University of Pittsburgh, ECE 1150
ASSIGNMENT 6

Show all steps in answering the following questions. Make sure to put units of measurements (if applicable) in your answers.

QUESTION 1: DATA LINK LAYER OF ETHERNET
   a) What are the main fields in an Ethernet frame (describe the frame structure pointing out the header and the trailer fields)?
   b) MAC addresses are used for addressing in the data link layer. Describe how is the MAC address is structured (how is it unique for each device?).
   c) Explain the Exponential Backoff algorithm used in Ethernet. Why is it needed?
   d) Using Exponential Backoff algorithm, what is the average number of backoff slots that a device will wait before attempting to retransmit after detecting 5 collisions?

   [You can use any software for calculation]
   e) Repeat (d) by computing the average number of back-off slots after 6 collisions?

QUESTION 2: A network is designed as illustrated in the figure below. Suppose that device A sends data to device G, and G responds back to A. Before these transmissions, the switch table was as follows:

MAC address	Port
B	1
E	2
H	3

Show how the transmission between A and G is handled by the network, and how the switch table is updated after A transmits to G and G responds to A .
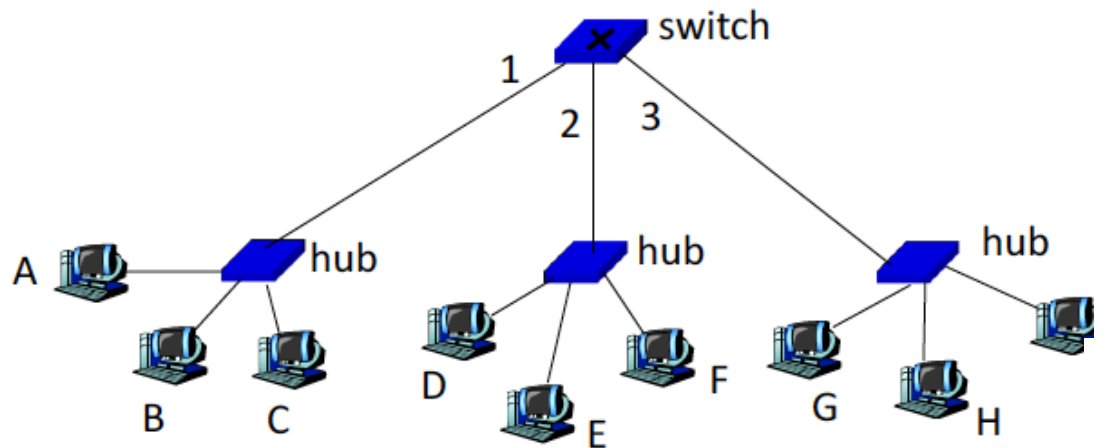
Figure: LAN network

QUESTION 3:

I)   Describe the DCF and PCF of CSMA/CA used in Wireless LANs.

II)   Follow the steps below to compare between two MAC protocols using Simulink.

1. Using Matlab add-on, please install Communications Toolbox in MATLAB (if not pre-installed)
2. Search "ALOHA and CSMA/CA Packetized Wireless Networks" using the search bar in MATLAB
3. Open the documentation and click on "Open Model" to run the model and visualize the performance. Read the documentation.

Compare Aloha and CSMA/CA using Simulink model
  a) Check throughput reported for each of the three nodes when Aloha is used (read from throughput icon in the model). [Note the throughput is proportional to the probability of successfully received packets]
  b) Check throughput of each of the three nodes when CSMA/CA is used. [You can double click on the switch in the model to change the MAC protocol]
  c) By clicking on the Fading Network Channel, you can check the SNR of the AWGN channel for each node. What is the impact of lowering the SNR on the throughput? Give an example for each of the MAC protocols through running the demo and reporting the SNR and throughput results.
  d) Comment (and justify) your results. Are the results expected?

QUESTION 4: From your understanding of the difference between the MAC address and IP address, answer the following. Let's assume that you have the following network architecture:

IP 3
MAC 3

IP 4
MAC 4

Network 1

Network 2

Computer 1

Gateway

Computer 2

IP 1
MAC 1

IP 2
MAC 2
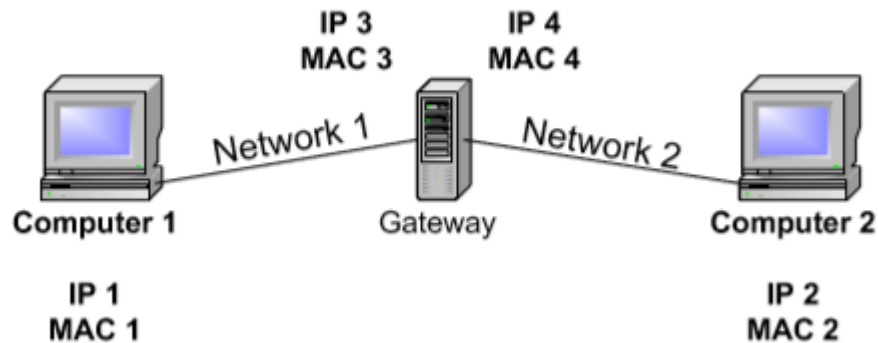
Computer 1 has IP address IP1 and MAC address MAC1. It sends a packet to
computer 2 with IP2 and MAC2. The computer 2 is located in a different
network, so the packet crosses a gateway router, which has two interfaces
(interface 1 has addresses IP3 and MAC3, while interface 2 has addresses IP4,
MAC4), as shown in figure.

Describe the addressing (IP and MAC addresses, source and destination addresses)
in the packet/frame headers from computer 1 to gateway's interface 1 and from
gateway's interface 2 to computer 2.

QUESTION 5: **If an organization need to support 100 hosts.**
   a. **What class of network should be used?**
   b. **If the organization uses a CIDR /N network, what should the number N
      be?**

QUESTION 6: **If your subnet mask is 255.255.254.0.**
   a. **How many bits in host ID of this network?**
   b. **If the network is /16 network, how many bits represents the subnet ID?**
   c. **What is the maximum number of subnets?**
   d. **If a device in the subnet has an IPv4 address 192.168.255.40, what is
      the subnet address?**