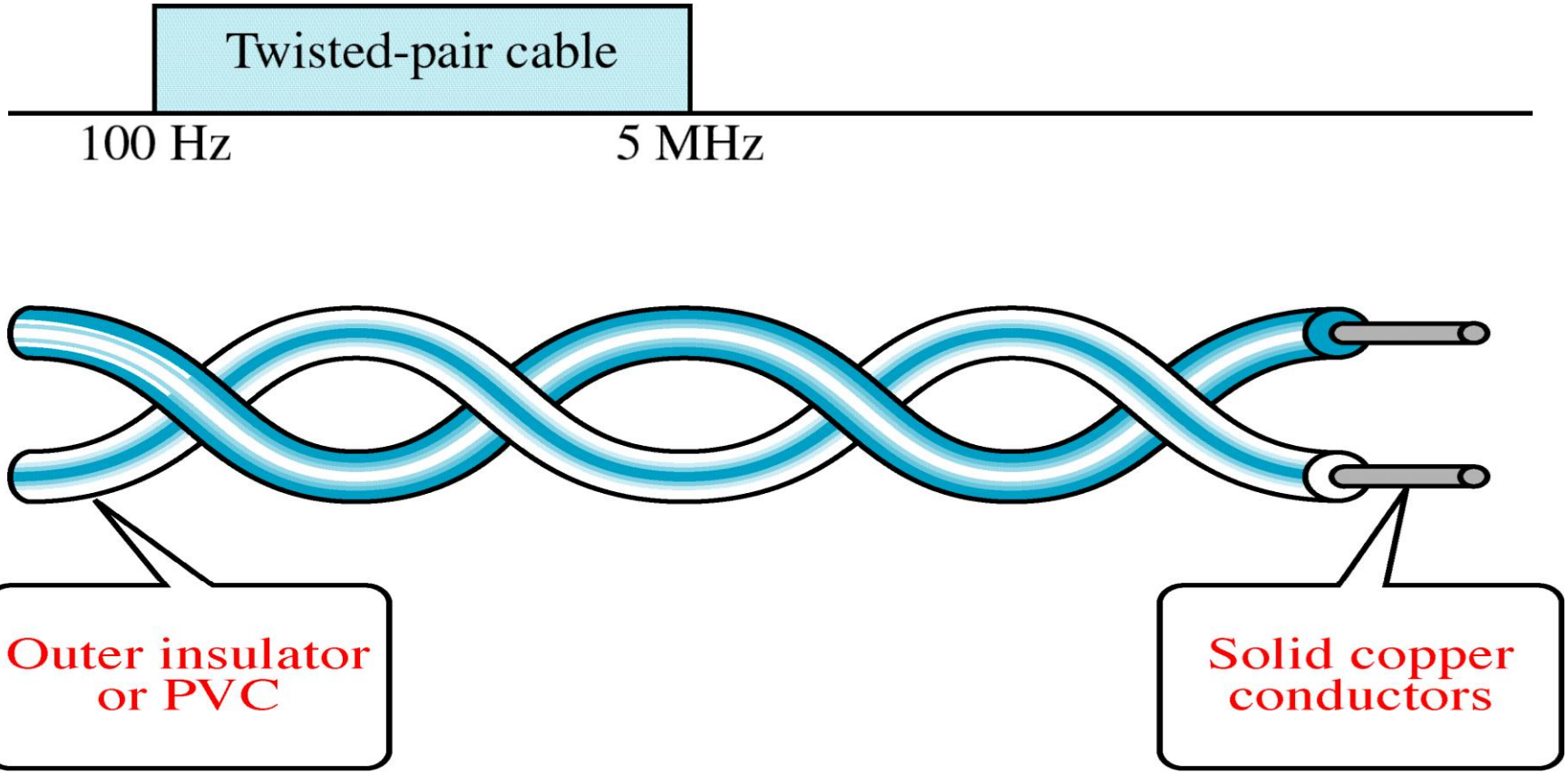
Transmission media(CO2)



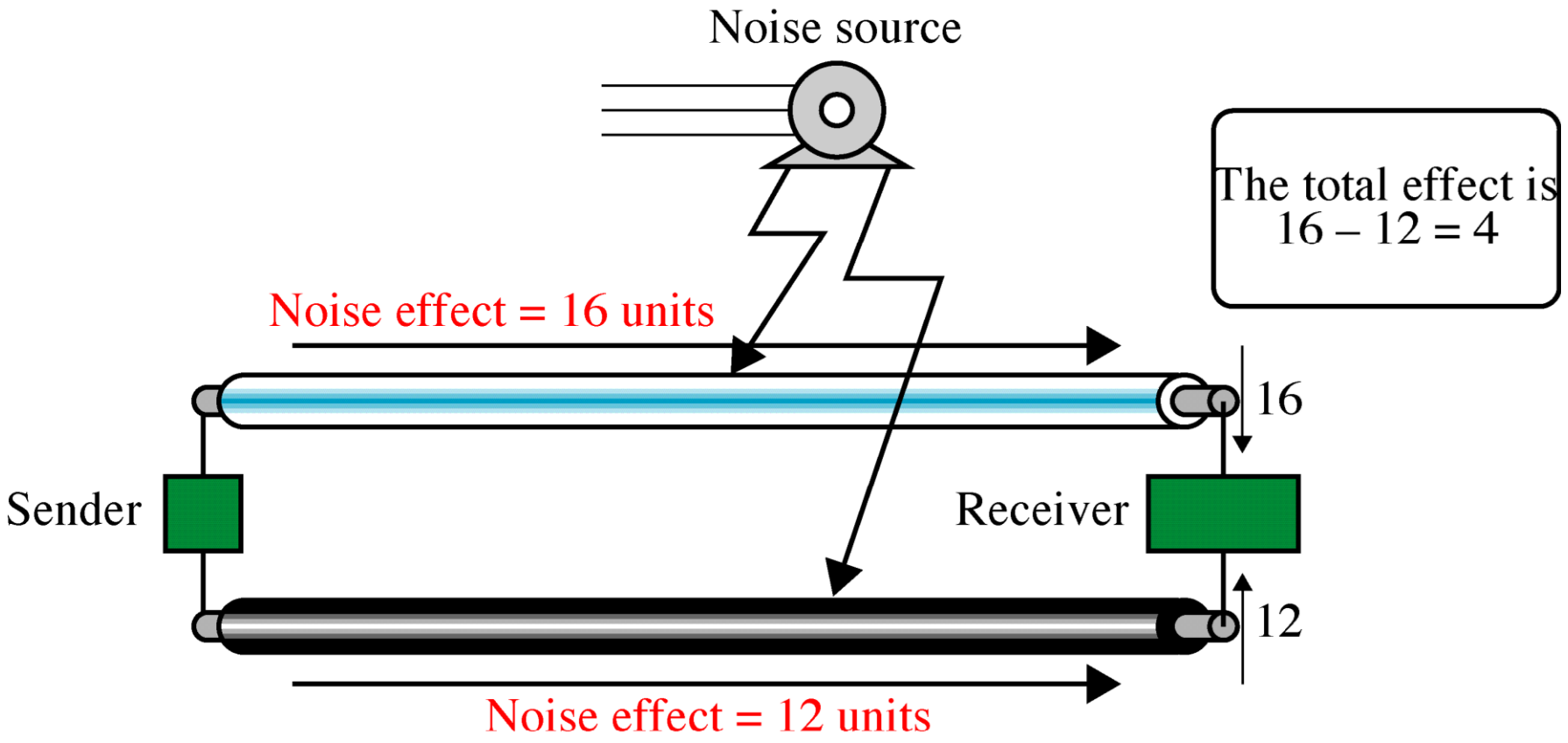
Transmission Media



Twisted-Pair Cable

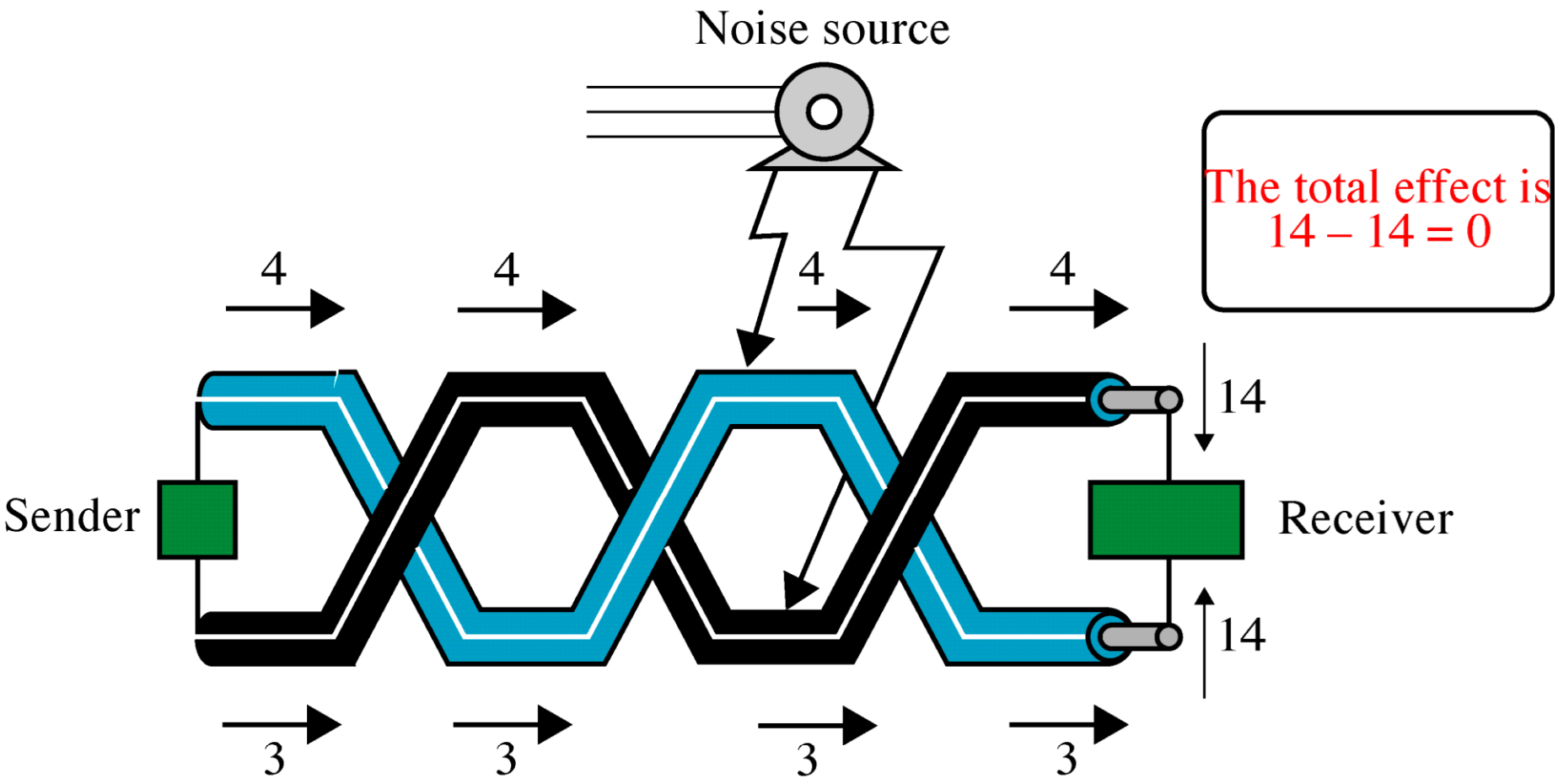


Noise Effect



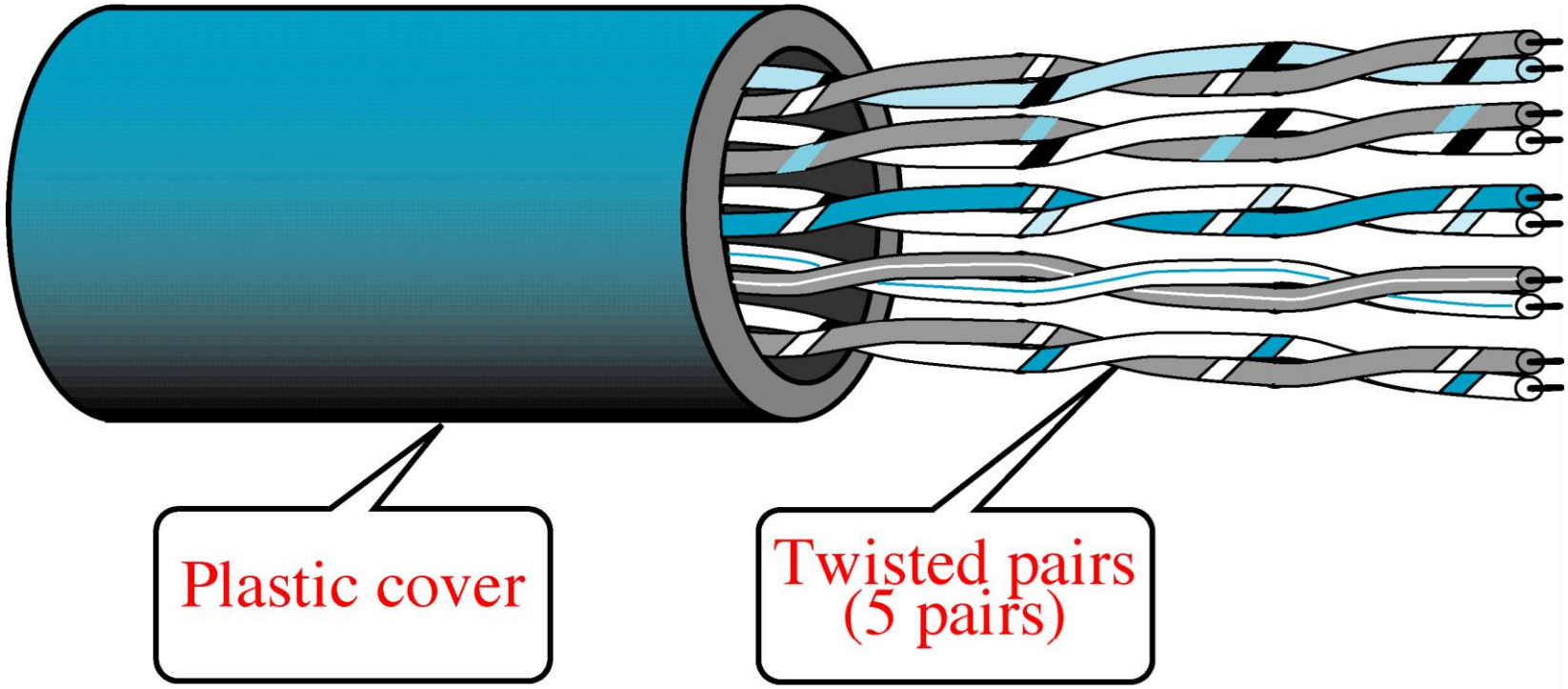
Transmission media

Noise on Twisted-Pair Lines



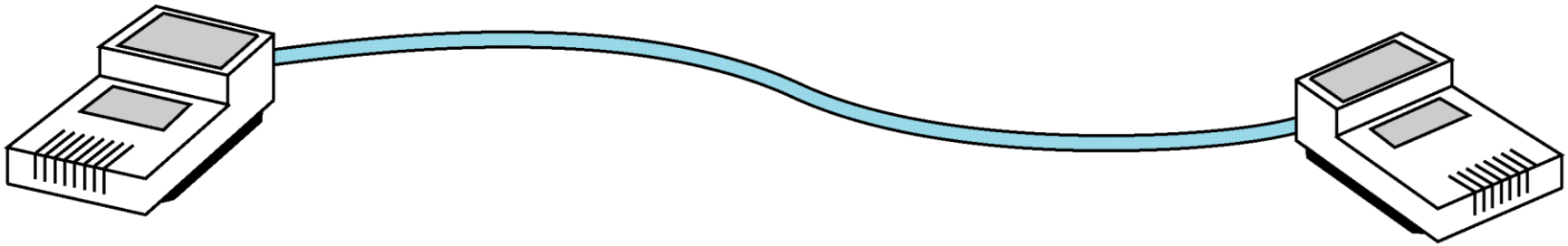
Transmission media

Unshielded Twisted-Pair Cable

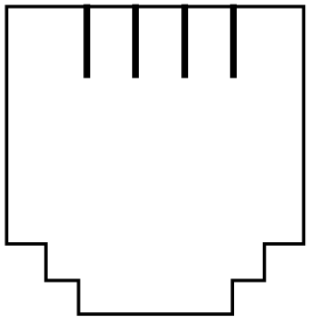


Transmission media

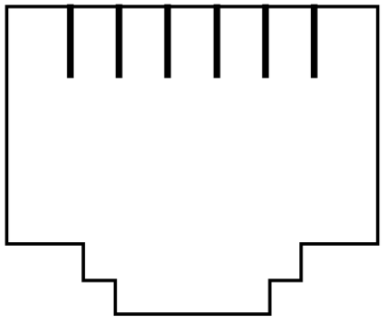
UTP Connectors



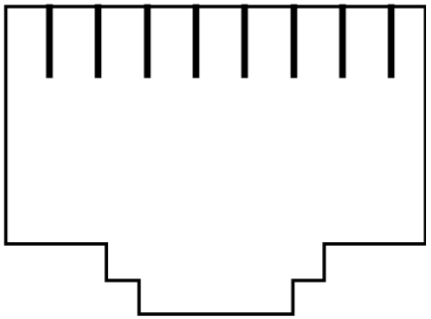
4-conductor



6-conductor



8-conductor



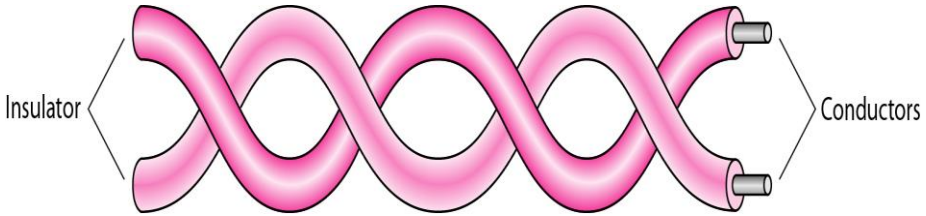
Transmission media - guided

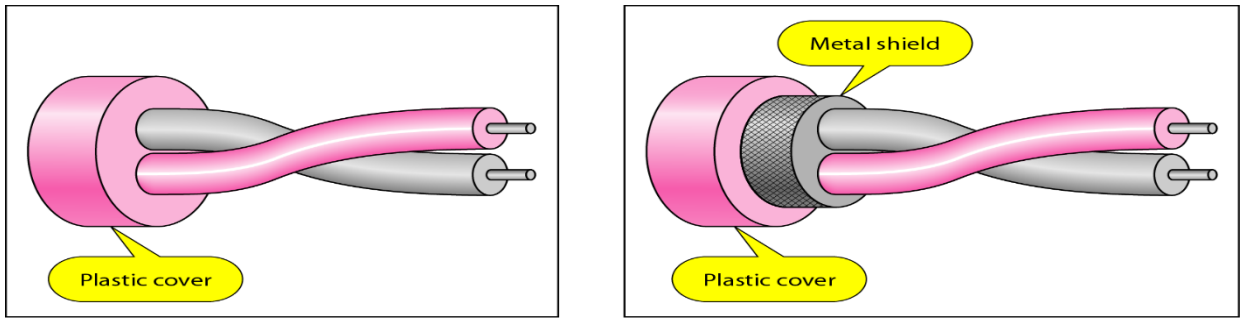
- Twisted Pair cable

Category	*Specification*	*Data Rate (Mbps)*	*Use*
1	Unshielded twisted-pair used in telephone	< 0.1	Telephone
2	Unshielded twisted-pair originally used in T-lines	2	T-1 lines
3	Improved CAT 2 used in LANs	10	LANs
4	Improved CAT 3 used in Token Ring networks	20	LANs
5	Cable wire is normally 24 AWG with a jacket and outside sheath	100	LANs
5E	An extension to category 5 that includes extra features to minimize the crosstalk and electromagnetic interference	125	LANs
6	A new category with matched components coming from the same manufacturer. The cable must be tested at a 200-Mbps data rate.	200	LANs
7	Sometimes called SSTP (shielded screen twisted-pair). Each pair is individually wrapped in a helical metallic foil followed by a metallic foil shield in addition to the outside sheath. The shield decreases the effect of crosstalk and increases the data rate.	600	LANs

Transmission media - guided

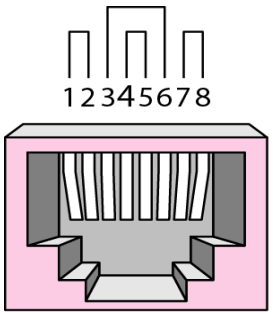
- Twisted Pair cable



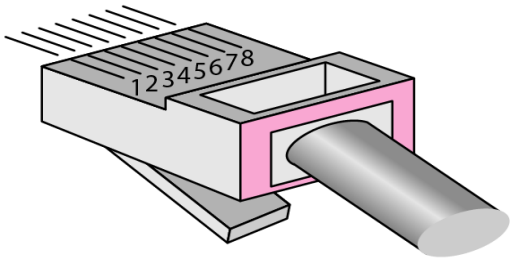


a. UTP

b. STP



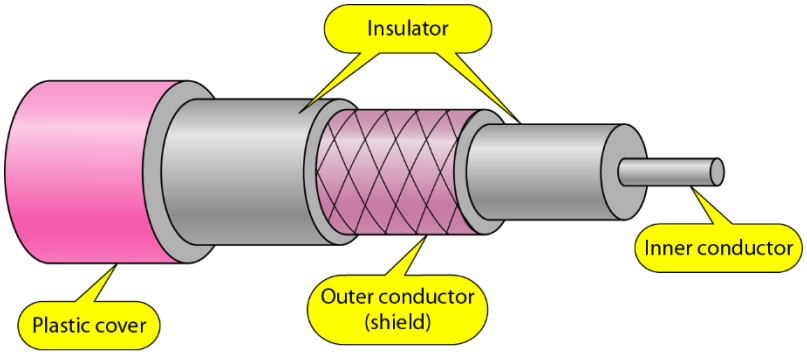
RJ-45 Female

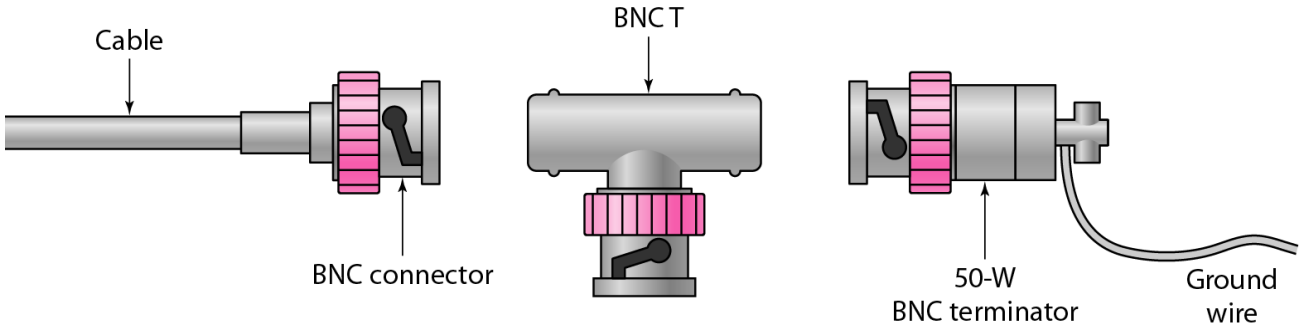


RJ-45 Male

Transmission media - guided

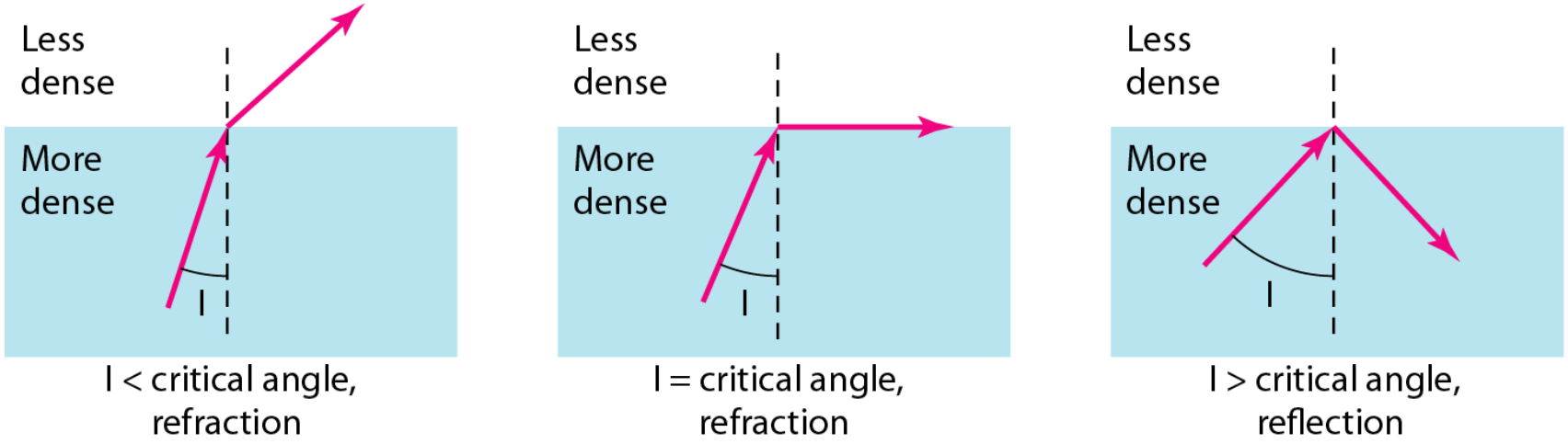
- Coaxial Cable

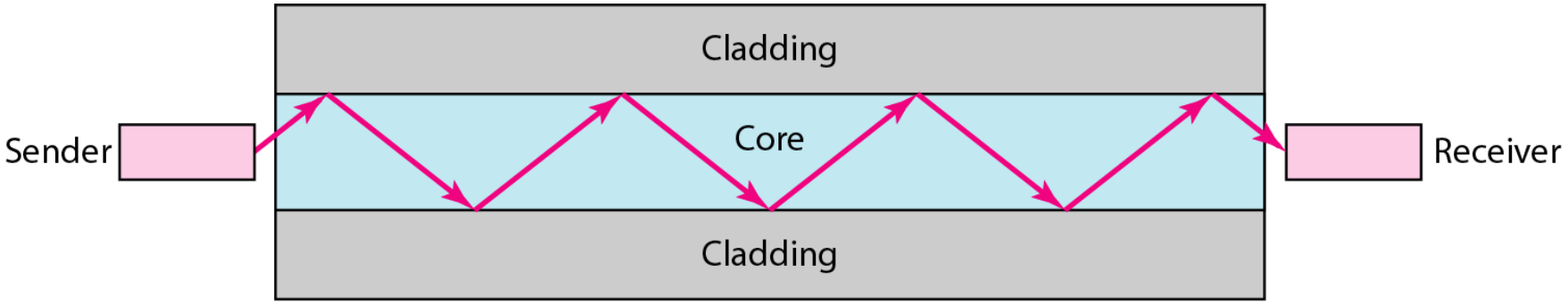




Transmission media - guided

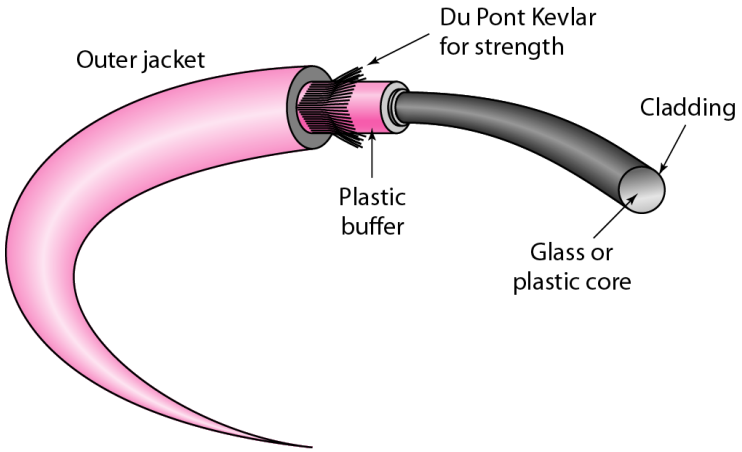
- Fiber Optic Cable based on

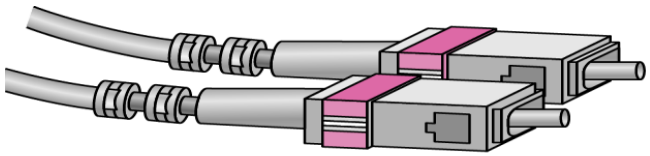


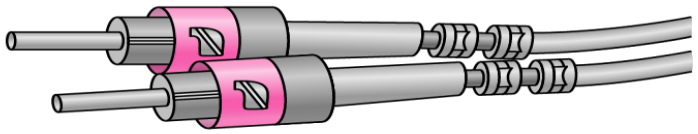


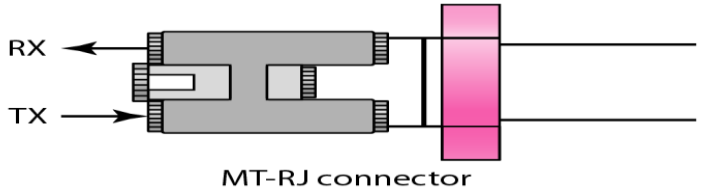
Transmission media - guided

- Fiber optic Cable



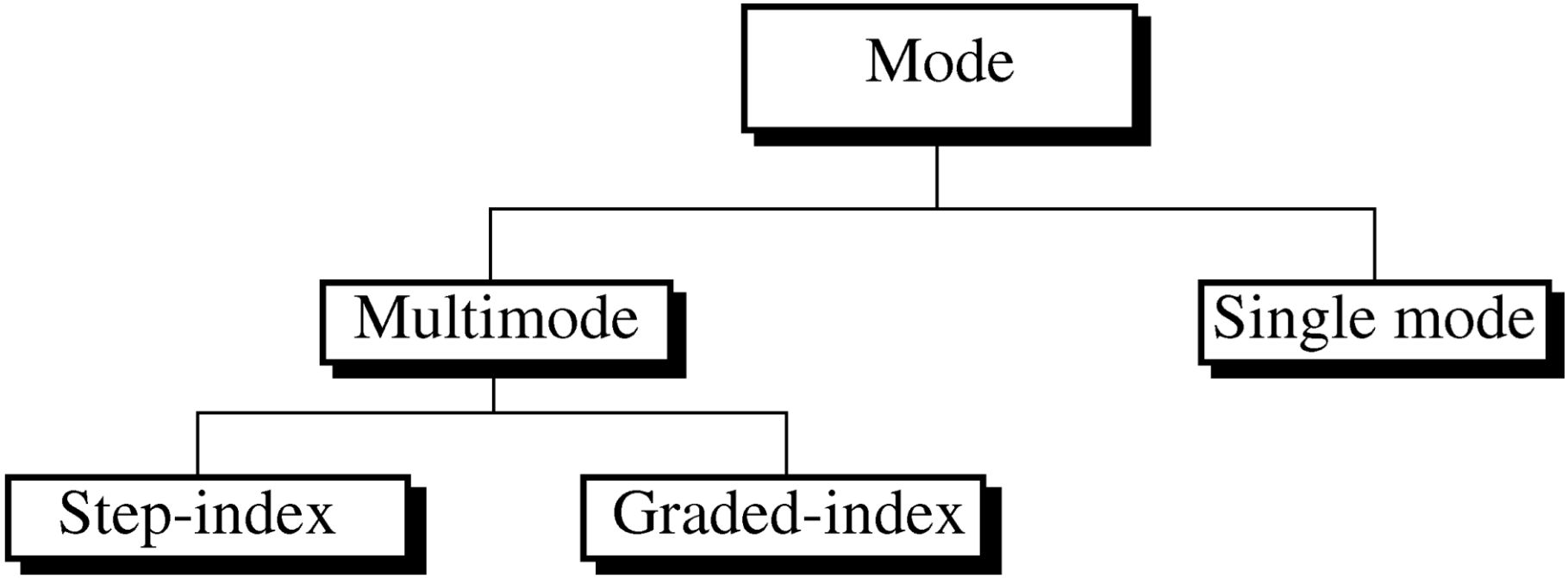

SC connector


ST connector



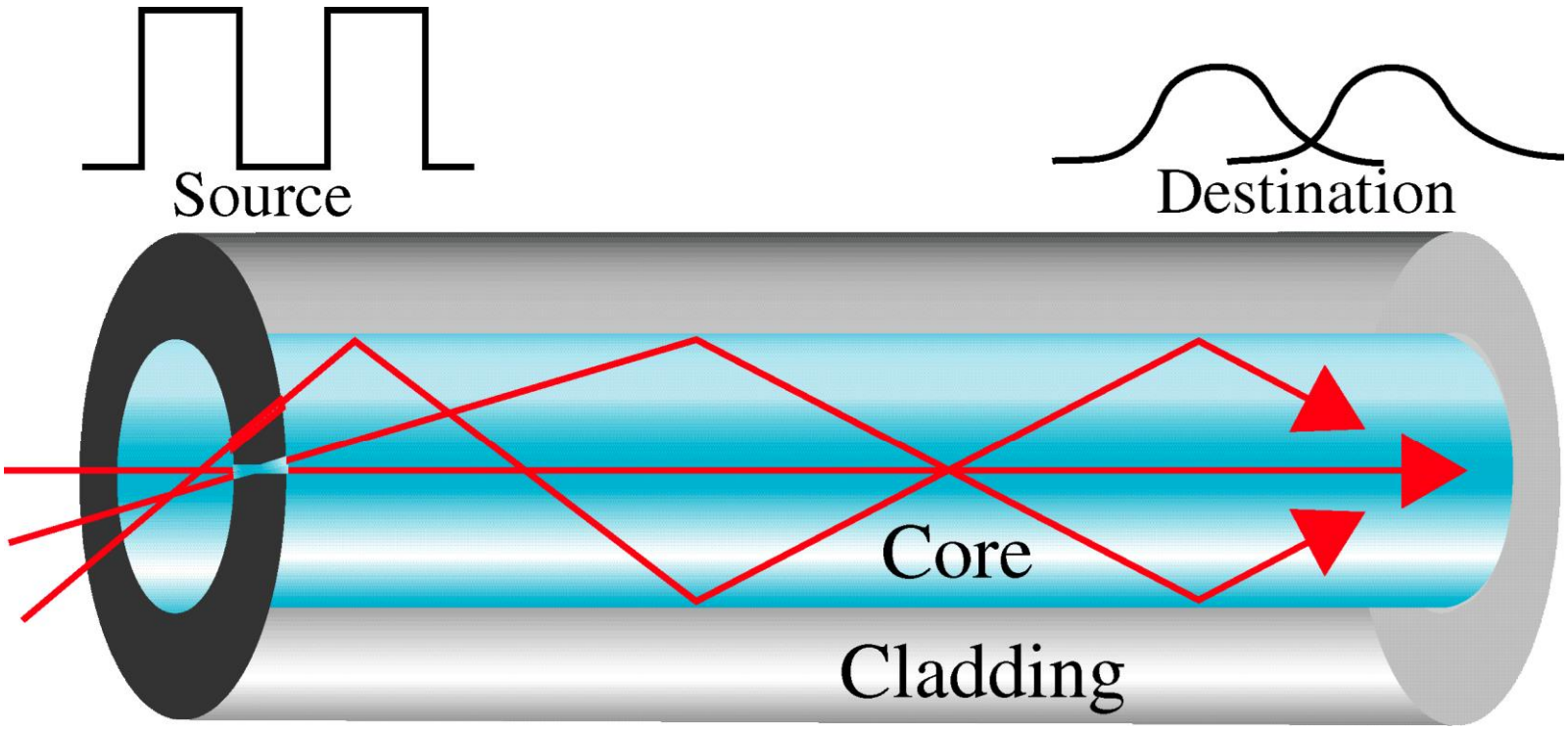
MT-RJ connector

Transmission media



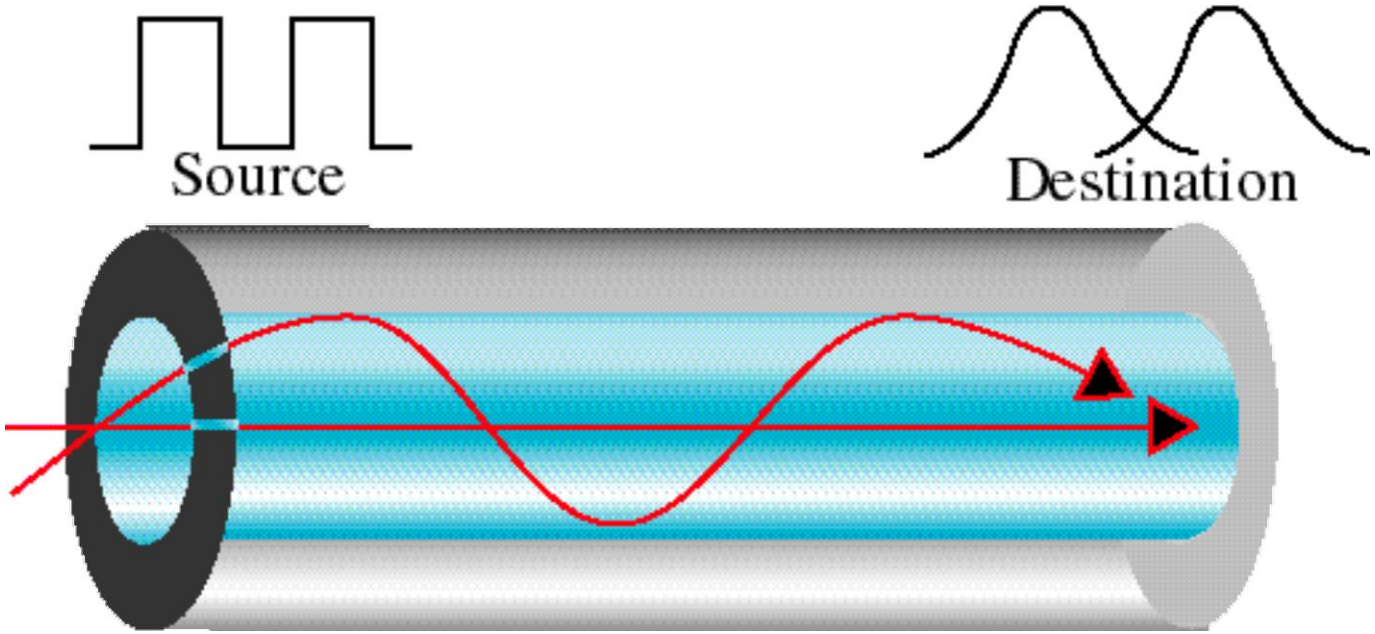
Transmission media

Multimode Step-Index



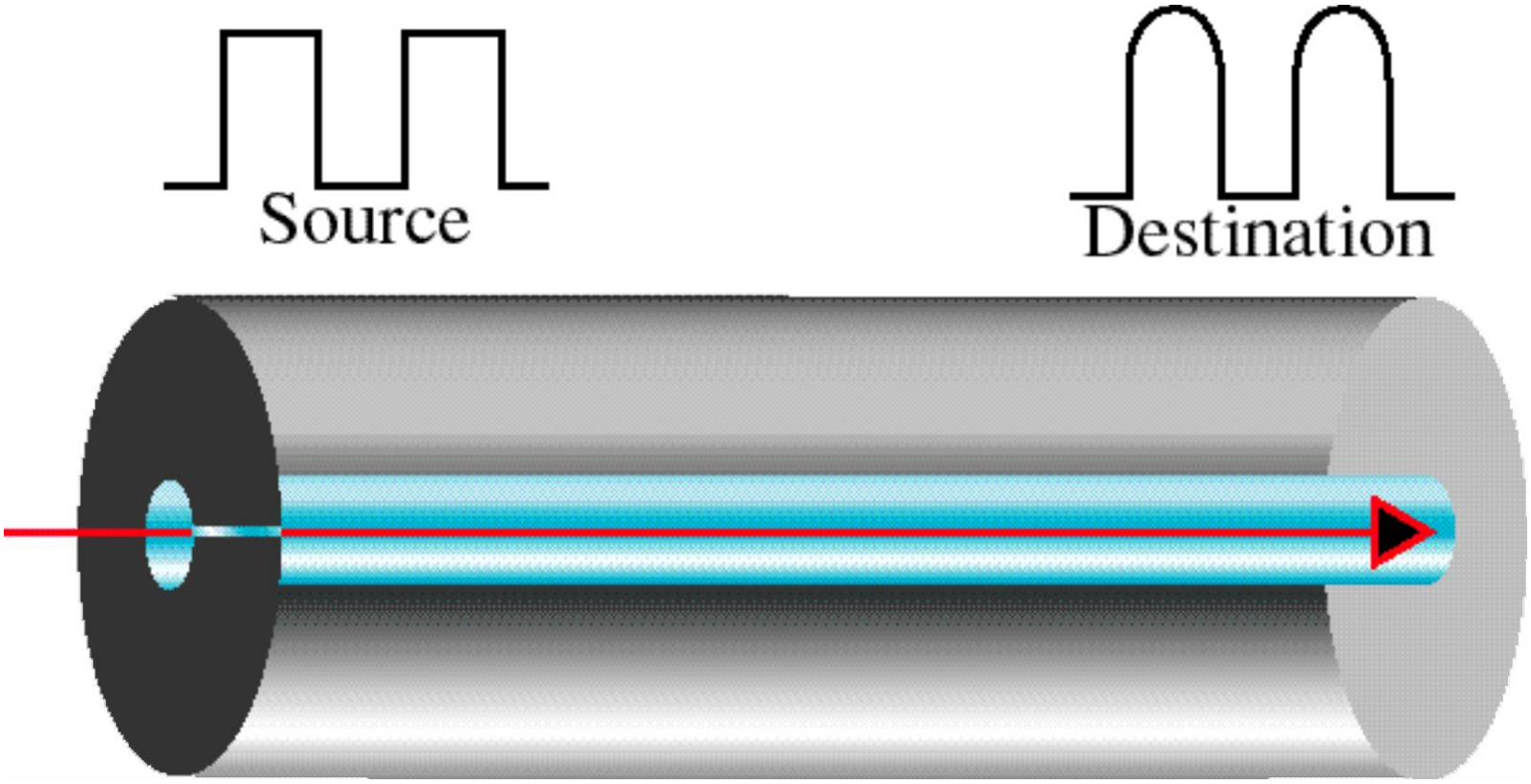
Transmission media

Multimode Graded-Index



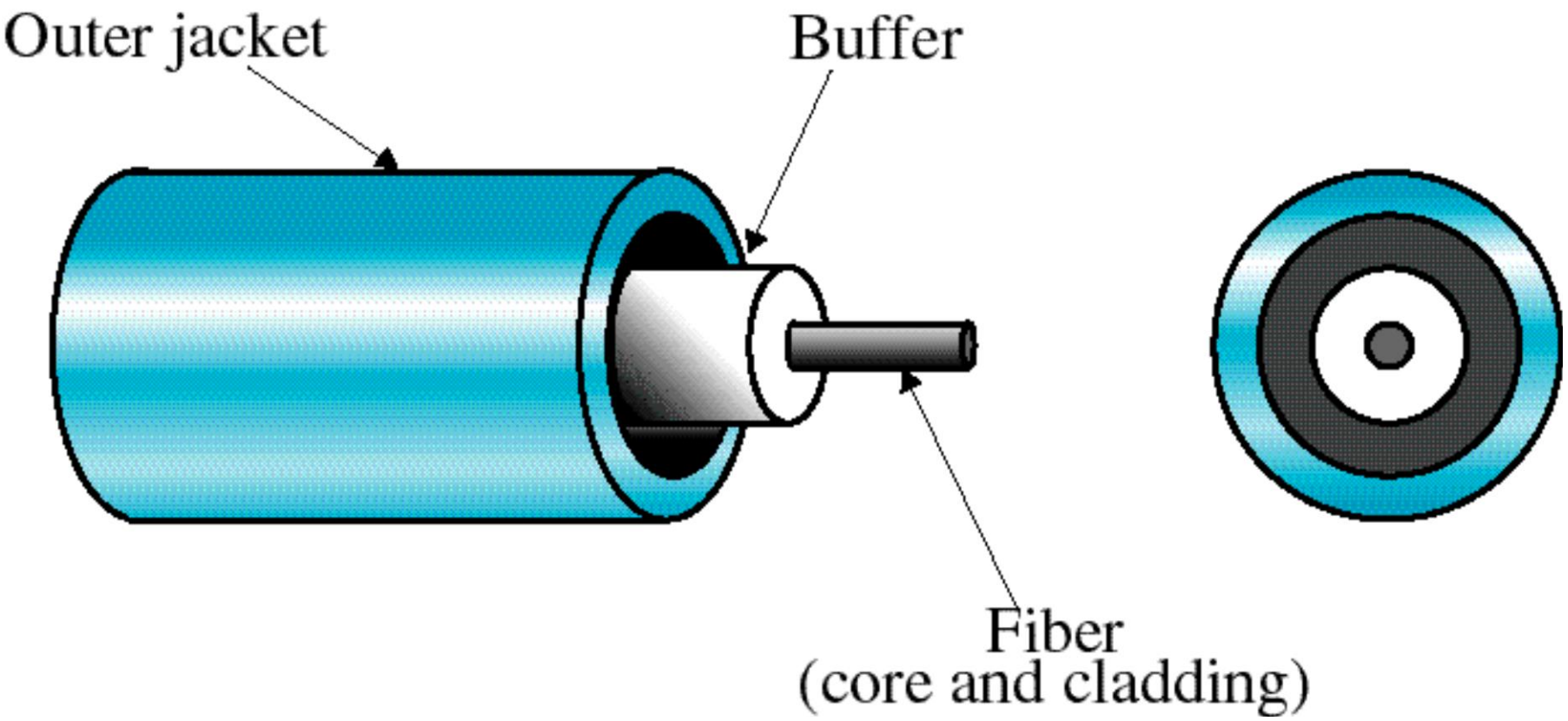
Transmission media

Single Mode



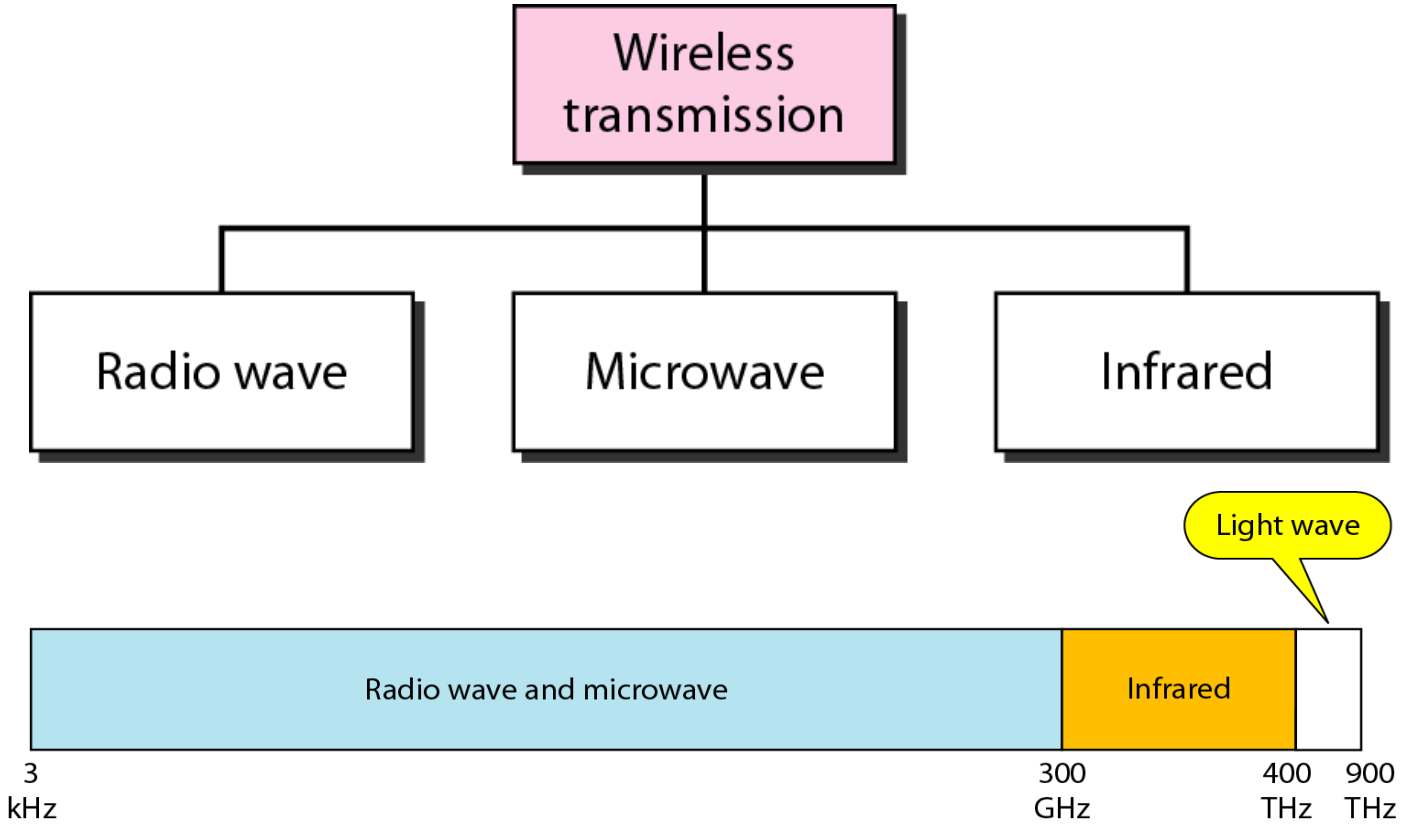
Transmission media

Fiber Construction



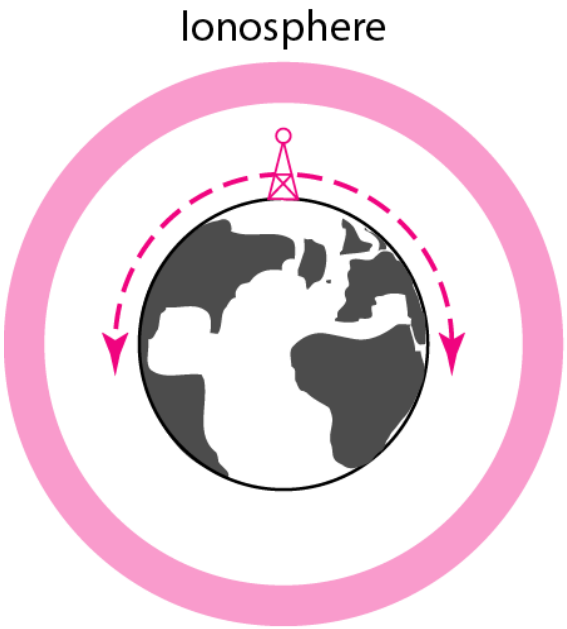
Transmission media - unguided

- Unguided media transport electromagnetic waves without using a physical conductor. This type of communication is often referred to as wireless communication.

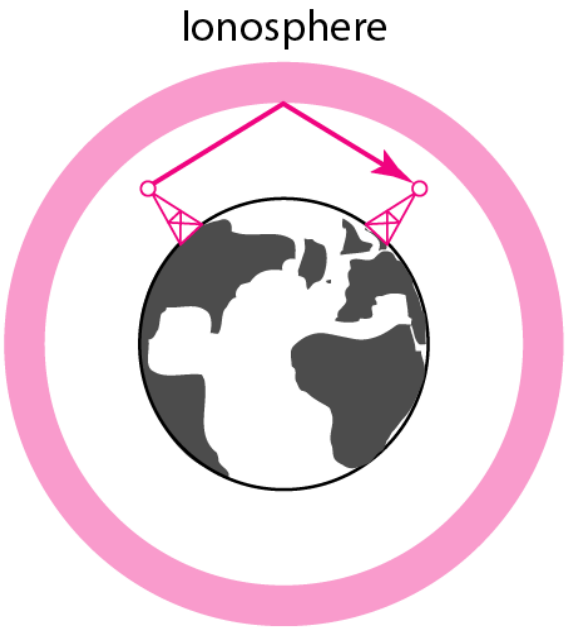


Transmission media - unguided

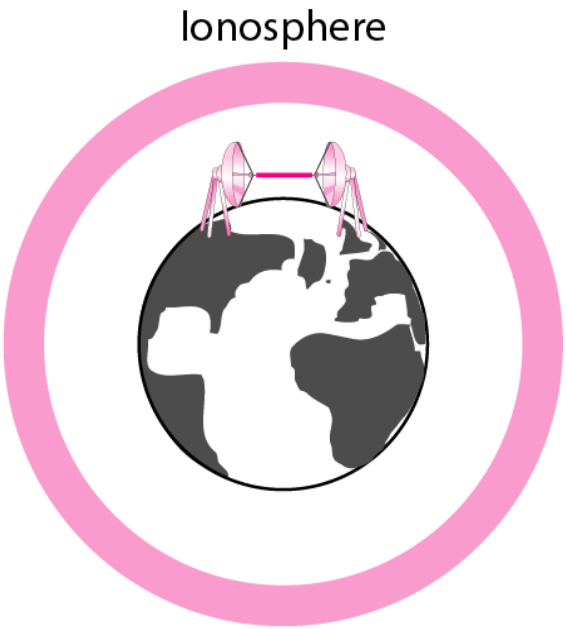
- Propagation modes



Ground propagation
(below 2 MHz)



Sky propagation
(2–30 MHz)



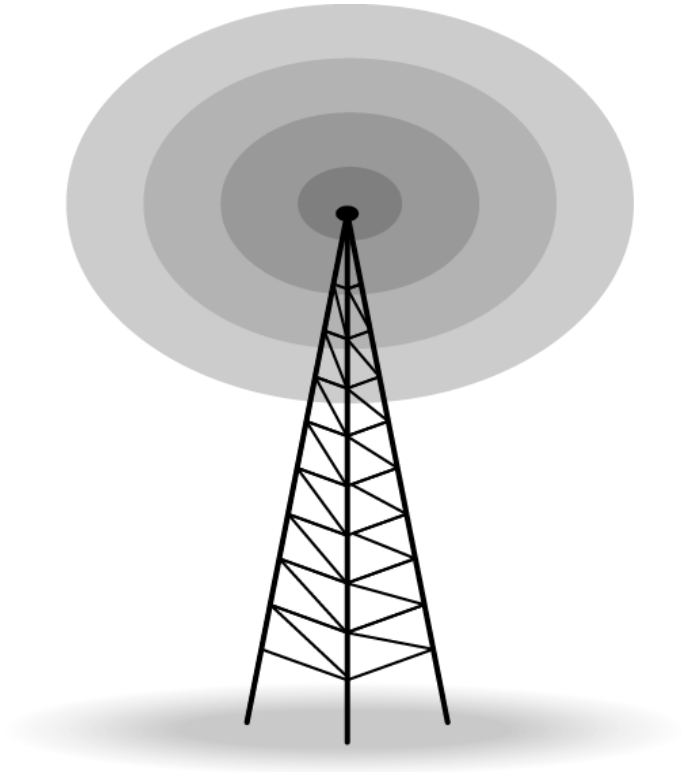
Line-of-sight propagation
(above 30 MHz)

Transmission media - unguided

Band	*Range*	*Propagation*	*Application*
VLF (very low frequency)	3–30 kHz	Ground	Long-range radio navigation
LF (low frequency)	30–300 kHz	Ground	Radio beacons and navigational locators
MF (middle frequency)	300 kHz–3 MHz	Sky	AM radio
HF (high frequency)	3–30 MHz	Sky	Citizens band (CB), ship/aircraft communication
VHF (very high frequency)	30–300 MHz	Sky and line-of-sight	VHF TV, FM radio
UHF (ultrahigh frequency)	300 MHz–3 GHz	Line-of-sight	UHF TV, cellular phones, paging, satellite
SHF (superhigh frequency)	3–30 GHz	Line-of-sight	Satellite communication
EHF (extremely high frequency)	30–300 GHz	Line-of-sight	Radar, satellite

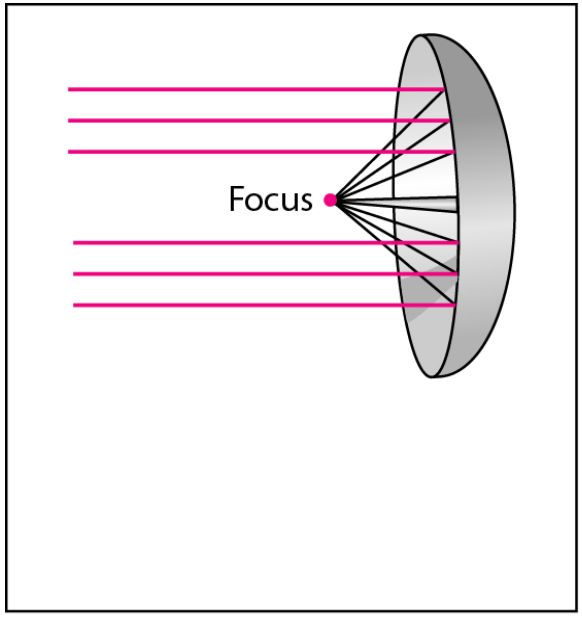
Transmission media - unguided

- Wireless communication
  - Radio waves are used for multicast communications, such as radio and television, and paging systems. They can penetrate through walls. Highly regulated. Use omni directional antennas

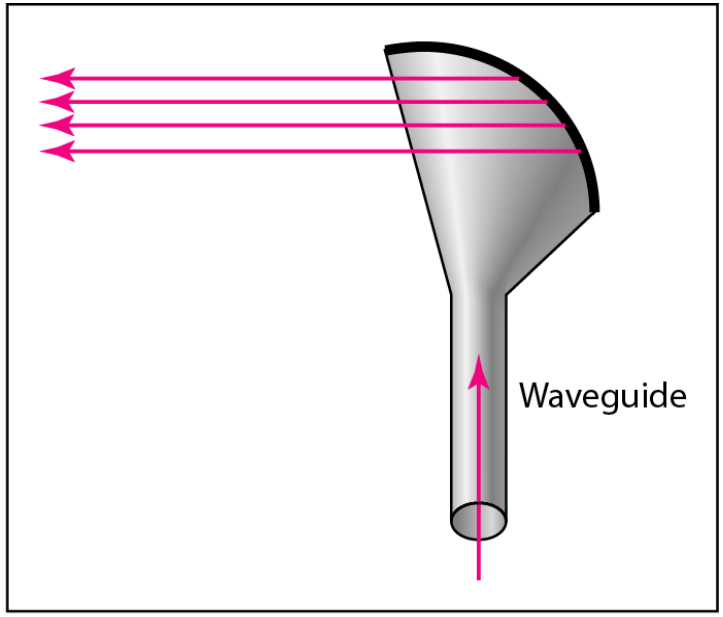


Transmission media - unguided

- Wireless communication
  - Microwaves are used for unicast communication such as cellular telephones, satellite networks,
    and wireless LANs. Higher frequency ranges cannot penetrate walls. Use directional antennas - point to point line of sight communications.



a. Dish antenna

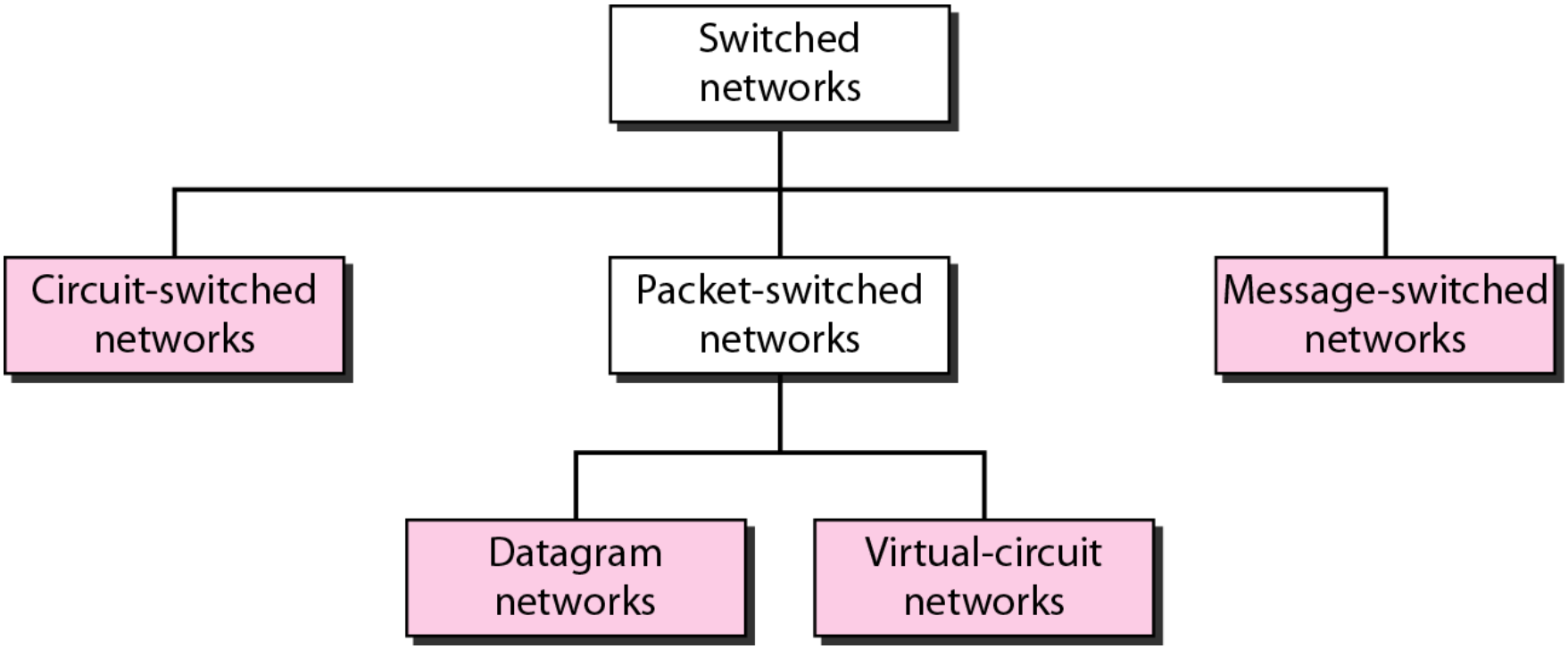


b. Horn antenna

Transmission media - unguided

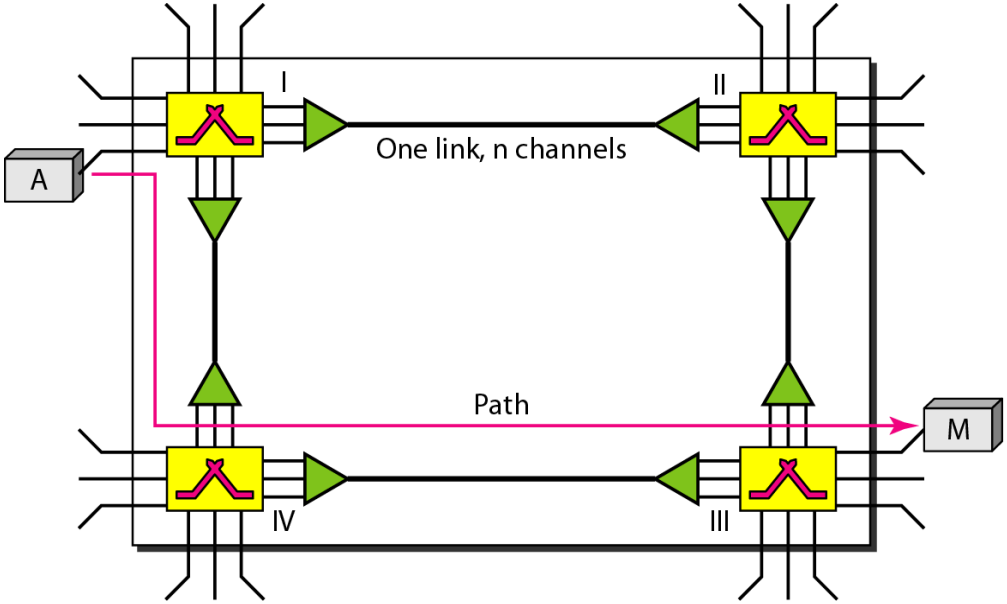
- Wireless communications
  - Infrared signals can be used for short-range communication in a closed area using line-of-sight propagation.
- Disadvantages of wireless channels
  - Are subject to a lot more errors than guided media channels.
  - Interference is one cause for errors, can be circumvented with high SNR.
  - The higher the SNR the less capacity is available for transmission due to the broadcast nature of the channel.
  - Channel also subject to fading and no coverage holes.

Switching methods(CO2)



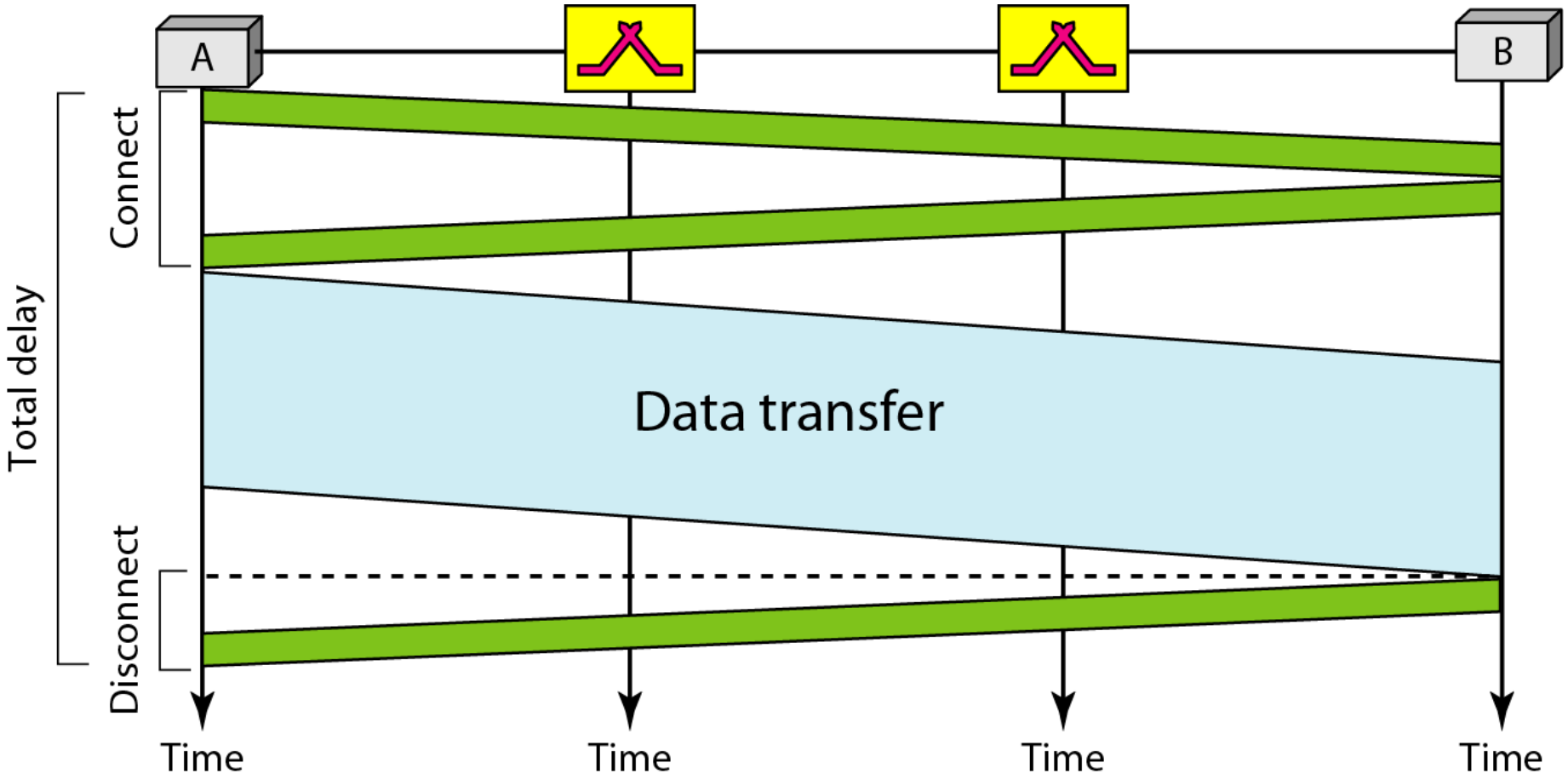
Switching methods(CO2)

- Circuit switched
  - *consists of a set of switches connected by physical links.*
  - *A connection between two stations is a dedicated path made of one or more links.*
  - *Each connection uses only one dedicated channel on each link.*
  - *Each link is normally divided into n channels by using FDM or TDM.*
-



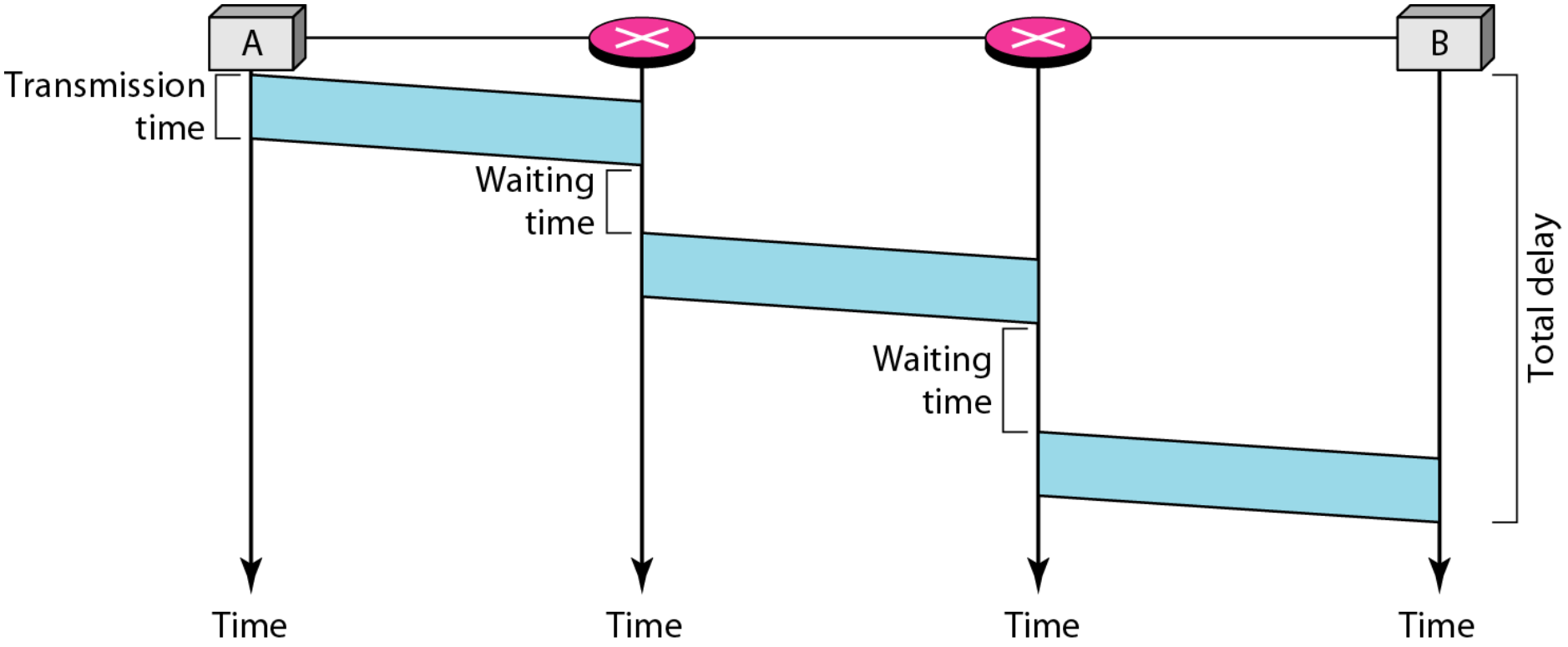
Switching methods(CO2)

- Delay in Circuit switched



Switching methods(CO2)

- Delay in datagram network

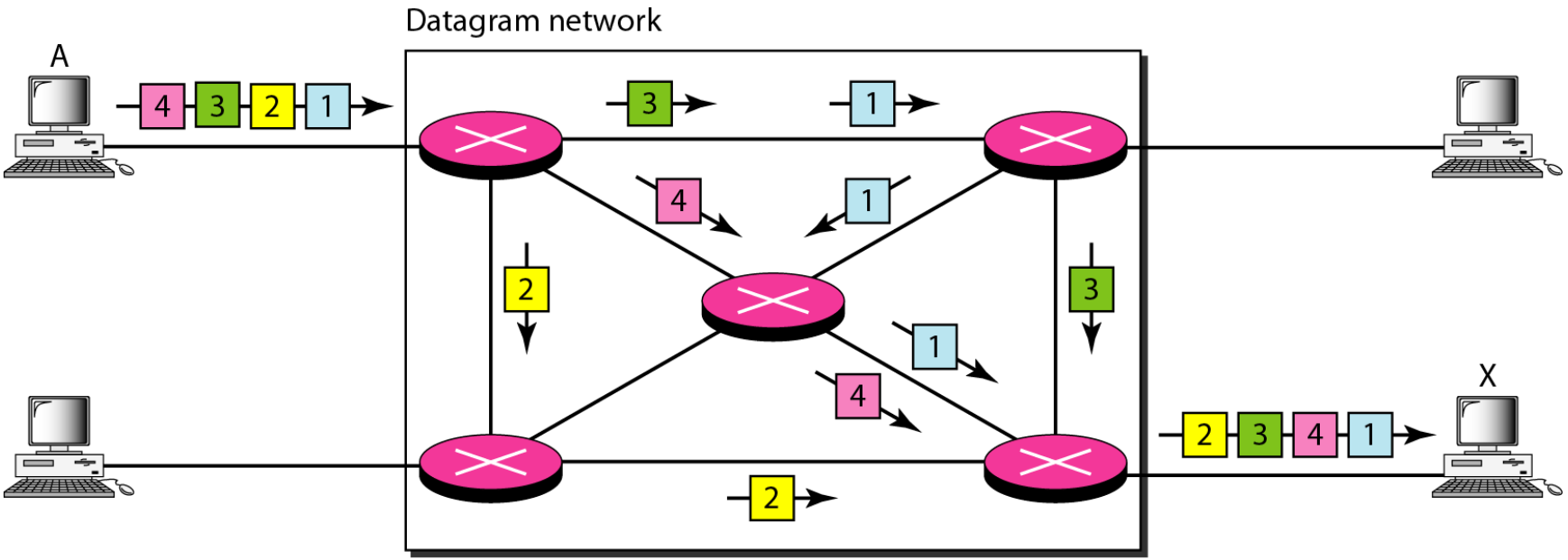


Switching methods(CO2)

- Packet switched
  - send messages from one end system to another.
  - If the message is going to pass through a packet-switched network, it needs to be divided into packets of fixed or variable size.
  - The size of the packet is determined by the network and the governing protocol.
  - In a packet-switched network, there is no resource reservation; resources are allocated on demand.

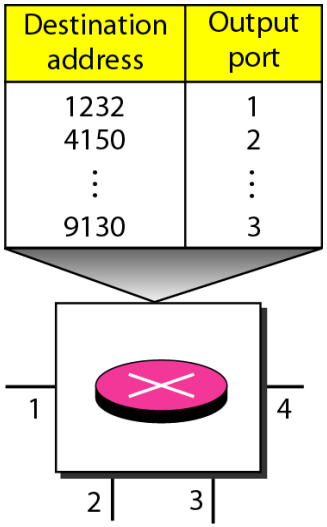
Switching methods(CO2)

Packet switched – Datagram network



Switching methods(CO2)

- Packet Switched – Datagram Network
  - Routing table
    - A switch in a datagram network uses a routing table that is based on the destination address.
    - The destination address in the header of a packet in a datagram network remains the same during the entire journey of the packet.

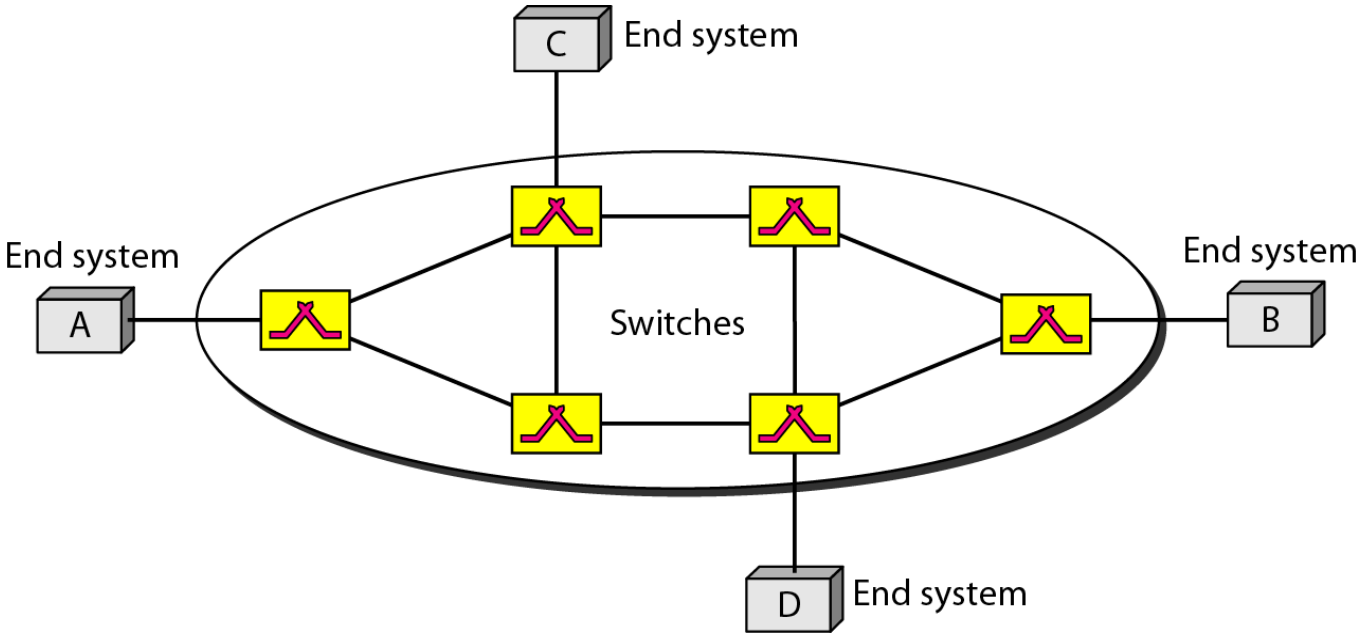


Switching methods(CO2)

- Packet Switched - Virtual-circuit network
  - a cross between a circuit-switched network and a datagram network.
  - It has some characteristics of both.
  - all packets belonging to the same source and destination travel the same path;
  - but the packets may arrive at the destination with different delays
    if resource allocation is on demand.

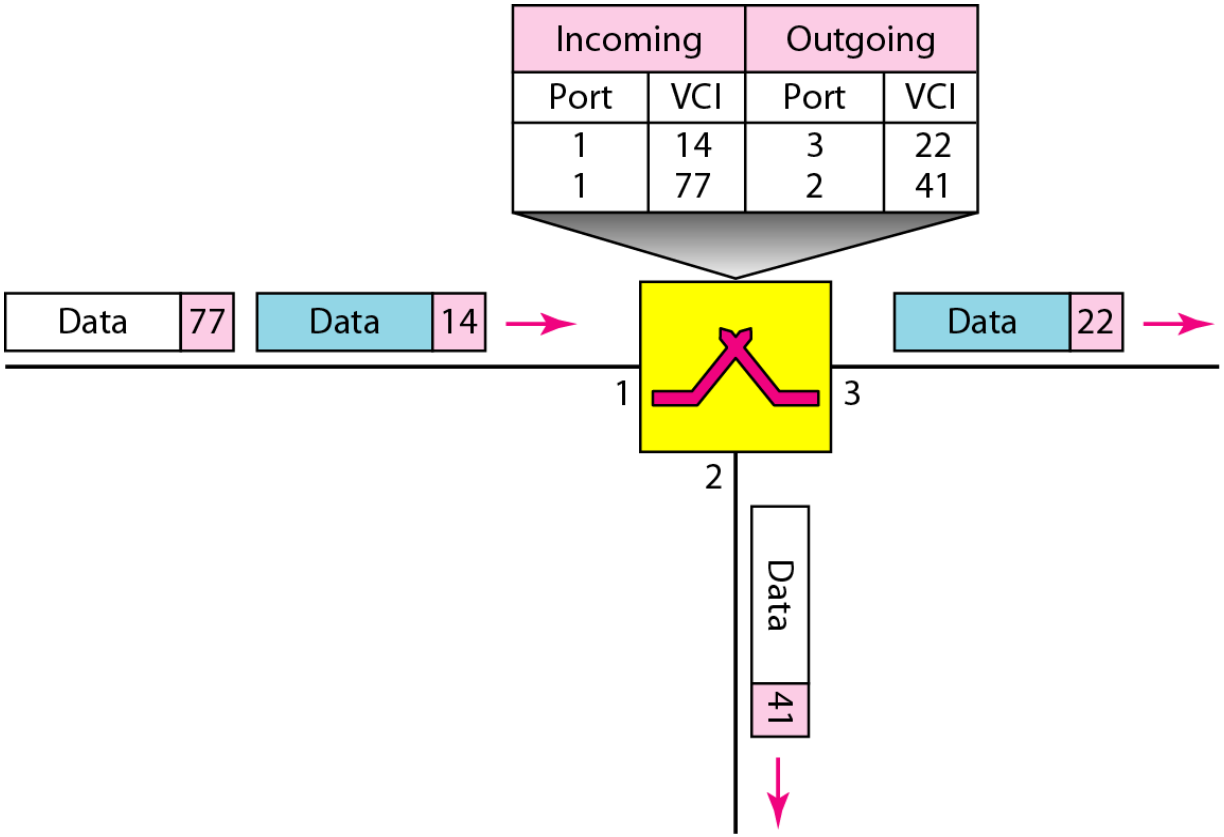
Switching methods(CO2)

- Packet Switched - Virtual-circuit network



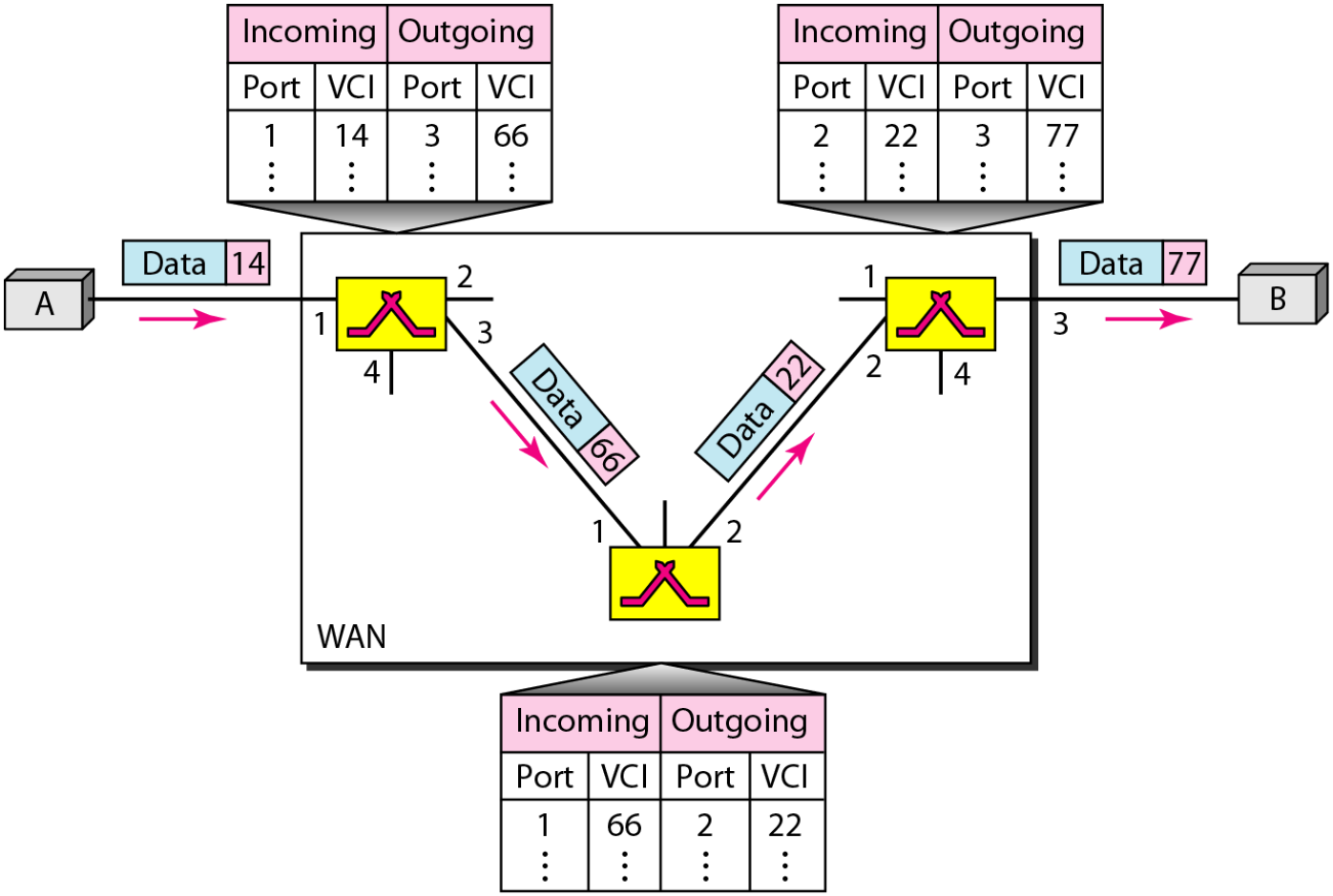
Switching methods(CO2)

- Packet Switched - Virtual-circuit network



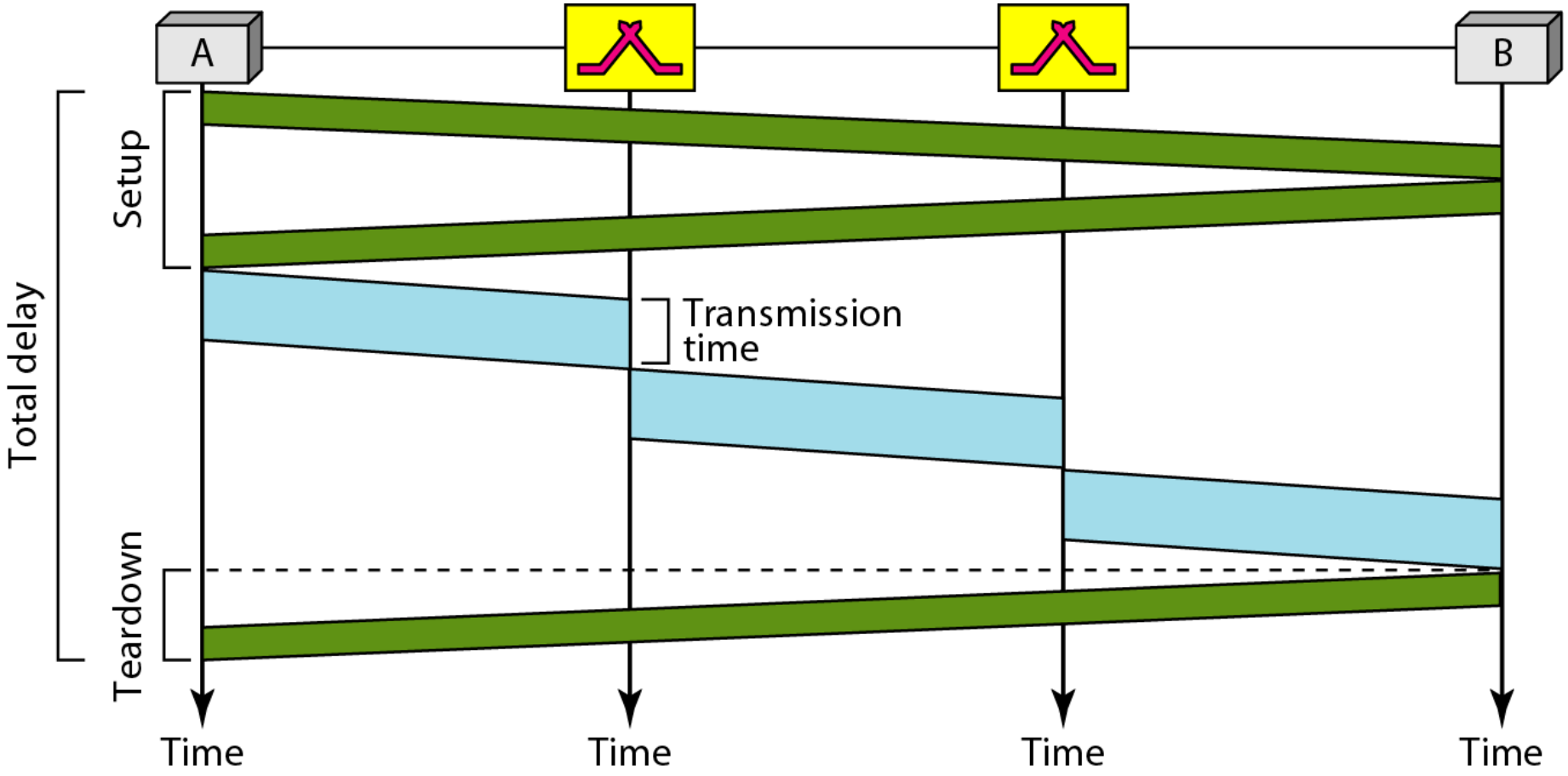
Switching methods(CO2)

- Packet Switched - Virtual-circuit network



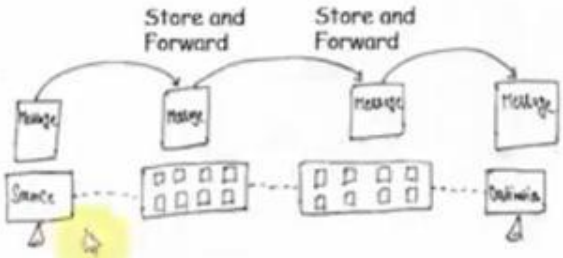
Switching methods(CO2)

- Delay in virtual circuit



Switching

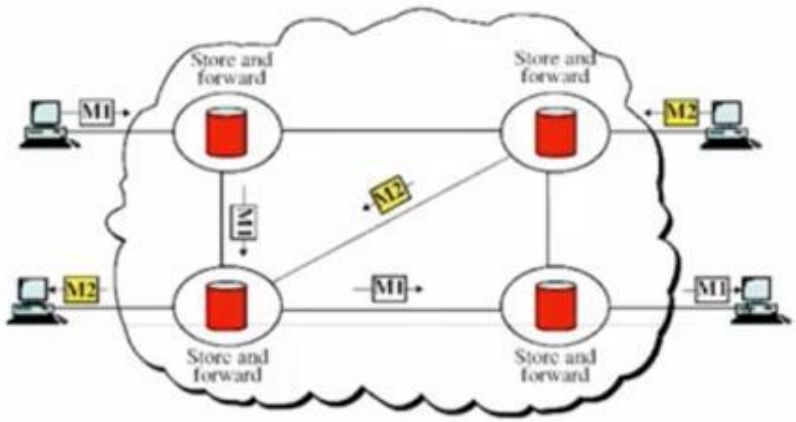
Message Switching

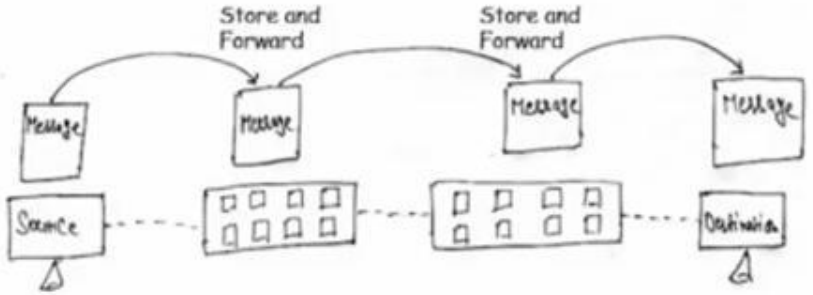


- In message switching, it is not necessary to establish a dedicated path between transmitter and receiver.
- In Message Switching, when source node sends a message, the destination address is append to the message. So in message switching there is no need to establish a dedicated path b/w two communication nodes.
- For sending message, There are many intermediary message switching nodes which are responsible for transferring the message, and the message is transmitted as a whole from source node-to-destination node.
- Each message switching node receive the **entire message**, store it in its **entirely on disk**, and then transmit the message to the next node.
- If the next node does not have enough resources to accommodate large size message, the message is stored and switch waits.
- This type of network is called a store-and-forward network.

Switching

Message Switching





Switching

Message Switching

Advantages :

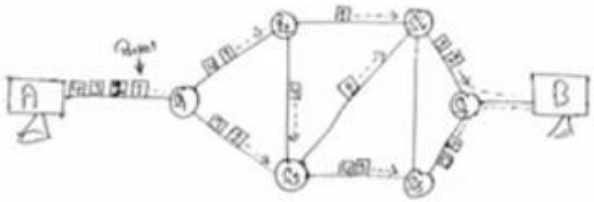
- Channel efficiency can be greater compared to circuit-switched systems, because more devices are sharing the channel.
- Traffic congestion can be reduced, because messages may be temporarily stored in route.
- Message priorities can be established due to store-and-forward technique.

Disadvantages:

- Message switching is not compatible with interactive applications.
- Store-and-forward devices are expensive, because they must have large disks to hold potentially long messages
- Message switching is very slow because of store-and-forward technique.
- Message switching is not recommended for real time applications like voice and video.

Switching

Packet Switching



- In packet, Message are divided into smaller pieces called packets.
- Each packet includes source, destination and intermediate node address information so that individual packet can be routed through the internetwork independently.
- It is easier for intermediate networking devices to store small size packets and they do not take much resources either on carrier path or in the internal memory of switches.

Switching

Difference b/w Circuit, Message and Packet Switching

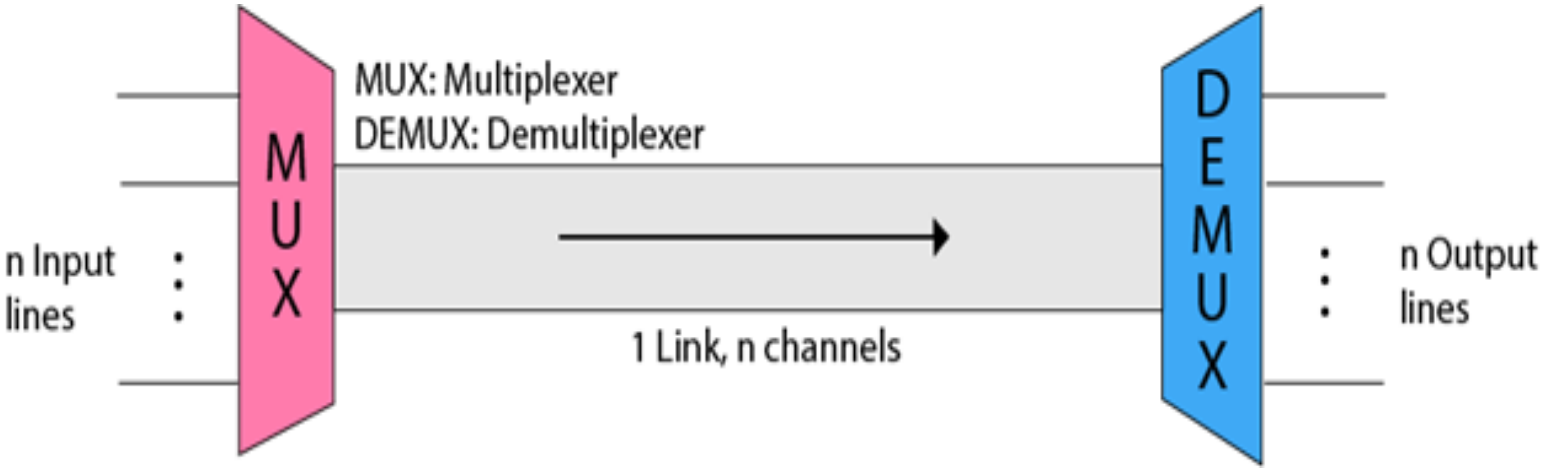
Circuit Switching	Message Switching	Packet Switching
There is physical connection b/w transmitter and receiver	No physical path is set in advance b/w transmitter and receiver	No physical path is established b/w transmitter and receiver
All the packet uses same path	Packet are stored and forward	Packet travels independently
Need an end to end path before the data transmission	No need of end to end path before data transmission	No need of end to end path before data transmission
Reserves the entire bandwidth in advance	Does not reserve the bandwidth in advance	Does not reserve the bandwidth in advance
Waste of bandwidth is possible	No waste of bandwidth	No waste of bandwidth
It cannot support store and forward transmission	It support store and forward transmission	It support store and forward transmission
Not suitable for handling interactive traffic	Suitable for handling interactive traffic	Suitable for handling interactive traffic

Multiplexing

Multiplexing is a technique used to combine and send the multiple data streams over a single medium. The process of combining the data streams is known as multiplexing and hardware used for multiplexing is known as a multiplexer.

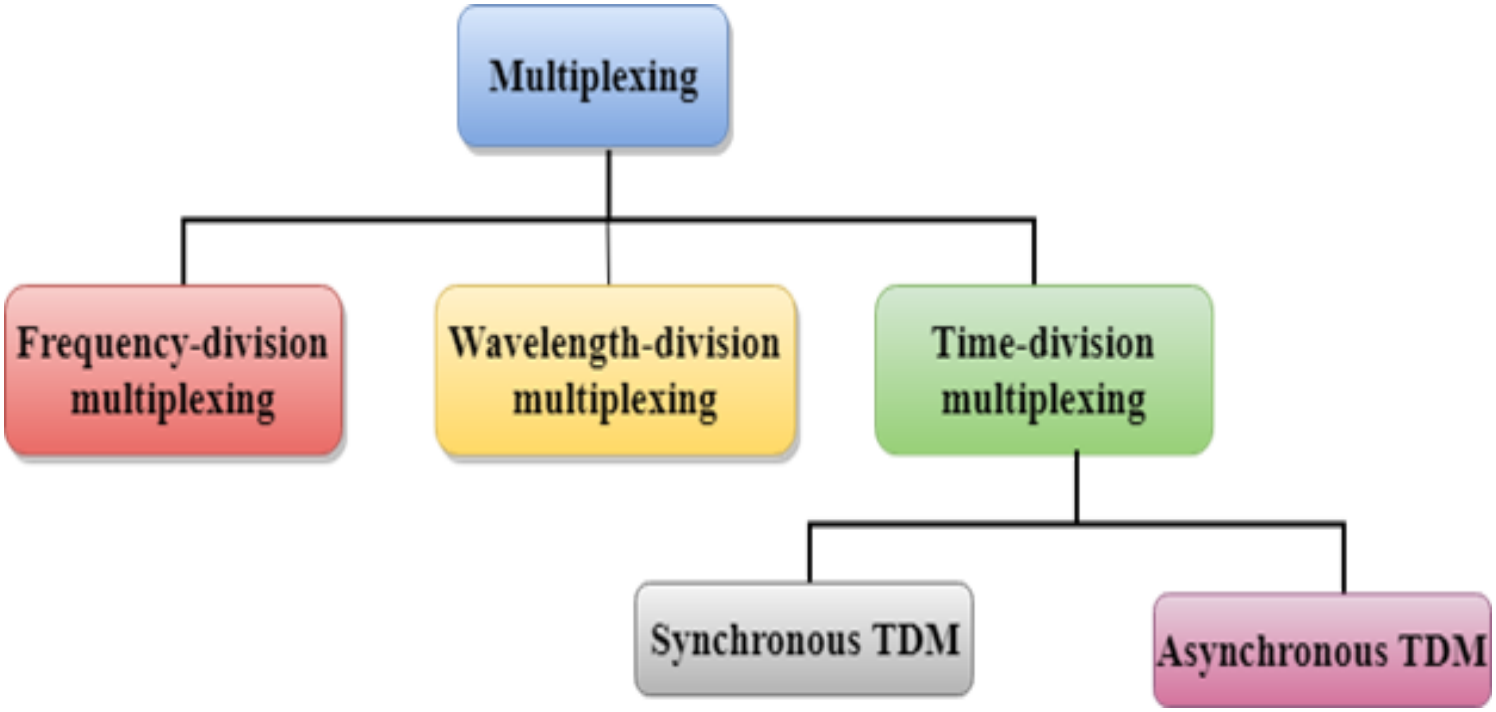
Multiplexing is achieved by using a device called Multiplexer **(MUX)** that combines n input lines to generate a single output line. Multiplexing follows many-to-one, i.e., n input lines and one output line.

Demultiplexing is achieved by using a device called Demultiplexer **(DEMUX)** available at the receiving end. DEMUX separates a signal into its component signals (one input and n outputs).



Multiplexing

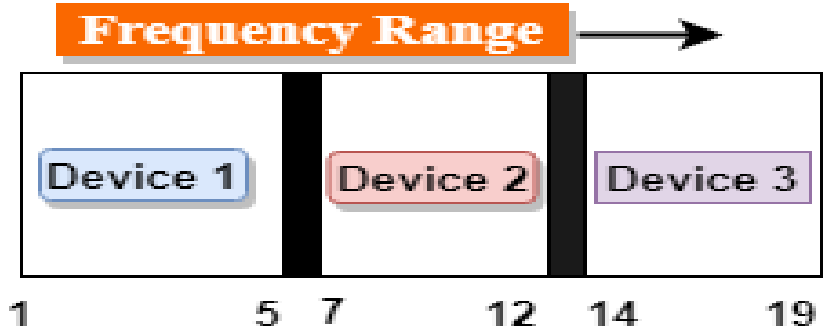
Multiplexing techniques can be classified as:



Multiplexing

Frequency-division Multiplexing (FDM)

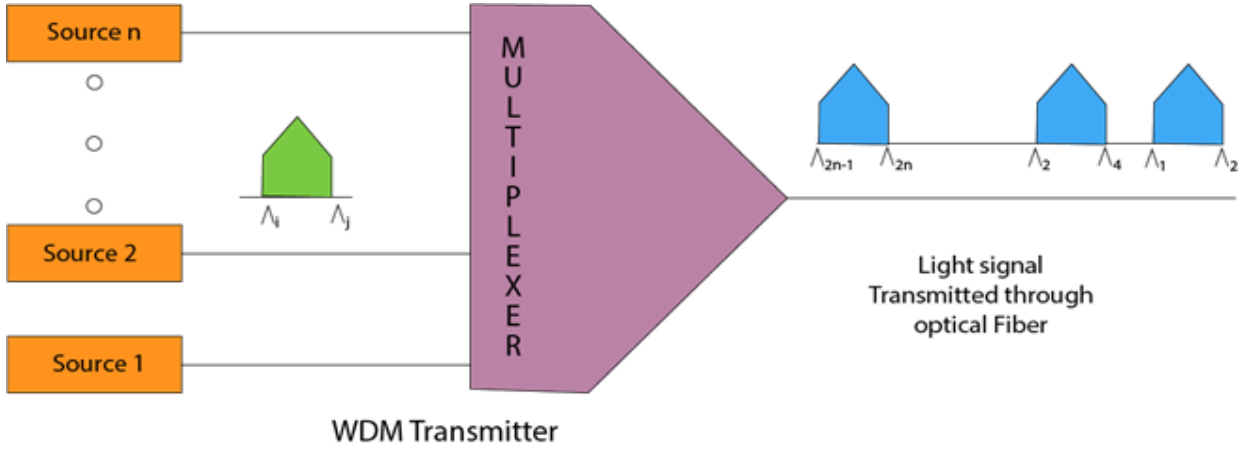
- It is an analog technique.
- **Frequency Division Multiplexing** is a technique in which the available bandwidth of a single transmission medium is subdivided into several channels.



- In the above diagram, a single transmission medium is subdivided into several frequency channels, and each frequency channel is given to different devices. Device 1 has a frequency channel of range from 1 to 5.
- **FDM** is mainly used in radio broadcasts and TV networks.

Wavelength Division Multiplexing (WDM)

- Wavelength Division Multiplexing is same as FDM except that the optical signals are transmitted through the fibre optic cable.
- WDM is used on fibre optics to increase the capacity of a single fibre.
- It is used to utilize the high data rate capability of fibre optic cable.
- It is an analog multiplexing technique.



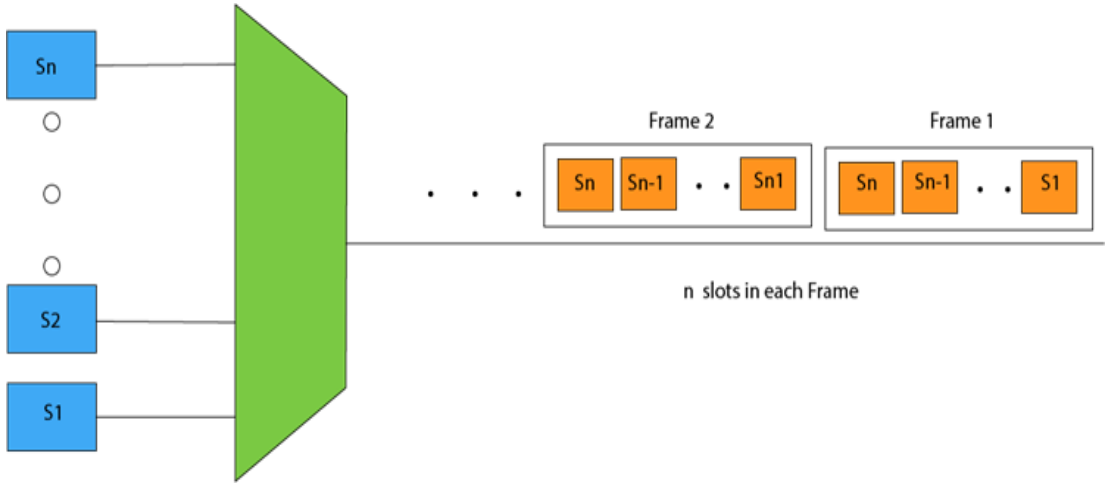
Multiplexing

Time Division Multiplexing (TDM)

- It is a digital technique.
- In Frequency Division Multiplexing Technique, all signals operate at the same time with different frequency, but in case of Time Division Multiplexing technique, all signals operate at the same frequency with different time.
- In **Time Division Multiplexing technique**, the total time available in the channel is distributed among different users. Therefore, each user is allocated with different time interval known as a Time slot at which data is to be transmitted by the sender.
- **There are two types of TDM:**

  Synchronous TDM

  Asynchronous TDM



IEEE Standards

IEEE 802 Standards

Standard	Name	Topic
802.1	Internetworking	Routing,Bridging,and network-to-network Communications
802.2	Logical Link Control	Error and flow control over data frames
802.3	Ethernet LAN	All forms of Ethernet media and interfaces
802.4	Token BUS LAN	All forms of Token Bus media and interfaces
802.5	Token Ring LAN	All forms of Token Ring media and interfaces
802.6	Metropolitan Area Network	MAN technologies,Addressing, and Services
802.7	Broadband technical Advisory Group	Broadband network media,interfaces, adn other Equipments
802.8	Fiber Optic Technical Advisory Group	Fiber Optic media used in token-passing Networks like FDDI
802.9	Integrated Voice/ Data Network	Integration of voice and data traffic Over a single network medium
802.10	Netwok Security	Network access controls,encryption,Certification, and other Security topics
802.11	Wireless Networks	Standards for wireless networking for many different broadcast frquencies and usage techniques
802.12	High-Speed Networking	A variety of 100 Mbps-plus technologies,including 100 BASE-VG
802.14	Cable Broadband LANs and MANs	Standards for designing network over coaxial cable-based broadband connections.
802.15	Wireless Personal Area Networks	The coexistence of wireless personal area networks with Others wireless devices in unlicensed frequency bands.
802.16	Broadband Wireless Access	The atmospheric interface and related functions associated with Wireless Local Loop(WLL)

IEEE Standards

IEEE 802 STANDARD	
IEEE802.1	Internetworking
IEEE802.2	Logical Link control(LLC)
IEEE802.3	Ethernet/CSMA
IEEE802.4	Token Bus
IEEE802.5	Token Ring
IEEE802.6	DQDB
IEEE802.11 IEEE802.15	Wi-Fi Bluetooth

MCQ s

1. A communication between a computer and a keyboard depicts
   a) full duplex transmission
   b) half duplex transmission
   c) simplex transmission
   d) Both A and B
2. _____ model is a protocol based model
   a) OSI
   b) IEEE
   c) TCP/IP
   d) All of the above

MCQ s

3. Computer Network can be defined as
   a) Multiple devices interconnected with a communication channel
   b) Collection of hardware components and computers
   c) Sharing of resources and information
   d) All of the above
4. The information to be communicated in the data communication system is the
   a) Message
   b) Medium
   c) Protocol
   d) Transmission

MCQ s

5. The Full form of ANSI is
   a) American Notation for standard international
   b) American national standardization Institute
   c) American notion standards Institute
   d) American national Standards Institute
6. The oldest and the still most commonly used transmission media is
   a) Twisted pair cable
   b) Coaxial cable
   c) Fiber optic
   d) WiFi

MCQ s

7. The example of guided media is
   a) Twisted pair cable
   b) Coaxial cable
   c) Fiber optic cable
   d) All of the above
8. Effectiveness of a data communication depends on
   a) Timeliness
   b) Delivery
   c) Accuracy
   d) All of the above

Glossary

- _____ are used for unicast communication such as cellular telephones, satellite networks
- One long cable acts as a backbone to link all the devices in a _____Topology
- A computer network is an interconnection of two or more computers that are able to _____ _____
- _____ _____ is a physical path by which message transmits
- _____a set of rules that govern data communications
- the number of physical links in a fully connected mesh network with n nodes = _____
- The devices are connected through a _____ in star topology
- LANs are distinguished from other types of networks by their _____ and _____

Weekly Assignment

1. Compare and contrast the ISO OSI model with TCP/IP model. CO1
2. Give advantages and disadvantages of fiber optic cable over metallic cable. Explain the use and design of latest technology used for transmission. CO1
3. A device is sending out data at the rate of 2000 bps. How long does it take to send out 100 bits? CO1
4. If you have to set up a lab of 50 computers, which topology will you use and why? CO1
5. Differentiate between connection oriented and connectionless communication. CO1

Weekly Assignment

6. List some applications of networking. CO1

7. Discuss the design issues for the layers in computer Networks. CO1

8. We modulate several voice signals and send them through the air. Is this baseband or broadband transmission. CO1

9. A periodic composite signal contains frequencies from 20 to 30 kHz, each with an amplitude of 8V. Draw the frequency spectrum. CO1

10. A signal travels from point A to point B. At point A, the signal power is 200 W. At point B, the power is 170 W. What is the attenuation in decibels? CO1

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- https://www.youtube.com/watch?v=lnU-Zw3NEEQ
- https://www.youtube.com/watch?v=kNKHM_isojI
- https://www.youtube.com/watch?v=vv4y_uOneC0

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- 14-15
- https://drive.google.com/open?id=1tjERKPwEA9icWcQTBZQnKUq_ttqBDeo5

Question paper of University Exam

Printed Pages: 02 Sub Code: RCS601

Paper Id: 110262 Roll No. | | | | | | | | | | |

B.TECH
(SEM-VI) THEORY EXAMINATION 2018-19
COMPUTER NETWORK

Time: 3 Hours ***Total Marks: 70***

Note: 1. Attempt all Sections. If require any missing data; then choose suitably.

SECTION A

1. Attempt *all* questions in brief. 2 x 7 = 14

a. What are header and trailers and how do they get added and removed?

b. A large FDDI ring has 100 stations & a token rotation time of 40msec. The token holding time is 10msec. What is the maximum achievable efficiency of the ring?

c. What is the difference between network layer delivery and the transport layer delivery?

d. If a class B network on the Internet has a subnet mask of 255.255.248.0, what is the maximum number of hosts per subnet?

e. What is count-to-infinity problem?

f. What is the difference between a user agent (UA) and a mail transfer agent (MTA)?

g. What is time-to-live or packet lifetime?

Question paper of University Exam

SECTION B

2. Attempt any *three* of the following: 7 x 3 = 21

a. Define topology and explain the advantage and disadvantage of Bus, Star and Ring topologies.

b. A channel has a bit rate of 20 kbps. The stop and wait protocol with frame size 4500 bits is used. The delay for error detection and sending ACK by the receiver is 0.25 seconds because of a fault. Find the maximum efficiency of the channel if the destination is 30000km away and the speed of the propagation of the signal is $2.8X10^8$ m/s. Find the decrease in efficiency due to the fault.

c. What is unicast routing? Discuss unicast routingprotocols.

d. Explain about the TCP header and working of TCP protocoland differentiate between TCP and UDP with frameformat.

e. (i) How is TFTP different from FTP?
(ii)What three functions can SNMP performto manage network devices?

SECTION C

3. Attempt any *one* part of the following: 7 x 1 = 7

(a) What is OSI Model? Explain the functions; protocols andservices of each layer?

(b) Encode the data-stream 10011010 using the following encoding scheme:
(i) Unipolar
(ii) Bipolar NRZ-L
(iii) Bipolar NRZ-I
(iv) RZ

Question paper of University Exam

(v) Manchestor
(vi) Differential Manchestor
(vii) AMI

4. Attempt any *one* part of the following: 7 x 1 = 7

(a) A slotted ALOHA network transmits 400-bit frames on a shared channel of 400 kbps. What is the throughput if the system (all stations together) produces –
(i) 1000 frames per second
(ii) 500 frames per second
(iii) 250 frames per second

(b) Explain ARQ Error Control technique, in brief.

5. Attempt any *one* part of the following: 7 x 1 = 7

(a) Write advantages of Next-generation IPV6 over IPV4.

(b) The IP network 200.198.160.0 is using subnet mask 255.255.255.224. Design the subnets.

6. Attempt any *one* part of the following: 7 x 1 = 7

(a) The following is the dump of a TCP header in hexa decimal format:
05320017 00000001 00000000 500207FF 00000000
(i) What is the sequence number?
(ii) What is the destination port number?
(iii) What is the acknowledgment number?

Question paper of University Exam

(iv) What is the window size?

(b) What do you understand by Quality of service, parameters? List various Quality of service parameters.

7. Attempt any *one* part of the following: 7 x 1 = 7

(a) (i) How is the BOOTP different from DHCP?
(ii) What is the purpose of the Domain Name System? Discuss the three main divisions of the domain name space.

(b) Write short notes on any two:
(i) SMTP
(ii) TELNET
(iii) HTTP

Expected Questions for University Exam

- Write the function of physical layer of ISO-OSI reference model. CO1
- What is a protocol? CO1
- List some applications of networking. CO1
- Explain different transmission media used for networking? CO1
- What are the goals of networking? CO1
- Explain the difference between OSI and TCP/IP model. CO1
- Define topology with advantage and disadvantage. CO1

Summary

- Understanding of Network structure and Architecture.
- The layout of OSI reference model and TCP/IP model.
- Various Network Topology Design used .
- The different Networking.
- Physical Layer and types of Transmission Media.
- Overview of ISDN and Terminal Handling.

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1. Forouzen, "Data Communication and Networking", TMH
2. A.S. Tanenbaum, Computer Networks, Pearson Education
3. W. Stallings, Data and Computer Communication, Macmillan Press
4. Gary R.Wright, W.Richard Stevens "TCP/IP Illustrated,Volume2 The Implementation" Addison-Wesley
5. Michael A. Gallo and William M. Hancock "Computer communication and Networking Technology" Cengage Learning
6. Bhavneet Sidhu, An Integrated approach to Computer Networks, Khanna Publishing House
7. Anuranjan Misra, “Computer Networks”, Acme Learning
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1. Behrouz Forouzan, “Data Communication and Networking”, McGraw Hill

2. Andrew Tanenbaum “Computer Networks”, Prentice Hall.

3. William Stallings, “Data and Computer Communication”, Pearson.

Thank You