

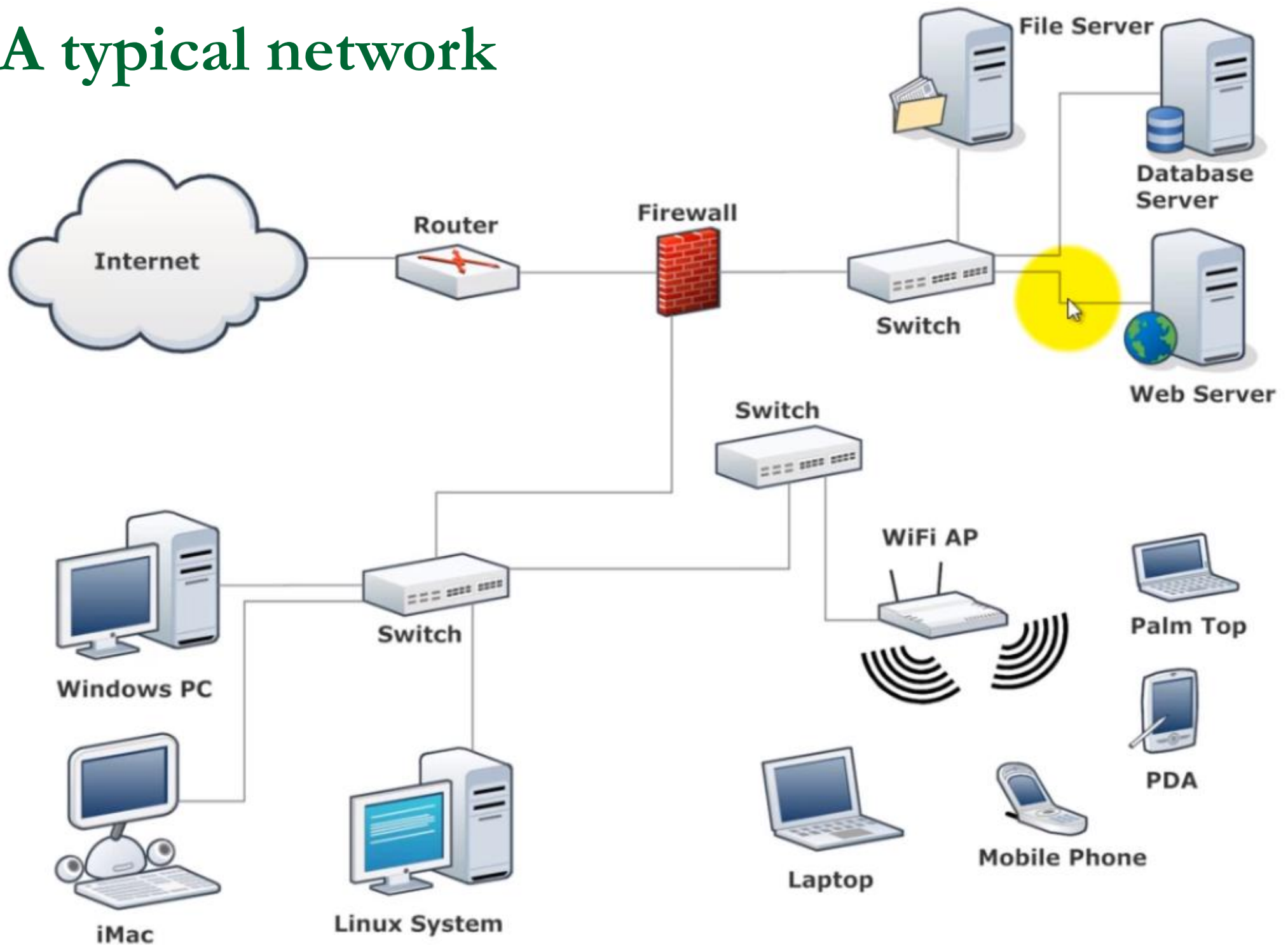
Data Communication and Computer Network

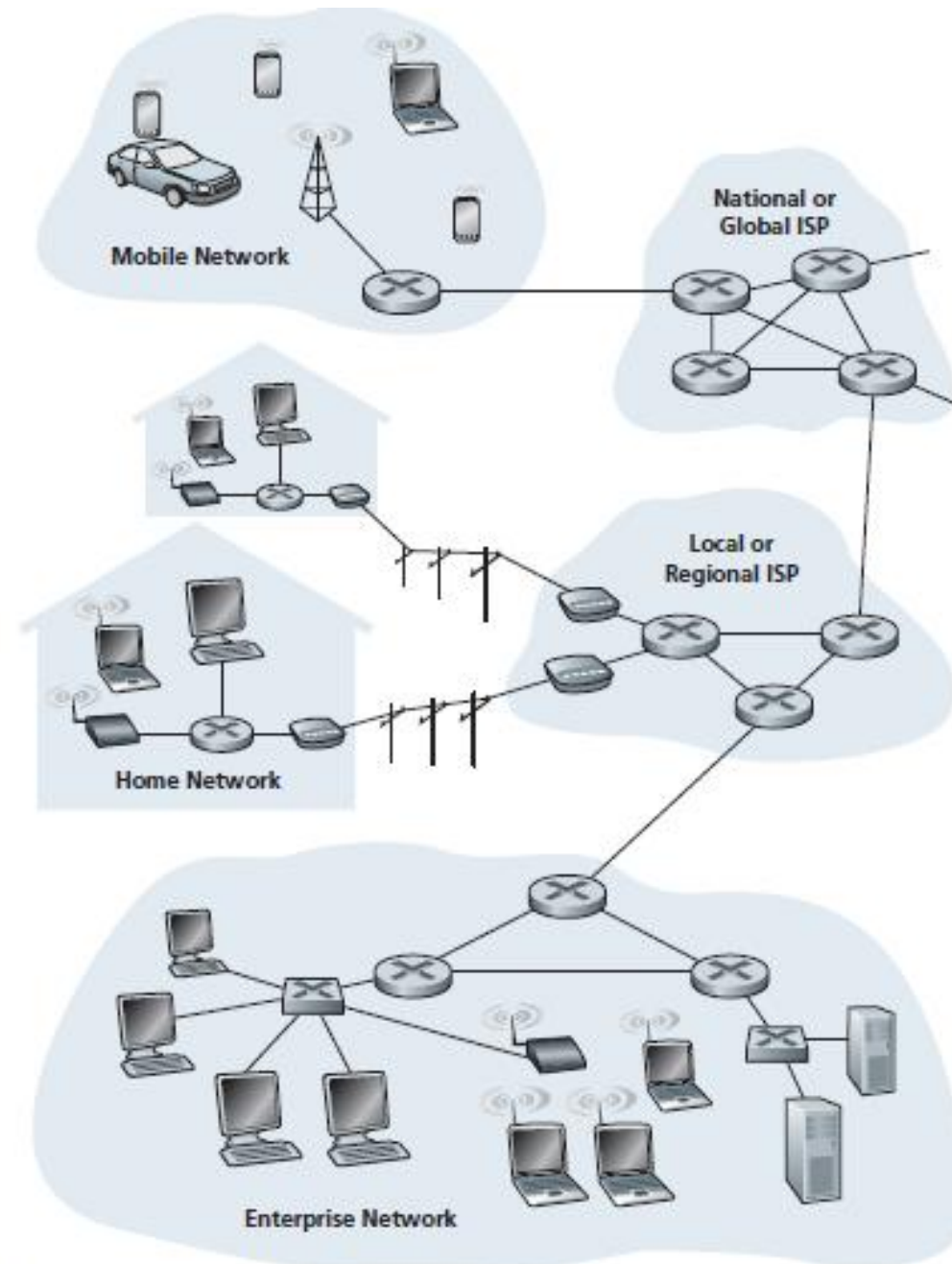
Introduction



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

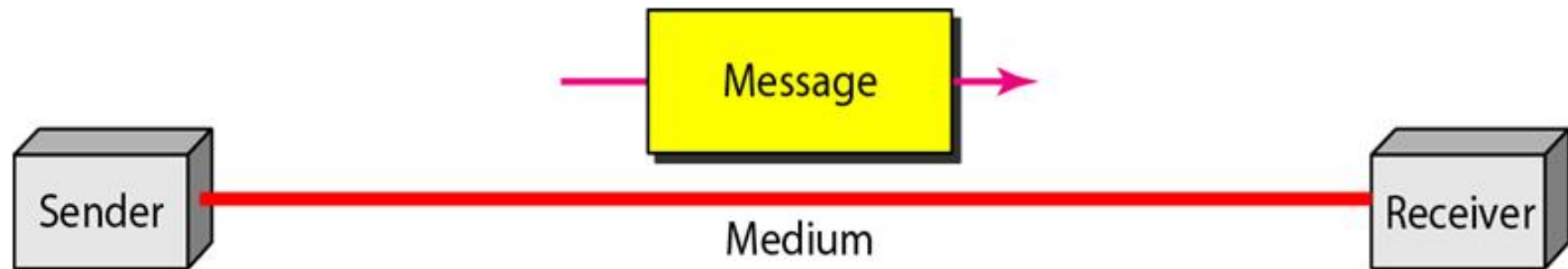
A typical network





Data Communications

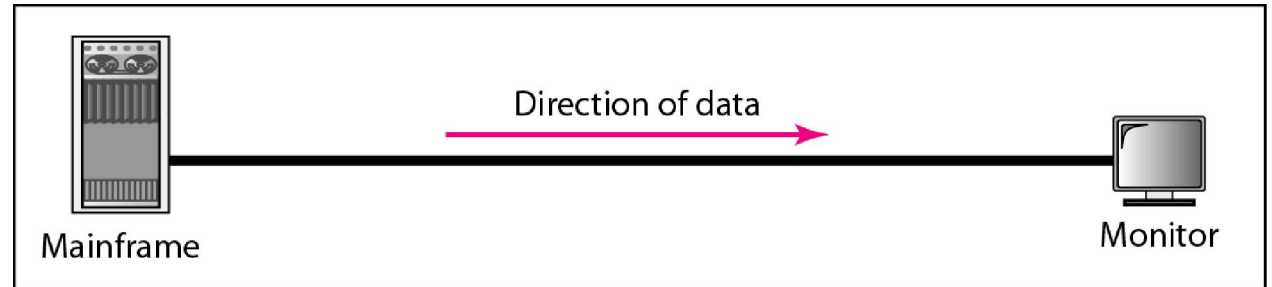
- ❑ The term telecommunication means communication at a distance.
- ❑ The word data refers to information presented in whatever form is agreed upon by the parties creating and using the data.
- ❑ Data communications are the exchange of data between two devices via some form of transmission medium (ex: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



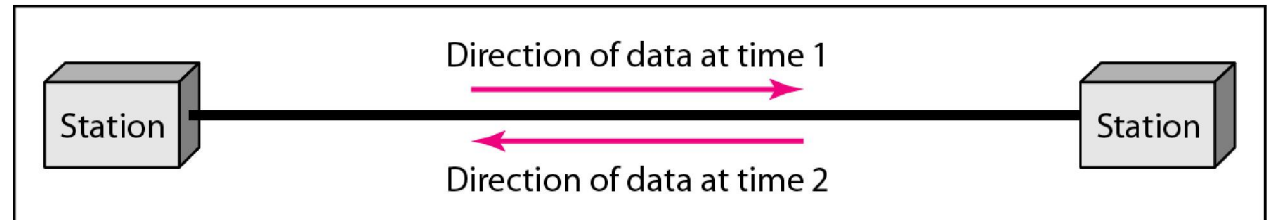
Types of transmissions

Types of transmission

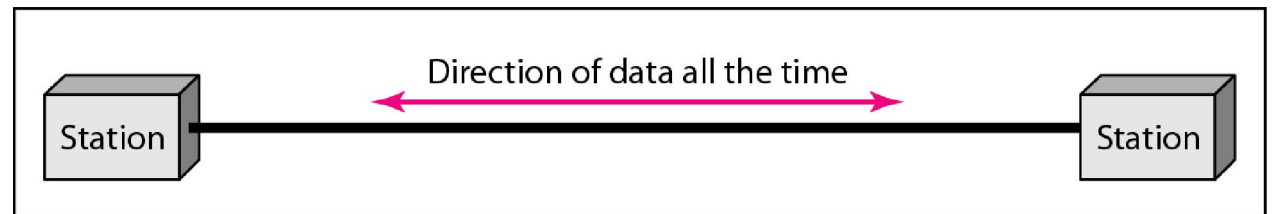
- a. Simplex
- b. Half-duplex
- c. Full-duplex



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.
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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)

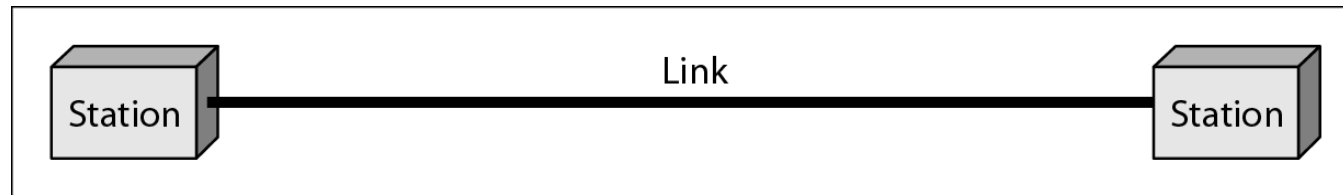
❑ Security

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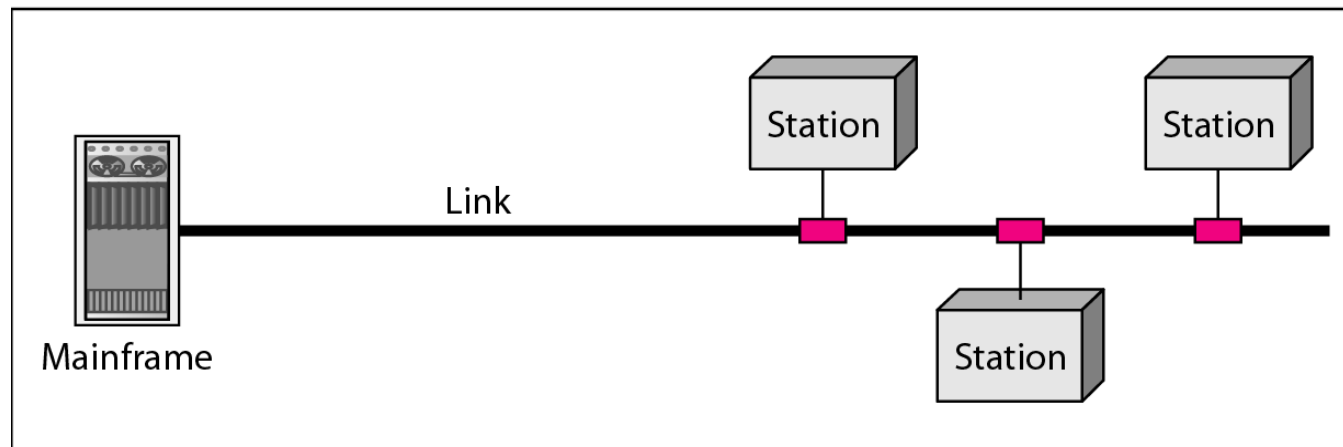
Physical Structures

Type of Connection

- a. Point to Point - single transmitter and receiver
- b. Multipoint (multidrop) - multiple recipients of single transmission



a. Point-to-point

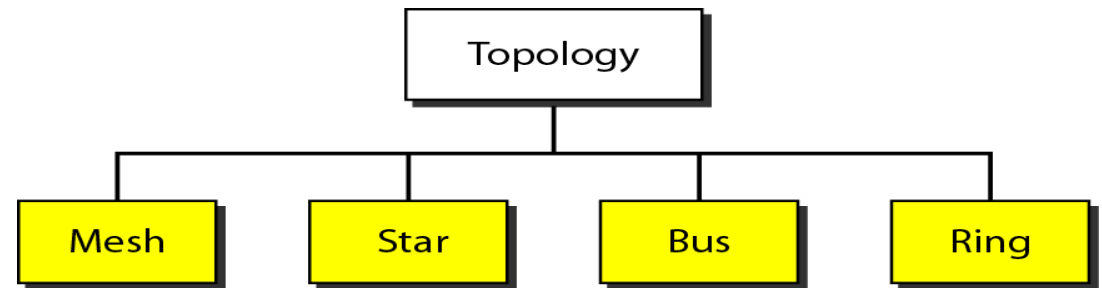


b. Multipoint

Physical Structures

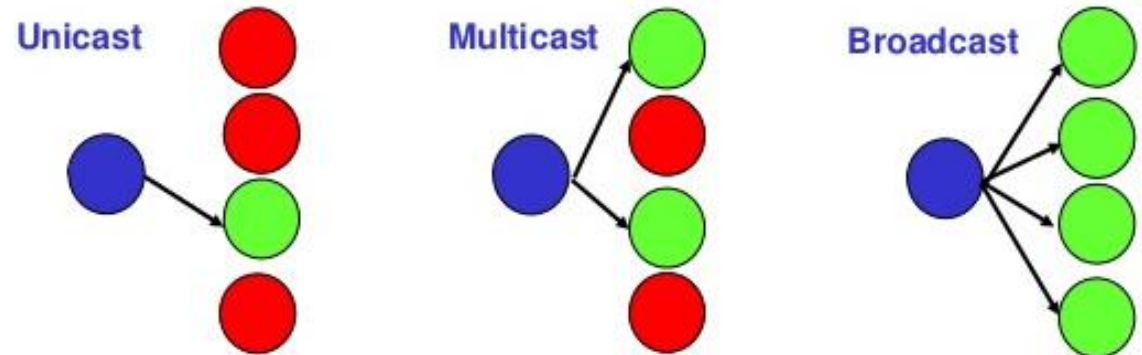
Physical Topology

❑ Connection of devices



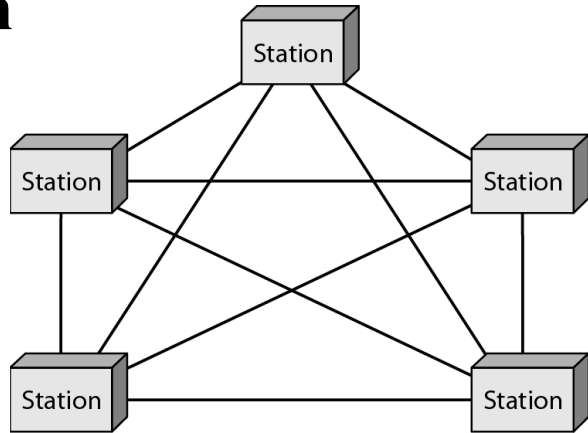
❑ Type of transmission

- Unicast,
- Multicast
- Broadcast

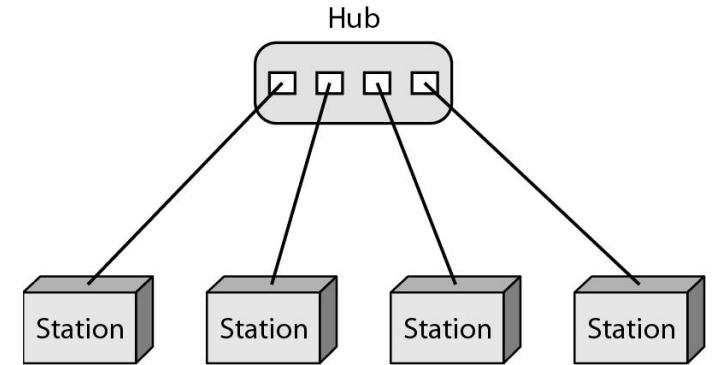


Physical Topology

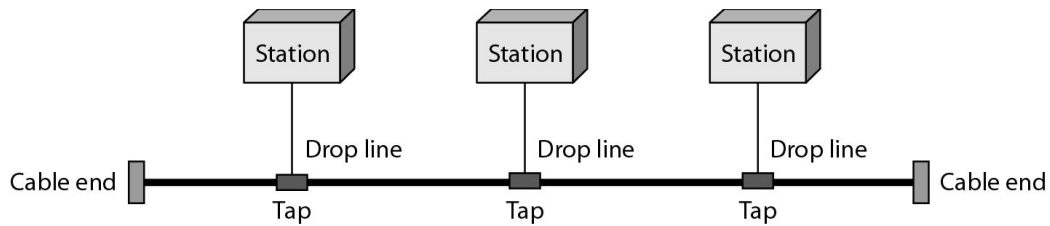
Mesh



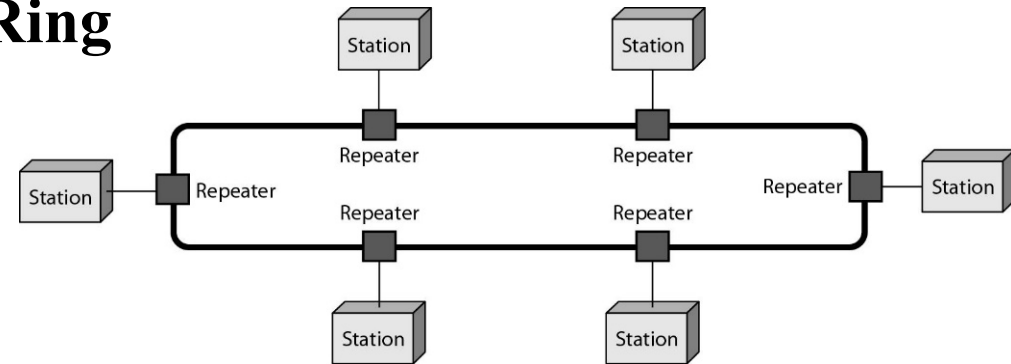
Star



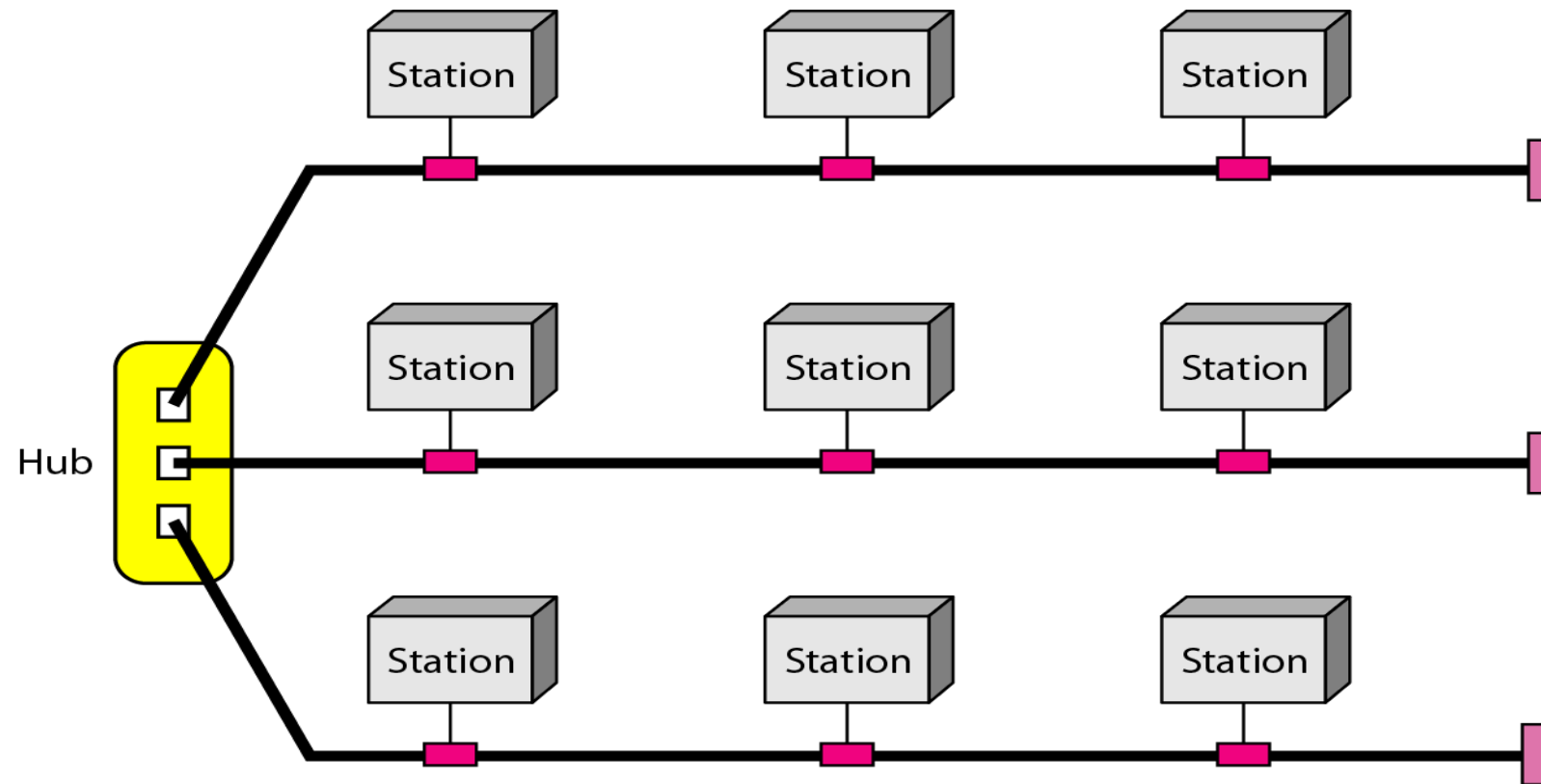
Bus



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.**

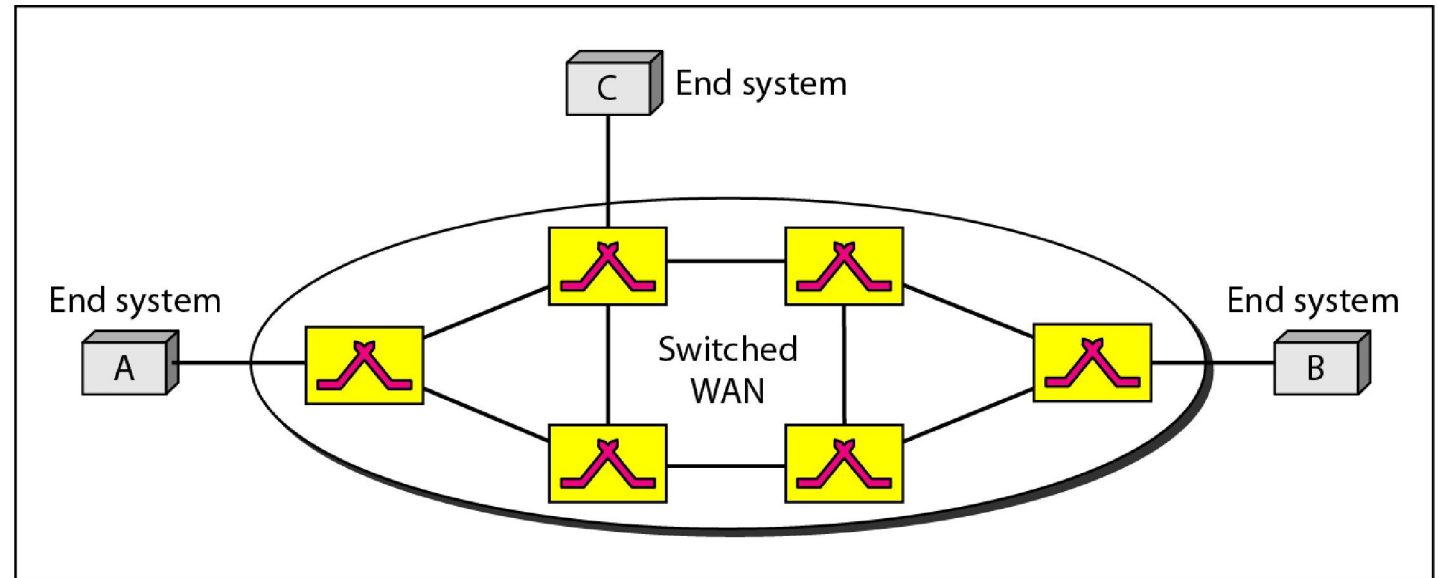
Metropolitan Area Networks (MANs)

- ❑ *Provide connectivity over areas such as a city, a campus*
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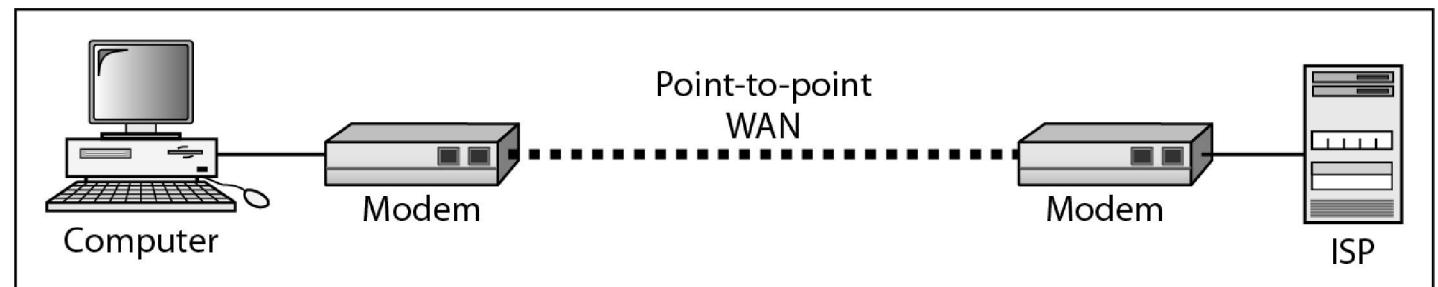
Type of WAN

a. Switched WAN

b. Point-to-point WAN



a. Switched WAN

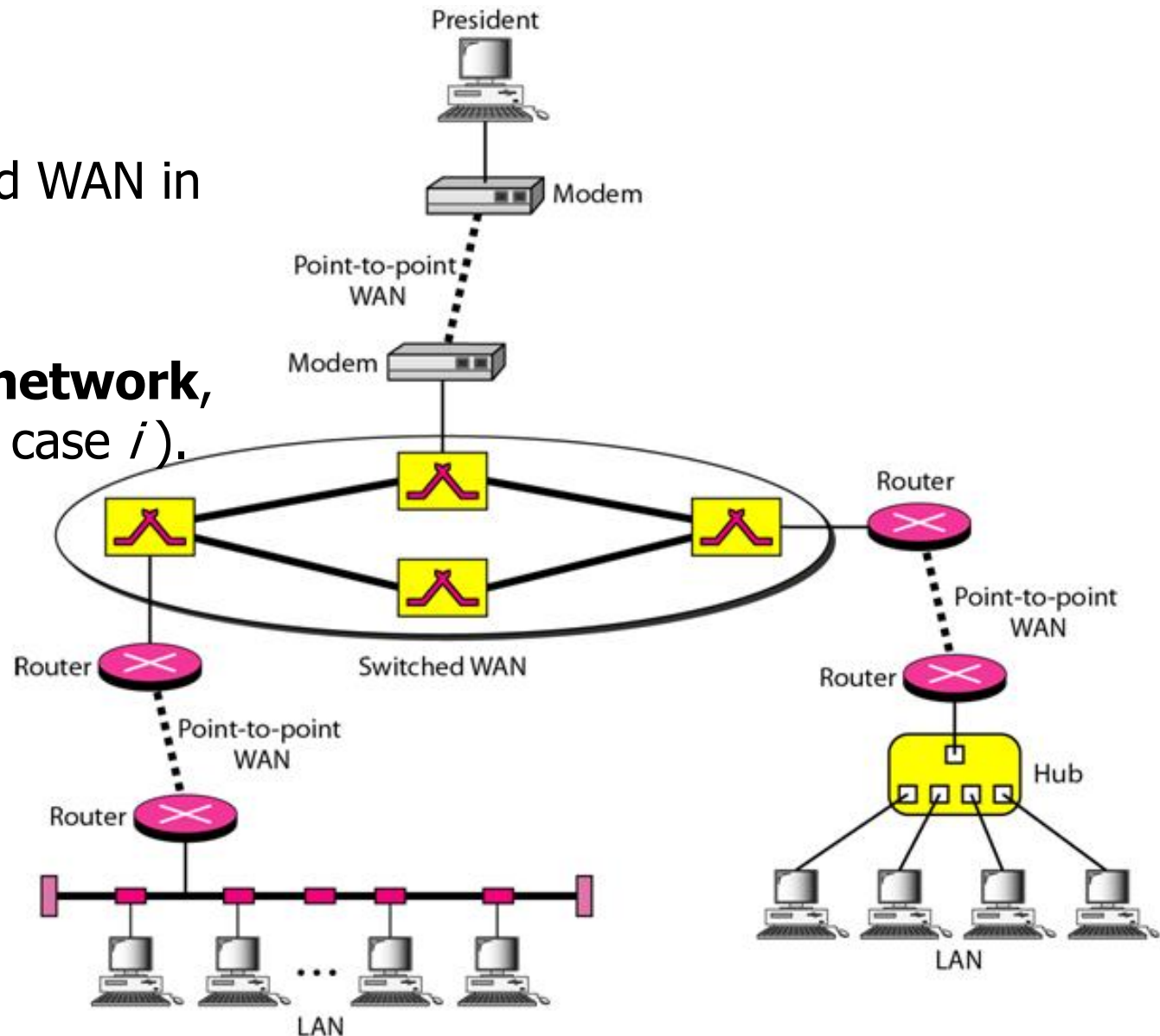


b. Point-to-point WAN

A typical heterogeneous network

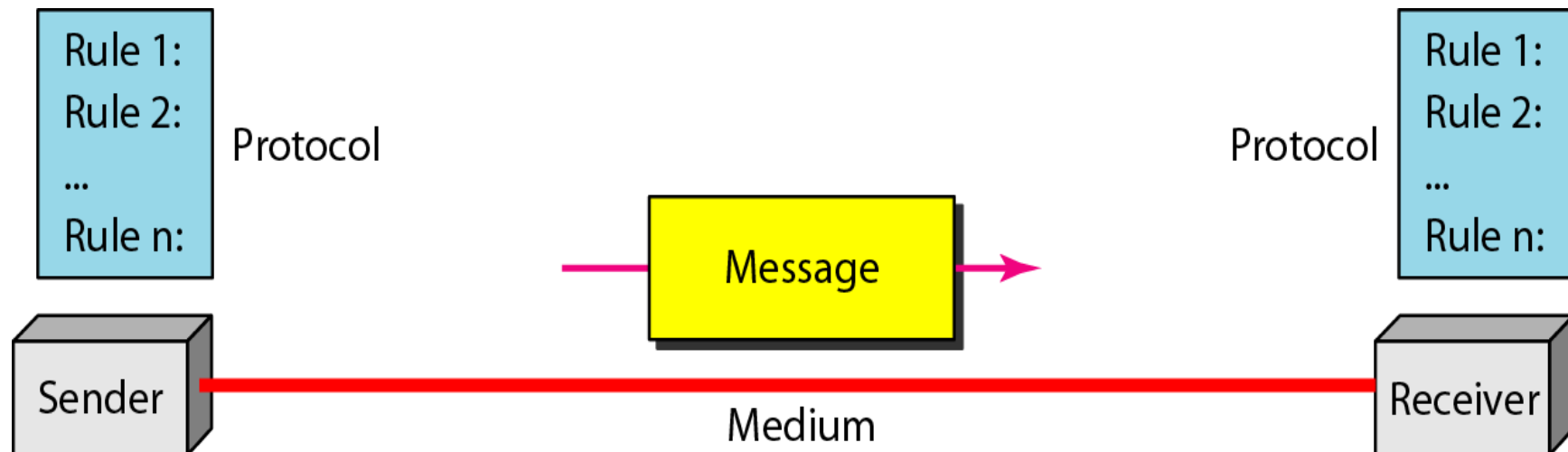
Internetwork

- ❑ 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
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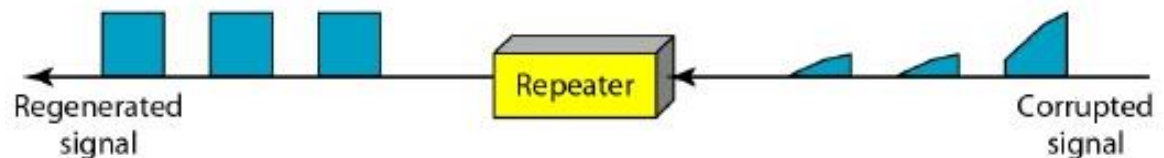
Modem, Repeater

❑ Modem (modulator-demodulator)

- 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

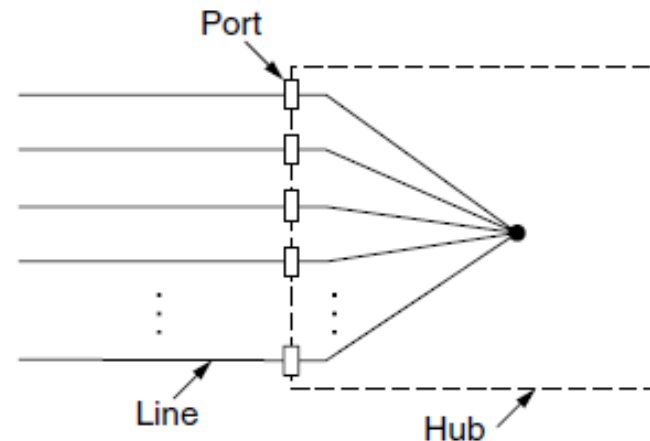
- Electronic device that receives a signal and retransmits it
- Used to extend transmissions so that the signal can cover longer distances



Hub

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

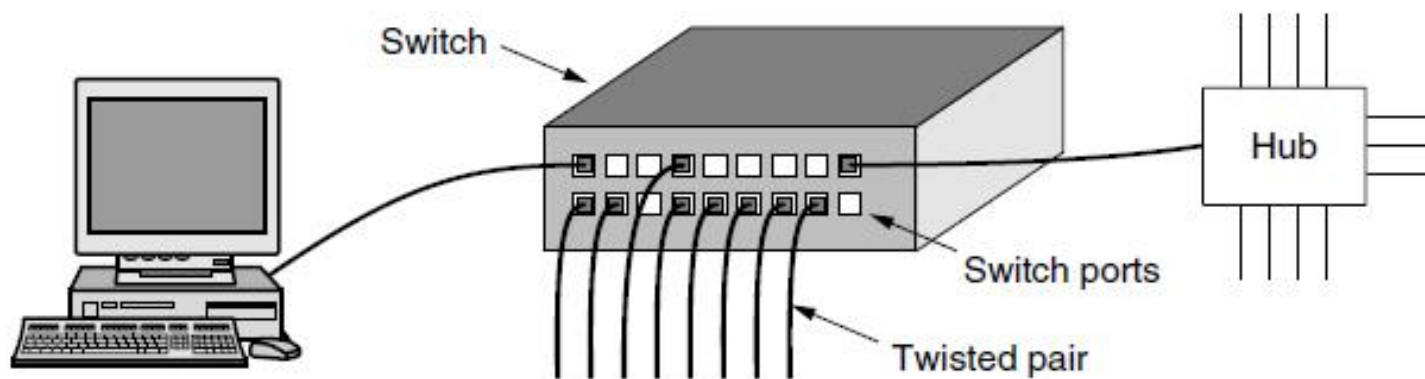
- Network hardware device for connecting multiple Ethernet devices together
- Multiple Information Outlet (I/O) ports, in which a signal introduced at the input of any port appears at the output of every port except the original incoming
- Acts as repeater also



Switch / Bridge

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

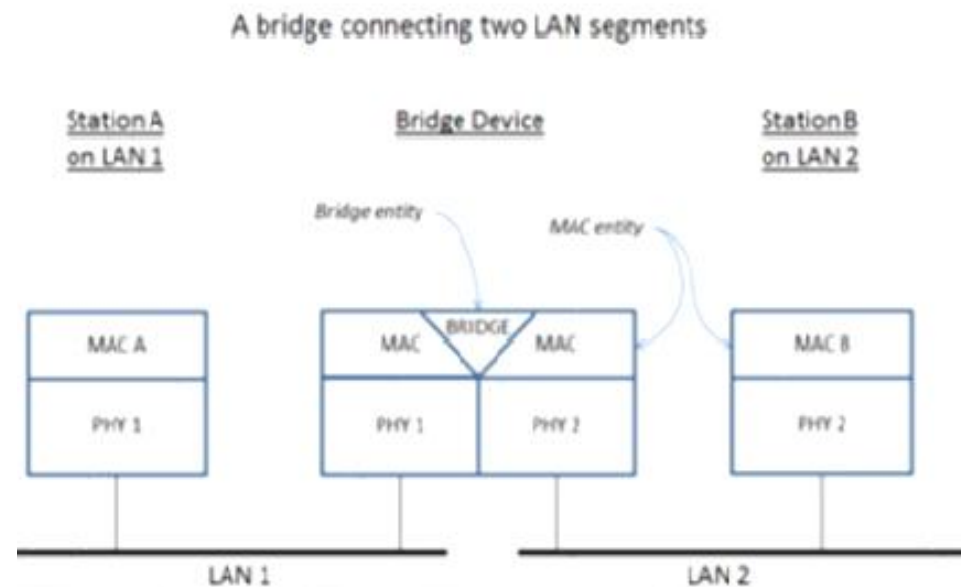
- Unlike *Hub*, it forwards data only to one or multiple devices that need to receive it, rather than broadcasting the same data out of each of its ports
- Process and forward data to the destination device on using hardware addresses (at Layer 2)



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)
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References

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