Data Communications and Networking Fourth Edition

Forouzan

Chapter 1

Introduction

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Course Objectives

Course Objectives	a) Introduce students to the evolution of computer networks and the concepts data communication; b) Introduce students the general principles of network design and compare the different network topologies; c) Introduce students to the digital and analogue representations and channels; d) Describe the mechanism and techniques of encoding; e) Introduce students to the general principles of circuit and packet switching; f) Introduce students to the wireless Local Area Networks; g) Provide students with in-depth knowledge of data link layer fundamental such as error detection, correction and flow control techniques; multiple access control techniques.

Learning Outcomes

Learning Outcomes	i.Independently understand basic computer network technology. ii.Understand and explain Data Communications System and its components. iii.Identify the different types of network topologies and protocols. iv.Enumerate the layers of the OSI model and TCP/IP. Explain the function(s) of each layer. v.Identify the different types of network devices and their functions within a network vi.Understand and building the skills of subnetting and routing mechanisms. vii.Familiarity with the basic protocols of computer networks, multiple access protocols, protocols to avoid collusion and how they can be used to assist in network design and implementation.

Teaching Methods

Teaching Methods	• Lectures • Presentations (when necessary) • Group discussions (when necessary) • Individual assignments and presentations

Assessment Methods	

Assessment Types	**Marks**
Attendance and Participation (Class Room & Course Page)	5%
Assignment	5%
Presentation	5%
3 Quizzes/ Class Tests	15%
Mid Term	30%
Final Exam	40%
Total	**100%**

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**

Figure 1.1 *Components of a data communication system*

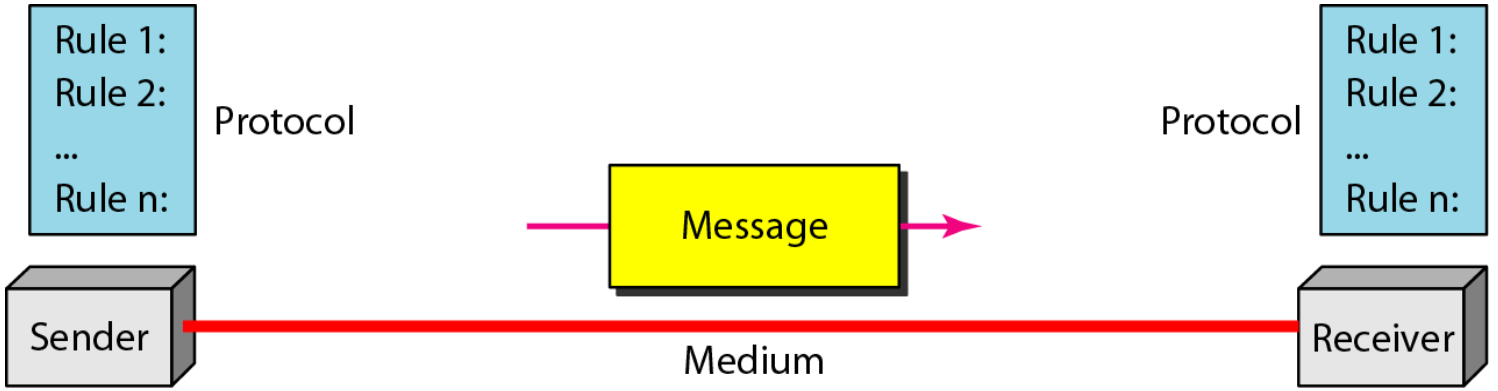
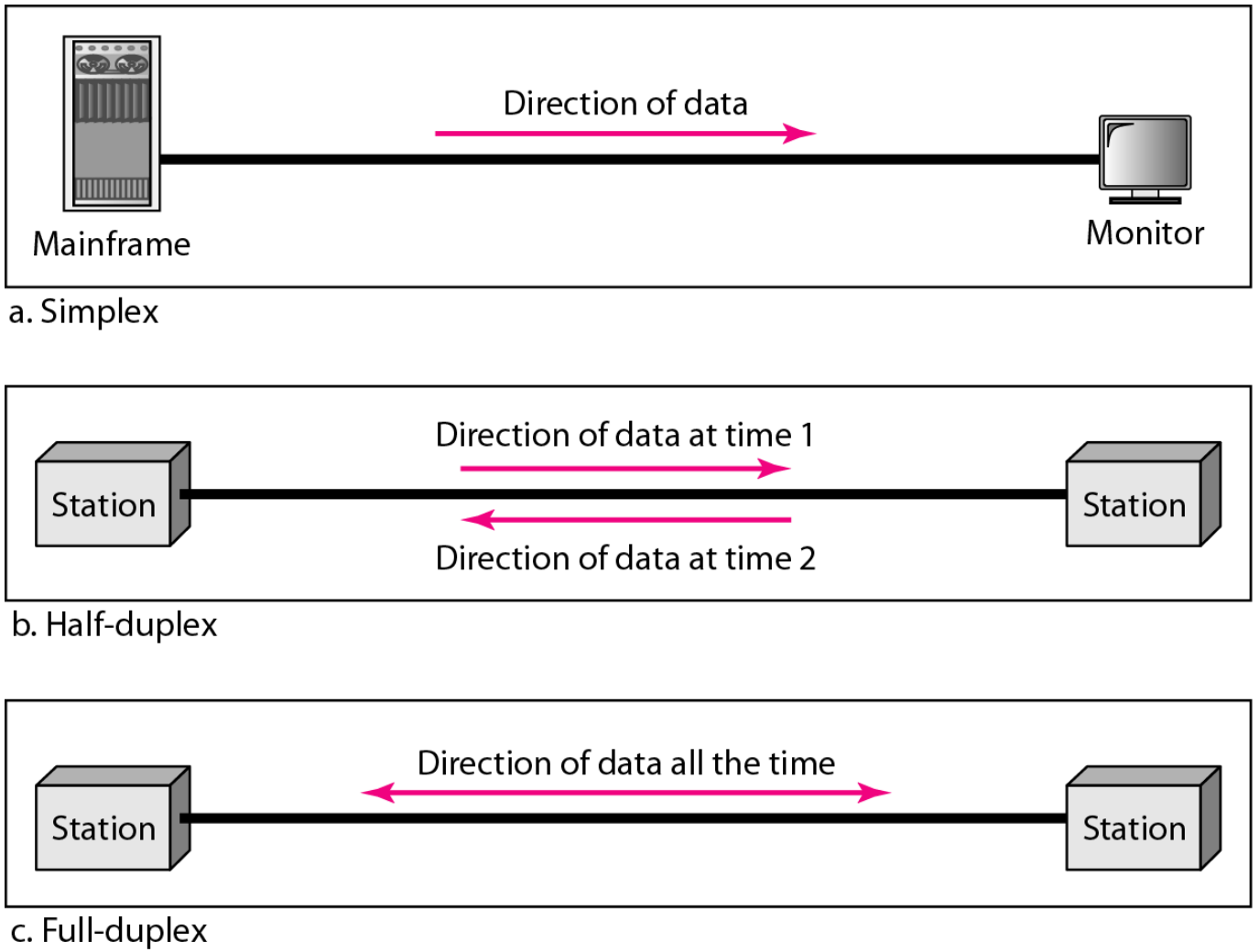


Figure 1.2 *Data flow (simplex, half-duplex, and full-duplex)*



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. 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*

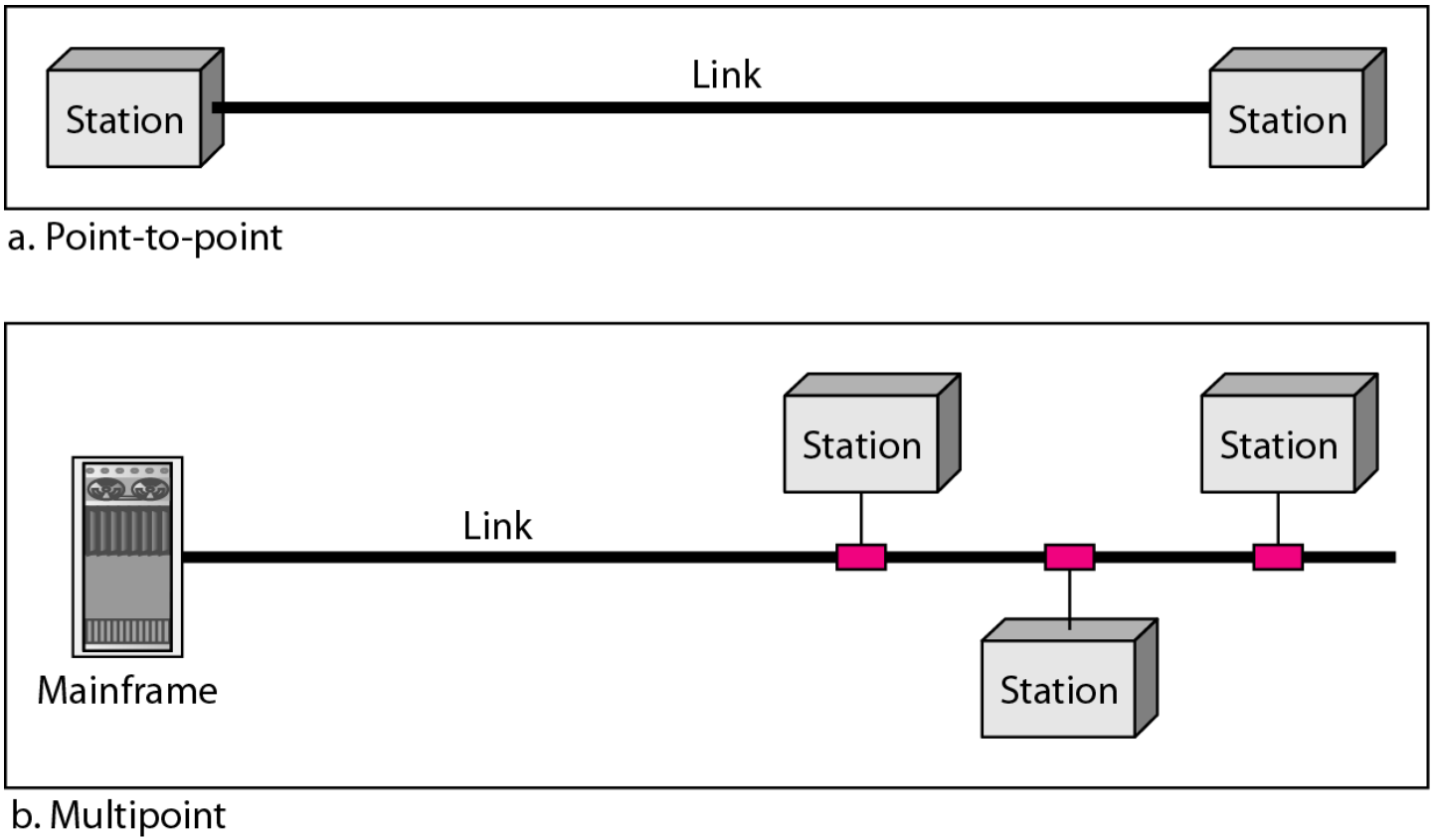


Figure 1.4 *Categories of topology*

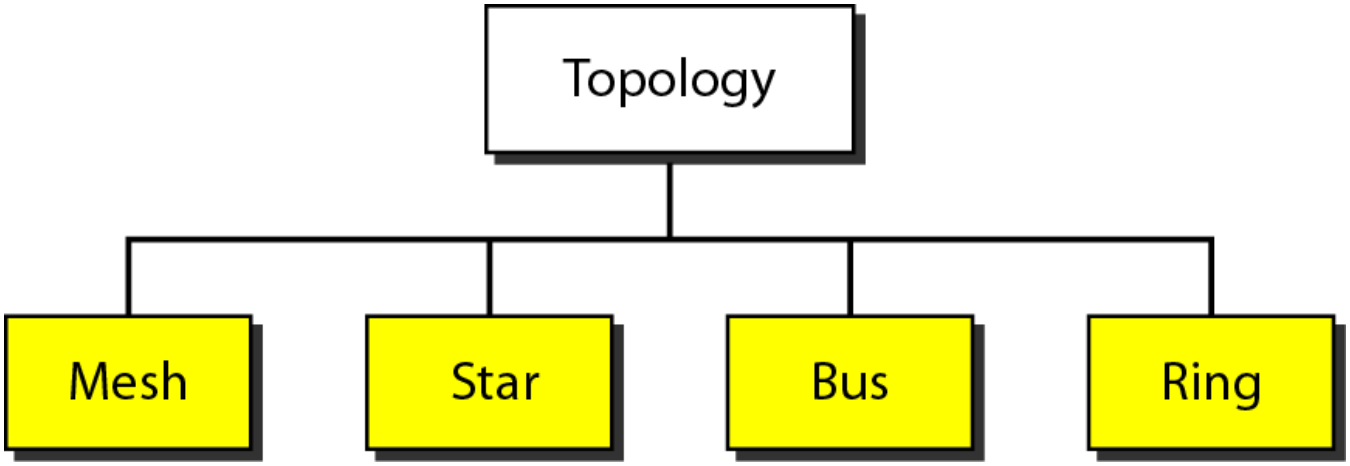


Figure 1.5 *A fully connected mesh topology (five devices)*

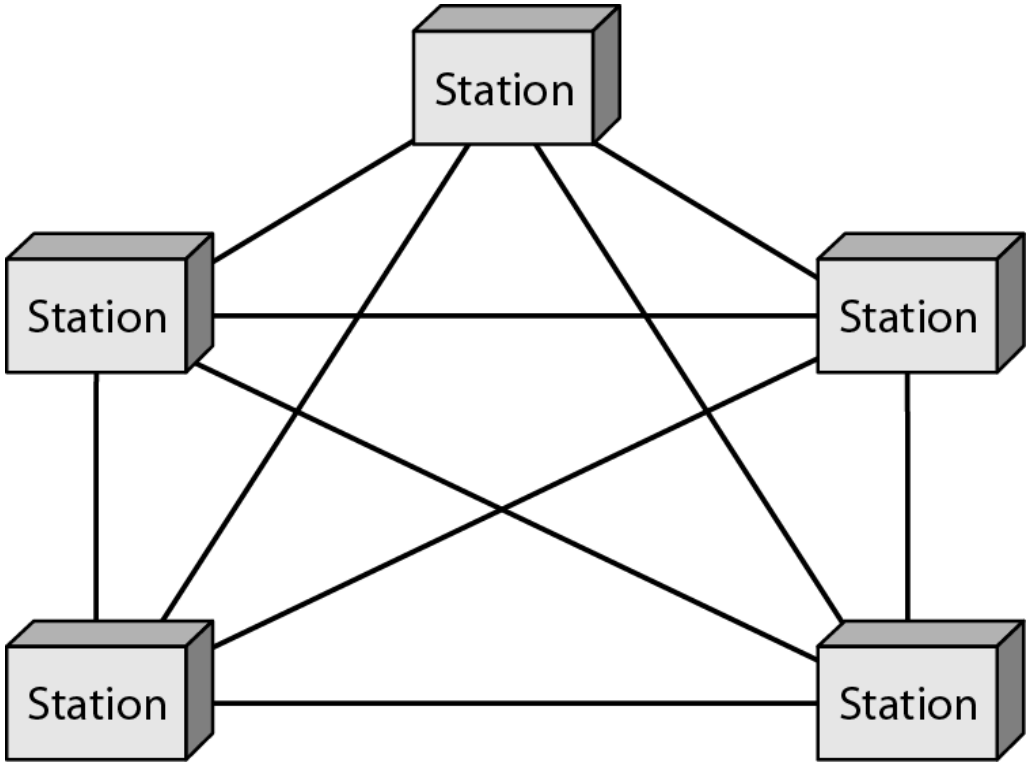


Figure 1.6 *A star topology connecting four stations*

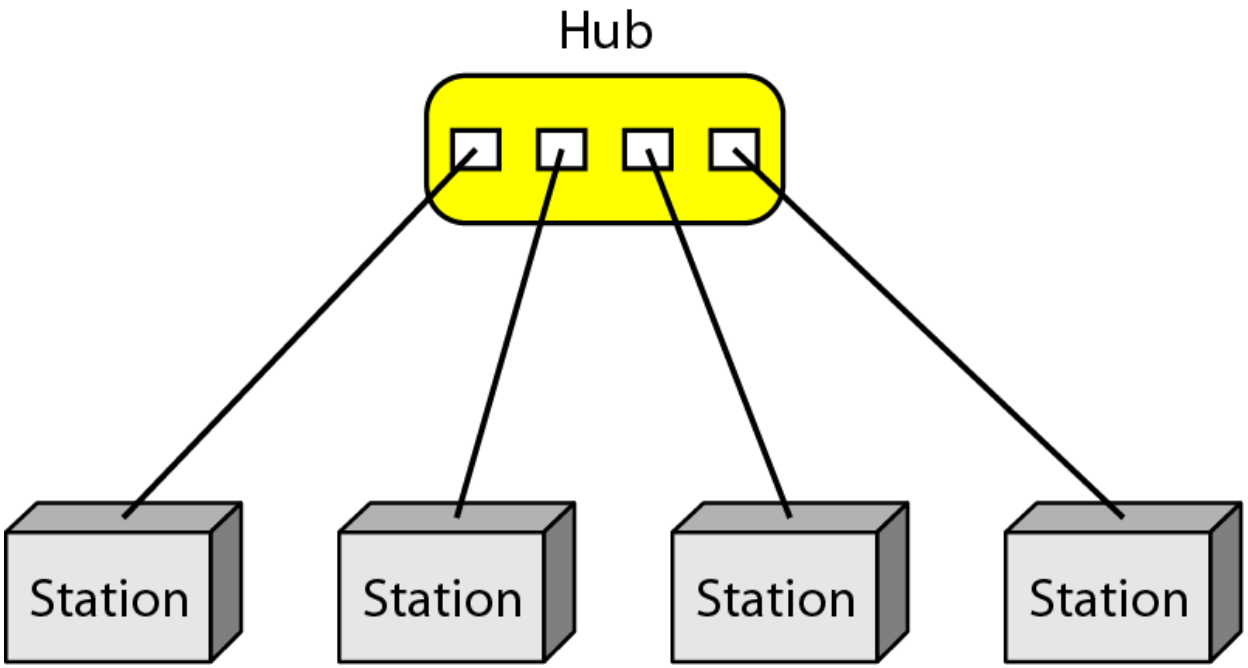


Figure 1.7 *A bus topology connecting three stations*

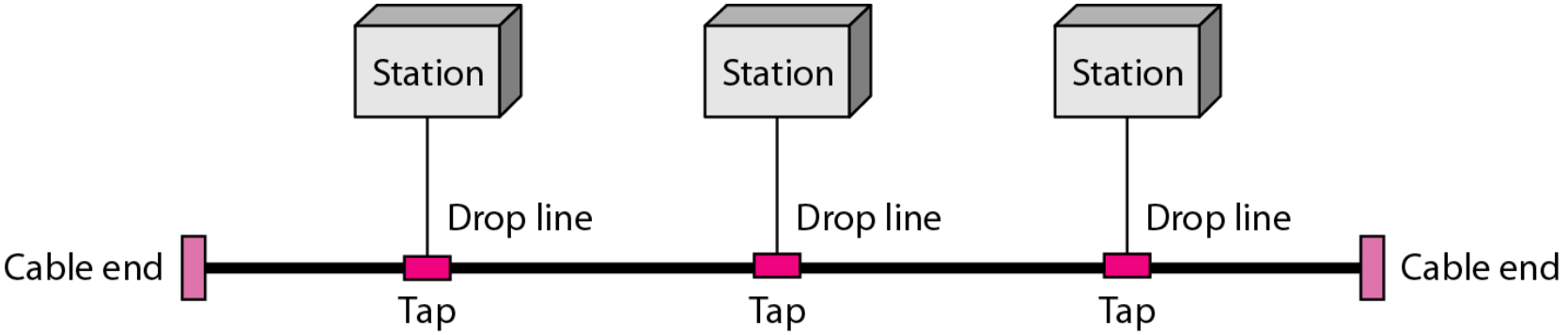


Figure 1.8 *A ring topology connecting six stations*

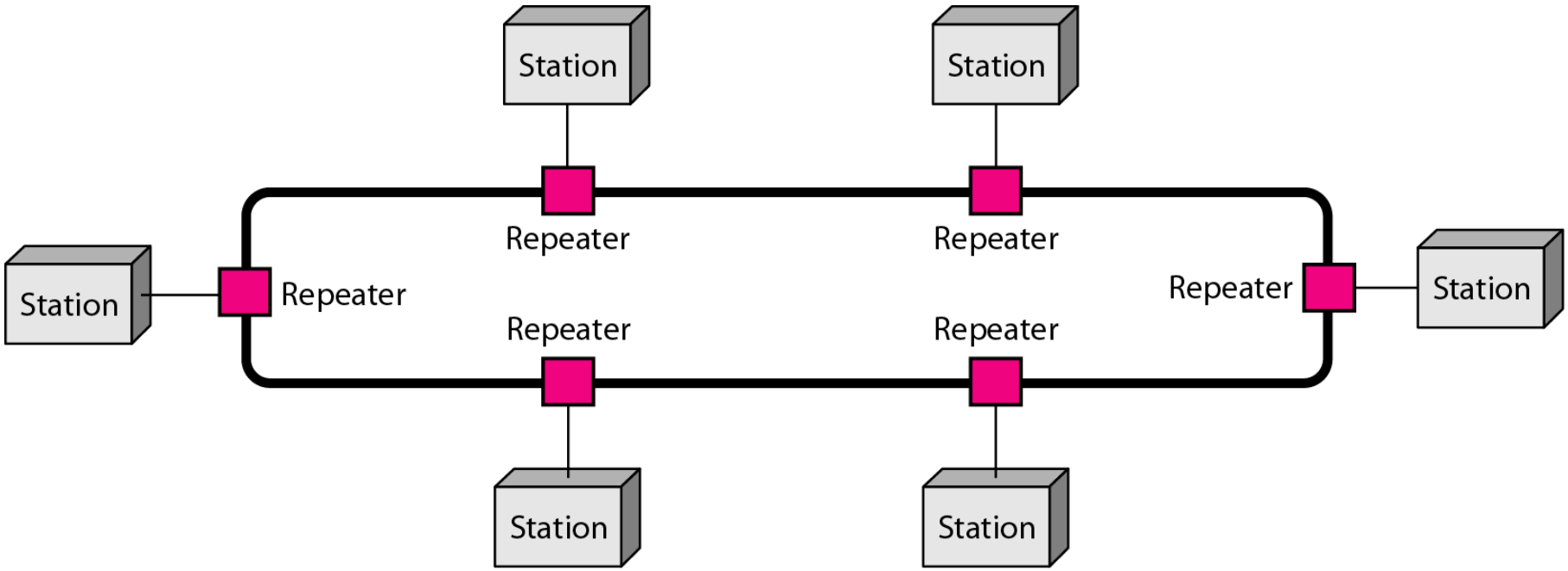
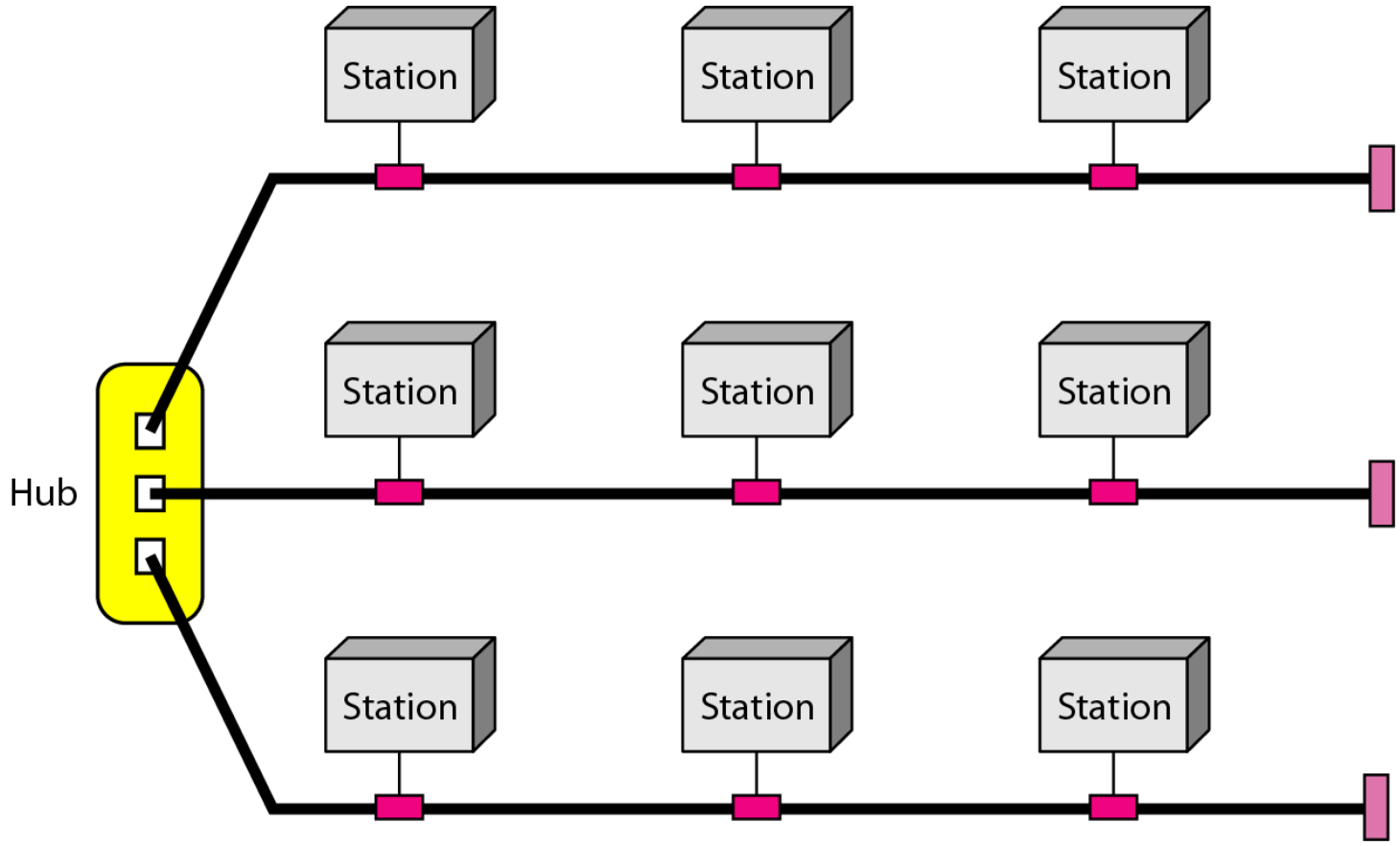


Figure 1.9 *A hybrid topology: a star backbone with three bus networks*



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*

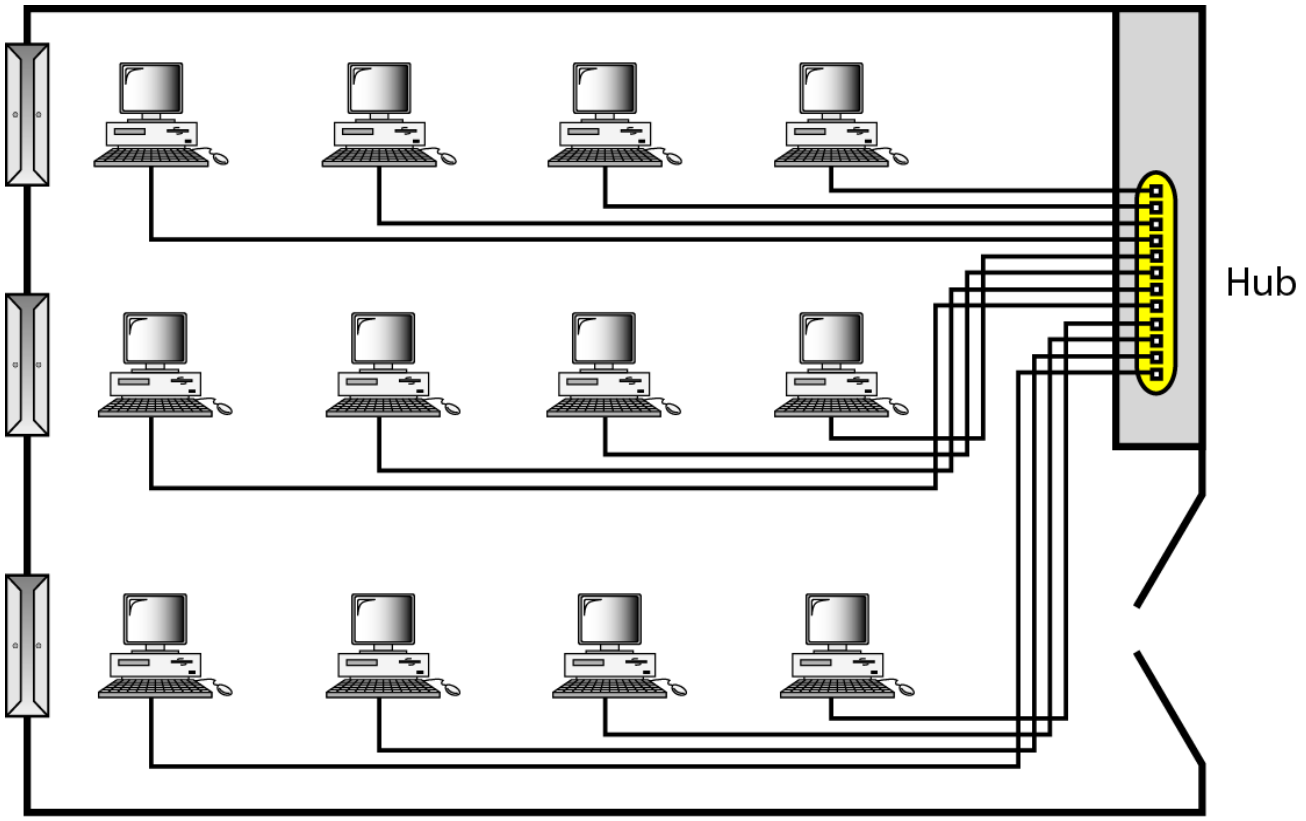
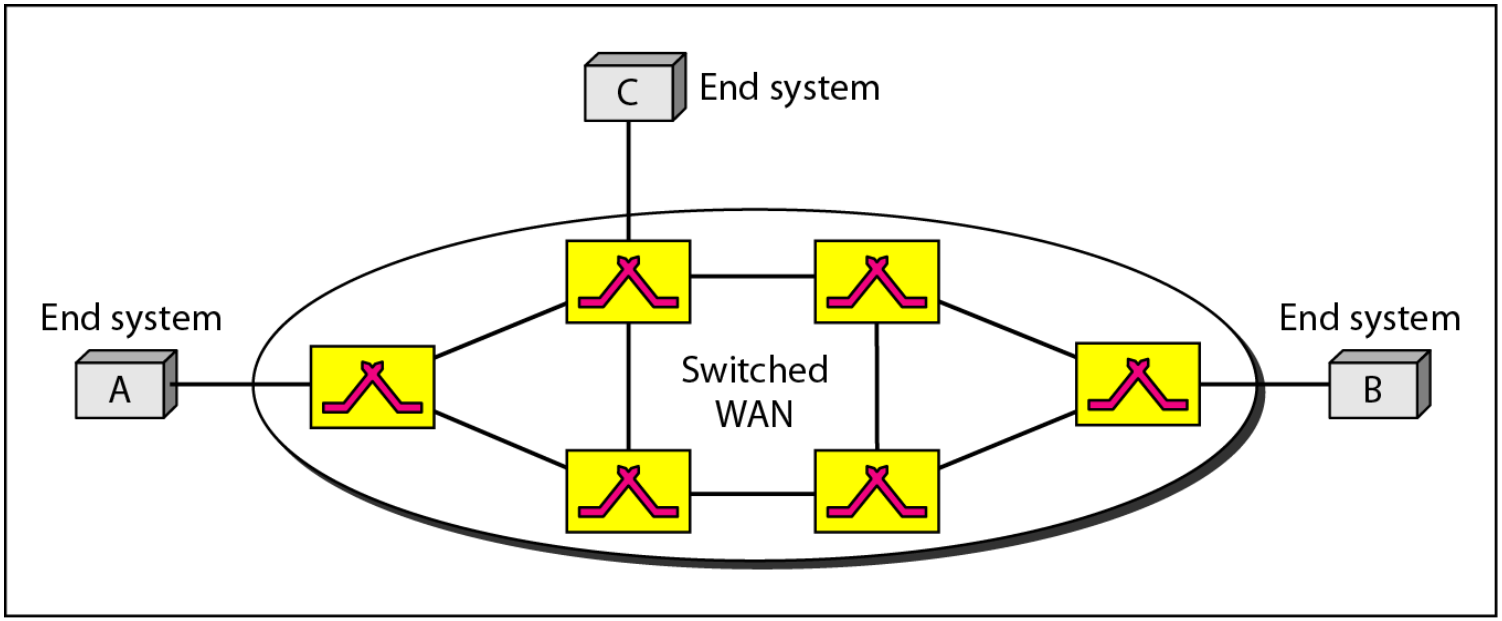
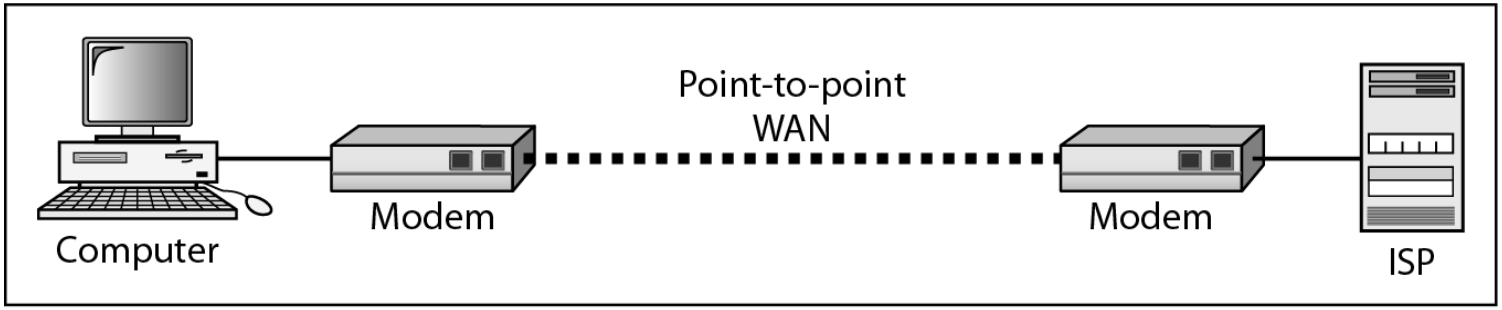


Figure 1.11 *WANs: a switched WAN and a point-to-point WAN*

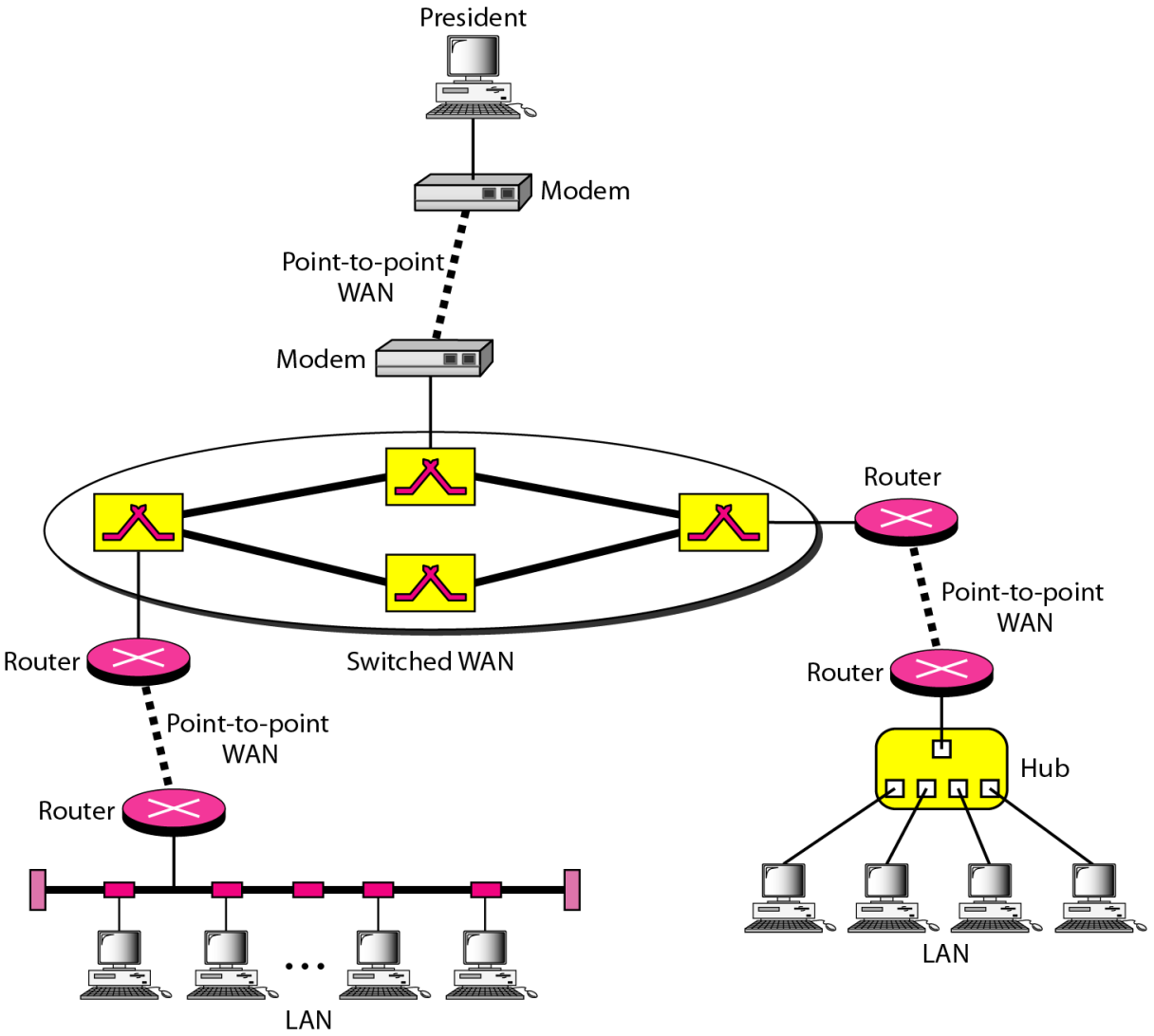


a. Switched WAN



b. Point-to-point WAN

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



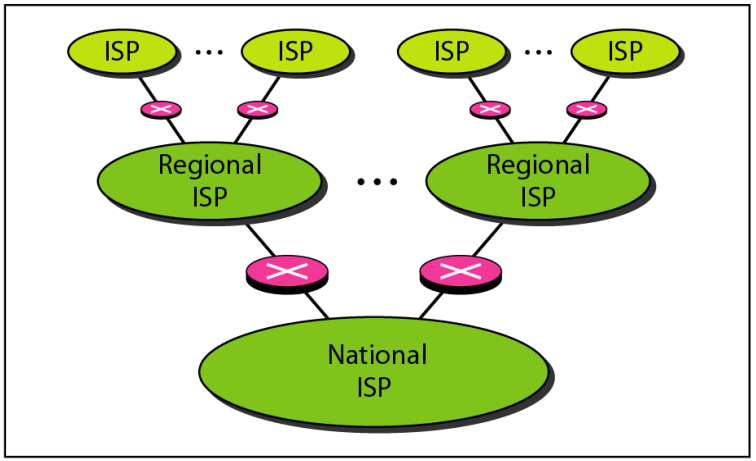
1-3 THE INTERNET

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.

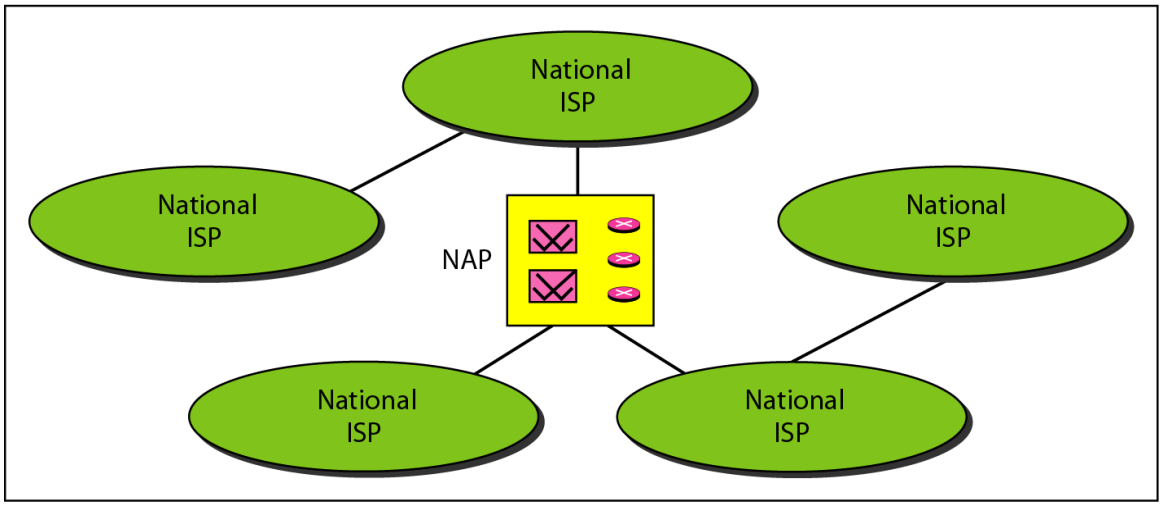
Topics discussed in this section:

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

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.**