2nd Licence year
May 27th, 2024

Communication Networks
12:30-14:00 Amphi A,B

Normal Session Exam

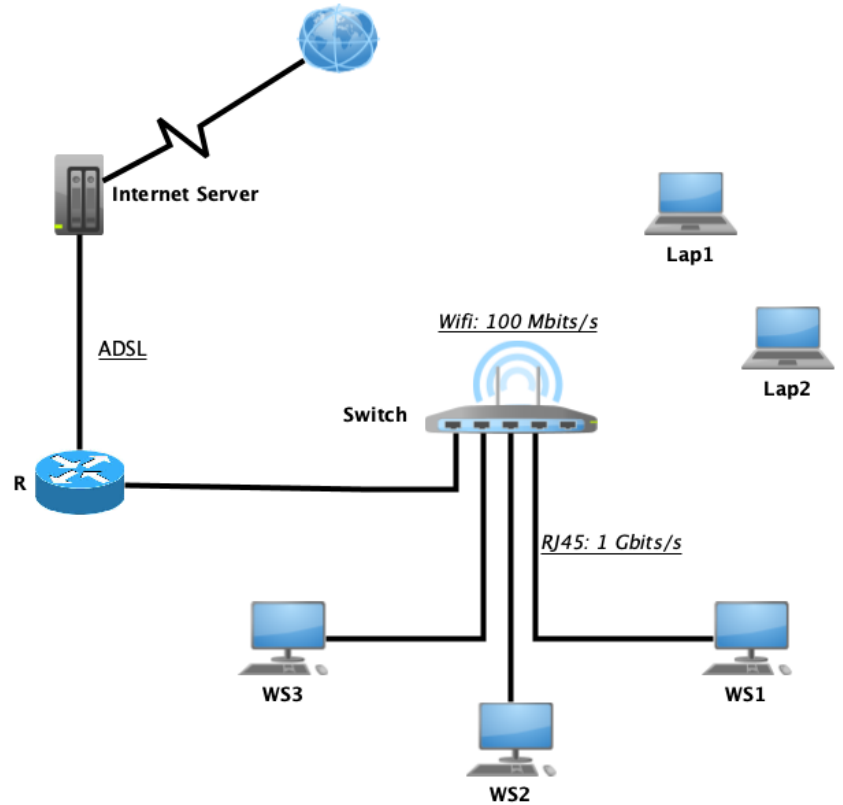**Name:** ....

Group:..................

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.

Exercise 1 Physical layer (10 pts : 3 + 1.5 + 1.5 + 1.5 + 2 + 0.5)

1. The transfer of a file of 40 MBytes from Lap1 to the Internet server took 35,52 seconds (We neglect the processing time at the nodes).

   (a) Calculate the throughput of the ADSL connection.
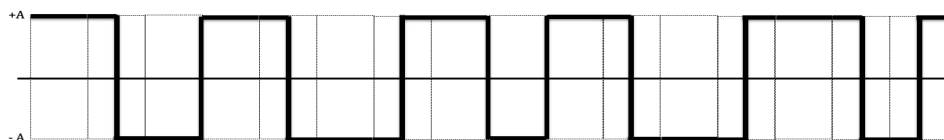
   ....
   ....
   ....
   ....

   (b) Deduce the average throughput between Lap1 and the internet server.

   ....
   ....

   (c) Compare the four throughputs, What do you conclude ?

   ....
   ....
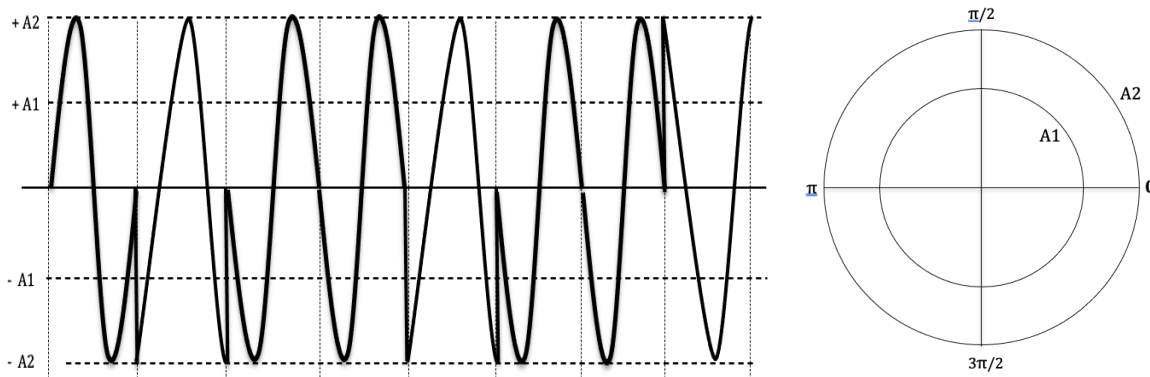
2. The work station WS2 sent the hexadecimal string **"4A2B"** to the Router R. Knowing the signal shape given below observed on the RJ45 cable, Deduce the used base band coding method.

....

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

....

....

Exercise 2 Data Link layer (10 pts : 5 + 2.5 + 2.5)

A. The LLC sub-layer of the Wifi network uses the HDLC protocol seen in the course, with a generator polynomial $G(x) = x^8 + x^5 + x$ (FCS on one byte). LLC of Lap1 receives the following frame :
"01111110 00000001 10111100 11011100 01111110"

1. Was this frame correctly sent ?

....

....

....

2. If yes :
   (a) Explain the frame by giving all its details,

   ....

   ....

   ....

   (b) Give the control field of the frame sent in response.

   ....

3. If no, what it has to do ?

....

B. Knowing that the used protocol on the MAC sub-layer is CSMA/CD, the minimum length of a frame is 64 Bytes and the signal speed is $3 \times 10^5 Km/s$ on both Wifi and RJ45 networks, Calculate

1. The maximum distance between a laptop and the switch (Access point) to ensure the proper functioning of the protocol CSMA/CD. ....

....

....

....

2. The maximum length of the cable on the RJ45 network to ensure the proper functioning of the protocol CSMA/CD.

....

....

....

....

Good Luck

Correction

Exercise 1 Physical layer (10 pts : 3 + 1.5 + 1.5 + 1.5 + 2 + 0.5)

1. The transfer of a file of 40 MBytes from Lap1 to the Internet server took 35,52 seconds (We neglect the processing time at the nodes).

   (a) Calculate the throughput of the ADSL connection.

   $\frac{40\times10^6\times8\ bits}{10^8\ bits/s} + \frac{40\times10^6\times8\ bits}{10^9\ bits/s} + \frac{40\times10^6\times8\ bits}{x} = 35,52$ **1 pt**

   $3,2 + 0,32 + \frac{320\times10^6\ bits}{x} = 35,52$ **1 pt**

   $x = 10^7 =$ **10 Mbits/s**   **1 pt**

   (b) Deduce the average throughput between Lap1 and the internet server.

   $= \frac{40\times10^6\times8\ bits}{35,52\ s} = 9009009$ Bits/s   **1.5 pt**

   (c) Compare the four throughputs, What do you conclude ?

   - Average throughput < ADSL throughput < Wifi throughput < RJ45 throughput   **0.75 pt**

   - Conclusion : The average throughput falls to the lower throughput   **0.75 pt**

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.
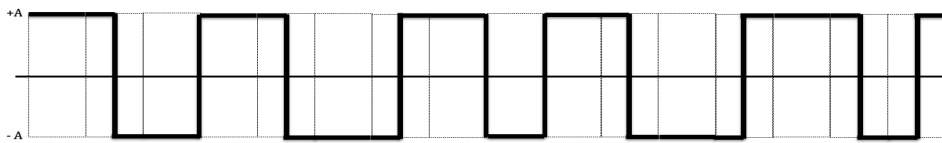
Miller   **1.5 pt**

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 :
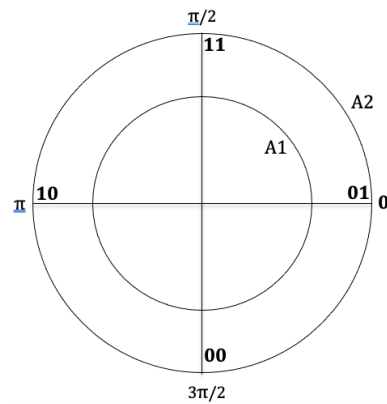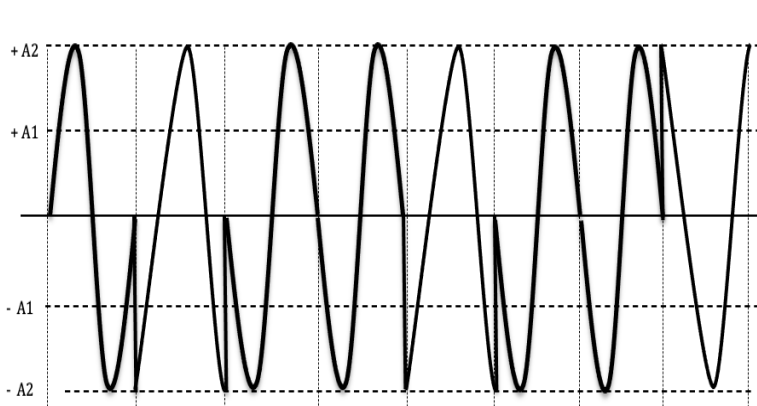
     1.5 pt

Calculate the modulation speed

Valence $= 4 \Rightarrow$; $R = \frac{D}{log_2(V)} = \frac{10Mbits}{log_2(4)}/5MBauds$ **0.5 pt**

Exercise 2 Data Link layer (10 pts : 5 + 2.5 + 2.5)

A. The LLC sub-layer of the Wifi network uses the HDLC protocol seen in the course, with a generator polynomial $G(x) = x^8 + x^5 + x$ (FCS on one byte). LLC of Lap1 receives the following frame :
"01111110 00000001 10111100 11011100 01111110"

1. Was this frame correctly sent ?

   Remove Flags : $T(x) = x^{16} + x^{15} + x^{13} + x^{12} + x^{11} + x^{10} + x^7 + x^6 + x^4 + x^3 + x^2$ **0.5 pt**

   $T(x)/G(x) = x^8 + x^7 + x^3 + x^2 + x$;   **0.5 pts**

   $R(x) = 0 \Rightarrow$ **0.5 pt**

   The frame was correctly sent   **0.5 pt**

2. If yes :

(a) Explain the frame by giving all its details,

01111110 : Flag ; **0.25 pt**

00000001 : Address ; **0.25 pt**

10111100 : Frame S, **0.5 pt**

Selective Reject of Frame 4, **1 pt**

Immediate response requested (P/F=1) **0.25 pt**

(b) Give the control field of the frame sent in response.

01000000 **0.75 pt**

B. Knowing that the used protocol on the MAC sub-layer is CSMA/CD, the minimum length of a frame is 64 Bytes and the signal speed is $3 \times 10^5 Km/s$ on both Wifi and RJ45 networks, Calculate :

1. The maximum distance between a laptop and the switch (Access point) to ensure the proper functioning of the protocol CSMA/CD.

Duration of minimal frame $= \frac{64 \times 8 \ bits}{10^8 \ bits/s} = 5.12 \times 10^{-6}s$ **1 pt**

Propagation time $= \frac{5.12 \times 10^{-6}s}{2} = 2.56 \times 10^{-6}s$ **0.5 pt**

Max Wifi distance $= 3 \times 10^5 Km/s \times 2.56 \times 10^{-6}s = 768 metres$ **1 pt**

2. The maximum distance of the cable on the RJ45 network to ensure the proper functioning of the protocol CSMA/CD.

Duration of minimal frame $= \frac{64 \times 8 \ bits}{10^9 \ bits/s} = 0.512 \times 10^{-6}s$ **1 pt**

Propagation time $= \frac{0.512 \times 10^{-6}s}{2} = 0.256 \times 10^{-6}s$ **0.5 pt**

Max cable length $= 3 \times 10^5 Km/s \times 0.256 \times 10^{-6}s = 76,8 metres$ **1 pt**