Department of Electrical & Computer Engineering
Prairie View A&M University

Doctoral Preliminary Examination

Computer Networks
Fall 2019

Name of the student: _____

Signature of the student: _____

1	20	
2	15	
3	15	
4	20	
5	30	
Total	100	

Instructions:

This is a CLOSED BOOK Examination. You can use approved calculator. You can access the Formula sheet provided by the Graduate Coordinator who is administering the examination.

(20pts) 1.

(5 pts) (1.1) Name the five layers of the Internet protocol stack. Which layers are needed in (a) a typical router, (b) a host?

(10pts) (1.2)

(a) Please briefly explain the function of DHCP (Dynamic Host Configuration Protocol) protocol, the packets exchange between a DHCP client and a DHCP server.

(b) Assume Host A is a DHCP client, and Host B is the DHCP server in that subnet. Host A is sending out a DHCP discover packet. Could you use that packet as a case study to demonstrate the network layering and encapsulation concept.

(5 pts) (1.3) Assume a CIDR address 158.233.188.105/21:

(a) What is the address mask?

(b) How many hosts can that network accommodate? What will be the address range?

(15 pts) 2. Suppose there is one packet switch between a source and destination. The transmission rate between source and switch is R1, and the rate between switch and destination is R2.

L bits per packet   3 2 1   destination

source

R1 bps   R2 bps
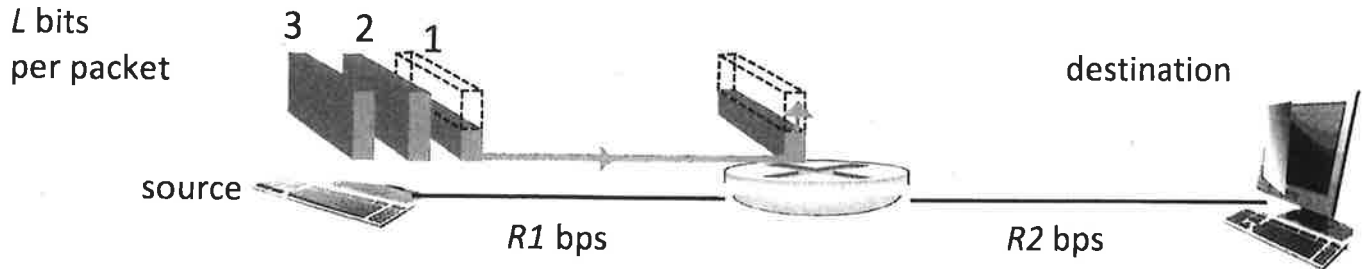
(4 pts) (2.1) Assume the switch uses store-and-forward packet switching, suppose a packet with length L is transmitted from source to destination, what is the transmission delay from source to destination?

(4 pts) (2.2) What is the transmission delay from source to destination if we have 4 packets with length L to be transmitted? (Assume R1=R2=R), How about N packets, what is the transmission delay.

(3 pts) 2.3) What is the transmission delay of sending **P** packets (each packet's length is L) over **M** Links of transmission rate R.

(4pts) (2.4) Consider sending a packet from source to destination over a fixed route. List the delay component in the end-to-end delay. Which of these delay are constant and which are variable?

(15 pts) 3. Suppose there are ten users sharing a 2Mbps link, and <u>user 1</u> suddenly generate **one thousand 2000-bit packets, while other users remain quiescent and do not generate packet.**

(5 pts) (3.1) Assume under Time division multiplexing (TDM) circuit switching with 10 slots per frame and <u>user 1</u> is allocated one time slot. How long does it take to transmit the **one thousand 2000-bit packets (2 million bits)** data for <u>user 1</u>?

(5pts) (3.2) How about using packet switching, how long it will take to transmit the **one thousand 2000-bit packets (2 million bits)** data for <u>user 1</u>?

(5pts) (3.3) Briefly explain the difference between <u>circuit-switching</u> and <u>packet-switching</u>. Please explain what scheme is Internet based?

(20pts) 4.
(2pts) (4.1) What are the two key network layer functions?

(2pts) (4.2) Do routers have IP addresses? If so, how many?

(6pts) (4.3) The process of using a forwarding table to select a next hop for a given datagram is called "forwarding", To handle ambiguity that arises from overlapping address mask, Internet forwarding uses a **"longest prefix match"**. Please briefly explain "longest prefix match" and **fill the table accordingly** following that algorithm, and briefly show the reasoning.

Suppose the couple rows from a forwarding table are

Prefix	Next hop
192.24.0.0/18	D
192.24.20.0/22	B

If the datagram with the following destination IP address, please fill in the next hop information

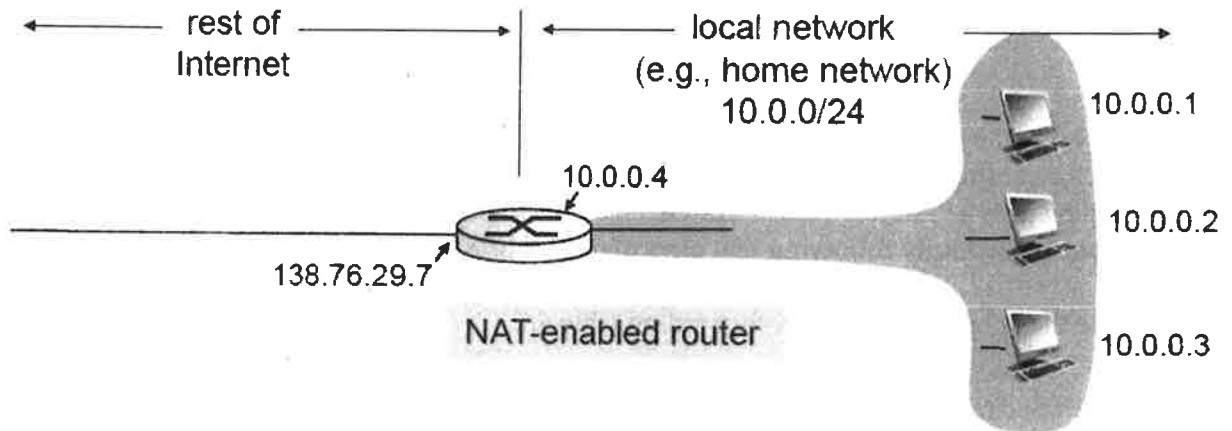| Destination IP address	Next hop
192.24.48.0	
192.24.14.32	
192.24.30.0	

(10pts) (4.4)

(a) What is NAT?

(b) Explain the difference of Private IP address vs. Public IP address.

(c) Please use the following diagram as an example, to explain how to set up a **NAT translation table**. Assume the hosts in the local network want to access the google website (IP address:216.58.194.132).

(30 pts) 5. Transport Layer

(5 pts) (5.1) please briefly explain the differencees between UDP and TCP.

(3pts) (5.2).   For the following services, which could be provided by Internet Transport Protocols? Briefly explain.

1. Guaranted Throughput
2. Delay
3. Security
4. Reliable data transfer

(3pts) (5.3).   For the following application protocols, please specify which transport protocol are used accordingly? Briefly explain why?

DNS
HTTP
FTP
DHCP
SMTP

(4 pts) (5.4) What packets are exchanged between two hosts when **establish** a TCP connection (Show the packet flows)?

(15 pts) (5.5) The Transmission Control Protocol uses a method called congestion control to regulate the traffic entering the network. The behavior of TCP congestion control can be represented as a graph in which the x-axis indicates the time, and the y-axis indicates congestion window size. Please use the graph shown below to the answer the following questions. Note that the graph does not explicitly show timeouts, but you should be able to figure out when timeouts happened based on the events shown (assume TCP Reno is used).
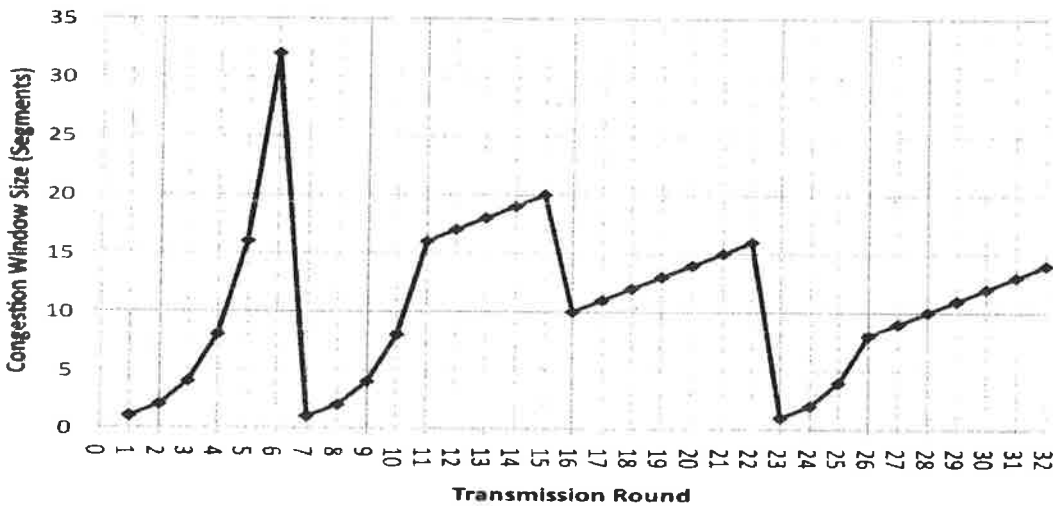
(3 pts) (a). **Slow Start**: give some reason why slow start is used, and explain why it does a better job than congestion avoidance for that function. Identify the intervals of time when TCP slow start is operating.

(3 pts) (b). **Congestion Avoidance**: identify the intervals of time when TCP congestion avoidance is operating. Why should congestion avoidance be used instead of slow start during these intervals?

(3 pts) (c). After the 15th transmission round, is segment loss detected by a triple duplicate ACK or by a timeout? Explain why?

(3 pts) (d). During what transmission round is the 70th segment sent?

(3 pts) (e). Could you summarize the mechanism used in TCP Congestion control and briefly explain it.