1.7 SUMMARY

- Data communications are the transfer of data from one device to another via some form of transmission medium.
- A data communications system must transmit data to the correct destination in an accurate and timely manner.
- The five components that make up a data communications system are the message, sender, receiver, medium, and protocol.
- Text, numbers, images, audio, and video are different forms of information.
- Data flow between two devices can occur in one of three ways: simplex, half-duplex, or full-duplex.
- A network is a set of communication devices connected by media links.
- In a point-to-point connection, two and only two devices are connected by a dedicated link. In a multipoint connection, three or more devices share a link.
- Topology refers to the physical or logical arrangement of a network. Devices may be arranged in a mesh, star, bus, or ring topology.
- A network can be categorized as a local area network or a wide area network.
- A LAN is a data communication system within a building, plant, or campus, or between nearby buildings.
- A WAN is a data communication system spanning states, countries, or the whole world.
- An internet is a network of networks.
- The Internet is a collection of many separate networks.
- There are local, regional, national, and international Internet service providers.
- A protocol is a set of rules that govern data communication; the key elements of a protocol are syntax, semantics, and timing.

- Standards are necessary to ensure that products from different manufacturers can work together as expected.
- The ISO, ITD-T, ANSI, IEEE, and EIA are some of the organizations involved in standards creation.
- Forums are special-interest groups that quickly evaluate and standardize new technologies.
- A Request for Comment is an idea or concept that is a precursor to an Internet standard.

1.8 PRACTICE SET

Review Questions

1. Identify the five components of a data communications system.

1. The five components of a data communication system are the ***sender***, **receiver**, ***transmission medium***, ***message***, and ***protocol***.

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2. What are the advantages of distributed processing?

2. The advantages of distributed processing are ***security***, ***access to distributed databases***, ***collaborative processing***, and ***faster problem solving***.

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3. What are the three criteria necessary for an effective and efficient network?

3. The three criteria are ***performance***, ***reliability***, and ***security***.

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4. What are the advantages of a multipoint connection over a point-to-point connection?

4. Advantages of a multipoint over a point-to-point configuration (type of connection) include ***ease of installation*** and ***low cost***.

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5. What are the two types of line configuration?

5. Line configurations (or types of connections) are ***point-to-point*** and ***multipoint***.

6. Categorize the four basic topologies in terms of line configuration.

6. We can divide line configuration in two broad categories:
   a. ***Point-to-point***: ***mesh***, ***star***, and ***ring***.
   b. ***Multipoint***: ***bus***

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7. What is the difference between half-duplex and full-duplex transmission modes?

7. In ***half-duplex transmission***, only one entity can send at a time; in a ***full-duplex transmission***, both entities can send at the same time.

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8. Name the four basic network topologies, and cite an advantage of each type.

8. We give an advantage for each of four network topologies:
   a. ***Mesh***: secure
   b. ***Bus***: easy installation
   c. ***Star***: robust
   d. ***Ring***: easy fault isolation

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9. For n devices in a network, what is the number of cable links required for a mesh, ring, bus, and star topology?

9. The number of cables for each type of network is:
   a. ***Mesh***: $n\ (n-1)\ /\ 2$
   b. ***Star***: n
   c. ***Ring***: $n-1$
   d. ***Bus***: one backbone and n drop lines

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10. What are some of the factors that determine whether a communication system is a LAN or WAN?

10. The general factors are ***size***, ***distances*** (covered by the network), ***structure***, and ***ownership***.

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11. What is an internet? What is the Internet?

11. An ***internet*** is an interconnection of networks. The ***Internet*** is the name of a specific worldwide network

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12. Why are protocols needed?

12. A ***protocol*** defines ***what*** is communicated, in ***what way*** and ***when***. This provides accurate and timely transfer of information between different devices on a network.

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13. Why are standards needed?

13. ***Standards*** are needed to create and maintain an open and competitive market for manufacturers, to coordinate protocol rules, and thus guarantee compatibility of data communication technologies.

Exercises

14. What is the maximum number of characters or symbols that can be represented by Unicode?

14. ***Unicode*** uses **32** bits to represent a symbol or a character. We can define 2^{32} different symbols or characters.

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15. A color image uses 16 bits to represent a pixel. What is the maximum number of different colors that can be represented?

15. With **16** bits, we can represent up to 2^{16} different colors.

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16. Assume six devices are arranged in a mesh topology. How many cables are needed? How many ports are needed for each device?

16.

a. Cable links: n $(n - 1) / 2 = (6 \times 5) / 2 =$ **15**
b. Number of ports: $(n - 1) =$ **5** ports needed per device

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17. For each of the following four networks, discuss the consequences if a connection fails.
    a. Five devices arranged in a mesh topology
    b. Five devices arranged in a star topology (not counting the hub)
    c. Five devices arranged in a bus topology
    d. Five devices arranged in a ring topology

17.

a. ***Mesh topology***: If one connection fails, the other connections will still be working.
b. **Star topology**: The other devices will still be able to send data through the hub; there will be no access to the device which has the failed connection to the hub.
c. **Bus Topology**: All transmission stops if the failure is in the bus. If the drop-line fails, only the corresponding device cannot operate.
d. ***Ring Topology***: The failed connection may disable the whole network unless it is a dual ring or there is a by-pass mechanism.

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18. You have two computers connected by an Ethernet hub at home. Is this a LAN, a MAN, or a WAN? Explain your reason.

18. This is a ***LAN***. The Ethernet hub creates a LAN as we will see in Chapter 13.

19. In the ring topology in Figure 1.8, what happens if one of the stations is unplugged?

19. Theoretically, in a ***ring topology***, unplugging one station, interrupts the ring. However, most ring networks use a mechanism that bypasses the station; the ring can continue its operation.

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20. **In** the bus topology in Figure 1.7, what happens if one ofthe stations is unplugged?

20. In a ***bus topology***, no station is in the path of the signal. Unplugging a station has no effect on the operation of the rest of the network.

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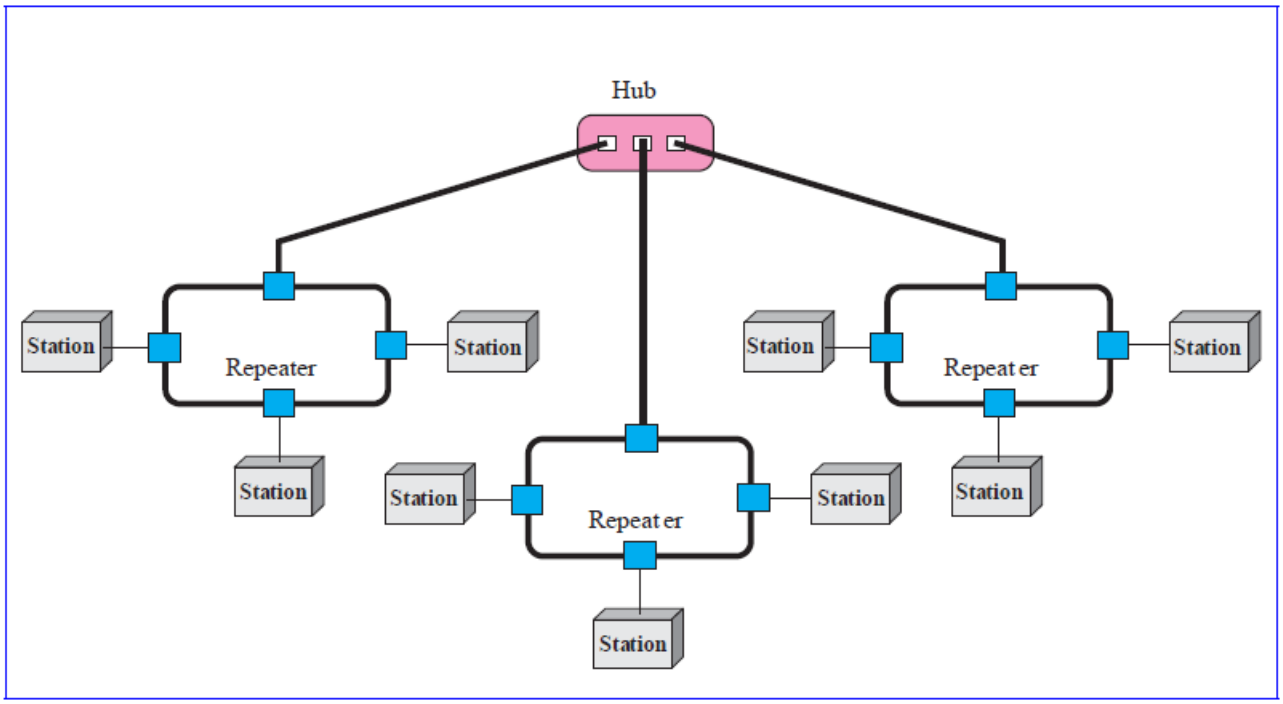
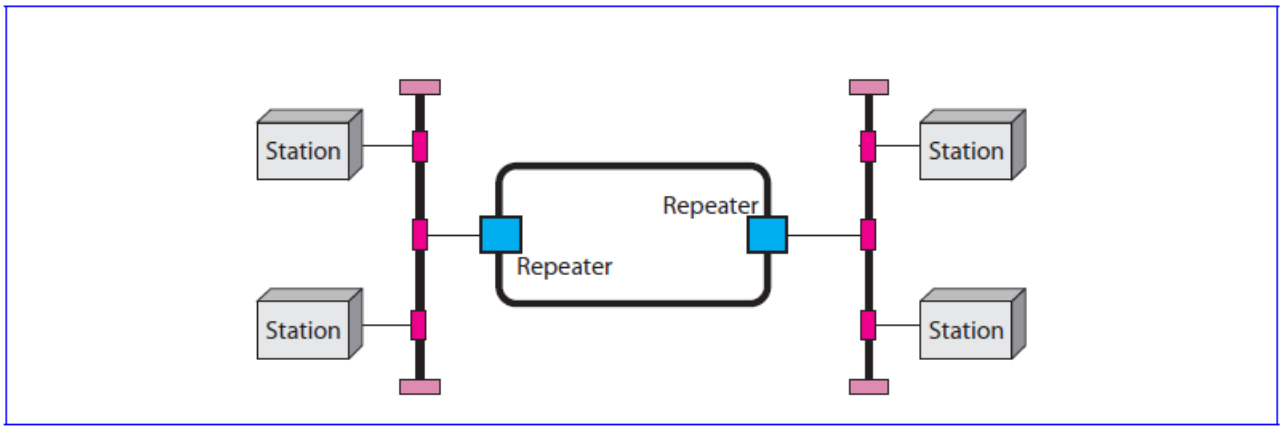
21. Draw a hybrid topology with a star backbone and three ring networks.

Figure 1.1 *Solution to Exercise 21*



22. Draw a hybrid topology with a ring backbone and two bus networks.

Figure 1.2 *Solution to Exercise 22*



23. Performance is inversely related to delay. When you use the Internet, which of the following applications are more sensitive to delay?
    a. Sending an e-mail
    b. Copying a file
    c. Surfing the Internet

23.
    a. E-mail is not an interactive application. Even if it is delivered immediately, it may stay in the mail-box of the receiver for a while. It is not sensitive to delay.
    b. We normally do not expect a file to be copied immediately. It is not very sensitive to delay.
    c. Surfing the Internet is the an application very sensitive to delay. We except to get access to the site we are searching.

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24. When a party makes a local telephone call to another party, is this a point-to-point or multipoint connection? Explain your answer.

24. In this case, the communication is only between a caller and the callee. A dedicated line is established between them. The connection is ***point-to-point.***

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25. Compare the telephone network and the Internet. What are the similarities? What are the differences?

25. The telephone network was originally designed for voice communication; the Internet was originally designed for data communication. The two networks are similar in the fact that both are made of interconnections of small networks. The telephone network, as we will see in future chapters, is mostly a circuit-switched network; the Internet is mostly a packet-switched network.