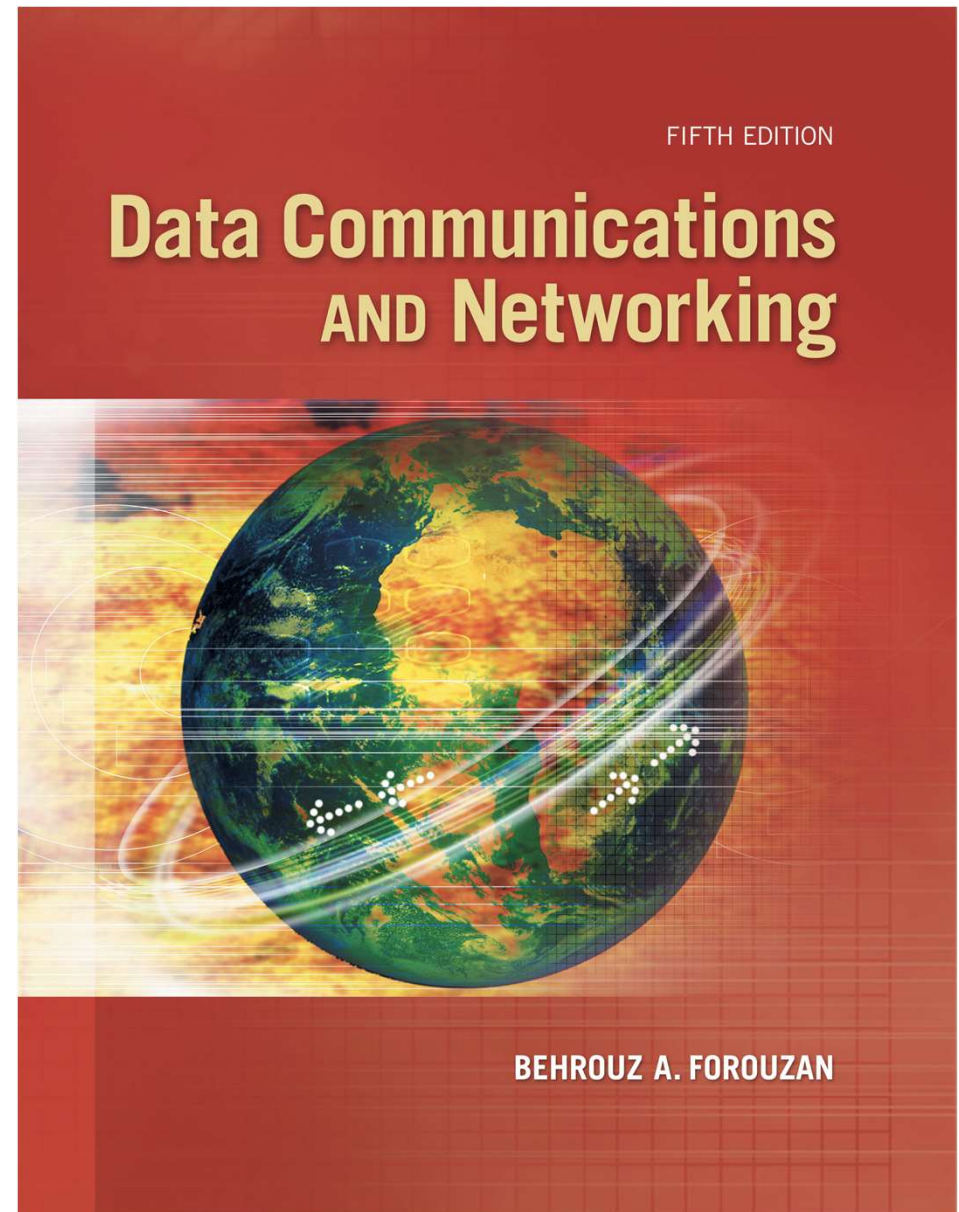


The McGraw-Hill Companies

Chapter 1

Introduction





Chapter 1: Outline

1.1 Data Communications

1.2 Networks

1.3 Network Types

1.4 Internet History



Chapter 1: Objective

- ❑ *Introducing data communications and defines their components and the types of data exchanged. It also shows how different types of data are represented and how data is flowed through the network.*
- ❑ *Introducing networks and defines their criteria and structures.*
 - ❑ *Network topologies*
- ❑ *Different types of networks: LANs, WANs, and internetworks (internets).*
 - ❑ *Internet, the largest internet in the world.*
 - ❑ *Switching to show how small networks can be combined to create larger ones.*
- ❑ *Brief history of the Internet.*
 - ❑ *divided into three eras: early history, the birth of the Internet, and the issues related to the Internet today.*

1-1 DATA COMMUNICATIONS

When we communicate, we are sharing information. This sharing can be local or remote. The term telecommunication, which includes telephony, telegraph, and television, means communication at a distance.

Data communications are the exchange of data between two devices via some form of transmission media.

Four fundamental characteristics:

- 1. Delivery*
- 2. Accuracy*
- 3. Timeliness*
- 4. Jitter*

1.1.1 Components

A data communications system has five components (see Figure 1.1).

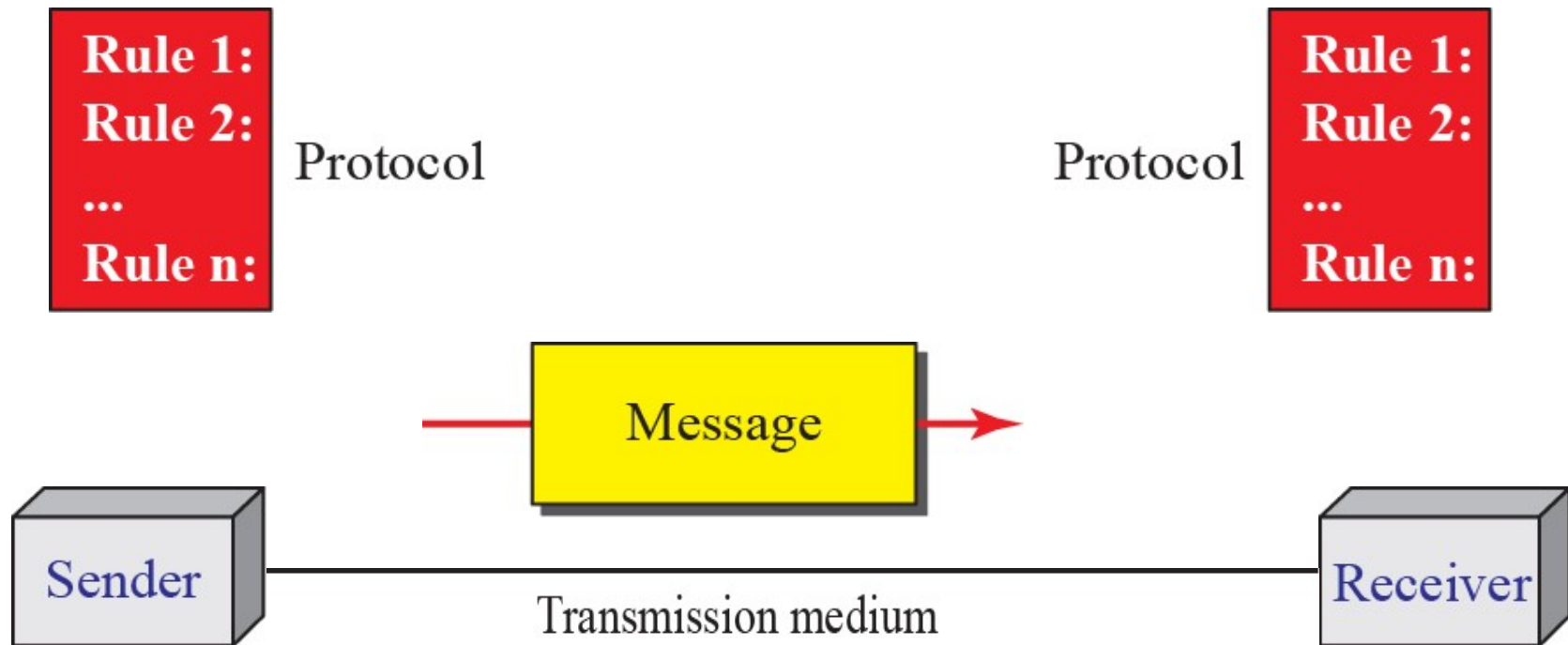


Figure 1.1: *Five components of data communication*



1.1.2 Data Representation

Information today comes in different forms such as

Text- Unicode, ASCII

Numbers- bit patterns

Images-Matrix of pixels e.g. Grayscale, RGB

Audio- Continuous e.g. using microphone to convert voice/music to an electric signal.

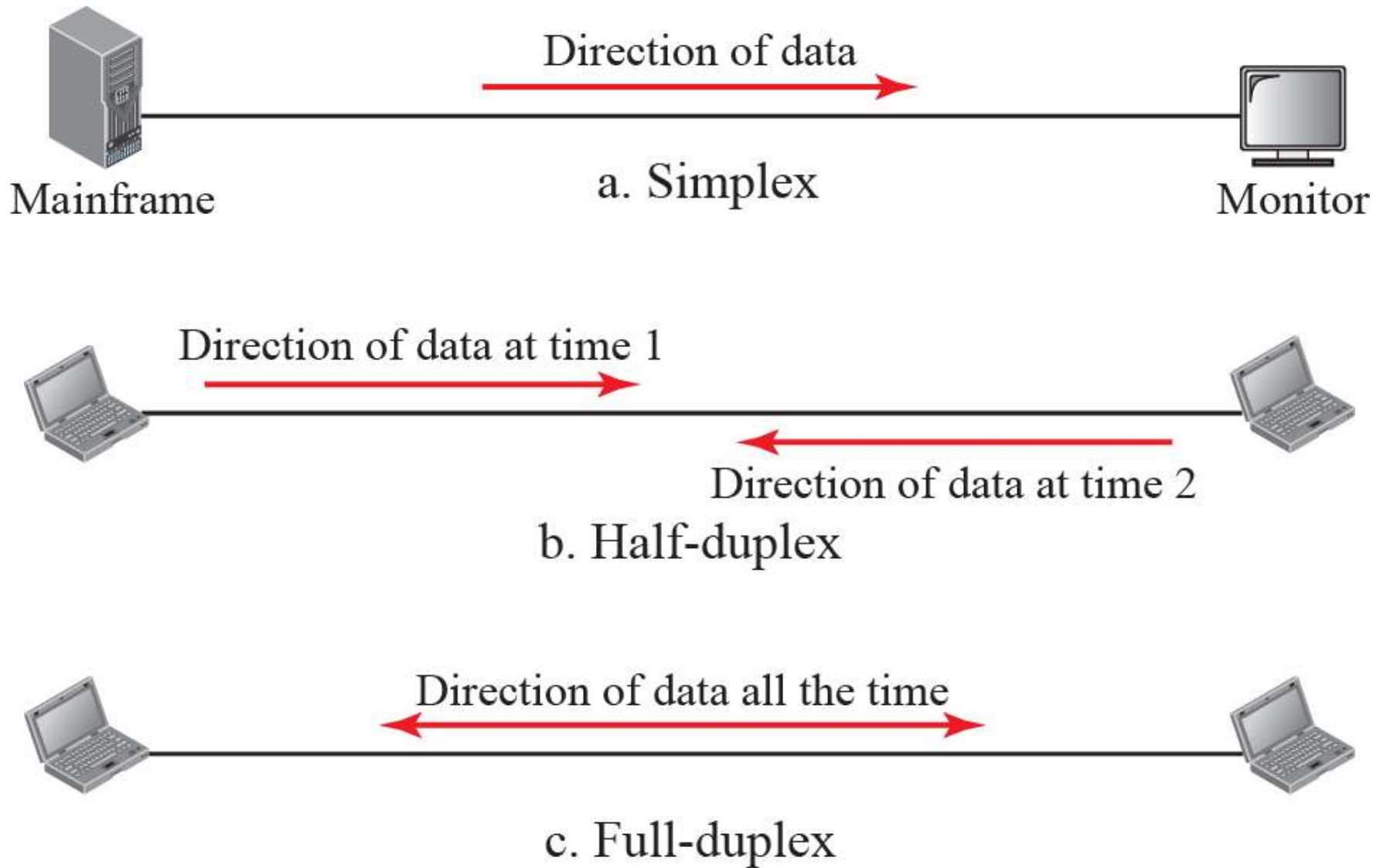
Video-Combination of frames



1.1.3 Data Flow

Communication between two devices can be simplex, half-duplex, or full-duplex as shown in Figure 1.2.

Figure 1.2: *Data flow*



1-2 NETWORKS

A network is the interconnection of a set of devices capable of communication. In this definition, a device can be a host such as a large computer, desktop, laptop, workstation, cellular phone, or security system. A device in this definition can also be a connecting device such as a router a switch, a modem that changes the form of data, and so on.



1.2.1 Network Criteria

A network must be able to meet a certain number of 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*



1.2.2 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 1.4 Categories of topology

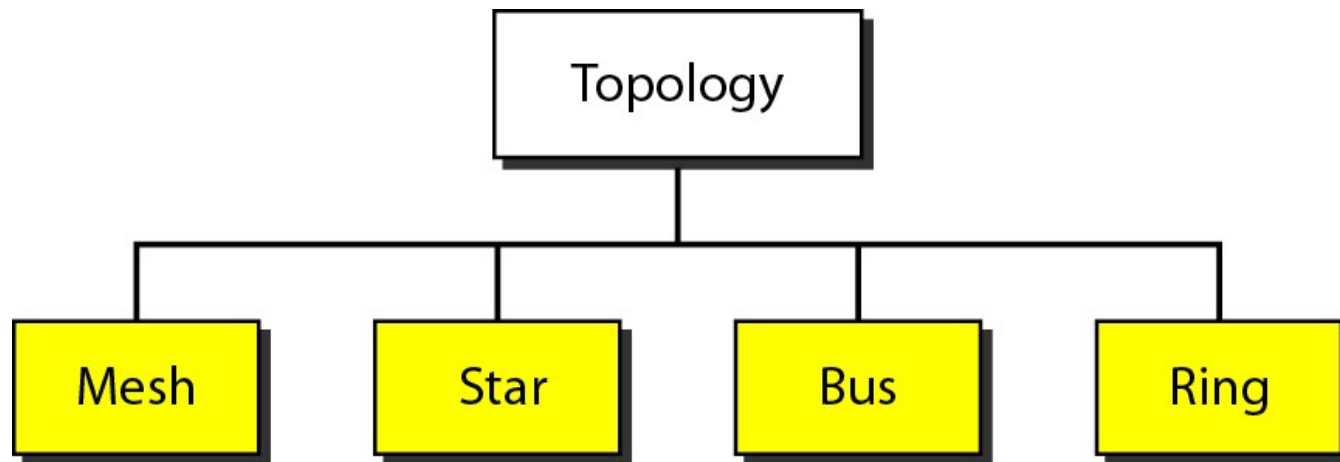


Figure 1.3: *Types of connection*

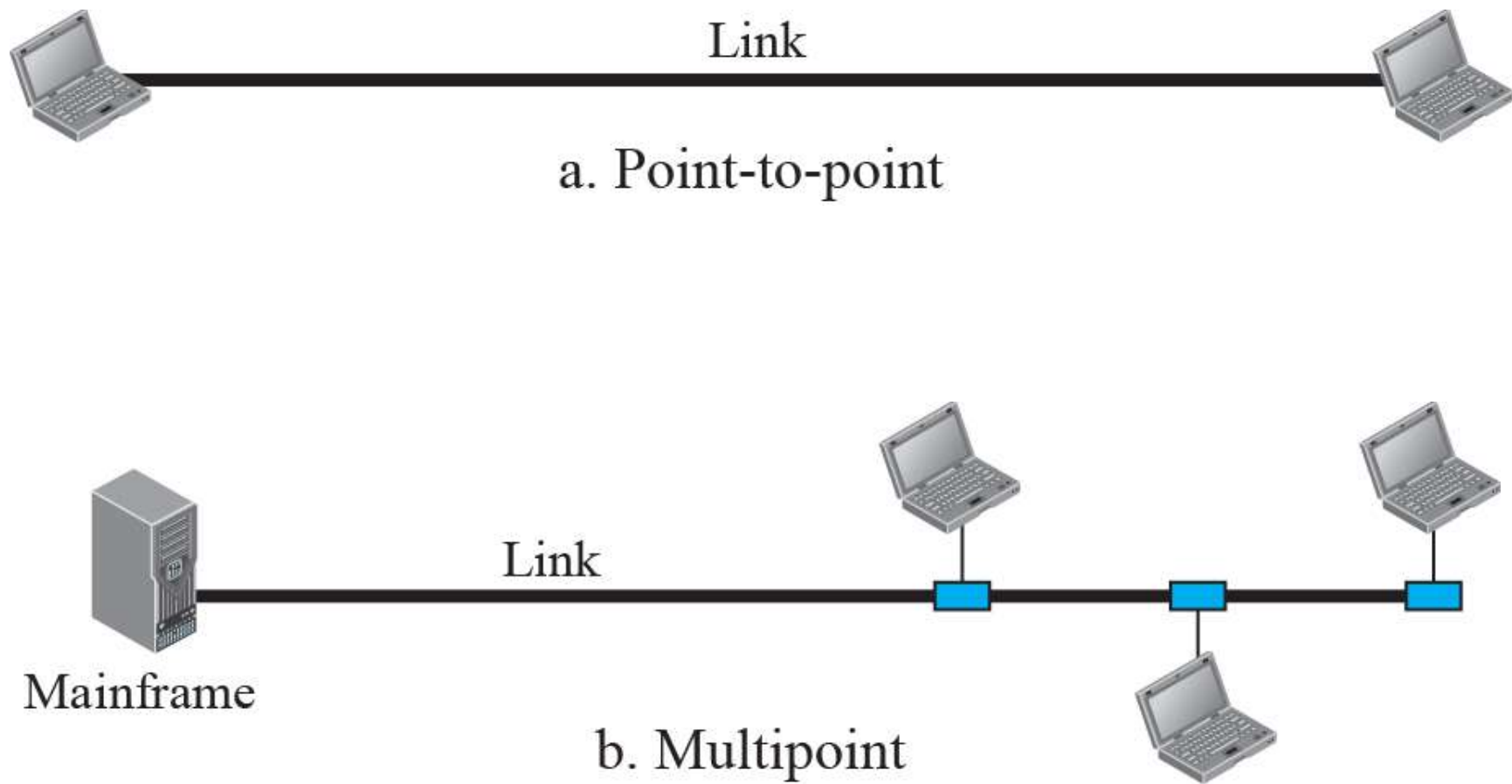


Figure 1.4: *A fully-connected mesh topology*

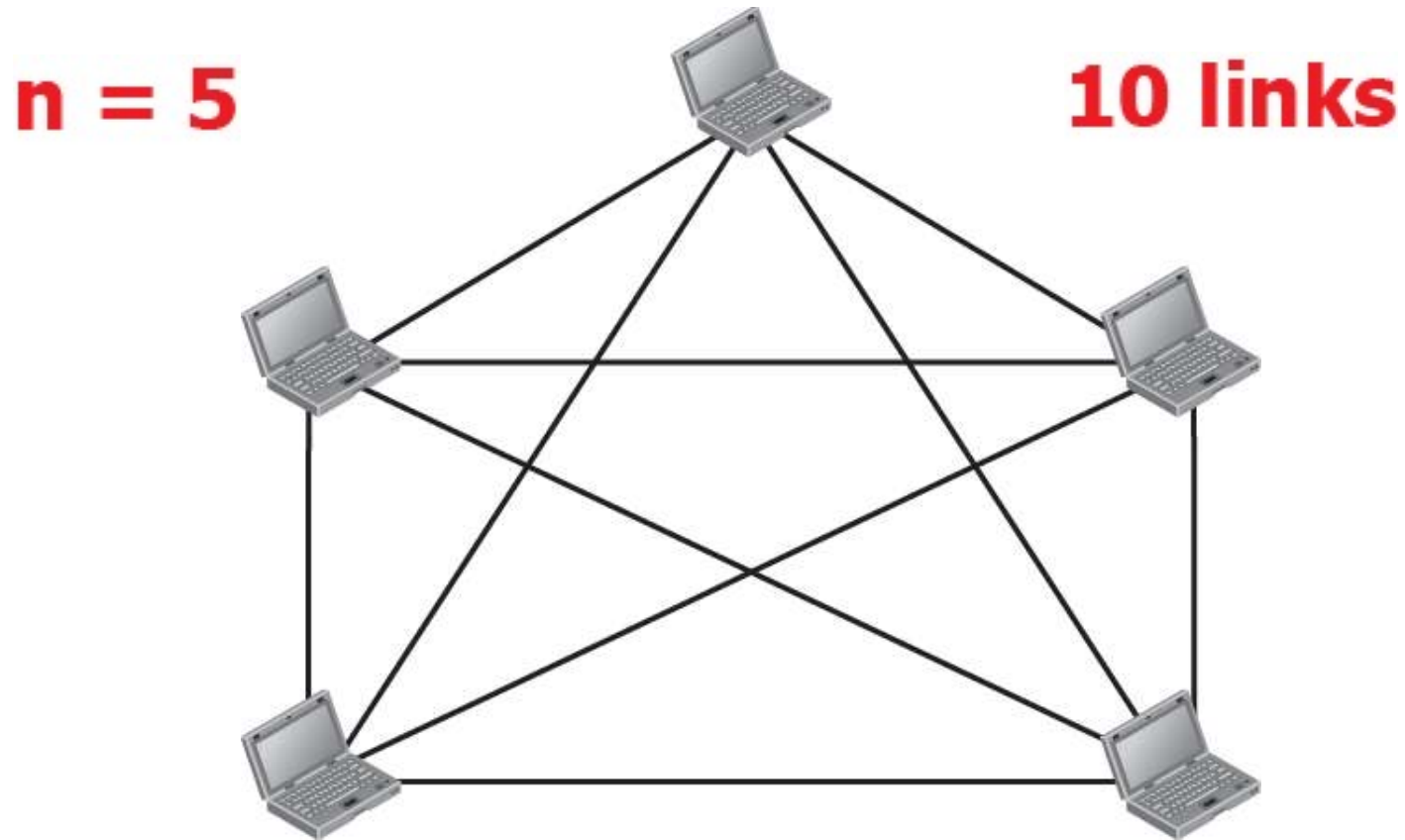


Figure 1.5: A star topology

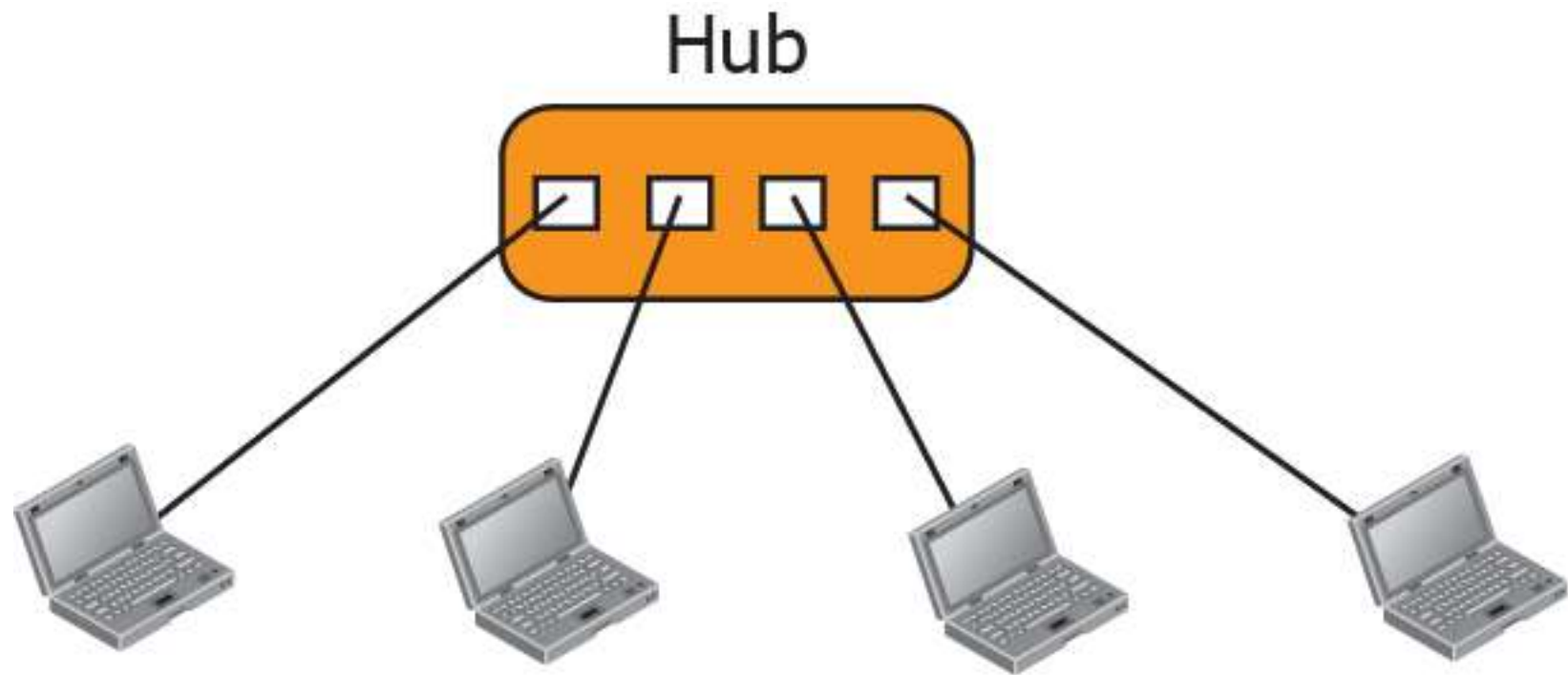


Figure 1.6: *A bus topology*

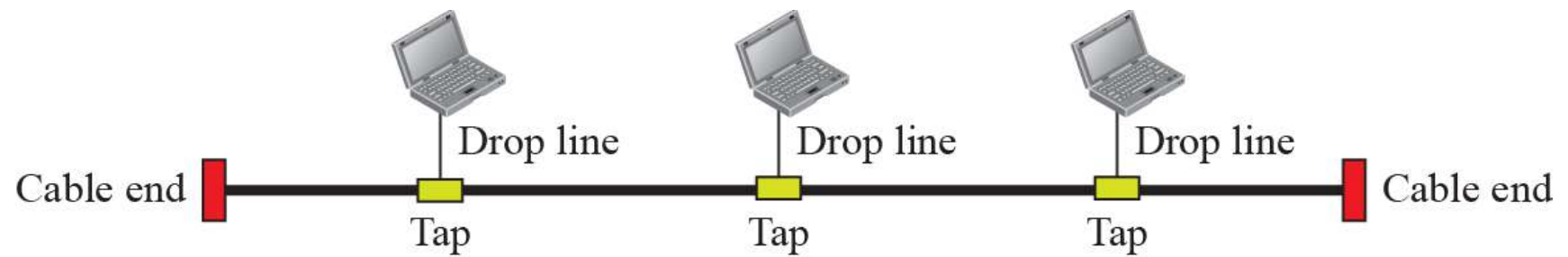
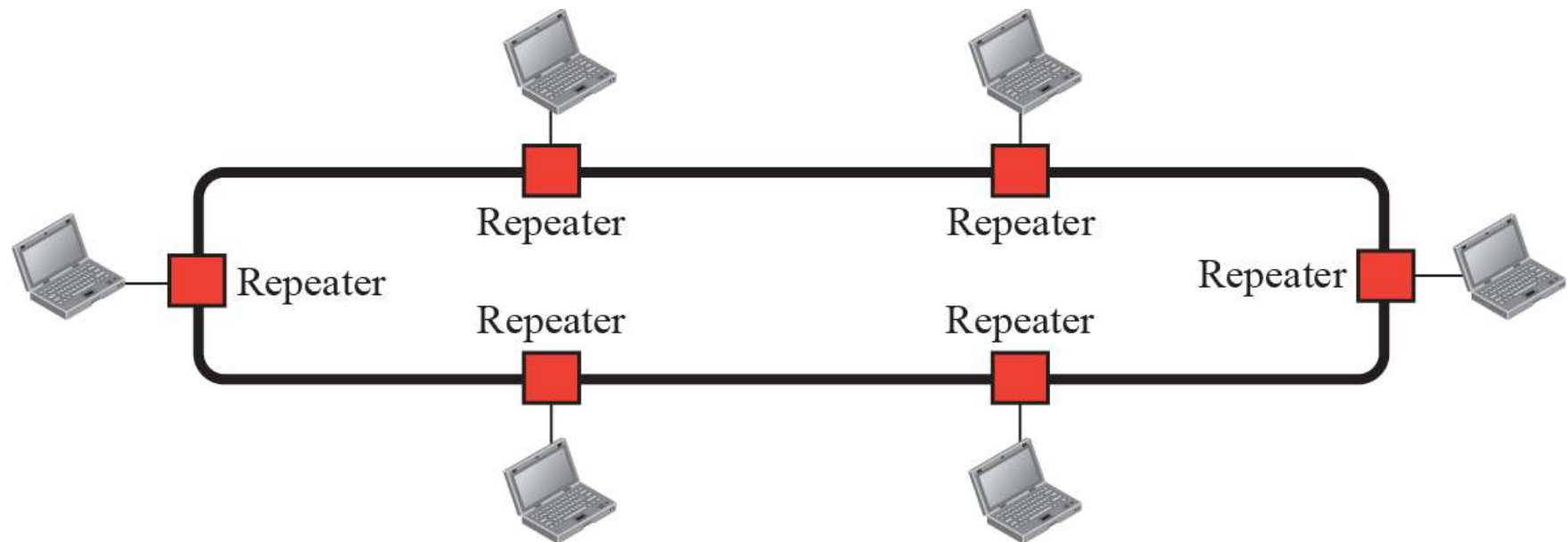


Figure 1.7: *A ring topology*



1-3 NETWORKS TYPES

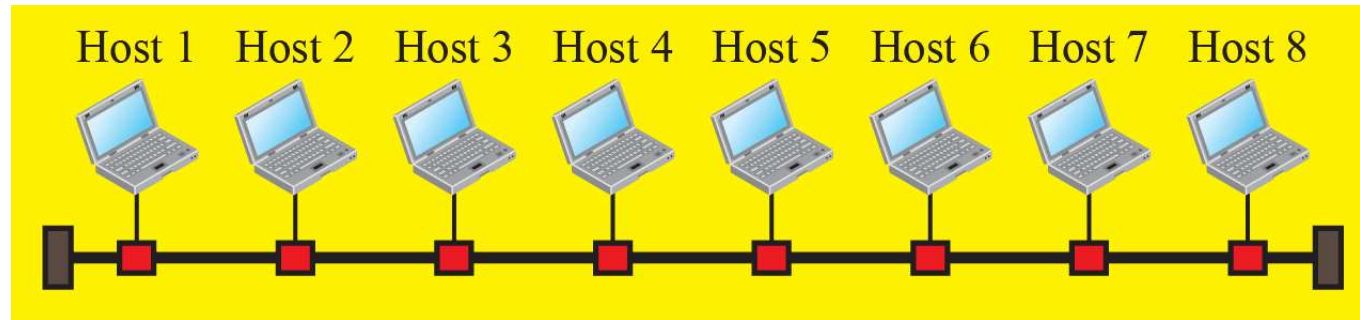
- *The criteria of distinguishing one type of network from another is difficult and sometimes confusing.*
- *We use a few criteria such as size, geographical coverage, and ownership to make this distinction.*



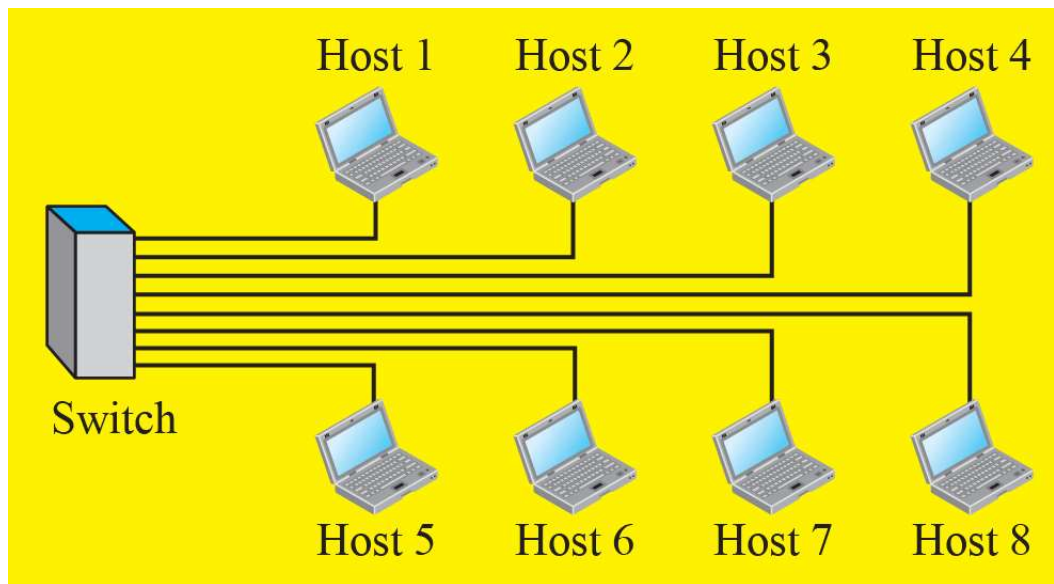
1.3.1 Local Area Network

A local area network (LAN) is usually privately owned and connects some hosts in a single office, building, or campus. Depending on the needs of an organization, a LAN can be as simple as two PCs and a printer in someone's home office, or it can extend throughout a company and include audio and video devices. Each host in a LAN has an identifier, an address, that uniquely defines the host in the LAN. A packet sent by a host to another host carries both the source host's and the destination host's addresses.

Figure 1.8: *An Isolated LAN in the past and today*

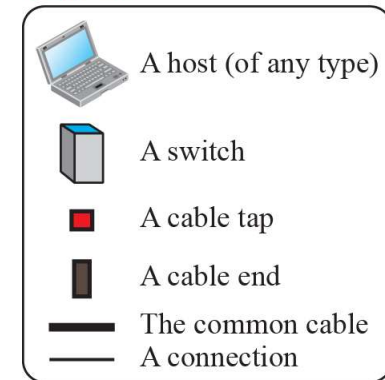


a. LAN with a common cable (past)



b. LAN with a switch (today)

Legend





1.3.2 Wide Area Network

A wide area network (WAN) is also an connection of devices capable of communication. However, there are some differences between a LAN and a WAN. A LAN is normally limited in size; a WAN has a wider geographical span, spanning a town, a state, a country, or even the world. A LAN interconnects hosts; a WAN interconnects connecting devices such as switches, routers, or modems. A LAN is normally privately owned by the organization that uses it; a WAN is normally created and run by communication companies and leased by an organization that uses it.

Figure 1.9: *A Point-to-Point WAN*

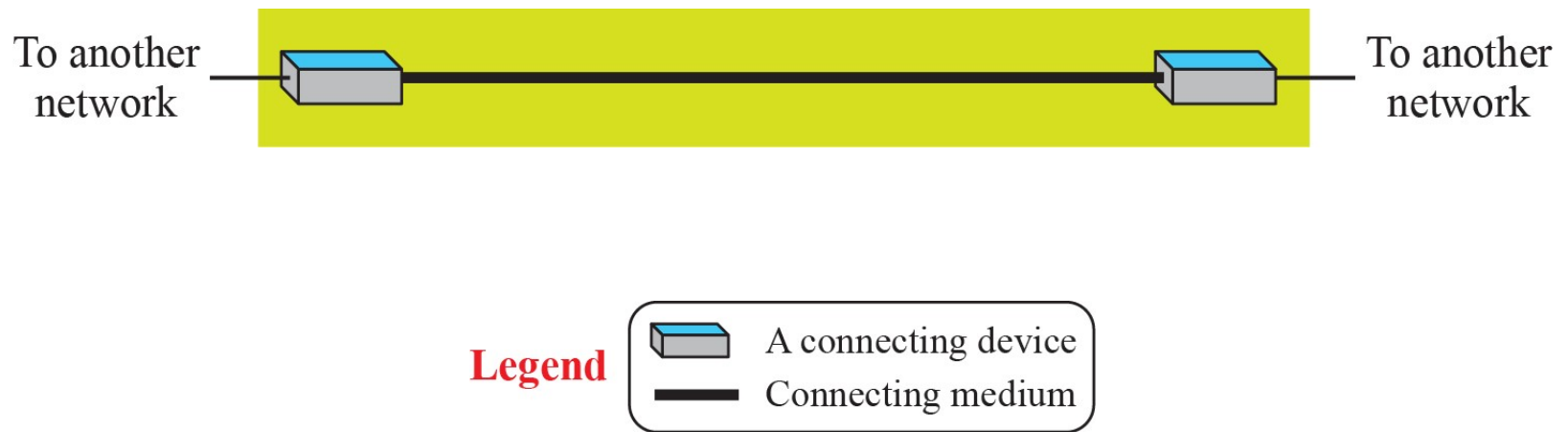
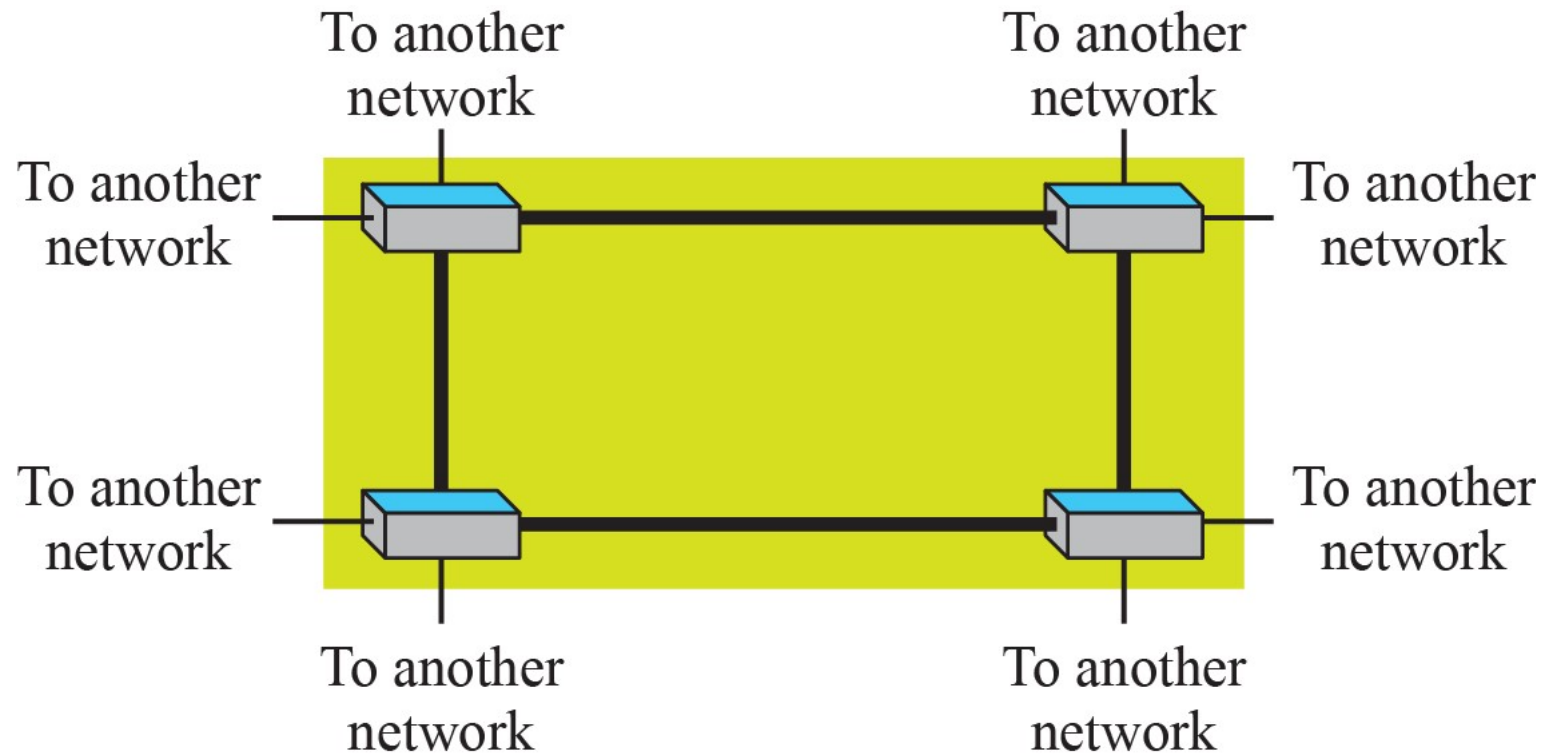


Figure 1.10: *A Switched WAN*



Legend

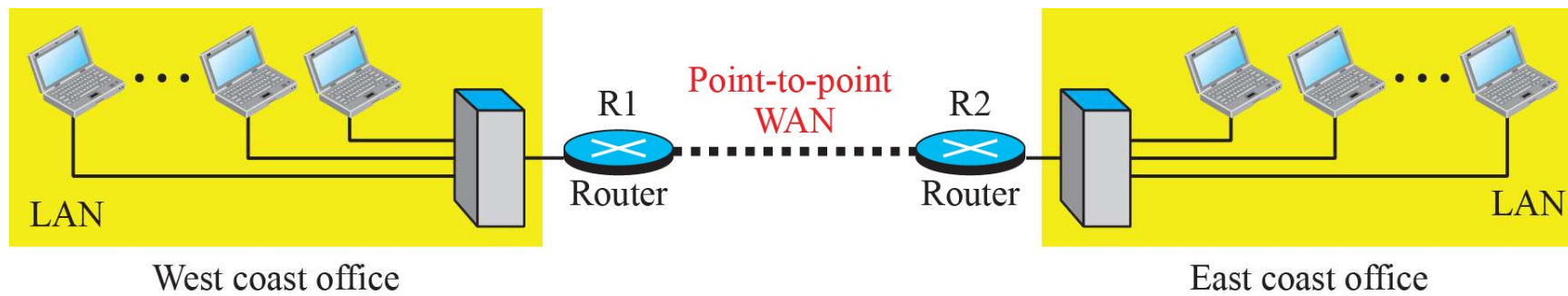


A switch



Connecting medium

Figure 1.11: *An internetwork made of two LANs and one WAN*





1.3.3 Switching

An internet is a switched network in which a switch connects at least two links together. A switch needs to forward data from a network to another network when required. The two most common types of switched networks are circuit-switched and packet-switched networks. We discuss both next.

Figure 1.13: *A circuit-switched network*

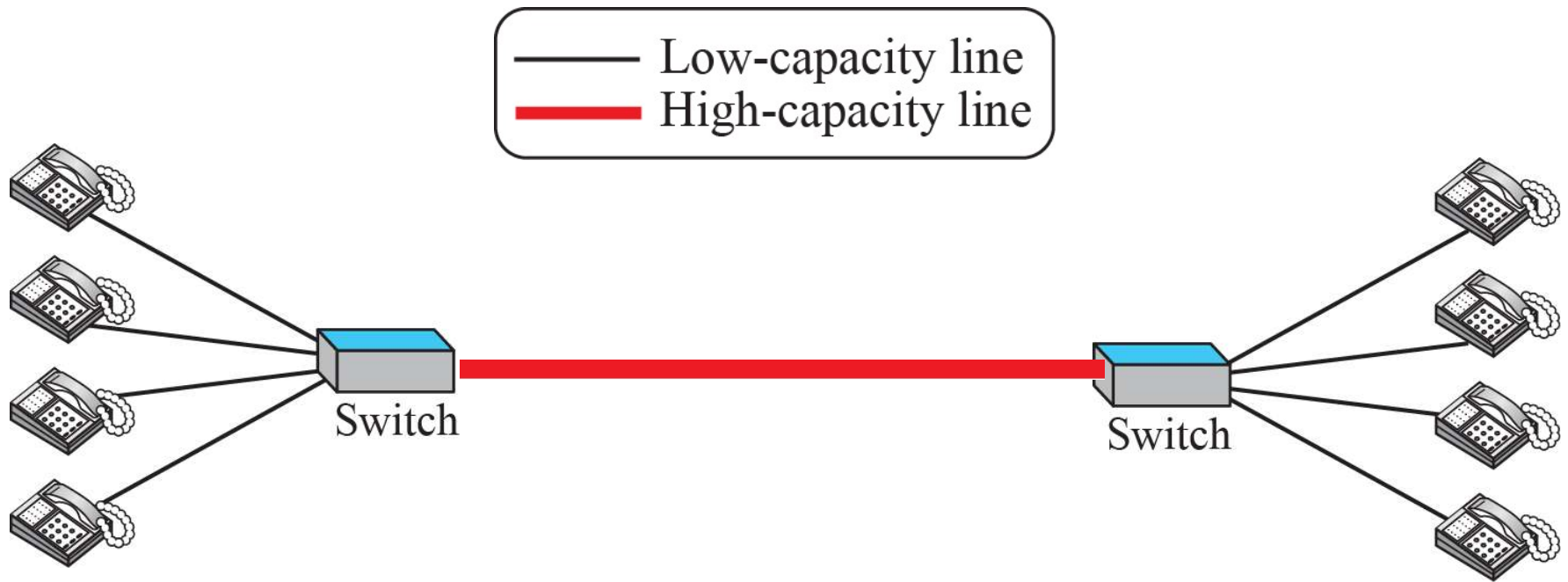
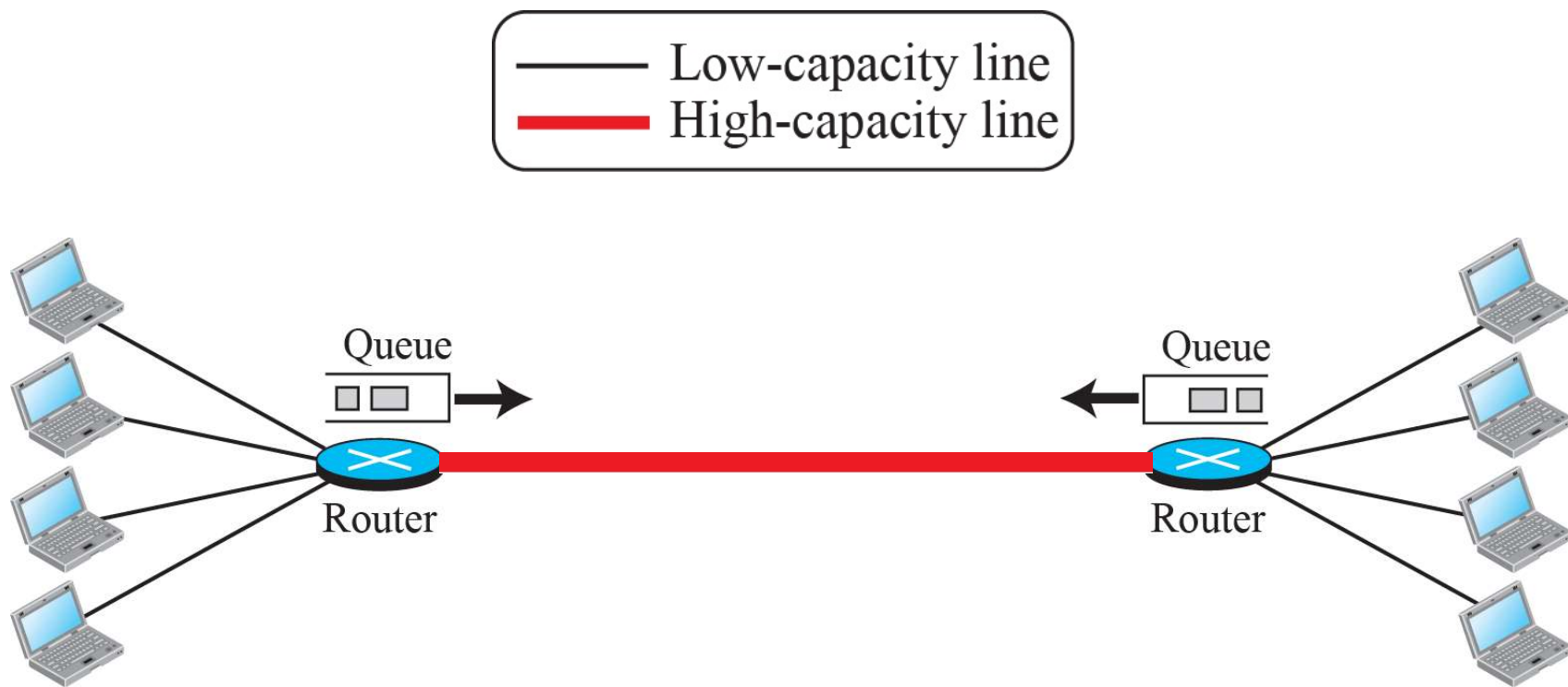


Figure 1.14: A packet-switched network

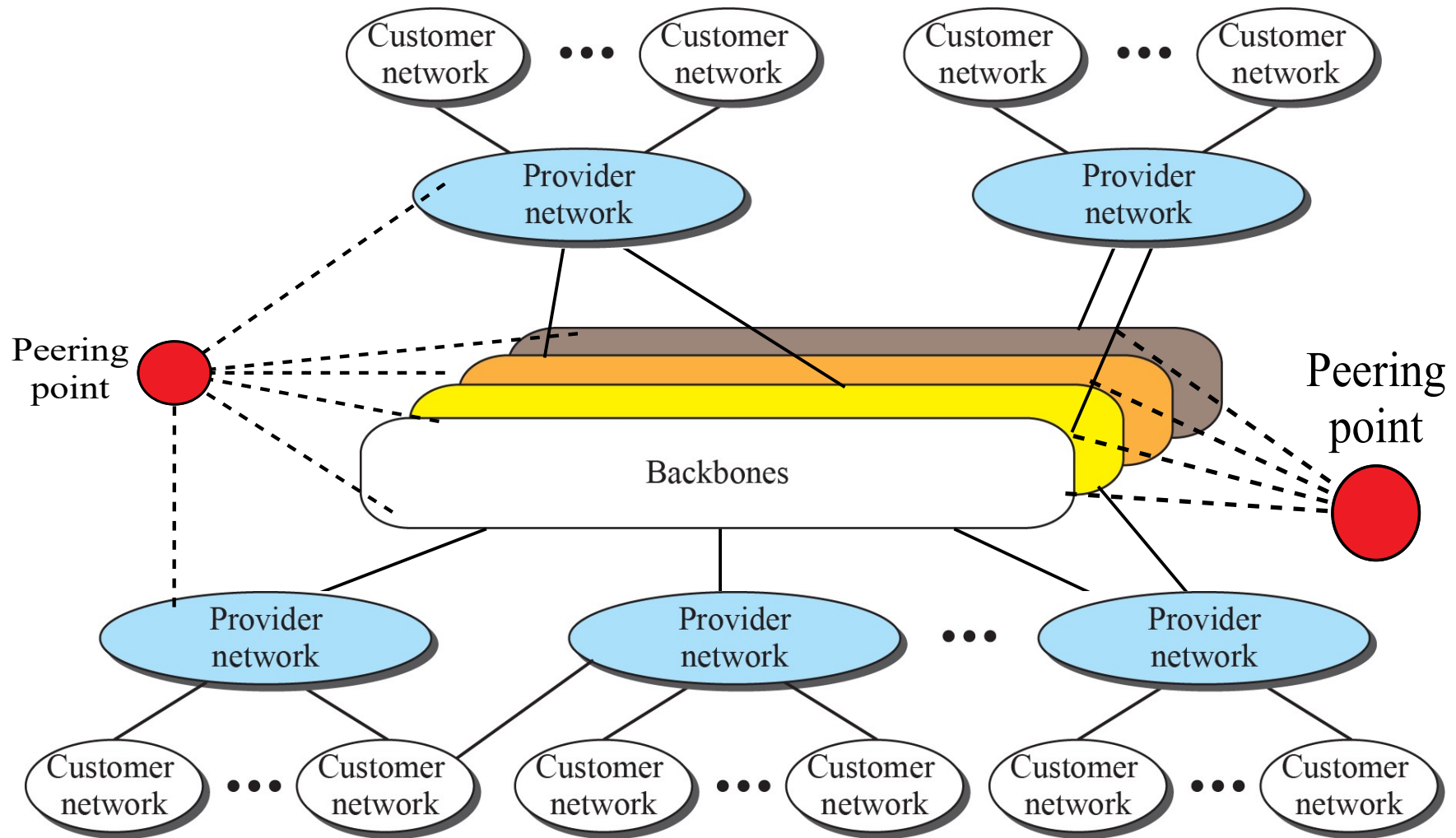




1.3.4 The Internet

As we discussed before, an internet (note the lowercase i) is two or more networks that can communicate with each other. The most notable internet is called the Internet (uppercase I), and is composed of thousands of interconnected networks. Figure 1.15 shows a conceptual (not geographical) view of the Internet.

Figure 1.15: The Internet today





1.3.5 Accessing the Internet

The Internet today is an internetwork that allows any user to become part of it. The user, however, needs to be physically connected to an ISP. The physical connection is normally done through a point-to-point WAN. In this section, we briefly describe how this can happen, but we postpone the technical details of the connection until Chapters 14 and 16.

1-4 INTERNET HISTORY

Now that we have given an overview of the Internet and its protocol, let us give a brief history of the Internet. This brief history makes it clear how the Internet has evolved from a private network to a global one in less than forty years.



1.4.1 Early History

There were some communication networks, such as telegraph and telephone networks, before 1960. These networks were suitable for constant-rate communication at that time, which means that after a connection was made between two users, the encoded message (telegraphy) or voice (telephony) could be exchanged. A computer network, on the other hand, should be able to handle bursty data, which means data received at variable rates at different times. The world needed to wait for the packet-switched network to be invented.



1.4.2 Birth of the Internet

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. They wanted to link dissimilar networks so that a host on one network could communicate with a host on another. There were many problems to overcome: diverse packet sizes, diverse interfaces, and diverse transmission rates, as well as differing reliability requirements. Cerf and Kahn devised the idea of a device called a gateway to serve as the intermediary hardware to transfer data from one network to another.



1.4.3 Internet Today

Today, we witness a rapid growth both in the infrastructure and new applications. The Internet today is a set of peer networks that provide services to the whole world. What has made the Internet so popular is the invention of new applications.