**BITS PILANI, DUBAI CAMPUS**

**Tutorial: 3**

**II Semester Session 2016-17 Subject: Communication Networks**

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1. 17

2.12

3. 

4. 

5. Tp = 2 sec  
  
Tt = Packet Size / Bw  
= 10^7 bits / 500 \* 10^6 bits per sec  
= 0.02 sec  
  
Efficiency = W / 1+2a  
= 7 / (1 + 2 \* 2/0.02)  
= 0.0348  
= 0.0348 \* 100  
= 3.48%

6.Suppose that a sender and a receiver are using ARQ to perform reliable data delivery.

1. In a Go-Back-N ARQ protocol, the window size is 6. Frames with sequence numbers 1, 2, 3, 4 and 5 have been sent. The sender just received an ACK for frame 1. Frames 6, 7, 8, 9 and 10 are waiting to be sent. Draw the time diagram showing this scenario.



1. Which frame(s) can the sender send before it must wait for the next ACK from the receiver? Explain.

The sender can have six frames unacknowledged after the ACK 1: that is, frames 2, 3, 4, 5, 6, and 7. So after seeing an ACK for frame 1, the sender can send frames 6 and 7.

1. Some time later, the sender transmitted frames 20, 21, 22, 23, 24, and 26; however, frame 22 got lost. If Go-Back-N is used, what frame(s) would the sender have to retransmit? Explain.

With Go-Back-N, the receiver has only one buffer (that is, it has a window size of 1). So the receiver will ACK the last in-sequence packet that it received (21), and the sender must retransmit all the frames that follow it.

1. Suppose the same situation as above, but sender and receiver use Selective-Repeat ARQ. What frame(s) would the sender need to retransmit? Explain.

With Selective-Repeat ARQ, the receiver has several buffers and can receive frames out of sequence. The receiver would acknowledge frames 20, 21, 23, 24, and 26 (but not 22 because it was lost). So the sender would need to resend 22.

1. Can Selective-Repeat ARQ use cumulative ACKs? Explain.

Yes. A cumulative ACK indicates that “all frames up to *n* have been received.” And so if a receiver has received a contiguous block of frames ending with frame *n*, it can ACK them cumulatively.

1. What are the trade-offs between Go-Back-N ARQ and Selective-Repeat ARQ?

Go-Back-N ARQ has a receive window of 1, and so it requires less memory for buffers in the receiver. However, since the receiver will not store frames that follow a lost frame, using Go-Back-N ARQ may cause retransmissions of otherwise properly received frames, wasting bandwidth. Selective-Repeat ARQ requires more buffer space in the receiver, and since it can store frames after a lost frame, it will not request unnecessary retransmissions and will not waste bandwidth.

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