# TD 1, 2 e 3

**Exercise 1)** What does ‘‘negotiation’’ mean when discussing network protocols? Give an example.

**Exercise 2)** List two ways in which the OSI reference model and the TCP/IP reference model are the same. Now list two ways in which they differ.

**Exercise 3)** Which of the OSI layer handles each of the following:

A) Dividing the transmitted bit stream into frames

B) Determining which route through the subnet to use

**Exercise 3)** What are two reasons for using layered protocol?

**Exercise 4)** The president of the Specialty Paint Corp. gets the idea to work with a local beer brewer to produce an invisible beer can (as an anti-litter measure). The president tells her legal department to look into it, and they in turn ask engineering for help. As a result, the chief engineer calls his counterpart at the brewery to discuss the technical aspects of the project. The engineers then report back to their respective legal departments, which then confer by telephone to arrange the legal aspects. Finally, the two corporate presidents discuss the financial side of the deal. What principle of a multilayer protocol in the sense of the OSI model does this communication mechanism violate?

**Exercise 5)** The bit sequence 1 0 1 1 1 0 1 0 1 1 is to be transmitted using following formats

1. NRZ
2. NRZI
3. Split-phase Manchester

4. Bipolar encoding

Draw all the waveforms

**Exercise 6)** Consider the delay of pure ALOHA versus slotted ALOHA at low load. Which one is less? Explain your answer.

**Exercise 7)** The binary data 101100110101 is transmitted over a baseband channel. Draw the waveform for the transmitted data using following formats

1. NRZ
2. NRZI
3. Manchester

**Exercise 8)**: The binary data 1101010110 is transmitted over a baseband channel. Draw the waveform for transmitted data using following format

1. Bipolar
2. NRZ
3. Manchester

**Exercise 9)** A noiseless 4-kHz channel is sample every 1 msec. What is the maximum data rate?

**Exercise 10)** Television channels are 6 Mhz wide. How many bits/sec can be sent if four-level digital signal are used? Assume a noiselles channel.

**Exercise 11)** If a binary signal is sent over a 3-kHz channel whose signal-to-noise ratio is 20 dB, what is the maximum achievable data rate?

**Exercise 12)** What signal-to-noise ratio is needed to put a T1 carrier on a 50-kHz line?

**Exercise 13)** A CDMA receiver gets the following chips: (−1 +1 −3 +1 −1 −3 +1 +1). Assuming the chip sequences (coder) defined above, which stations transmitted, and which bits did each one send?

A: (-1 -1 -1 +1 +1 -1 +1 +1)
B: (-1 -1 +1 -1 +1 +1 +1 -1)
C: (-1 +1 -1 +1 +1 +1 -1 -1)
D: (-1 +1 -1 -1 -1 -1 +1 -1)

The chip sequences

**Exercise 14)** All chip sequences are pairwise orthogonal, by which we mean that the normalized inner product of any two distinct chip sequences, S and T (written as S•T) is 0 (zero). In the exercise above, there are four stations that can transmit. Suppose now that we have four more stations that are added. Provide the chip sequences of these stations.

**Exercise 15**) Six stations, A through F, communicate using the MACA protocol. Is it possible for two transmissions to take place simultaneously? Explain your answer.

**Exercise 16)** Suppose that A, B, and C are simultaneously transmitting 0 bits, using a CDMA system with the chip sequences of exercise above. What is the resulting chip sequence?

**Exercise 17)** Consider now the following resulting chip sequence (-1 +1 -3 +1 -1 -3 +1 +1) Suppose that the receiver is interested in extracting the bit sent by station C from each of the six sums S1 through S6. What are the bits sent by station C?

**Exercise 18)** A cable TV system has 100 commercial channels, all of them alternating programs with advertising. Is this more TDM or like FDM?

**Exercise 19**) A group of N stations share a 56-kbps pure ALOHA channel. Each station outputs a 1000-bit frame on average once every 100 sec, even if the previous one has not yet been sent (e.g., the stations can buffer outgoing frames). What is the maximum value of N?

**Exercise 20)** What is the essential difference between message switching and packet switching?

**Exercise 21)** What is the difference between Baseband and Passband Transmission?

**Exercise 22)** Explain the difference between the following multiplexing methods:

A) Frequency Division Multiplexing

B) Orthogonal FDM

C) Time Division multiplexing

D) Code Division Multiple Access

**Exercise 23)** Ten signals, each requiring 4000 Hz, are multiplexed onto a single channel using FDM. What is the minimum bandwidth required for the multiplexed channel? Assume that the guard bands are 400 Hz wide.

**Exercise 24)** Let us consider an airport lounge with many pairs of people conversing. Now consider the following scenarios:

A) There are pairs of people in the room taking turns speaking.

B) There are pairs of people speaking at different pitches, some high-pitched and some low-pitched such that each pair can hold its own conversation at the same time as but independently of the others.

C) Each pair of people talking at once, but in a different language.

Which multiplexing scheme can be used in each scenario above?

**Exercise 25)** A large population of ALOHA users manage to generate 50 requests/sec, including both originals and retransmissions. Time is slotted in units of 40 msec.

(a) What is the chance of success on the first attempt?
(b) What is the probability of exactly k collisions and then a success?
(c) What is the expected number of transmission attempts needed?

**Exercise 26)** Consider five wireless stations, A, B, C, D, and E. Station A can communicate with all other stations. B can communicate with A, C and E. C can communicate with A, B and D. D can communicate with A, C and E. E can communicate A, D and B.

(a) When A is sending to B, what other communications are possible?
(b) When B is sending to A, what other communications are possible?
(c) When B is sending to C, what other communications are possible?