PRINCE OF SONGKLA UNIVERSITY
FACULTY OF ENGINEERING

Mid-Term Examination: Semester I Academic Year: 2016
Date: 14 October 2016 Time: 09.00-11.00 (2 hrs)
Subject: 242-464 Design and Development of Network Com Room: หัวหุ่น

ทุจริตในการสอบ โทษขั้นต่ำคือ ปรับตกในรายวิชาที่ทุจริต และพักการเรียน 1 ภาคการศึกษา

- All types of calculators, dictionaries and electronic devices are not allowed.
- All notes and books are not allowed.

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1. Let P_f be the probability that a frame transmission has errors and needs to be re-transmitted. The probability of no error frames is $1-P_f$. Stop-and-Wait ARQ on average requires $t_{SW}=t_0/(1-P_f)$ seconds to get a frame through

$$\eta_{SW} = \frac{1-\frac{n_0}{n_f}}{1+\frac{n_a}{n_f}+\frac{2(t_{prop}+t_{proc})R}{n_f}}(1-P_f)$$

Where

n_f = number of bits in the information frame
n_a = number of bits in the ack frame
n_0 = number of overhead bits in a frame (given by the total number of bits in the header and the number of CRC bits
R = bit rate of the transmission channel

1.1 Suppose that frames are 1,250 bytes long including 25 bytes of overhead. Also assume that ACK frames are 25 bytes long. Calculate the efficiency of Stop-and Wait ARQ in a system that transmits at R= 1 Mbps and with reaction times, 2(tprop + tproc), of 1 ms, 10 ms, 100 ms, and 1 second (10 marks)

1.2 Suppose that frames are 1,250 bytes long including 25 bytes of overhead. Also assume that ACK frame are 25 bytes long. Calculate the efficiency of Stop-and-Wait ARQ in the system that transmits at R=1 Mbps and with reaction time of 1 msec for channels with bit error rates of 10^-6, 10^-5, and 10^-4 (10 marks)

Answer

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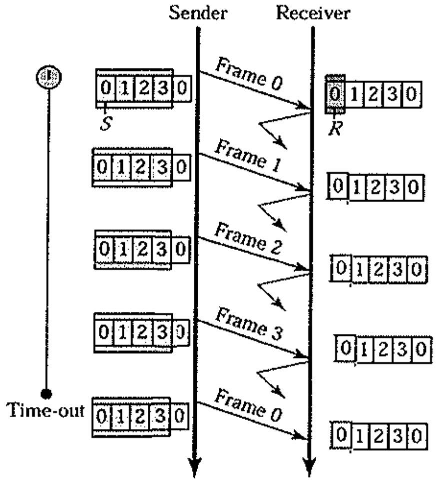
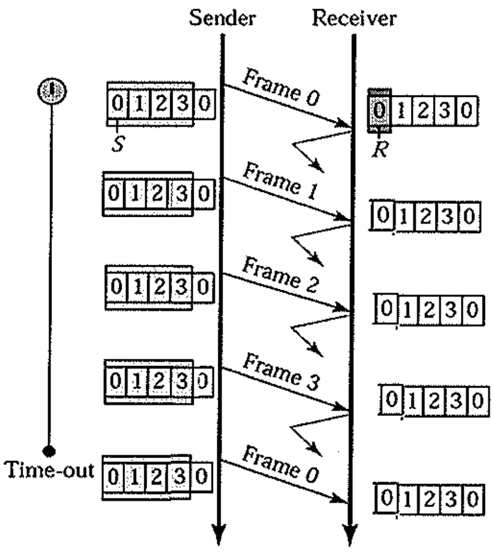
2. Below is Go-Back-End mechanism, it shows sending and receiving windows. Please put the pointer on the sending window (S) when the sender sends each frame out, and the receiving window (R) when the receiver sees each frame (10 marks)



Answer

(You may use the below figure to answer, put the pointers on)



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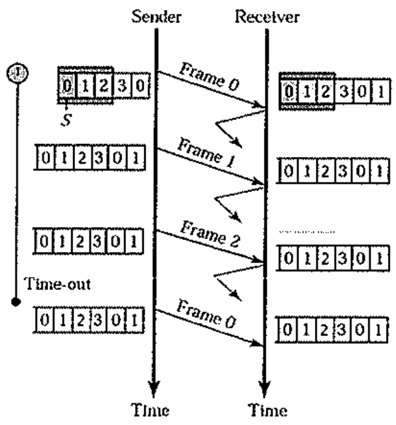
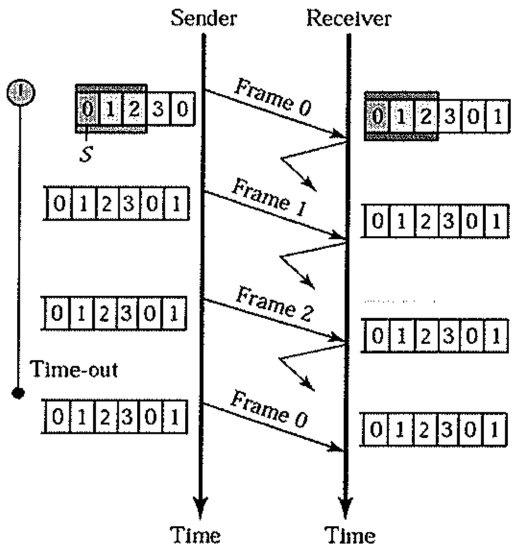
3. Below is Selective ARQ mechanism, it shows sending and receiving windows. Please put the pointer on the sending window (S) when the sender sends each frame out, and the receiving window (R) when the receiver sees each frame (10 marks)



Answer
(You may use the below figure to answer, put the pointers on)



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4. In a Stop-and-Wait ARQ system, the bandwidth of the line is 1 Mbps, and 1 bit takes 20 ms to complete a round trip.
   4.1 What is the bandwidth-delay product? (5 marks)
   4.2 If the system data frames are 1000 bits in length, what is the utilization percentage of the link? (5 marks)
   4.3 What is the utilization percentage of the link in previous example if the link uses Go-Back-N ARQ with a 15-frame sequence? (5 marks)

Answer

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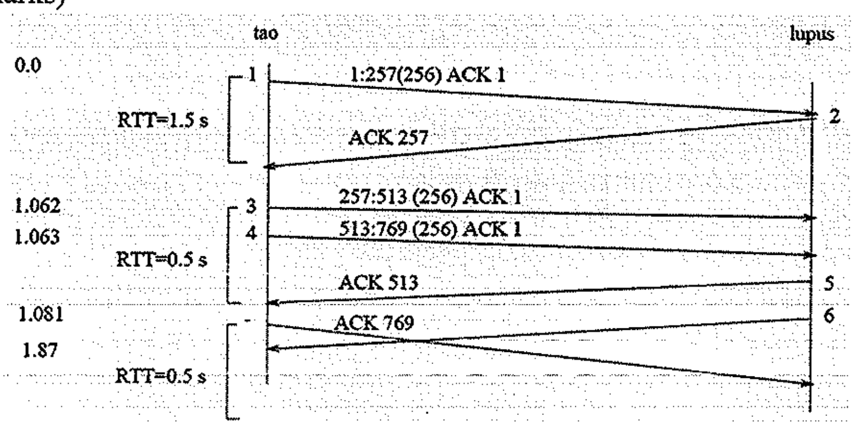
5. Below is the round trip time estimation of TCP mechanism. As the 500 ms timers is used for determining the RTT, what is the time at Tao node sees ACK 513 and ACK 769? (5 marks)



Answer

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6. TCP needs to estimate how long the source node takes to receive an object from a Web server after sending a request. The first round trip is for TCP connection establishment. Assume that one link between client and server has a rate of R, fixed congestion window, W segments, no retransmissions (no loss, no corruption). The following notations are used:
   S: MSS (bits) –> Message Size -> Packet size
   O: object size (bits) -> O/S = No. of packet in window

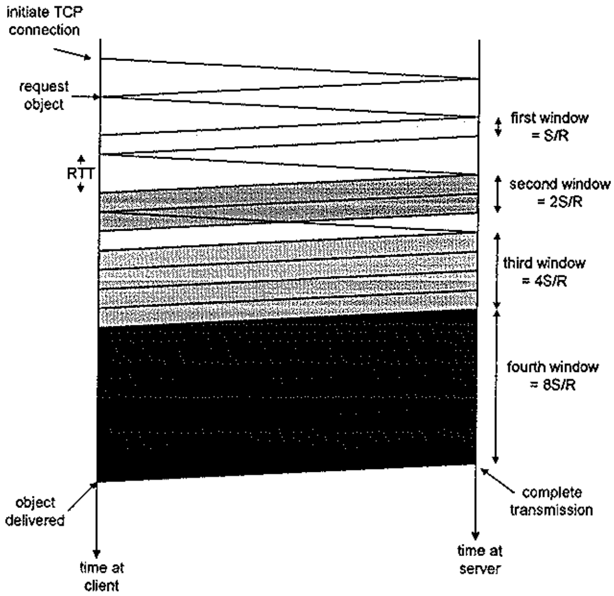
   Now suppose window grows according to the slow start. If the object size is O, the latency of the size O is:
   - P, where P is the number of times TCP stalls (idle) at server:
   - Q, where Q is the number of times the server would stall if the object is of infinite size.
   - K is the number of windows that cover the object.

   The latency model is then:

$$Latency = 2RTT + \frac{O}{R} + P\left[RTT + \frac{S}{R}\right] - (2^P - 1)\frac{S}{R}$$

$$P = \min\{Q, K-1\}$$

   The figure below demonstrates how TCP actions, window sizes are:



There are 15 segments needed for sending in this case. Please determine:

6.1 What is the number of windows (K)? (5 marks)

6.2 How many times that server is idle? (5 marks)

6.3 If RTT is 200 ms and packet transmitting time is 100 ms. How long it takes to complete on sending the whole object (5 marks)

Answer

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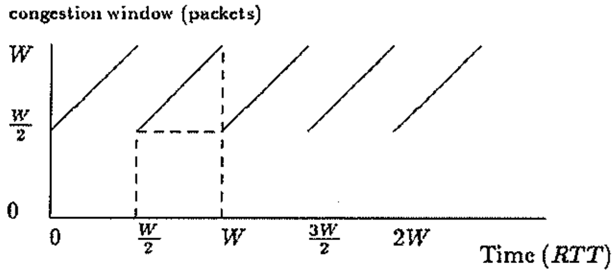
7. Below is the approximation of TCP with lose model.



The following assumptions are used:

- A maximum window size is W,
- A minimum window size is W/2
- **Constant Packet loss Probability is *p*,**
- we approximate random packet loss at constant probability *p* by assuming that the link delivers approximately *1/p* consecutive packets, followed by one drop.,
- TCP run on steady state, so *slow start* (during start up) is not concerned.

In this case, no. of packets transmitted during a packet loss is

$$\text{Number of Pkts} = \frac{1}{2}\frac{T}{RTT}\left(\frac{W}{2} + W\right)$$

Where *T* is the periodic between detecting packet losses.
The time taken to increase its window from *W/2* to *W* is

$$T = RTT(W/2)$$

Please show that this model will give ***inverse square-root p law.***

Answer

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8. Please draw the behavior of TCP Reno and Tarho (10 marks)