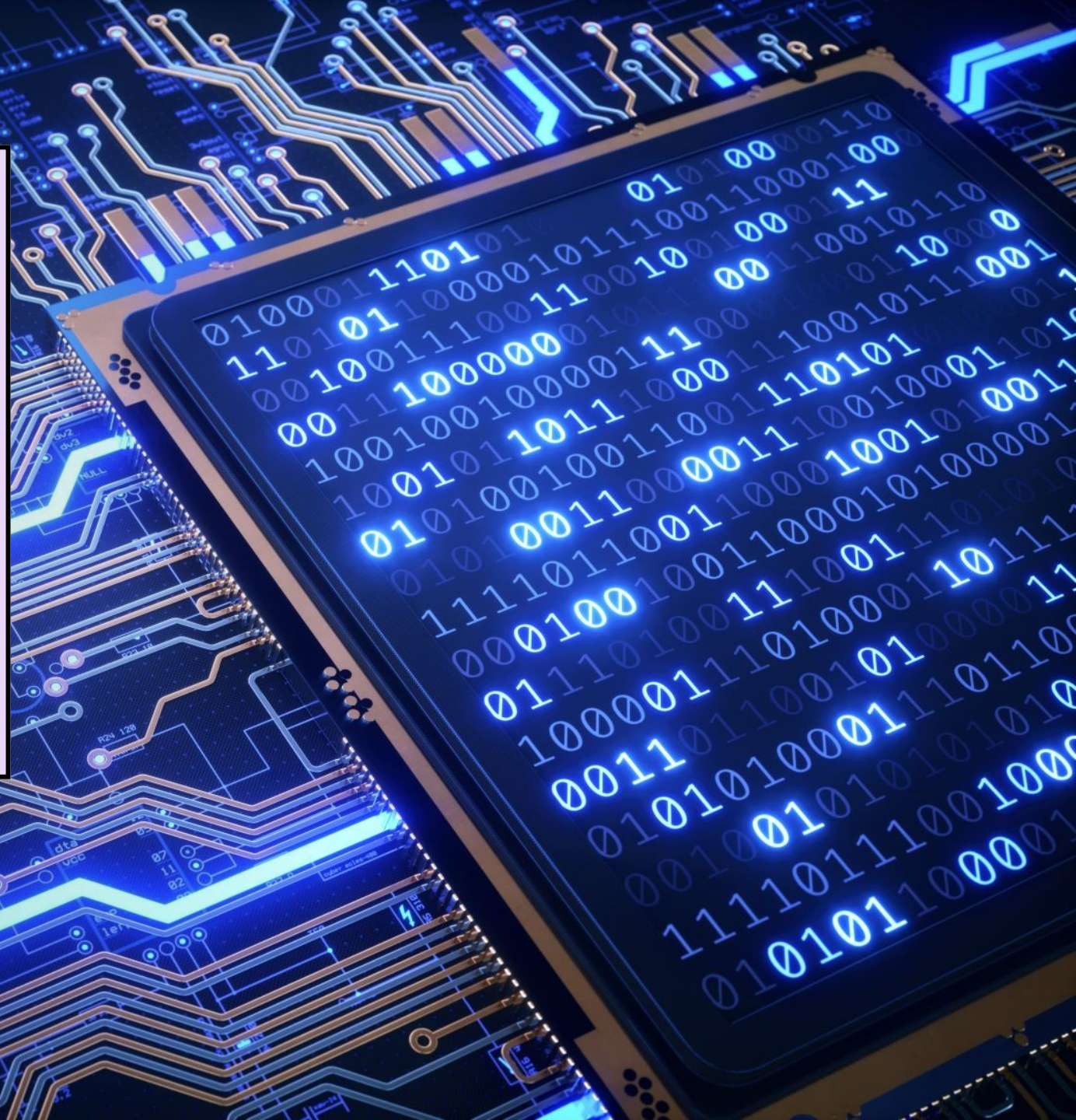


COMPUTER NETWORKS

INTRODUCTION TO DATA
COMMUNICATION &
COMPUTER NETWORKS



○ Class & Office Hours

- Section A:
 - Monday 2:10 PM – 3:30 PM
 - Wednesday 12:30 PM – 1:50 PM
- Section B:
 - Tuesday 9:30 AM – 11:00 AM
 - Thursday 11:00 AM – 12:30 PM
- Office Hours:
 - Tuesday & Wednesday 11:00 AM – 12:00 PM



○ About Me

- Mashal Khan
- BS Computer Systems Engineering (UET Peshawar)
- MS Information Security (NUST Islamabad)
- Email: mashal.khan@nu.edu.pk



○ Books and Relevant Content

- Data communications and networking by Behrouz A. Forouzan
- Data and Computer Communications by William Stallings
- Software Defined Networks
- Reading materials and Articles
- Reference Slide at the end of every lecture to make your life easier ☐



○ Evaluations

Assessment	Weightage (%age)
Assignments / Case Studies	10
Quizzes	10
Project	10
Sessional 1	15
Sessional 2	15
Finals	40



○ Introduction

- What is networks?
- Its importance
- Major areas of Application
- Industry Application/usage
- Softwares used
- Major Research Areas.





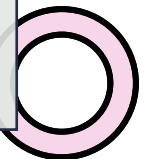
Today's Topics

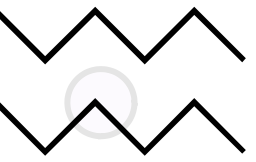
Data and Data Communication

- Effectiveness
- Components
- Data Flow

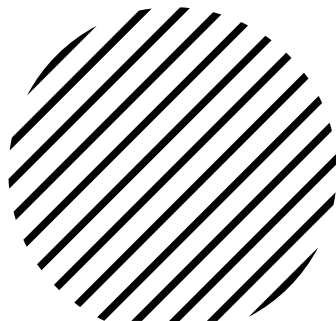
Networks

- Criteria
- Structure
 - Topologies
- Categories
- Types





Data Communication



Networks exist so that data may be sent from one place to another.



Telecommunication network that allows computers to exchange data.



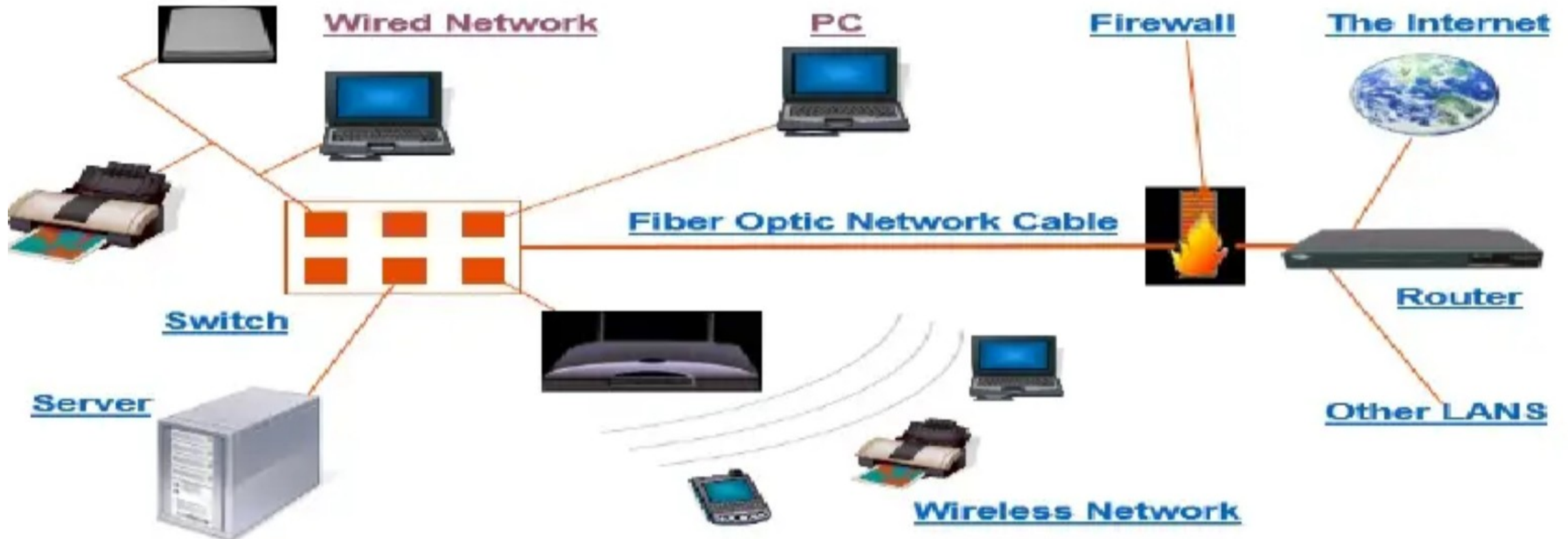
Connection between the exchanging devices can be wired or wireless.



Best known Computer network is Internet.



- A system containing any combination of computers, computer terminals, printers, audio or visual display devices, or telephones interconnected by telecommunication equipment or cables: used to transmit or receive information





Data Communication



When we communicate we share information

Local Communication, if
Face to Face

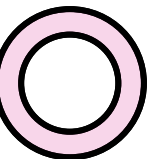
Remote (*tele*), if through
Telephone, Telex, television
etc



Data

Information presented in
any form that is agreed
upon by communicating
parties.

- Text, Image, Video, Audio



- • Exchange of data between two devices via some form of transmission medium such as a wire or wireless
- Data Communication is the exchange of information from One entity to another using a transmission medium
- Keywords
 - Exchange
 - Information
 - Entity
 - Transmission medium



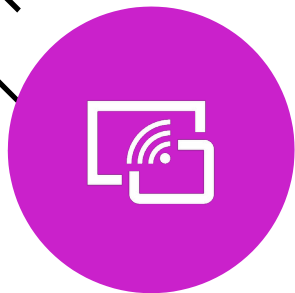
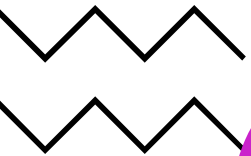


Effectiveness of a Data Communications

The effectiveness of a data communications system depends on four fundamental characteristics:

- Delivery,
- Accuracy,
- Timeliness, and
- Jitter.





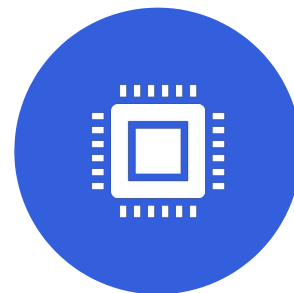
Delivery: The system must deliver data to the correct destination. Data must be received by the only intended device or user.



Accuracy: The system must deliver the data accurately. Data that have been altered in transmission and left uncorrected are unusable.



Timeliness: The system must deliver data in a timely manner. Data delivered late are useless. In the case of video and audio, timely delivery means delivering data as they are produced, in the same order that they are produced, and without significant delay. This kind of delivery is called ***real-time*** transmission.



Jitter: Jitter refers to the variation in the packet arrival time. It is the uneven delay in the delivery of audio or video packets. For example, let us assume that video packets are sent every 3 ms. If some of the packets arrive with 3 ms delay and others with 4 ms delay, an uneven quality in the video is the result.



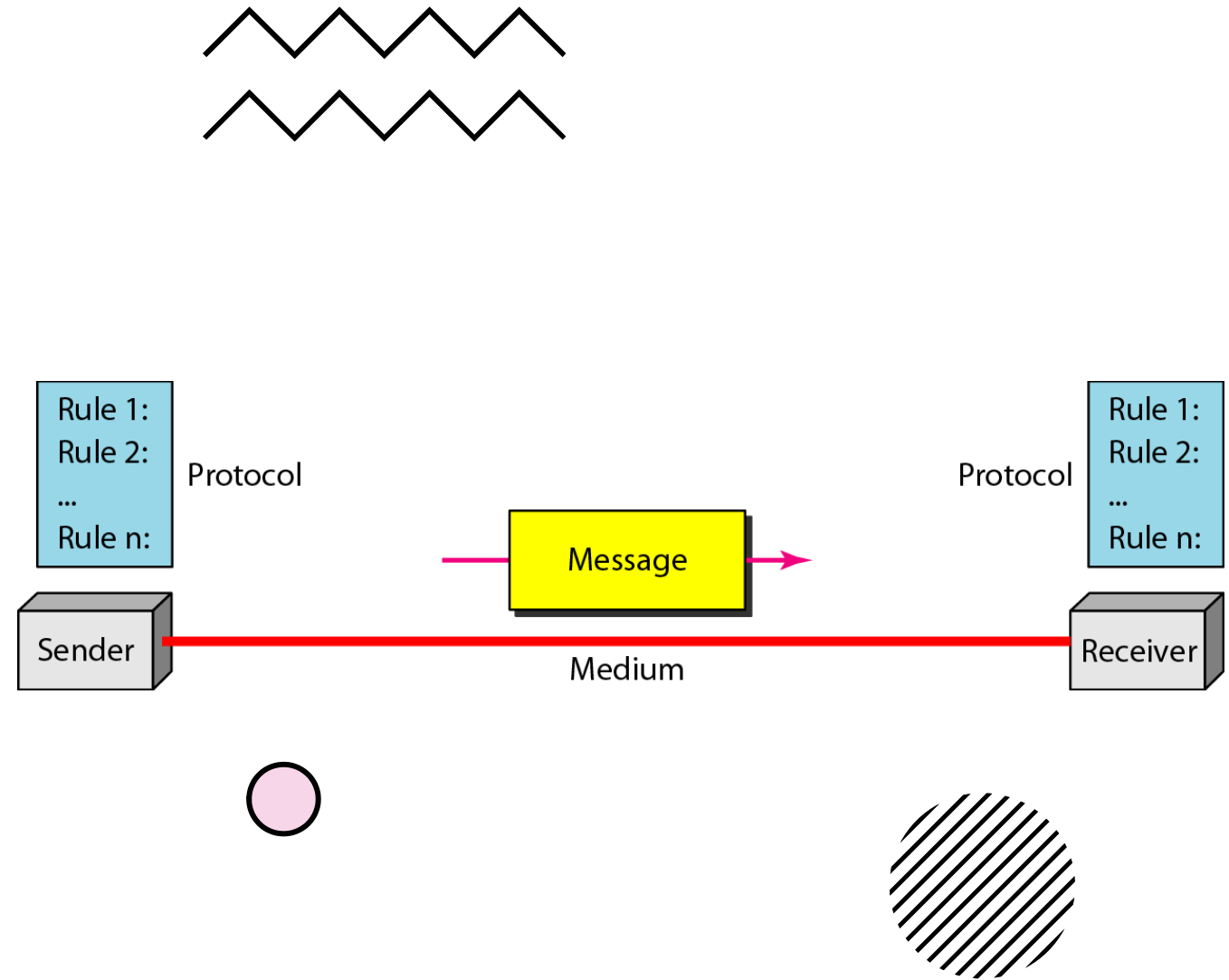


Components

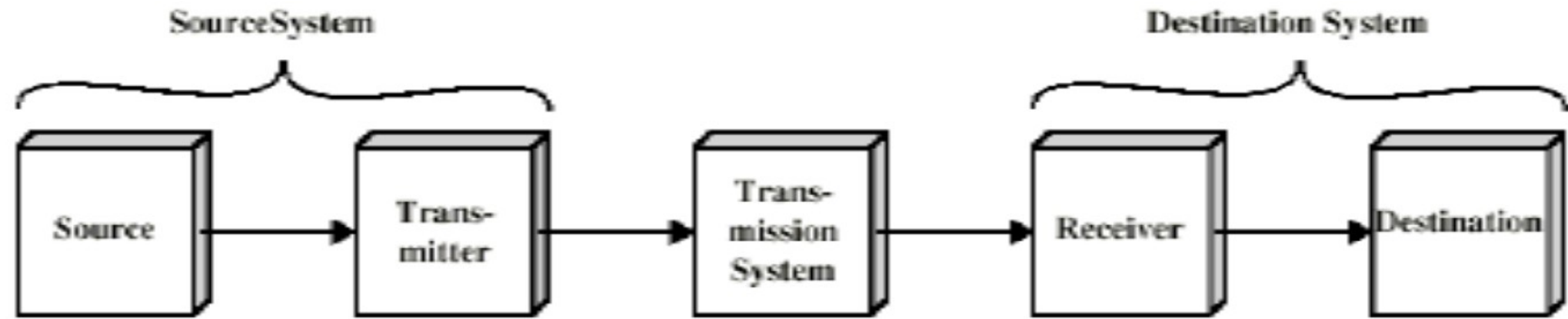
Five basic Components of data communication

- Message
- Sender
- Receiver
- Transmission medium
- Protocol

- **Message:** The message is the information (data) to be communicated.
- **Sender/ Receiver:** The sender/receiver is the device that sends/receives the data message.
- **Transmission medium:** The transmission medium is the physical path by which a message travels from sender to receiver.
- **Protocol:** A protocol is a set of rules that govern data communications.



● Communication Model



(a) General block diagram



(b) Example





Parts of Communication Model

Source

- Generates data to be transmitted
 - Telephone, Mic, Computer, Web Cam, Scanner, Digital Camera

Transmitter

- Data produced can not be transmitted directly
- Data should be converted to signals
- Transmitter converts data into transmittable signals
 - **Mod**em converts Data Bits into Signals
 - Modulation



Parts of Communication Model

Transmission System

- It carries data from one party (sender) to another (receiver)
- Can be Wired / Wireless medium
- Can be complex network like Internet

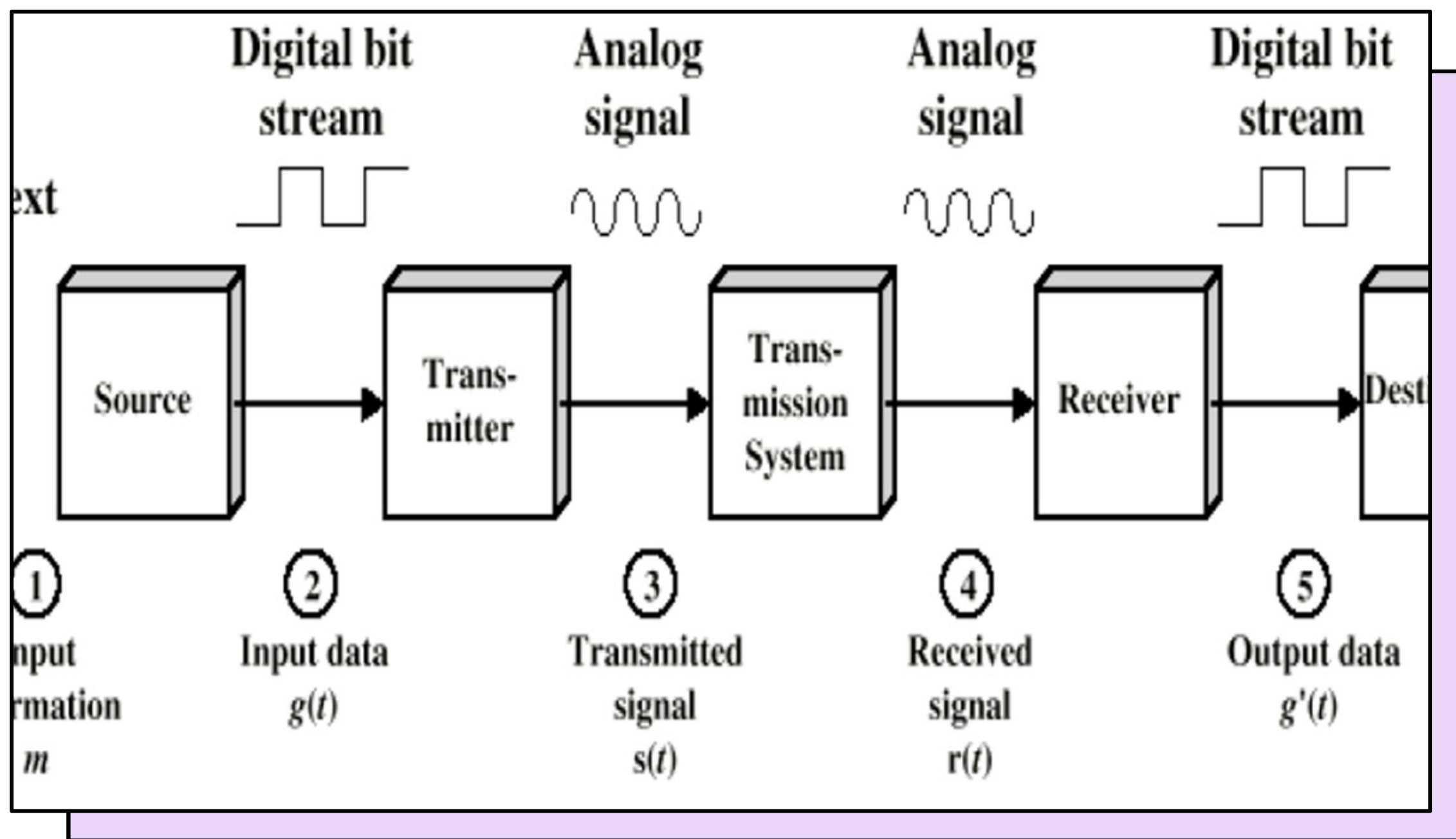
Receiver

- It receives signal
- Converts received signal into data (bits)
 - **Modem** (demodulation)

Destination

- Takes incoming data from receiver.



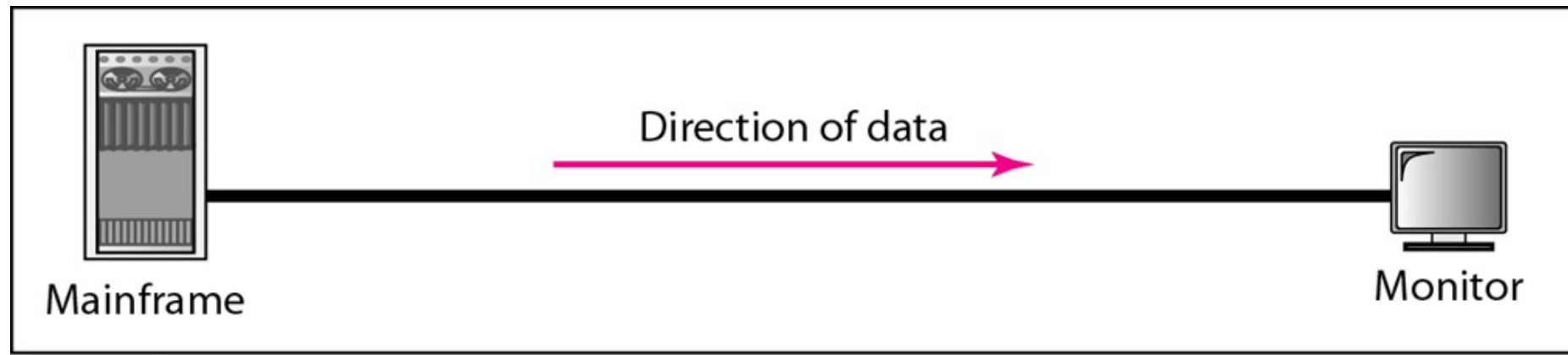


○ Types of Communication or Connections

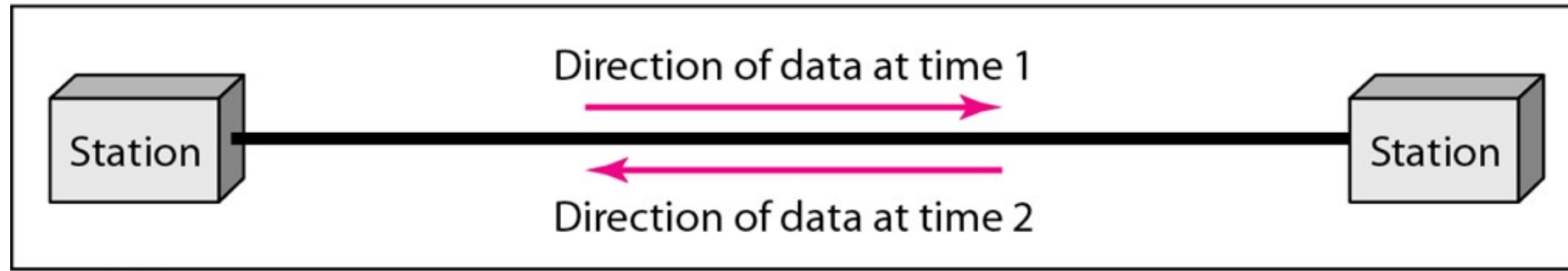
Directions of Data Flow

- Communication modes could be:
 - Simplex
 - One Way (Uni directional) only
 - One device is sender and other is receiver
 - Monitor, Speakers, Bluetooth devices etc
 - Is Keyboard Simplex?
 - Half Duplex
 - Bi-directional
 - Only One device can send at a time and other will receive
 - Traditional Wireless Sets
 - Full Duplex
 - Bi-Directional
 - Both Devices can send/Receive simultaneously
 - Telephone Network

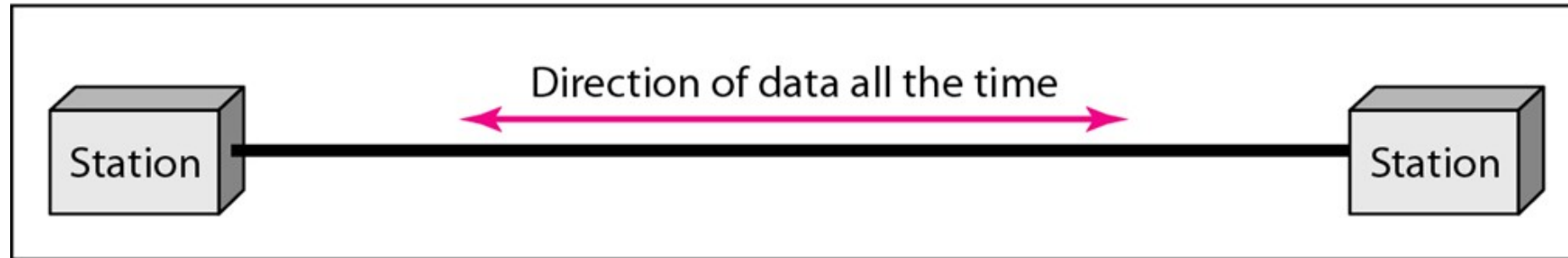




a. Simplex



b. Half-duplex



c. Full-duplex



○ 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.

A **link** can be a cable, air, optical fiber, or any medium which can transport a signal carrying information.

- Network Criteria
- Physical Structures
- Categories of Networks



○ Network Criteria

Performance

- Depends on Network Elements
- Measured in terms of Delay and Throughput

Reliability

- Failure rate of network components
- Measured in terms of availability/robustness

Security

- Data protection against corruption/loss of data due to:
 - Errors
 - Malicious users



○ Physical Structure

Type of Connection

- Point to Point -single transmitter and receiver
- Multipoint -multiple recipients of single transmission

Physical Topology

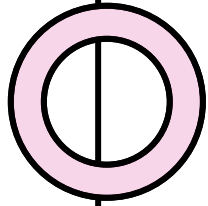
- Connection of devices
- Type of transmission -unicast, mulitcast, broadcast



○ Point to point Connection

- Point to point communication not usually practical
 - Dedicated link between two devices.
 - Entire capacity of the link is reserved for transmission between those two devices.
 - Most point-to-point connections use an actual length of wire or cable to connect the two ends, but other options, such as microwave or satellite links, are also possible
 - Devices are too far apart
 - Large set of devices would need impractical number of connections
- Solution is a Communications Network
 - Attach all devices to a communication network





Multi Point Connection

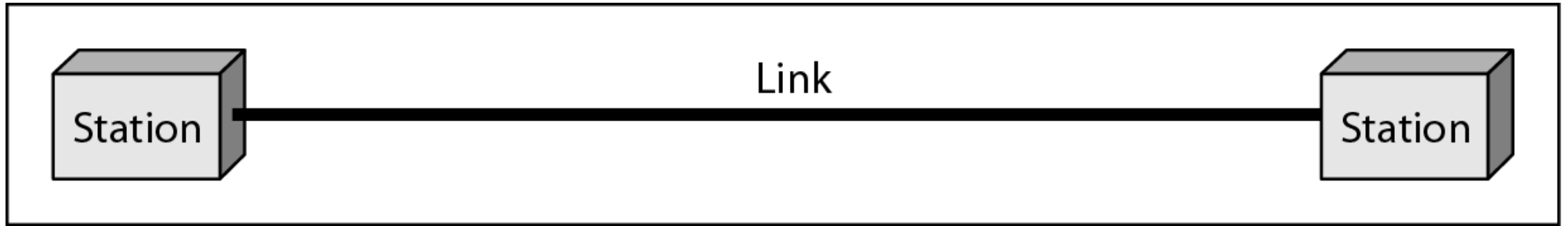
Also called multidrop

More than two specific devices share a single link

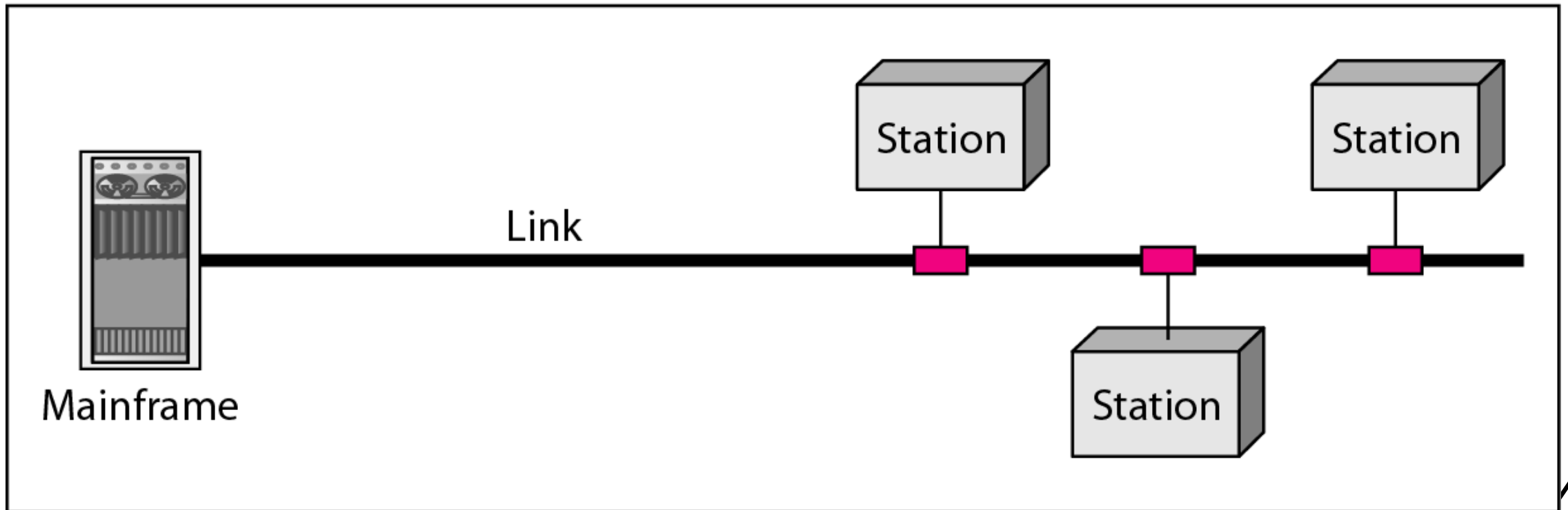
The capacity of the channel is shared, either spatially or temporally.

If several devices can use the link simultaneously, it is a *spatially shared* connection.

If users must take turns, it is a *timeshared* connection.



a. Point-to-point



b. Multipoint

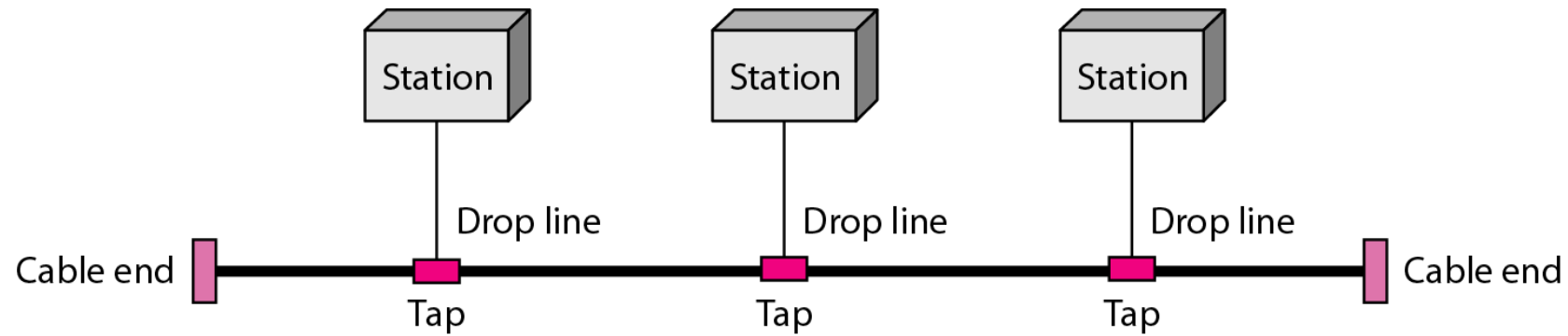


Physical Topology

- Topology dictates that how nodes are physically connected in a network
- Geometric representation of relationship of all the links and linking devices
- Four basic topologies:
 - Mesh
 - Star
 - Bus
 - Ring

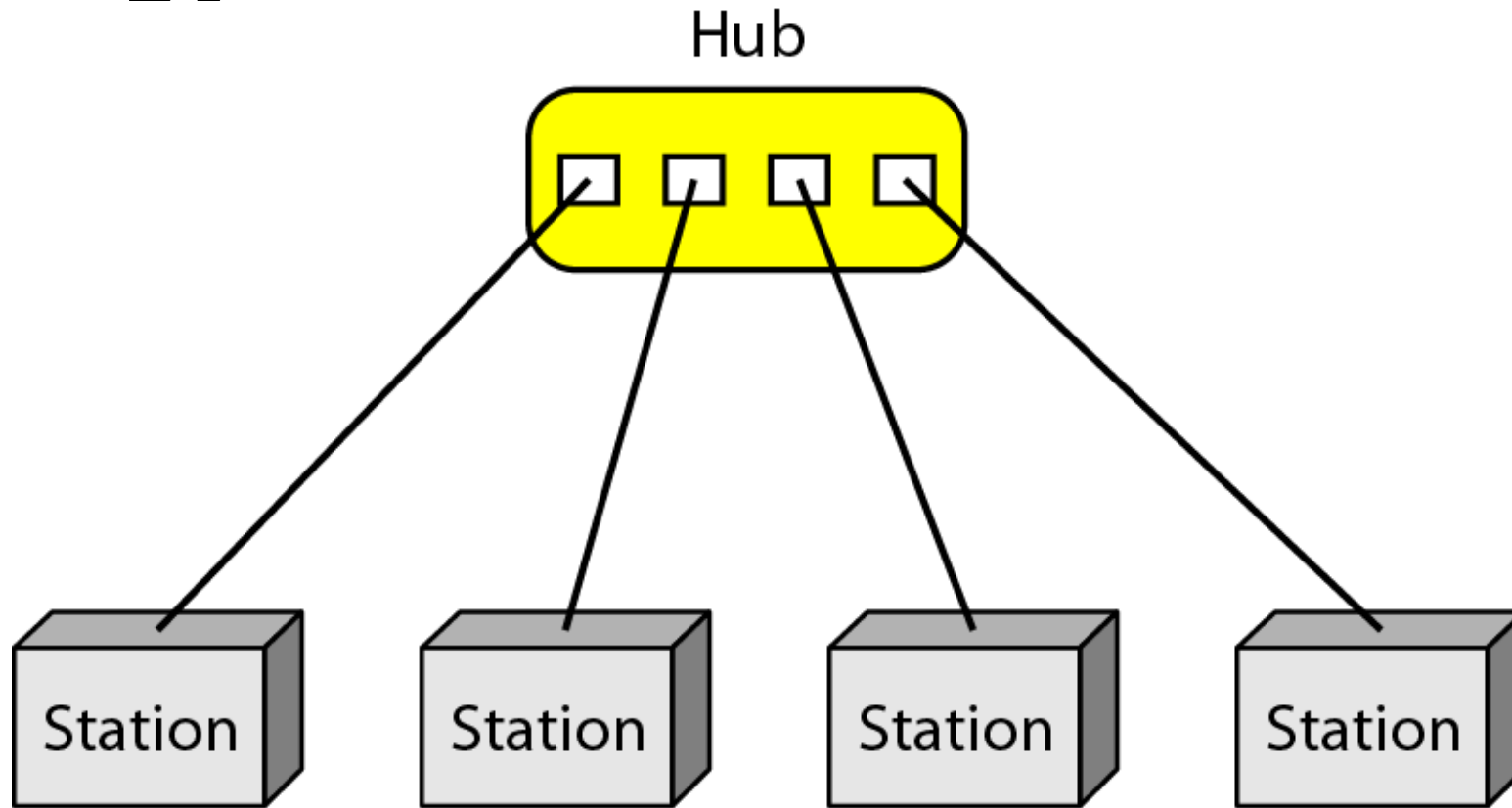


○ Topology: Bus



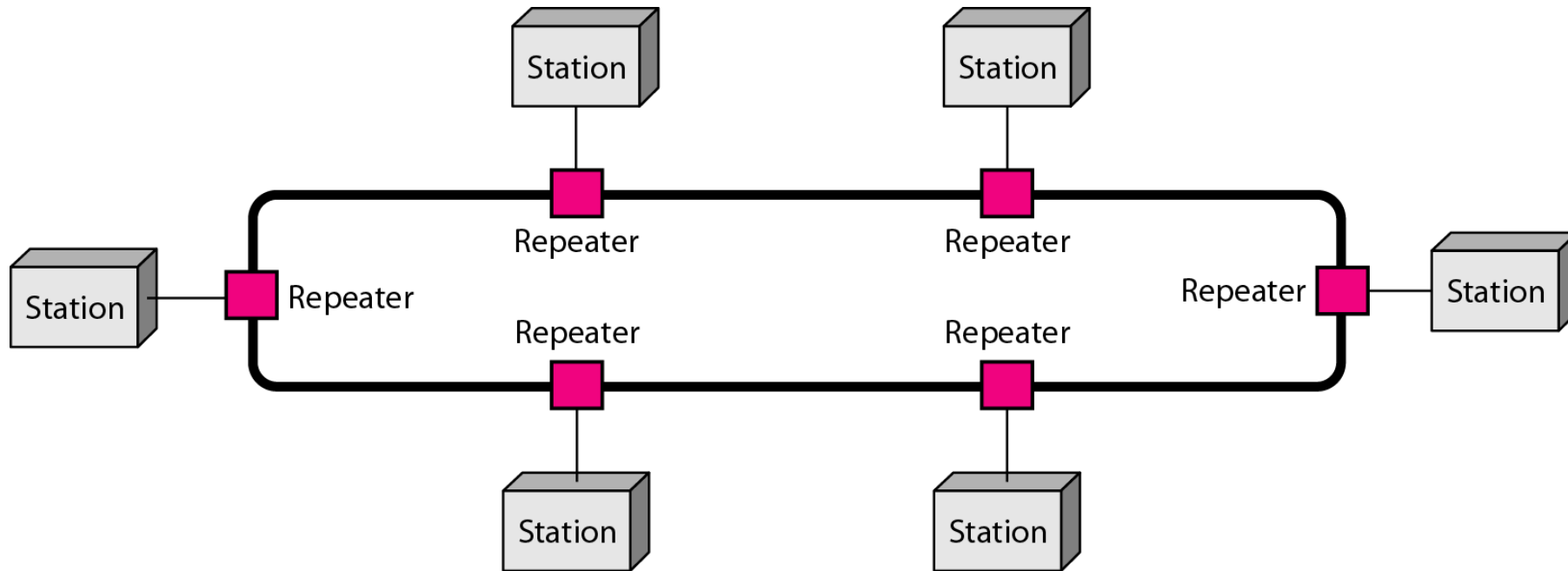
A Bus Topology connecting three stations

- Topology: Star



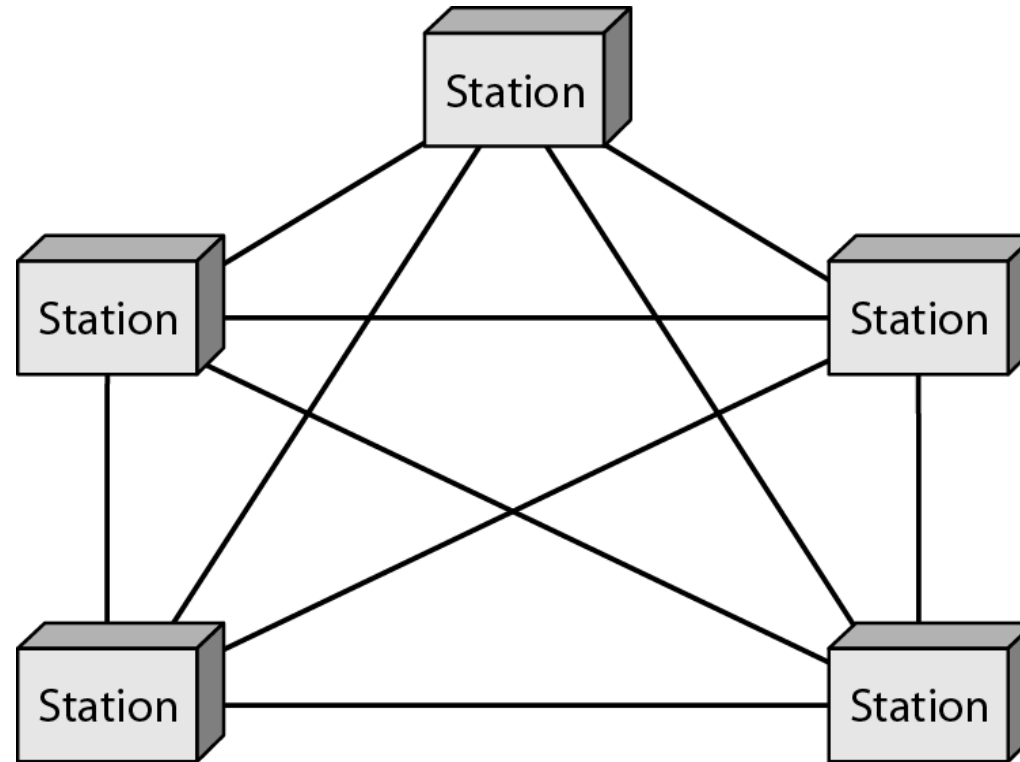
A star topology connecting four stations through a central device (hub)

○ Topology: Ring



A Ring Topology connecting six stations

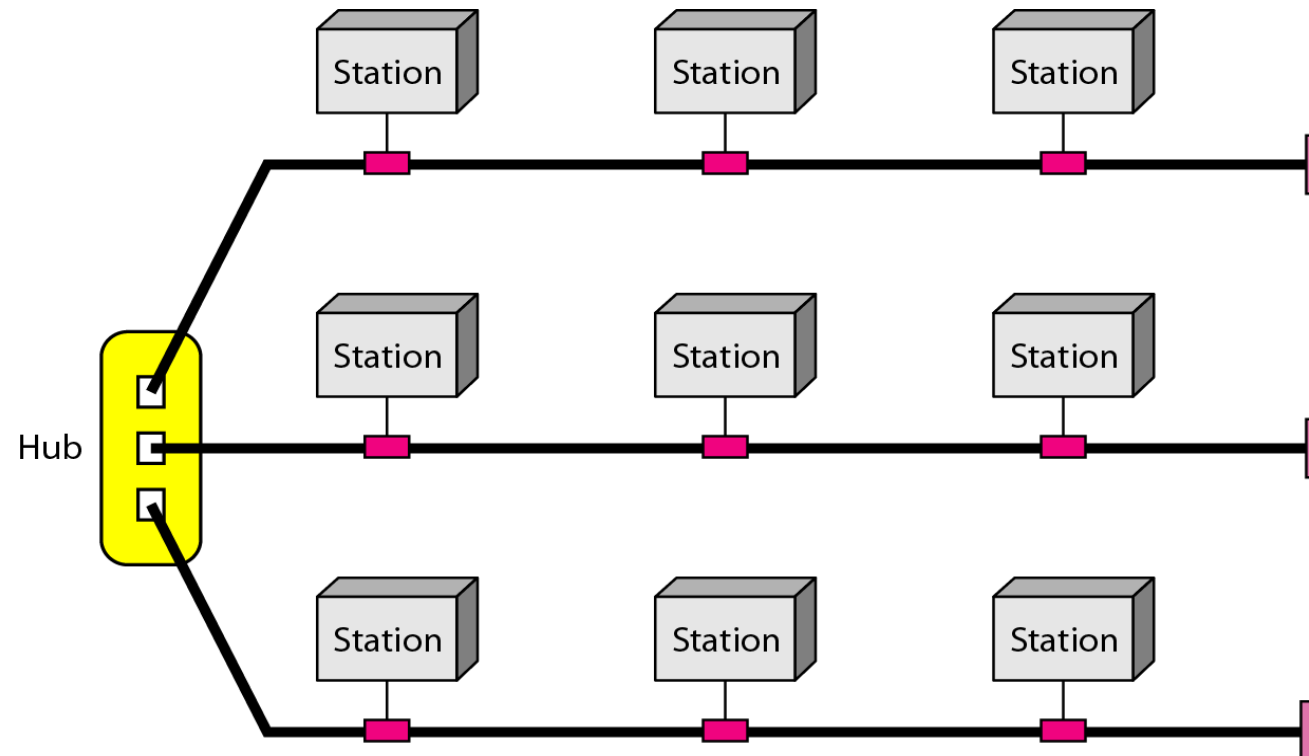
- Topology: Fully Connected Mesh



All the stations have a P-to-P link with all other stations in the network

Hybrid Topology

- Topology that is constituted by integrating more than one topology





Assignment

Compare and contrast Network Topologies (Advantages and Disadvantages)

- Star
- Mesh
- Hybrid
- Bus
- Ring
- Tree

Find and explain practical examples for each of them (At least 2 each).

Any other possible topology? 

○ Categories of Network

- Local Area Networks (LANs)
 - Short distances
 - Designed to provide local interconnectivity
- Wide Area Networks (WANs)
 - Long distances
 - Provide connectivity over large areas
- Metropolitan Area Networks (MANs)
 - Provide connectivity over areas such as a city, a campus

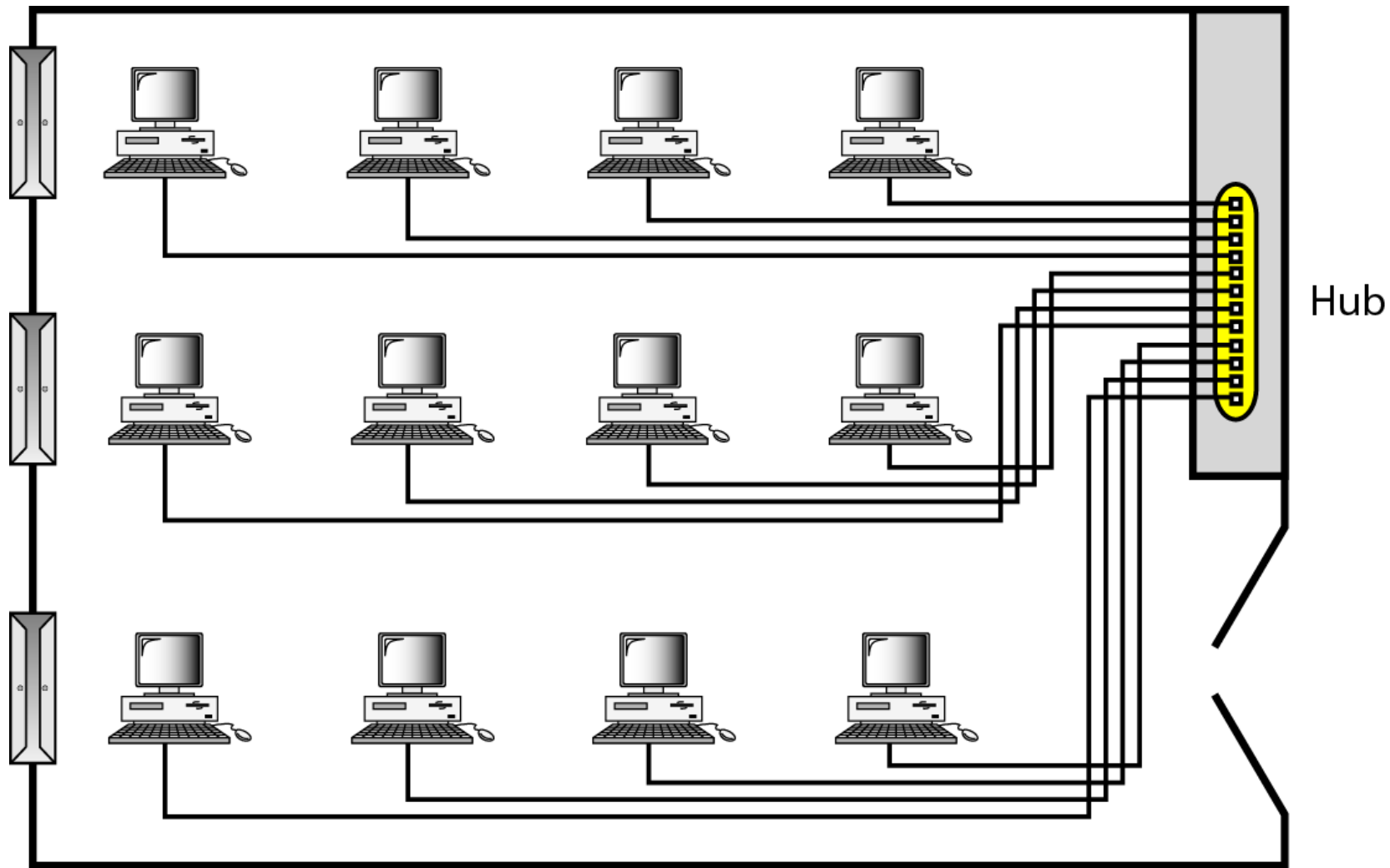


○ Local Area Network (LAN)

- Smaller scope
 - Building or small campus
 - Usually owned by served organization/company
- Data rates much higher
- Traditionally it used broadcast systems instead of switched approach
 - Now switched systems (Ethernet) and ATM (ATM LANs) have replaced broadcasting hubs



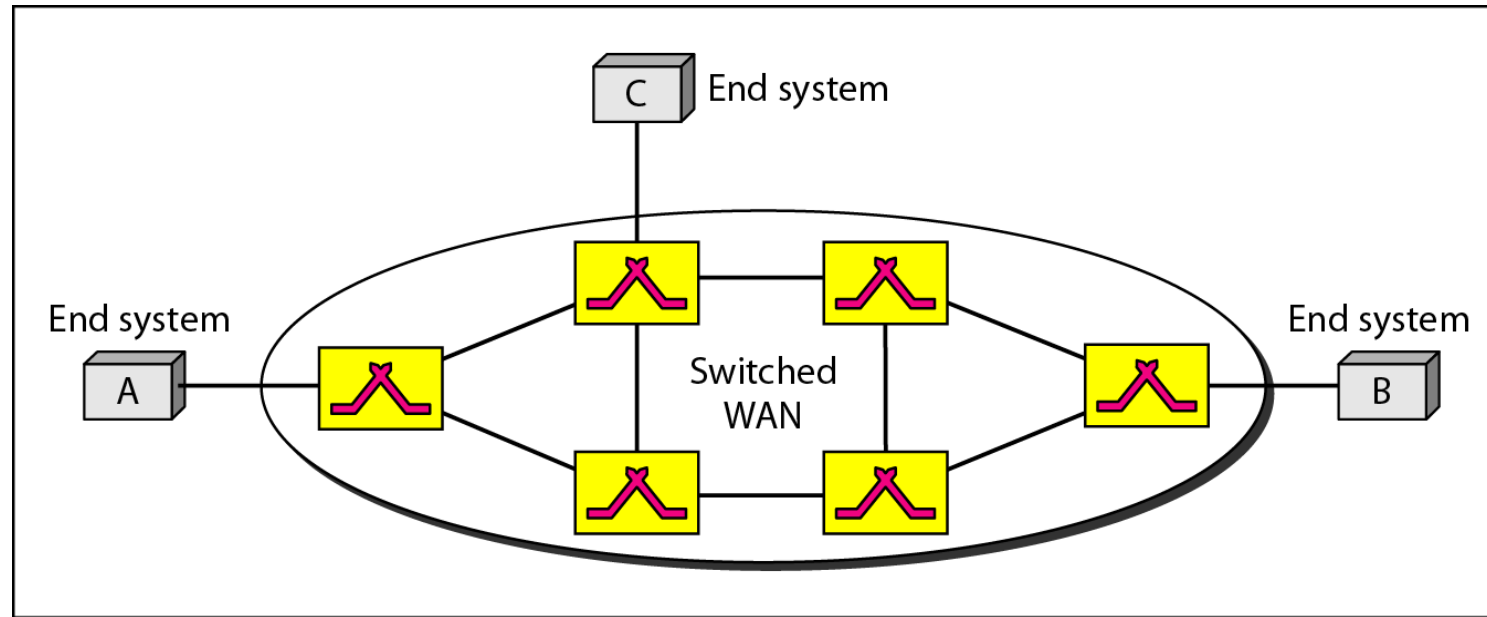
LAN



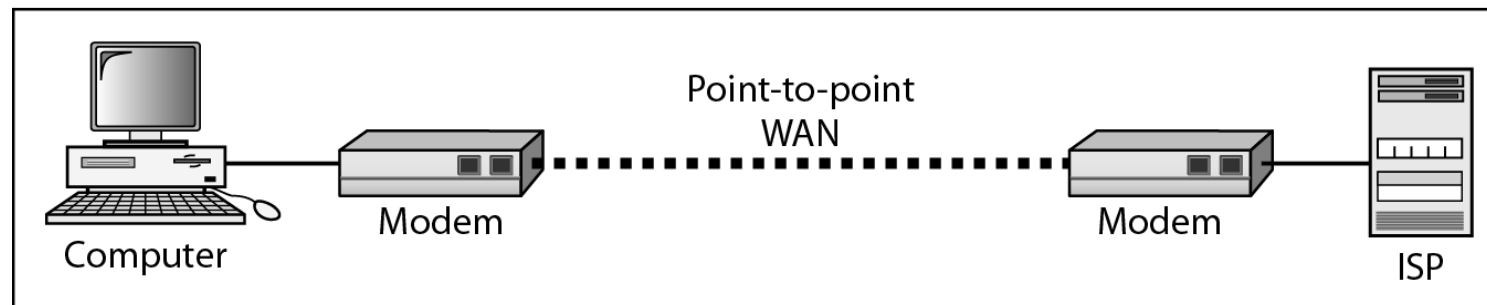
○ Wide Area Networks (WAN)

- Large geographical area
- Connect LANs
- Usually Public but may be Private
- Slower than LAN
- Consist of interconnected switching nodes
 - Switching nodes have no concern with data
 - Just meant for providing switching facility toward destination

○ WAN

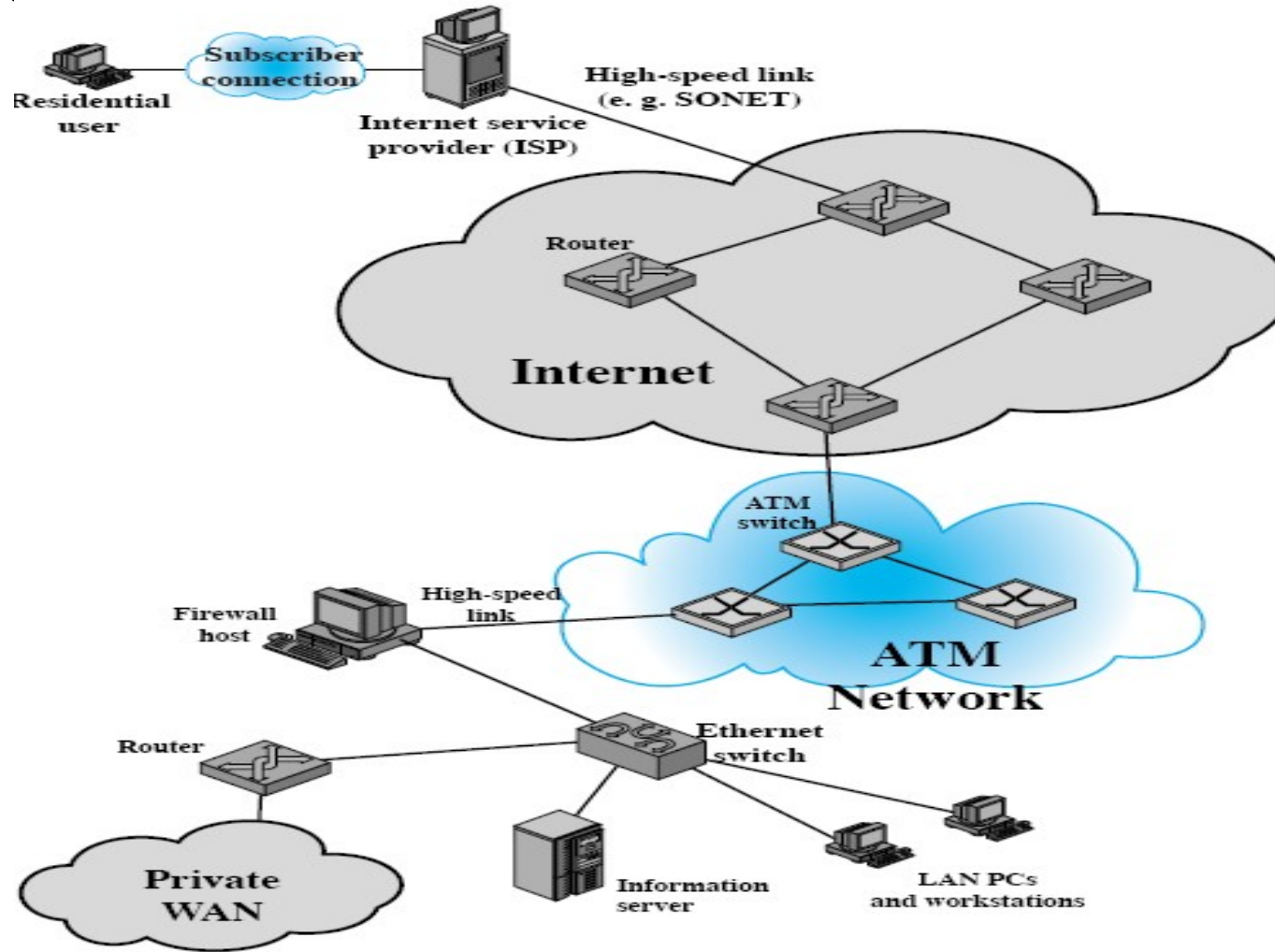


a. Switched WAN



b. Point-to-point WAN

○ A Typical Network Configuration



○ Reading Assignment

- Some types of networks have been discussed like LAN and WAN. You are required to learn about other network configurations including:
 - WAN (Wide Area Network)
 - LAN (Local Area Network)
 - WLAN (Wireless Local Area Network)
 - MAN (Metropolitan Area Network)
 - SAN (Storage Area Network)
 - CAN (Campus/Controlled/Cluster Area Network)
 - PAN (Personal Area Network)
- Note: All reading assignments are part of course

○ Types of Networks

- Client Server Networks
- Peer To Peer Networks

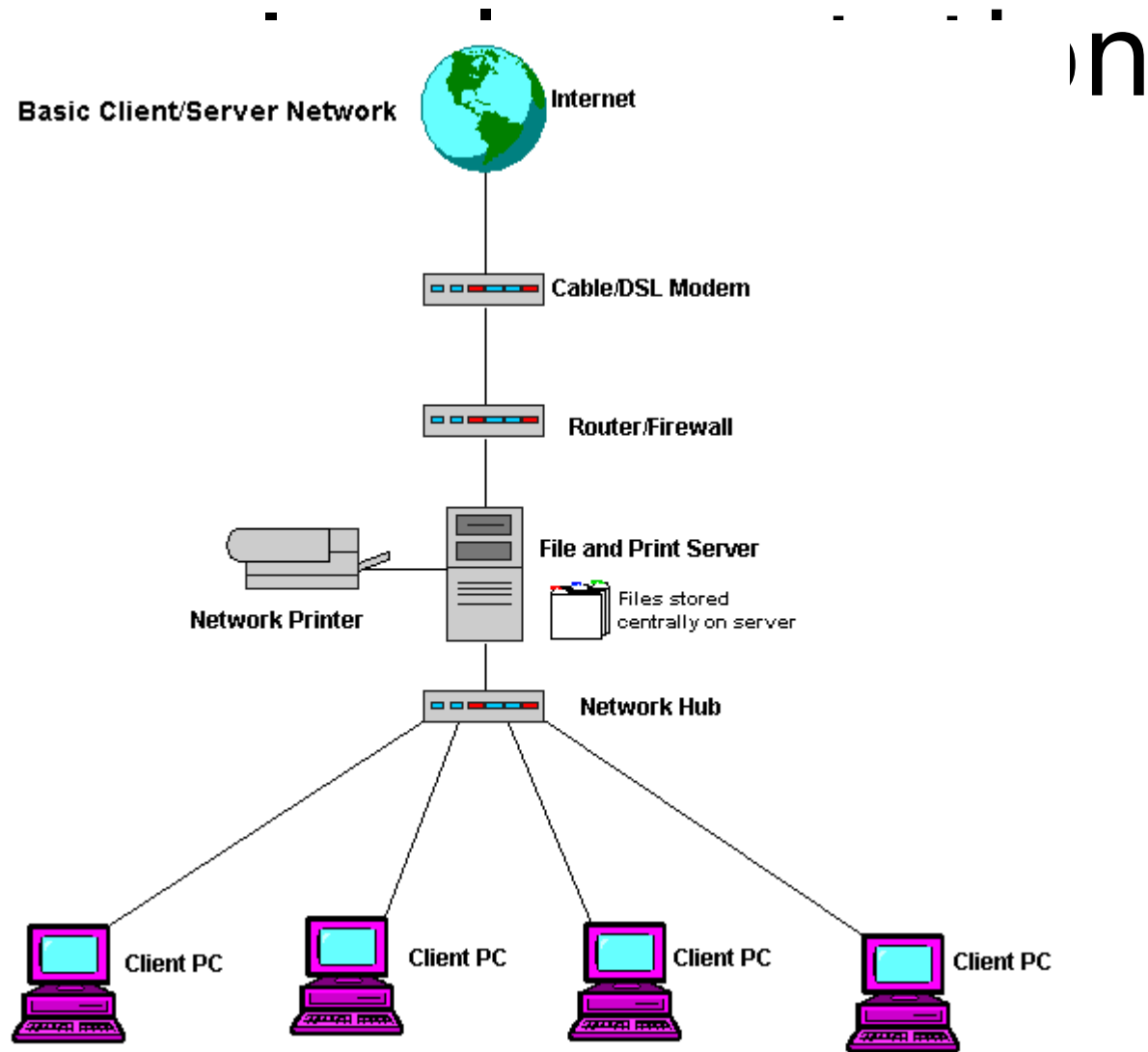


○ Client Server Implementation

- Servers are distinguished from other systems which are known as clients and all these are connected over a computer network
- Servers offer services which are used by client systems
 - Server serves clients
- Server always keep listening for clients
- A Server could be used for
 - Data Storage
 - Distributed Application
 - Resource Sharing
 - Authorization
 - Accountancy
 - Security & easy Administration
 - Centralized Control
- A Server may require clients to log on before any services may be provided



Client Se



○ Client Server Implementation

- What is the difference in Servers and Clients
 - Physically Different
 - Separate Kind of Machines?
 - Actual Difference in Software
 - Server runs server software while client runs software module (usually very small in comparison to server software)
 - Used Yahoo Messenger?
 - You have a very tiny module of Yahoo Messenger (Clients)
 - Actual Yahoo Messenger Server S/W is much heavy

○ Client Server Implementation (Advantages)

- Centralized Control
- Security Policies are easily implemented
- Logs could be create
- Reliability
- Easy to share resources
- Stable environment (Both H/W and S/W)
- Performance degrade gracefully in higher loads

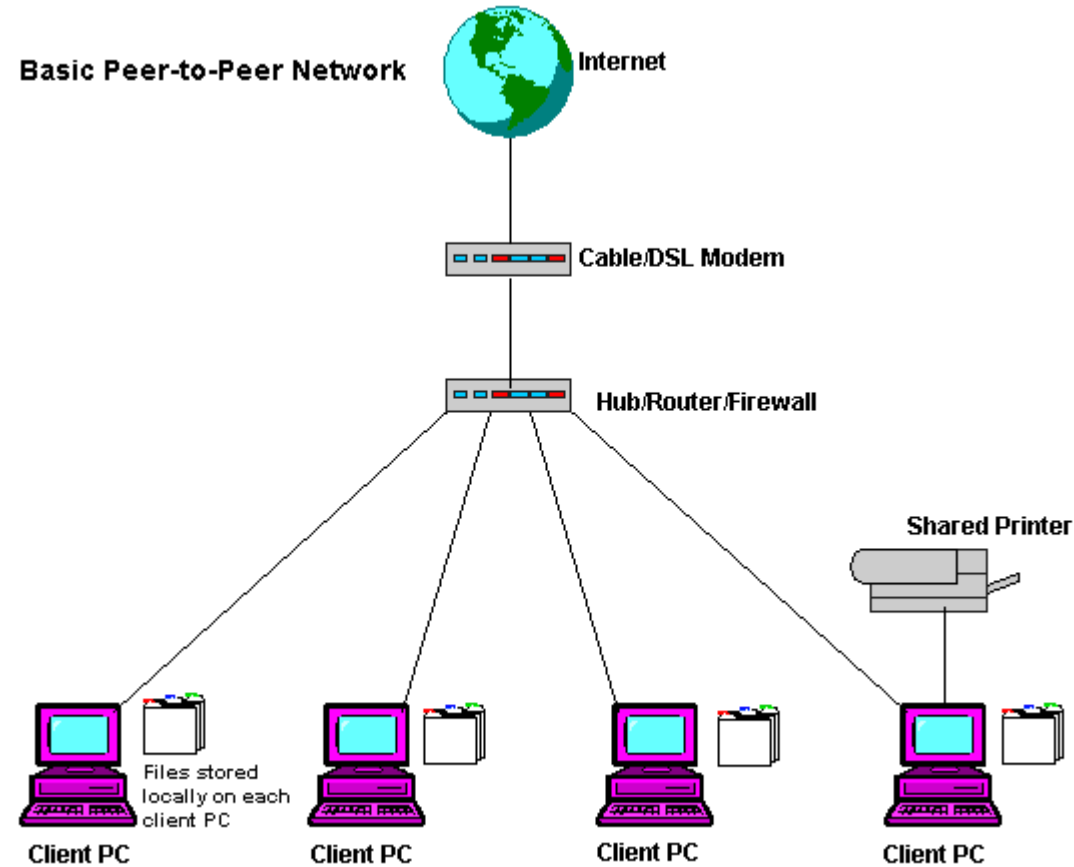
○ Client Server Implementation (Disadvantages)

- Costly to install
- Usually require Expert personnel to manage

○ Peer-to-Peer Networks

- Each computer serves both as client as well as server
- No centralized control for user access
- Usually useful for SOHO (Small Office/Home Office)

Peer-to-Peer Networks



○ Peer-to-Peer Networks Advantages

- Easy to setup
- Low H/W, S/W cost
- Usually useful for file/print/internet sharing
- Useful in environments where security is not an issue

○ Peer-to-Peer Networks Disadvantages

- Not Reliable
- Performance degrade exponentially as new nodes add into the network
- Compromised network security

○ Network Models

- Computer networks are created by different entities.
- Standards are needed so that these heterogeneous networks can communicate with one another.
- The two best-known standards are the OSI model and the Internet (TCP/IP) model.
- The OSI (Open Systems Interconnection) model defines a seven-layer network
- The Internet model(TCP/IP) defines a five-layer network.



○ Topics For the Next Class

- Internet
- Software Defined Networks SDN



○ References

- [Data Communication and Computer Networks by Behrouz A Forouzan.pdf](#)
- [Data And Computer Communications by William Stallings.pdf](#)
- https://www.academia.edu/37562829/INTRODUCTION_TO_COMPUTER_NETWORKS

