COMP 3331 Computer Networks and Applications

Link Layer

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?

* framing, link access:
  + encapsulate datagram into frame, adding header.
  + “MAC” addresses used in frame headers to identify source, destination.
* reliable delivery between adjacent nodes
* flow control: pacing between adjacent sending and receiving nodes
* error detection: receiver detects presence of errors, e.g., CRC
* error correction: receiver identifies and corrects bit error(s) without resorting to retransmission, e.g., two-dimensional parity
* half-duplex and full-duplex: with half duplex, nodes at both ends of link can transmit, but not at same time
* framing: there is also framing in IP and TCP;
* 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;
* 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?

* 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?

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.

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

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

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

Q8. Consider the three LANs interconnected by two routers, as show in the figure below.

(a) Assign IP addresses to all of the interfaces. For Subnet 1 use addresses of the form 192.168.1.xxx; for Subnet 2 use addresses of the form 192.168.2.xxx; and for subnet 3 use addresses of the form 192.168.3.xxx.

(b) Assign MAC addresses to all of the adapters.

(c) Consider sending an IP datagram from Host E to Host B. Suppose all of the ARP tables are up to date. Enumerate all the steps, as done for the single-router example in Section 5.4.1 of the textbook.

(d) Repeat (c), now assuming that the ARP table in the sending host is empty (and the other tables are up to date)

# Quiz (Week 9)

Q1. LAN address is also known as:

A. TCP address

B. IP address

**C. MAC address**

D. Virtual address

Q2. LAN address is usually written in:

**A. Hexadecimal notation**

B. Binary notation

C. Decimal notation

D. in words

Q3. ARP is used to resolve:

A. the IP address of a domain name

B. the next hop address for an arriving packet

**C. the associated LAN address of an IP address**

D. the associated IP address of a LAN address

Q4. A network admin is needed to configure an ARP table. True or **False?**

Q5. Which of the following is an example of link layer protocol?

A. RIP

B. OSPF

**C. Ethernet**

D. TCP

Q6. One of the advantages of using bus-based Ethernet is that collisions can be completely avoided. True or **False**?

Q7. Switching tables in LAN switches are typically configured by network admin. True or **False**?

Q8. In a LAN switch, packets:

A. are never flooded

B. are always flooded

**C. can be flooded sometimes**

D. are flooded only when reliable service is required.

Q9 . If a LAN switch has flooded a packet, it means the switch did not know which LAN segment the packet came from. True or **False**?

Q10. If a LAN switch has flooded a packet, it means the switch did not know which LAN segment the packet destination is connected to. **True** or False?

# **Students to Discuss Solution: ARP (Week 9)**

Nodes 1, 2, 3 and 4 on an Ethernet LAN have Ethernet addresses E1, E2, E3 and E4, and IP addresses I1, I2, I3 and I4, respectively. Assume that the nodes are connected via a star topology via a central Ethernet switch (typical star topology as shown in the lecture slides) All nodes maintain an ARP cache and respond to ARP queries immediately. Unless refreshed, ARP cache entries are timed out and removed if more than 15 minutes old. At time t = 0, assume that all the ARP caches are empty. After ARP responses are received subsequent to each of the following ARP queries, state which nodes have an Ethernet-IP address mapping for which other nodes in their ARP caches.

1. At time t = 5 minutes, node 1 broadcasts an ARP query for IP address I3, and node 2 broadcasts an ARP query for IP address I1.



1. At time t = 15 minutes, node 3 broadcasts an ARP query for IP address I2.



1. At time t = 25 minutes, node 4 broadcasts an ARP query for IP address I2.



### LINK LAYER (AND NETWORK LAYER) ADDRESSING AND FORWARDING

Consider the figure below. The IP and MAC addresses are shown for nodes A, B, C and D, as well as for the router's interfaces.

A picture containing text

Description automatically generated

Consider an IP datagram being sent from node B to node D.

QUESTION LIST

1. What is the source mac address at point 3?  
  
2. What is the destination mac address at point 3?  
  
3. What is the source IP address at point 3?  
  
4. What is the destination IP address at point 3?  
  
5. Do the source and destination mac addresses change at point 4? Answer with yes or no.  
  
6. What is the source mac address at point 4?  
  
7. What is the destination mac address at point 4?  
  
8. Do the source and destination mac addresses change at point 5? Answer with yes or no.

SOLUTION

. The source mac address at point 3 is 60-B0-E2-AD-4E-C1  
  
2. The destination mac address at point 3 is 18-75-43-10-75-3C  
  
3. The source IP address at point 3 is 128.119.162.41  
  
4. The destination IP address at point 3 is 128.119.50.184  
  
5. Yes, the datagram is being passed through a router, which causes a subnet change.  
  
6. The source mac address at point 4 is 22-30-E5-1E-F5-DE  
  
7. The destination mac address at point 4 is 0B-11-E1-4B-D9-79  
  
8. No, datagrams can be sent across the subnet via the link layer in one go.