Chapter 1
Introduction
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
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**
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, multicast, broadcast
Figure 1.3 *Types of connections: point-to-point and multipoint*

a. Point-to-point

b. Multipoint
Figure 1.4  Categories of topology

- Topology
  - Mesh
  - Star
  - Bus
  - Ring
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**

![Diagram of a switched WAN and a point-to-point WAN]

a. Switched WAN

b. Point-to-point WAN
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
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.