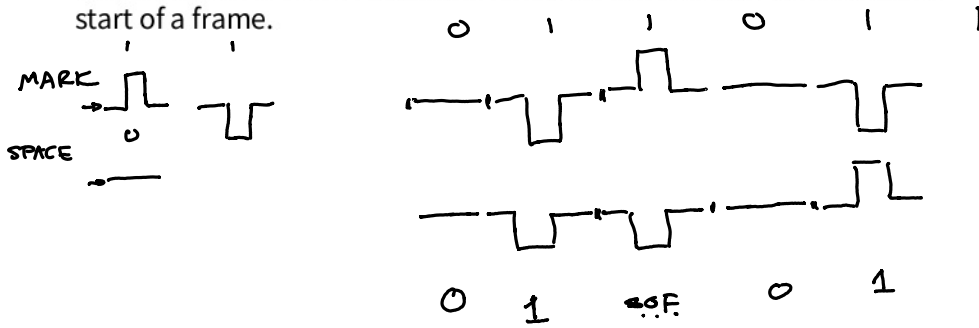


Framing

Exercise 1: Draw the waveform for an AMI-RZ 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.



Exercise 2: Preambles such as this allow multiple transmission formats to be used in a backwards-compatible way. What might be some disadvantages of using such a preamble? *Hint: to be decoded by old ("legacy") devices the preamble must be transmitted at the lowest possible data rate. This can be 100 times slower than the fastest devices.*

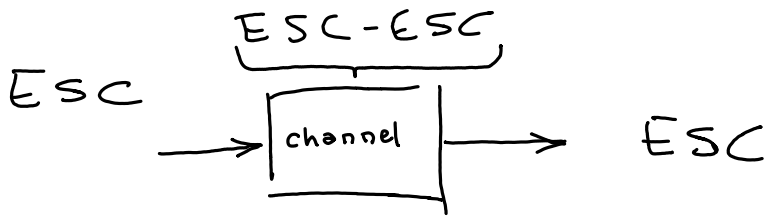
e.g. 192 bit preamble @ 1Mb/s
takes 192 μ s.

at 50 Mb/s in this same time we

could transmit $50 \times 192 = 24 \times 50 = 1200$
bytes.

"greenfield preambles" \rightarrow not backwards compatible

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



$\frac{1}{2}$ as fast ($\frac{1}{2}$ the speed)

or 2x slower

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

7e = flag
 7d = escape

7e ff 03
 S.OF ↓ ↓

PPP escape
 ↓
 data
 ↓
7d 7d 1b
 ↓ ↓

PPP escape
 ↓
 data
 ↓
7d 7e 7e
 ↓ ESC

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?

(not done)

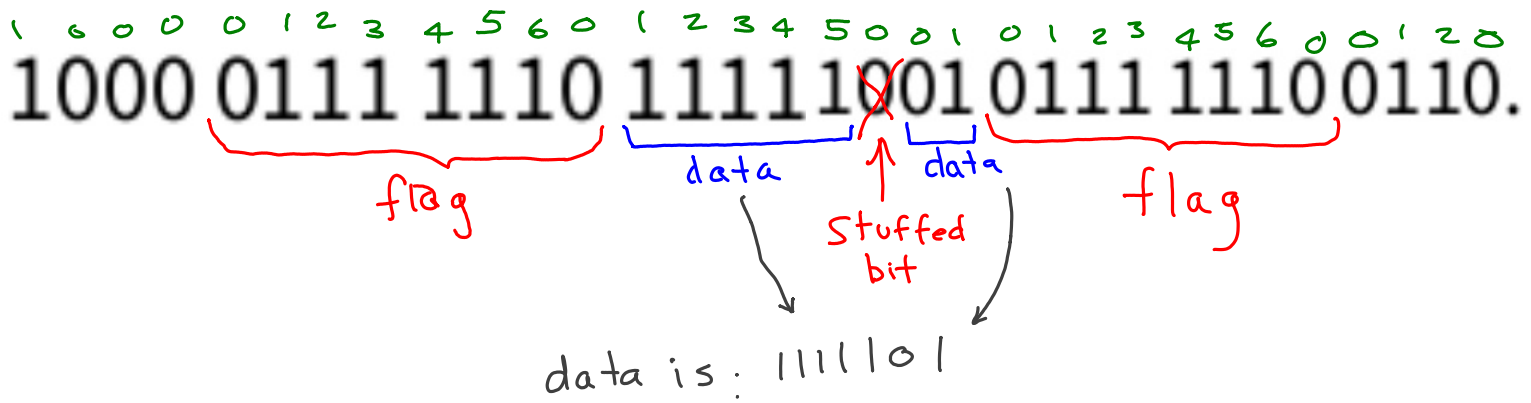
Exercise 6: Write out the complete sequence of 1's and 0's required to transmit the 12 bits 0110 1111 1100. Include the start and end flag sequences and any necessary bit stuffing.

0 1 2 3 4 5 6 0 0 1 2 0 1 2 3 4 5 ↓ 1 0 0
 0 1 1 1 1 1 0 0 1 1 0 1 1 1 1 1 0 1 0 0

stuffed bit

0 1 2 3 4 5 6 0
 0 1 1 1 1 1 0

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



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?

$$128 \text{ bytes} = 128 \times 8 = 1024 \text{ bits}$$

$$\frac{1024}{3} = 341 \frac{1}{3} \quad 341 \text{ "full" symbols}$$

plus 1 extra bit. \therefore need $3-1=2$ padding bits