

Assignment #5 – Link Layer

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

(\rightarrow) “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?

(\nrightarrow) “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: General Multiple Choice Review ($3 \times 4 = 12$ pt)

For each question, indicate all the correct answers (there may be one or several or none). Correct answers will get full point even without justification. However, if you feel unsure, and would like partial credit, you may justify your choice **on the answer sheet!** (so be brief, no more than a couple of sentences).

1. Random Medium Access Protocols, as opposed to channel partitioning, have the following advantages:
 - (a) Because they are using an explicit vulnerability period, they avoid collisions.
 - (b) They have very little overhead, almost all the channel capacity is used at all times for new data.
 - (c) With a fixed retransmission probability p for all nodes, the system becomes more and more efficient as the number of nodes increases.
 - (d) They require little coordination to be deployed.

Explanation: _____

2. The following are advantages or reasons to use Poisson Process for modeling discrete time events.
 - (a) They were invented in France while it was still a famous place for mathematics.
 - (b) They follow from the two following natural assumptions: that the events appear independently, and that the time between two events is a Gaussian variable.
 - (c) The number of events in a given interval and the time between two successive events follow simple closed form formula.
 - (d) Two Poisson processes of intensity λ that are independent can be merged and the result is a Poisson process with same intensity.

Explanation: _____

3. Link layer. Which of the following statements are true?
 - (a) An Ethernet switch can interconnect a 10Mb/s Ethernet network and a 1Gb/s Ethernet.
 - (b) An Ethernet hub can interconnect a 10Mb/s Ethernet network and a 1Gb/s Ethernet.
 - (c) An Ethernet network cannot detect collisions until it has computed a checksum over the frame.
 - (d) While it's possible for some link layer protocol to have link layer ACK, Ethernet does not specify one.

Explanation: _____

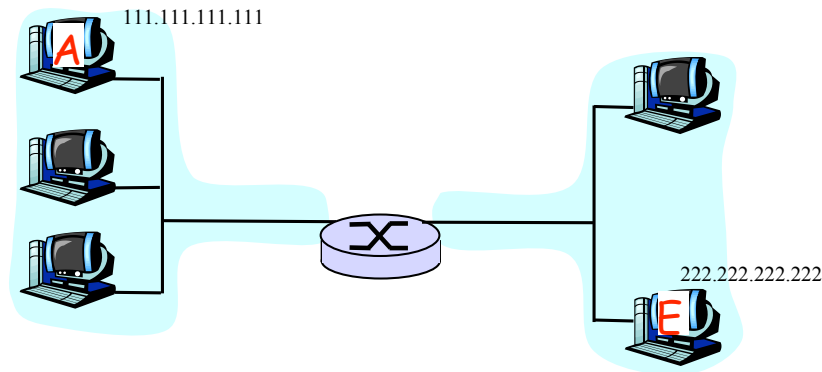
Exercise 2: Competition between slotted and pure random access protocol (14 pt) Suppose that n devices share a LAN, where each device sends frames that take L microseconds to transmit onto the wire, with $L > 2\tau$ where τ is the maximum propagation delay on the LAN. k of these n devices use a simple unslotted protocol, similar to ALOHA, so that transmission occurs with a rate λ . The other $n - k$ devices are synchronized and use a slotted protocol, with slots of size L , they also receive messages to transmit with a rate λ and starts transmitting at the beginning of the next time slot.

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

Exercise 3: Addressing with Router and Bridges (14 pt)

Motivation: In this exercise 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. (\rightarrow) 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 the previous question? Why?
3. (\rightarrow) 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?