City University of Hong Kong
Department of Electronic Engineering

EE3009 Data Communications and Networking

Tutorial 5

1. Prove that, with Stop-and-Wait ARQ, the average total time to transmit a frame is given by

$$E[t_{SW}] = t_0 + \frac{t_{out} P_f}{1 - P_f}$$

where t_0 is the frame transmission time, t_{out} is the time out period and P_f is the frame transmission error.

2. A telephone modem is used to connect a personal computer to a host computer. The speed of the modem is 56 kbps and the one-way propagation delay is 100 ms. Assume that $n_0 = n_a = t_{proc} = 0$.

   i) Find the efficiency for Stop-and-Wait ARQ if the frame size is 256 bytes, assuming a bit error rate of 10^{-4}.
   ii) Find the efficiency of Go-Back-N if three-bit sequence numbering is used with frame sizes of 256 bytes. Assume a bit error rate of 10^{-4}.

3. Consider a bidirectional link that uses Selective Repeat ARQ with a window size of 4. Suppose that all frames are one unit long and use a time-out value of 3. Assume that the one-way propagation delay is 0.5 unit, the processing delays are negligible, and the ACK frames are one unit long. Assuming stations A and B begin with their sequence numbers set to zero, show the pattern of transmissions for the case that Station A sends six frames in a row, and all frames, except frame 3, are received correctly.