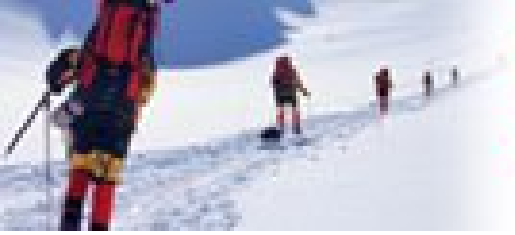


Data Communications and Networking Fourth Edition

Forouzan

Chapter 1

Introduction

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.

Topics discussed in this section:

Components
Data Representation
Data Flow

Figure 1.1 *Five components of data communication*

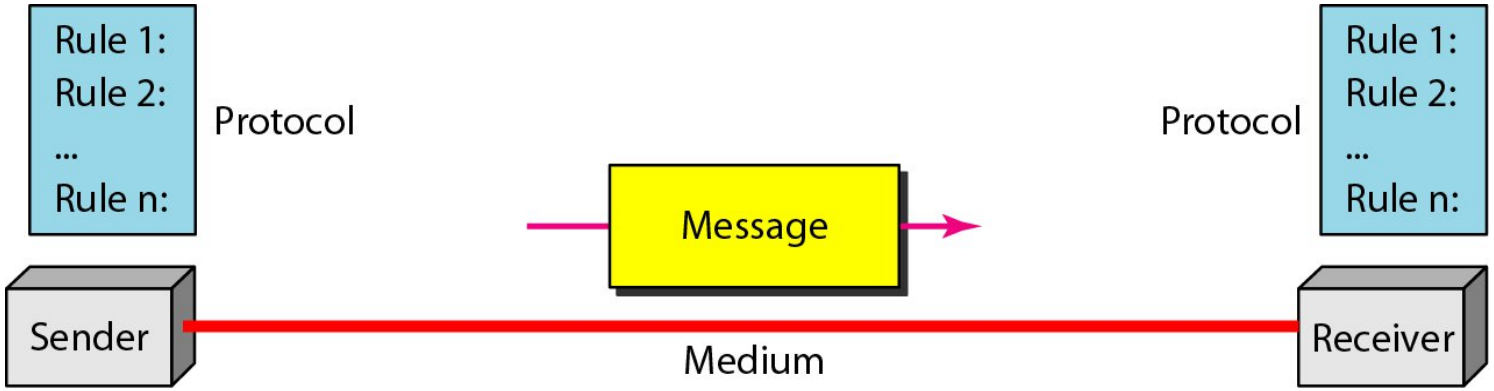
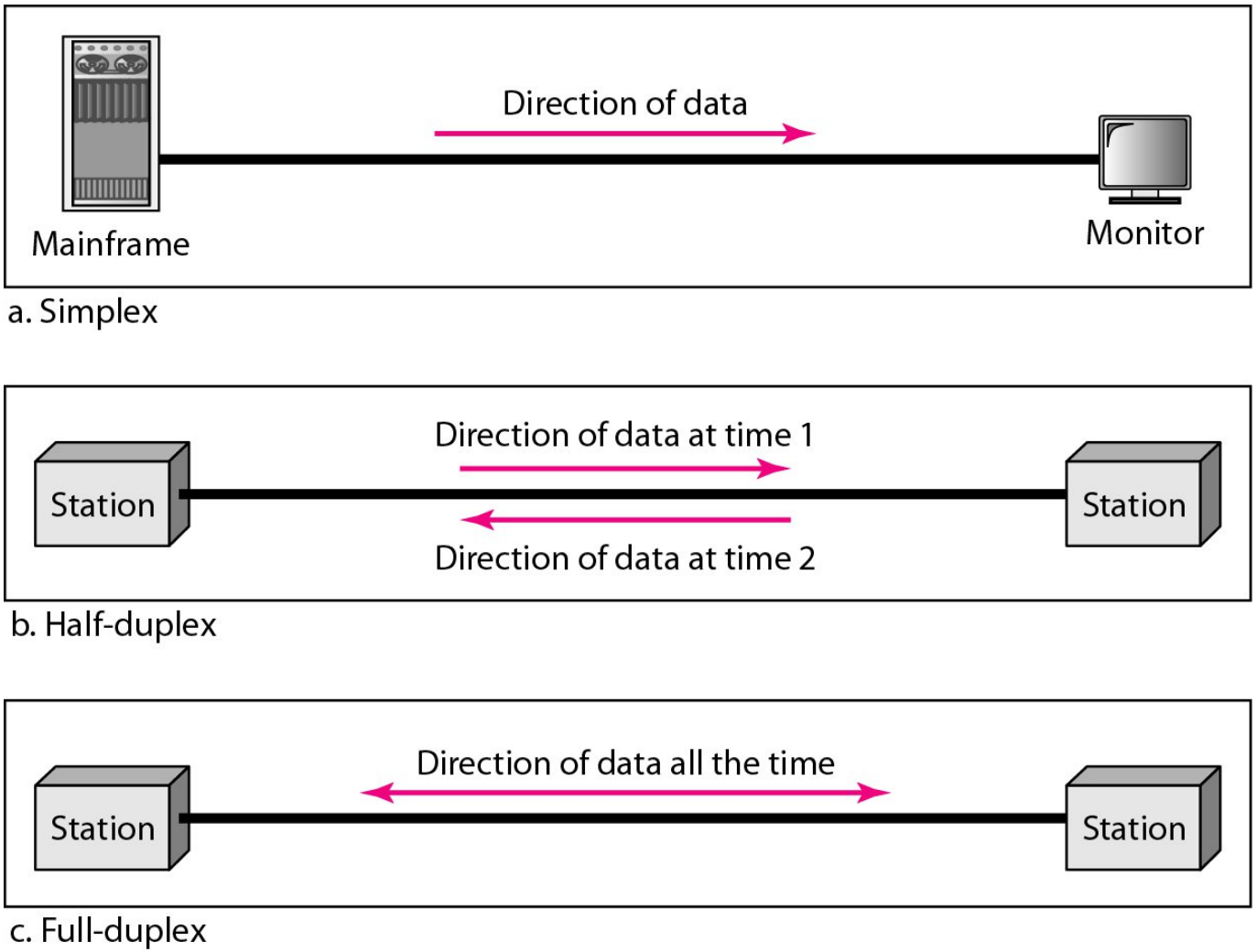


Figure 1.2 *Data flow (simplex, half-duplex, and full-duplex)*



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
Physical Structures
Network Models
Categories of Networks
Interconnection of Networks: Internetwork

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

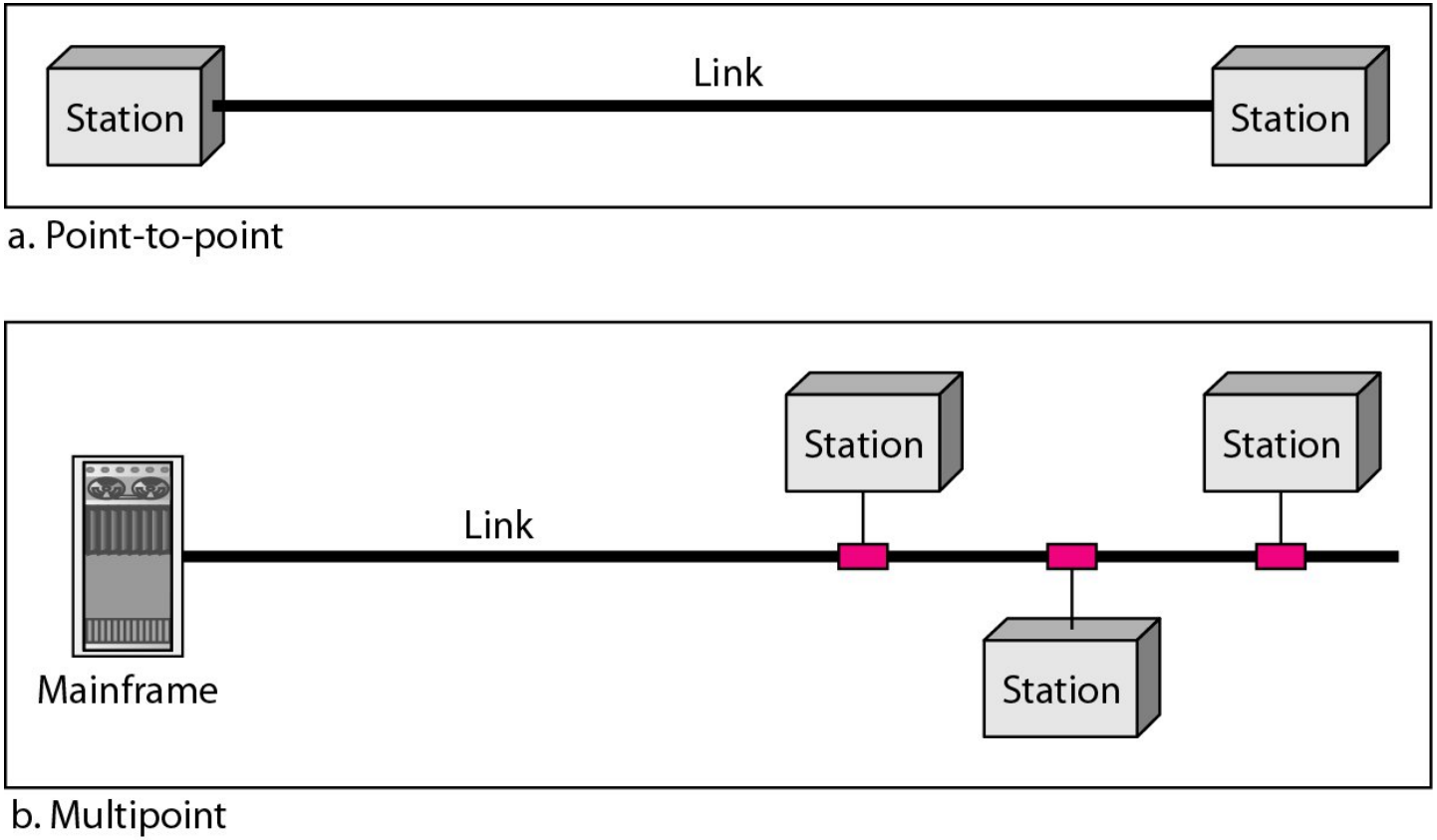


Figure 1.4 *Categories of topology*

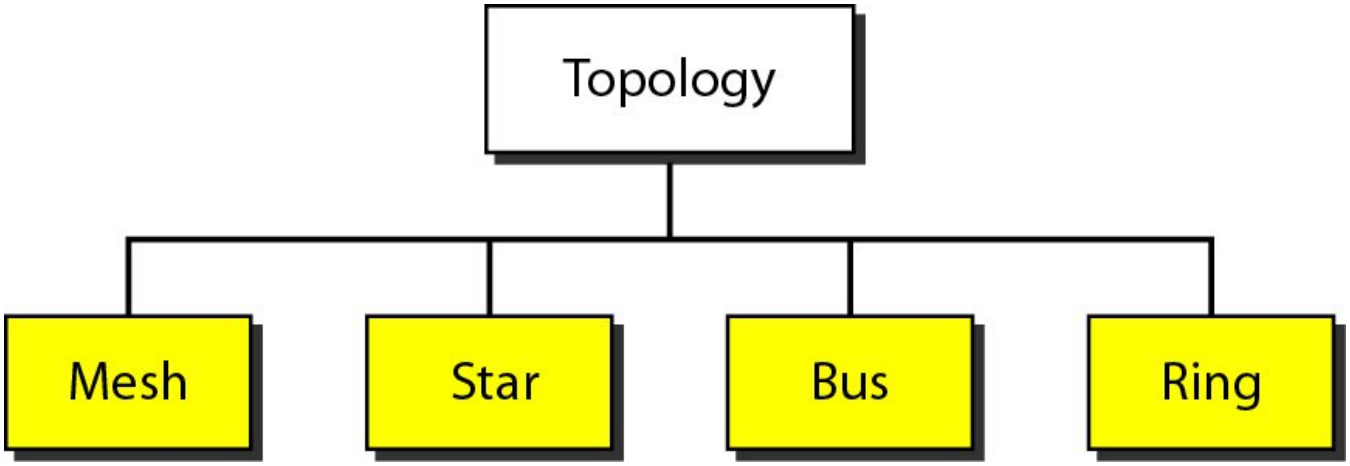
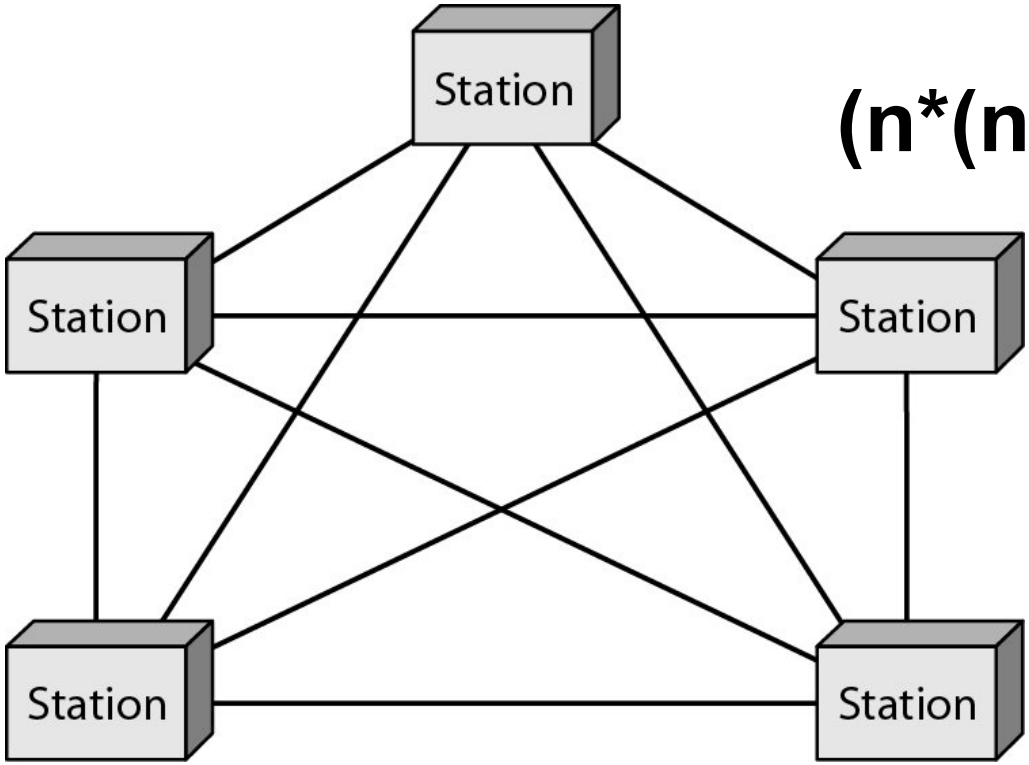


Figure 1.5 *A fully connected mesh topology (five devices)*



(n*(n-1)/2)=10

Figure 1.6 *A star topology connecting four stations*

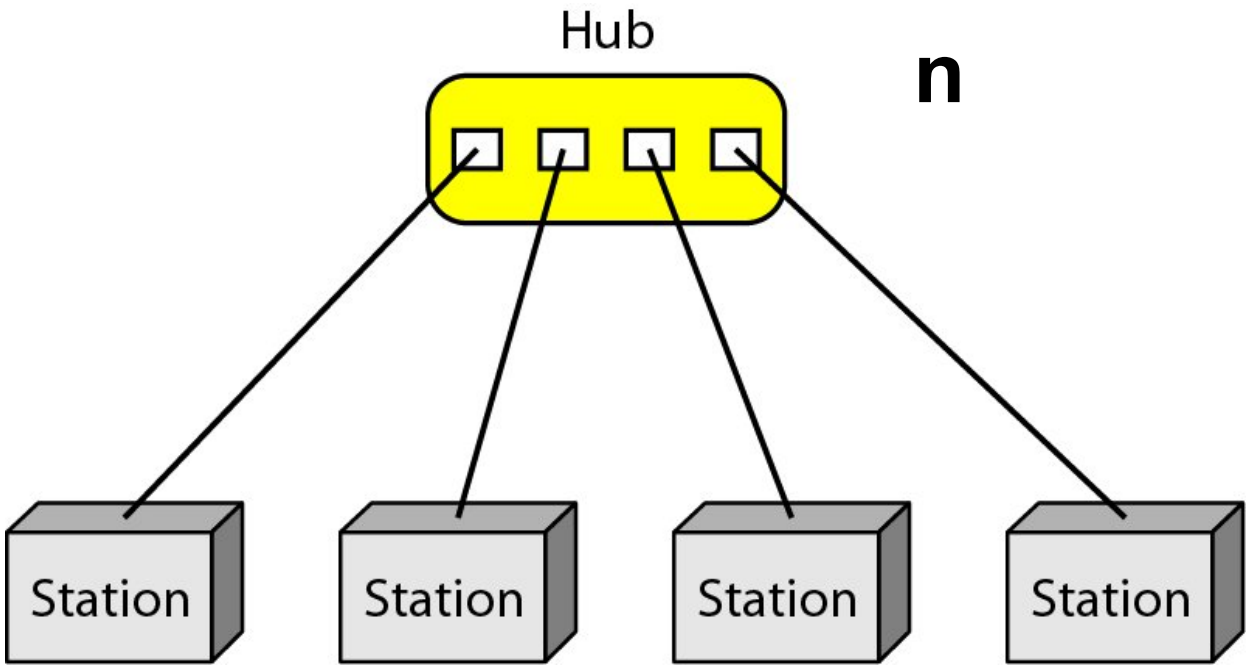


Figure 1.7 *A bus topology connecting three stations*

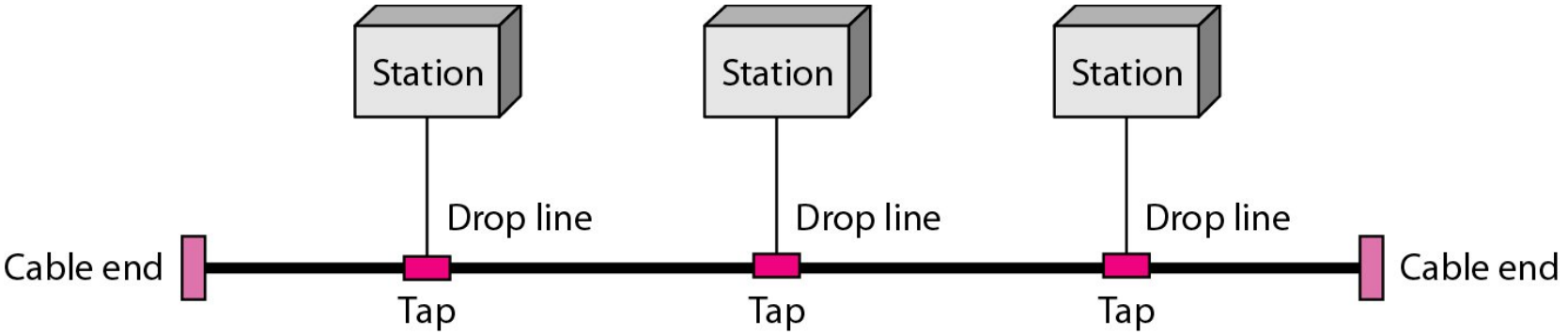


Figure 1.8 *A ring topology connecting six stations*

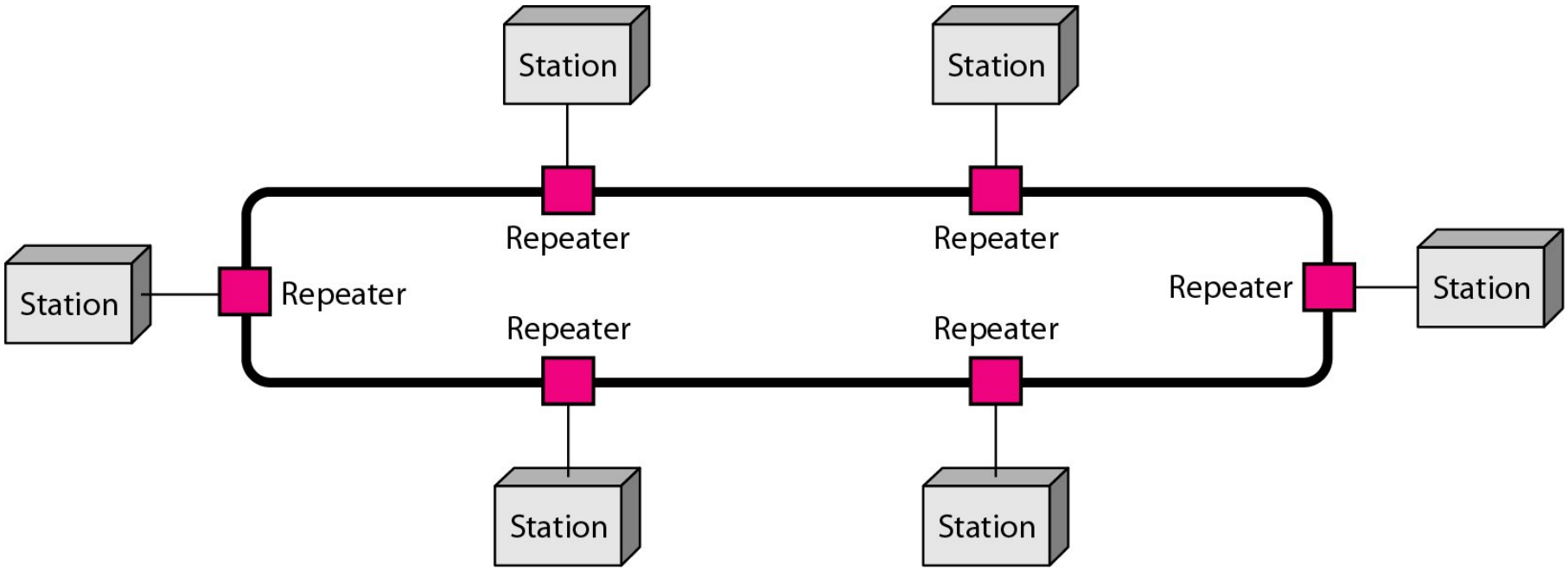
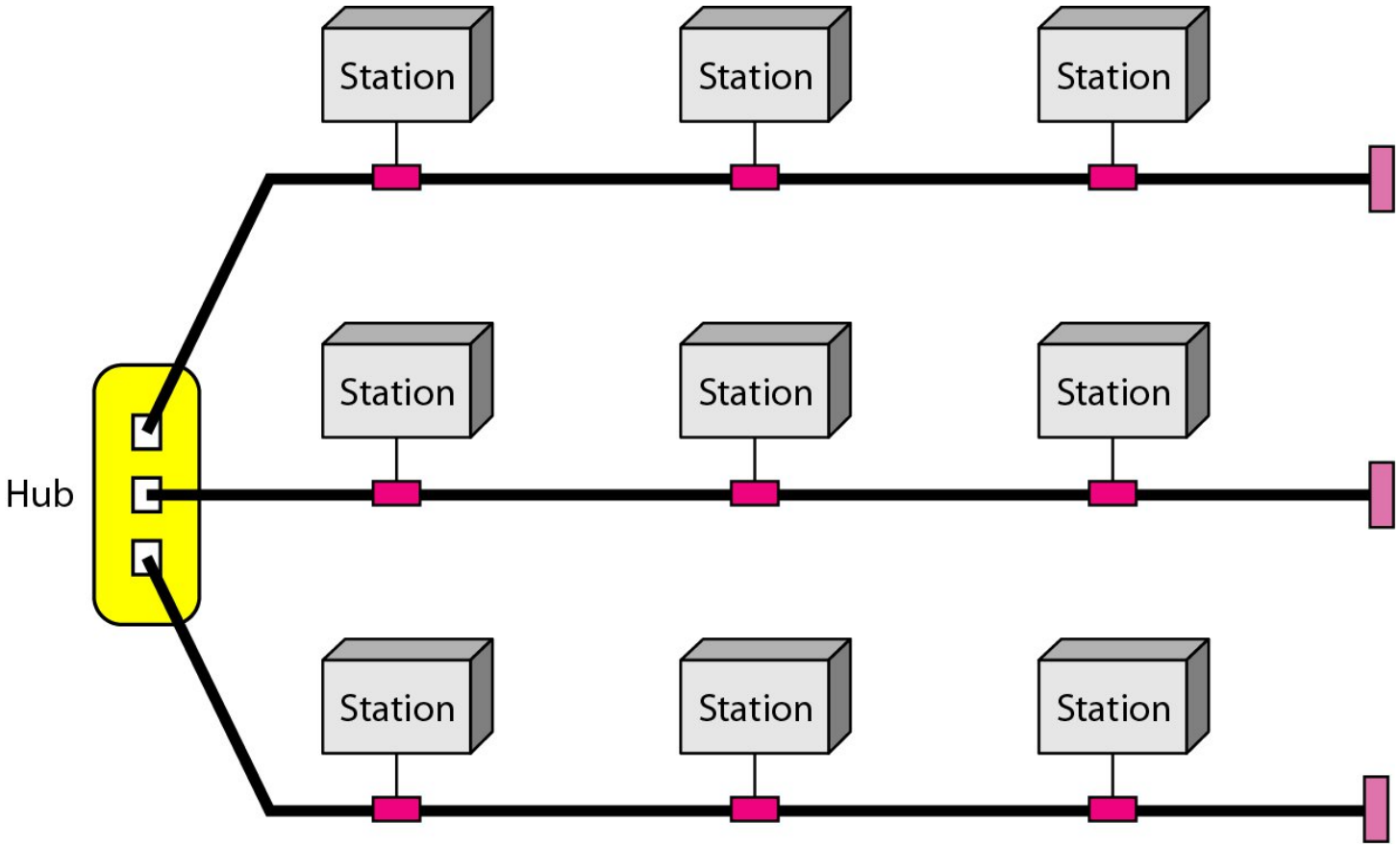


Figure 1.9 *A hybrid topology: a star backbone with three bus networks*



- Computer networks are created by different entities.
- Standards are needed so that these heterogeneous networks can communicate with one another.
- The two best-known standards are the OSI model and the Internet model.

Categories of Networks

- LAN
- MAN
- WAN

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

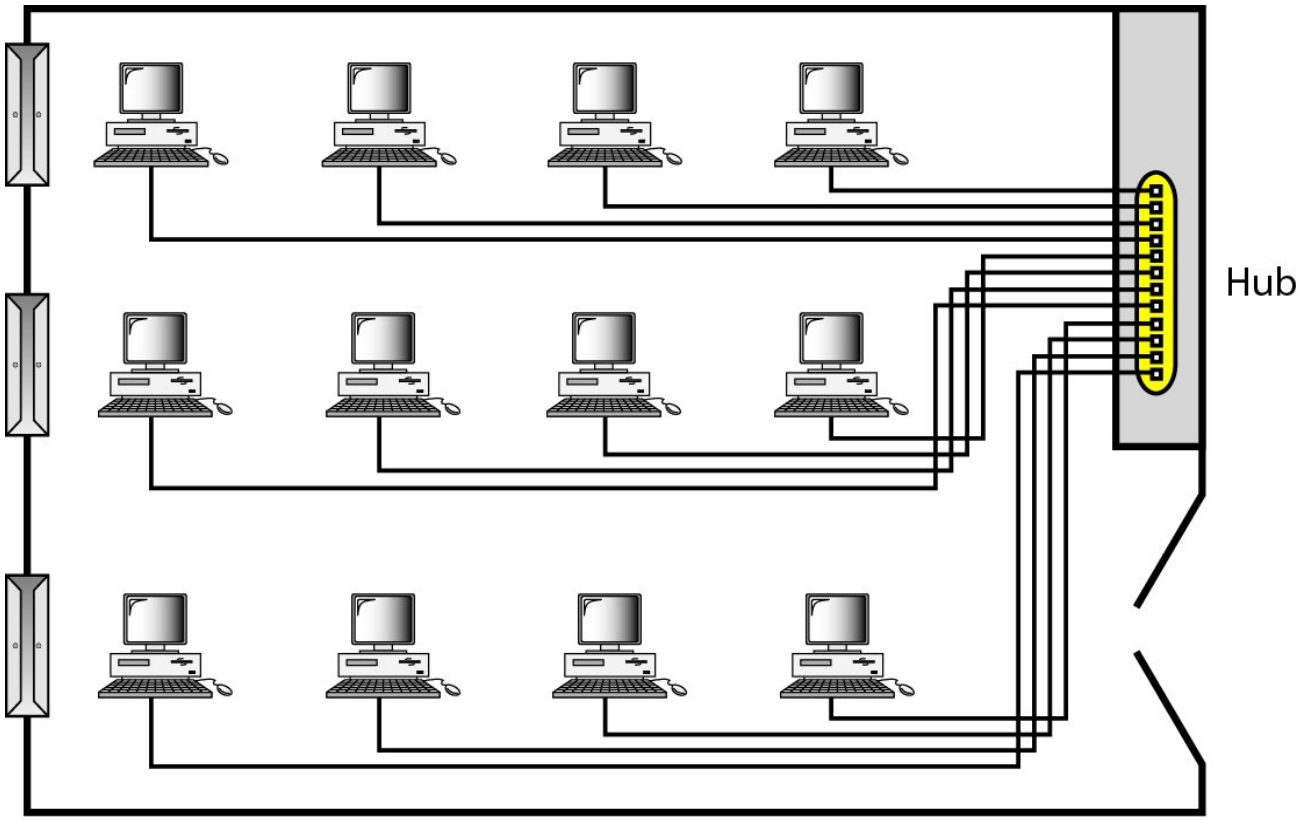
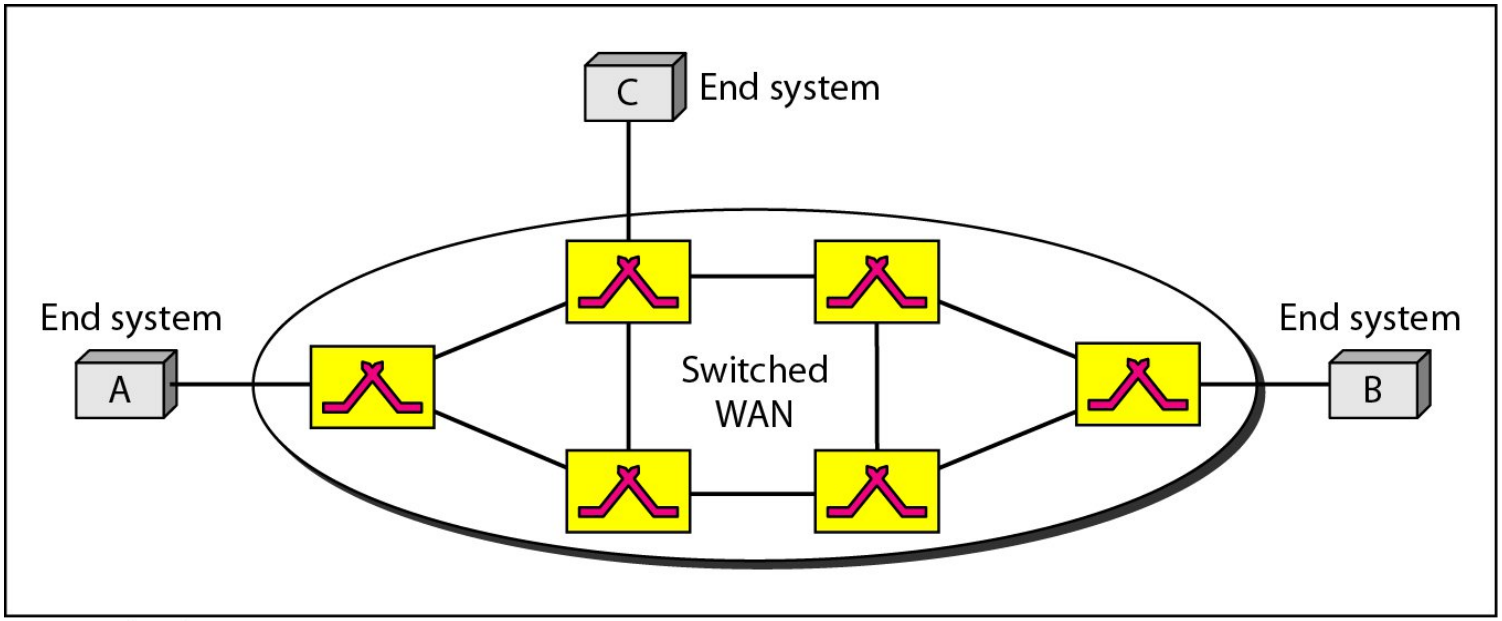
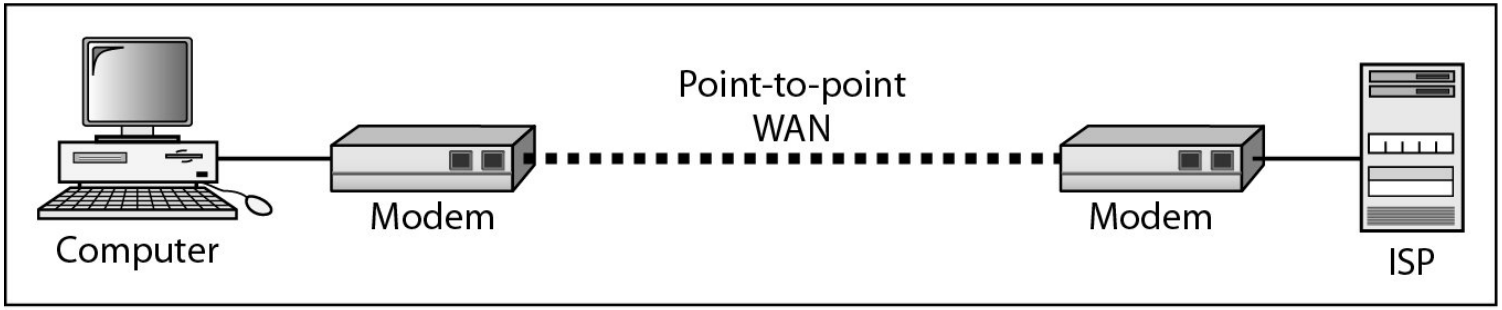


Figure 1.11 *WANs: a switched WAN and a point-to-point WAN*



a. Switched WAN

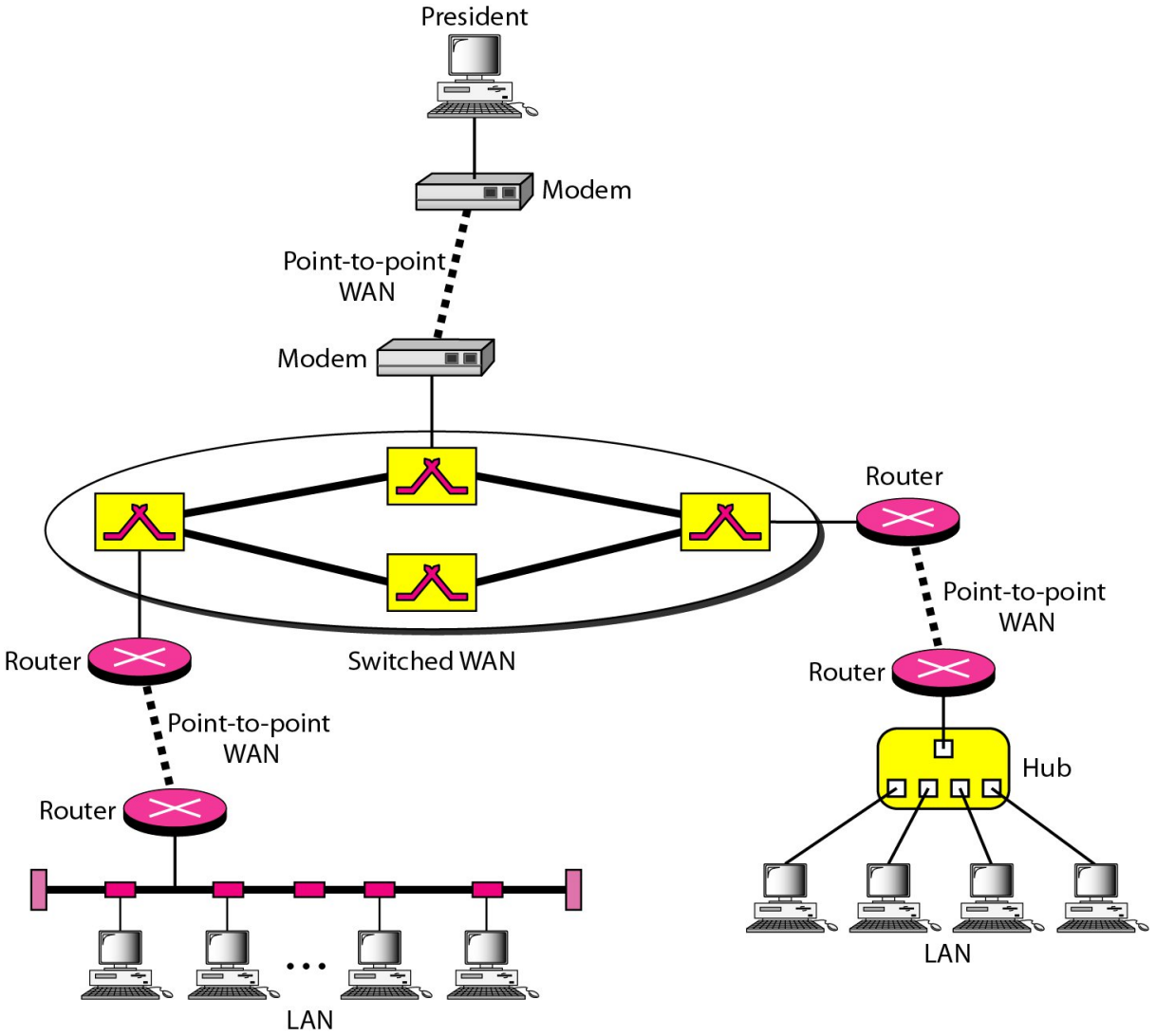


b. Point-to-point WAN

Internetwork- Interconnection of network

- When two or more networks are connected, they become an internetwork, or internet.
- Assume that an organization has two offices, one on the east coast and the other on the west coast. The established office on the west coast has a bus topology LAN;
- The newly opened office on the east coast has a star topology LAN.
- The president of the company lives somewhere in the middle and needs to have control over the company.

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)

A Brief History

- In the mid-1960s, mainframe computers in research organizations were standalone devices.
- In 1967, at an Association for Computing Machinery (ACM) meeting, ARPA presented its ideas for ARPANET, a small network of connected computers.
- By 1969, ARPANET was a reality. Four nodes, were connected via the IMPs to form a network. Software called the *Network Control Protocol* (NCP) provided communication between the hosts.
- In 1972, Vint Cerf and Bob Kahn, both of whom were part of the core ARPANET group, collaborated on what they called the *Internetting Project*
- Cerf and Kahn's landmark 1973 paper outlined the protocols to achieve end-to-end delivery of packets. This paper on Transmission Control Protocol (TCP) included concepts such as encapsulation, the datagram, and the functions of a gateway.

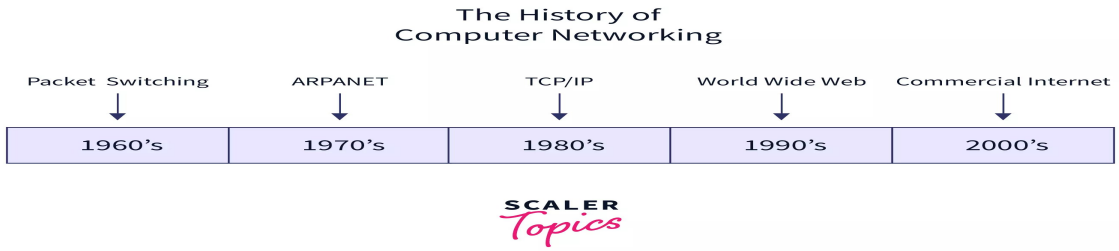
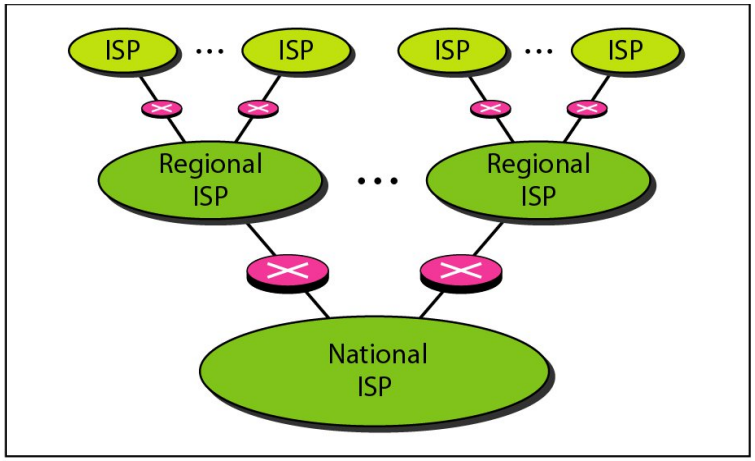
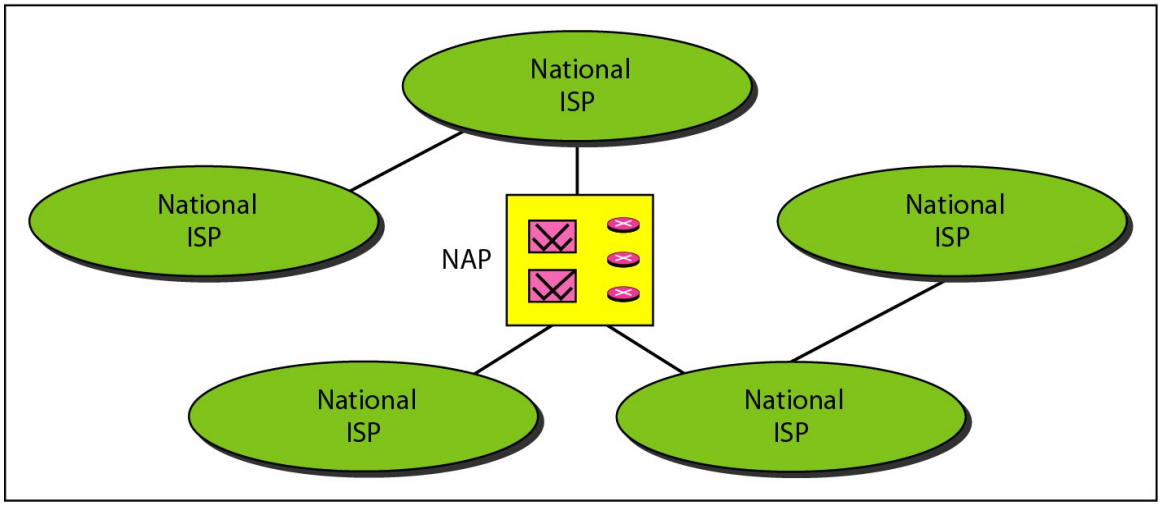


Figure 1.13 *Hierarchical organization of the Internet*



a. Structure of a national ISP



b. Interconnection of national ISPs

1-4 PROTOCOLS AND STANDARDS

In this section, we define two widely used terms: protocols and standards. First, we define protocol, which is synonymous with rule. Then we discuss standards, which are agreed-upon rules.

Topics discussed in this section:

Protocols
Standards
Standards Organizations
Internet Standards

Protocol

- A protocol is a set of rules that govern data communications.
- Syntax. The term *syntax* refers to the structure or format of the data, meaning the order in which they are presented
- Semantics. The word *semantics* refers to the meaning of each section of bits.
- Timing. The term *timing* refers to two characteristics: when data should be sent and how fast they can be sent.

Standards

- Data communication standards fall into two categories: *de facto* (meaning "by fact" or "by convention") and *de jure* (meaning "by law" or "by regulation").
- De facto- standards are often established originally by manufacturers who seek to define the functionality of a new product or technology.
- De jure. Those standards that have been legislated by an officially recognized body are de jure standards.

Standards Organization

- International Organization for Standardization (ISO)
- International Telecommunication
- American National Standards Institute (ANSI).
- Institute of Electrical and Electronics Engineers (IEEE).
- Electronic Industries Association (EIA).

Regulatory Agencies

- All communications technology is subject to regulation by government agencies such as the **Federal Communications Commission** (FCC) in the United States.