ITS323 – Quiz 4

Introduction to Data Communications, Semester 1, 2011

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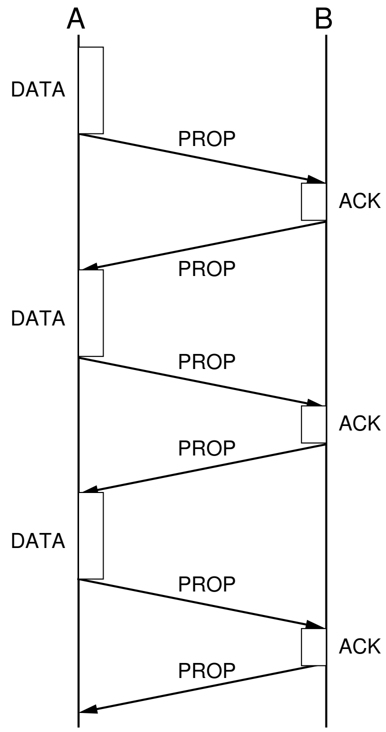
ITS323Y11S1Q04, Steve/Courses/ITS323/Assessment/Quiz4.tex, r1958

Question 1 [4 marks]

Consider stop-and-wait flow control being used on an error-free link from A to B. Device A has 3 frames to send to B. The link propagation delay is [100ms | 5us | |], the frame transmission time is [50ms | 100us | |] and the ACK transmission time is [5ms | 5us | |]. If A starts transmitting at time 0, what is the minimum time before which A can receive the entire ACK for the last transmitted frame? You must draw a diagram illustrating the exchange of frames [4 marks].

Answer. *To complete one DATA frame transfer takes: DATA + ACK + 2× PROP. With DATA transmission 50ms and propagation 100ms, one transfer takes 255ms, and the entire 3 transfers are complete after 765ms. With DATA transmission 100us and propagation 5us, one transfer takes 115us, and all 3 take 345us.*



Question 2 [2 marks]

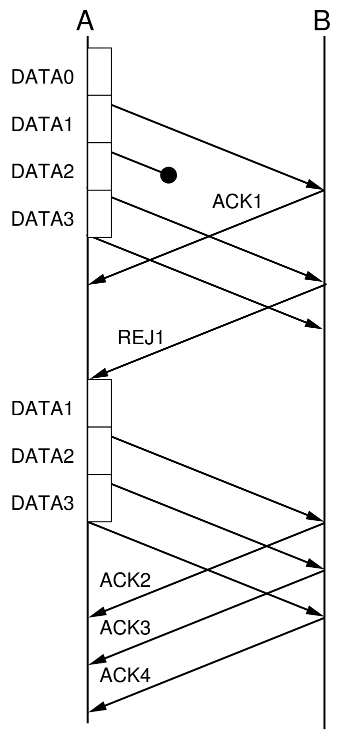
Consider question 1 above. If you want to keep the link efficiency above 50% and also want to use a simple flow control protocol, which protocol do you think is most appropriate: stop-and-wait (as in question 1) or sliding-window? Explain your answer.

Answer. *With a large propagation delay compared to data transmission, stop-and-wait is generally inefficient. For example, with 100ms propagation and 50ms DATA transmission (and 5ms ACK), the efficiency is about 50/255 or about 20%. This is much less than the desired 50% and hence sliding-window should be used as it can increase the efficiency (assuming window size is greater than 1).*

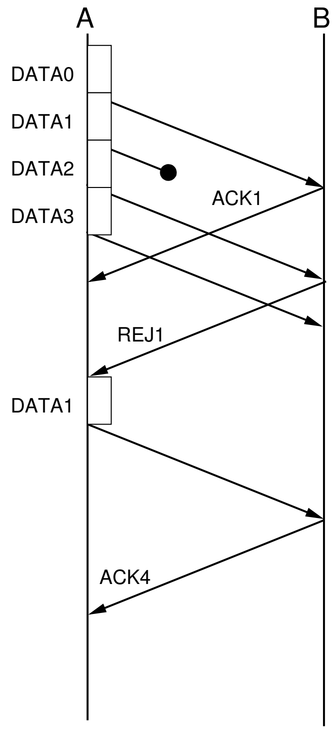
However with the variant where propagation is 5us and DATA transmission 100us, the efficiency with stop-and-wait is about 100/115 or about 85%. This is much greater than the desired 50% and since a simple protocol is also desired, stop-and-wait is sufficient. Sliding-window may increase the efficiency slightly but increases the complexity.

Question 3 [4 marks]

Consider [Go-Back-N | Selective-Reject | |] ARQ being used on a link from A to B, using a maximum window size of [15 | 7 | |]. The link has a very long propagation delay (compared to delay of transmitting multiple frames). Device A has 4 frames to send to B. B sends an ACK for each data frame. If the 2nd frame transmitted by A is lost, then draw a diagram illustrating the exchange of frames (up to the point where all 4 frames have been successfully acknowledged). Be sure to clearly label the sequence and ACK numbers. [4 marks]



Answer.



Question 4 [5 marks]

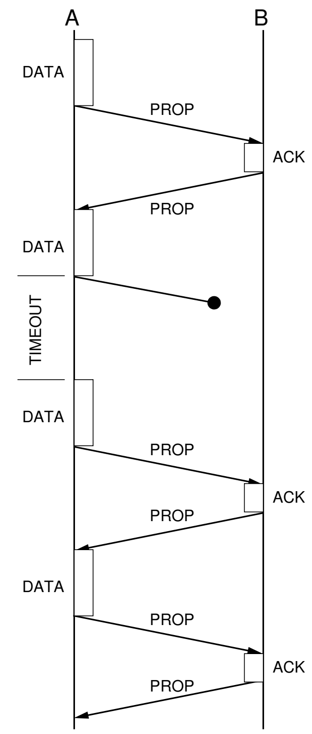
Consider stop-and-wait ARQ being used on a link from A to B. Device A has 3 frames to send to B. The link propagation delay is [| | 100ms | 50us], the frame transmission time is [| | 50ms | 100us], the ACK transmission time is [| | 5ms | 5us] and the timeout interval is [| | 400ms | 200us] (timer starts after data frame transmission is complete). If A starts transmitting at time 0 and the 2nd frame transmitted by A is lost, what is the minimum time before which A can receive the entire ACK for the last transmitted frame? You must draw a diagram illustrating the exchange of frames. [4 marks]

Answer. *To complete one successful DATA frame transfer takes: DATA + ACK + 2× PROP. With DATA transmission 50ms and propagation 100ms, one transfer takes 255ms, and the 3 transfers take 765ms. With DATA transmission 100us and propagation 50us, one transfer takes 205us, and all 3 take 615us.*

However the lost frame and timeout also take time: DATA + TIMEOUT. With DATA transmission 50ms and timeout 400ms, that is an additional 450ms. So the total time to deliver all 3 frame successfull is 765 + 450 = 1215ms. With DATA transmission 100us and timeout 200us, that is an additional 300us. So the total time to deliver all 3 frame successfull is 615 + 300 = 915us.

Question 5 [2 marks]

Consider question 1 above. If all delays were fixed and could be predicted by device A, what would the ideal timeout interval be? Explain you answer stating any assumptions.



Answer. *Ideally, the timeout interval should be long enough to give B time to respond, but no longer (as A would wait too long if a frame is lost). Assuming no or very small processing delay at B, the time to receive an ACK (from after the DATA is transmitted) is: 2 × PROP + ACK. With propagation of 100ms and ACK transmission of 5ms, the ideal timeout should be at least 205ms. With the variant, it should be at least 105us.*

Question 6 [3 marks]

You have 9000 bits of data to transmit across a link using stop-and-wait ARQ. If 1 out the 9000 bits is in error, then in terms of efficiency which option is better (ignore fairness and buffer sizes):

- Option 1: Frame with 1000 bits of data and 10 bit header
- Option 2: Frame with [| | 90 | 900] bits of data and 10 bit header

Explain your answer showing any calculations.

Answer. *With option 1, there are 9 original data frames (*$9 \times 1000 = 9000$*). But there will also be 1 frame transmitted. Therefore a total of 10 frames each contain 1010 bits are to be transmitted across the link.* $10 \times 1010 = 10100$ *bits.*

With option 2, with a data frame with 90 bits, there must be 100 original frames plus 1 retransmitted. Each frame contains 100 bits. Total bits transmitted is $101 \times 100 = 10100$ *bits. This is the same as option 1 and so neither option is better—they are the same.*

With option 2, with a data frame of 900 bits, there must be 10 original frames plus 1 retransmitted. Each frame contains 910 bits. Total bits transmitted is $11 \times 910 = 10010$ *bits. This is less than option 1 and hence is better than option 1.*