COMP5621 Computer Networks I

Fall Semester 20xx Midterm Examination

Date: 20 Oct. 20xx Time: 19:00 - 21:00

Name:_____ Student ID: _____Email:_____

Instructions

1. Please write your name, student ID and email address on this page.
2. Please answer all the questions within the space provided on the examination paper.
3. This paper consists of 7 questions and 7 pages, verify that you have all pages.
4. Please read each question very carefully and answer the questions carefully and **clearly to the point**. Make sure your answers are **neatly written and legible**.
5. Show all the steps used in deriving your answer, wherever appropriate.
6. Calculators and electronic devices are not allowed.

Question	Points	Score
1	10	
2	16	
3	10	
4	22	
5	10	
6	12	
7	20	
Total	**100**	

Problem 1 General Questions (10 pts)

Answer the following true/false questions by circling either T or F

a) Local domain name servers do not use caching to improve performance. They instead perform full name resolution each time they receive a name resolution request to avoid stale information.

T (F)

b) Connectionless services do not possess flow control

(T) F

c) Circuit switching uses statistical multiplexing to save bandwidth

T (F)

d) In general, one way to speed up downloads with HTTP1.0 is to open parallel TCP connections

(T) F

e) HTTP servers listen for the clients' requests on protocol port 25

T (F)

f) DNS runs usually on top of TCP

(T) F

g) The mail-reader of the receiver of an email message uses SMTP to download the message from the receiver's mailbox.

T (F)

h) Considering a long period of time, instantaneous throughputs of a link at any point in this period are larger than the average throughput over this period.

T (F)

i) Queuing delay is usually random in nature

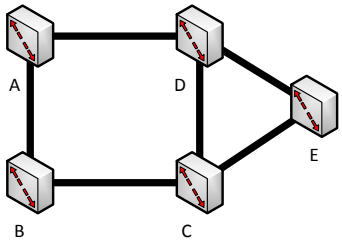
(T) F

j) Internet is a network of networks

(T) F

Problem 2 (16 pts) Circuit switching

Consider the following circuit switched network made up of five switches (A, B, C, D and E) connected as shown via 6 links. Each link has *n* FDM circuits and each FDM circuit is slotted in a revolving frame of 2*m* TDM slots each. Assuming that any connection between any two users requires at least one time slot used in half-duplex for uplink and downlink communication.



a) What is the maximum number of connections that can be ongoing at a given particular time instant in this network? (5pts)

b) Assuming now that each connection requires a minimum throughput of 2 slots to be effective; what is the maximum total number of connections that can be in progress in this network in any continuous period of time of one TDM frame? (5pts)

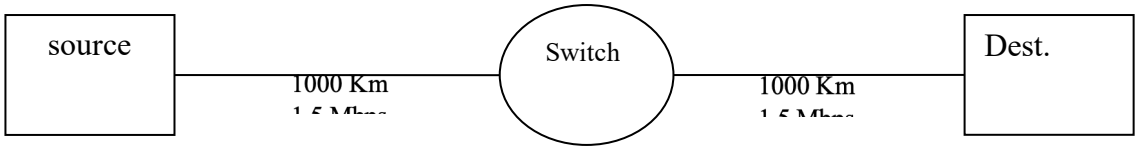
c) Assuming now that each connection requires a minimum of 2 slots to be effective, and that all connections originate at switch A and are destined to users on switch C, what is the maximum number of connections that can be in progress in this network in any continuous period of time of one TDM frame? (6pts)

Problem 3 (10 points) Reliable Data Transfer – Stop-and-Wait

Based on the finite state machines of **`rdt 3.0`**, describe a channel condition (bit errors, losses, and so on) under which the receiver of **`rdt 3.0`** would accept stale (old) duplicate data as new data. Draw a trace (time-space diagram) to illustrate this condition (in the trace use M0, M1, …, for data and A0, A1, … for Acks) (10pts)

Problem 4 (22 points) Reliable Data Transfer

A 64-kilobytes message is to be transmitted from the source to the destination in the following packet switched network.



The switch uses store and forward and the network limits packets to a maximum size of 2 kilobytes, and each packet is mapped to a link layer frame that has a 32-bytes header. The transmission lines have no errors and no losses. Assuming the signals propagate at a speed of 2 x 10^5 Km/s, and that transmission time for ACKs is negligible,

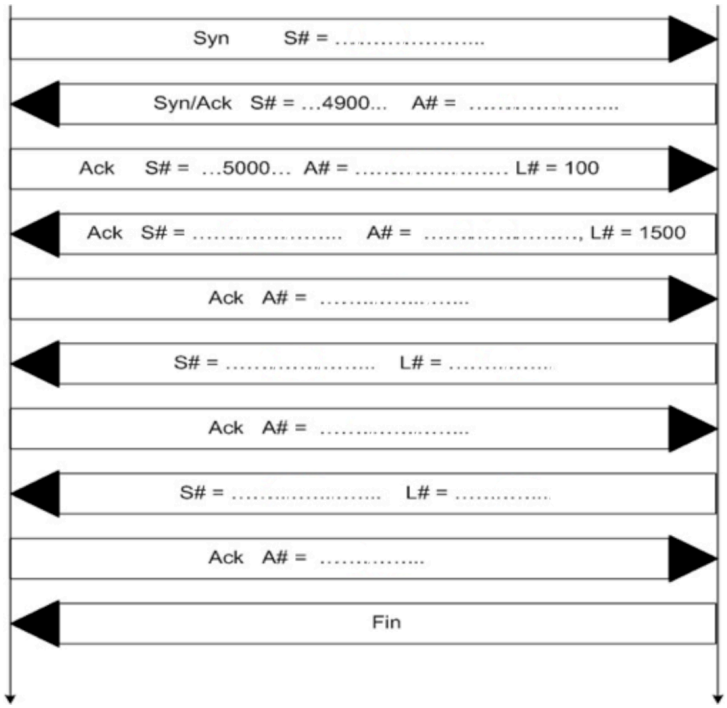
a) Assuming stop-and-wait is used at the link layer to ensure reliability and that all delays but transmission (t) and propagation (s) are negligible, give an expression for the time it take the message to get from the sending application process to the receiving application process? Explain, show your steps and draw a time-space diagram to illustrate your answer. (8pts)

b) Will the sending Application process ever know if the message is delivered to the destination or not? (If yes, explain and calculate the time it takes, and if no explain why not.) (6pts)

c) Repeat a) and b) by assuming now that stop-and-wait is deployed end-to-end from source to destination instead. (8pts)

Problem 5 (12pts): TCP Protocol and Sequence Numbers Puzzle

Consider the following trace of packets exchanged between a web client (on the left) and a web server (on the right). The web client sent the request that consisted in a total of 100 bytes, and the web server responded with a reply that contains the base html file. The reply message contained 3500 bytes and the MSS is 1500 bytes. Fill in the empty spaces with the appropriate values.
We use th4 following conventions:
Ack means the Ack bit is set; Syn means the Syn bit is set; Fin means the Fin bit is set; A# means the Acknowledgement number; S# means the Sequence number; L# means the Data length in bytes.



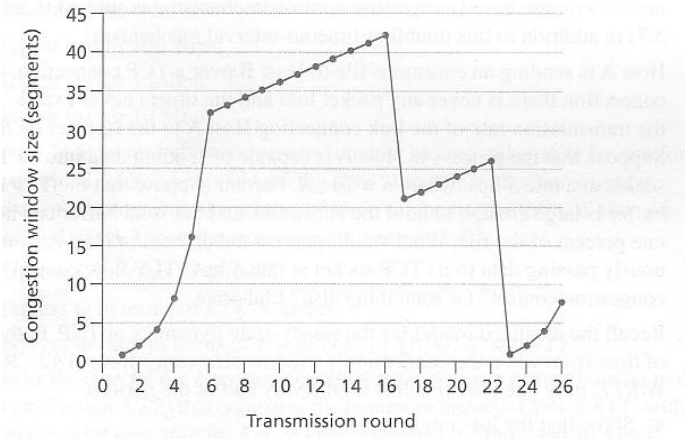
Problem 6 (10pts) Peer-to-Peer file distribution

Consider distributing a file of F bits to N peers using P2P model. Assume a fluid model where the server can simultaneously transmit to multiple peers, transmitting to each peer at different rates, as long as the combined rate does not exceed the server's upload rate u_s. For simplicity, assume that d_{min}, the minimum peer download rate, is infinite (i.e., large enough so that peer download bandwidth is never a bottleneck.)

Denote by u_i the upload rate of peer i, i=1,…N, and suppose $u_s \geq (u_s + u_{1 + \ldots + } u_N)/N$. Specify a distribution scheme that has a distribution time of $NF/(u_s + u_{1 + \ldots + } u_N)$.

Problem 7: TCP Congestion Control Basics (20pts)

Consider the following macroscopic plot of TCP congestion window size as a function of the transmission round (we do not consider fast recovery here). Explain all your answers below



a) Which version of TCP is this Tahoe or Reno? State briefly why. (3pts)

b) Identify the intervals of time when TCP slow start is operating. State briefly why. (3pts)

c) Identify the intervals of time when TCP congestion avoidance is operating. State briefly why. (3pts)

d) After the 16th transmission round, is segment loss detected by a triple duplicate ACK or by a timeout? State briefly why. (3pts)

e) After the 22nd transmission round, is segment loss detected by a triple duplicate ACK or by a timeout? State briefly why. (2pts)

f) What is the initial value of ssthreshold at the first transmission round? State briefly why. (2pts)

g) During what transmission round is the 70th segment sent? (4pts)

END OF PAPER