Assignment 5

Assignments Instructions:

1- Please briefly justify/explain your approach and/or answers.
2- In addition to your approach, please calculate the final answer when applicable.
3- Use the coversheet provided in the course page.
4- If you decide to team up with another student in an assignment, please recall that you are NOT allowed to team up with one student more than once in this course for all assignments (no matter if required or optional) .

Problem 1: Address Resolution Protocol

This is how a junior software engineer implement the IP to MAC translation in the network stack (`packet` is the packet that we want to send, `IP` is the IP address that we want to find its MAC address, and `ARP_Cache` is the ARP cache table

```
procedure SendIPPacket(packet, IP, ARP_Cache)
    if IP in ARP_Cache then
        Send packet using MAC address ARP_Cache[IP]
    else
        Send out an ARP request
        Queue packet until we receive the ARP reply
    end if
end procedure
```

What is the problem with this implementation if we need to send a burst of packets destined to an IP? How can we change it to solve this problem?

Problem 2: Random Access Protocol - Slotted ALOHA

Suppose four active nodes (i.e., node A, B, C, D) are competing for access to a channel using slotted ALOHA. Assume each node has an infinite number of packets to send. Each node attempts to transmit in each slot with probability *p*. The first slot is numbered slot1, the second slot is numbered slot 2, and so on.

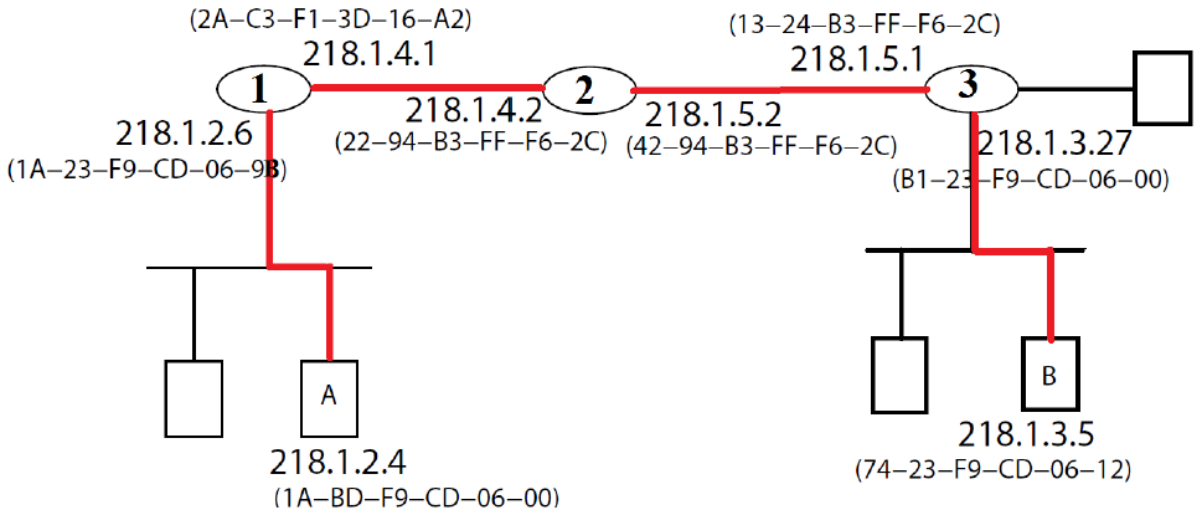
a) What is the probability that node A succeeds for the first time in slot 3?

b) What is the probability that some node (either A, B, C, or D) succeeds in slot 4?

c) What is the probability that the first success occurs in slot 5?

Problem 3: Link-Layer Addressing

The figure below gives a topology of hosts and routers with the corresponding MAC and IP addresses.



Assume that host A sends a message to host B, using the route indicated in red in the above figure. For the network between router 2 and router 3, indicate the addresses that are used in the frame, including the source and destination IP addresses and the source and destination MAC addresses.

Problem 4: 2D Parity, CSMA/CD, Multiple Access

a) Explain how we can detect all 3-bit errors with two-dimensional parity.

b) Recall that with the CSMA/CD protocol, the adapter waits K×512 bit times after a collision, where K is randomly drawn. Answer the following two questions:

i) For K=50, how long does the adapter wait before trying to resend a frame for a 10 Mbps broadcast channel?

ii) For K=100, how long does the adapter wait before trying to resend a frame for a 10-Mbps broadcast channel?

c) N Ethernet stations are trying to send data at the same time. They use an access control algorithm that needs N/3 time slots to select a host that can transmit next. If each packet needs 15 time slots to be sent, what will be the utilization of the link as a function of N?

Problem 5: Learning Switch

Consider the operation of a learning switch in the context of a network in which 6 nodes labeled A through F are star connected into an Ethernet switch. Suppose that *(i)* B sends a frame to E, *(ii)* E replies with a frame to B, *(iii)* A sends a frame to B, *(iv)* B replies with a frame to A. 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.