CSc 361: Computer Communication and Networks (10:30-11:20 am, Dec 1, 2023)

Exam 3

Name: Student ID:

Closed-book exam. Nevertheless, a letter-sized, double-sided cheat sheet is allowed. A non-communicating calculator is also allowed. Please read all questions [marks] on all the **four** pages first. **Duration: 50 minutes**

1. Please answer if the following statements are true or false. **Just answer true or false.**

F (a) If wireless links are very reliable (e.g. no bit loss) and very fast (e.g., the transmission speed is 10 Gbps), then CSMA/CD can be used for wireless networks. [3]

F (b) When a client and a server are on different networks, the client should use the ARP protocol to find the server's MAC address before it sends a packet to the server. [3]

F (c) In IEEE 802.11, all nodes need to share the same NAV (Network Allocation Vector) so that they know the current channel allocation status. [3]

F (d) In an Ethernet switch (i.e., Layer-2 switch), every interface of the switch will be assigned a unique IP address. [3]

T (e) When an Ethernet switch receives a frame with the destination MAC address of DD-DD-DD-DD-DD-DD from its interface x, the switch will discard the frame if there is an entry in its switch table associating DD-DD-DD-DD-DD-DD with interface x.

F (f) Slotted ALOHA achieves a higher maximum throughput than ALOHA because a node using slotted ALOHA transmits faster than one using ALOHA [3].

T (g) In IEEE 802.11, the value of SIFS is smaller than the value of DIFS [3].

T (h) In IEEE 802.11, different SSIDs can be assigned to the same AP. [3]

2. Assume that R_1 is the maximum rate, in frames per second, for Ethernet frames of size N bytes ($64 \leq N \leq 759$). Consider the maximum rate R_2, in frames per second, for frames of size $3N$. Assume that there is no fragmentation. Which one of the following statements is true? **Just give your answer. No need to explain.** [10]

   - R_1 is smaller than $3R_2$ ✓
   - R_1 is equal to $3R_2$
   - R_1 is greater than $3R_2$

3. Consider three LANs interconnected by two routers, as shown in the following figure. IP addresses and MAC addresses have been assigned to all of the NICs (Network Interface Cards),

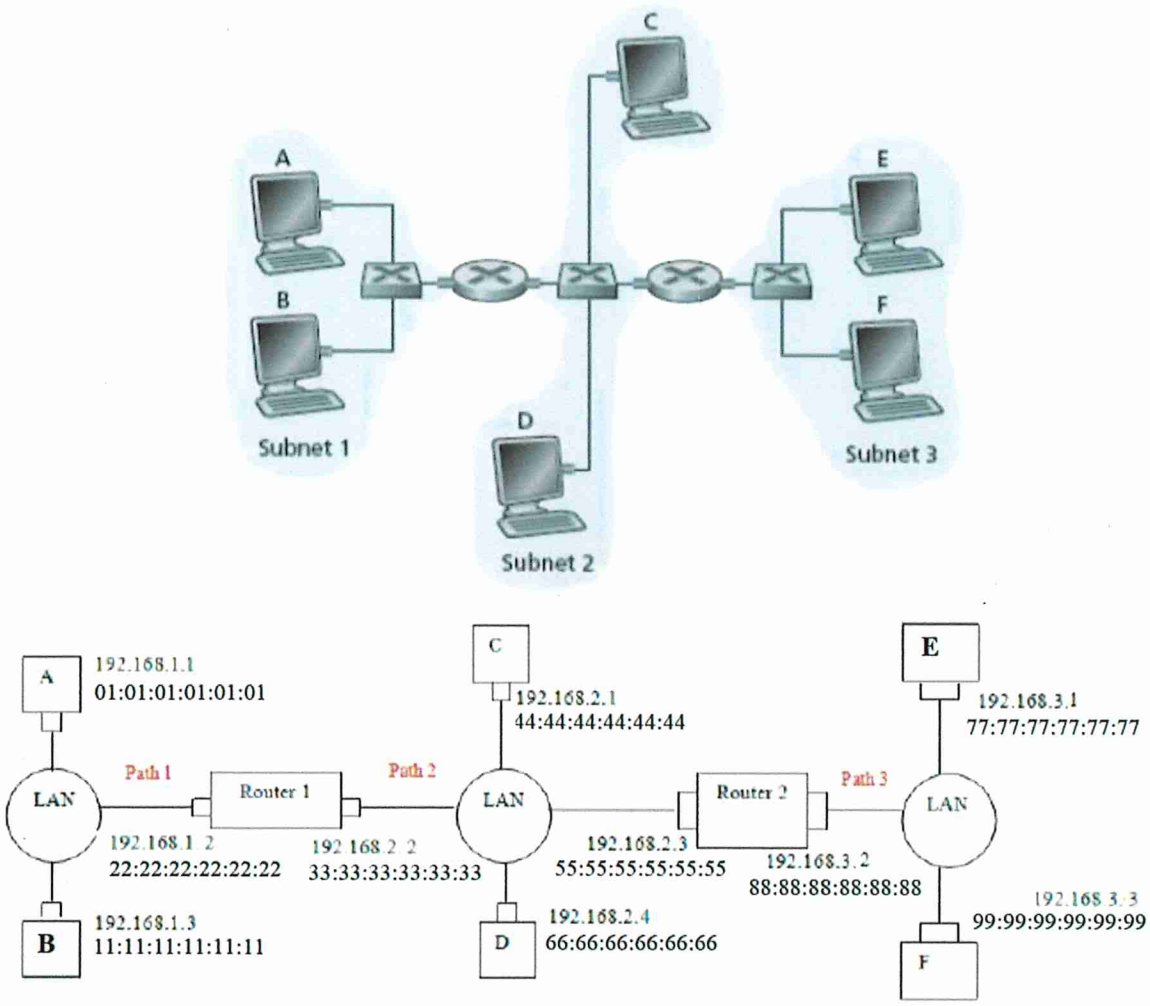

Figure 1: Three LANs interconnected by two routers.

shown in the figure. Subnet 1 uses addresses of the form 192.168.1.x; Subnet 2 uses addresses of the form 192.168.2.x; and Subnet 3 uses addresses of the form 192.168.3.x.

Consider sending a packet from Host B to Host E. Suppose all of the ARP tables are up to date. Fill the IP addresses and MAC addresses of this packet on different path segments (using the same address format drawn in the figure).

- **On path 1 (i.e., Host B to Router 1)** [6]:
  The source IP address of this packet is [1]: 192.168.1.3
  The destination IP address of this packet is [1]: 192.168.3.1
  The source MAC address of this packet is [2]: 11:11:11:11:11:11
  The destination MAC address of this packet is [2]: 22:22:22:22:22:22

- **On path 2 (i.e., Router 1 to Router 2)** [6]:
  The source IP address of this packet is [1]: 192.168.1.3
  The destination IP address of this packet is [1]: 192.168.3.1
  The source MAC address of this packet is [2]: 33:33:33:33:33:33

The destination MAC address of this packet is [2]: 55:55:55:55:55:55

- **On path 3 (i.e., Router 2 to Host E)** [6]:
  The source IP address of this packet is [1]: 192.168.1.3
  The destination IP address of this packet is [1]: 192.168.3.1
  The source MAC address of this packet is [2]: 88:88:88:88:88:88
  The destination MAC address of this packet is [2]: 77:77:77:77:77:77

4. Assume that on a 1 Gbps Ethernet, the bus cable length is 100 meters. Assume that the signal propagation speed is $2 * 10^8$ meters per second. What is the minimum frame length in the unit of byte? [12]

$\frac{L}{1Gbps} \geq \frac{2*100}{2*10^8}$

$L \geq \frac{2*100}{2*10^8} \times 10^9 = 1000$ bits $L \geq 125$ bytes

The minimum frame length is 125 bytes

5. The following figure shows a screenshot of WireShark. The trace was captured at a Windows machine running traceroute to destination 8.8.8.8. Packet #3 is the ICMP ping message with TTL=1 sent from the client, and Packet #4 is the ICMP error message received by the client. Note that an intermediate router generates Packet #4 since this router cannot forward Packet #3 further.

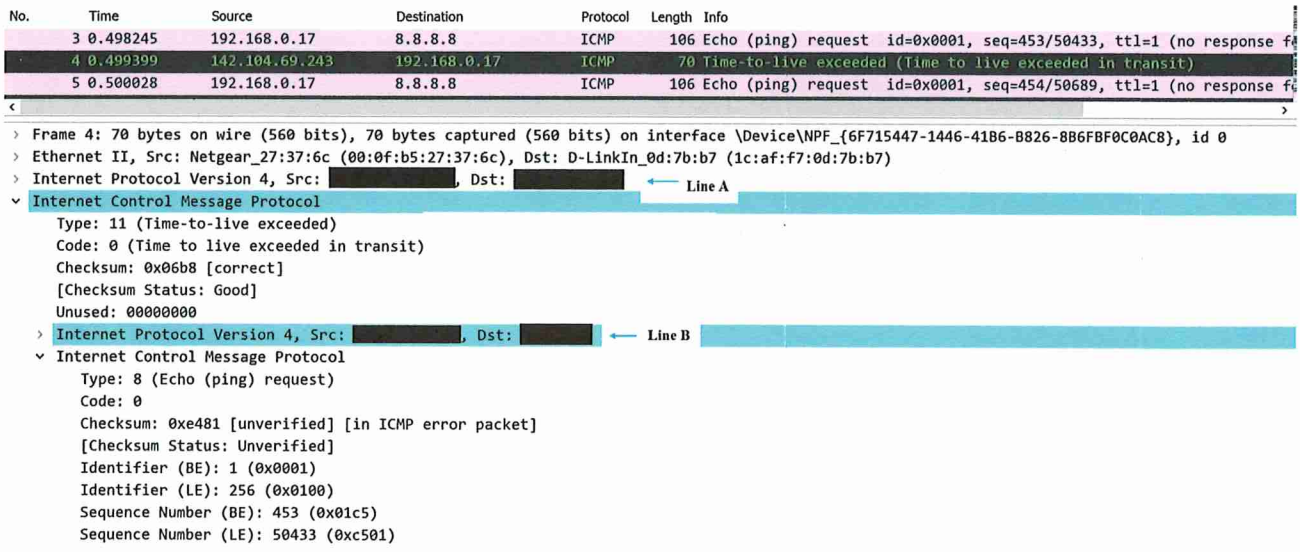

Figure 2: Screenshot of WireShark.

- The source and the destination IP addresses at Line A in the figure are hidden.
  The source IP address at Line A is: [4] 142.104.69.243
  The destination IP address at Line A is: [4] 192.168.0.17
- The source and the destination IP addresses at Line B in the figure are hidden.
  The source IP address at Line B is: [4] 192.168.0.17
  The destination IP address at Line B is: [4] 8.8.8.8

6. The following figure shows an example of the DCF operation of IEEE 802.11. Assume that the size of the data frames is the same: 2000 bits. Assume that the size of ACK frames is the same: 120 bits. Assume that four-way handshake (RTS/CTS/DATA/ACK) is used and the size of RTS and CTS frames is the same: 50 bits. Assume that the data frames are not fragmented. Assume that the channel speed is 2 Mbps. Assume that DIFS is equal to 6 microseconds. Assume that SIFS is equal to 4 microseconds. Assume that the initial backoff values (translated to time) of stations B, C, D are 100 microseconds, 50 microseconds, 70 microseconds, respectively. Assume that the backoff value (translated to time) of station E at point T1 is 40 microseconds.

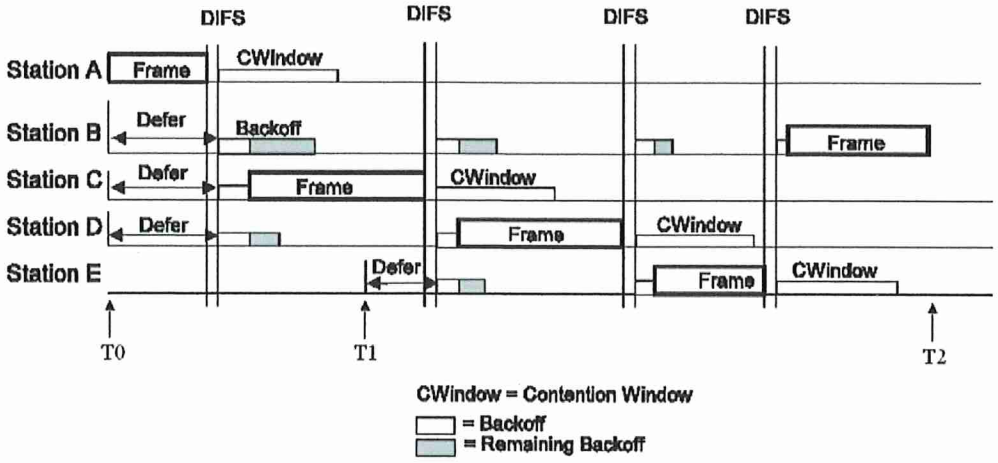

Figure 3: An example of DCF operation of IEEE 802.11.

- Calculate the duration (in microseconds) of "Frame" period in the figure (round up to an integer if your answer is a float number, e.g., 4.1 and 4.9 all rounded up to 5). [10]

1122

$\frac{50+50+2000+120}{2} + 3*4 = 1122$

- Calculate the duration from T0 to T2 (in microseconds) in the figure (round up to an integer if your answer is a float number, e.g., 4.1 and 4.9 all rounded up to 5). [10]

5734

$5 * 1122 + 4 * 6 + 100 = 5734$