



Computer Networking(CN)

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SIT Bhubaneswar

Syllabus

Detailed Syllabus:

Module#	CO	Topics	Hours
Module-1	CO1	Introduction: Overview of Data Communication Networks, Protocols and standards, OSI Reference model, TCP/IP Protocol; Physical Layer: Analog Signals, Digital Signals, Data Rate Limits, Transmission Impairment, Transmission Modes; Digital Transmission: Digital-to-Digital & Analog-to-Digital conversion; Analog Transmission: Digitalto-Analog & Analog-to-Analog conversion; Multiplexing: FDM, TDM; Transmission Media: Guided Media, Unguided media; Switching: Circuit Switched, Datagram, and Virtual-Circuit Networks.	12
Module-2	CO2	Error Detection & Correction: Types of Errors, Error Detection mechanisms (Linear codes, Hamming codes, CRC, Checksum); Data Link Control and Protocols: Flow and Error Control, Stop-and-Wait ARQ, Go-Back-N ARQ, Selective Repeat ARQ; Introduction to HDLC and Point-to-Point Protocol; Multiple Access Mechanisms: Random Access - ALOHA, CSMA, CSMA/CD, CSMA/CA; Controlled Access: Polling, Reservation, Token Passing; Channelization: FDMA, TDMA, CDMA; Wired LANs (Ethernet): Traditional, Fast, and Gigabit Ethernet.	12
Module-3	CO3	Wireless LANs: IEEE 802.11 Standards and Bluetooth; Connecting Devices: Hubs, Repeaters, Bridges, Switches, Routers, Gateway; Network Layer: IPV4 & IPV6 addresses, Subnets; Internet Protocol: Internetworking, IPV4 & IPV6 datagram format.	12
Module-4	CO4	Network Layer Protocols: ARP, RARP, ICMP; Routing: Unicast and Multicast Routing Protocols; Transport Layer: Process to Process Delivery, User Datagram Protocol (UDP) and Transmission Control Protocol (TCP), TCP and UDP segments and Flow Control.	12
Module-5	CO5	Domain Name System (DNS): Name Space, Domain Name Space, DNS in Internet, Resolution and Dynamic Domain Name System (DDNS); Electronic Mail (SMTP) and File transfer Protocol (FTP); World Wide Web (WWW): Architecture & Web document, HTTP: Persistent and Nonpersistent Connection.	8
		Total	56 Hours

Text Books:

- 1. Data Communications and Networking: Behrouz A. **Forouzan**, Tata McGraw-Hill, 4th Ed
- 3. Computer Networks: A. S. **Tannenbum**, D. Wetherall, Prentice Hall, Imprint of Pearson 5th Ed

Reference Book :

- 1. Computer Networks:A system Approach:Larry L, Peterson and Bruce S. Davie,Elsevier, 4th Ed
- 2. Computer Networks: Natalia Olifer, Victor Olifer, Willey India
- 3. Data and Computer Communications: William Stallings, Prentice Hall, Imprint of Pearson, 9th Ed.
- 4. Data communication & Computer Networks: Gupta, Prentice Hall of India
- 5. Network for Computer Scientists & Engineers: Zheng, Oxford University Press
- 6. Data Communications and Networking: White, Cengage Learning

1-1 DATA COMMUNICATIONS

Telecommunication:

- **Telecommunication** means communication at a distance.

Data:

- **Data** refers to information presented in whatever form is agreed upon by the parties creating and using the data.

Data Communication:

- **Data communications** are the exchange of data between two devices via some form of transmission medium such as a wire cable.

Network

- A **network** can be defined as a group of computers and other devices connected in some ways so as to be able to exchange data.

Components of Network

- Sender
- Receiver
- Message
- Communication medium
- Protocols(set of rules used for data communication in a network)

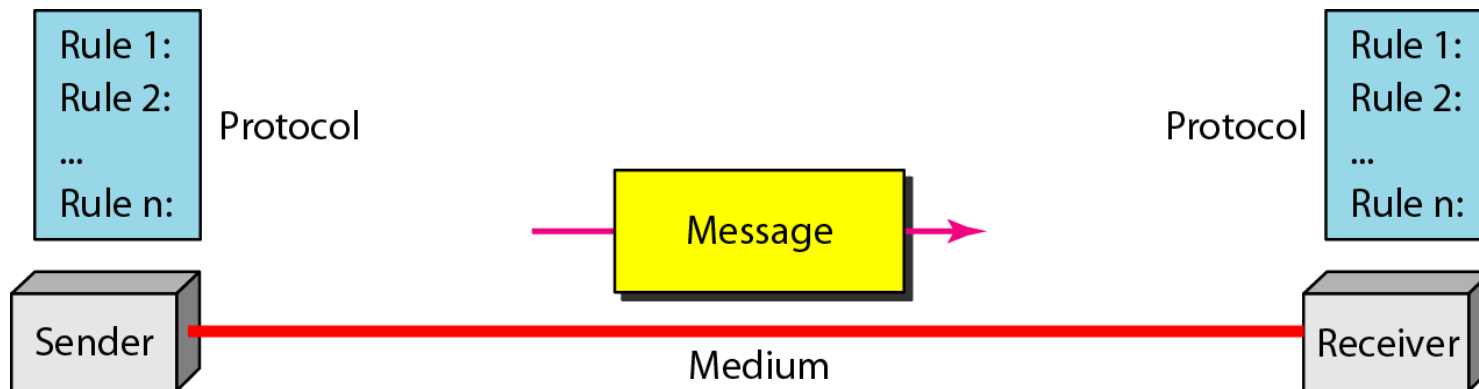


Figure 1.1 *Five components of data communication*

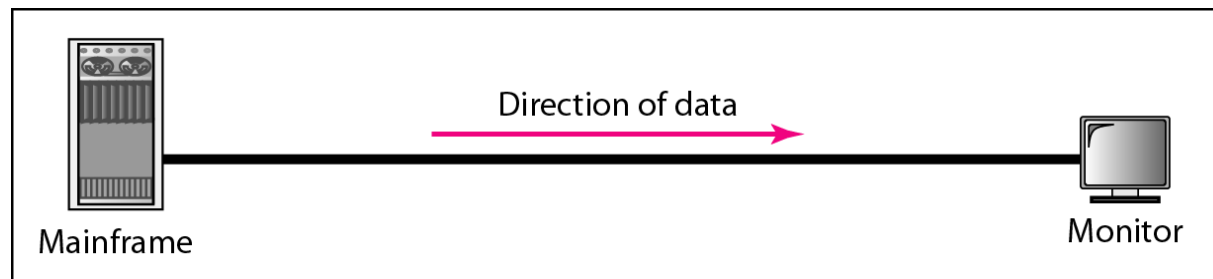
Data Représentation

- Text: Bit patterns (sequence of 0 and 1).
ASCII code used
- Numbers: Represented in bit patterns
- Images: Represented in bit patterns
- Audio: Sound or music (Continuous signal)
- Video: Picture of movie (Combination of continuous and discrete entity)

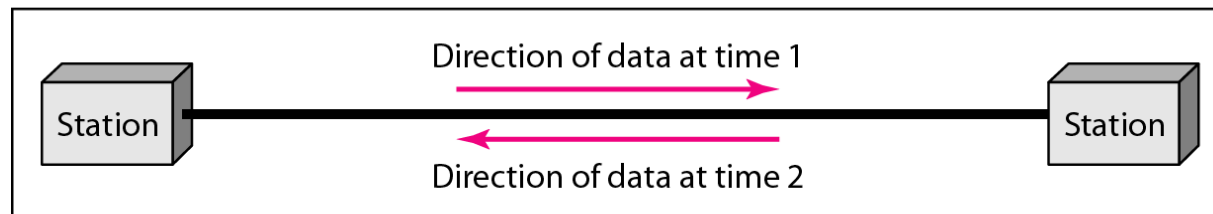
Data flow

(Transfer of data/information)

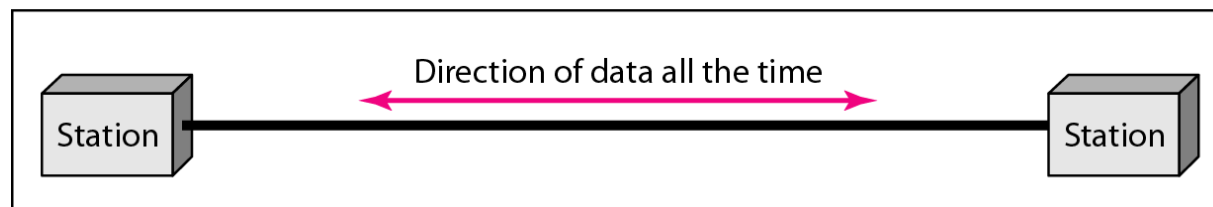
(simplex, half-duplex, and full-duplex)



a. Simplex



b. Half-duplex



c. Full-duplex

1-2 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.

❑ Each node in the network has a unique address.

Example: 142.250.182.174

www.google.com

Network Criteria

- Performance
 - ✓ Transit time
 - ✓ Response time
 - ✓ Throughput
 - ✓ Delay
- Reliability: Frequency of failure and time to recover from it
- Security :Authentication, Authorization and Integrity

Distributed Processing

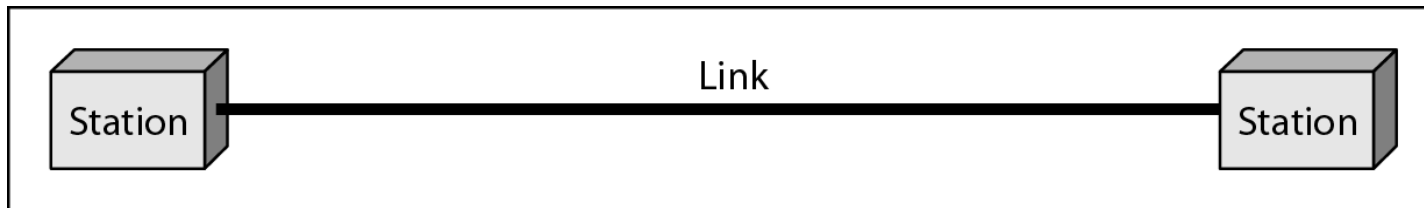
- Task divided among multiple computers

Physical Structure of Network

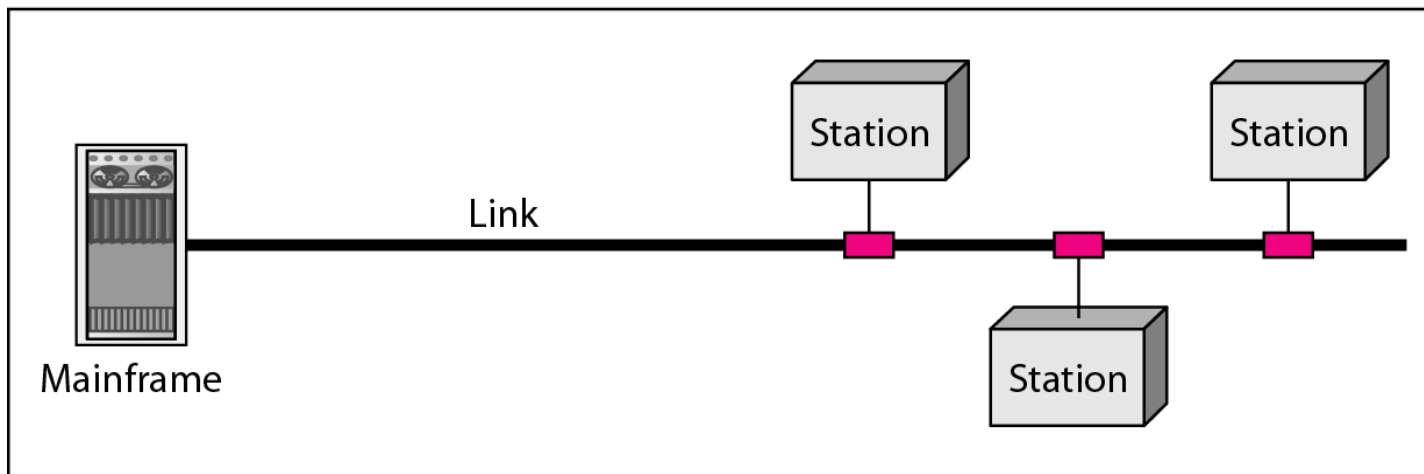
■ Types of Connection

- **Point to Point:** Link shared dedicatedly between two devices.
- **Multipoint:** Link shared among multiple devices.

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



a. Point-to-point



b. Multipoint

Physical Topology

- Topology defines the arrangement/structure of the network comprising of nodes.
- Defines how all the components are interconnected to each other

Types

- Physical topology: Defines how nodes are actually interconnected with wires and cables
- Logical topology: How they appear.

Figure 1.4 *Categories of topology*

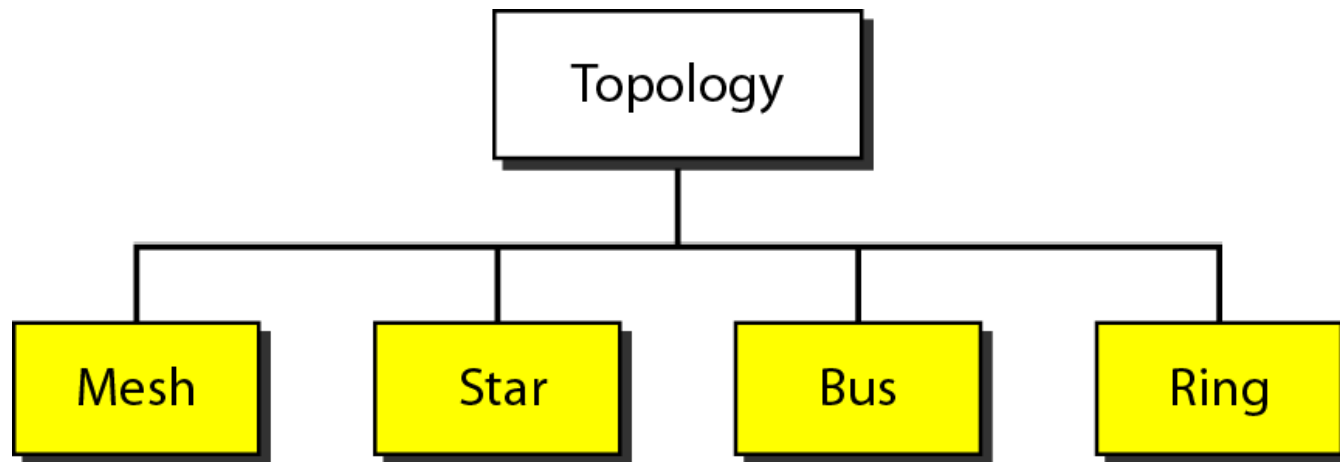
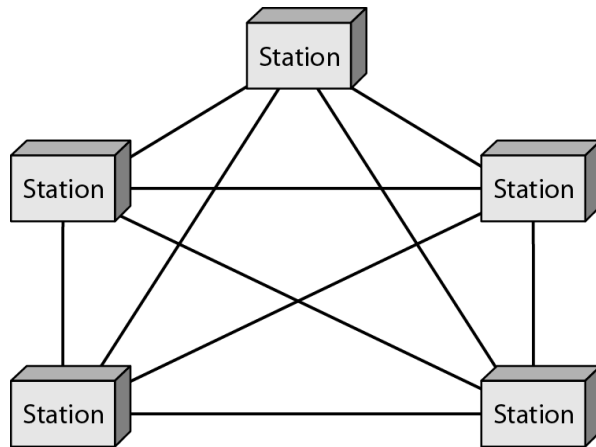


Figure 1.5 *A fully connected mesh topology (five devices)*



- ✓ In a mesh topology, every device is connected to another device via a particular channel.
- ✓ Total number of dedicated links required to connect N devices in a mesh topology is ${}^N C_2$ i.e. $N(N-1)/2$.

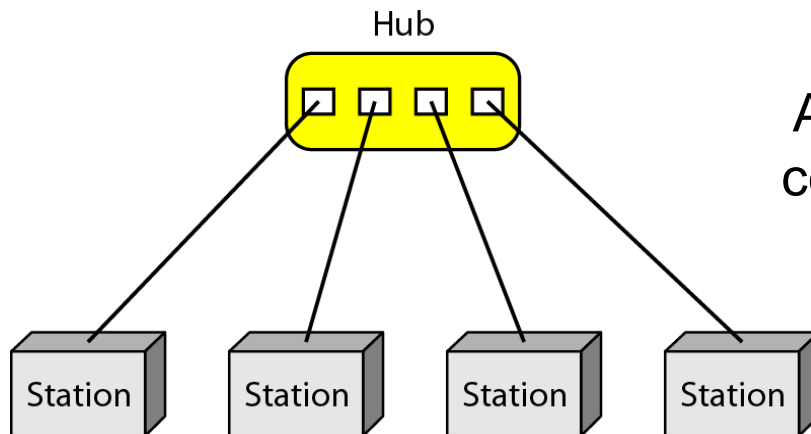
Advantages of this topology

- ✓ It is robust.
- ✓ The fault is diagnosed easily. Data is reliable because data is transferred among the devices through dedicated channels or links.
- ✓ Provides security and privacy.

Disadvantages this topology

- ✓ Installation and configuration are difficult.
- ✓ The cost of cables is high as bulk wiring is required, hence suitable for less number of devices.
- ✓ The cost of maintenance is high.

Figure 1.6 *A star topology connecting four stations*



All the devices are connected to a central hub

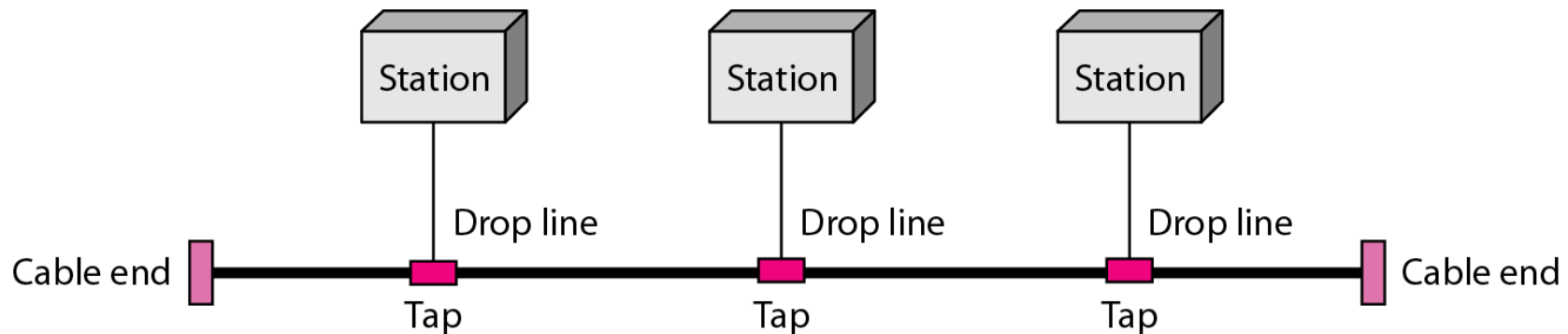
Advantages

- ✓ If N devices are connected to each other in a star topology, then the number of cables required to connect them is N .
- ✓ It is easy to set up.
- ✓ Each device requires only 1 port i.e. to connect to the hub, therefore the total number of ports required is N .

Disadvantages

- ✓ If the hub on which the whole topology relies fails, the whole system will crash down.
- ✓ The cost of installation is high.
- ✓ Performance is based on the hub.

Figure 1.7 *A bus topology connecting three stations*



The nodes/stations are connected to the shared backbone channel via drop lines

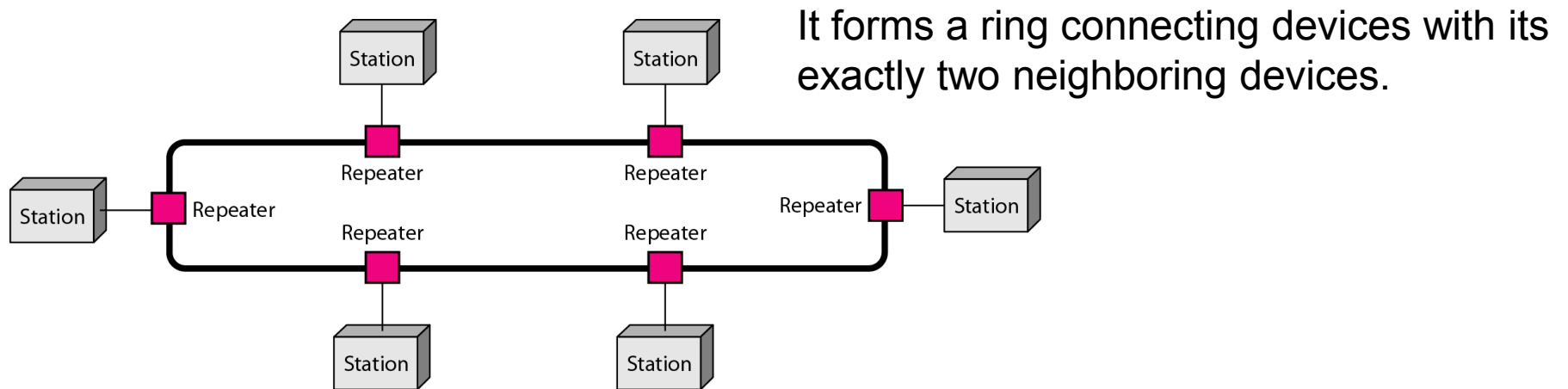
Advantages:

- ✓ If N devices are connected, then the number of cables required to connect them is 1, which is known as backbone cable, and N drop lines are required.
- ✓ The cost is less as compared to other topologies,
- ✓ It is used to build small networks.

Disadvantages:

- ✓ If the common cable fails, then the whole system will crash down.
- ✓ If the network traffic is heavy, it increases collisions in the network.
- ✓ Security is very low.

Figure 1.8 *A ring topology connecting six stations*



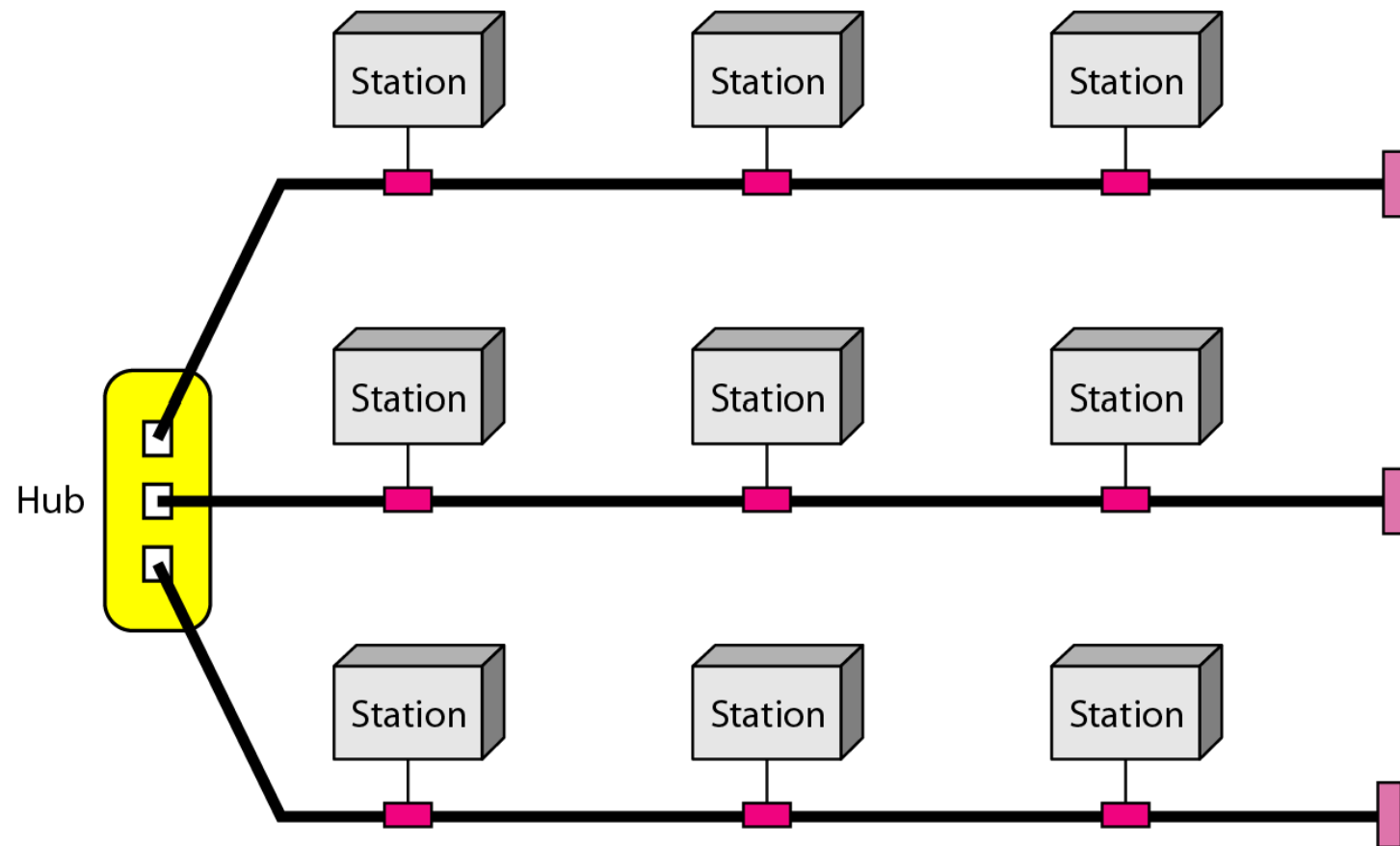
Advantages

- ✓The possibility of collision is minimum in this type of topology.
- ✓Cheap to install and expand.

Disadvantages

- ✓Troubleshooting is difficult in this topology.
- ✓The addition of stations in between or removal of stations can disturb the whole topology.
- ✓Less secure.

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



Network Models

- OSI(Open Systems Interconnection): Seven Layers
- Internet Model(TCP/IP): Five Layers

Categories of Networks

■ **PAN(Personal Area Network):**

- Smallest network which is very personal to a user.
- 1-10m range
- This may include Bluetooth enabled devices or infra-red enabled devices.
- PAN may include wireless computer keyboard and mouse, Bluetooth enabled headphones, wireless printers and TV remotes.

■ **LAN(Local Area Network):**

- A LAN is a data communication system within a building, plant, or campus, or between nearby buildings.
- 10m-1km range
- LAN uses either Ethernet or Token-ring technology.
- Ethernet is most widely employed LAN technology and uses Star topology, while Token-ring is rarely seen.
- LAN can be wired, wireless, or in both forms at once.

- **MAN(Metropolitan Network):**

- A MAN is a data communication system covering an area the size of a town or city.
- 10-100km
- It can be in the form of Ethernet ,Token-ring, ATM, or Fiber Distributed Data Interface (FDDI).

- **WAN(Wide Area Network):**

- A WAN is a data communication system spanning states, countries, or the whole world.
- Types of WAN: Point to Point WAN and Switched WAN

Types of WAN

- Switched WAN: Uses router and switches to connect two or more networks(LAN,MAN,WAN) and end systems
- Point to Point WAN: Uses leased line from telephone line or cable TV provider that connects home computer or small LAN to ISP

Figure 1.10 *An isolated LAN connecting 12 computers to a hub in a closet*

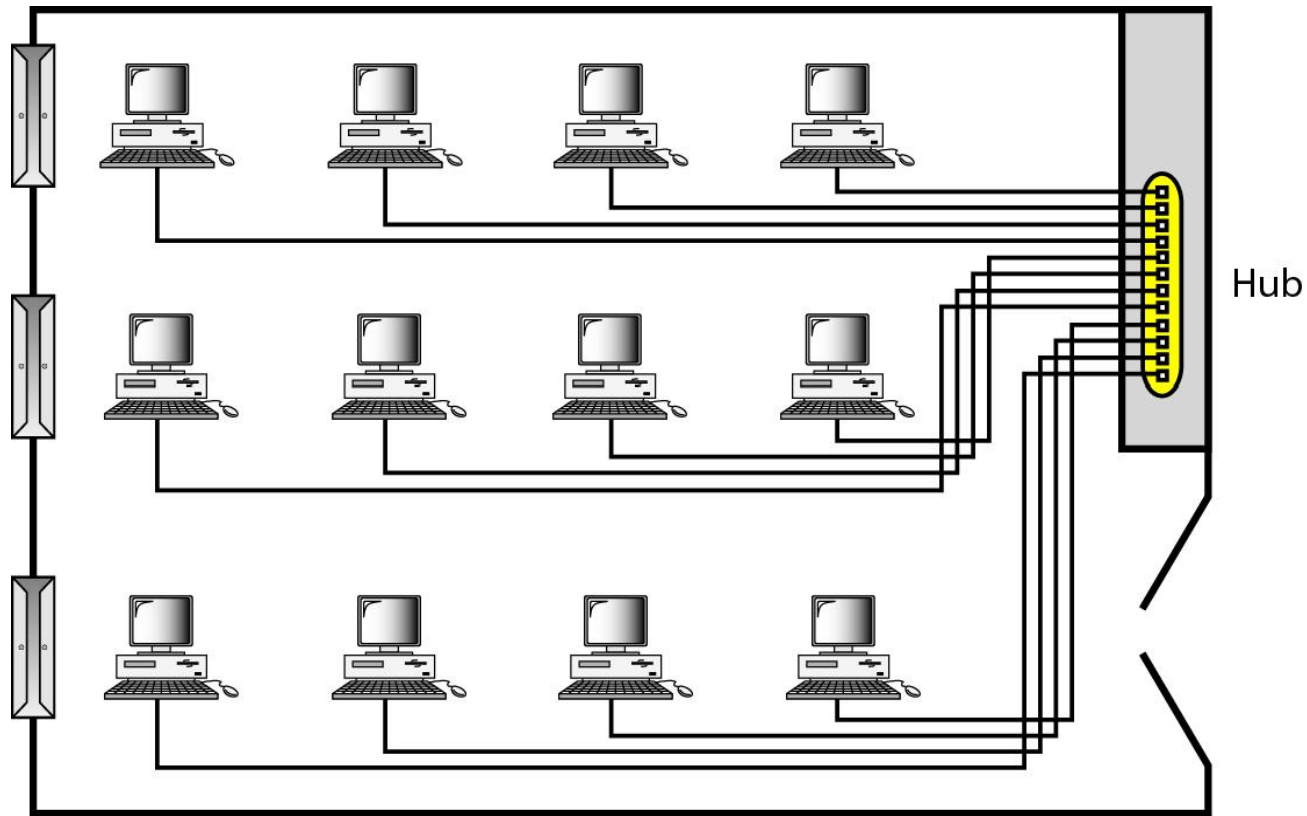
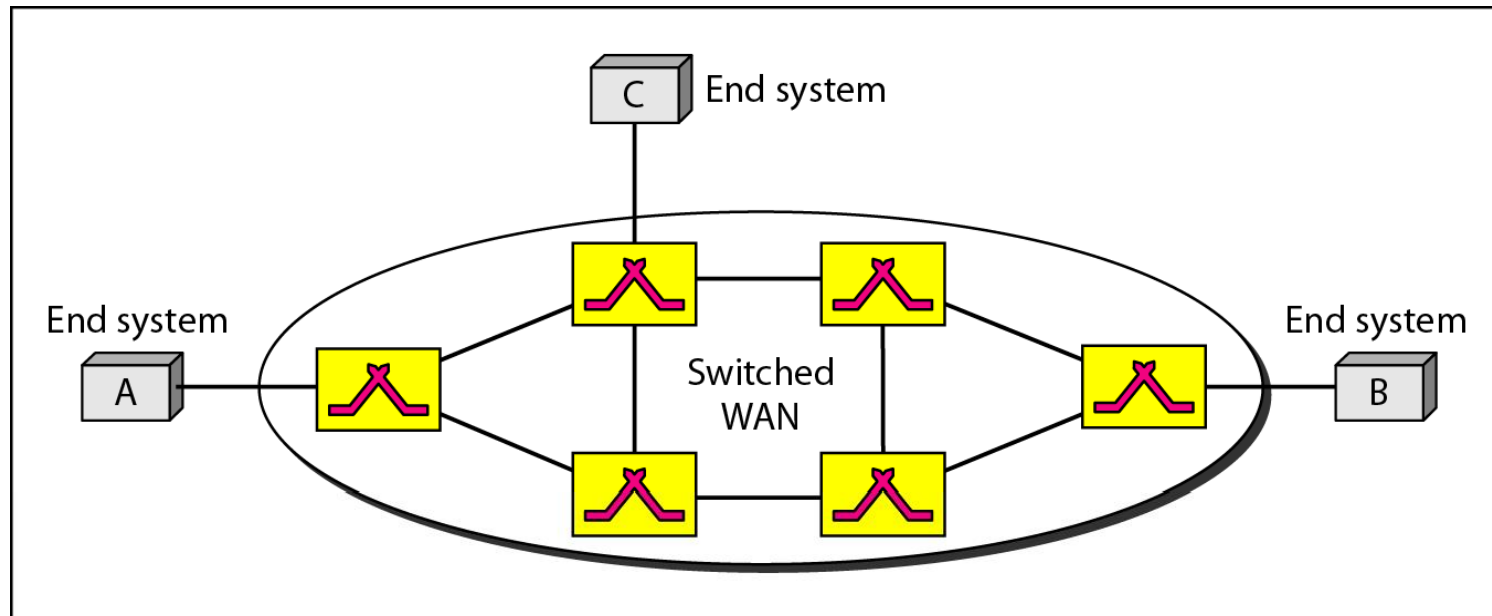
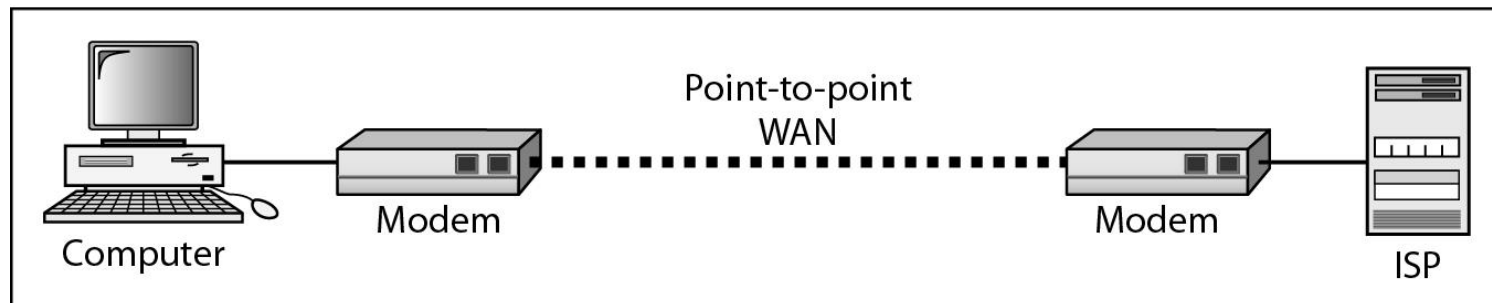


Figure 1.11 *WANs: a switched WAN and a point-to-point WAN*

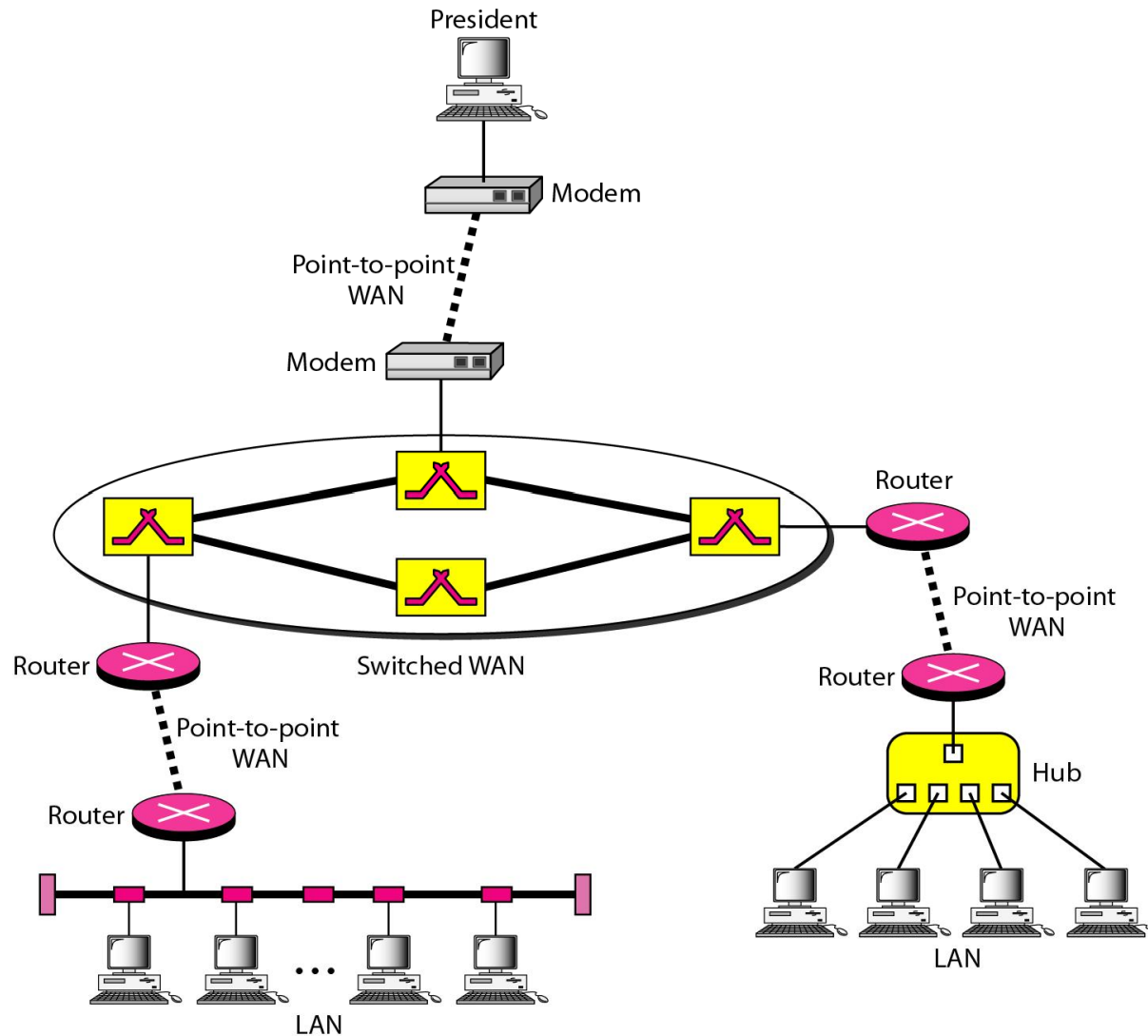


a. Switched WAN



b. Point-to-point WAN

Figure 1.12 *A heterogeneous network made of four WANs and two LANs*



1-3 THE INTERNET

- An internet is a network of networks.
The Internet is a collection of many separate networks.
- TCP/IP is the protocol suite for the Internet.
- The Internet has revolutionized many aspects of our daily lives.
- It has affected the way we do business as well as the way we spend our leisure time.
- The Internet is a communication system that has brought a wealth of information to our fingertips and organized it for our use.

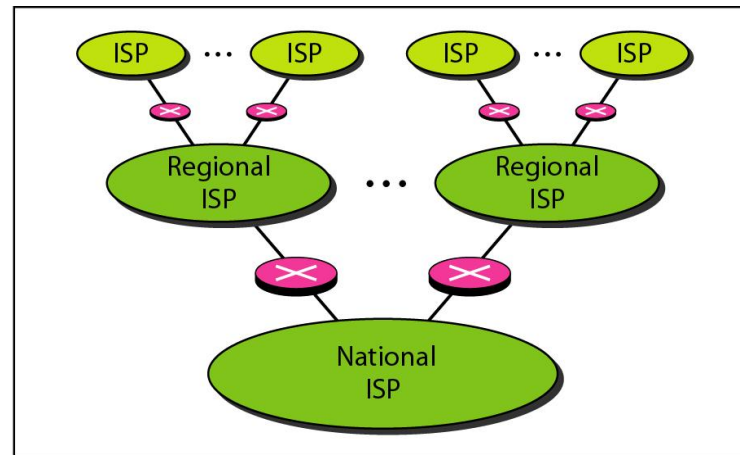
Internet service providers (ISPs)

Organization that provides services accessing and using the Internet.

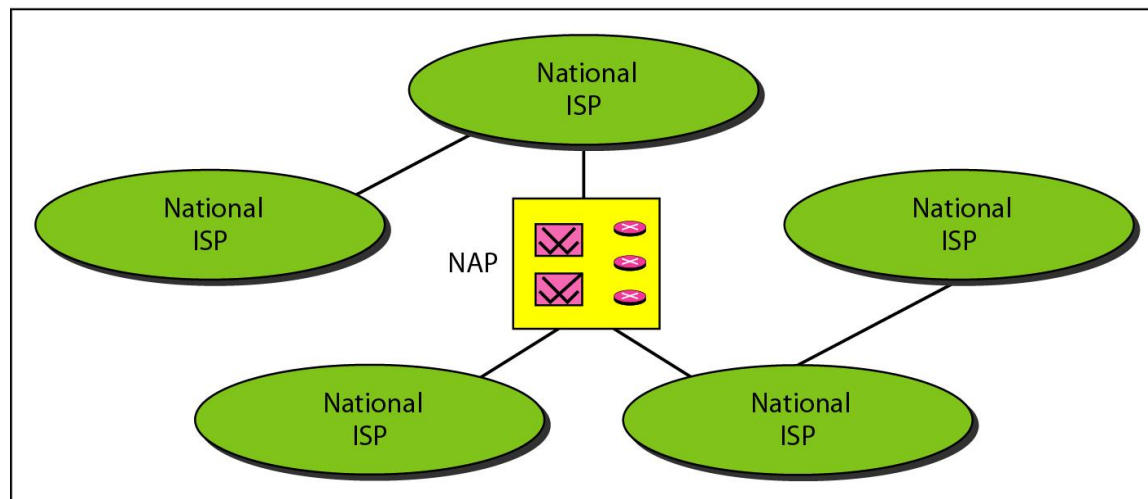
Types

- Local (ISPs)
- Regional (ISPs)
- National (ISPs)
- International (ISPs)

Figure 1.13 *Hierarchical organization of the Internet*



a. Structure of a national ISP



b. Interconnection of national ISPs

Protocol

- A protocol is a set of rules that governs data communication; the key elements of a protocol are syntax, semantics, and timing.

Examples

http,tcp,ftp

Standards

- Standards are necessary to ensure that products from different manufacturers can work together as expected.
 - Defacto: By Fact
 - Dejure: By Law

Standards Organizations

- The ISO, ITU-T, ANSI, IEEE, and EIA are some of the organizations involved in standards creation.
- Regulatory Agencies: Govt agencies such as FCC(Federal Communications Commision) in US

Internet Standards

- Internet Draft(Working Documents)
- RFC(Request For Comment): A number assigned to the draft and made available for stake holders.