Computer Networking

ASSIGNMENT 3

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Changelog

- V1: May 27, 2021

Assignment 3

- Deadline
  - Friday, **June 4**, 18:59 CET (Lugano time)
  - Late submissions will be accepted until Monday, **June 7**, 18:59 CET
- Submission
  - One **PDF file** per group
  - Uploaded in iCorsi by the deadline
- Correction & grading
  - Will be provided by TAs by **June 11**

The PDF file

- One (1) PDF file with all your answers

- The PDF must contain
  - The names of all group members
  - Answers to/solutions of the single exercises in the assignment

- How you create the PDF file is up to you
  - Using a text editor is highly recommended
  - Take pictures of your sketches/hand-written text, if no better option available
  - The TAs will not correct poorly readable files!
    - Example: Low-quality pictures are poorly readable

Answers must be exhaustive and unambigous

- Solutions to the exercise must be motivated and exhaustive to be considered valid

- Incomplete/inaccurate answers will lead to a complete or partial reduction of points in the grading

- Examples
  - In Exercise 1, one should not only indicate the number that tells how big the different address spaces are but also explain how one derives that number
  - In Exercise 2, one should clearly motivate the answer, using references to protocol standards and possibly also pictures or sketches.

This is a training for the exam!

- The following exercises resemble typical exam questions and exercises

Overview

Exercise #	Exercise	Points max.
1	Address spaces	6
2	Ethernet frame	6
3	Ethernet MAC	6
4	Reliable link layer	6
5	Packet loss probability	6
6	CRC computation	10
7	CSMA/CD	15
8	Switch table	15
9	RTC/CTS	30

Exercise 1: Address spaces (6 points)

How big is the EUI-48 MAC address space? The IPv4 address space? The IPv6 address space?

Exercise 2: Ethernet frame (6 points)

Compare the frame structures for 10BASE-T, 100BASE-T, and Gigabit Ethernet. How do they differ?

Exercise 3: Ethernet MAC (6 points)

The Ethernet MAC adopts a collision detection technique, whereas the IEEE 802.11 MAC uses collision avoidance. Why is collision detection not used in IEEE 802.11?

Exercise 4: Reliable link-layer (6 points)

If all the links in the Internet were to provide reliable delivery service, would the TCP reliable delivery service be redundant? Why or why not?

Exercise 5: Packet loss probability (6 points)

As a mobile node gets farther and farther away from a base station, what are two actions that a base station could take to ensure that the loss probability of a transmitted frame does not increase?

Exercise 6: CRC computation (10 points)

For the computation of a cyclic redundancy check (CRC) the 5-bit generator $G = 10011$ is used. Suppose that the data to protect D has the value 0110100011. What is the value of the remainder R?

Exercise 7: CSMA/CD (15 points)

When running the CSMA/CD protocol, an Ethernet adapter that experienced a collisions waits for a time $T_{wait} = K \cdot T_{min}$ before attempting to retransmit, where $T_{min} = 512\ bit\ times$ and K is drawn at random from a given set of possible values.

a) After the fifth collision, what is the probability that a node chooses $K = 10$?
b) For $K = 10$, how many milliseconds does the adapter wait after a collision, until checking again if the channel is idle, for a 10 Mbps broadcast channel?
c) And how many milliseconds for K=1 and a 100 Mbps broadcast channel?

Exercise 8: Switch table (15 points)

Consider five Ethernet stations A, B, C, D, and E attached to a switch in a star configuration. Assume the last two hexadecimal diits of the MAC addresses of the stations are 0A, 0B, 0C, 0D, 0E and that the stations are attached to the interfaces 1, 2, 3, 4, and 5 of the switch.

a) How many hexadecimal digits are there in total in each of the MAC addresses of the stations? Motivate your answer.
b) Suppose that (i) at time t_0, A broadcasts a frame; (ii) at time t_1, B sends a frame to C; and (iii) at time t_2 C replies with a frame to B. Assuming that the switch table is initially empty, shows the entries of the switch table after these events and describe the forwarding and filtering actions taken by the switch after each event. (You can use the last two hexadecimal dogots as a proxy of the MAC addresses of the stations. Motivate all your answers.

Exercise 9: RTC/CTS (30 points)

Suppose an IEEE 802.11b station wants to transmit a frame at time t_0, and that all other stations in the same collision domain are idle at this time. Assume a transmission rate of 11 Mbps. Further assume that the length of all control frames is 32 bytes and that there are no bit errors.

a) Which value should be given to the RTS threshold, to ensure that the RTS/CTS exchange is skipped for this frame and any other frame sent by this station?

b) Assuming that the RTS threshold is set such that the RTS/CTS exchange is skipped, calculate, as a function of SIFS and DIFS, the time T_{tot} required to transmit the entire frame and to receive the acknowledgment.

c) Compute the value of T_{tot} assuming that the values of DIFS and SIFS of 50 µs and 10 µs, that the transmission rate is 11 Mbps, and that the length of all control frames is 32 bytes.

d) Assume the station measures for the ACK message an RSSI of 10 dBm. What is the value of the corresponding value of the received power?