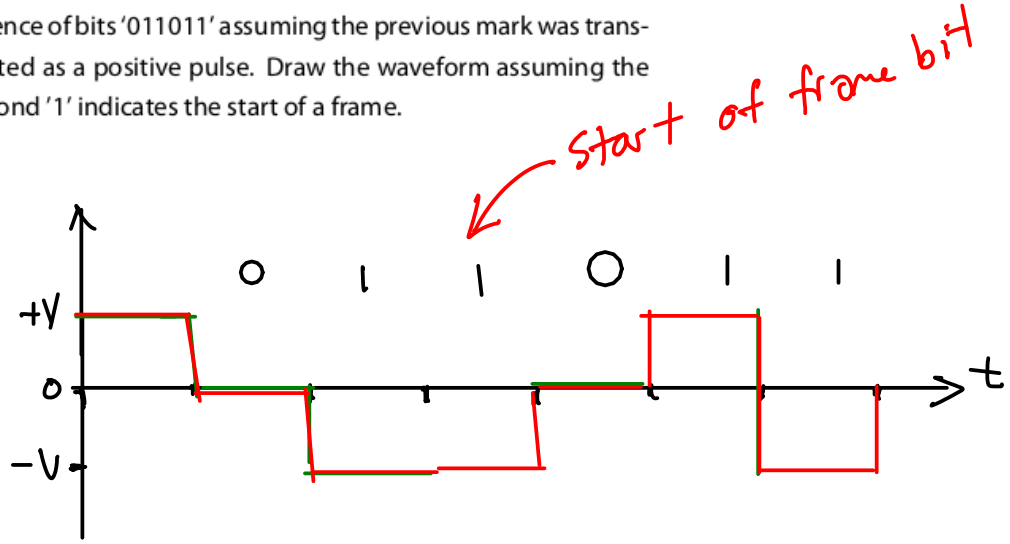
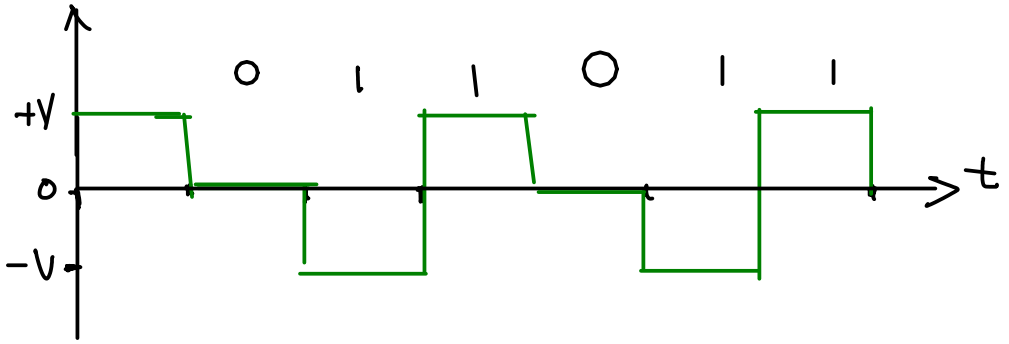
Lecture 8 - Framing

Exercise 1: Draw the waveform for an AMI-NRZ encoded sequence of bits '011011' assuming the previous mark was transmitted as a positive pulse. Draw the waveform assuming the second '1' indicates the start of a frame.



average voltage value

$+2 - 3 = -1$



$+3 - 2 = +1$

Exercise 2: What is the average (DC) value for the two cases in the previous exercise assuming the pulse voltage is ± 1V?

Exercise 3: What might be some advantages of using a preamble? What might be some disadvantages?

adv. – backwards compatibility

disadvantage

① overhead

192 bits @ 1 Mb/s = 192 μs.

but @ 1 Gb/s we could send 192 kbits > 20 kBytes.

② complexity compared to single-format protocols

Exercise 4: By how much does the use of escape characters slow down a link transmitting a continuous stream of escape characters?

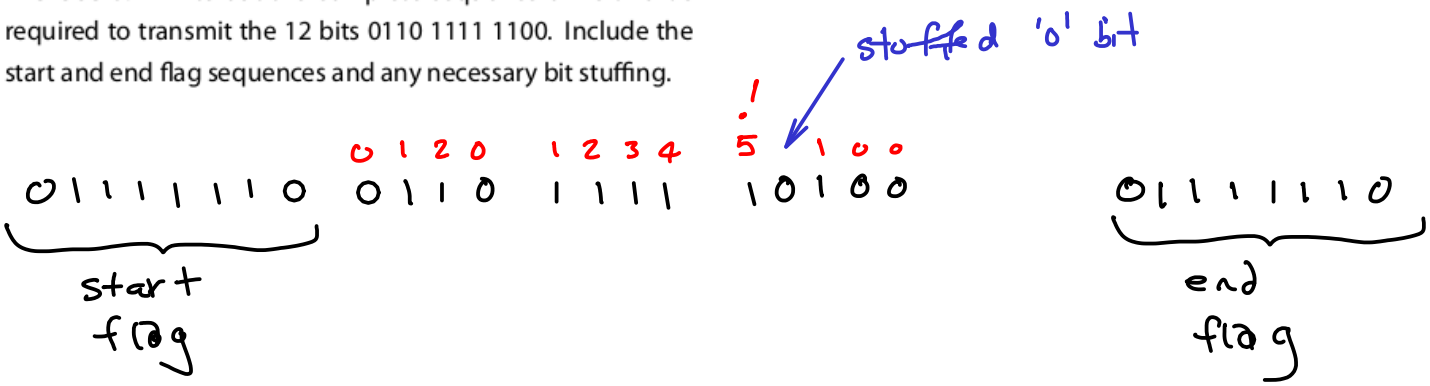
"\n" "\\"

$\frac{1}{2}$

Exercise 5: What sequence of bytes would be sent to transmit a PPP-encapsulated frame containing the bytes 0xff 0x03 0x7d 0x1b 0x7e?

frame start: 0x7e | 0xff | 0x03 | 0x7d (escape) | 0x7d (data) | 0x1b (ASCII ESC, not special for PPP) | 0x7d (escape) | 0x7e (data) | 0x7e (frame end)

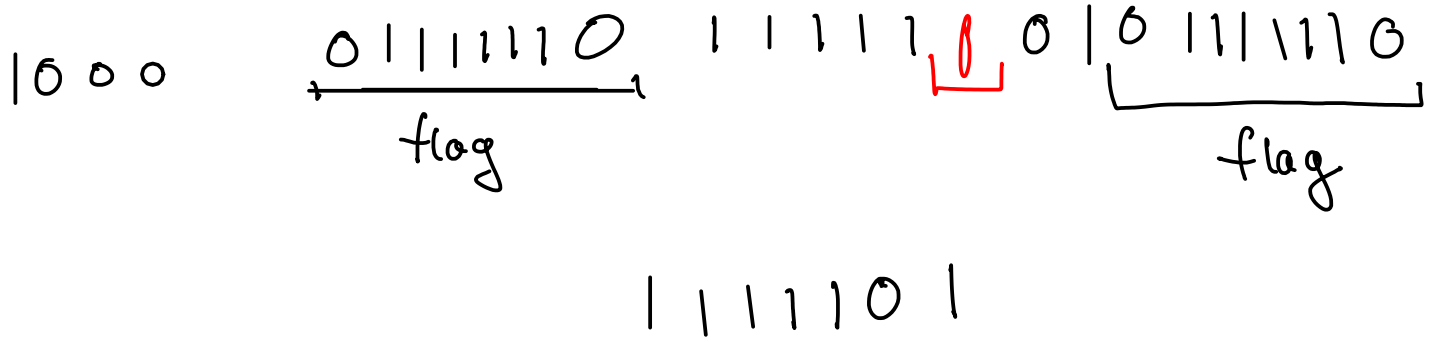
Exercise 6: Write out the complete sequence of 1's and 0's required to transmit the 12 bits 0110 1111 1100. Include the start and end flag sequences and any necessary bit stuffing.



01111110

stuffed bit, remove

Exercise 7: An HDLC receiver sees the sequence 1000 0111 1110 1111 1001 0111 1110 0110. What data bits were contained within the frame?



111110

Exercise 8: A physical layer transmits 3 bits per symbol. A frame of 128 bytes is being transmitted. How many padding bits will have to be added to the frame?

128 bytes = 128 X 8 bits

$= 2^7 \cdot 2^3 = 2^{10} = 1024$ bits

0, 3, 6, 9, ---, 1023, 1026

3 X 341 3X342

$\frac{1024}{3} = 341.3$

$\lceil 341.3 \rceil = 342$

900
120
3
1023

to fit all the bits we need to send 342 symbols

this holds $342 \times 3 = 1026$ bit

so we need to "pad" the data with 2 extra bits.

$$\left(\left\lceil \frac{\#\text{bits}}{\text{bits/symbol}} \right\rceil \times \text{bits/symbol} \right) - \#\text{bits}$$

(the bracketed term: symbols to send; the whole parenthesized term: bits to be sent)

$$\left\lceil \frac{1024}{3} \right\rceil \times 3 - 1024$$