Department of Computer Science and Engineering
Introduction to Internet (IT30037)
Class Test – 2

Date: 3-11-2017 Time: 8-9 am Marks: 20

1. **(5M+2M)**

(a) Packets of 1000 bits of data send over a 1-Mbps channel. How long does it take to send 1-million (1,000,000) bits of data using (i) stop and wait ARQ, (ii) go-back-n ARQ and (iii) selective repeat ARQ. Assume that all three ARQs are using 3 bits for representing sequence numbers. The distance between sender and receiver is 5000 Km and the propagation speed is 2×10^8 m. Ignore the size of the acknowledgement, waiting and processing delays. Assume no data or control frame is lost or damaged.

Soln:

Round trip delay = $(10000 \times 10^3) / (2 \times 10^8) = 50$ ms
Number of packets = 1000000/1000 = 1000
Transmission time of a packet = 1000/1000000 = 1ms
Time required to send 1000 packets by Stop-and-wait ARQ = 51 ms X 1000 = 51 sec
Time required to send 1000 packets by Go-back-N ARQ = 51 ms X (1000 /7) + 6 ms = 7.292 sec
Time required to send 1000 packets by Selective repeat ARQ = 51 ms X (1000 /4) + 3 ms = 12.753 sec

(b) For the above problem, to achieve the minimum delay for the transmission of 1 million bits using (i) go-back-n ARQ and (ii) selective repeat ARQ, what will be the optimal size of sender and receiver windows and what will be the optimal number of bits required for go-back-n and selective repeat ARQs to incorporate sequence (SN) and request (RN) numbers.

Soln:

(i) Go-back-N: Optimal sender window size = 50, Optimal receiver window size = 1, SN = 6, RN = 1
(ii) Selective repeat: Optimal sender window size = 50, Optimal receiver window size = 50, SN = 7, RN = 7

2. What is meant by bit-stuffing in the context of framing at DLC layer. For the given data (N/W layer packet + header + trailer), prepare the frame, mark the flags (frame boundaries) and mark the locations where bit-stuffing has been incorporated.
Data: 0 0 0 1 1 1 1 1 1 1 0 0 1 1 1 1 1 0 1 0 0 0 1 1 1 1 1 1 1 1 1 1 1 1 0 0 0 0 1 1 1 1 **(3M)**

Bit-stuffing: Inserting zero, if 011111 pattern appears in the data, to avoid the appearance of flag in the data.
01111110 0 0 0 1 1 1 1 1 0 1 1 0 0 1 1 1 1 1 0 0 1 0 0 0 1 1 1 1 1 0 1 1 1 1 1 0 1 0 0 0 0 1 1 1 1 1 0 01111110

3. One thousand stations on a pure ALOHA network share a 10-Mbps channel. If frames are 2000 bits long and each station is sending 5 frames per second (assume frame arrivals follow Poisson distribution). Find the (i) frame transmission time, (ii) average number of frames transmitted over a frame transmission time (iii) probability of no traffic (zero frames) during vulnerable period and (iv) throughput. **(4M)**

Soln:

Frame transmission time = 2000/10000000 = 0.2 ms
average number of frames transmitted over a frame transmission time (G) = 5 X 1000 X 0.0002 = 1
probability of no traffic (zero frames) during vulnerable period (P_0) = e^{-2}
Throughput (S) = $G.P_0 = e^{-2} = 0.13533$

4. With neat diagrams clearly explain the problems encountered in wireless LANs by using simple CSMA protocols for channel allocation. Discuss how those problems are alleviated by using CSMA/CA protocol. Consider the scenario (placement of stations in the figure) such a way that at least one station experiences each problem independently and one station experiences all problems. **(6M)**

Soln:

Hidden station problem: If the station present outside the coverage zone of the transmitting station and the receiving station present within the coverage zone of the hidden station.

Exposed station problem: If the station is within the coverage zone of transmitting station and the intended receiver to the transmitter is outside the coverage area of the station.

Solution to Hidden station and exposed station problems: Use of RTS send by the transmitting station and CTS send by the receiver.