**Chapter:8 Questions**

**Q8-1.**Describe the need for switching and define a switch.

Ans: Need for Switching is must to connect multiple devices in a network. A Switch is a device capable of temporary connection between one or more devices linked to the switch.

**Q8-2.**List the three traditional switching methods. Which are the most common   
today?

Ans: Circuit Switching, Packet Switching and Message Switching. The most common are circuit switching and packet switching.

**Q8-3.**What are the two approaches to packet switching?

Ans: Datagram Approach and Virtual Circuit Approach

**Q8-4.**Compare and contrast a circuit-switched network and a packet-switched network.

Ans:

* Data are not packetized in Circuit Switched Network and Data are Packetized in Packet Switched Network.
* In Packet Switched Network, each packet is somehow independent entity with its global and local addressing information whereas in Circuit Switched Network data flow is somehow a continuation of bits that travel the same channel during the data transfer phase

**Q8-5.**What is the role of the address field in a packet traveling through a datagram   
network?

Ans: Role of the address field in a packet traveling through a datagram network is defining end-to-end addressing.

**Q8-6.**What is the role of the address field in a packet traveling through a virtual- circuit network?

Ans: Role of address field in a packet traveling through a virtual circuit network defines Virtual Circuit Number Addressing.

**PROBLEMS:**

**P8-1.** A path in a digital circuit-switched network has a data rate of 1 Mbps. The exchange of 1000 bits is required for the setup and teardown phases. The distance between two parties is 5000 km. Answer the following questions if the propagation speed is 2 × 108 m:

**Solution**: The delay for the phases can be calculated as: (|8 is raise to power 8)

3[(5000 km)/(2×10 |8 m/s)] +3 [(1000 bits/1 Mbps)] = 75 ms + 3 ms = 78 ms.

**What is the total delay if 1000 bits of data are exchanged during the data- transfer phase?**

**Ans:** Delay for setup and teardown + propagation delay + transmission delay = 78 + 25 + 1 = 104 ms

**What is the total delay if 100,000 bits of data are exchanged during the data-transfer phase?**

**Ans:** Delay for setup and teardown + propagation delay + transmission delay = 78 + 25 + 100 = 203 ms

**What is the total delay if 1,000,000 bits of data are exchanged during the data-transfer phase?**

**Ans:** Delay for setup and teardown + propagation delay + transmission delay = 78 + 25 + 1000 = 1103 ms

**Find the delay per 1000 bits of data for each of the above cases and compare them. What can you infer?**

**Ans:** In (a) we have 104 ms, In (b) we have 203/100 = 2.03 ms and In (c) we have 1103/1000 = 1.101ms. The ratio for case C is smallest because we use one setup and teardown to send more data.

**P8-2.**Five equal-size datagrams belonging to the same message leave for the destination. We assume that the delay for each switch (including waiting and processing) is 3, 10, 20, 7, and 20 ms respectively. Assuming that the propagation speed is 2 × 108 m, find the order the datagrams arrive at the destination and the delay for each. Ignore any other delays in transmission.

**Solution**: We assume no transmission time in this case. This means all datagram starts at time 0.

First (3200 Km) / (2 × 10 |8 m/s) + (3 +20+20 ) = 59.0 ms

Second (11700 Km) / (2 × 10 |8 m/s) + (3 +10 + 20 ) = 91.5 ms

Third (12200 Km) / (2 × 10 |8 m/s) + (3 +10 + 20 + 20) = 114.0 ms

Fourth (10200 Km) / (2 × 10 |8 m/s) + (3 + 7 + 20 ) = 81.0 ms

Fifth (10700 Km) / (2 × 10 |8 m/s) + (3 + 7 + 20 + 20 ) = 103.5 ms

The order of arrival is 3 -> 5 -> 2 -> 4 -> 1

**P8-3.**Transmission of information in any network involves end-to-end addressing and sometimes local addressing (such as VCI).

Answer the following questions:

**a. Why does a circuit-switched network need end-to-end addressing during the setup and teardown phases? Why are no addresses needed during the data transfer phase for this type of network?**

**Ans:** In circuit switched network, end-to-end addressing is needed to create the connection for the whole data transfer phase. The data flow travels through the already-reserved resources. The switch remain connected for the entire duration of the data transfer. There is no need for further addressing.

**b. Why does a datagram network need only end-to-end addressing during the data transfer phase, but no addressing during the setup and teardown phases?**

**Ans:** In a datagram network, each packet is independent. The routing of the packet is done for each packet individually. So packets needs to carry an end-to-end address. There is no set up and tear down phases in datagram network. The entries in the routing able are permanent and made by other processes such as routing protocols.

**c. Why does a virtual-circuit network need addresses during all three phases?**

**Ans:** In a virtual circuit network, there is a need for end to end addressing during the setup and tear down phase to make corresponding entry in switching table. The entry is made for each request for connection. Each packet must carry a virtual circuit identifier during the transfer phase, to show which virtual phase that packet follows.

**P8-4.**We mentioned that two types of networks, datagram and virtual-circuit, need a routing or switching table to find the output port from which the information belonging to a destination should be sent out, but a circuit-switched network   
has no need for such a table. Give the reason for this difference.

Ans: A datagram or virtual-circuit network handles packetized data. For each packet, the switch needs to consult its table to find the output port in the case of a datagram network, and to find the combination of the output port and the virtual circuit identifier in the case of a virtual-circuit network. In a circuit switched network, data are not packetized; no routing information is carried with the data. The whole path is established during the setup phase.

**P8-5.**An entry in the switching table of a virtual-circuit network is normally created during the setup phase and deleted ————-book————

Ans: In circuit-switched and virtual-circuit networks, we are dealing with connections. A connection needs to be made before the data transfer can take place. In the case of a circuit-switched network, a physical connection is established during the setup phase and the is broken during the teardown phase. In the case of a virtual-circuit network, a virtual connection is made during setup and is broken during the tear- down phase; the connection is virtual, because it is an entry in the table. These two types of networks are considered connection-oriented. In the case of datagram network no connection is made. Any time a switch in this type of network receives a packet, it consults its table for routing information. This type of network is considered connectionless network.

**P8-6.**The minimum number of columns in a datagram network is two; the minimum number of columns in a virtual-circuit network is four. Can you explain the reason? Is the difference related to the type of addresses carried in the packets   
of each network?

Ans: The switching or routing in a datagram network is based on the final destination address, which is global. The minimum number of entries is two; one for the final destination and one for the output port. Here the input port, from which the packet has arrived is irrelevant. The switching or routing in a virtual-circuit network is based on the virtual circuit identifier, which has a local jurisdiction. This means that two different input or output ports may use the same virtual circuit number. Therefore, four pieces of information are required: input port, input virtual circuit number, output port, and output virtual circuit number.

**P8-7.  ———book——**

Ans: Packet 1: 2

Packet 2: 3

Packet 3: 3

Packet 4: 2

**P8-8.**

**Ans:** Packet 1: 2, 70

Packet 2: 1, 45

Packet 3: 3, 11

Packet 4: 4, 41

**P8-9.**Answer the following questions:

a. Can a routing table in a datagram network have two entries with the same   
destination address? Explain.

Ans: In datagram network, the destination addresses are unique. They cannot be duplicated in the routing table.

b. Can a switching table in a virtual-circuit network have two entries with the   
same input port number? With the same output port number? With the same incoming VCIs? With the same outgoing VCIs? With the same incoming values (port, VCI)? With the same outgoing values (port, VCI)?

Ans: In a virtual-circuit network, the VCIs are local. A VCI is unique only in relationship to a port. In other words, the (port, VCI) combination is unique. This means that we can have two entries with the same input or output ports. We can have two entries with the same VCIs. However, we cannot have two entries with the same (port, VCI) pair.

**Chapter:9 Questions**

**Q9-1.**Distinguish between communication at the network layer and communication at the data-link layer.

Ans: Data Link Layer handles communication between systems on the same local network. Network Layer is responsible for end to end packet delivery and packet routing through intermediate hosts.

**Q9-2.**Distinguish between a point-to-point link and a broadcast link.

Ans: A broadcast link is the link that connects two or more nodes where one node can transmit the signal for the rest of the nodes to receive the signal at the same time. Point to Point link is the link that connects just two nodes or endpoints where one node sends the signal and the other node receives it.

**Q9-3.**Can two hosts in two different networks have the same link-layer address? Explain.

Ans: Yes, they can. The destination address comes before the source.An interface is a connection of a router to a link. A router with n interfaces is connected to the Internet at n points.

**Q9-4.**Is the size of the ARP packet fixed? Explain.

Ans: No. It can have two two MAC addresses in it and two different protocol addresses in it. The size depends upon the network and datalink protocol.

**Q9-5.**What is the size of an ARP packet when the protocol is IPv4 and the hardware is Ethernet?

Ans: **28 bytes** = 2 + 2 + 1 + 1 + 2 + 6 + 4 + 6 + 4

**Q9-6.**Assume we have an isolated link (not connected to any other link) such as a private network in a company. Do we still need addresses in both the network layer and the data-link layer? Explain.

Ans: Each host should know its own link layer address. The destination link layer address is determined by using the Address Resolution Protocol.

**Q9-7.**In Figure 9.9, why is the destination hardware address all 0s in the ARP request message?

Ans: System A does not know the link layer address of system B yet. It uses an all zero address to define that this address is needed.

**Q9-8.**In Figure 9.9, why is the destination hardware address of the frame from A to B a broadcast address?

Ans: The frame uses a broadcast address so that the intended recipient on the network will receive the frame even though the sender does not know the specific hardware address of the intended recipient.

**Q9-9.**In Figure 9.9, how does system A know what the link-layer address of system B is when it receives the ARP reply?

Ans: The source hardware address defines the link layer address of station B.

**Q9-10.**When we talk about the broadcast address in a link, do we mean sending a message to all hosts and routers in the link or to all hosts and routers in the Internet? In other words, does a broadcast address have a local jurisdiction or a universal jurisdiction? Explain.

Ans: A broadcast address is an address used to indicate that the information being sent out should be delivered to every client on LAN. Broadcast on the data link layer correspond to MAC addresses. When a MAC address broadcast is sent out, each network interface card on the LAN will see the broadcast address.

**Q9-11.**Why does a host or a router need to run the ARP program all of the time in the background?

Ans: A host doesn’t know when the other host sends an ARP request. It needs to be ready all of the time to respond to an ARP request.

**Q9-12.**Why does a router normally have more than one interface?

Ans: The router normally have more than one interface because its purpose is to connect two or more networks together. It will then route data between them .

**Q9-13.**Why is it better not to change an end-to-end address from the source to the destination?

Ans: If an end-to-end address is changed during the packet journey, it is not guarantee that the packet arrives at its destination.

**Q9-14.**How many IP addresses and how many link-layer addresses should a router have when it is connected to five links?

Ans: A router should have **five** different IP addresses and **five** different link-layer addresses.

**PROBLEMS:**

**P9-1.**Assume we have an internet (a private small internet) in which all hosts are connected in a mesh topology. Do we need routers in this internet? Explain.

Ans: No, because all Mesh Topology Point-To-Point Device of communication, and therefore direct the way we communicate with anyone we want.

**P9-2.**In the previous problem, do we need both network and data-link layers?

Ans: We do not need IP addresses because the global communication is one to one. If a station has a packet to send to another station, it uses the link-layer address of the destination host (or even port number related to the destination) to send a packet. However, if the internet uses the TCP/IP protocol suite, then messages pass through the network layer and IP address come to the picture.

**P9-3.**Explain why we do not need the router in Figure 9.15.

Ans: We do not need routers because we have direct connection to the server.

**P9-4.**Explain why we may need a router in Figure 9.16.

Ans: Router is needed in this situation because both the devices are connected to internet through modem

**P9-5.**Is the current Internet using circuit-switching or packet-switching at the data- link layer? Explain.

Ans: Packet Switching at the data link layer. The source divides the data at the data-link layer into frames and each frame is independent.

**P9-6.**Assume Alice is travelling from 2020 Main Street in Los Angeles to 1432 American Boulevard in Chicago. If she is travelling by air from Los Angeles Airport to Chicago Airport,  
**a.** find the end-to-end addresses in this scenario.

Ans: Source: 2020 Main Street in Los Angeles

Destination: 1432 American Boulevard in Chicago

**b.** find the link-layer addresses in this scenario.

Ans: In this scenario we have three links, home to Los Angeles Airport then Los Angeles Airport to Chicago Airport and from there to destination.

**First Link**: Source: 2020 Main Street in Los Angeles Destination: Los Angeles Airport

**Second Link**: Source: Los Angeles Airport Destination: Chicago Airport

**Third Link**: Source: Chicago Airport Des±na±on: 1432 American Boulevard in Chicago.

**P9-7.**In the previous problem, assume Alice cannot find a direct flight from the Los Angeles to the Chicago. If she needs to change flights in Denver,

**a.** find the end-to-end addresses in this scenario - **Source:** 2020 Main Street, Los Angeles and **Destination:** 1432 American Boulevard, Chicago

**b.** find the link-layer addresses in this scenario -

First Link - Source: 2020 Main Street and Destination: Los Angeles Airport

Second Link - Source: Los Angeles Airport and Destination: Denver Airport

Third Link - Source: Denver Airport and Destination: Chicago Airport

Fourth Link - Source: Chicago Airport and Destination: 1432 American Boulevard

**P9-8.**When we send a letter using the services provided by the post office, do we use an end-to-end address? Does the post office necessarily use an end-to-end address to deliver the mail? Explain.

Ans: Yes, we use end-to-end address whenever we send a letter using the services provided by the post office to ensure it safely reaches the desired destination. It is necessary for the post office to use an end-to-end address to deliver the mail. Since, the delivery of the mail is essential to the desired address.

**P9-9.**In Figure 9.5, assume Link 2 is broken. How can Alice communicate with Bob?

Ans: Communication cannot be done anyway.

**P9-10.**In Figure 9.5, show the process of frame change in routers R1 and R2.

Ans: L2 L1 N1 N8 Data changes to L5 L4 N1 N8 Data

L5 L4 N1 N8 Data changes to L8 L7 N1 N8 Data

**P9-11.**In Figure 9.7, assume system B is not running the ARP program. What would happen?

Ans: The packet cannot be delivered unless system A broadcast it and system B receive it. In this case, all stations receive the packet. Other stations should drop it.

**P9-12.**In Figure 9.7, do you think that system A should first check its cache for map- ping from N2 to L2 before even broadcasting the ARP request?

Ans: System A can use its cache considering the policy the cache is designed for. If system A is mapping from L2 to N2, there is a possibility that System A’s cache will have the mapping address if it had accessed the mapping locations is the near past.

**P9-13.**Assume the network in Figure 9.7 does not support broadcasting. What do you suggest for sending the ARP request in this network?

Ans: Two approaches can be used. In the first approach, system A has a table to match the network-layer addresses to data-link addresses, it can use the table to find the data-link address of system B. In the second approach, system A has only the list of all data-link layer addresses, it can send unicast ARP packet to all stations to find out the one which matches the network-layer address. None of the approaches are practical because a host may change its data-link layer address without notice. Some networks support tunneling, in which the network encapsulates a broadcast or multicast packet in a unicast packet and send them to all stations. Some networks support *tunneling*, in which the network encapsulates a broadcast or multicast packet in a unicast packet and send them to all stations.

**P9-14.**In Figures 9.11 to 9.13, both the forwarding table and ARP are doing a kind of mapping. Show the difference between them by listing the input and output of mapping for a forwarding table and ARP.

Ans: Figure 9.11: **Input**: Na Nb Data **Output** L1 La Na Nb Data

Figure 9.12: **Input**: L1 La Na Nb Data **Output** L3 L2 Na Nb Data

Figure 9.13: **Input**: L3 L2 Na Nb Data **Output** Lb L4 Na Nb Data

**P9-15.**Figure 9.7 shows a system as either a host or a router. What would be the actual entity (host or router) of system A and B in each of the following cases:

Ans:

**a.** If the link is the first one in the path? A: host B: router

**b.** If the link is the middle one in the path? A: router B: router

**c.** If the link is the last one in the path? A: router B: Host

**d.** If there is only one link in the path (local communication)? A: host B: host