



# Chapter 1

## Introduction

# 1-1 DATA COMMUNICATIONS

*The term **telecommunication** means communication at a distance.*

***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**

# The effectiveness of a data communications system depends on four fundamental characteristics:

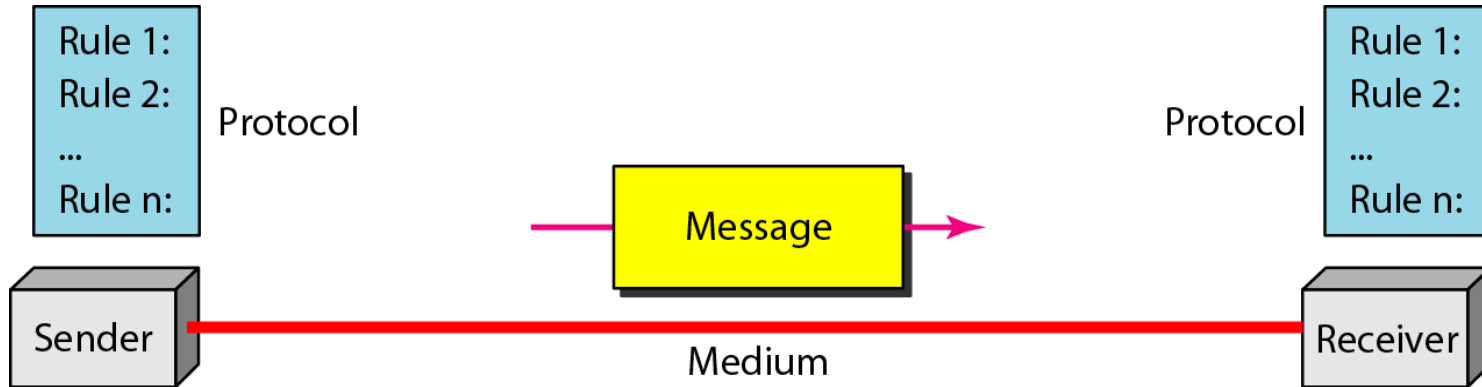
**1.Delivery:** The system must deliver data to the correct destination. Data must be received by the intended device or user and only by that device or user.

**2.Accuracy:** The system must deliver the data accurately.

**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*



# *Five components of data communication*

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

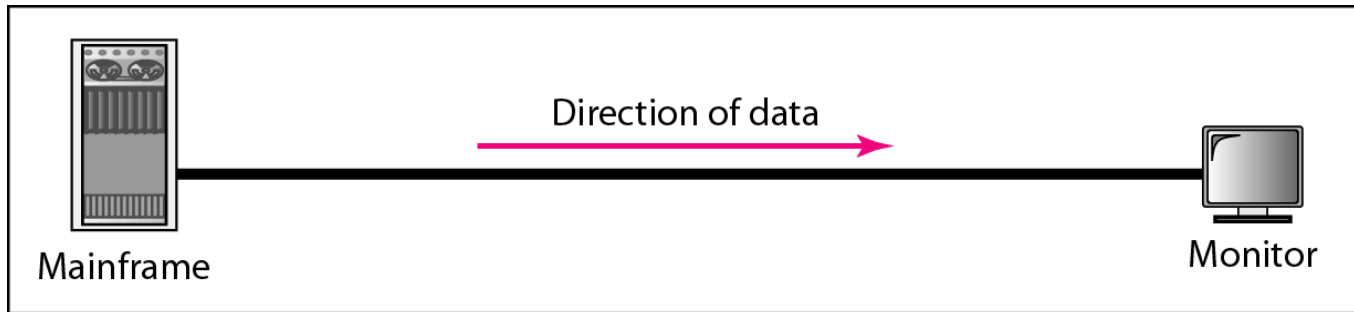
**2 Sender:** The sender is the device that sends the data message. It can be a computer, workstation, telephone handset, video camera, and so on.

**3. Receiver:** The receiver is the device that receives the message. It can be a computer, workstation, telephone handset, television, and so on.

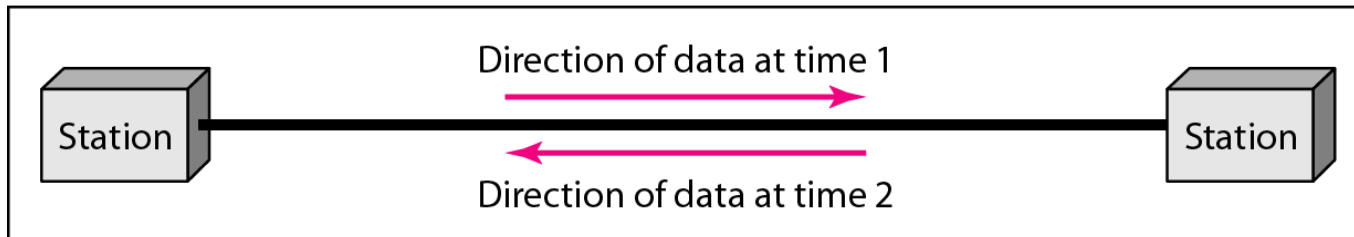
**4.Transmission medium:** The transmission medium is the physical path by which a message travels from sender to receiver. Some examples of transmission media include twisted-pair wire, coaxial cable, fiber-optic cable, and radio waves.

**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.

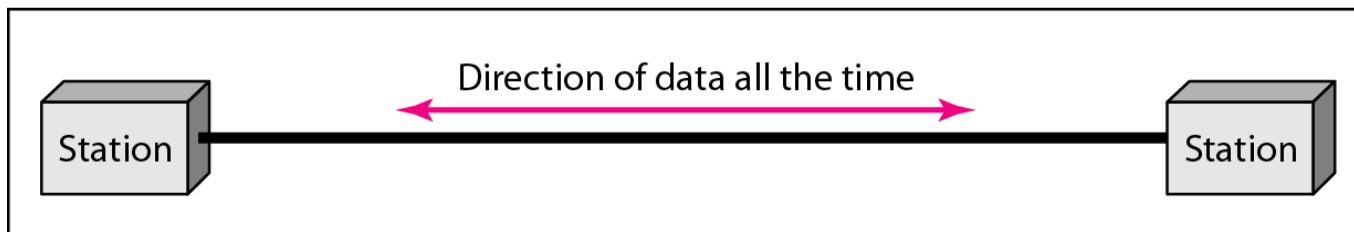
**Figure 1.2** *Data flow (simplex, half-duplex, and full-duplex)*



a. Simplex



b. Half-duplex



c. Full-duplex

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

## ***Simplex***

In simplex mode, the communication is unidirectional, as on a one-way street. Only one of the two devices on a link can transmit; the other can only receive. Keyboards and traditional monitors are examples of simplex devices. The keyboard can only introduce input; the monitor can only accept output.

## ***Half-Duplex***

In half-duplex mode, each station can both transmit and receive, but not at the same time. When one device is sending, the other can only receive, and vice versa. The half-duplex mode is like a one-lane road with traffic allowed in both directions. When cars are traveling in one direction, cars going the other way must wait. Walkie-talkies and CB (citizens band) is half-duplex systems.

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

## ***Full-Duplex***

In full-duplex mode (also called duplex), both stations can transmit and receive simultaneously .

One common example of full-duplex communication is the telephone network. When two people are communicating by a telephone line, both can talk and listen at the same time.



# 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**

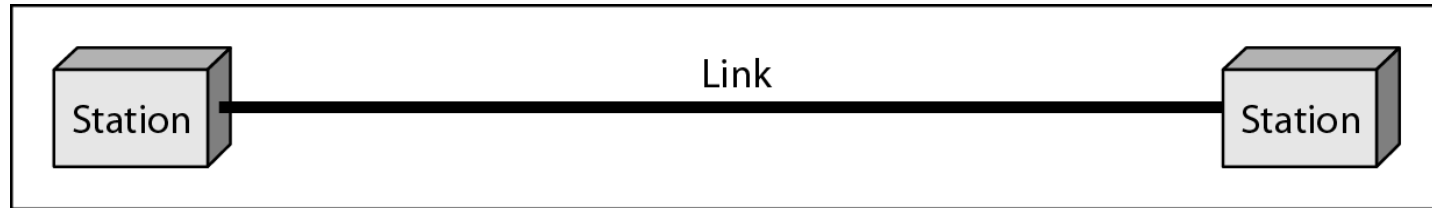
**Physical Structures**

**Network Models**

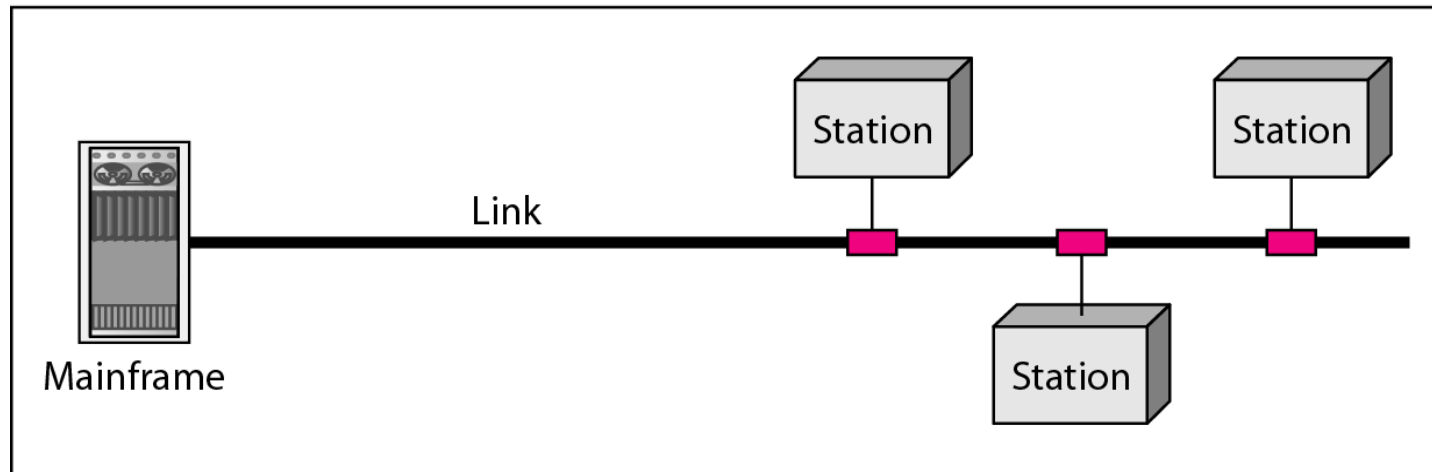
**Categories of Networks**

**Interconnection of Networks: Internetwork**

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



a. Point-to-point



b. Multipoint

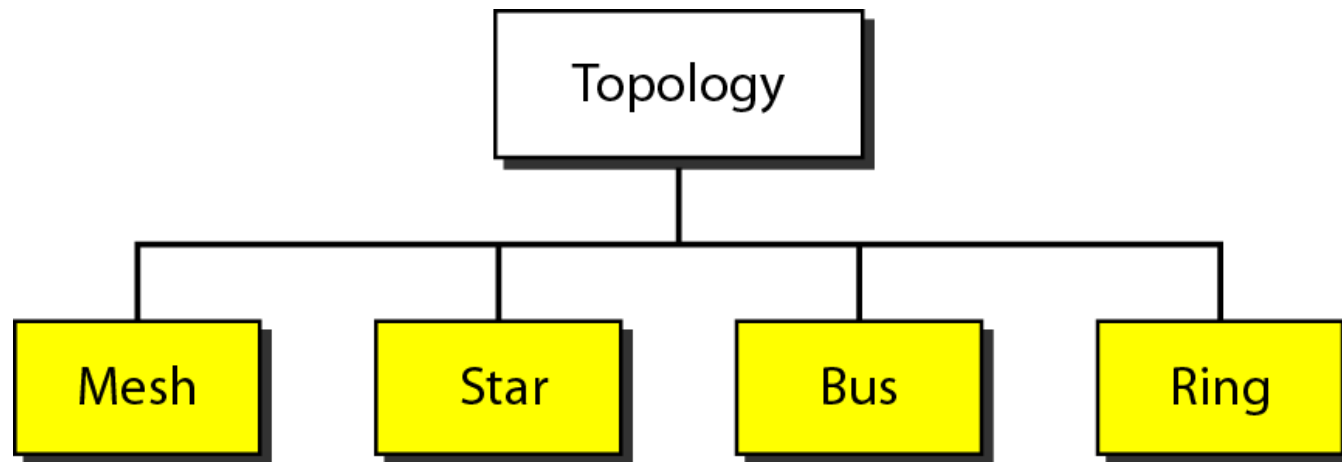
The topology of a network is the geometric representation of the relationship of all the links and linking devices (usually called nodes) to one another. There are four basic topologies possible: mesh, star, bus, and ring.

**Topology description and advantages disadvantages—  
SEE BOOK**

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**Figure 1.4** *Categories of topology*

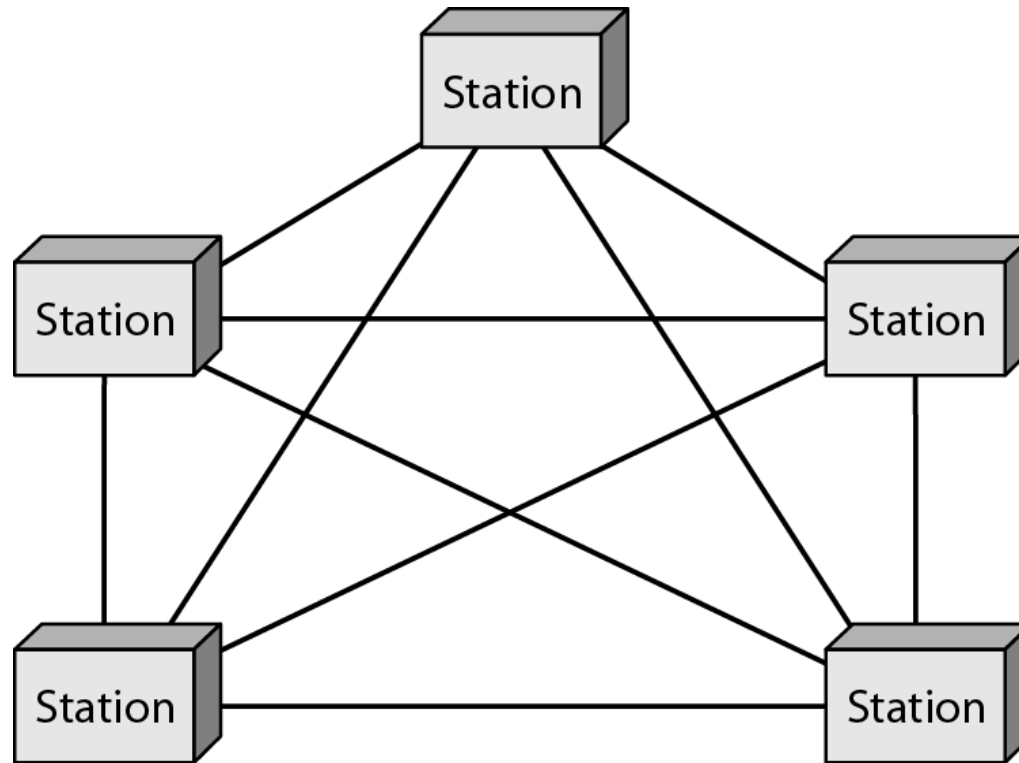
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**Figure 1.5** *A fully connected mesh topology (five devices)*

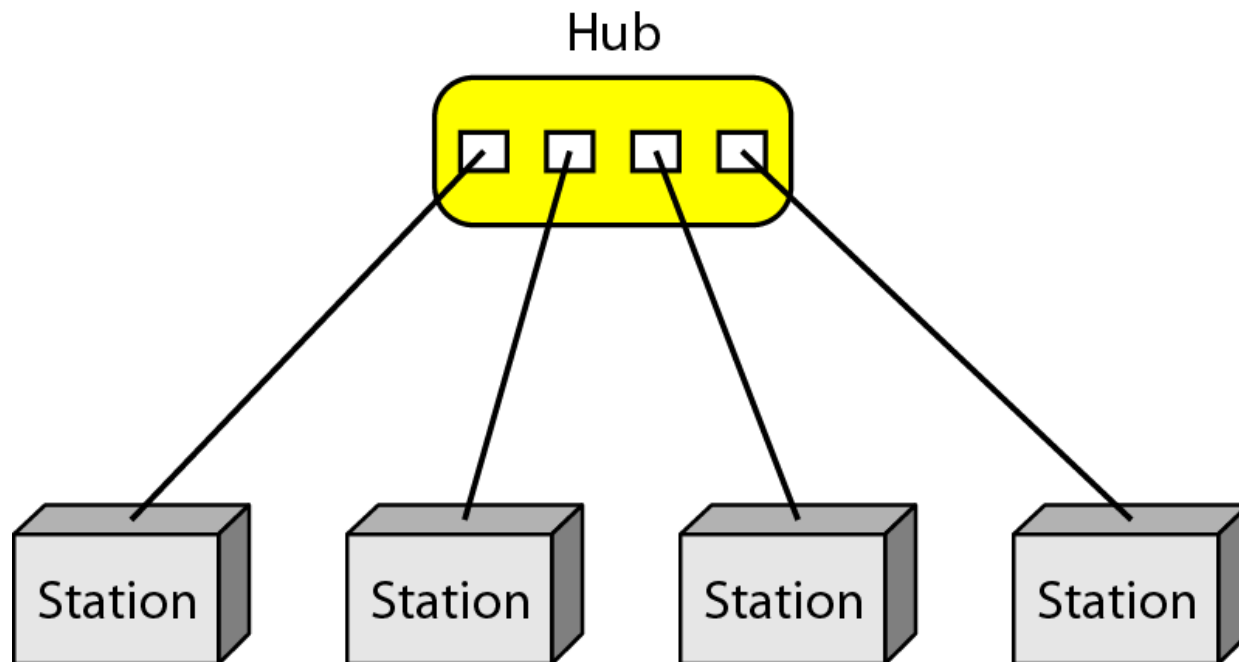
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**Figure 1.6** *A star topology connecting four stations*

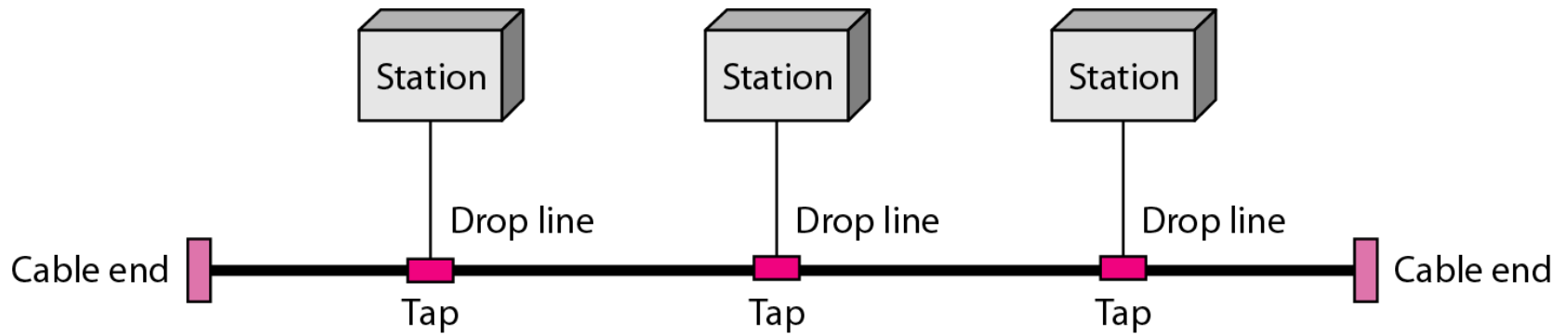
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**Figure 1.7** *A bus topology connecting three stations*

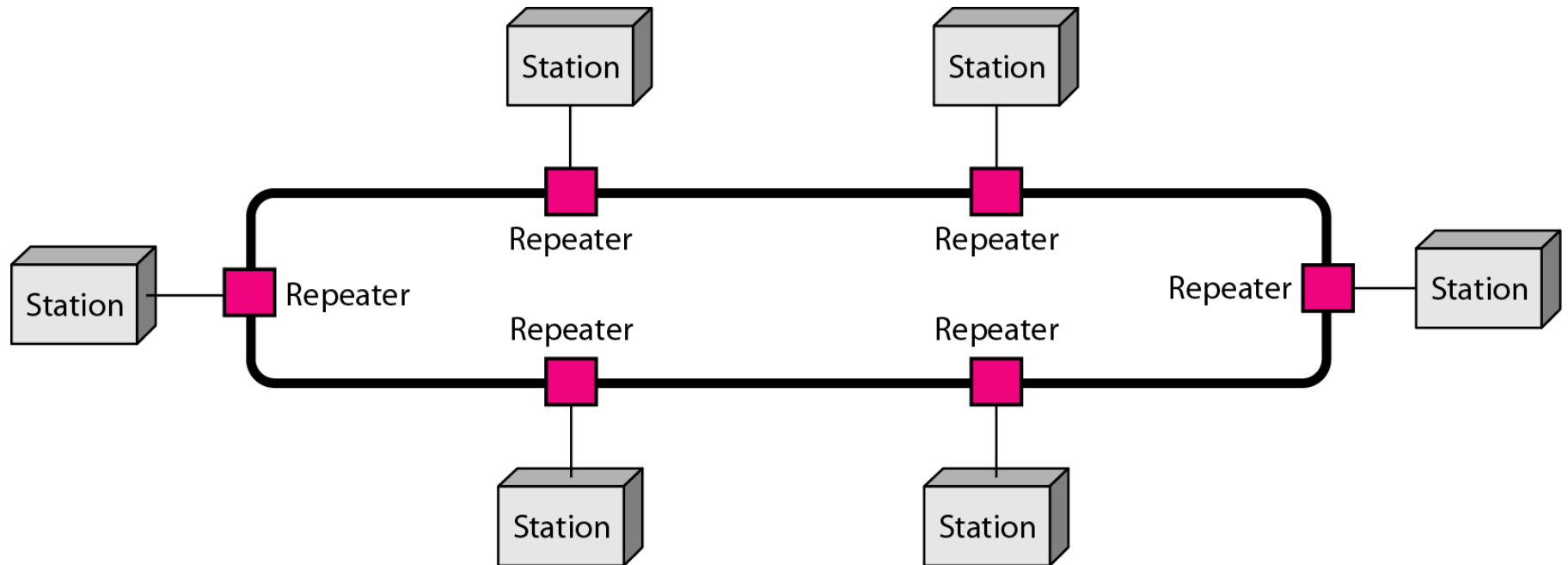
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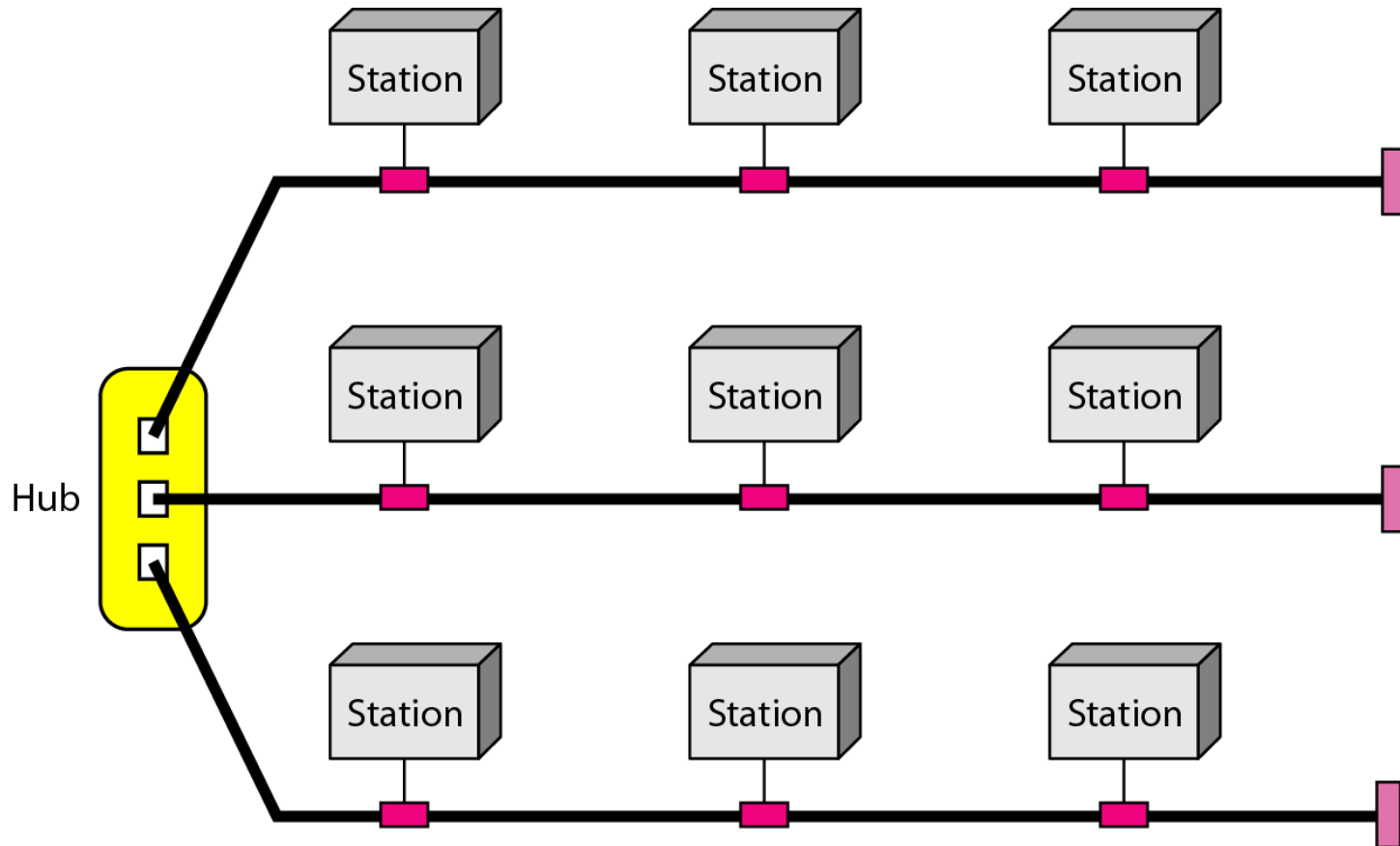
**Figure 1.8** *A ring topology connecting six stations*

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



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## Categories of Networks

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See Types of Network slide **or book**

# 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

# PROTOCOLS AND STANDARDS

A protocol is a set of rules that govern data communications. A protocol defines what is communicated, how it is communicated, and when it is communicated. The key elements of a protocol are syntax, semantics, and timing.

- o **Syntax:** The term *syntax* refers to the structure or format of the data, meaning the order in which they are presented. For example, a simple protocol might expect the first 8 bits of data to be the address of the sender, the second 8 bits to be the address of the receiver, and the rest of the stream to be the message itself.

- o **Semantics:** The word *semantics* refers to the meaning of each section of bits. How is a particular pattern to be interpreted, and what action is to be taken based on that interpretation? For example, does an address identify the route to be taken or the final destination of the message?

- o **Timing:** The term *timing* refers to two characteristics: when data should be sent and how fast they can be sent. For example, if a sender produces data at 100 Mbps but the receiver can process data at only 1 Mbps, the transmission will overload the receiver and some data will be lost.