

- Laptop Lap1 needs to send a 10 MBytes file to the internet server. Calculate the transmission time for this file, and deduce the average throughput between Lap1 and the server (disregarding device processing time).

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**Exercise 2 Data Link layer (10 pts : 3 + 1.5 + 1.5 + 1.5 + 2.5)**

The LLC sub-layer of the RJ45 network uses the HDLC protocol covered in class, with a generator polynomial  $G(x) = x^8 + x^5 + x + 1$ . WS1 (address 00) is sending a file to WS2 (address 01) :

- Complete the following table representing the exchange between the two stations :

	1	2	3	4	5	6	7
WS1	SABM	SABM	I00,I01,I02,I03.	I02,I04,I05,I06	I05,I06,I07,I00	I01,I02,I03,I04	wait
WS2	.....	.....	.....	.....	.....	.....	.....

	8	9	10	11	12	13
WS1	.....	.....	.....	.....	.....	END
WS2	REJ-07	RR-03	SREJ-03	RR-02	UA	END

- Give the bit size of a supervision frame and an unnumbered frame. Deduce the time required to send each one

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- Given that each information frame carries a 128-byte block, calculate the frame size in bits and determine the time required to transmit it.

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- Calculate the transmission time required to send the file from WS1 to WS2.

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- Give the hexadecimal representation of the 9<sup>th</sup> frame sent by WS2.

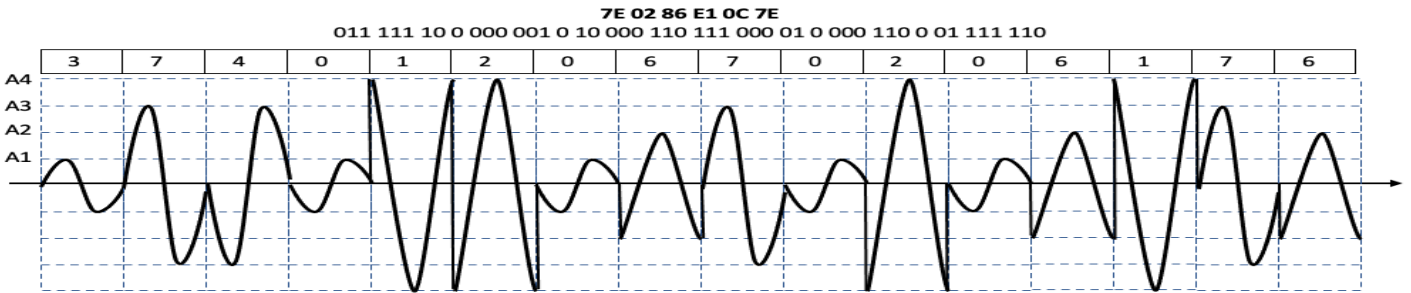
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Good Luck

## Correction

### Exercise 1 Physical layer ( 10 pts : 5 + 2 + 3)

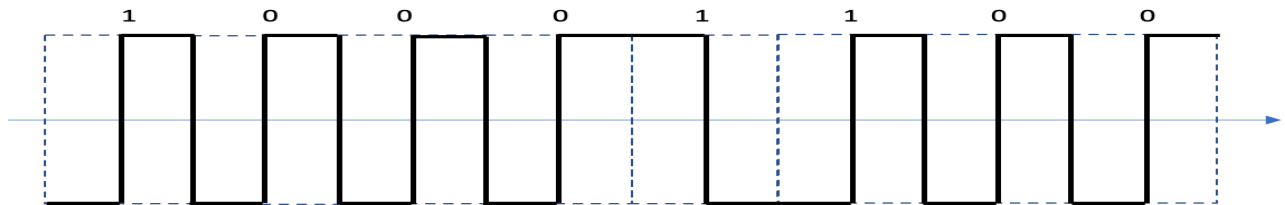
1. Signal waveform



**3 pts**

- Frame saize=  $6 \times 8 = 48$  bits, Network throughput = 2 Mbits/s .....
- Transmission time =  $\frac{48bits}{2 \times 10^6 bits/s} = 24 \mu seconds$  ..... **1 pt**
- Valence V = 8 .....
- Modulation speed =  $\frac{2Mbits/s}{\log_2(V)} = 1.66 MBauds$  ..... **1 pt**

2. Differential Manchester encoding waveform



**2pts**

3. Laptop Lap1 needs to send a 10 MBytes file to the internet server. Calculate the transmission time for this file, and deduce the average throughput between Lap1 and the server (disregarding device processing time).

- Transmission time from Lap1 to the Switch =  $\frac{10 \times 8 \times 10^6 bits}{100 \times 10^6 bits/s} = 0.8 seconds$  ..... **0.75pt**
- Transmission time from the Switch to the router R =  $\frac{10 \times 8 \times 10^6 bits}{10^9 bits/s} = 0.08 seconds$  ..... **0.75pt**
- Transmission time from the router R to the internet Server =  $\frac{10 \times 8 \times 10^6 bits}{2 \times 10^6 bits/s} = 40 seconds$  ... **0.75pt**
- Transmission time =  $0.8 + 0.08 + 40 = 40.88 seconds$  ..... **0.75pt**
- Average throughput =  $\frac{10 \times 8 \times 10^6 bits}{40.88 seconds} = 1.95 Mbits/s$  ..... **0.75pt**

### Exercise 2 Data Link layer (10 pts : 3 + 1.5 + 1.5 + 1.5 + 2.5)

The LLC sub-layer of the RJ45 network uses the HDLC protocol covered in class, with a generator polynomial  $G(x) = x^8 + x^5 + x + 1$ . WS1 (address 00) is sending a file to WS2 (address 01) :

1. The exchange between the two stations :

	1	2	3	4	5	6	7
WS1	SABM	SABM	I00,I01,I02,I03.	I02,I04,I05,I06	I05,I06,I07,I00	I01,I02,I03,I04	wait
WS2	DM	UA	SREJ-02	REJ-05	RR-01	RNR-05	RR-05

	8	9	10	11	12	13	
WS1	I05,I06,I07,I00	I07,I00,I01,I02	I03,I04,I05,I06	I03,I07,I00,I01	DISC	END	..... <b>3 pts</b>
WS2	REJ-07	RR-03	SREJ-03	RR-02	UA	END	

2. Size of a supervision frame and an unnumbered frame :
- S Frame or U Frame : 7E @ CTRL FCS 7E : 6 bytes = 48 bits ..... **0.75 pt**
  - Time to send S or U frame =  $\frac{48\text{bits}}{10^9\text{bits/s}} = 48 \text{ } \eta\text{secondes}$  ..... **0.75 pt**
3. Information frame size :
- I Frame : 7E @ CTRL Info FCS 7E : 6 + 128 bytes = 134 x 8 = 1072 bits ..... **0.75 pt**
  - Time to send I frame =  $\frac{1072\text{bits}}{10^9\text{bits/s}} = 1072 \text{ } \eta\text{secondes}$  ..... **0.75 pt**
4. Time required to send the file from WS1 to WS2 :
- The file is sent in : 6 U + 9 S + 32 I = 6 x 48 + 9 x 48 + 32 x 1072 bits = 35024 bits .... **0.75 pt**
  - Time to send the file =  $\frac{35024\text{bits}}{10^9\text{bits/s}} = 35024 \times 10^{-9} \text{ } \eta\text{secondes}$  ..... **0.75 pt**
5. The hexadecimal representation of the 9<sup>th</sup> frame sent by WS2.
- 9<sup>th</sup> frame : RR-03 ..... **0.5 pt**
  - Flag=7E, @=00, CTRL = 10000011 = 83, FCS=? ..... **1 pt**
  - $M(x) = 10000011 = x^7 + x + 1, r=8, M(x) \times x^8 = x^{15} + x^9 + x^8$  ..... **0.5 pt**
  - $\text{Rest}\left(\frac{x^{15}+x^9+x^8}{x^8+x^5+x+1} = x^7 + x^5 + x^4\right) = 10110000, \text{FCS} = 00 \text{ B0}$  ..... **1 pt**
  - Frame = 7E 00 83 00 B0 7E ..... **0.5 pt**