Data Communications and Networking Fourth Edition

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Chapter 1

Introduction

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1-1 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 such as a wire cable.

Fundamental Characteristics:

Delivery, Accuracy, Timeliness, Jitter

Topics discussed in this section:

Components (Message, Sender, Receiver, Transmission Medium, Protocol).

Data Représentation (Text, Number, Images, Audio, Video)

Data Flow (Simplex, Duplex, Half Duplex)

Components

1. **Message.** The **message** is the information (data) to be communicated. Popular forms of information include text, numbers, pictures, audio, and video.

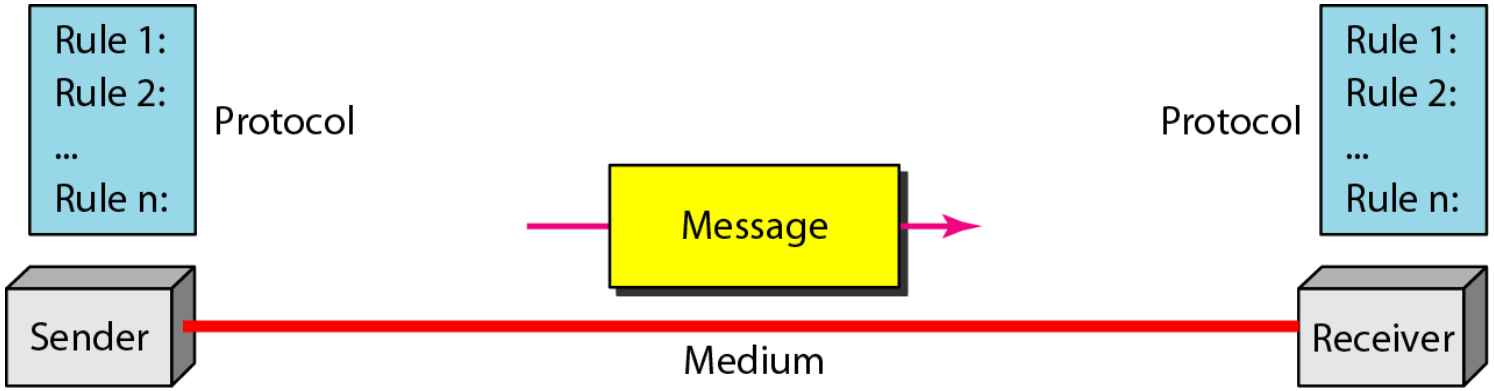
2. **Sender.** The **sender** is the device that sends the data message. It can be a computer, workstation, telephone handset, video camera, and so on.

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 1.1 *Five components of data communication*



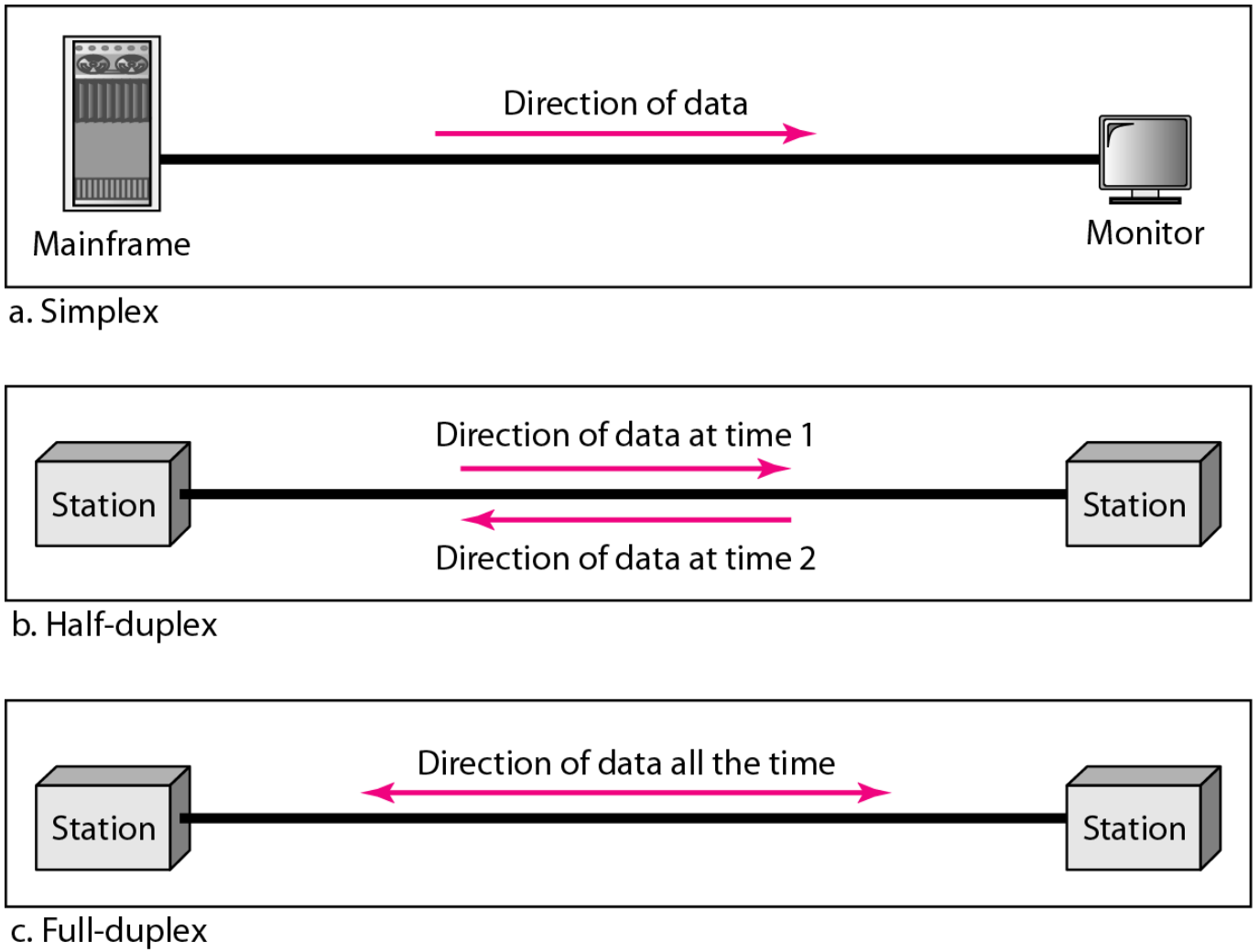
Data Representation

- Text (Unicode, American Standard Code for Information Interchange (ASCII))
- Numbers
- Images (Divided into pixel with size in bit patterns, has color scheme of RGB- *r*ed, *g*reen, and *b*lue or YCM- *y*ellow, *c*yan, and *m*agenta.
- Audio
- Video

Data Flow

- Simplex
- Duplex
  - Half Duplex
  - Full Duplex

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

Topics discussed in this section:

Distributed Processing
Network Criteria (performance, reliability, security)
Physical Structures (Type of Connection: Multipoint, Point to Point. Topology: Mesh, Star, Bus, Ring, Hybrid)
Network Models (OSI, TCP/IP)
Categories of Networks (PAN, LAN, MAN, WAN)
Interconnection of Networks: Internetwork

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

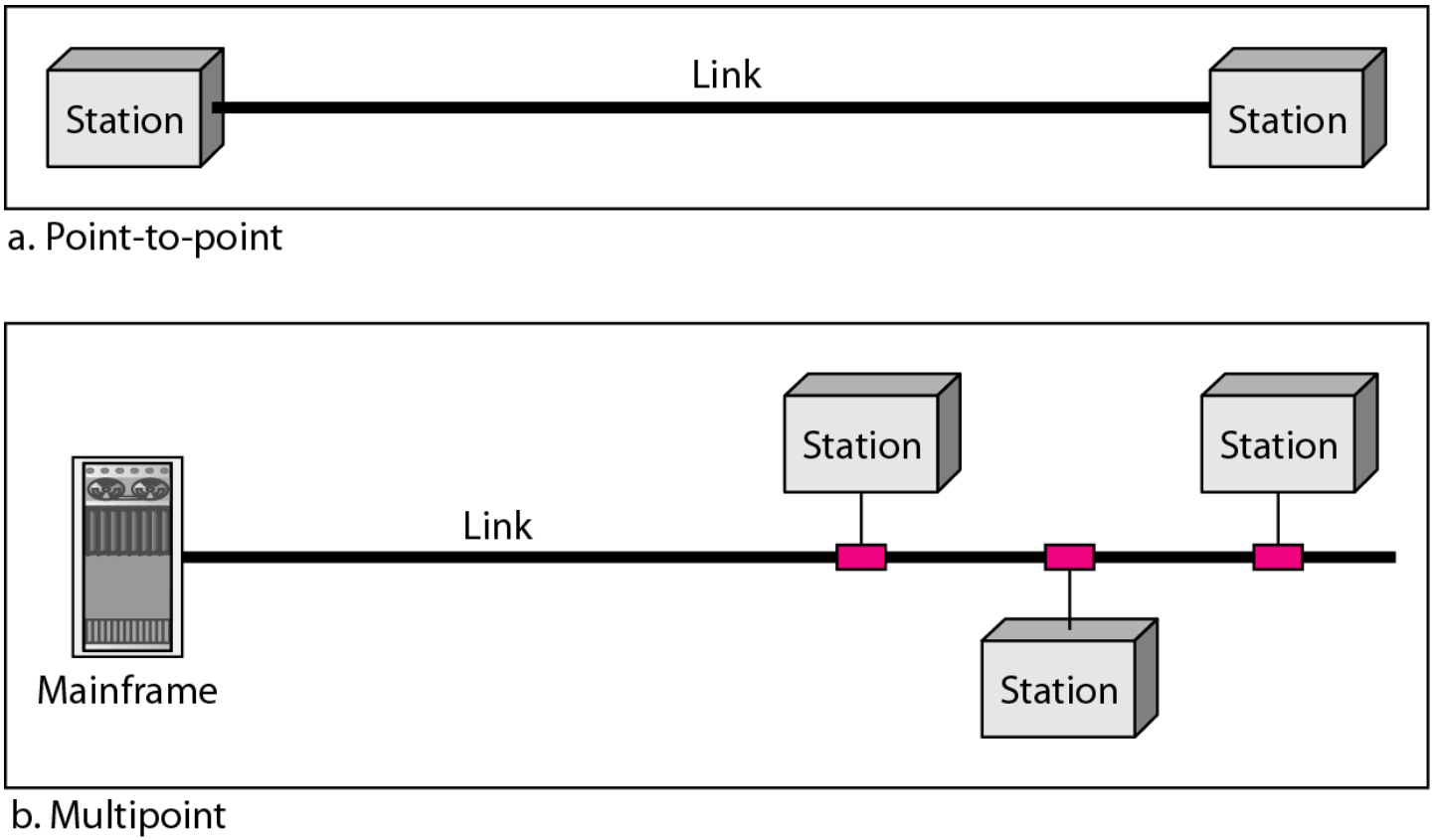
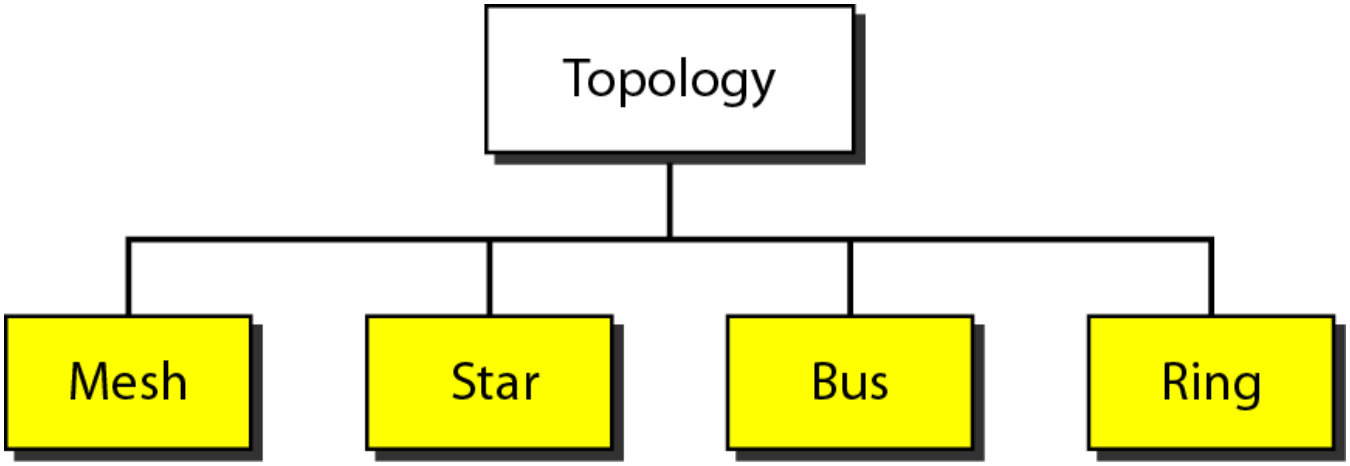


Figure 1.4 *Categories of topology*



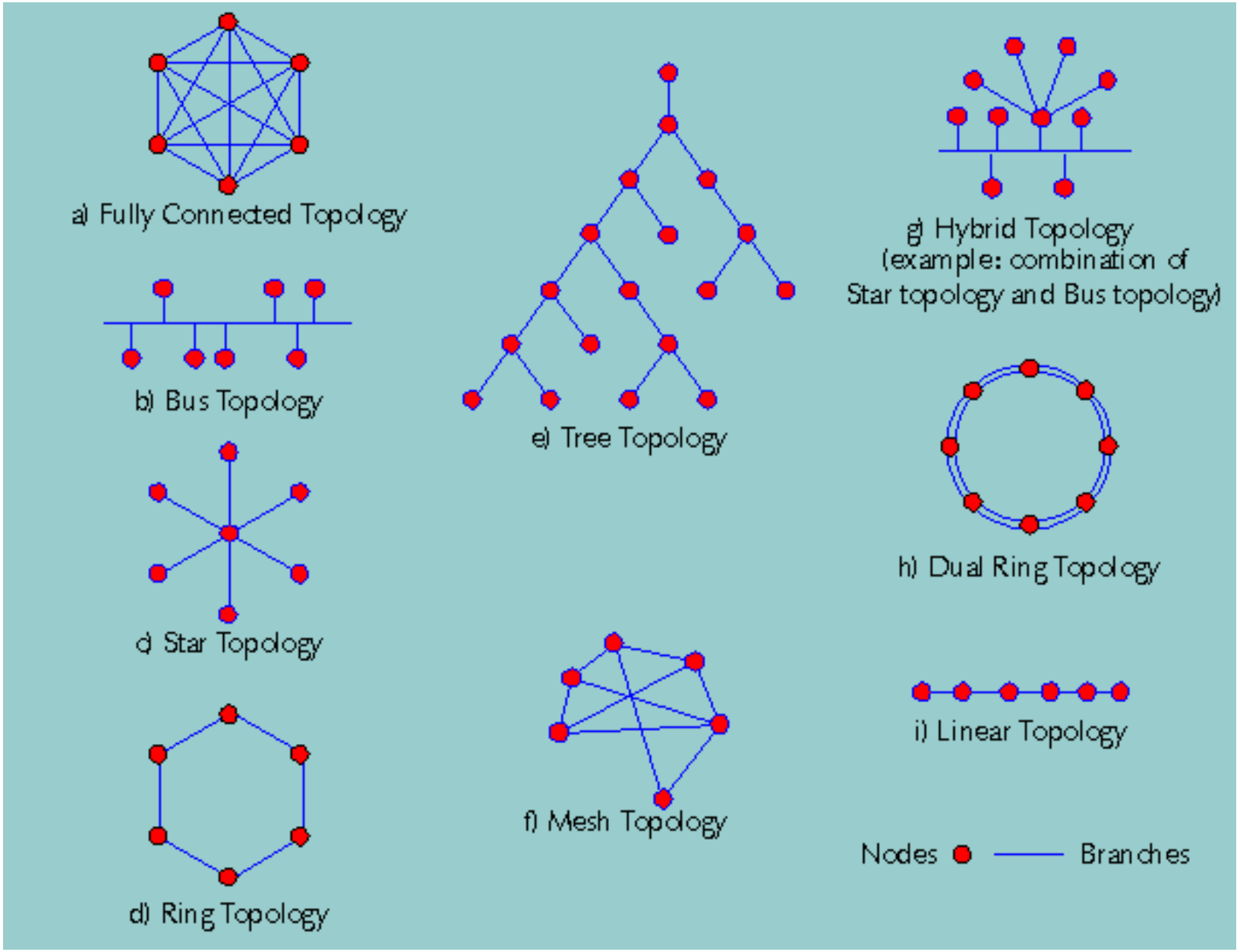

a) Fully Connected Topology
b) Bus Topology
c) Star Topology
d) Ring Topology
e) Tree Topology
f) Mesh Topology
g) Hybrid Topology
(example: combination of
Star topology and Bus topology)
h) Dual Ring Topology
i) Linear Topology
Nodes
Branches

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

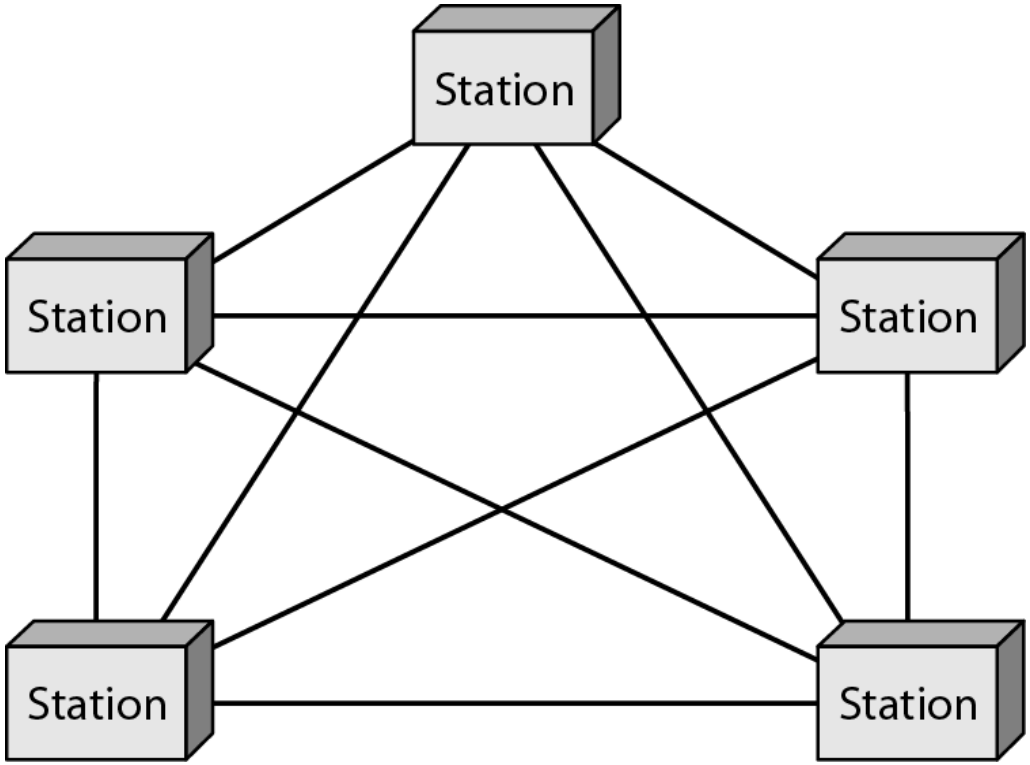


Figure 1.6 *A star topology connecting four stations*

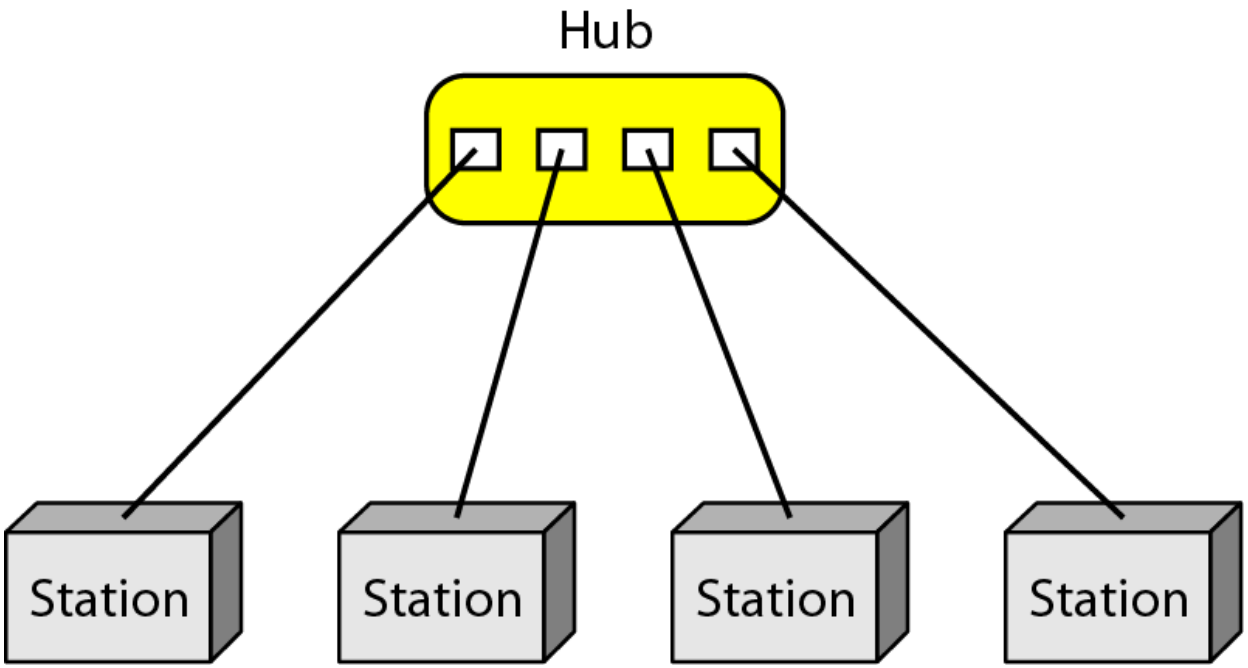
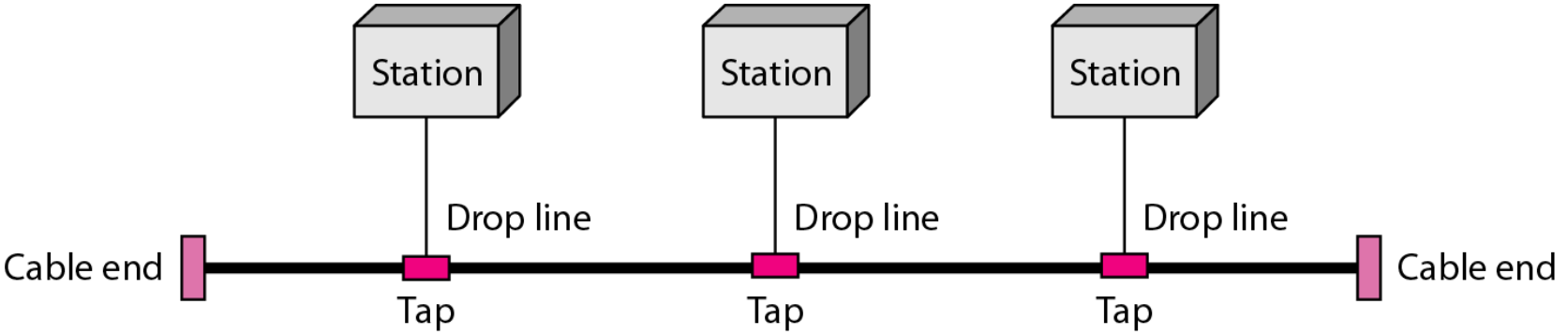
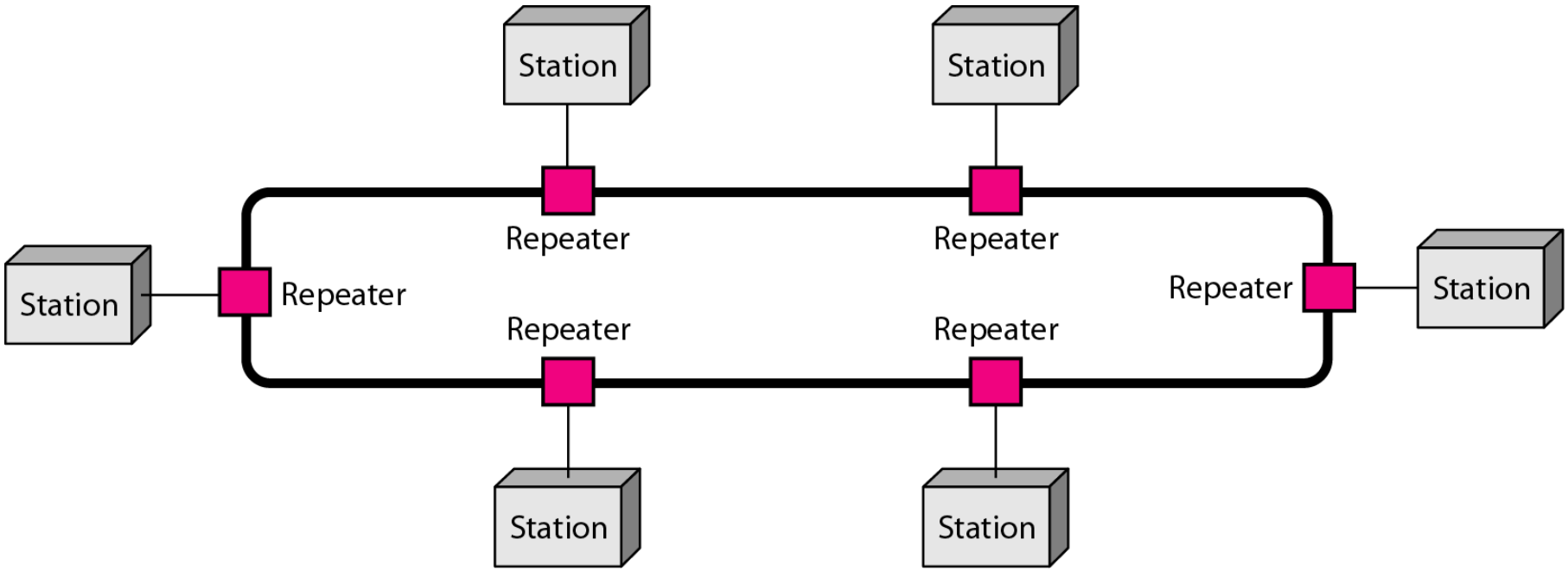


Figure 1.7 *A bus topology connecting three stations*



Back Bone Cable are connected to Drop line through Taps.
Signal becomes weak as it travels further distance.
Advantages: Ease of Installation. Uses less cables. Less complex.
Disadvantages: Difficult to fault isolation and reconnection. Difficult to add new devices.
Signal reflection at tapes reduces the signal quality. A fault or break in the bus cable stops all transmission.

Figure 1.8 *A ring topology connecting six stations*



Easy to install and reconfigure. Fault isolation is simplified. If one device does not receive a signal within a specified period, it can issue an alarm. The alarm alerts the network operator to the problem and its location.

The only constraints are media and traffic considerations (maximum ring length and number of devices).
Unidirectional traffic can be a disadvantage. In a simple ring, a break in the ring (such as a disabled station) can disable the entire network. Solution: Dual Ring.

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

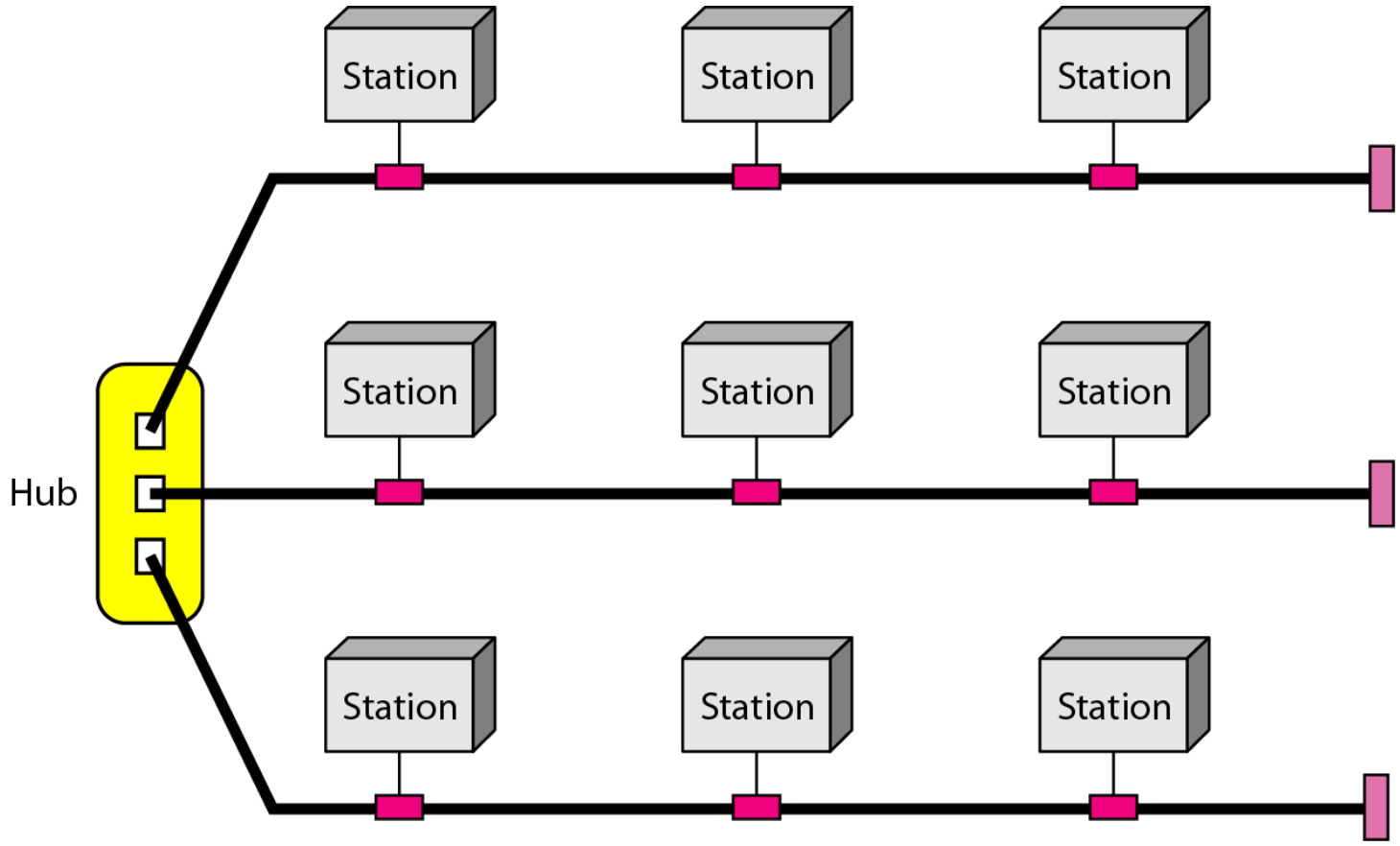


Figure 1.10 *An isolated LAN connecting 12 computers to a hub in a closet*

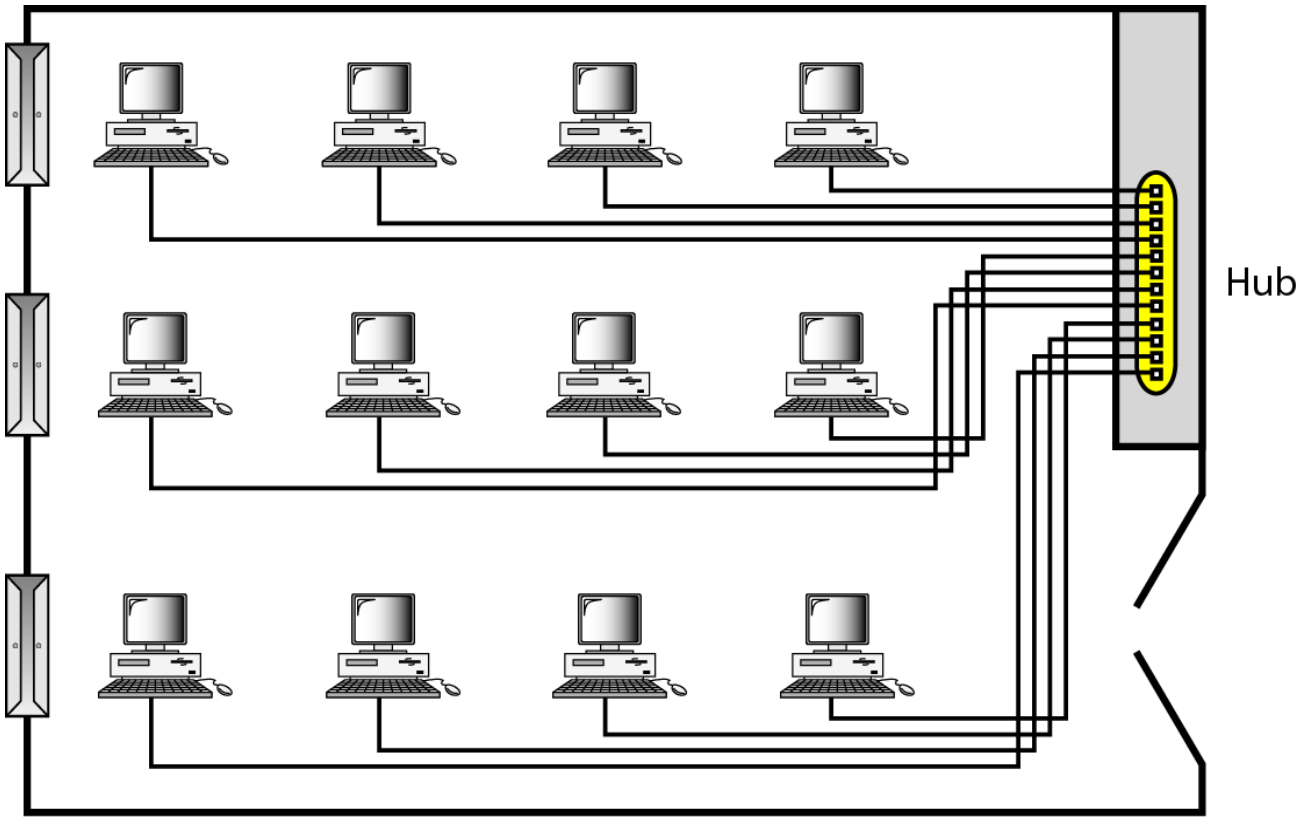
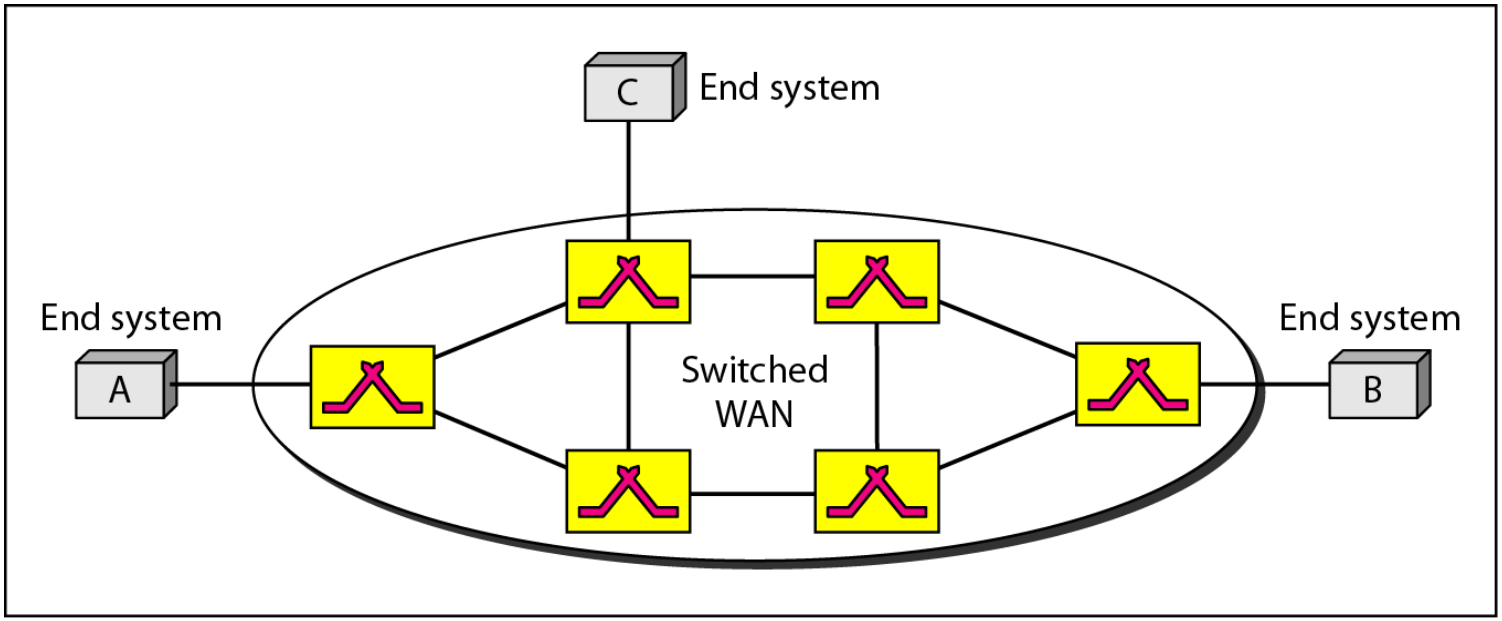
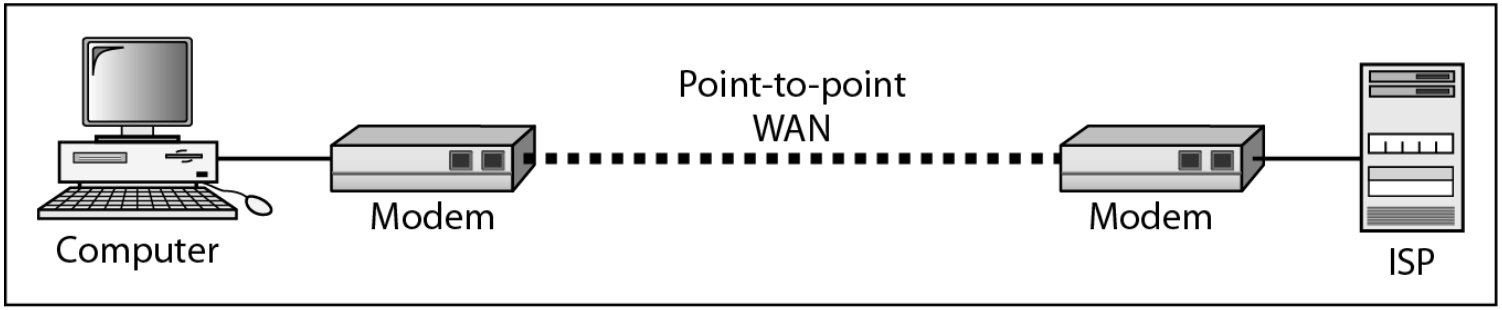


Figure 1.11 *WANs: a switched WAN and a point-to-point WAN*

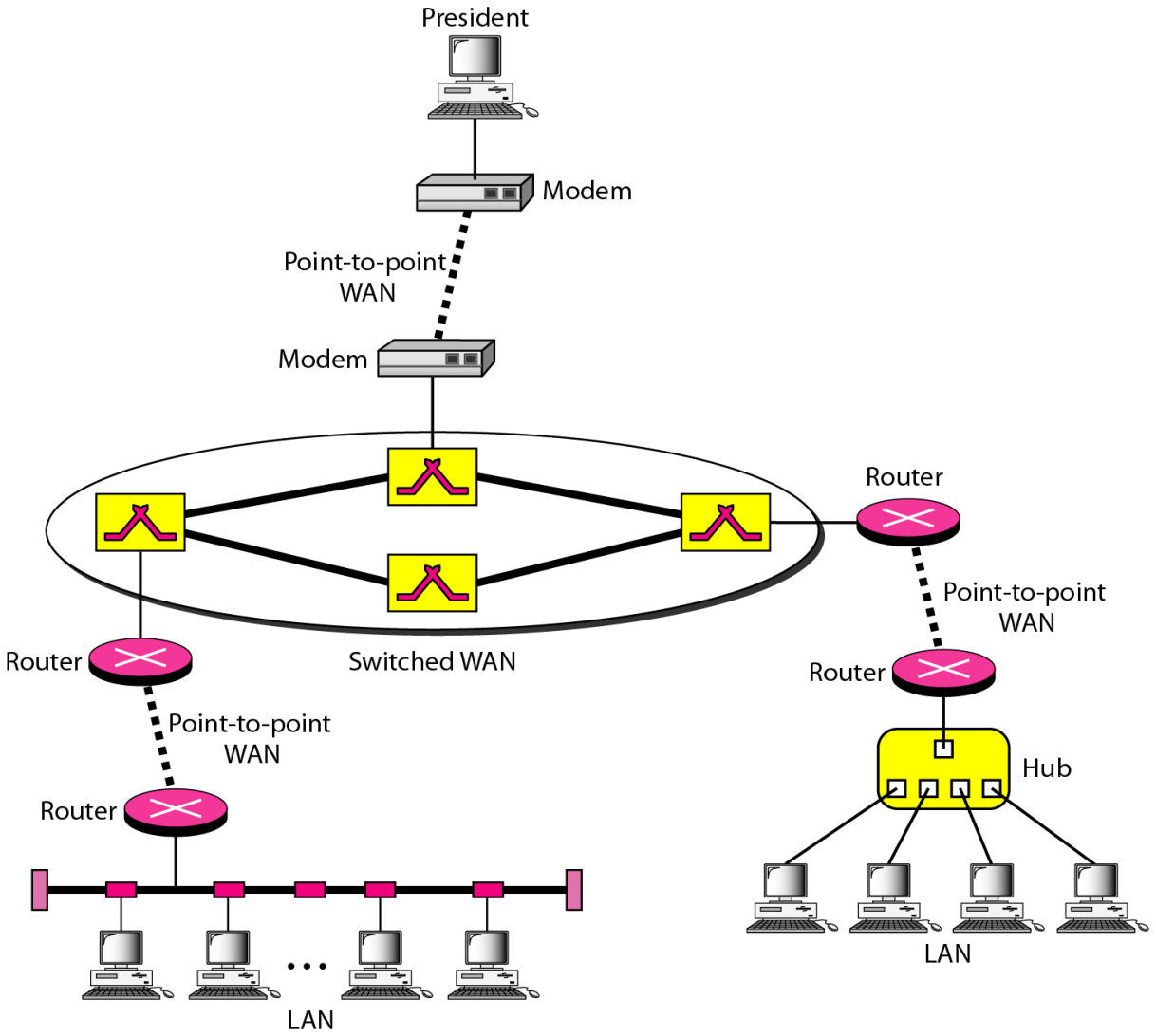


a. Switched WAN



b. Point-to-point WAN

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



1-3 THE INTERNET

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.

Topics discussed in this section:

A Brief History
The Internet Today (ISPs)

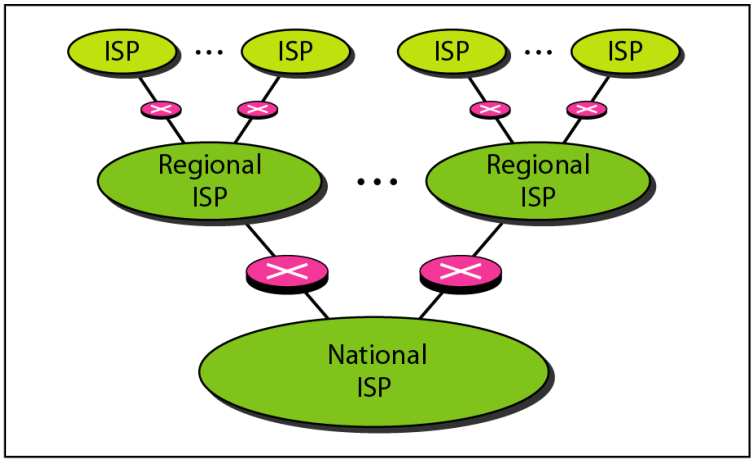
Brief History

- Came into existence in 1969 only after Packet Switched Network was invented in 1961 at MIT by Leonard Kleinrock.
- DoD (Dept of Defense) through ARPA (Advanced Research Projects Agency) represented ARPANET in ACM (Association of Comuting Machinery) meeting in 1967.
- Introduced IMP (Interface Message Processor).
- In 1969, UCLA – UCSB – SRI – UoU got connected.
  - University of California Los Angeles – UCLA
  - University of California Santa Barbara – UCSB
  - University of Utah – UoU
  - Sanford Research Institute (SRI)
- Software Support by NCP – Network Control Protocol.
- 1972, Vint Cerf and Bob Kahn came up with paper on TCP with networking concepts of encapsulation, datagram, gateways, end to end delivery of packets.
- Soon TCP was split into TCP and IP.
- In 1981, UC Berkeley modified the UNIX operating system to include TCP/IP which popularized Internetworking.
- Then came creation of CSNET in 1981. **Computer Science Network (CSNET) was a network sponsored by the National Science Foundation** (NSF).
- In 1983, ARPANET split into two networks: **Military Network (MILNET) for military** users and ARPANET for nonmilitary users.
- Today, it is managed by ISP – Internet Service Providers.

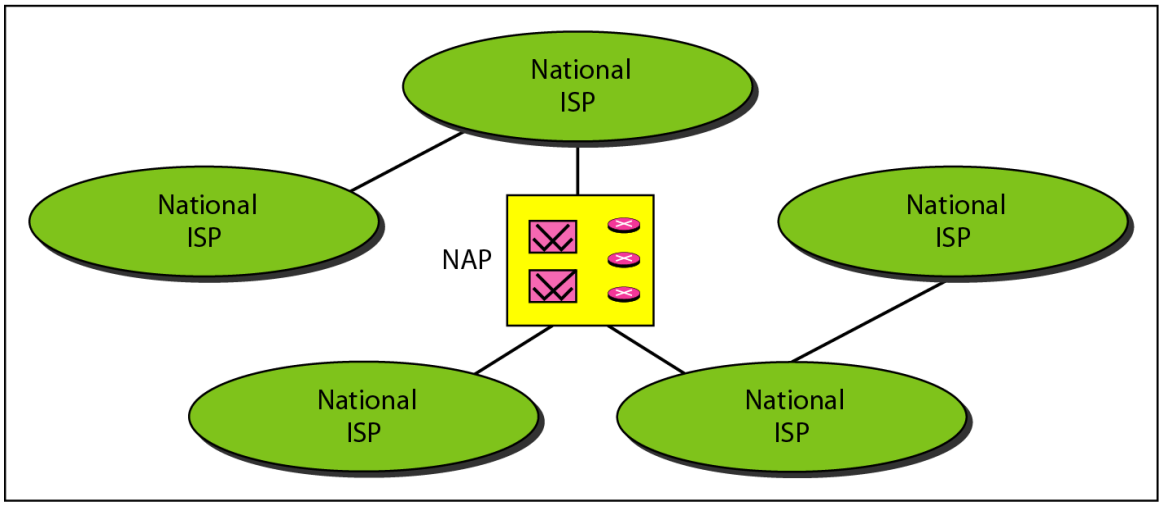
Figure 1.13 *Hierarchical organization of the Internet*

ISP – Internet Service Provider
NAP – Network Access Point

ISP Communicate with each others network through NAP



a. Structure of a national ISP



b. Interconnection of national ISPs

Standards Organization

- ISO – International Organization of Standardization
- ITU-T – International Telecommunication Union Telecommunication Standards formed CCITT in 1993 for research.
- CCITT – Consultative Committee for International Telegraphy and Telephony.
- ANSI – American National Standards Institutions.
- IEEE – Institute of Electric and Electronics Engineers
- EIA – Electronic Industries Association
- FCC – Federal Communication Commission
- RFC – Request for Comment
- How about Controlling body in India?

Standards Organization in INDIA

- Press Council of India (PCI),
- News Broadcasting Standards Authority (NBSA),
- Central Board of Film Certification (CBFC),
- Telecom Regulatory Authority of India (TRAI),
- Indian Broadcasters Federation (IBF),
- News Broadcasters Association (NBA),
- Indian Media Group (IMG),
- Indian Society of Advertisers (ISA),
- The Advertising Standards Council of India (ASCI),
- Advertising Agencies Association of India (AAAI),
- Media Research Users Council (MRUC),
- Audit Bureau of Circulations (ABC),
- Press Trust of India (PTI),
- Confederation of Indian Industry (CII),
- the Associated Chambers of Commerce and Industry of India (ASSOCHAM),
- Federation of Indian Chambers of Commerce and Industry (FICCI),
- United News of India (UNI)

Number	Topic
802.1	Overview and architecture of LANs
802.2 ↓	Logical link control
802.3 *	Ethernet
802.4 ↓	Token bus (was briefly used in manufacturing plants)
802.5	Token ring (IBM's entry into the LAN world)
802.6 ↓	Dual queue dual bus (early metropolitan area network)
802.7 ↓	Technical advisory group on broadband technologies
802.8 †	Technical advisory group on fiber optic technologies
802.9 ↓	Isochronous LANs (for real-time applications)
802.10 ↓	Virtual LANs and security
802.11 *	Wireless LANs
802.12 ↓	Demand priority (Hewlett-Packard's AnyLAN)
802.13	Unlucky number. Nobody wanted it
802.14 ↓	Cable modems (defunct: an industry consortium got there first)
802.15 *	Personal area networks (Bluetooth)
802.16 *	Broadband wireless
802.17	Resilient packet ring