Link Layer - Solutions

Q1. What are some of the possible services that a link-layer protocol can offer to the network layer? Which of these link-layer services have corresponding services in IP and TCP?

Answer. framing: there is also framing in IP and TCP; link access; reliable delivery: there is also reliable delivery in TCP; flow control: there is also flow control in TCP; error detection: there is also error detection in IP and TCP; error correction; full duplex: TCP is also full duplex.

Q2. Why is an ARP query sent within a broadcast frame? Why is an ARP response sent within a frame with a specific destination MAC address?

Answer. An ARP query is sent in a broadcast frame because the querying host does not know which adapter address corresponds to the IP address in question. Broadcast enables this query to be sent to all hosts on that subnet. For the response, the sending node knows the adapter address to which the response should be sent, so there is no need to send a broadcast frame (which would have to be processed by all the other nodes on the LAN).

Q3. Suppose nodes A, B and C each attach to the same broadcast LAN through their adapters, If A sends thousands of IP datagrams to B with each encapsulating frame addressed to the MAC address of B, will C's adapter process these frames? If so, will C's adapter pass the IP datagrams in these frames to C (that is, the adapter's parent node)? How would your answers change if A sent frames with the MAC broadcast address?

Answer. C's adapter will process the frames, but the adapter will not pass the datagrams up the protocol stack. If the LAN broadcast address is used, then C's adapter will both process the frames and pass the datagrams up the protocol stack.

Q4. Consider a network with 6 nodes connected in a star topology (all nodes directly connect to a switch) to a central switch. Suppose that (i) A sends a frame to D, (ii) D replies with a frame to A, (iii) C sends a frame to D, (iv) D replies with a frame to C. The switch table is initially empty. Show the state of the switch table before and after each of these events. For each of these events, identify the link(s) on which the transmitted frame will be forwarded, and briefly justify your answers.

Answer.

Action	**Switch Table State**	**Link(s) packet is forwarded to**	**Explanation**
A sends a frame to D	Switch learns interface corresponding to MAC address of A	B, C, D, E, and F	Since switch table is empty, so switch does not know the interface corresponding to MAC address of D
D replies with a frame to A	Switch learns interface corresponding to MAC address of D	A	Since switch already knows interface corresponding to MAC address of A
C sends a frame to D	Switch learns the interface corresponding to MAC address of C	D	Since switch already knows the interface corresponding to MAC address of D
D replies with a frame to C	Switch table state remains the same as before	C	Since switch already knows the interface corresponding to MAC address of C

Q5. Why are Acknowledgment used in 802.11but not used in wired Ethernet?

Answer: In wireless channels bit error rates are high and collision detection cannot be effectively done.

Q6. Why would the token passing protocol be inefficient if a LAN had a very large perimeter?

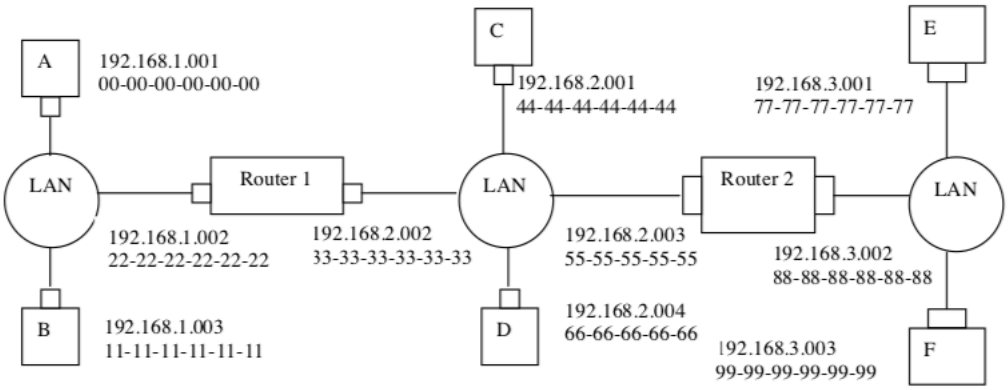
Answer: When a node transmits a frame, the node has to wait for the frame to propagate around the entire ring before the node can release the token. Thus, if L/R is small as compared to T_{prop}, then the protocol will be inefficient.

Q7. In CSMA/CD, after the fifth collision, what is the probability that a node chooses $K=4$?

Answer: After the 5th collision, the adapter chooses from {0, 1, 2, ..., 31}. The probability that it chooses 4 is 1/32.

Q8.

a & b)



c)

1. Forwarding table in E determines that the datagram should be routed to interface 192.168.3.002.

2. The adapter in E creates an Ethernet packet with Ethernet destination address 88-88-88-88-88-88.

3. Router 2 receives the packet and extracts the datagram. The forwarding table in this router indicates that the datagram is to be routed to 198.162.2.002.

4. Router 2 then sends the Ethernet packet with the destination address of 33-33- 33-33-33-33 and source address of 55-55-55-55-55-55 via its interface with IP address of 198.162.2.003.

5. The process continues until the packet has reached Host B.

d)

ARP in E must now determine the MAC address of 198.162.3.002. Host E sends out an ARP query packet within a broadcast Ethernet frame. Router 2 receives the query packet and sends to Host E an ARP response packet. This ARP response packet is carried by an Ethernet frame with Ethernet destination address 77-77-77-77-77-77.