CSEE 4911: Computer Networks — Due on Thursday, April 26th, 2012

Assignment #5 – Link Layer

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How to read this assignment : Exercise levels are indicated as follows

($\rightarrowtail$) "elementary": the answer is not strictly speaking obvious, but it fits in a single sentence, and it is an immediate application of results covered in the lectures.

Use them as a checkpoint: it is strongly advised to go back to your notes if the answer to one of these questions does not come to you in a few minutes.

($\curvearrowright$) "intermediary": The answer to this question is not an immediate translation of results covered in class, it can be deduced from them with a reasonable effort.

Use them as a practice: how far are you from the answer? Do you still feel uncomfortable with some of the notions? which part could you complete quickly?

($\looparrowright$) "tortuous": this question either requires an advanced notion, a proof that is long or inventive, or it is still open.

Use them as an inspiration: can you answer any of them? does it bring you to another problem that you can answer or study further? It is recommended to work on this question only AFTER you are done with the rest!

Exercise 1: Getting to know 802.11 MAC and association protocol (20 pt) Complete the Wireshark lab for 802.11 that is provided on the website.

Exercise 2: Competition between slotted ALOHA and pure ALOHA (5 pt) Suppose that n devices share a LAN, where each device sends frames that take L microseconds to transmit onto the wire, with $L > 2\tau$ where τ is the maximum propagation delay on the LAN. k of these n devices use ALOHA, where transmission occurs at rate λ, the other $n-k$ devices use slotted ALOHA with slots of size L and transmission occurs at rate λ.

1. ($\curvearrowright$) What is the probability of successful transmission for one of the devices that uses ALOHA
2. ($\curvearrowright$) What is the probability of successful transmission for one device that uses slotted ALOHA
3. ($\curvearrowright$) What is the probability of successful transmission for a device chosen uniformly at random from the set of devices.

Exercise 3: Minimum frame size (5 pt)

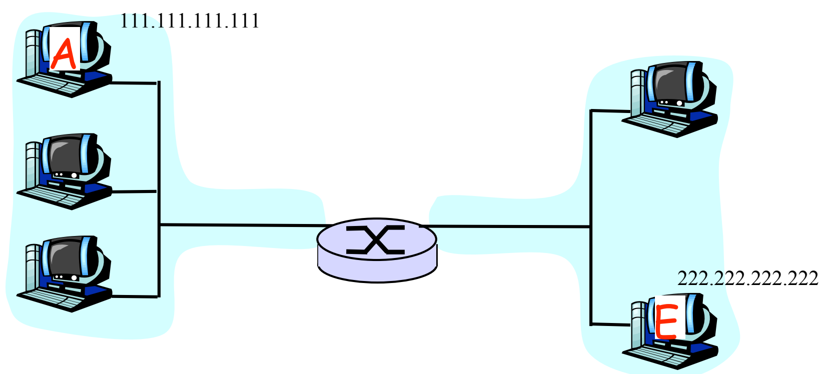
Suppose A and B are on the same 10Mbps Ethernet bus. Suppose node A begins transmitting a frame of minimum size and, before it finishes, node B begins transmitting a frame.

1. ($\curvearrowright$) Assuming for this question that the propagation delay between the node is 325 bit times. Is it possible that B collides with A and that A finishes transmitting before it notices that, making A incorrectly assume that the frame was well received?
2. ($\curvearrowright$) Can you provide a solution to the above problem by specifying a minimum frame size needed on an Ethernet bus connecting hosts at distance at most d (NB: you will assume that the signal propagates at 1.8 10^8 m/sec) ? What is this size for d=2km?

Exercise 4: Addressing with Router and Bridges (10 pt)

Motivation: In this exercice you will look in details at the address used by switching and routing in a simple case.

Consider the simple network shown below (where the device in the middle is a router):



1. ($\rightarrowtail$) Write down an IP address for all interfaces at all hosts and routers in the network. The IP addresses for A and E are as given. You should assign IP addresses so that interfaces on the same network have the same network-part of their IP address. Indicate the number of bits in the network-part of this address.
2. ($\curvearrowright$) Choose physical addresses (LAN addresses) for only those interfaces on the path from A to E. Can these addresses be the same as in part a)? Why?
3. ($\rightarrowtail$) Now focus on the actions taken at both the network and data link layers at sender A, the intervening router, and destination E in moving an IP datagram from A to E:

   How do A, E and the router determine the IP addresses needed for the IP datagram? What, specifically, are the addresses in the IP datagram that flows from A to the router? What, specifically, are the addresses in the IP datagram that flows from the router to E? How do A, E and the router determine the physical (LAN) addresses needed for the data link layer frame?
4. ($\curvearrowright$) Suppose that a bridge replaces the router in the figure.

   How would the IP addresses change in this case? How would the physical (LAN) addresses change in this case? How would does a learning bridge learn the physical addresses of the attached hosts?