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

# **Doctoral Preliminary Examination**

Computer Networks Fall 2018

Name of the student:

Signature of the student:

1	22	
2	13	
3	25	
4	25	
5	15	
Total	100	

Instructions:

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

(22pts) 1.

(**4pts**) (1.1) please briefly explain 5-layer Internet TCP/IP reference model. Sketch those layers and also sketch the associated packet (showing headers, payload, and Encapsulation concept).

(4 pts) (1.2) Given an Ethernet frame, what fields must be examined to determine whether the frame carries a TCP segment.

(**4 pts**) (1.3) Why do we need hierarchical routing in Internet? What is an autonomous system (AS)?

## (6pts) (1.4)

- (a) For the bit stream 101011100, draw the NRZ line coding.
- (b) Repeat part (a) for Manchester coding.

(4pts) (1.5) What is the **propagation delay** for a packet of length 2000 bytes to propagate over a link of distance 2000 km, while propagation speed is  $2x10^8$  m/s, and transmission rate 2Mbps?

(13 pts) 2. 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.

(4pts) (2.1) 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>?

(4pts) (2.2) 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**) (**2.3**) Briefly explain the difference between <u>circuit-switching</u> and <u>packet-switching</u>. Please explain what scheme is Internet based?

(25pts) 3.(2pts) (3.1) What are the two key network layer functions?

(2pts) (3.2) What is the optimal network mask of the gateway interface in a sub-network where maximum of 30 hosts exist and gateway IP address is 192.168.1.1? a) 192.168.1.0 b) 192.168.1.224 c) 255.255.255.192 d) 255.255.255.0 e) 255.255.224 f) 192.168.1.240

(2pts) (3.3) Do routers have IP addresses? If so, how many?

(**6pts**) (3.4) Please briefly explain the router architecture. (a) The components of a router, and (b) the function of each block in the router input ports and output port.



(**5pts**) (3.5) 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.

Suppose the couple rows from a forwarding table are

Prefix	Next hop
192.24.0.0/18	D
192.24.12.0/22	В

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

Destination IP address	Next hop
192.24.6.0	D
192.24.14.32	
192.24.54.0	

(**8pts**) (3.6) (**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).



#### (25 pts) 4. Transport Layer

(5pts) (4.1) please briefly explain the differencees between UDP and TCP.

(20pts) (4.2) 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).



(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.

(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?

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

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

### (15 pts) 5. IP Addressing

Assume a Classless Inter-Domain Routing (CIDR) address 158.233.167.135/21:

(3 pts) (5.1) What is the address mask?

(3 pts) (5.2) How many hosts can that network accommodate? What will be the address range?

(9 pts) (5.3) Suppose one ISP has this address block 158.233.160.0/21. There are 2 customers applying for address blocks. Customer A needs 27 IP addresses, Customer B needs 312 IP addresses. Could you help the ISP assign the addresses to the two customers, explain how.