

- **Computer Networks**
- **Al-Mustansiryah University**
- **Elec. Eng. Department College of Engineering**  
**Fourth Year Class**

# **Chapter 1**

# **Introduction**

# 1-1 DATA COMMUNICATIONS

**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:

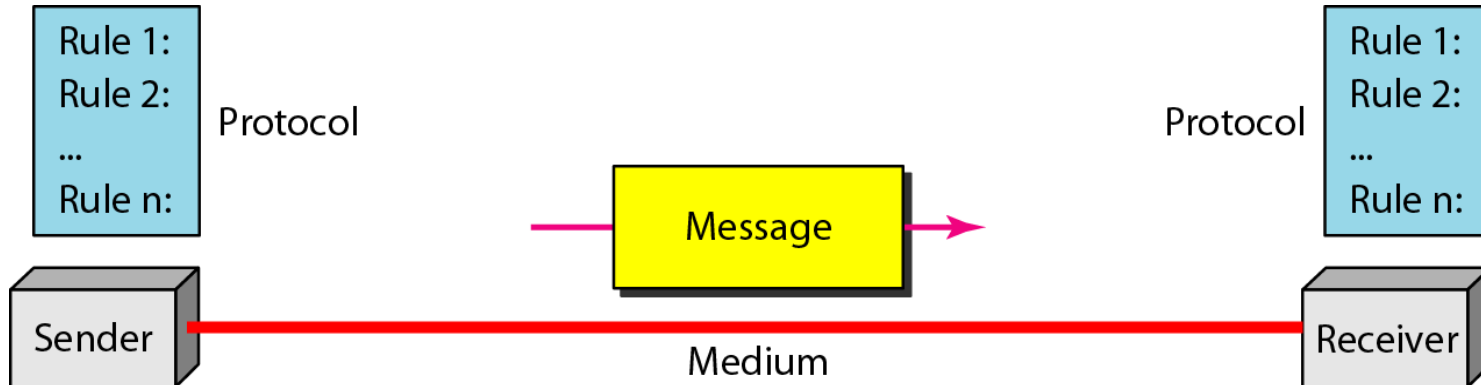
- Components of a data communications system
- Data Flow

---

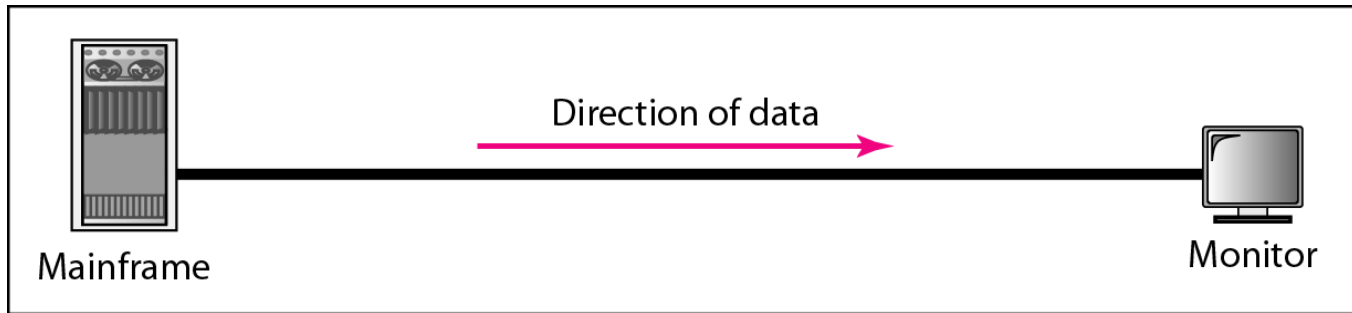
## Figure 1.1 Components of a data communication system

---

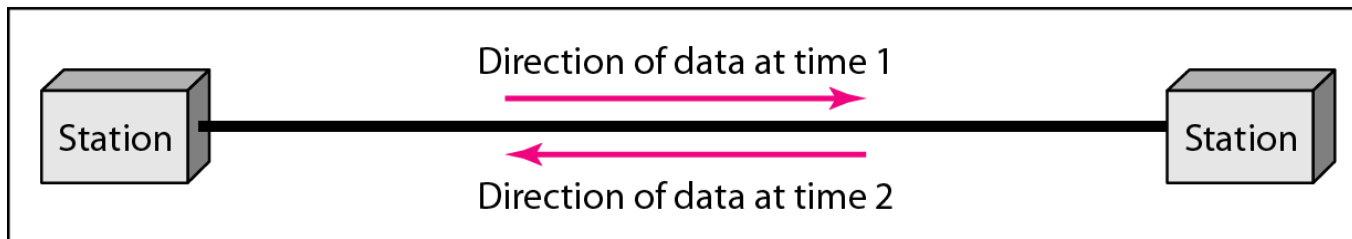
The five components that make up a data communications system are the **Message, sender, receiver, medium, and protocol.**



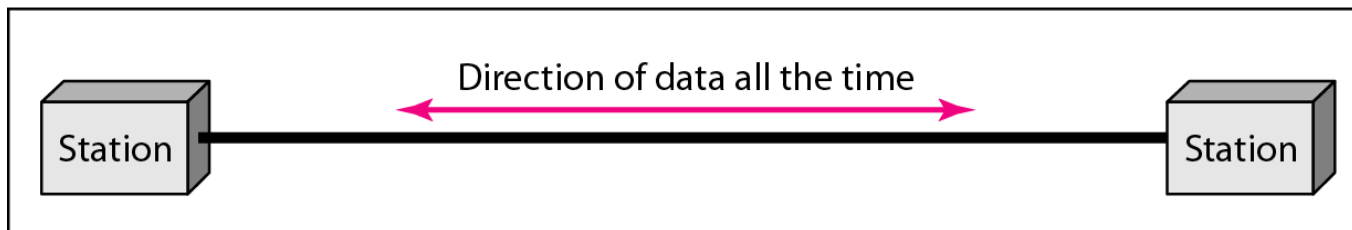
## Figure 1.2 Data flow (simplex, half-duplex, and full-duplex)



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

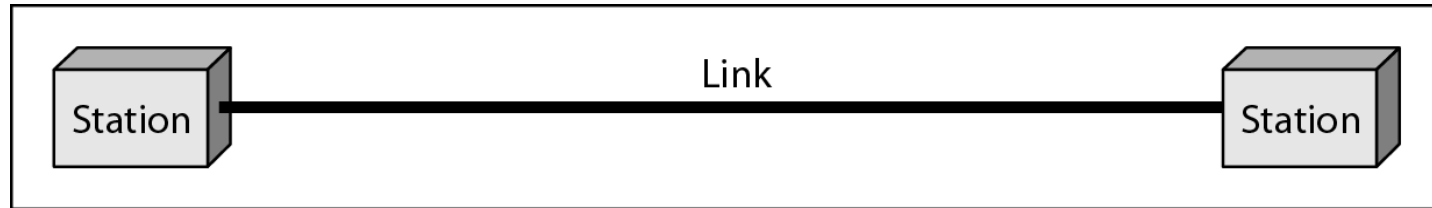
---

- **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**

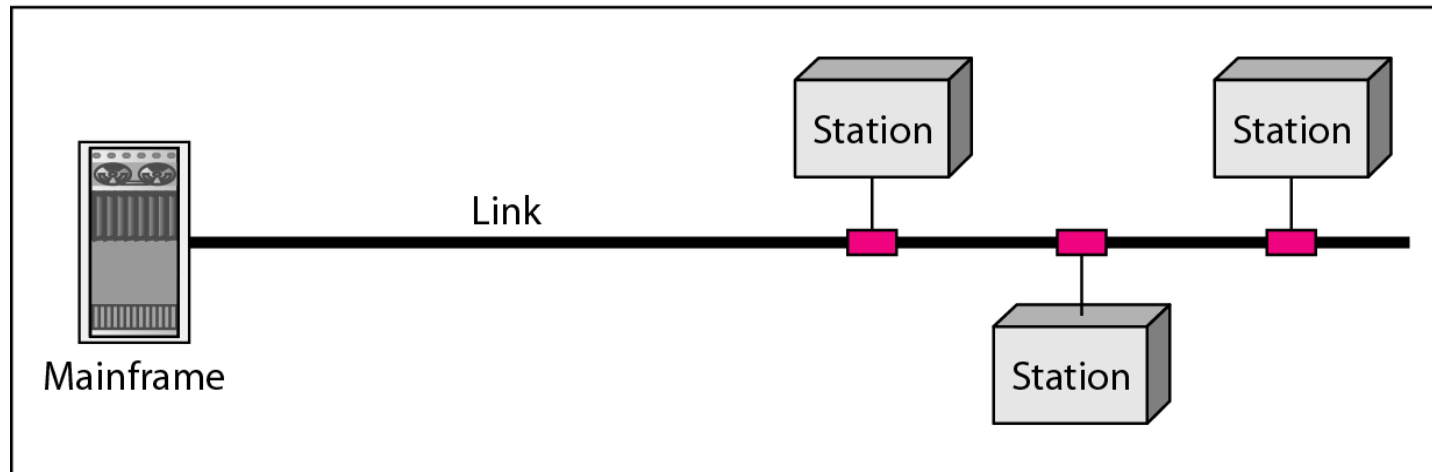
---

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

---



a. Point-to-point



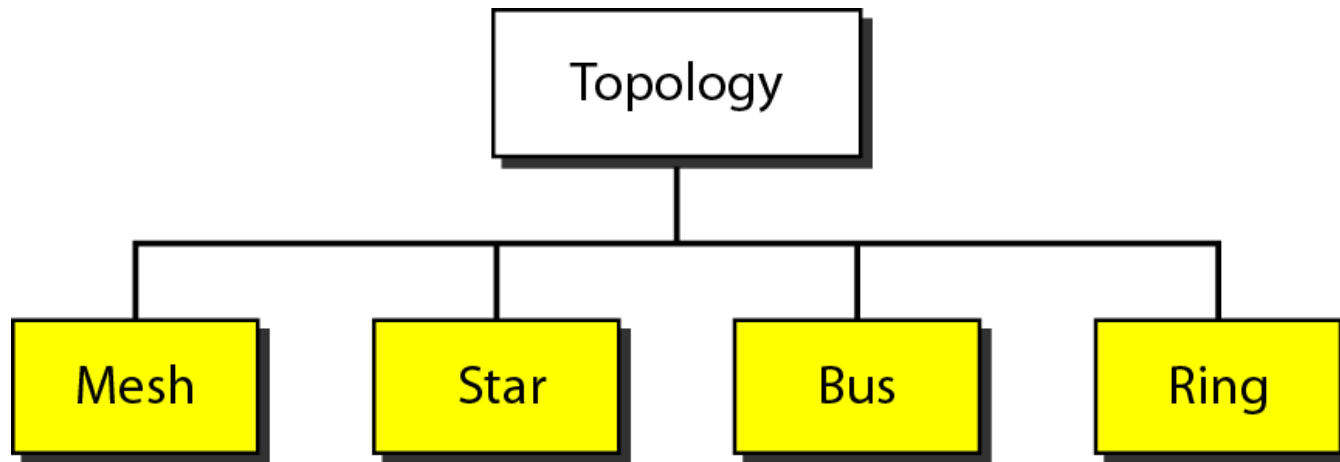
b. Multipoint



---

**Figure 1.4** *Categories of topology*

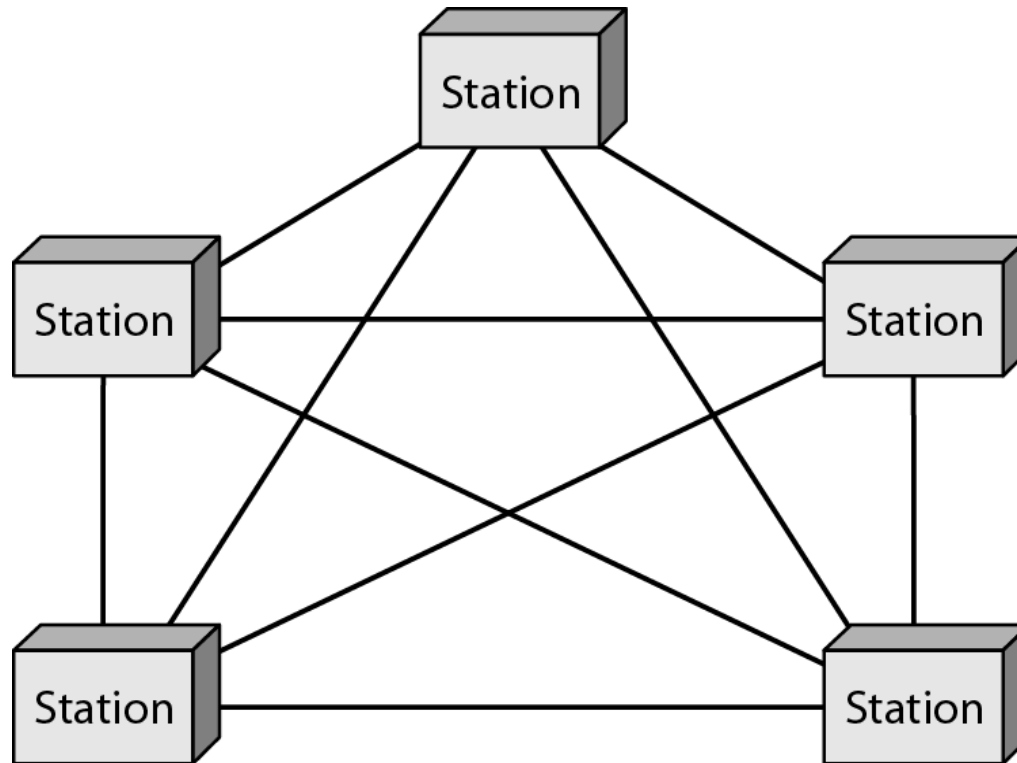
---



---

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

---



In mesh topology, we need  $n(n - 1) / 2$  duplex-mode links

---

## Advantage of mesh topology

- 1- Use of dedicated links guarantees that each connection can carry its own data load.
- 2- Robust. If one link becomes unusable, it does not incapacitate the entire system.
- 3- Security. When every message travels along a dedicated line, only the intended recipient sees it.
- 4- Point-to-point links make fault identification and fault isolation easy.

---

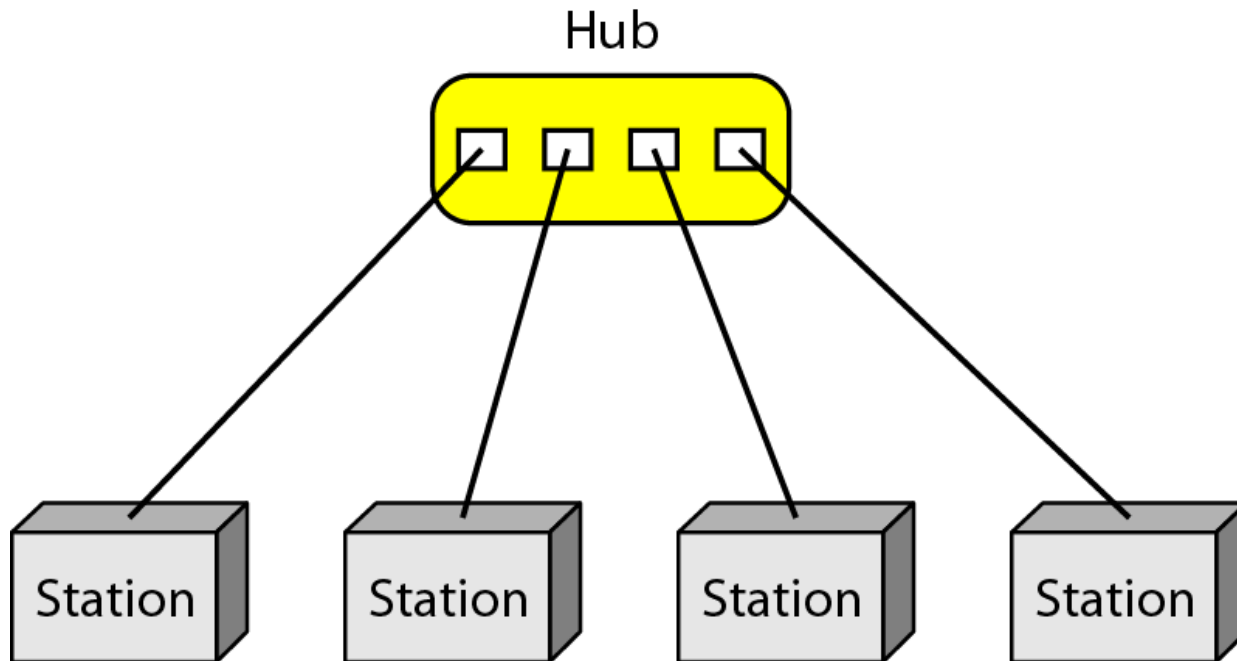
## **Disadvantage of mesh topology**

- 1- The amount of cabling because every device must be connected to every other device.
- 2- The number of I/O ports required.
- 3- The hardware required to connect each link can be prohibitively expensive.

---

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

---



---

## **Advantage of Star topology**

- 1- Less expensive than a mesh topology.
- 2- Easy to install and reconfigure. Far less cabling needs to be housed.
- 3- Include robustness.

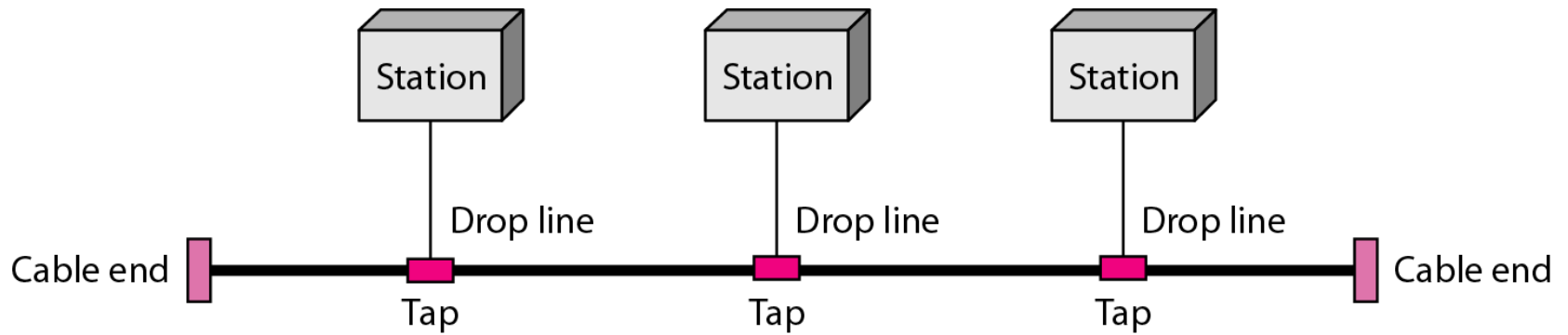
## **Disadvantage of Star topology**

- 1- the dependency of the whole topology on one single point.
- 2- more cabling is required in a star than in some other topologies (such as ring or bus).

---

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

---



---

## **Advantage of Bus topology**

- 1- Ease of installation.
- 2- Less cabling than mesh or star topologies.
- 3- Backbone cable can be laid along the most efficient path, then connected to the nodes by drop lines of various lengths.



---

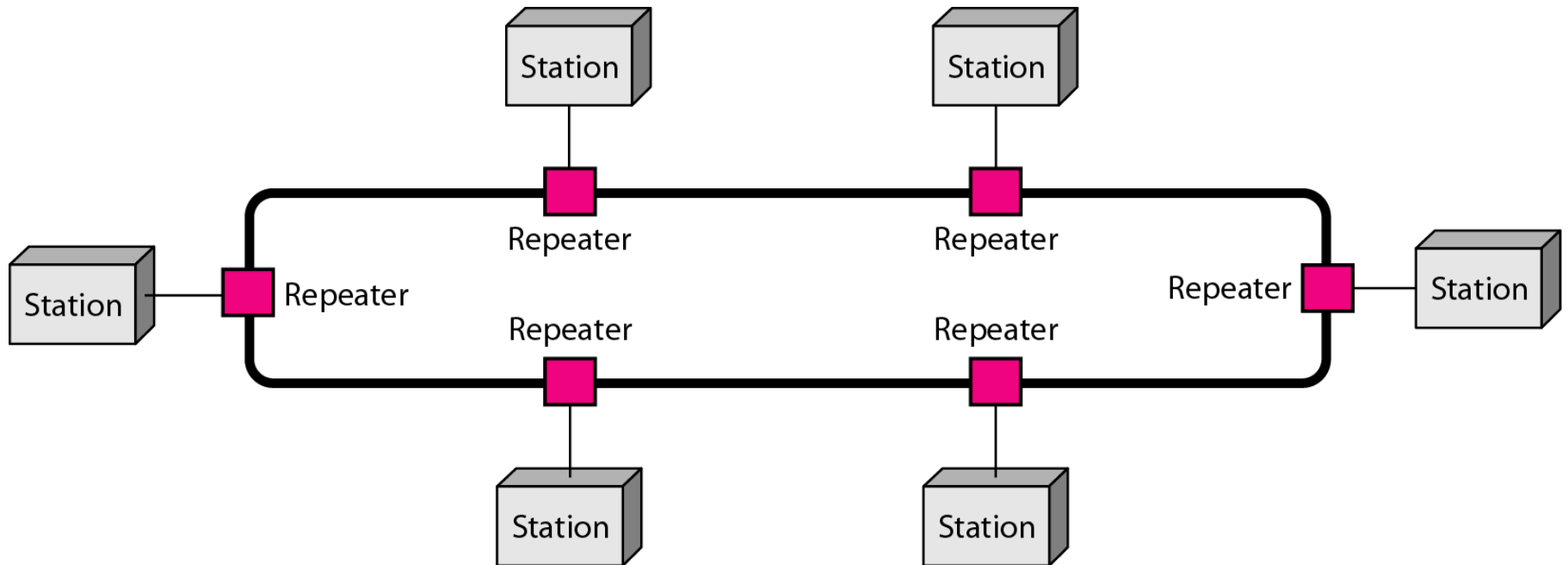
## **Disadvantage of Bus topology**

- 1- Difficult reconnection and fault isolation.
- 2- Signal reflection at the taps can cause degradation in quality.
- 3- Fault or break in the bus cable stops all transmission.

---

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

---



---

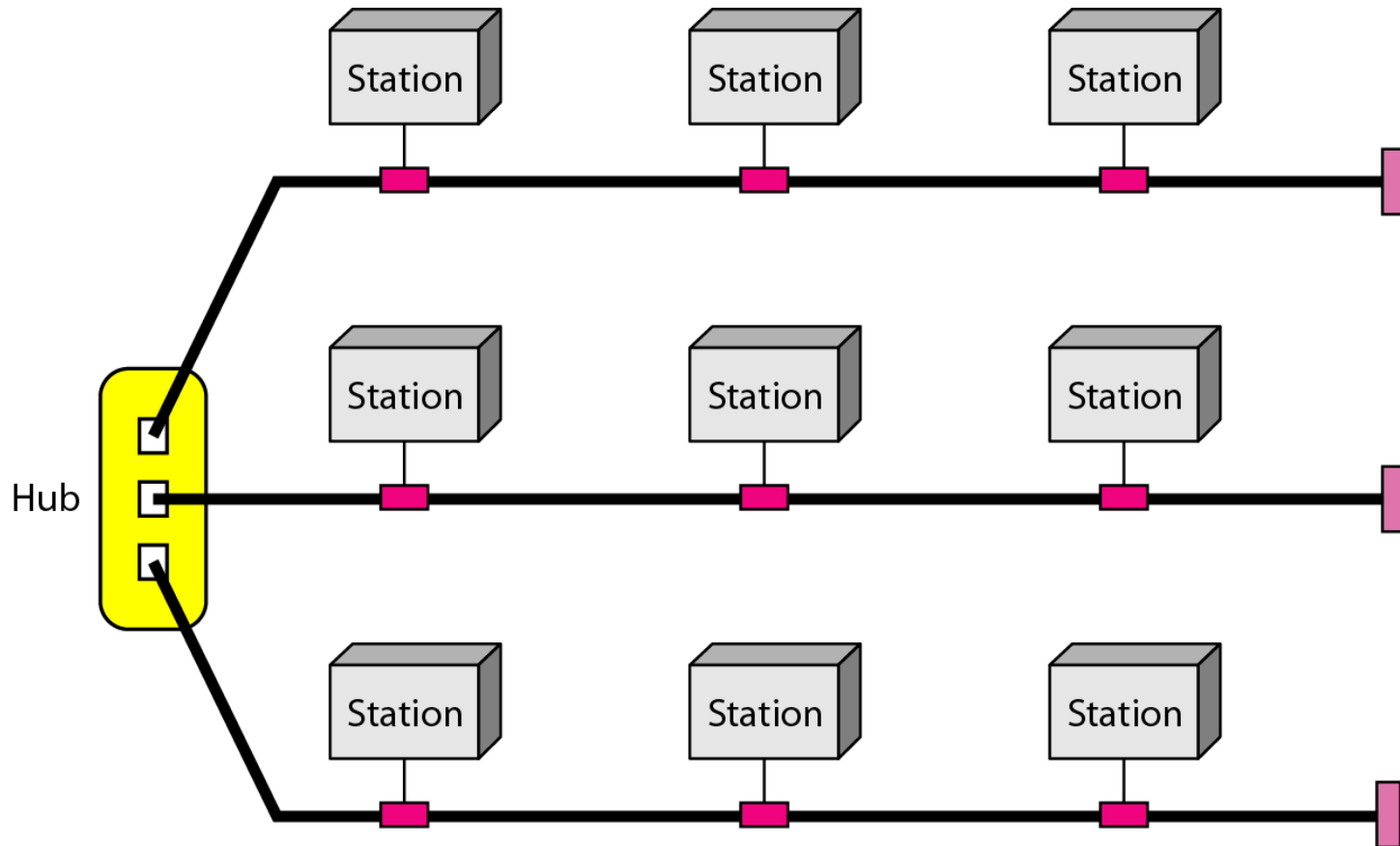
## **Advantage of Ring topology**

- 1- Easy to install and reconfigure.
- 2- Fault isolation is simplified.

## **Disadvantage of Ring topology**

- Unidirectional traffic.

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



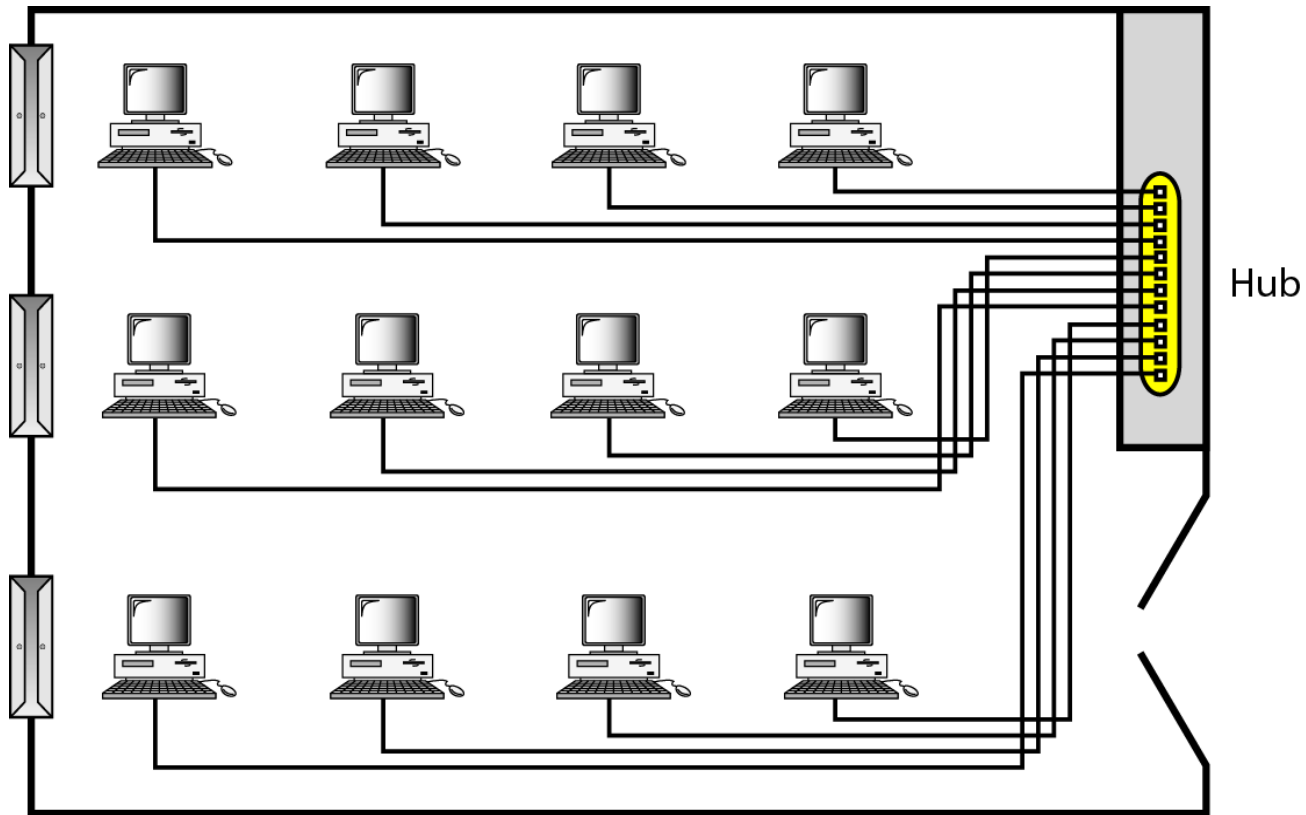
---

# Categories of Networks

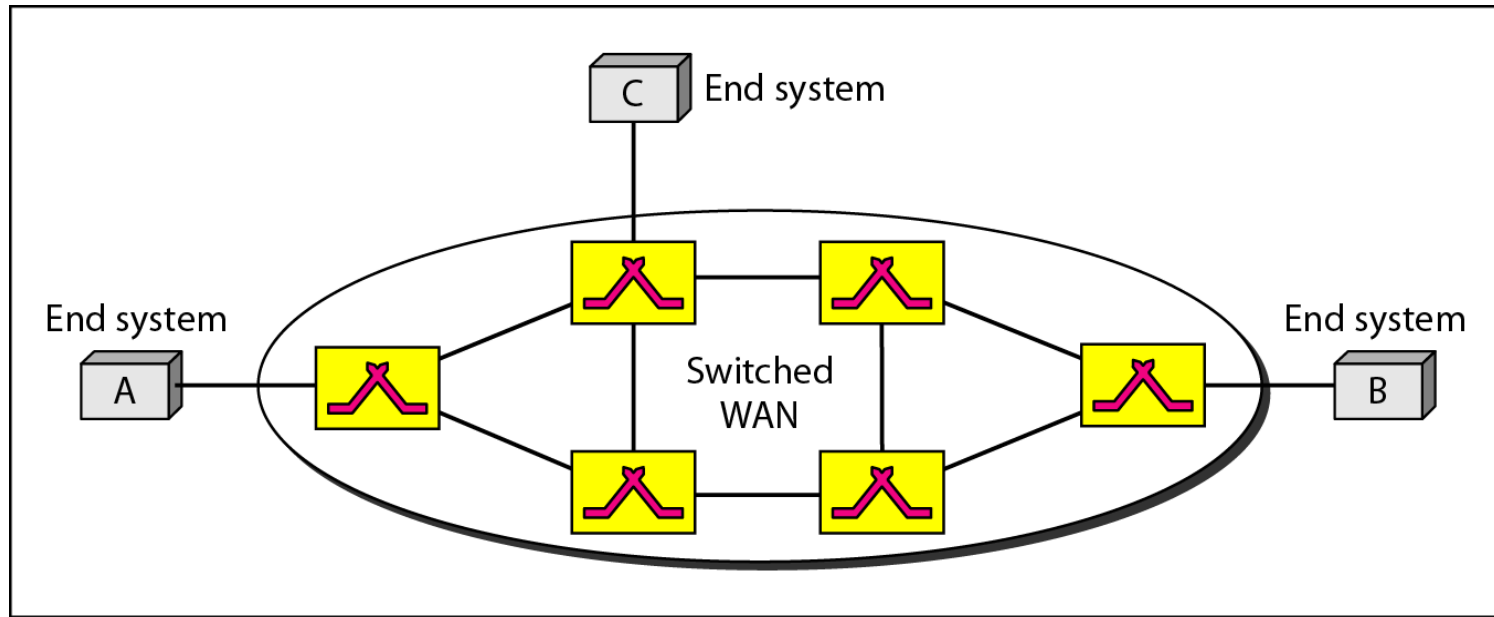
---

- **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

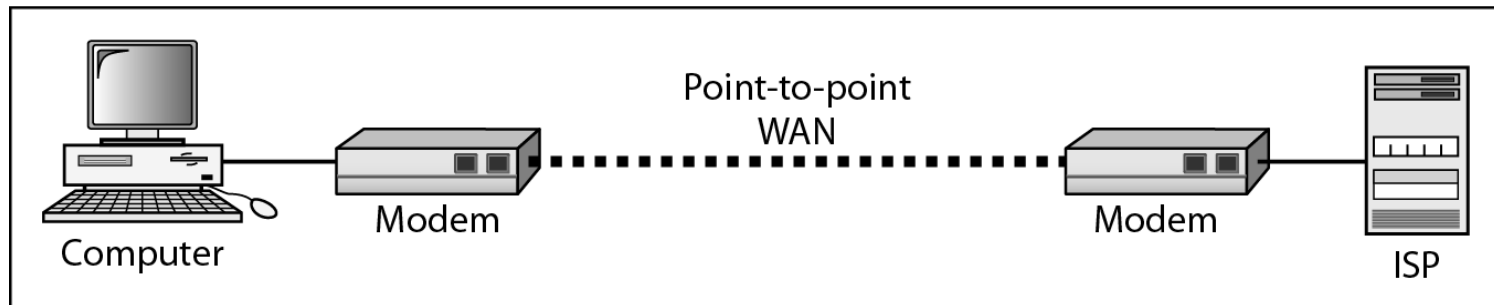
**Figure 1.10** *An isolated LAN connecting 12 computers to a hub in a closet*



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



a. Switched WAN



b. Point-to-point WAN

# 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.**

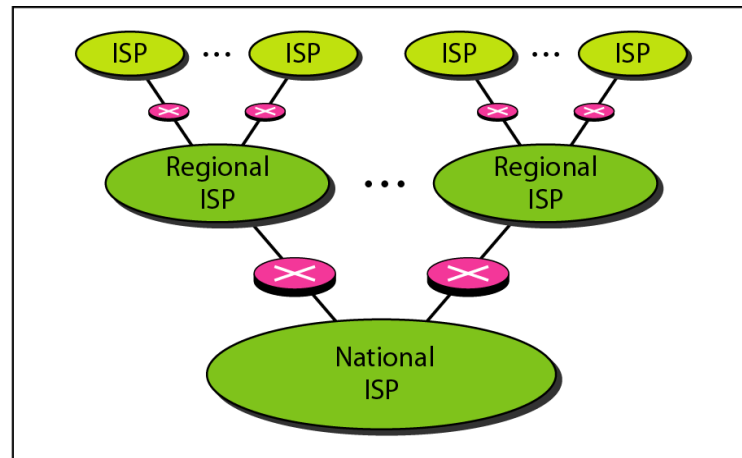
## **Topics discussed in this section:**

**Organization of the Internet**

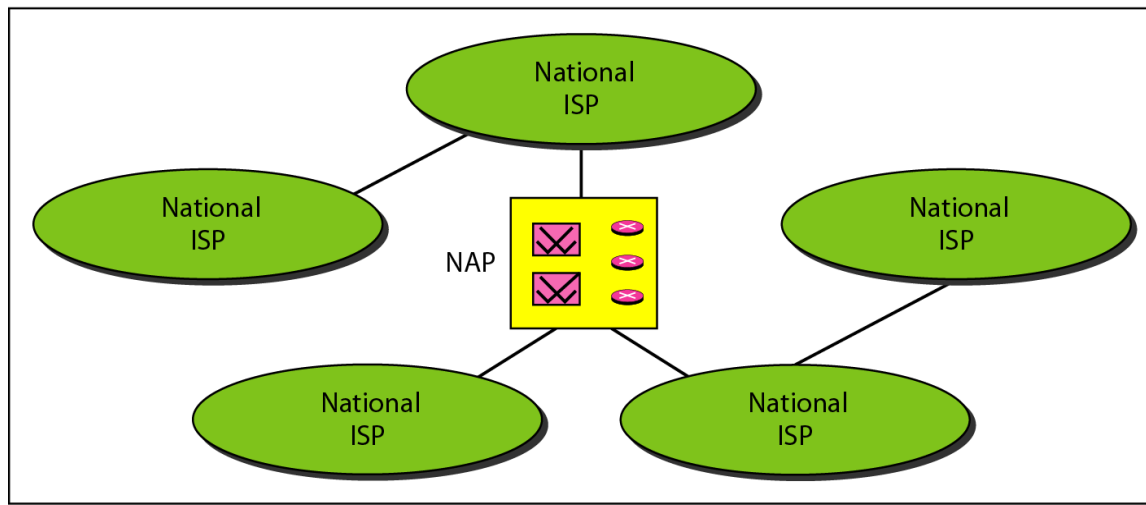
**Internet Service Providers (ISPs)**



## 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