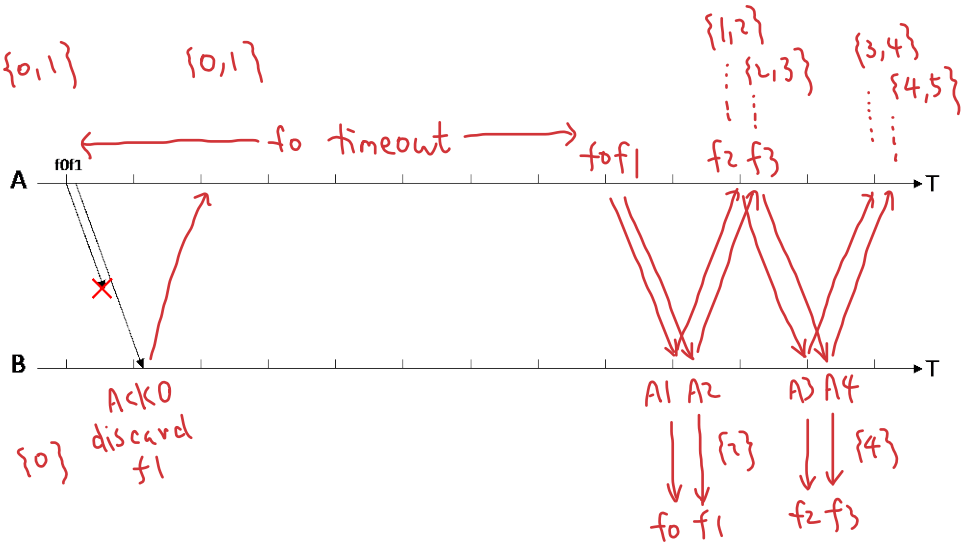
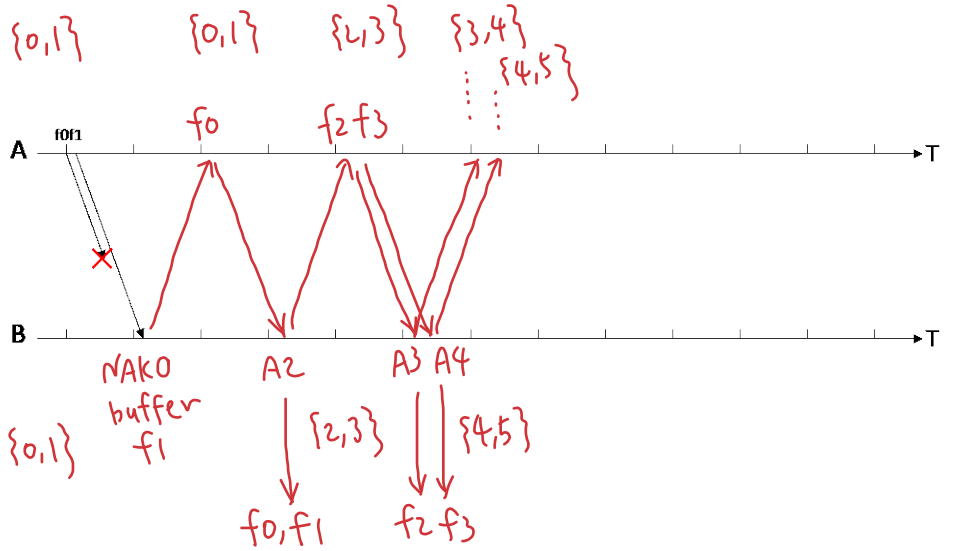
Cpr E 489 Spring 2023
Homework #3 Solution

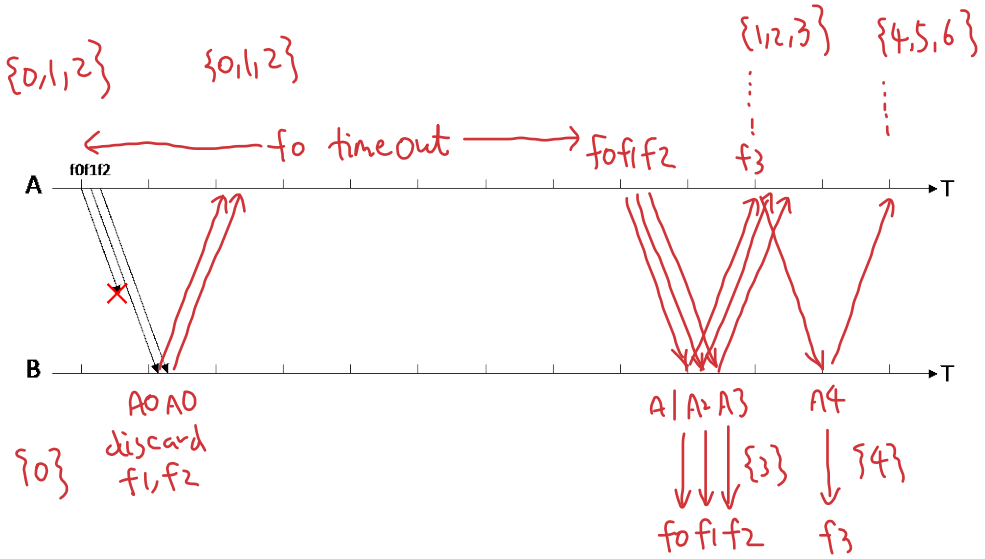
1. (80 points) ARQ Protocols
   a. (50 points) Suppose A tries to send **four frames (f0, f1, f2, f3)** to B (i.e., no more frames to send after f3). Suppose that f0 is lost on the first attempt, while all other transmissions (including re-transmitted data frames and ACK/NAK frames) succeed. Suppose one-way propagation delay is 1 time unit, and timeout for each frame is 8 time units. Complete the frame exchange sequence until all four frames are delivered successfully with each one of the following ARQ protocols.
      i. Go-Back-N ARQ protocol with N = 2.



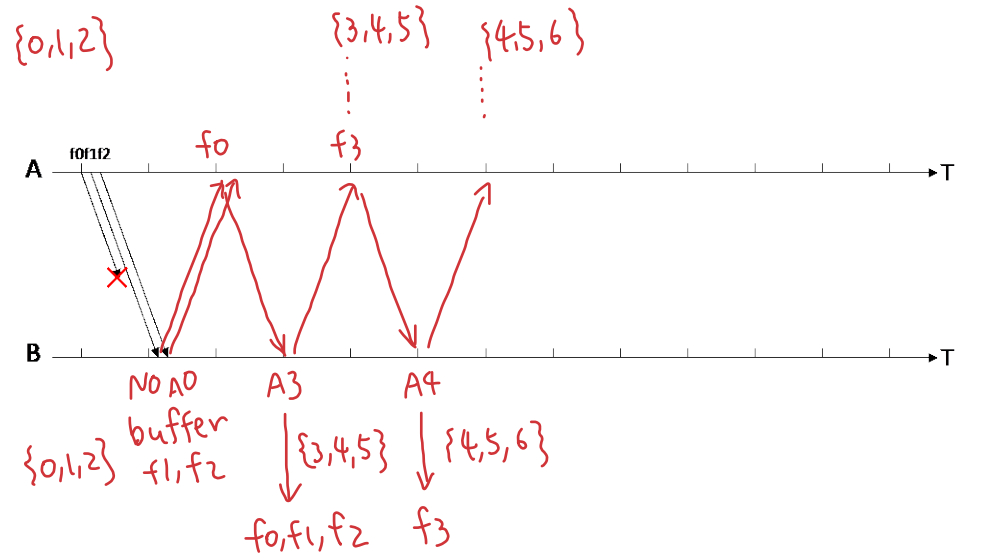
      ii. Selective Repeat ARQ protocol with Ws = Wr = 2.



iii. Go-Back-N ARQ protocol with N = 3.

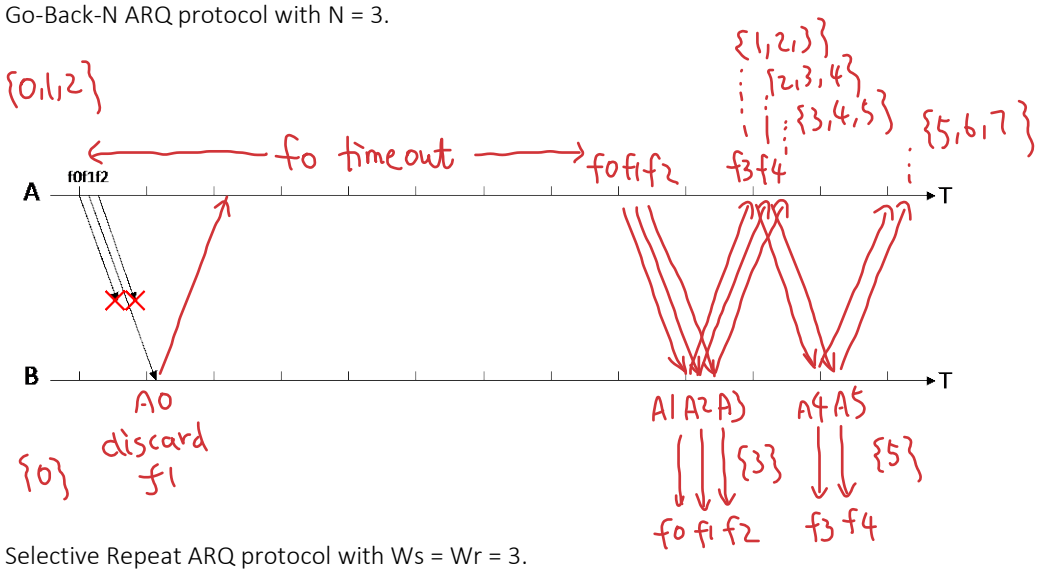


iv. Selective Repeat ARQ protocol with Ws = Wr = 3.

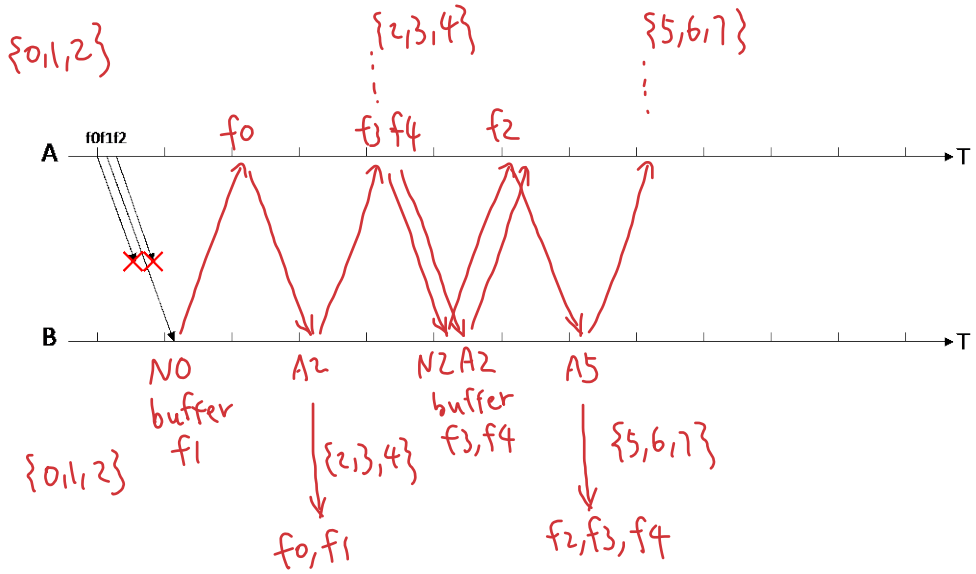


b. (30 points) Suppose A tries to send **five frames (f0, f1, f2, f3, f4)** to B (i.e., no more frames to send after f4). Suppose that f0 and f2 are lost on the first attempt, while all other transmissions (including re-transmitted data frames and ACK/NAK frames) succeed. Suppose one-way propagation delay is 1 time unit, and timeout for each frame is 8 time units. Complete the frame exchange sequence until all five frames are delivered successfully with each one of the following ARQ protocols.

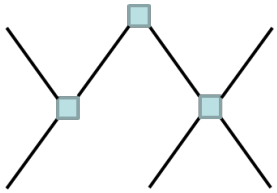
i. Go-Back-N ARQ protocol with N = 3.



ii. Selective Repeat ARQ protocol with Ws = Wr = 3.



2. (20 points) As shown in the figure, a CSMA/CD based LAN has a **tree topology** and it consists of 7 segments connected by 3 repeaters. The maximum length of each segment is 120 meters and the processing delay at each repeater is 1 μs. It transmits at 110 Mbps and signal propagates at $2*10^8$ m/s. What is the **minimum frame size** required for this CSMA/CD based LAN to operate properly? Justify your answer.



Answer:

t_{prop} = [(120 m * 4) / ($2 * 10^8$) m/s] + 1 μs * 3 = 5.4 μs

mini-slot time = 2 * t_{prop} = 2 * 5.4 μs = 10.8 μs

minimum frame size = 10.8 μs * 110 Mbps = 1188 bits