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.

AMI-NRZ

AMI-RZ

line coding violation
≡ start of frame.

SFD

Exercise 2: What might be some advantages of using a preamble? What might be some disadvantages?

advantages — backwards / forward   compatible
          — allows   different performance / cost
disadvantage — frame is longer , more complex

$0x1b$ =

$0x1B$ =

B A   b a

0 ... 9 A B .. F
        ↓ ↓   ↓
       10 ↳   15

a b .- -f
16 17   2↑

Exercise 3: By how much does the use of escape characters slow down a link transmitting a continuous stream of escape characters?

doubles — every ESC character has to be sent twice.

Exercise 4: What sequence of bytes would be sent to transmit a PPP-encapsulated frame containing the bytes 0xff 0x03 0x7d 0x1b 0x7e?

esc.   flag

① escape any special char (7d or 7e)

② put flags before & after the frame.

ASCII, not PPP escape.

0x7e, 0xff, 0x03, 0x7d, 0x7d, 0x1b, 0x7d, 0x7e, 0x7e

SOF

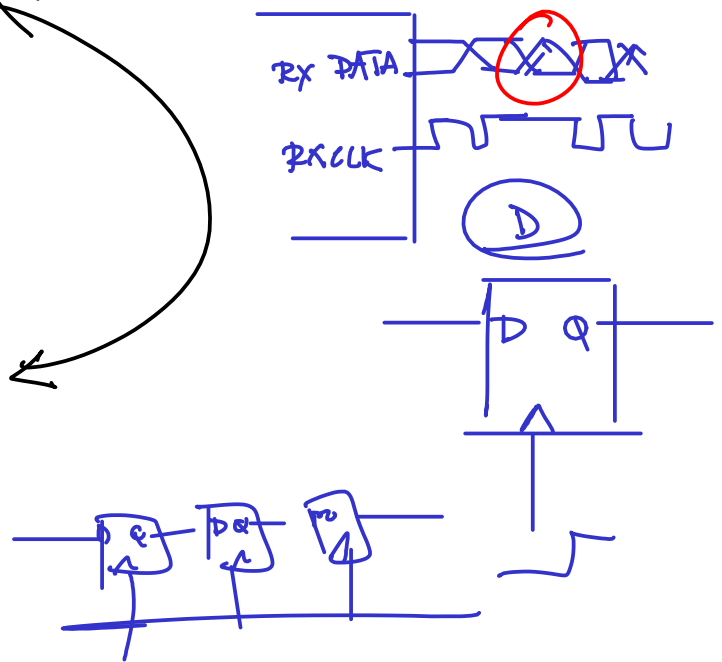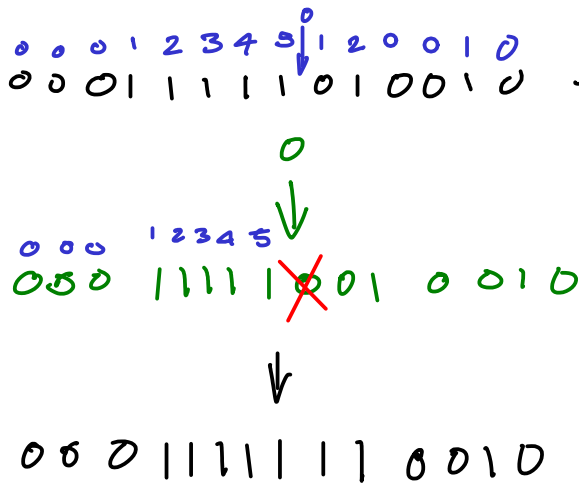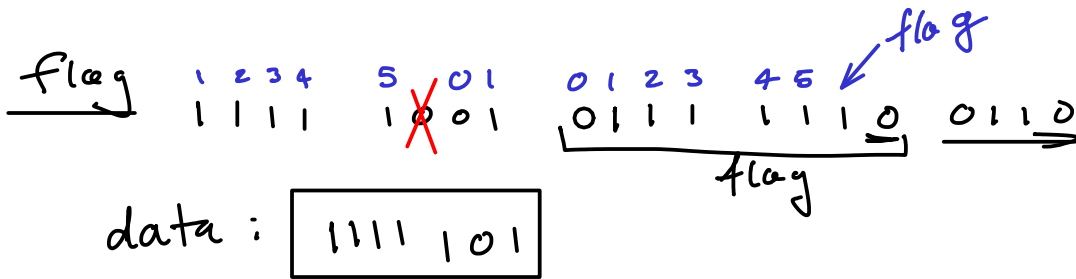escapes PPP esc.

escapes PPP flag

EOF

Exercise 5: You receive the sequence of bits 10001101 and are told that bit stuffing was used to limit runs of 0 to three or fewer. What was the original data sequence?

0 1 2 3   0 1   0

1 0 0 0 ⨯ 1 0   1

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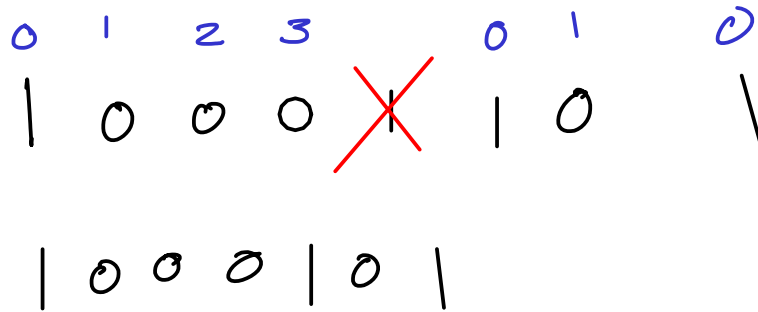
Exercise 6: Write out the complete sequence of 1's and 0's required to transmit the 12 bits 0110 1111 1100. Include the start and end flag sequences and any necessary bit stuffing.

stuffed bit

flag   0 1 2 0   1 2 3 4   5 1   flag
01111110   0110   1111   10100   01111110
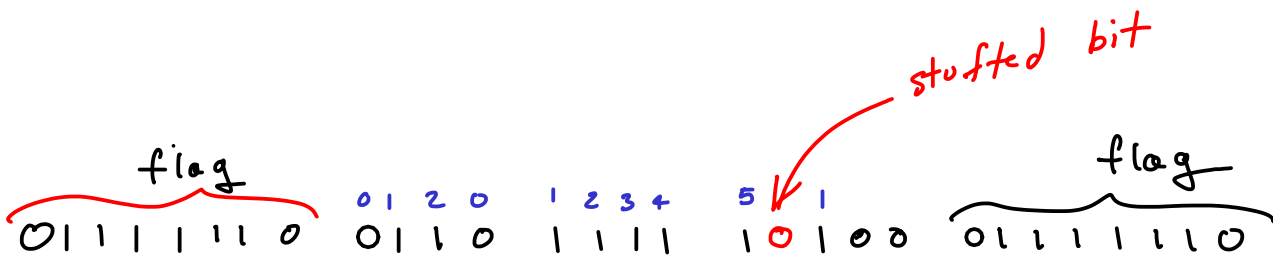
Exercise 7: An HDLC receiver sees the sequence 1000 0111 [junk] 1110 1111 1001 0111 1110 0110. What data bits were contained within the frame?

flag   1 2 3 4   5 0 1   0 1 2 3   4 5 ← flag

1 1 1 1   1 ~~0~~ 0 1   0 1 1 1   1 1 1 0   0 1 1 0

flag

data :
$$\boxed{1111 \ 101}$$

0 0 0 1 2 3 4 5 | 1 2 0 0 1 0
0 0 0 1 1 1 1 1 0 1 0 0 1 0

↓ 0

0 0 0   1 2 3 4 5 ↓
0 ~~0~~ 0 1 1 1 1 1 ~~0~~ 0 1   0 0 1 0

↓

0 0 0 1 1 1 1 1 1 1 0 0 1 0

RX DATA

RXCLK

D

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?

$$128 \times 8 \text{ bits}$$

$$= \frac{1024}{3} = 341 \frac{1}{3}$$

need 2 padding bits   transmit 1026 bits total