CHAPTER 9

PRACTICE SET

Questions

Q9-1. Communication at the network layer is *host-to-host*; communication at the data-link layer is *node-to-node*.

Q9-2. A *point-to-point link* is dedicated to the two devices connecting at the two ends of the link. A *broadcast link* shares its capacity between pairs of devices that need to use the link.

Q9-3. Two hosts in two different networks can theoretically have the same link-layer address because a link-layer address has only local jurisdiction. However, the tendency is to avoid this for the future development of the Internet. Even today, manufacturers of network interface cards (NIC) use different set of link-layer addresses to make them distinguished.

Q9-4. The size of an ARP packet is variable, depending on the length of the protocol and hardware addresses used.

Q9-5. ARP Packet Size = 2 + 2 + 1 + 1 + 2 + 6 + 4 + 6 + 4 = 28 bytes (Figure 9. 8).

Q9-6. An isolated network does not need network-layer addresses. Data-link layer addresses are enough to handle communication between the hosts. However, if the network uses TCP/IP protocol switch, then network addresses are needed at the network layer.

Q9-7. Station A does not know the link-layer address of station B yet. It uses an all-zero address to define that this address is desired.

Q9-8. Station A does not know the link-layer address of B (the reason for sending an ARP packet). It sends a broadcast address to all stations so that the station with IP address defined in destination protocol address respond.

Q9-9. The source hardware address defines the link-layer address of station B.

Q9-10. The broadcast address here means the local broadcast. The packet does not leave the network.

Q9-11. A host does not know when another host sends an ARP request; it needs to be ready all of the time to respond to an ARP request.

Q9-12. A router, by nature, is connected to two or more network. It needs an interface (port) for each network it is connected to.

Q9-13. 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. A router should have five different IP addresses and five different link-layer addresses. Each IP address belongs to the set of addresses assigned to a network (See Chapter 18). Each link-layer address also define the router at the connection at the data-link layer.

Problems

P9-1. Theoretically, 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.

P9-2. Again, we do not need network layer, but if we use TCP/IP protocol suite, the network layer is inevitably involved.

P9-3. A router is need when we have more than one paths for the packet to travel from the source to destination. In Figure 9.15 (in the text) there is only path in each direction. We need no router.

P9-4. In Figure 9.16 (in the text), we have two separate networks. We normally do not want that the packets with the source and destination in the same network to go to the other network. The filtering can be done by switches (if they are link layer switches). However, it is more safe that the router drops the packets that should not reach the other network. If we think of the router as three interfaces (two connected to the two networks and one discards the packet) we can see that there is more than one path from the source to destination and we need a router.

P9-5. The current Internet is using 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. We can think of one journey with three links in this case: home-to-airport, airport-to-airport, and airport-to-home

a. **End-to-end addresses** (the whole journey)
Source: 2020 Main Street, Los Angeles
Destination: 1432 American Boulevard, Chicago

b.

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

Second Link
Source: Los Angeles Airport
Destination: Chicago Airport

Third Link
Source: Chicago Airport
Destination: 1432 American Boulevard

P9-7. We can think of one journey with four links in this case: home-to-airport, airport-to-airport, and airport-to-home

a. **End-to-end addresses** (the whole journey)
Source: 2020 Main Street, Los Angeles
Destination: 1432 American Boulevard, Chicago

b.

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

Second Link
Source: Los Angeles Airport
Destination: Denver Airport

Third Link
Source: Denver Airport
Destination: Chicago Airport

Fourth Link
Source: Chicago Airport
Destination: 1432 American Boulevard

P9-8. We use an end-to-end address on each letter. The post office, however, may use different links to get the letter to the destination. The letter (with other letters) may go from the local post office to a local airport, from the local airport to the airport of the destination city. From the last airport to the local post office, and from the local office to the destination resident or office.

P9-9. The communication is impossible unless router R1 can reach router R2 using another path.

P9-10.

a. Router R1 gets the frame received from interface L2, decapsulates the network-layer packet (N1, N2, Data). The router then consults its routing table to find what is the next router for destination N2. It finds that the packet should be delivered to router R2. It sends an ARP packet to find the link-layer address of R2, which is L5. Router R1 now encapsulates the network-layer packet in a frame with source address L4 and destination address L5.

b. Router R2 gets the frame received from interface L5, decapsulates the network-layer packet (N1, N2, Data). The router then consults its routing table to find what is the next router or host for destination N2. It finds that the packet should be delivered to host N8. It sends an ARP packet to find the link-layer address of N8, which is L8. Router R1 now encapsulates the network-layer packet in a frame with source address L6 and destination address L8.

P9-11. 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. Checking the cache definitely saves the time and make the system more efficient.

P9-13. 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 (by changing NIC as we see in Chapter 13). 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.

a. Forwarding table
input: destination network-layer address of the packet
output: network-layer address of the next system

b. ARP
input: network-layer address of the next system
output: data-link layer address of the next system

P9-15.

a. A: host	B: router
b. A: router	B: router
c. A: router	B: host
d. A: host	B: host