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2nd licence year
Serie of exercises

Communication Networks tutorial
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Physical layer

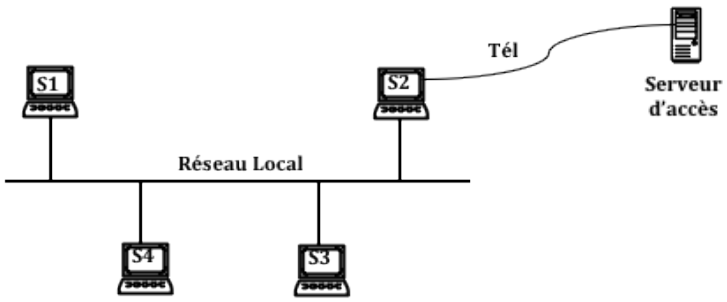
Exercice 1 We want to transfer a 320 KByte text file from one computer to another. Each character of the file is coded on 08 bits. The transmission is asynchronous with a Start bit, a Stop bit and a control bit on a line with a throughput of 9600bits/sec.

1. Calculate the durations T_1 and T_2 of transfer of this file such as :
   - duration T_1 : without taking into account the Start, Stop and control bits.
   - duration T_2 : taking into account the Start, Stop and Control bits.
   - Calculate then Comment the Ratio R= $\frac{T_2-T_1}{T_2}$
2. Knowing that in the previous case the valence of the signal used was 2. Calculate the total transfer delay T3 if we switch to a valence of the signal equal to 16.

Exercice 2 A full-duplex digital connection is established between 02 points A and B of the earth via a geostationary satellite located 36,000 km from each of the two points. A signal is emitted from A at a rate of 64 Kbits/sec and where the speed of propagation in the air is equal to 300,000 km/sec. Once the beginning of the signal has been received, B returns an acknowledgment (response).

1. Calculate the time T1 it will take for the first bit to reach B.
2. How many bits can be sent by A before it knows that B has received the first information.
3. Knowing that station A wishes to send to B an information string of size equal to 96Kbits. Calculate the total transfer time T2 of this chain.
4. If the connection between A and B is half-duplex, when can A knows that B is not receiving.

Exercice 3 Consider the following network :



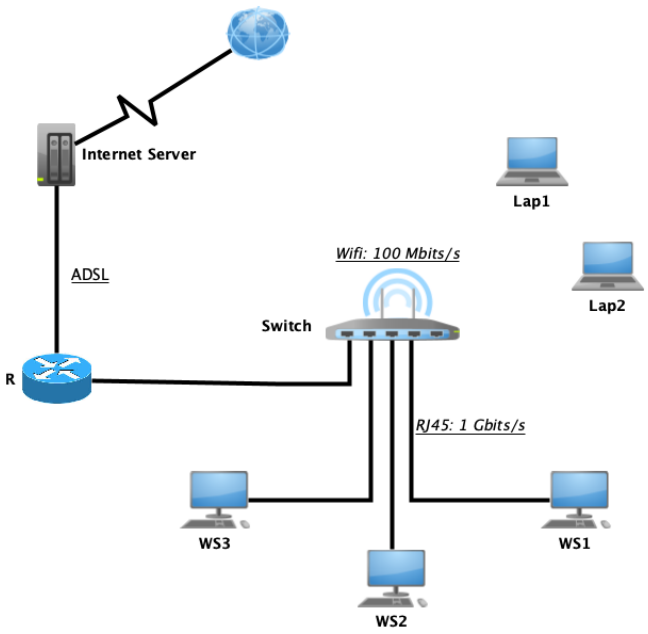
Stations S_1, S_2, S_3, S_4 are linked by a local bus network offering a throughput of 10 Mbits/s. The station S2 is connected to an Internet access server by a phone link whose frequency band is [300-3400 Hz]. Given that the line rate is 62 Kbits/s :

1. Calculate the valence of the signal,
2. Calculate the signal/noise ratio allowing the correct operation of the line, give its value in decibels.
3. Station S_1 wants to send the binary sequence [1 1 0 0 0 0 0 1 0 1] to station S_2. Give the shape of the transmitted signal using Manchester and Miller coding.
4. Station S_1 wants to send the binary sequence [0 1 0 1 1 0 1 1 0 0] to station S_2. Give the shape of the emitted signal using Differential and Bipolar Manchester coding.
5. Knowing that the coding of the signal on the telephone line uses a modulation with two phases (0 and 180°) and two amplitudes (V and 2V) :
   - Give the valence of the signal,
   - Give the shape of the signal used to send the previous string of bits from station S2 to the Internet access server.
6. Knowing that the coding of the signal on the phone line uses a modulation with four phases (0, 90, 180 and 270°) and two amplitudes (V and 2V) :
   - Give the valence of the signal

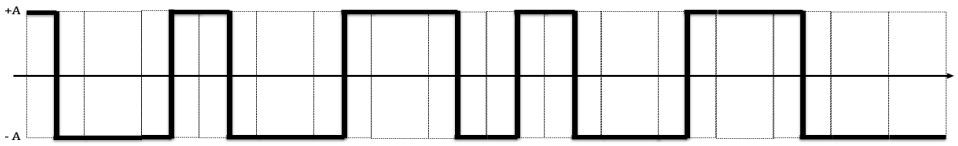
- Draw a diagram (circle of phases and amplitudes) representing the signals used and their corresponding codes.
- Give the shape of the signal used to send the series of bits [00111011100010101101101] from station S_2 to the Internet access server.

7. Calculate the average throughput between station S_1 and the Internet server.

Exercice 4 Consider the network represented in the figure, where the switch connects two networks : an RJ45 1 GBit/s network (WS1, WS2, WS3) and a wifi 100 Mbits/s network (Lap1, Lap2) and connected to an internet server via a Router R using an ADSL connection.



1. The transfer of a file of 50 MBytes from Lap1 to the Internet server took 6 minutes and 44,4 seconds (We neglect the processing time at the nodes).
   (a) Calculate the throughput of the ADSL connection.
   (b) Deduce the average throughput between Lap1 and the internet server.
   (c) Compare the four throughputs, What do you conclude ?
2. The work station WS2 sent the hexadecimal string **"4A2B"** to the Router R. Knowing the signal shape given below observed on the RJ45 cable, Deduce the used base band coding method.



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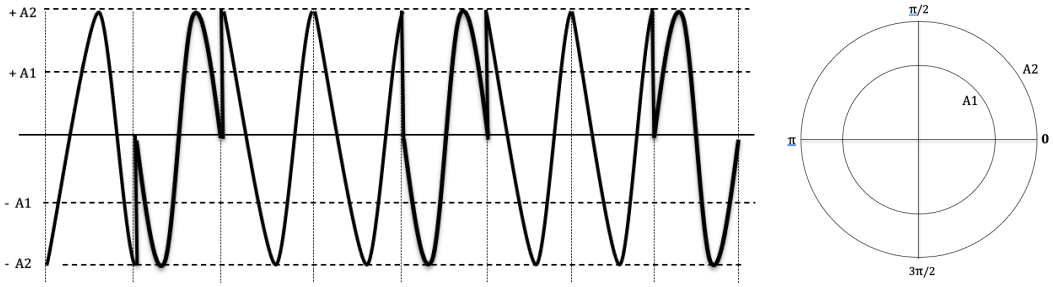
3. The same hexadecimal string **"4A2B"** is sent from the Router R to the Internet server. Knowing the signal shape given below observed on the ADSL cable, Complete the used coding diagram :



Calculate the modulation speed

Good luck