**QUESTIONS**

**Q1-1. Identify the five components of a data communications system.**

Ans:

The five components of a data communications system are:

1. Message: The information or data to be communicated.

2. Sender: The device or entity that initiates the communication process by transmitting the message.

3. Receiver: The device or entity that receives the transmitted message.

4. Medium: The physical or logical pathway through which the message travels from sender to receiver. This can include cables, fiber optics, wireless signals, etc.

5. Protocol: A set of rules and conventions that govern the communication process, including formatting of the message, error handling, and addressing.

**Q1-2. What are the three criteria necessary for an effective and efficient network?**

ANS:

The three criteria necessary for an effective and efficient network are:

1. Performance: The network should provide adequate bandwidth and response time to meet the demands of users and applications.

2. Reliability: The network should be dependable, ensuring that data is delivered accurately and consistently, without loss or corruption.

3. Security: The network should protect data from unauthorized access, ensuring confidentiality, integrity, and availability.

**Q1-3. What are the advantages of a multipoint connection over a point-to-point one?**

ANS:

Advantages of a multipoint connection over a point-to-point one include:

**- Reduced cost:** Multipoint connections can share resources, such as communication lines, more efficiently than point-to-point connections.

- **Simplified management:** With fewer connections to manage, administering and maintaining a multipoint connection network can be easier.

- **Increased flexibility:** Multipoint connections allow multiple devices to communicate with each other simultaneously, facilitating collaboration and data sharing.

**Q1-4. What are the two types of line configuration?**

ANS:

The two types of line configuration are:

**1. Point-to-point:** In this configuration, A point-to-point connection provides a dedicated link between two devices.

2**. Multipoint (or multipoint-to-multipoint):** In this configuration, A multipoint (also called multidrop) connection is one in which more than two specific devices share a single link.

**Q1-5. Categorize the four basic topologies in terms of line configuration.**

ANS:

The four basic topologies categorized in terms of line configuration are:

**1. Bus topology:** Multipoint configuration.

**2. Star topology:** Multipoint configuration.

**3. Ring topology:** Point-to-point configuration.

**4. Mesh topology:** Point-to-point configuration.

**Q1-6. What is the difference between half-duplex and full-duplex transmission modes?**

ANS:

The difference between half-duplex and full-duplex transmission modes is:

**- Half-duplex:** In this mode, communication can occur in both directions, but not simultaneously. Devices take turns transmitting and receiving data.

**- Full-duplex:** In this mode, communication can occur simultaneously in both directions. Devices can transmit and receive data concurrently.

**Q1-7. Name the four basic network topologies, and cite an advantage of each type**

ANS:

The four basic network topologies are:

**1. Bus topology**: Advantage - Little cabling, Easy to install.

**2. Star topology:** Advantage -Robustness, One I/O port per device.

**3. Ring topology:** Advantage -Easy to install, Easy to identify fault.

**4. Mesh topology:** Advantage – Privacy, dedicated links.

**Q1-8. For n devices in a network, what is the number of cable links required for a mesh, ring, bus, and star topology?**

ANS:

For n devices in a network, the number of cable links required for different topologies are:

- Mesh: n(n-1)/2

- Ring: n

- Bus: 1

- Star: n

**Q1-9. What are some of the factors that determine whether a communication system is a LAN or WAN?**

ANS:

Factors that determine whether a communication system is a LAN or WAN include:

**- Geographic scope:** LANs typically cover smaller geographic areas, such as a single building or campus, while WANs cover larger geographic areas, such as cities, countries, or continents.

**- Ownership and control:** LANs are usually owned and controlled by a single organization, while WANs often involve multiple organizations and may be operated by service providers.

**- Transmission technology:** LANs typically use high-speed, short-range technologies like Ethernet, while WANs may utilize a variety of technologies including leased lines, satellites, and fiber optics to cover longer distances.

**Q1-10. What is an internet? What is the Internet?**

ANS:

An internet is a network of networks, typically referring to any interconnected set of networks using the Internet Protocol (IP).

The Internet, on the other hand, is the global system of interconnected computer networks that use the Internet Protocol Suite (TCP/IP) to communicate. It is the largest and most well-known example of an internet.

**Q1-11. Why are protocols needed?**

ANS:

Protocols are needed to define rules and conventions for communication between devices in a network. They ensure that data is transmitted, received, and interpreted correctly by defining standards for data formatting, error detection and correction, addressing, routing, and security.

**Q1-12. In a LAN with a link-layer switch (Figure 1.8b), Host 1 wants to send a message to Host 3. Since communication is through the link-layer switch, does the switch need to have an address? Explain**

ANS:

In a LAN with a link-layer switch, the switch needs to have addresses to determine where to forward messages. Each device connected to the switch typically has a unique MAC (Media Access Control) address, which the switch uses to identify and forward messages to the appropriate destination.

**Q1-13. How many point-to-point WANs are needed to connect n LANs if each LAN should be able to directly communicate with any other LAN?**

ANS:

To connect n LANs so that each LAN can directly communicate with any other LAN, (n-1) point-to-point WAN connections are needed for each LAN to connect to every other LAN.

**Q1-14. When we use local telephones to talk to a friend, are we using a circuit switched network or a packet-switched network?**

ANS:

When using local telephones to talk to a friend, it's typically a circuit-switched network. Traditional telephone networks establish a dedicated circuit for the duration of the call, ensuring a continuous connection between the two parties until the call ends.

**Q1-15. When a resident uses a dial-up or DLS service to connect to the Internet, what is the role of the telephone company?**

ANS:

When a resident uses dial-up or DSL service to connect to the Internet, the role of the telephone company is to provide the physical infrastructure (telephone lines) and network connectivity to establish the connection between the user's location and the Internet Service Provider (ISP).

**Q1-16. What is the first principle we discussed in this chapter for protocol layering that needs to be followed to make the communication bidirectional?**

ANS:

The first principle discussed for protocol layering to make communication bidirectional is to have separate layers for sending and receiving. This separation allows devices to both send and receive data independently, facilitating bidirectional communication.

**Q1-17. Explain the difference between an Internet draft and a proposed standard.**

ANS:

An Internet draft is a working document intended for review and discussion within the Internet Engineering Task Force (IETF) community. A proposed standard is a specification that has been recommended by the IETF for implementation and use as a standard practice on the Internet.

**Q1-18. Explain the difference between a required RFC and a recommended RFC.**

ANS:

A required RFC (Request for Comments) is a document that describes a standard or protocol that is mandatory for implementation and use. A recommended RFC is a document that provides guidelines, best practices, or additional information that is not mandatory but is considered beneficial for implementation and understanding.

**Q1-19. Explain the difference between the duties of the IETF and IRTF.**

ANS:

The Internet Engineering Task Force (IETF) is responsible for developing and promoting voluntary Internet standards through the publication of RFCs, while the Internet Research Task Force (IRTF) focuses on longer-term research topics related to the Internet's architecture, protocols, and technology.

**Q1-21. Which of the following data units has an application-layer message plus the header from layer 4?**

ANS: Option b. a user datagram

**Q1-22. List some application-layer protocols mentioned in this chapter.**

ANS:

Application-layer protocols mentioned in networking often include HTTP, FTP, SMTP, DNS, DHCP, Telnet, etc.

**Q1-23. If a port number is 16 bits (2 bytes), what is the minimum header size at the transport layer of the TCP/IP protocol suite?**

ANS:

The TCP header size is variable but ranges from 20 to 60 bytes, depending on the options. UDP has an 8-byte header. So, if we are considering TCP or UDP within the TCP/IP protocol suite, the minimum header size would be 20 bytes for TCP and 8 bytes for UDP.

**Q1-24. What are the types of addresses (identifiers) used in each of the following layers?**

ANS:

a. application layer: Generally, at the application layer, we use logical addresses or identifiers, such as URLs, email addresses, or service names.

b. network layer: At the network layer, IP addresses are used as identifiers.

c. data-link layer: MAC (Media Access Control) addresses are used as identifiers at the data-link layer.

**Q1-25. Assume we want to connect two isolated hosts together to let each host communicate with the other. Do we need a link-layer switch between the two? Explain.**

ANS:

No, if there are only two hosts and they are directly connected (for instance, through a crossover Ethernet cable), there is no need for a link-layer switch. Link-layer switches are used to connect multiple hosts in a local network, where they facilitate communication between multiple devices by forwarding frames based on MAC addresses. However, in a direct connection scenario, hosts can communicate without the need for an intermediate device like a switch.

**PROBLEMS**

**P1-1. What is the maximum number of characters or symbols that can be represented by Unicode?**

ANS:

The maximum number of characters or symbols that can be represented by Unicode is 1,114,112 (0x10FFFF in hexadecimal).

**P1-2. A color image uses 16 bits to represent a pixel. What is the maximum number of different colors that can be represented?**

ANS:

A color image using 16 bits per pixel can represent a maximum of 65,536 (2^16) different colors.

**P1-3. Assume six devices are arranged in a mesh topology. How many cables are needed? How many ports are needed for each device?**

ANS:

In a mesh topology with six devices, the number of cables needed is \( \frac{n(n-1)}{2} = \frac{6(6-1)}{2} = 15 \) cables. Each device needs \( n-1 \) ports to connect to the other devices, so each device in this case would require 5 ports.

**P1-4. . 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**

ANS:

Consequences of a connection failure in different network topologies:

a. Mesh Topology: In a mesh topology, each device is connected to every other device, so the failure of one connection typically doesn't disrupt communication significantly, as alternative paths can be used.

b. Star Topology: If a connection to a hub fails, the device connected to that hub loses connectivity to the network, but other devices on the network remain unaffected.

c. Bus Topology: If a station (device) is unplugged in a bus topology, the segment of the network beyond that station becomes inaccessible, but the rest of the network continues to function.

d. Ring Topology: If one station is unplugged in a ring topology, it can break the entire network since the data cannot circulate around the ring.

**P1-5. In the ring topology in Figure 1.7, what happens if one of the stations is unplugged?**

ANS:

In a ring topology, if one of the stations is unplugged, it breaks the continuity of the ring, and communication between stations on the ring is disrupted.

**P1-6. In the bus topology in Figure 1.6, what happens if one of the stations is unplugged?**

ANS:

In a bus topology, if one of the stations is unplugged, it breaks the continuity of the bus, and communication along the entire bus segment is disrupted. However, the rest of the network remains unaffected.

**P1-7. When a party makes a local telephone call to another party, is this a point-topoint or multipoint connection? Explain the answer**

ANS:

When a party makes a local telephone call to another party, it's a point-to-point connection. This is because the call is established between two specific parties (points) using a dedicated communication channel.

**P1-8. Compare the telephone network and the Internet. What are the similarities? What are the differences?**

**ANS:**

Similarities between the telephone network and the Internet:

- Both facilitate communication between individuals or devices.

- Both rely on network infrastructure to transmit data.

- Both provide means for connecting people across distances.

Differences between the telephone network and the Internet:

- The telephone network primarily supports voice communication, while the Internet supports various types of data communication including voice, video, text, and multimedia.

- The telephone network traditionally operates on circuit-switched technology, establishing dedicated connections for calls, while the Internet operates on packet-switched technology, breaking data into packets for transmission.

- The telephone network typically requires dedicated lines for each connection, while the Internet allows multiple users to share the same network infrastructure.

**P1-9: Answer the following questions about Figure 1.15 when the**

**communication is from Maria to Ann:**

**a. What is the service provided by layer 2 to layer 3 at**

**Maria’s site?**

**b. What is the service provided by layer 2 to layer 3 at Ann’s**

**site?**

For Figure 1.15:

**a.**

- At Maria's site, layer 2 (the data-link layer) provides the service of transmitting data frames between her device and the network interface card (NIC), thus providing the network layer (layer 3) with the ability to send data over the network.

**b.**

- Similarly, at Ann's site, layer 2 (the data-link layer) provides the service of transmitting data frames between her device and the network interface card (NIC), allowing the network layer (layer 3) to send data over the network.

**P1-10. Assume that the number of hosts connected to the Internet at year 2010 is 500 million. If the number of hosts increases only 20 percent per year, what is the number of hosts in year 2020?**

- To solve this, you would use the formula for exponential growth. You would start with the initial value of 500 million and apply the growth rate of 20% per year for 10 years (2020 - 2010). The formula would be:

**P1-11. Assume a system uses five protocol layers. If the application program creates a message of 100 bytes and each layer (including the fifth and the first) adds a header of 10 bytes to the data unit, what is the efficiency (the ratio of application-layer bytes to the number of bytes transmitted) of the system?**

- To find the efficiency, you need to calculate the total number of bytes transmitted after adding headers at each layer and then calculate the ratio of application-layer bytes to the total number of bytes transmitted.

Let's tackle each of these questions:

P1-11. \*\*Efficiency Calculation\*\*:

ANS:

- Total bytes transmitted = \(100 \text{ bytes} + 10 \text{ bytes/layer} \times 5 \text{ layers} = 100 \text{ bytes} + 50 \text{ bytes} = 150 \text{ bytes}\)

- Efficiency = \(\frac{\text{Application-layer bytes}}{\text{Total bytes transmitted}} = \frac{100 \text{ bytes}}{150 \text{ bytes}} = \frac{2}{3} = 0.67\)

So, the efficiency of the system is \(0.67\) or \(67\%\).

**P1-12. Match the following to one or more layers of the TCP/IP protocol suite:**

**a. route determination**

**b. connection to transmission media**

**c. providing services for the end user**

ANS:

- a. Route determination: Network layer (IP layer)

- b. Connection to transmission media: Link layer (Network Interface layer)

- c. Providing services for the end user: Application layer

**P1-13. Match the following to one or more layers of the TCP/IP protocol suite:**

**a. creating user datagrams**

**b. responsibility for handling frames between adjacent nodes**

ANS:

- a. Creating user datagrams: Transport layer (UDP layer)

- b. Responsibility for handling frames between adjacent nodes: Link layer (Data link layer)

**P1-14. Assume that a private internet requires that the messages at the application layer be encrypted and decrypted for security purposes. If we need to add some information about the decryption process (such as the algorithms used in the process), does it mean that we are adding one layer to the TCP/IP protocol suite? Redraw the** **TCP/IP layers (Figure 1.17b) if you think so.**

ANS:

Adding encryption/decryption typically falls under the application layer. It doesn't necessarily add a new layer to the TCP/IP protocol suite; rather, it's an additional function performed at the application layer. So, you wouldn't redraw the TCP/IP layers for this.

**P1-15. Protocol layering can be found in many aspects of our lives such as air travelling. Imagine you make a round trip to spend some time on vacation at a resort. You need to go through some processes at your city airport before flying. You also need to go through some processes when you arrive at the resort airport. Show the protocol layering for the round trip using some layers such as baggagechecking/claiming, boarding/unboarding, takeoff/landing.**

ANS:

This question requires you to illustrate the protocol layering concept using air travel processes like baggage checking/claiming, boarding/unboarding, takeoff/landing. You can depict it in a hierarchical manner, similar to how networking protocols are layered.

**P1-16. The presentation of data is becoming more and mor important in today’s Internet. Some people argue that the TCP/IP protocol suite needs to add a new layer to take care of the presentation of data (see Appendix C). If this new layer is added in the future, where should its position be in the suite? Redraw Figure 1.17 to include this layer.**

ANS:

If a new layer for data presentation is added to the TCP/IP protocol suite, it would likely be placed between the application layer and the transport layer. This new layer would handle tasks related to data formatting, encoding, encryption, and similar operations before passing data to the transport layer for transmission. You would redraw Figure 1.17 with this new layer inserted between the application layer and the transport layer.