Computer Networks

BCSE308L

COURSE OUTCOMES

Course Outcomes
On completion of this course, student should be able to: 1. Interpret the different building blocks of Communication network and its architecture. 2. Contrast different types of switching networks and analyze the performance of network 3. Identify and analyze error and flow control mechanisms in data link layer. 4. Design sub-netting and analyze the performance of network layer with various routing protocols. 5. Compare various congestion control mechanisms and identify appropriate transport layer protocol for real time applications with appropriate security mechanism.

Module:1	**Networking Principles and Layered Architecture**	**6 hours**
Data Communications and Networking: A Communications Model – Data Communications - Evolution of network, Requirements , Applications, Network Topology (Line configuration, Data Flow), Protocols and Standards, Network Models (OSI, TCP/IP)		
Module:2	**Circuit and Packet Switching**	**7 hours**
Switched Communications Networks – Circuit Switching – Packet Switching – Comparison of Circuit Switching and Packet Switching – Implementing Network Software, Networking Parameters(Transmission Impairment, Data Rate and Performance)		
Module:3	**Data Link Layer**	**8 hours**
Error Detection and Correction – Hamming Code , CRC, Checksum- Flow control mechanism – Sliding Window Protocol - GoBack - N - Selective Repeat - Multiple access Aloha - Slotted Aloha - CSMA, CSMA/CD – IEEE Standards(IEEE802.3 (Ethernet), IEEE802.11(WLAN))- RFID- Bluetooth Standards		
Module:4	**Network Layer**	**8 hours**
IPV4 Address Space – Notations – Classful Addressing – Classless Addressing – Network Address Translation – IPv6 Address Structure – IPv4 and IPv6 header format		
Module:5	**Routing Protocols**	**6 hours**
Routing-Link State and Distance Vector Routing Protocols- Implementation-Performance Analysis- Packet Tracer		
Module:6	**Transport Layer**	**5 hours**
TCP and UDP-Congestion Control-Effects of Congestion-Traffic Management-TCP Congestion Control-Congestion Avoidance Mechanisms-Queuing Mechanisms-QoS Parameters		
Module:7	**Application layer**	**3 hours**
Application layer-Domain Name System-Case Study : FTP-HTTP-SMTP-SNMP		
Module:8	**Contemporary Issues**	**2 hours**

Text Book	
1.	Behrouz A. Forouzan, Data communication and Networking, 5th Edition, 2017, McGraw Hill Education.
Reference Books	
1.	James F. Kurose and Keith W.Ross, Computer Networking: A Top-Down Approach, 6th Edition, 2017, Pearson Education.
2.	William Stallings, "Data and Computer Communication", 10th Edition, 2017, Pearson, United Kingdom.

Mode of Evaluation: CAT, Written Assignment, Quiz, FAT			
Recommended by Board of Studies	04-03-2022		
Approved by Academic Council	No. 65	Date	17-03-2022

- COMMUNICATION- wired, wireless
- DATA COMMUNICATION-
  - end nodes- PC, printer
  - Intermediate nodes- Switch, internet Cloud, router
- NETWORK- resource sharing
- ARCHITECTURE

Data communication

- 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 such as a wire cable.

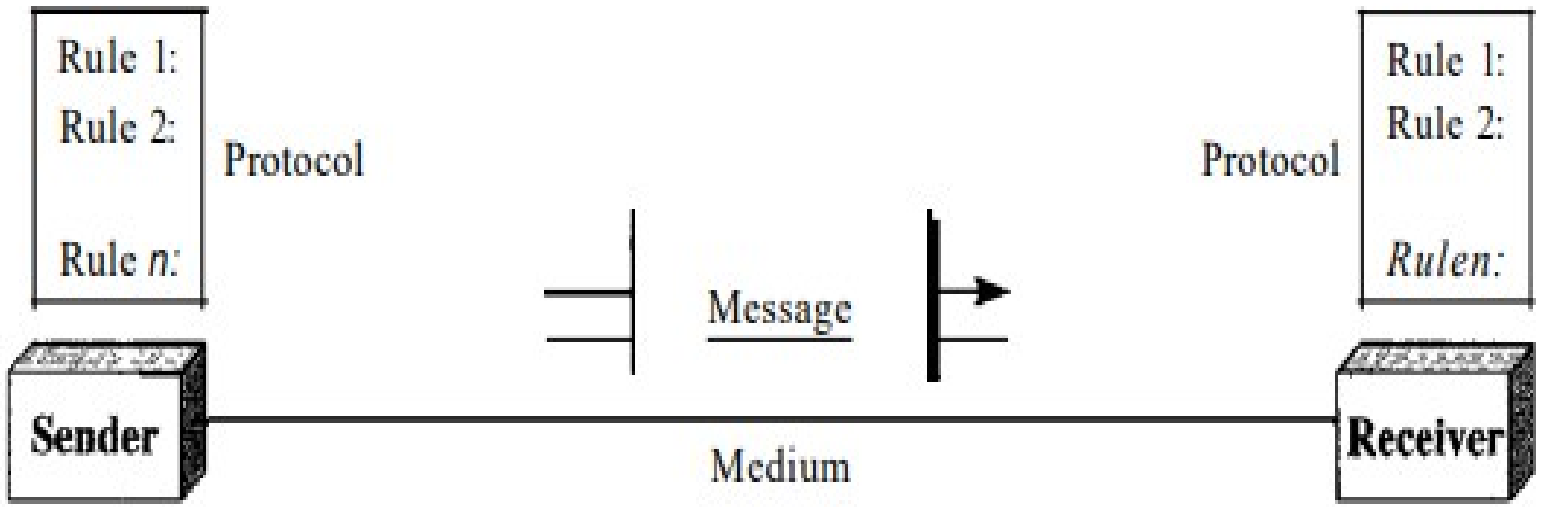
Data communication characteristics

- Delivery
- Accuracy
- Timeliness
- Jitter

Data communication characteristics

1. Delivery. The system must deliver data to the correct destination. Data must be received by the intended device or user and only by that device or user.
2. Accuracy. The system must deliver the data accurately. Data that have been altered in transmission and left uncorrected are unusable.
3. 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.
4. 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 3D ms. If some of the packets arrive with 3D-ms delay and others with 4D-ms delay, an uneven quality in the video is the result.

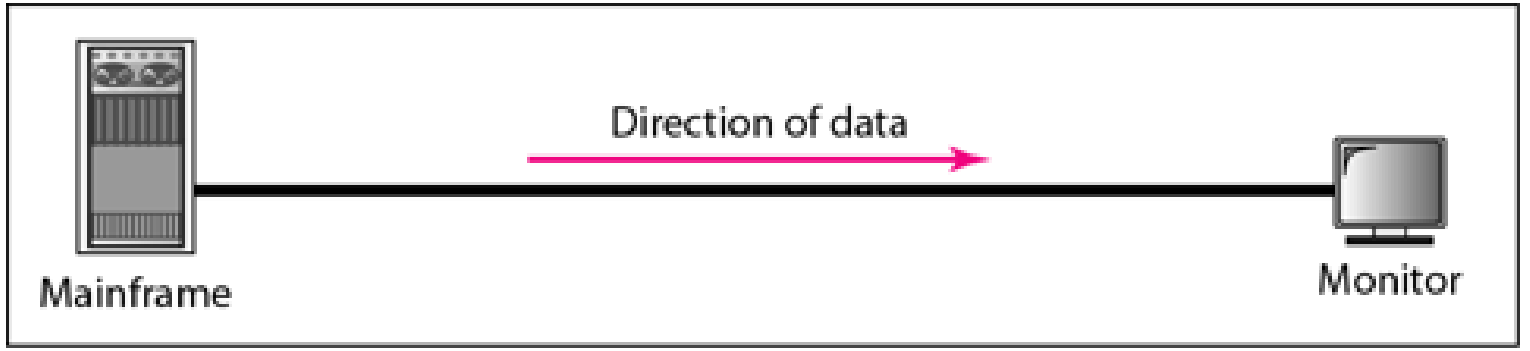
Figure 1.1 *Five components of data communication*



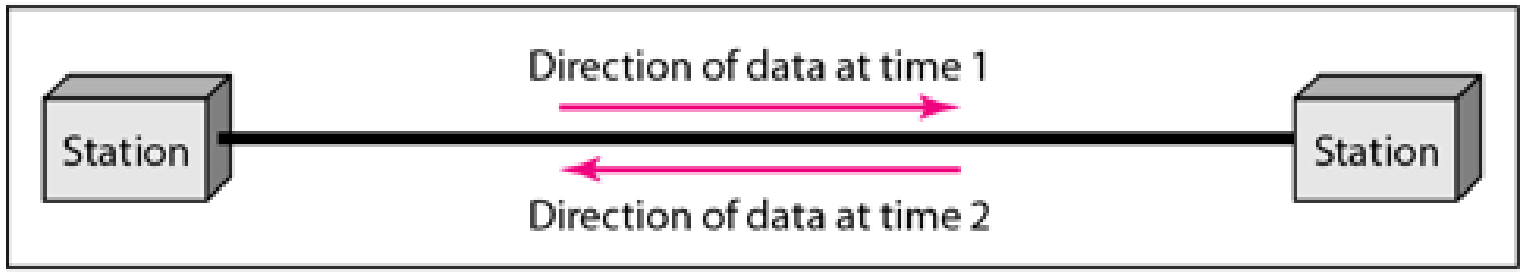
Components

1. Message. The message is the information (data) to be communicated. Popular forms of information include text, numbers, pictures, audio, and video.
2. Sender. The sender is the device that sends the data message. It can be a computer, workstation, telephone handset, video camera, and so on.
3. Receiver. The receiver is the device that receives the message. It can be a computer, workstation, telephone handset, television, and so on.
4. Transmission medium. The transmission medium is the physical path by which a message travels from sender to receiver. Some examples of transmission media include twisted-pair wire, coaxial cable, fiber-optic cable, and radio waves.
5. Protocol. A protocol is a set of rules that govern data communications. It represents an agreement between the communicating devices. Without a protocol, two devices may be connected but not communicating, just as a person speaking French cannot be understood by a person who speaks only Japanese.

Figure 1.2 *Data flow (simplex, half-duplex, and full-duplex)*



a. Simplex



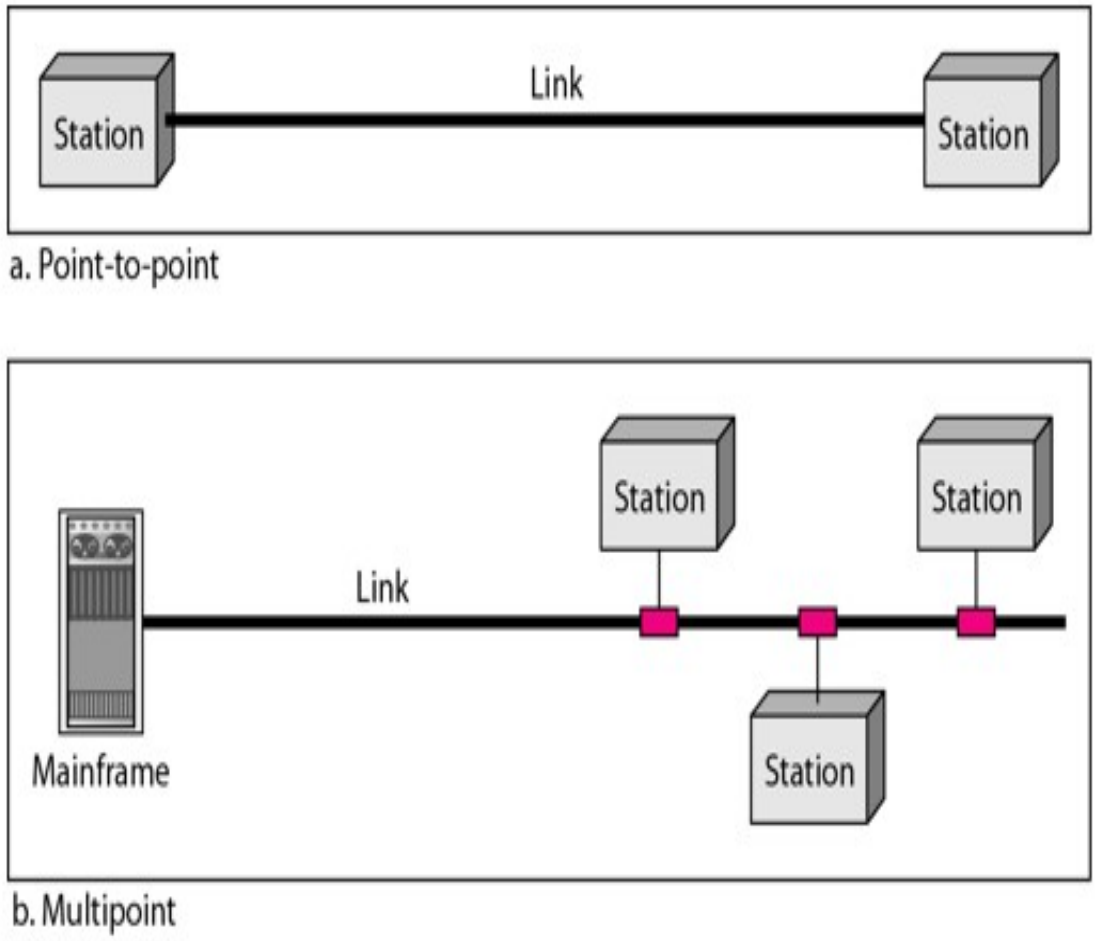
b. Half-duplex

c. Full-duplex

Network

- 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.

Figure 1.3 *Types of connections: point-to-point and multipoint*



Point to Point:

Between two devices.

Entire capacity is reserved between two devices

Multi Point:

Broadcast connection

Two or more share a single link

Capacity is shared

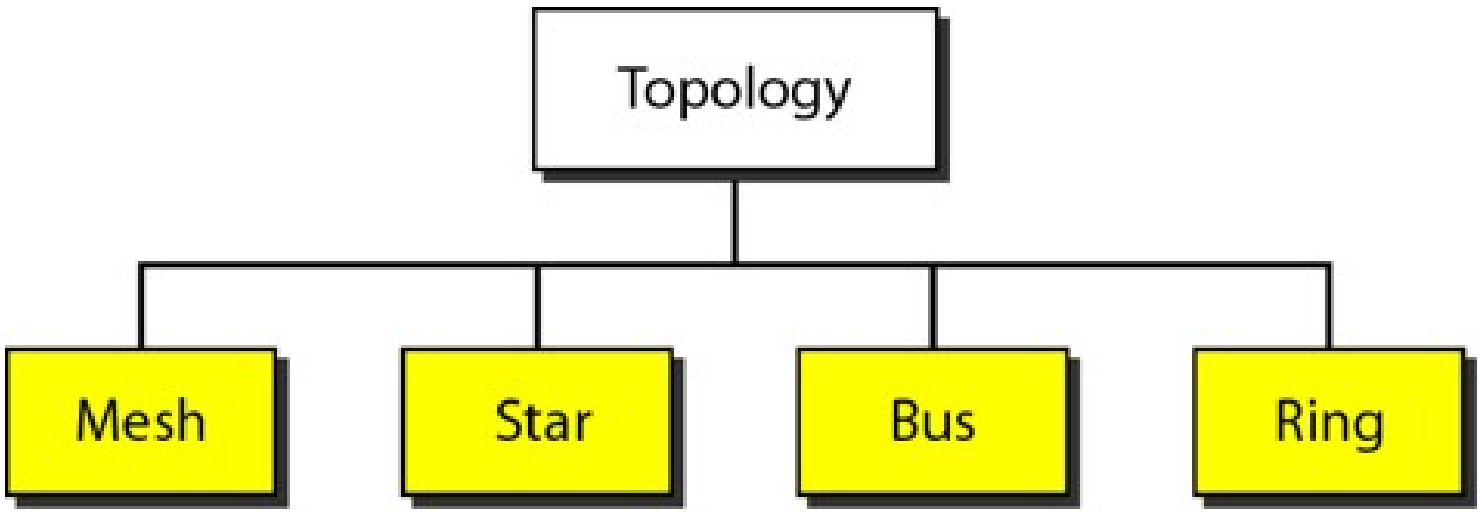
Spatial(link shared simultaneously)

Temporal(shared on turn basis)

Networking Protocols

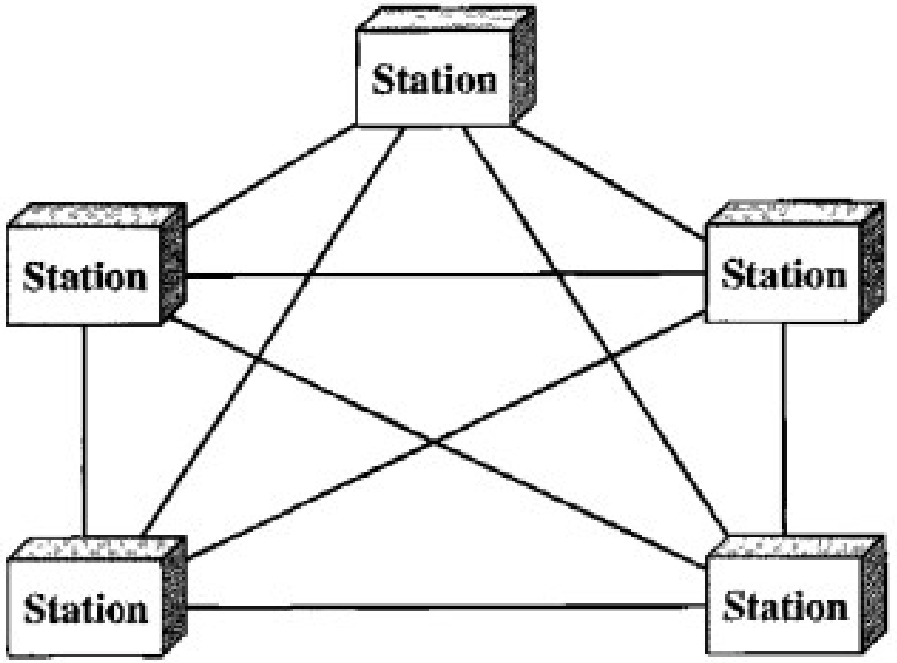
- Message encoded(Signal conversion)
- Message transmitted(Channel)
- Message received(unicast, multicast, broadcast)
- Peer- Peer network(one to one)
- Client- Server network(server to client)

Figure 1.4 *Categories of topology*



Mesh Topology

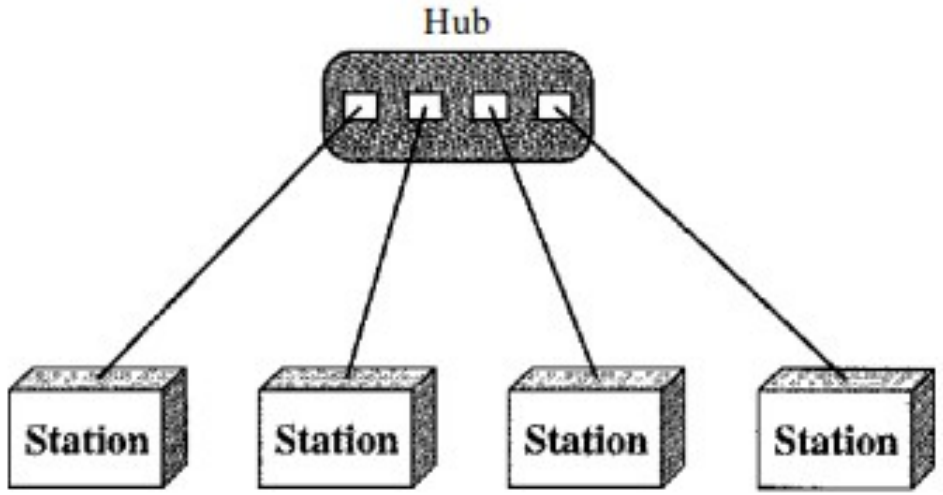
Figure 1.5 *A fully connected mesh topology (five devices)*



No of links = n(n-1)/2

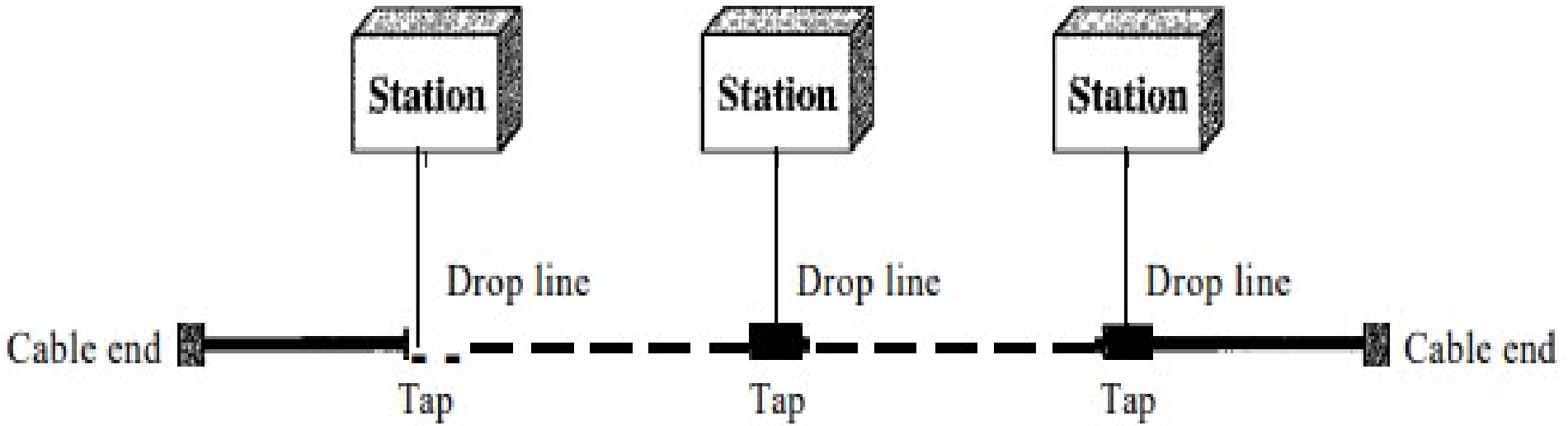
Star topology

Figure 1.6 *A star topology connecting four stations*



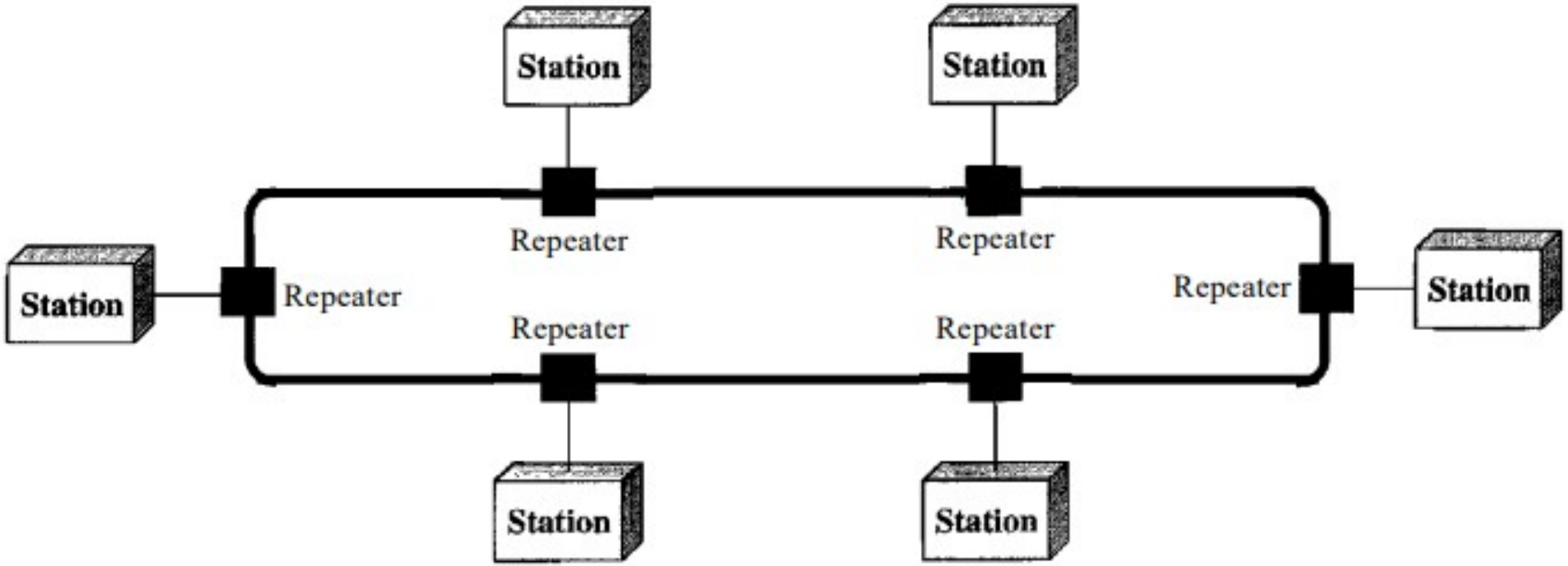
Bus topology

Figure 1.7 *A bus topology connecting three stations*



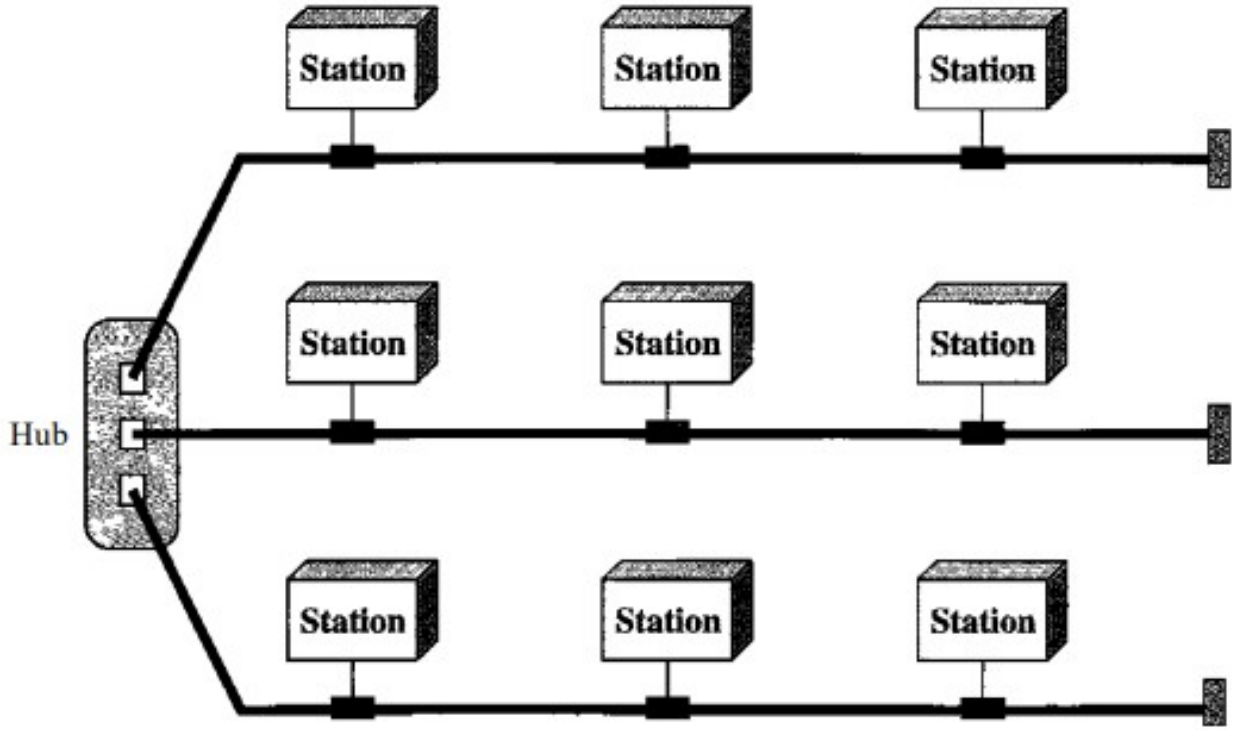
Ring topology

Figure 1.8 *A ring topology connecting six stations*



Hybrid Topology

Figure 1.9 A *hybrid topology: a star backbone with three bus networks*



Components of computer network

- Nodes(End nodes-computers, printers, cameras. Intermediate node-Switches, Hub, Routers)
- Media(Medium of transmission-Wired, Wireless)
- Services(Gaming ,e-mail, google drive(storage), file sharing, instant communication, World wide web)

Wired medium

- Ethernet Straight through cable-(Connection btw two different nodes)
- Ethernet crossover cable-(connections between same kind of nodes)
- FOC(Fiber Optic cable)
- Coaxial Cable
- USB cable

Wireless medium

- Infra red(Tv remote)
- Radio waves(Bluetooth, WiFi)
- Microwaves (Cellullar Systems)
- Satellite (GPS)

Classification of computer networks

- Local Area Network(LAN)-(limited area)
  - Wired LAN(Ethernet-Hub, Switch)
  - Wireless LAN(Wi-Fi)
- Metropolitan Area Network(MAN)(connects network geographically in small range, btw two LAN)
- Wide Area Network(WAN)- connects wide goegraphical area-telecommunication network
- Internet (wide WAN)

IPv4, IPv6, MAC

- IP address(ipconfig)
  - Location based
  - 4 octets(32 bits- decimal)
  - 0.0.0.0 to 255.255.255.255
  - Manual or dynamic

MAC ADDRESS(ipconfig/all)

- Name of the device
- Physical address
- Not on locality
- UNIQUE
- 48 bits(- . :)
  hexadecimal

Port address port number

- Identify the process(resmon-resource monitoring)
- Communicate the end point
- Assigned by OS
- 0-65535