

## Assignment 2

*Due Tuesday, April 1. Show your work. Hand in your assignment using the appropriate dropbox on the course web site. Assignments submitted after the solutions are made available will be given a mark of zero.*

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### Question 1

What is the highest DOCSIS MAC layer that handles each of the following frames:

- (a) a ranging packet
- (b) a packet with a Google search query

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### Question 2

In what direction (upstream or downstream) are MAP frames transmitted? Why?

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### Question 3

The cable company installs a high-pass filter that only passes frequencies above 52 MHz on your cable drop. Will your cable modem be able to establish a connection?

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### Question 4

What parameter(s) does the CM adjust during uplink ranging to avoid interfering with:

- (i) other CMs on the same channel?
- (ii) other CMs on adjacent channels?

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### Question 5

Assuming the A/D converter sampling rate is 3 times the highest frequency in the input, what is sampling rate is required by an ADSL-1 modem? What sampling rate is required at the ADSL-1 DSLAM? In both cases you can assume “highest frequency” means the highest frequency at which the PSD mask has its maximum value.

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### Question 6

Assuming an OFDM system with a sampling rate of 4 MHz and an OFDM symbol size of 128 samples, what is the subcarrier spacing?

If the guard time has to be a number of samples that is a power of 2 and must be at least 3 microseconds, what is the length of the cyclic prefix in samples? In microseconds?

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### Question 7

You are designing a PON system with receivers that have a sensitivity of -25 dBm. The transmitter output power is 3 dBm and the maximum cable loss is 18 dB. What is the largest power-of-2 split ratio you can use assuming ideal splitters and no margin?

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### Question 8

Rank the following wireless cellular data standards in order from lowest to highest maximum downlink data rate:

- (i) GSM
- (ii) EV-DO
- (iii) LTE
- (iv) WCDMA

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### Question 9

What is the maximum duration, in microseconds, that you would see a zero voltage on a T1 signal? Take into account the duty cycle of the marks (the ‘1’ pulses).

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**Question 10**

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In which of the following cases do frame slips happen on a T1 link:

- (i) the transmitter and receiver use independent clocks
- (ii) the receiver recovers its clock from the received signal
- (iii) the transmitter and receiver use the same clock

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**Question 11**

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A PBX (private branch exchange, a privately-owned telephone switch) is connected to a CO over a T1 line. The PBX has its own 8 kHz reference clock; it is not derived from the T1. The CO frequency accuracy is  $10^{-11}$  while the PBX clock accuracy is 10ppm. How often do frame slips happen?