

## Solutions to assignment #5

### Computer Networks 1

1. The inserted stuff bits are underlined.

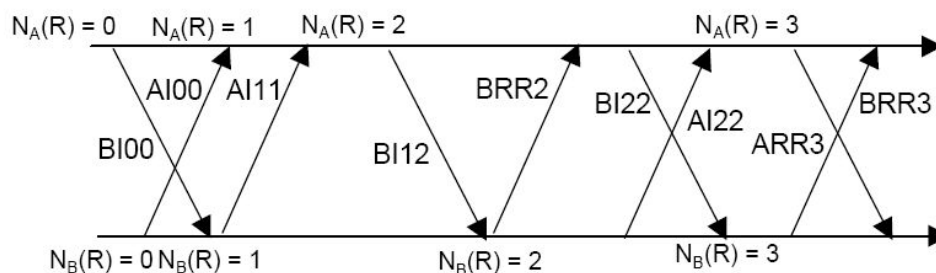
1101111111011111110101  $\rightarrow$  110111110110111110110101

2. The removed stuff bits are indicated by a '-'.  
111011111011111101111110  $\rightarrow$  111011111-11111-1111110

3. If the station is a secondary station, the bit is a 'P' (and the station is being *Polled* for more frames). If it is a primary station, the bit is a 'F' bit (indicating the *Final* frame of the current transmission).

4. Suppose two outstanding SREJ frames exist. Let frame A have  $N(R) = m$  and frame B have  $N(R) = n$ . Without loss of generality, suppose  $n > m$ . Since each SREJ frame with value  $N(R)$  implicitly acknowledges all previous frames up to  $N(R) - 1$ , frame A indicates that frame  $m$  has not yet been received and frame B indicates that frame  $m$  has been received. Thus, if two SREJ are allowed to be outstanding at the same time, contradictory information will be sent to the receiver.

- 5.



6. Assuming the overhead in one packet is equal to 8 bytes for the PPP header plus 20 bytes for the IPv4 header and 20 bytes for the TCP header. Thus, the total overhead in bits is  $8 \times (8 + 20 + 20) = 384$  bits. Thus, Time to send  $8 \times 10^{16}$  bits = (time for 1 packet)(# of packets needed)

$$\begin{aligned}
 &= \left(\frac{n_f}{R}\right) \left(\frac{8 \times 10^6}{n_f - n_o}\right) \\
 &= \left(\frac{8 \times 500 \text{ bits}}{56 \times 10^3 \text{ bps}}\right) \left[\frac{10^6 \text{ bytes}}{(500 - 70) \text{ bytes}}\right] \\
 &= 0.7143 \frac{\text{sec}}{\text{packet}} \times 2326 \text{ packets} \\
 &= 166.14 \text{ seconds}
 \end{aligned}$$