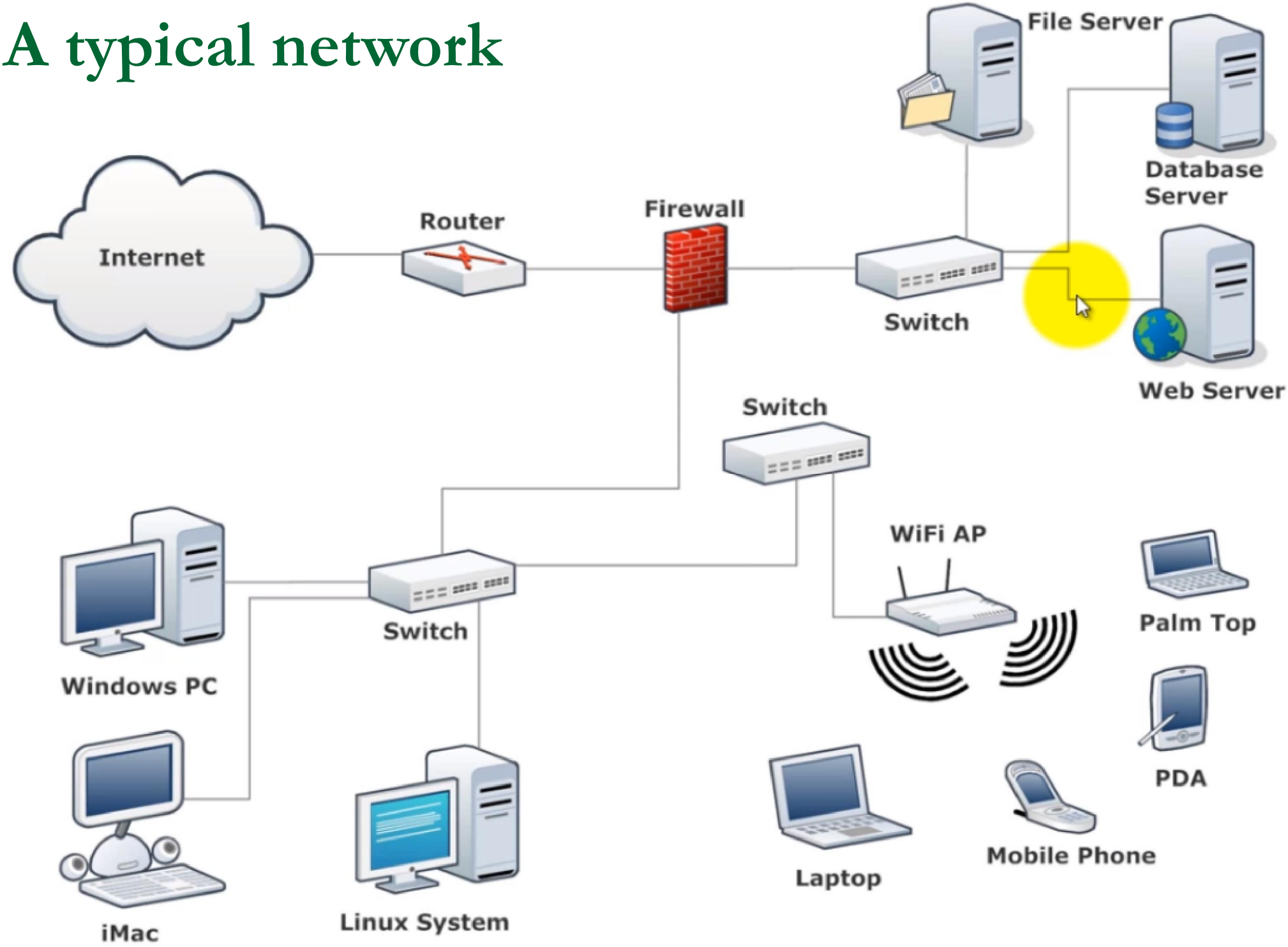
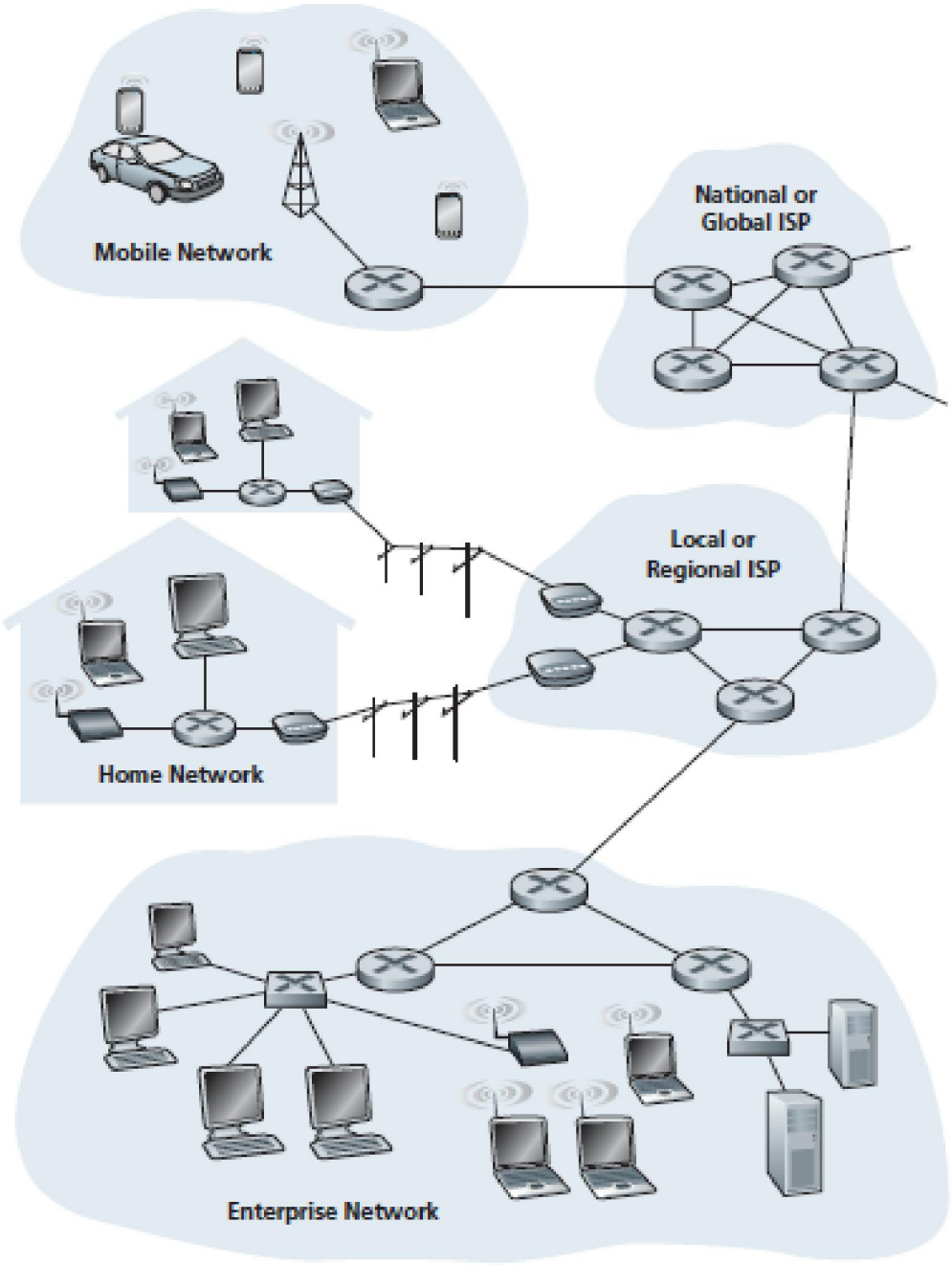
Data Communication and Computer Network

Introduction

"Sometimes when my Internet is down, I forget that the rest of my computer still works"

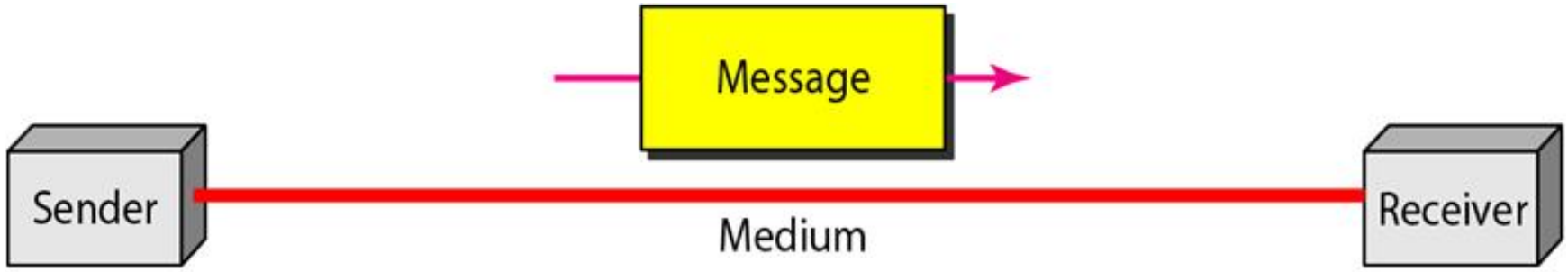
A typical network




Mobile Network
National or
Global ISP
Local or
Regional ISP
Home Network
Enterprise Network

Data Communications

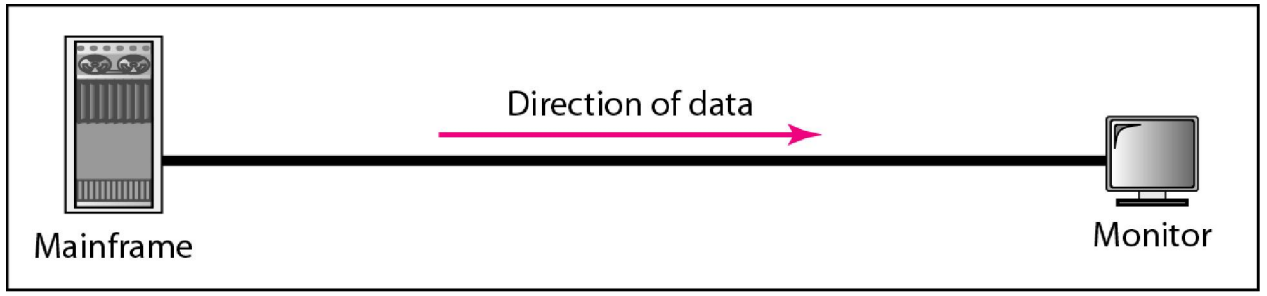
- The term telecommunication means communication at a distance.
- The word data refers to information presented in whatever form is agreed upon by the parties creating and using the data.
- Data communications are the exchange of data between two devices via some form of transmission medium (ex: a wire cable).



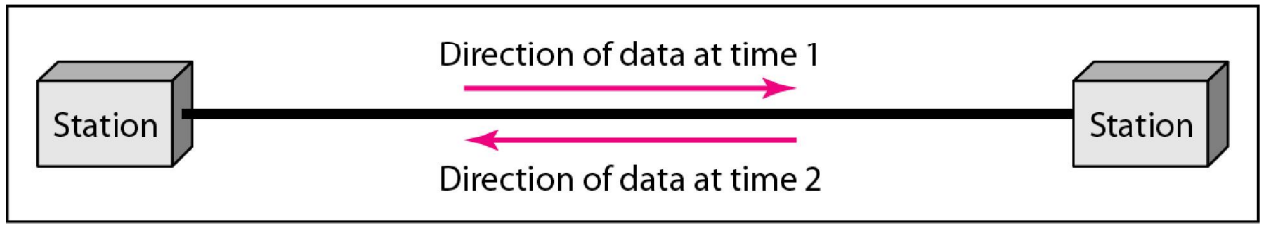
Types of transmissions

Types of transmission

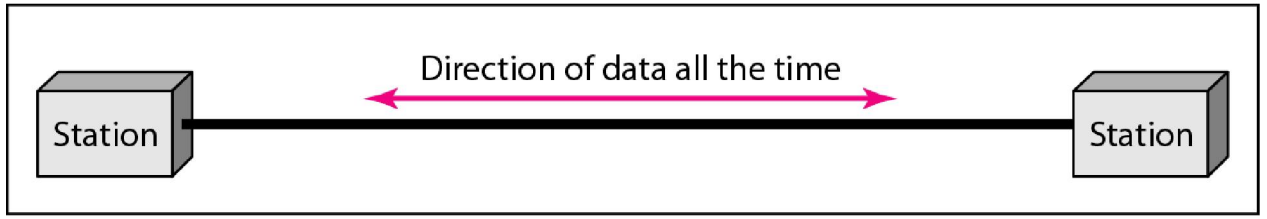
a. Simplex
b. Half-duplex
c. Full-duplex



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.

Basic Characteristic of CN/ Network Criteria

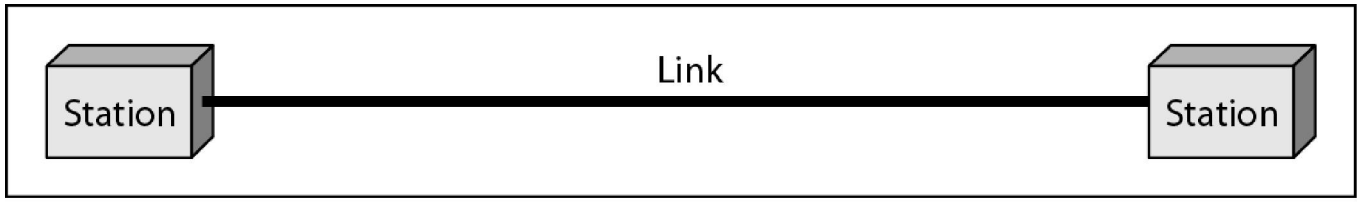
- Scalability and Performance
  - Depends on Network Elements
  - Measured in terms of Delay and Throughput
- Reliability / Fault tolerance
  - Failure rate of network components
  - Measured in terms of availability/robustness
- Quality of Services (QoS)
- Security
  - Data protection against corruption/loss of data due to:
    - ✓ Errors
    - ✓ Malicious users

Physical Structures

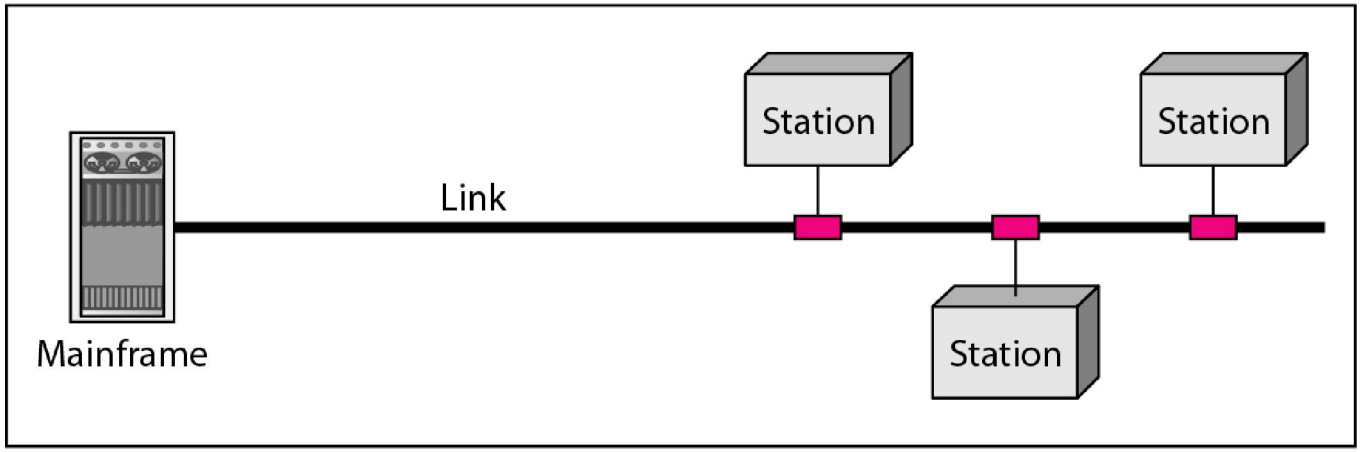
Type of Connection

a. Point to Point - single transmitter and receiver

b. Multipoint (multidrop) - multiple recipients of single transmission



a. Point-to-point

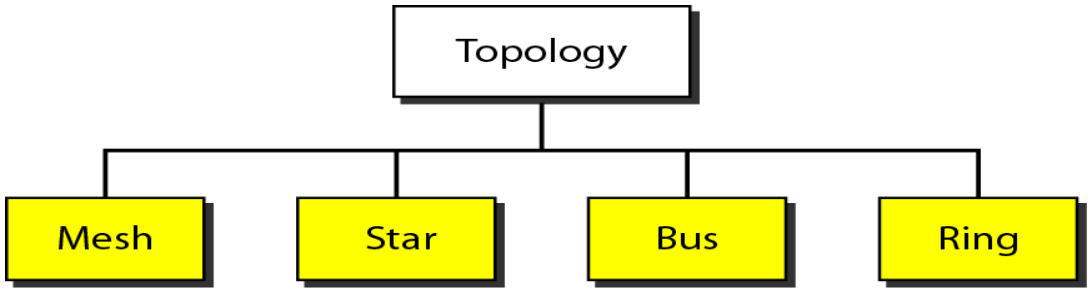


b. Multipoint

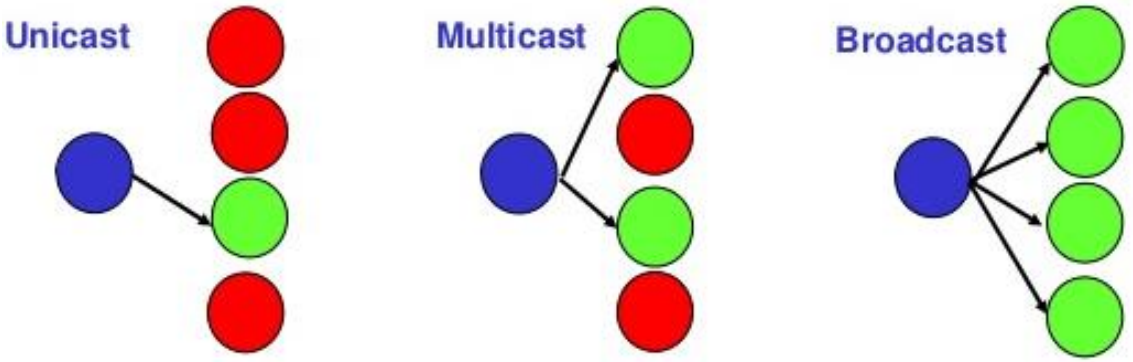
Physical Structures

Physical Topology

- Connection of devices

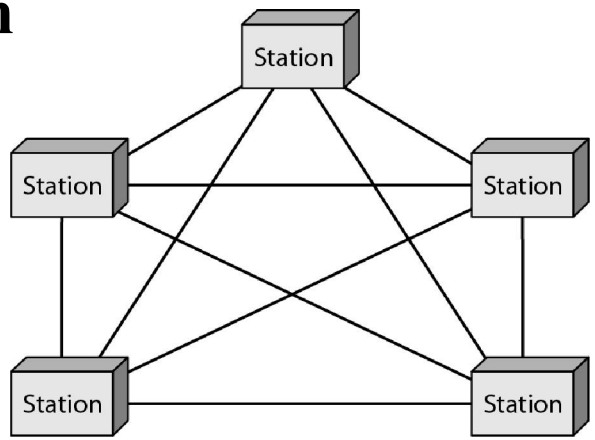


- Type of transmission
  - Unicast,
  - Mulitcast
  - Broadcast

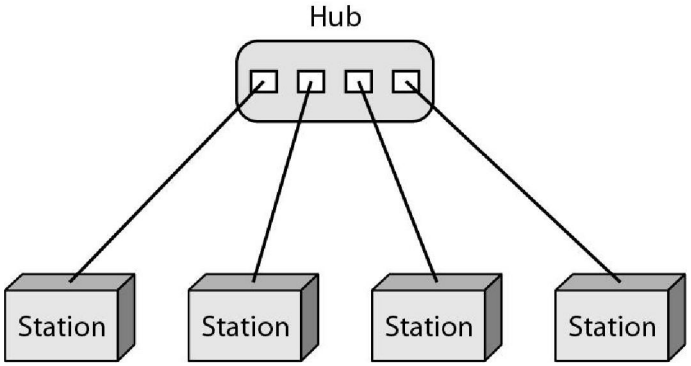


Physical Topology

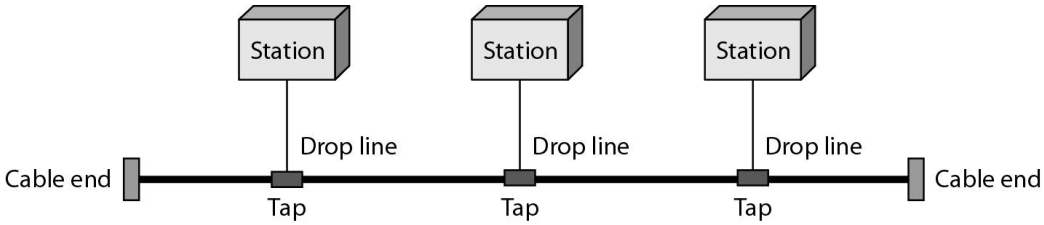
Mesh



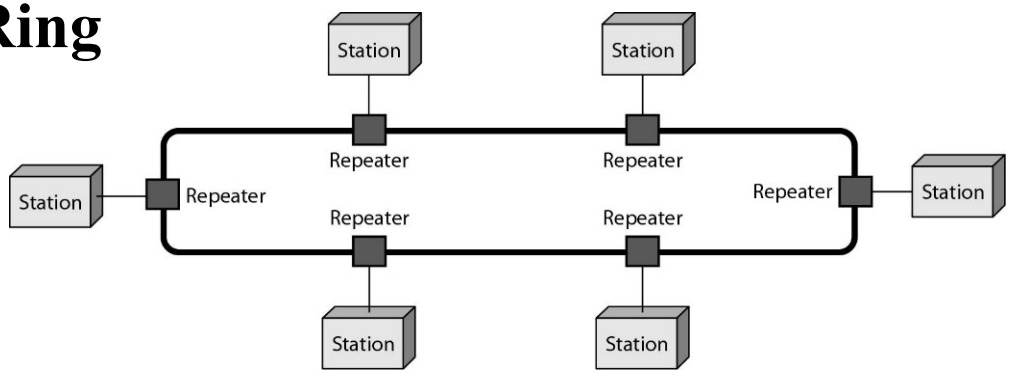
Star



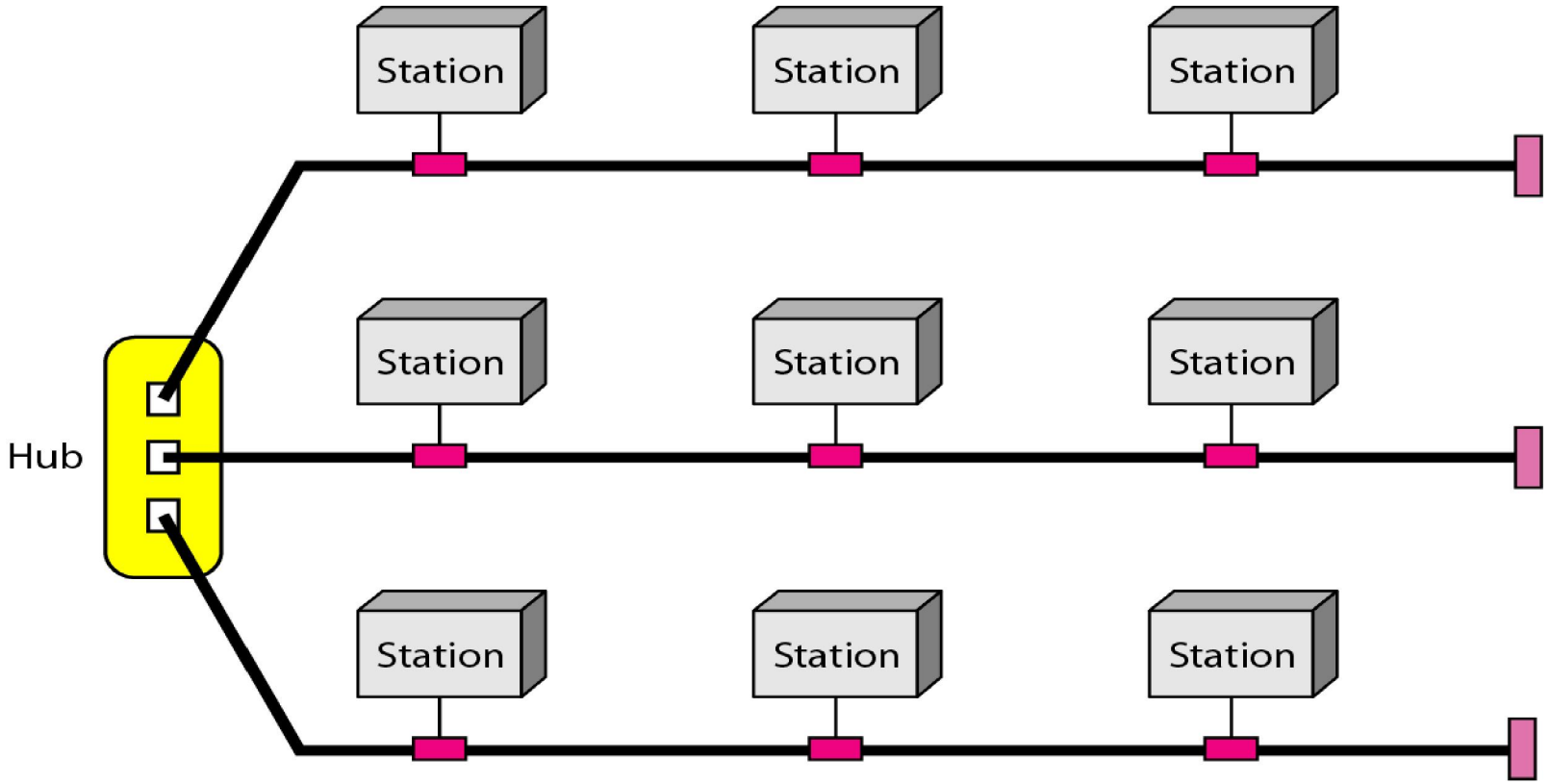
Bus



Ring



A hybrid topology: a star backbone with three bus networks



Categories of Networks

Local Area Networks (LANs)

- Short distances
- Designed to provide local interconnectivity – office, a building or a campus
- Interconnects **hosts**

Wide Area Networks (WANs)

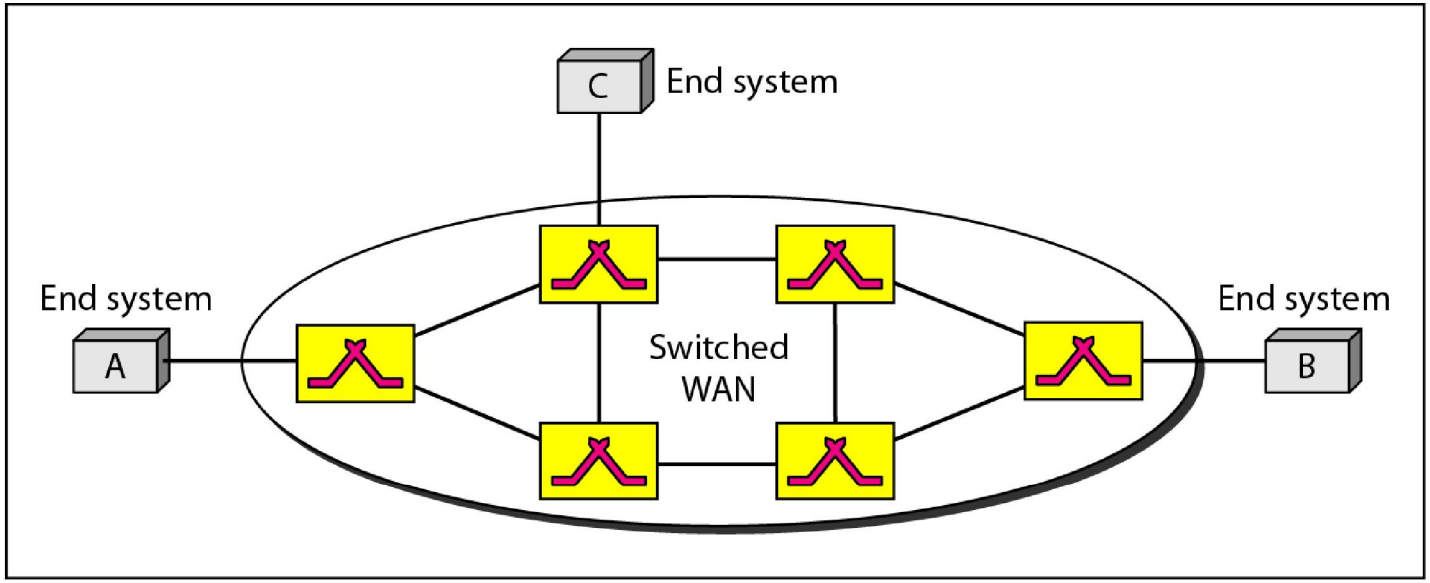
- Long distances
- Provide connectivity over large areas – a town, a state, a country or even world
- Interconnects connecting devices, i. e. **switches, routers, or modem**.

Metropolitan Area Networks (MANs)

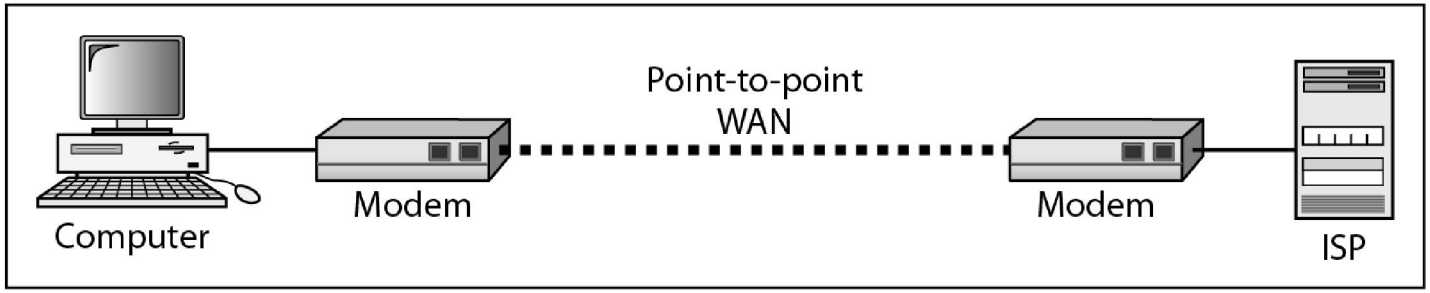
- *Provide connectivity over areas such as a city, a campus*

Type of WAN

a. Switched WAN
b. Point-to-point WAN



a. Switched WAN

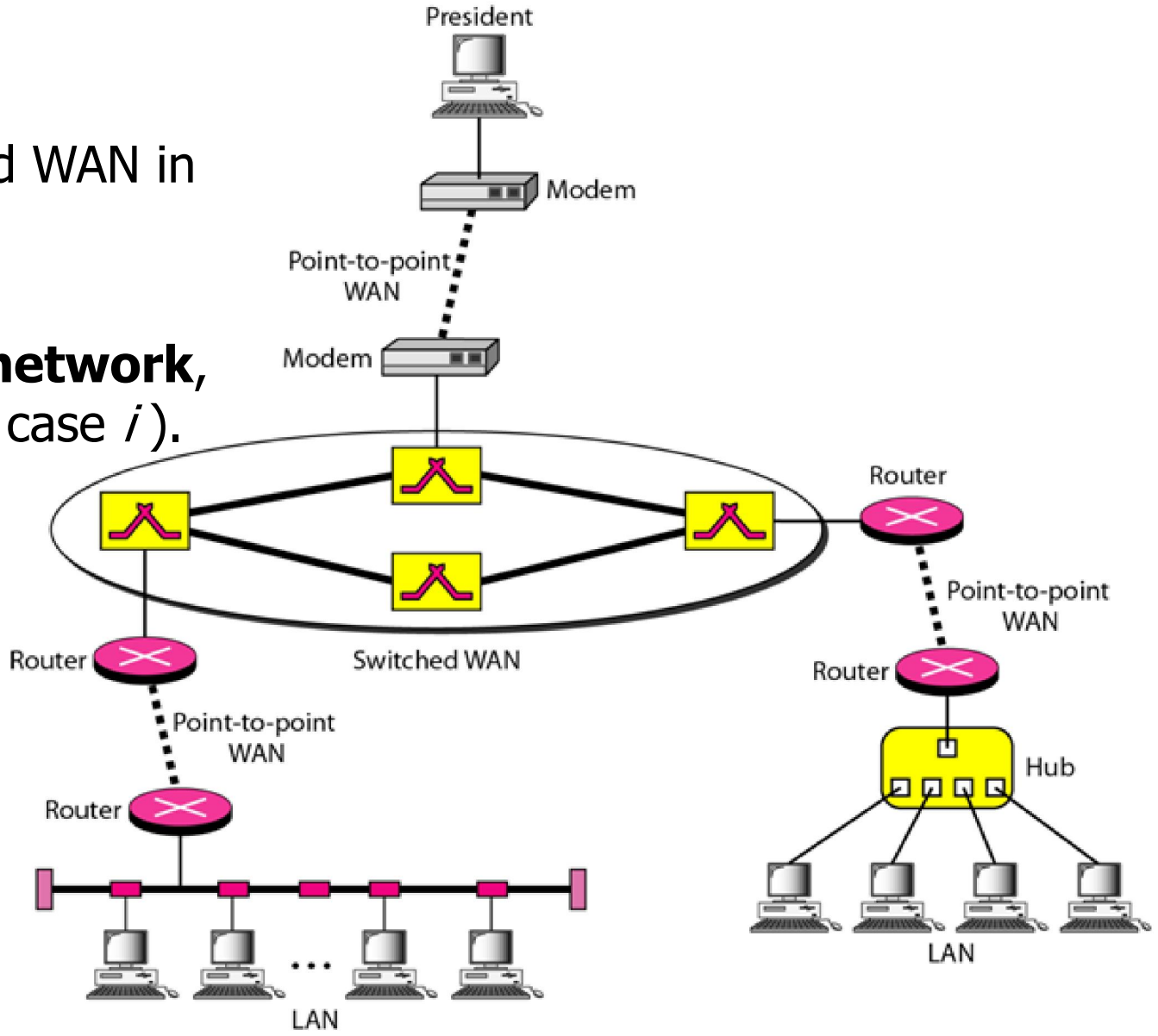


b. Point-to-point WAN

A typical heterogeneous network

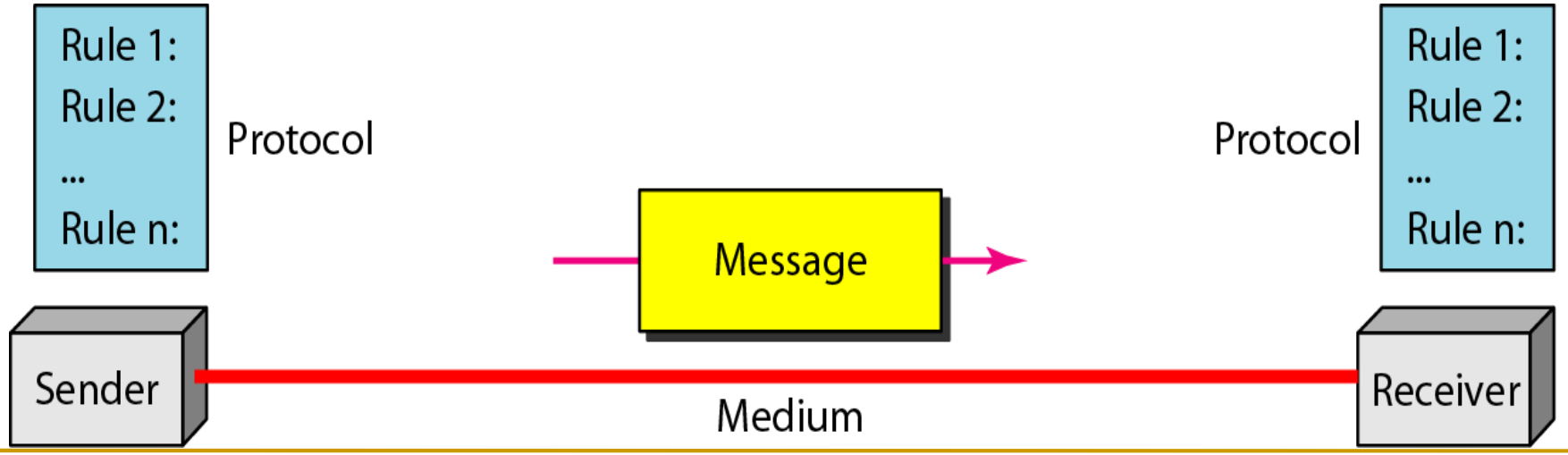
Internetwork

- Very rare to see LAN and WAN in isolation
- Two or more networks connected, forms **internetwork**, or **internet** (with lower case *i*).



Protocols

- A protocol is synonymous with rule. It consists of a set of rules that govern data communications.
- It determines
  - what is communicated
  - how it is communicated
  - when it is communicated
- The key elements of a protocol are syntax, semantics and timing



Elements of a Protocol

Syntax

- Structure or format of the data
- Indicates how to read the bits - field delineation

Semantics

- Interprets the meaning of the bits
- Knows which fields define what action

Timing

- When data should be sent
- Speed at which data should be sent or speed at which it is being received.

Few important terms in Networking

- Modem
- Repeater
- Hub
- Bridge
- Switch
- Router
- Gateways

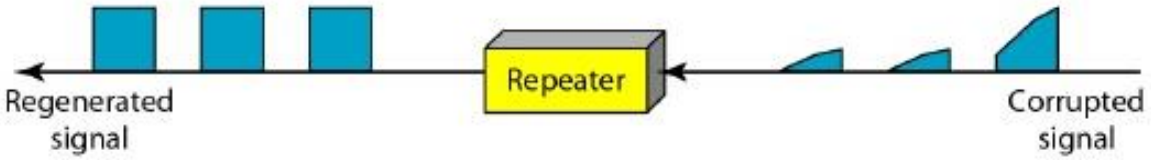
Modem, Repeater

❑ Modem (**mo**dulator-**dem**odulator)

- ➢ Hardware device works on physical layer
- ➢ Can be used with any means of transmitting analog signals
- ➢ Modulates one or more carrier wave signals to encode digital information for transmission
- ➢ Demodulates signals to decode the transmitted information

❑ Repeater

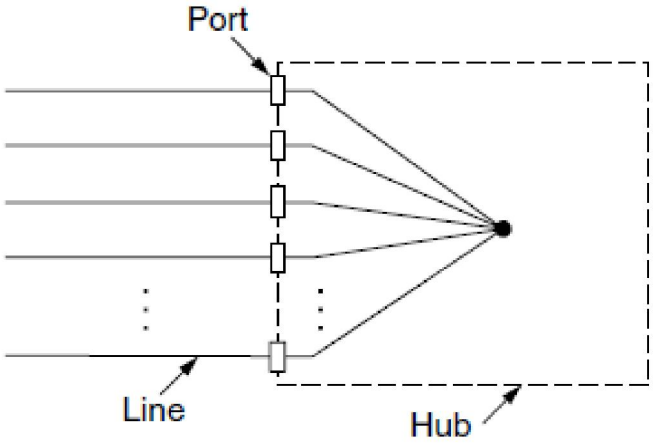
- ➢ Electronic device that receives a signal and retransmits it
- ➢ Used to extend transmissions so that the signal can cover longer distances



Hub

❑ Hub (Ethernet hub, network hub, repeater hub, multiport repeater)

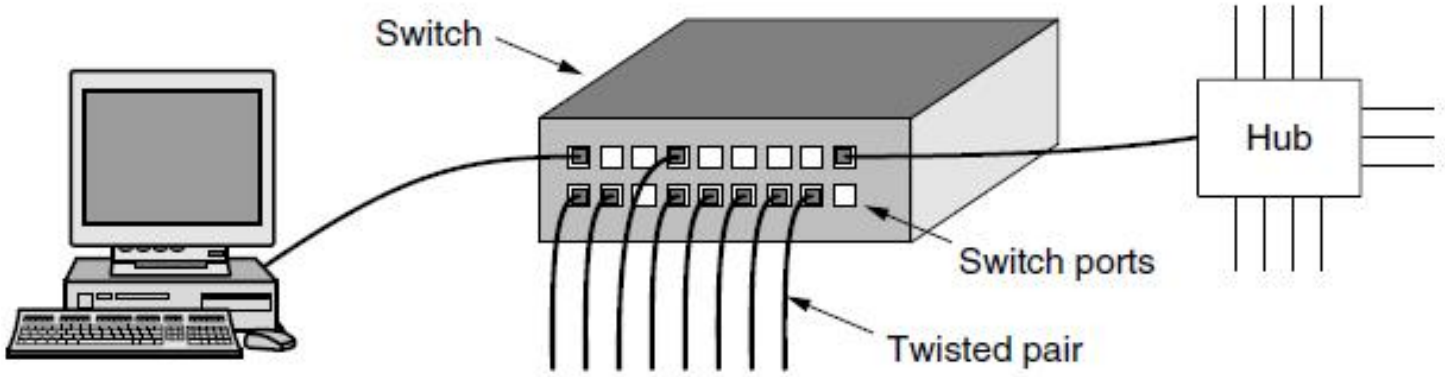
- ➢ Network hardware device for connecting multiple Ethernet devices together
- ➢ Multiple Information Outlet (I/O) ports, in which a signal introduced at the input of any port appears at the output of every port except the original incoming
- ➢ Acts as repeater also



Switch / Bridge

❑ Switch (or Bridge /switching hub, bridging hub, MAC bridge)

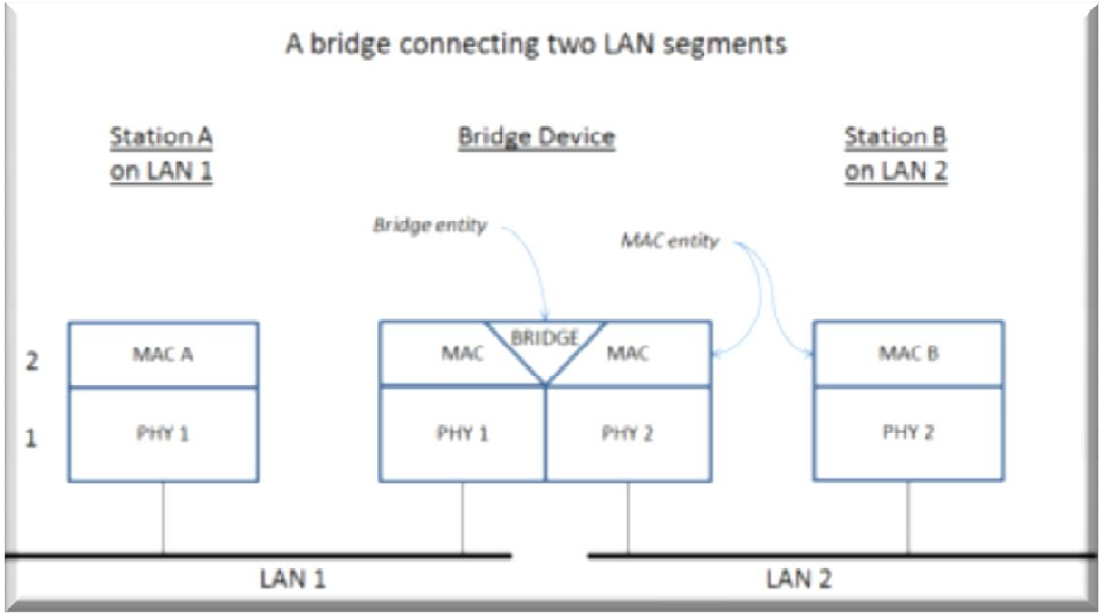
- Unlike **Hub**, it forwards data only to one or multiple devices that need to receive it, rather than broadcasting the same data out of each of its ports
- Process and forward data to the destination device on using hardware addresses (at Layer 2)



Switch / Bridge (contd)

❑ Switch (or Bridge /switching hub, bridging hub, MAC bridge)

- Creates a single aggregate network from multiple network segments
- Allows multiple different networks (of same type) to communicate independently while remaining separate (different collision domain)
- It can perform error checking before forwarding data



Router, Gateways

❑ Router

- Networking device that forwards data packets between computer networks.
- Perform the traffic directing (routing) functions on the Internet.
- A data packet is typically forwarded from one router to another through the networks that constitute the internetwork until it reaches its destination node
- Regulates traffic between similar networks (in transport protocols like TCP, UDP, SCTP)

❑ Gateway

- Unlike Router, it regulates traffic between dissimilar networks (TCP ←→ SCTP etc)

References

- *Data Communications & Networking, 5th Edition, Behrouz A. Forouzan*
- *Computer Networks, Andrew S. Tanenbaum and David J. Wetherall*
- *Wikipedia*