

Usman Habib, PhD

usman.habib@nu.edu.pk

Assistant Professor

Department of Computer Science



**National University of Computer & Emerging
Sciences**

Peshawar, Pakistan

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 of a data communications system**
- **Data Flow**

Characteristics of Data Communications

- Delivery.
- Accuracy.
- Timeliness.
- Jitter.

Figure 1.1 *Components of a data communication system*

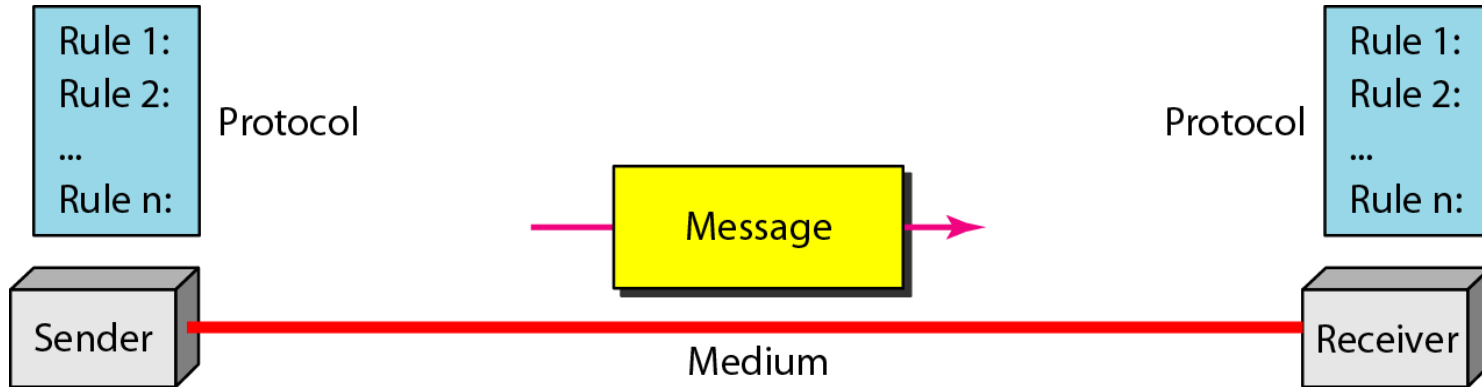
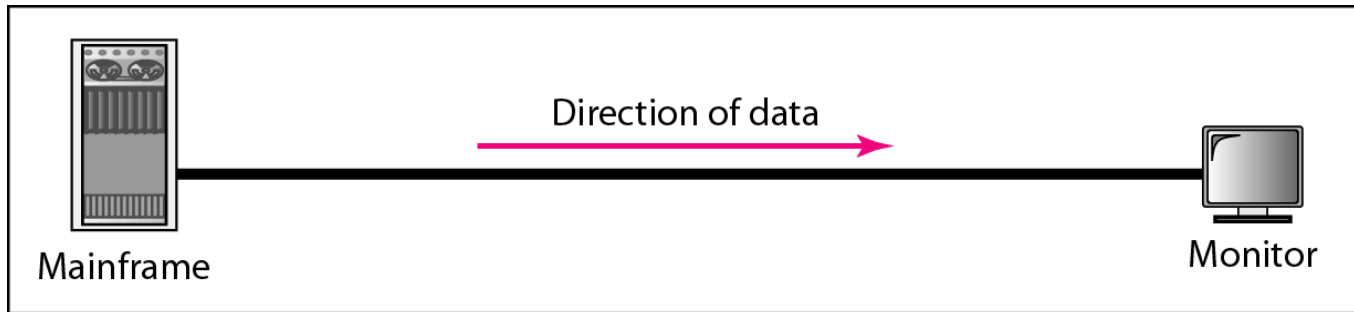
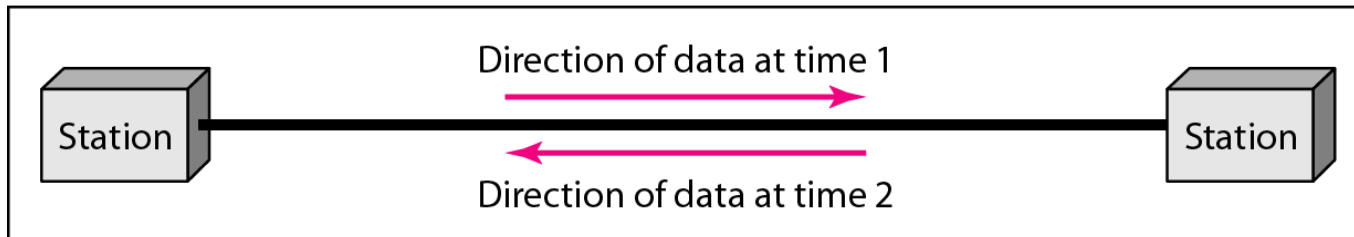


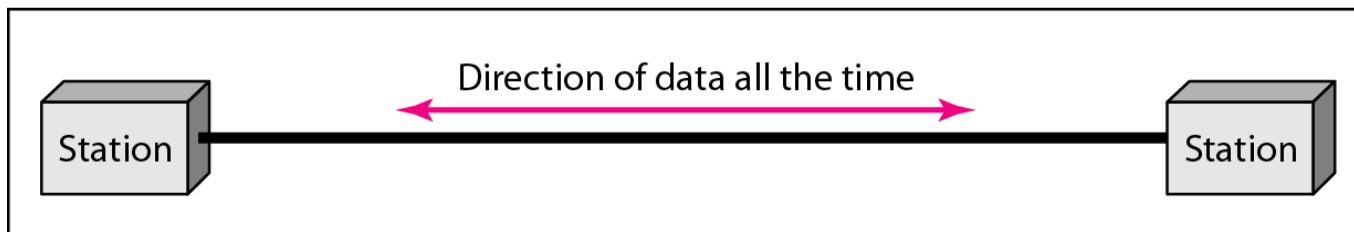
Figure 1.2 *Data flow (simplex, half-duplex, and full-duplex)*



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. A link can be a cable, air, optical fiber, or any medium which can transport a signal carrying information.*

Topics discussed in this section:

- Network Criteria
- Physical Structures
- Categories of Networks

Network Criteria

- **Performance**

- **Depends on Network Elements**
- **Measured in terms of Delay and Throughput**

- **Reliability**

- **Failure rate of network components**
- **Measured in terms of availability/robustness**

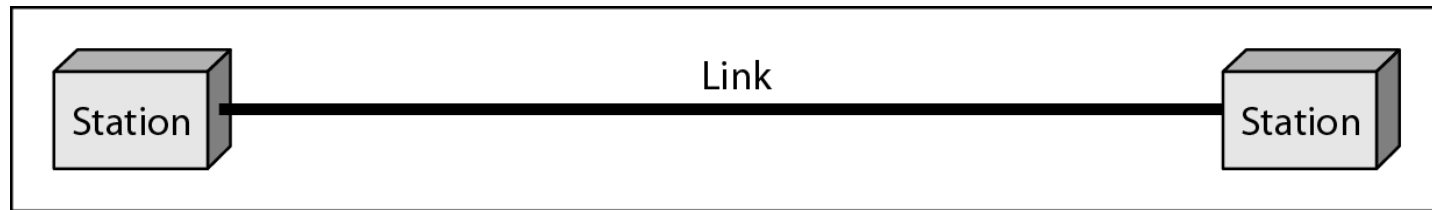
- **Security**

- **Data protection against corruption/loss of data due to:**
 - **Errors**
 - **Malicious users**

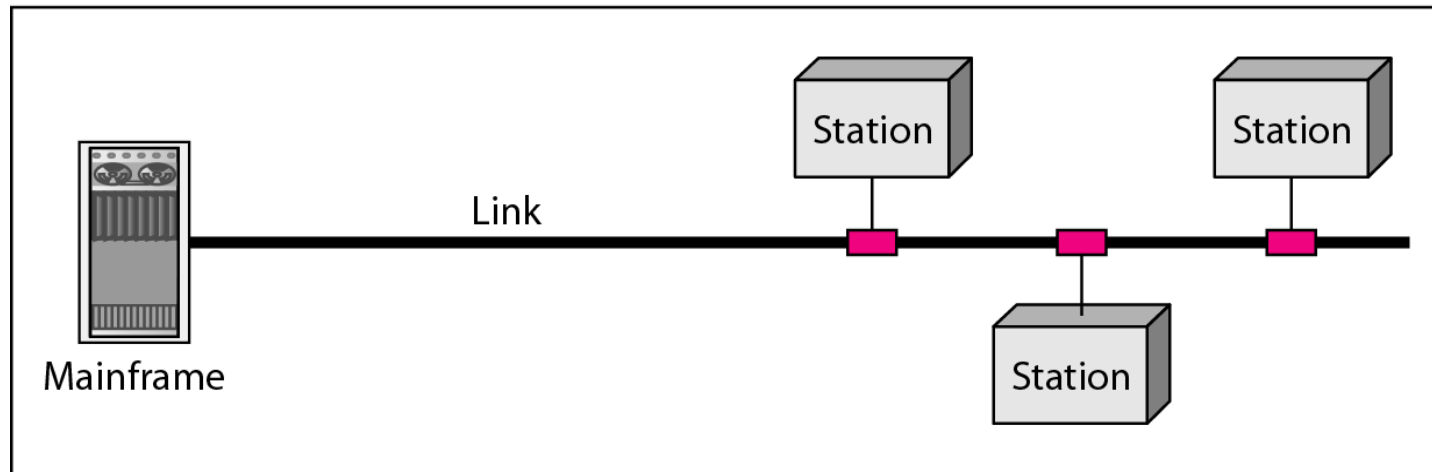
Physical Structures

- **Type of Connection**
 - **Point to Point - single transmitter and receiver**
 - **Multipoint - multiple recipients of single transmission**
- **Physical Topology**
 - **Connection of devices**
 - **Type of transmission - unicast, mulitcast, broadcast**

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



a. Point-to-point



b. Multipoint

Figure 1.4 *Categories of topology*

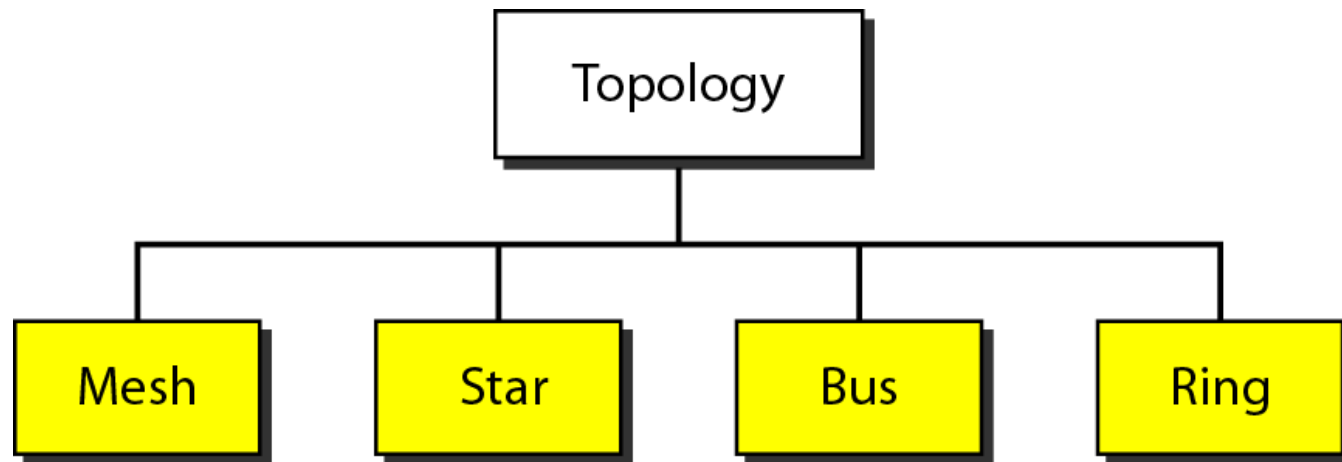


Figure 1.5 *A fully connected mesh topology (five devices)*

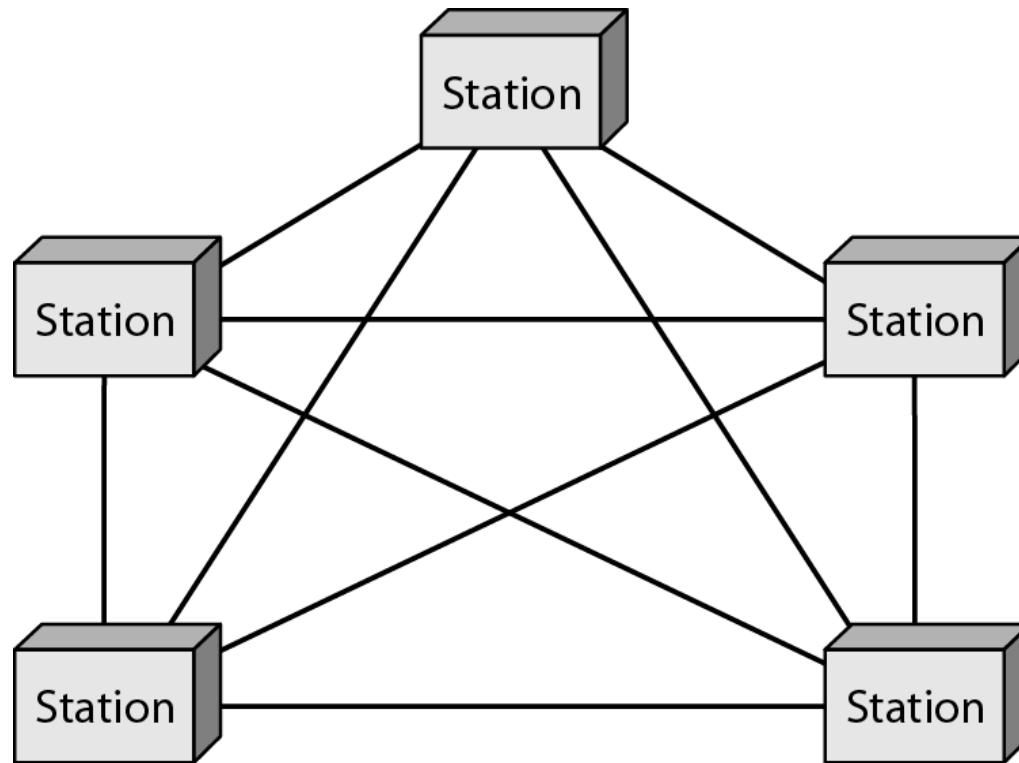


Figure 1.6 *A star topology connecting four stations*

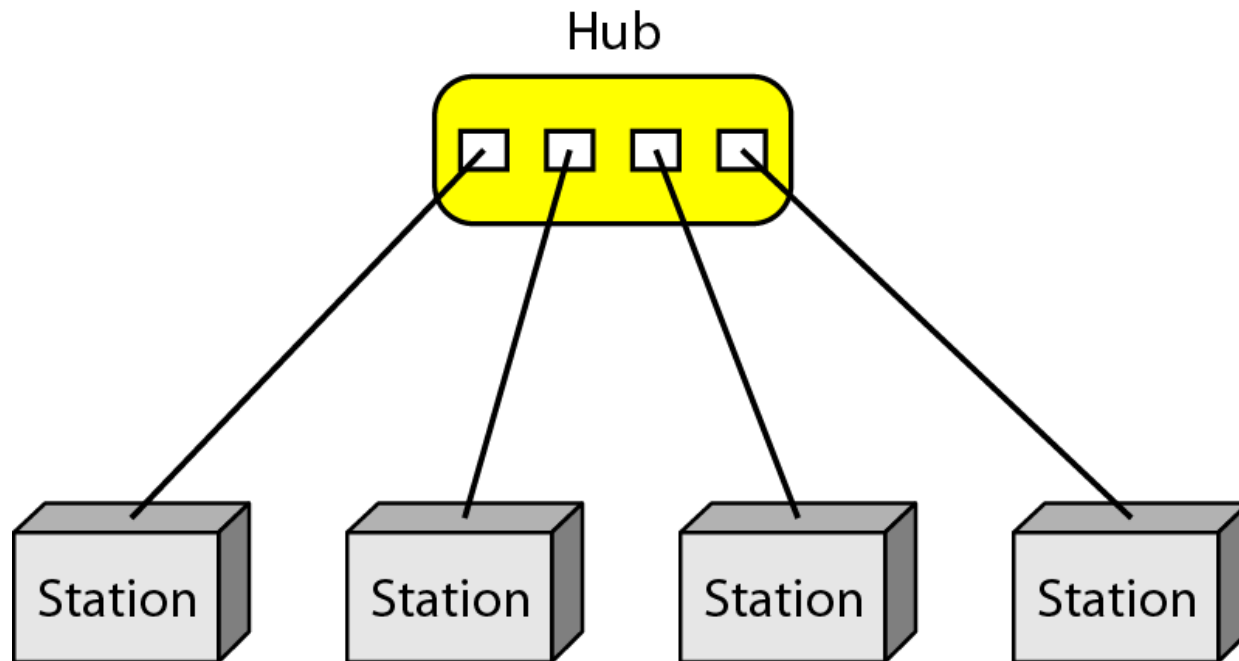


Figure 1.7 *A bus topology connecting three stations*

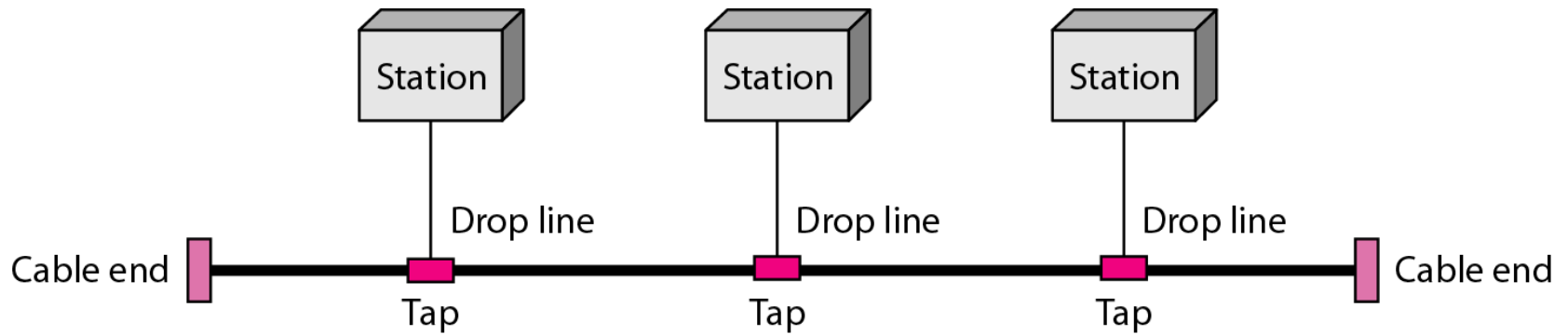


Figure 1.8 *A ring topology connecting six stations*

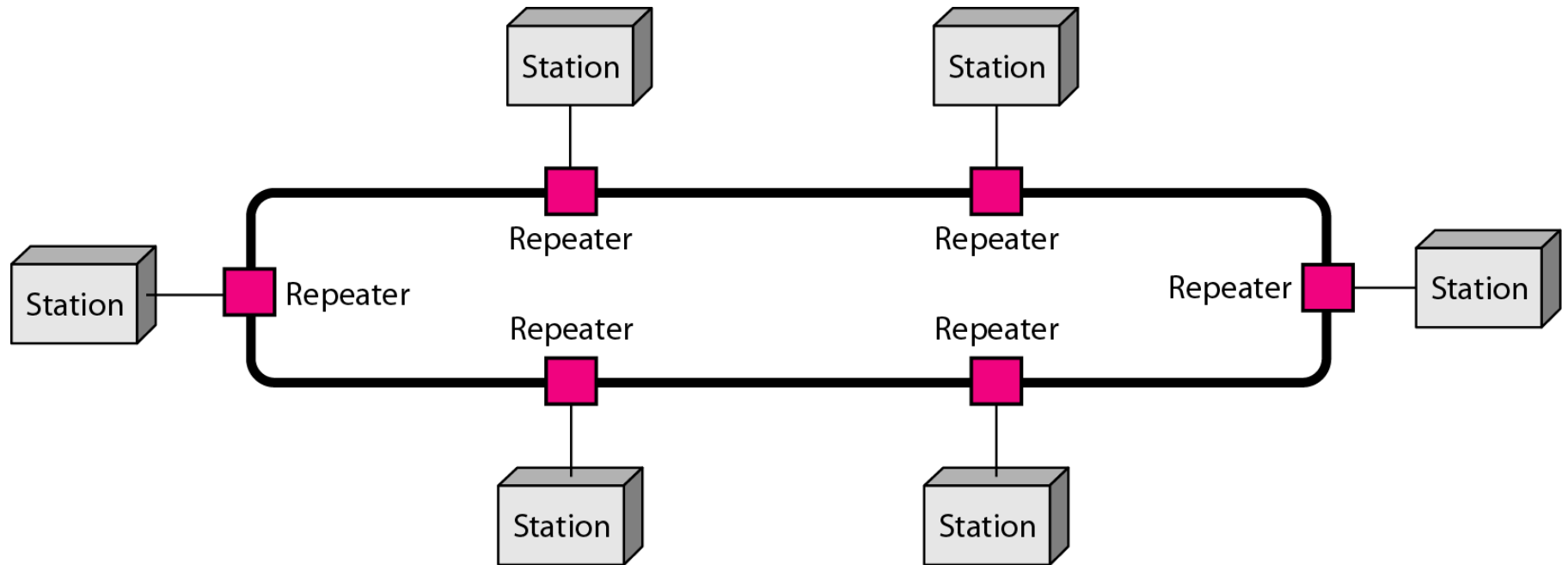
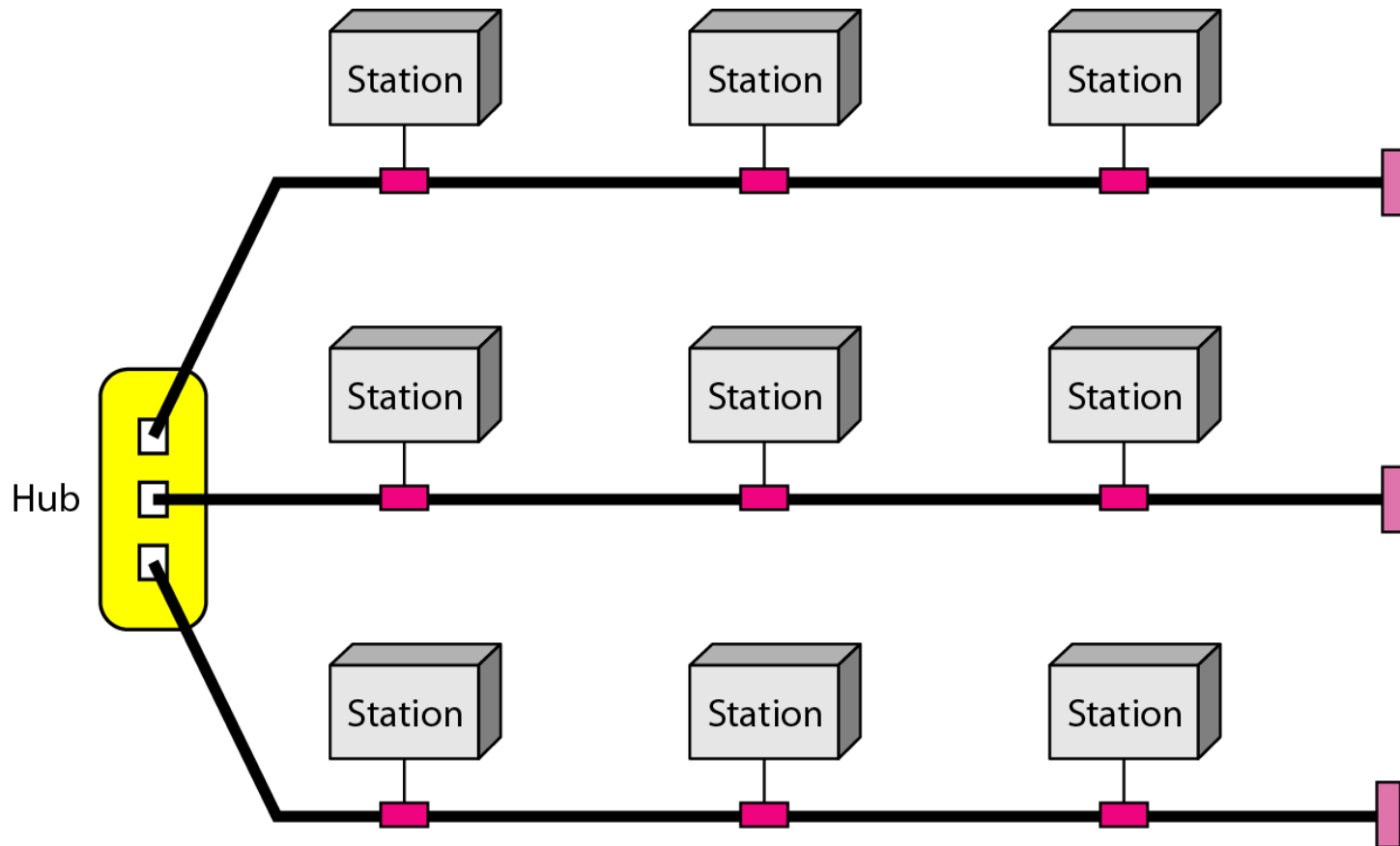


Figure 1.9 *A hybrid topology: a star backbone with three bus networks*



Categories of Networks

- **Local Area Networks (LANs)**
 - Short distances
 - Designed to provide local interconnectivity
- **Wide Area Networks (WANs)**
 - Long distances
 - Provide connectivity over large areas
- **Metropolitan Area Networks (MANs)**
 - Provide connectivity over areas such as a city, a campus

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

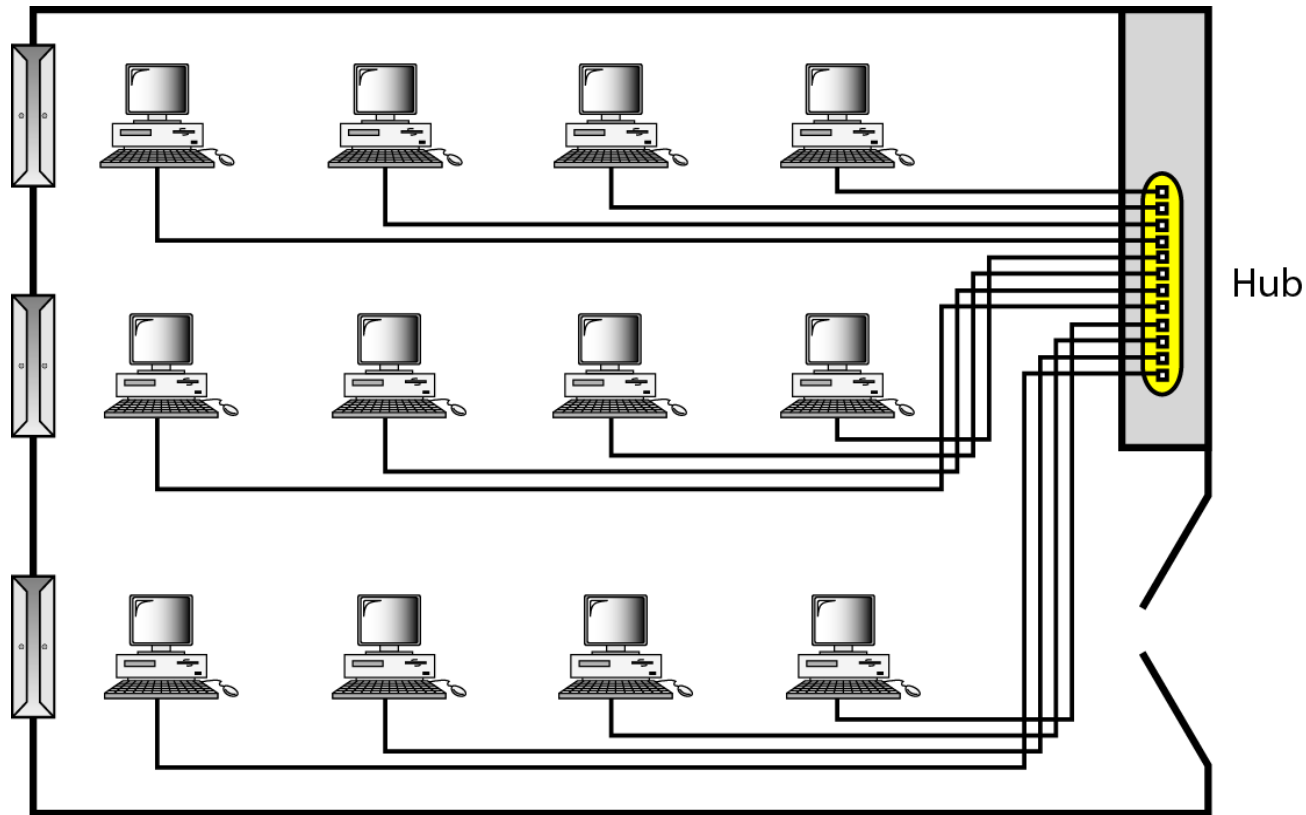
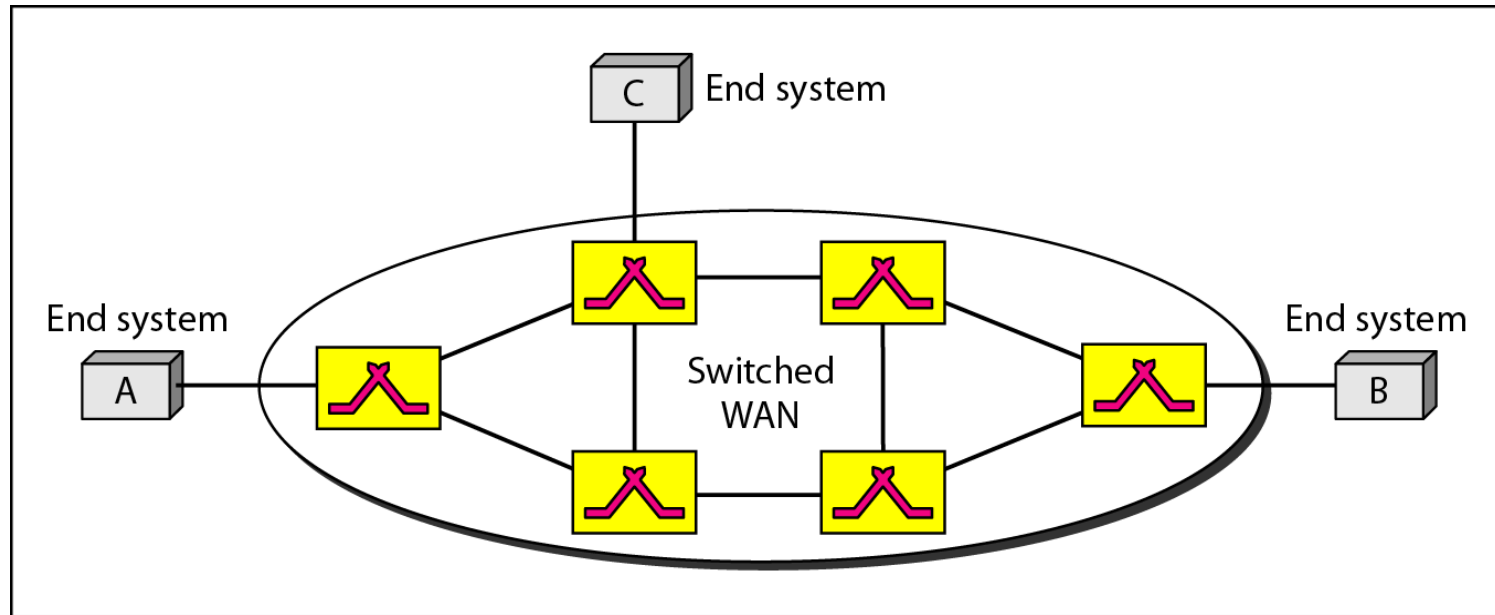
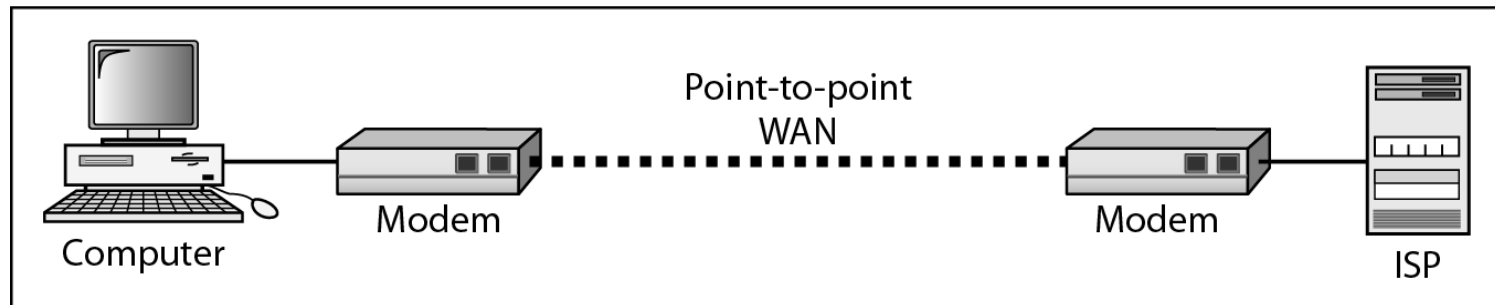


Figure 1.11 *WANs: a switched WAN and a point-to-point WAN*

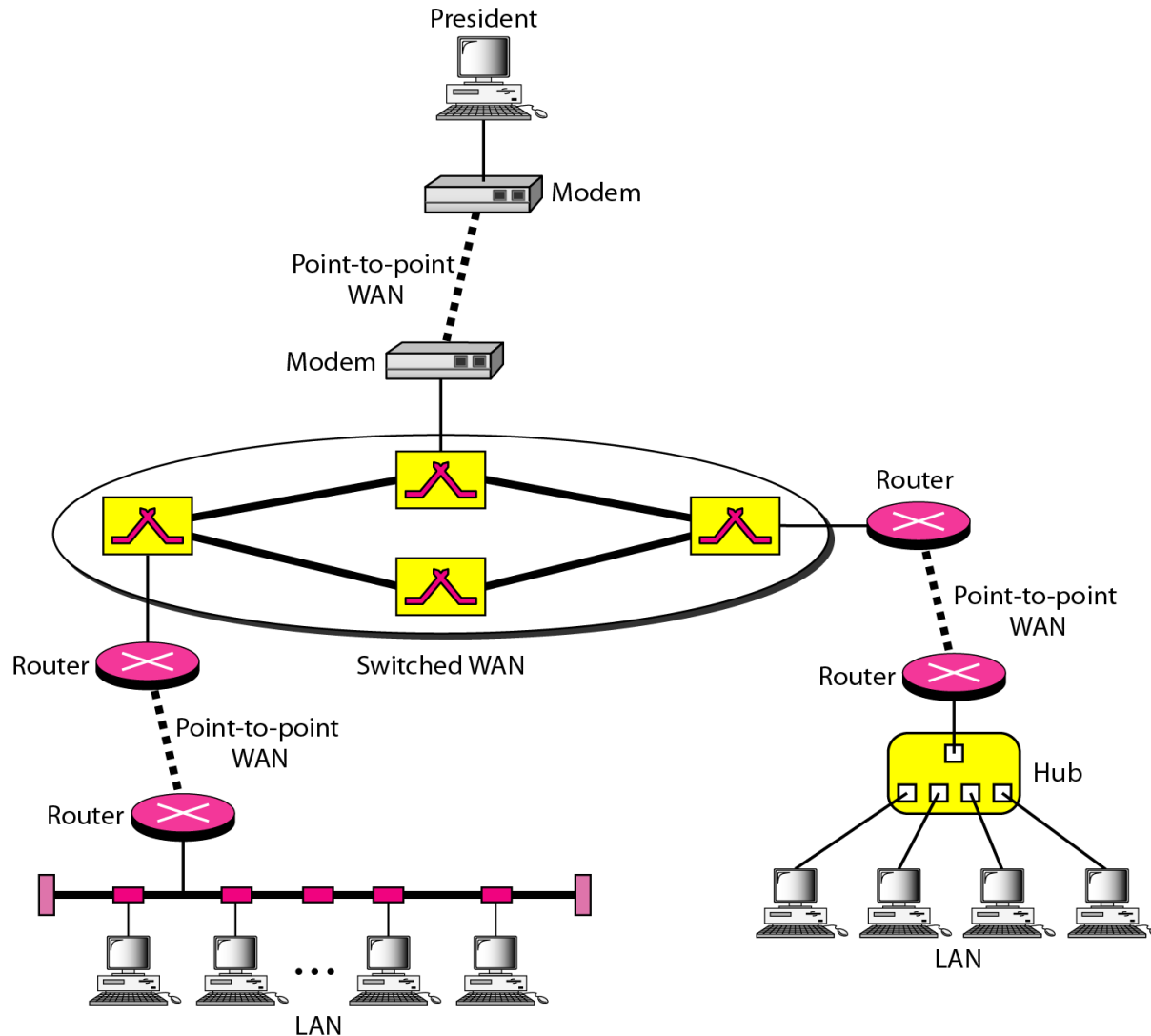


a. Switched WAN



b. Point-to-point WAN

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



1-3 THE INTERNET

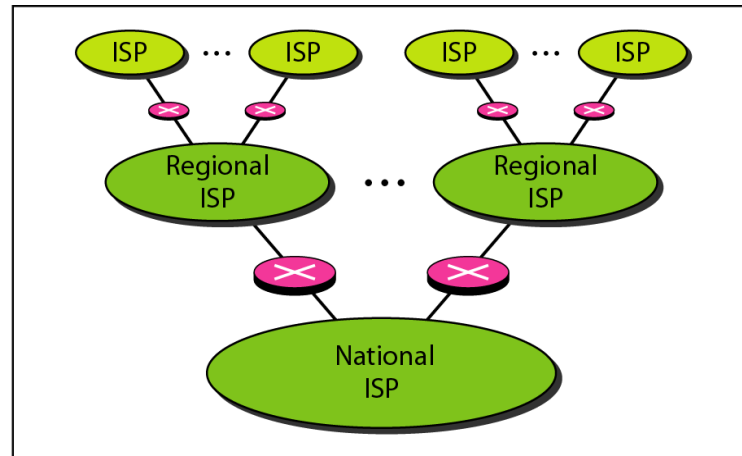
*The **Internet** has revolutionized many aspects of our daily lives. It has affected the way we do business as well as the way we spend our leisure time. The Internet is a communication system that has brought a wealth of information to our fingertips and organized it for our use.*

Topics discussed in this section:

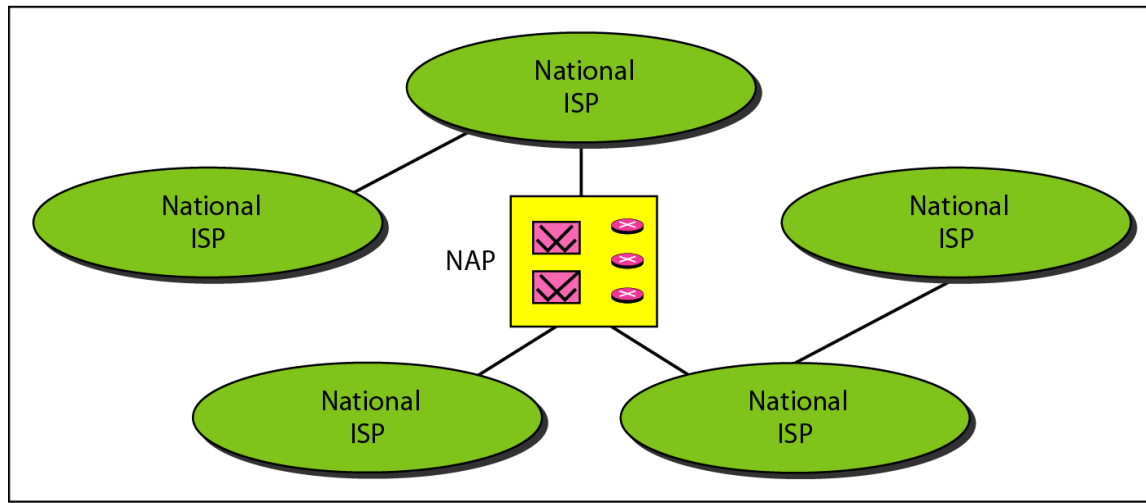
Organization of the Internet

Internet Service Providers (ISPs)

Figure 1.13 *Hierarchical organization of the Internet*



a. Structure of a national ISP



b. Interconnection of national ISPs

1-4 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 and when it is communicated. The key elements of a protocol are syntax, semantics and timing

- De-jure and De-facto Protocols.

Topics discussed in this section:

- Syntax
- Semantics
- 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 and what
 - Speed at which data should be sent or speed at which it is being received.