

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

**Doctoral Preliminary Examination**

**Computer Networks  
Spring 2019**

Name of the student: \_\_\_\_\_

Signature of the student: \_\_\_\_\_

1	25	
2	20	
3	28	
4	27	
<b>Total</b>	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.

**(25pts) 1.**

**(5 pts) (1.1)** List the 5-layer in the TCP/IP Internet reference model, give a brief explanation of each.

**(5 pts) (1.2)** Assuming TCP/IP reference model is adopted, what layers of a protocol stack are used on a router? How about a host?

**(5 pts) (1.3)** List and describe the three primary measures of network performance.

**(5 pts) (1.4)** Please give at least two technologies for (a) home Internet access and (b) Internet access in the Enterprise scenario, respectively.

**(5 pts) (1.5)** Why do we need hierarchical routing in Internet? What is an autonomous system (AS)?

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

**(6 pts) (2.1)** Assume under Time Division Multiplexing (TDM) circuit switching with 10 slots per frame and user 1 is allocated one time slot. How long does it take to transmit the **one thousand 2000-bit packets (2 million bits)** data for user 1?

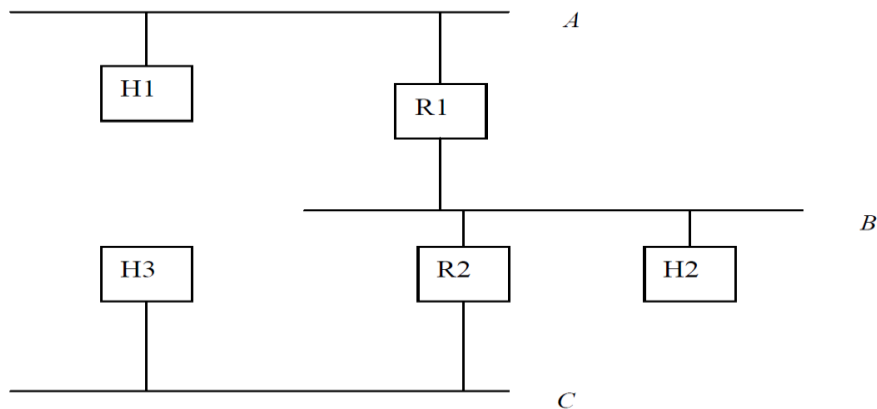
**(7pts) (2.2)** How about using packet switching, how long it will take to transmit the **one thousand 2000-bit packets (2 million bits)** data for user 1?

**(7pts) (2.3)** Briefly explain the difference between circuit-switching and packet-switching. Please explain what scheme is Internet based?

**(28 pts) 3.**

(6 pts) (3.1) The range of IP addresses blocks available for company M are 221.65.192.0/23 and a brief architecture of the network for company M is shown below. There are three Local Area Networks (LANs) (A, B, C), and each LAN need at most 254 IP addresses.

As the network administrator of company M, please find an assignment of unique subnet numbers and subnet masks for each LAN segment and unique IP addresses for each host and router interface shown in the figure below, where R1 and R2 are routers, H1, H2, and H3 are hosts.



(6 pts) (3.2) Based on the IP addresses you assigned on the previous sub-problem (3.1), assume that we are using protocol IPv4 and the header format of IPv4 is shown as follows:

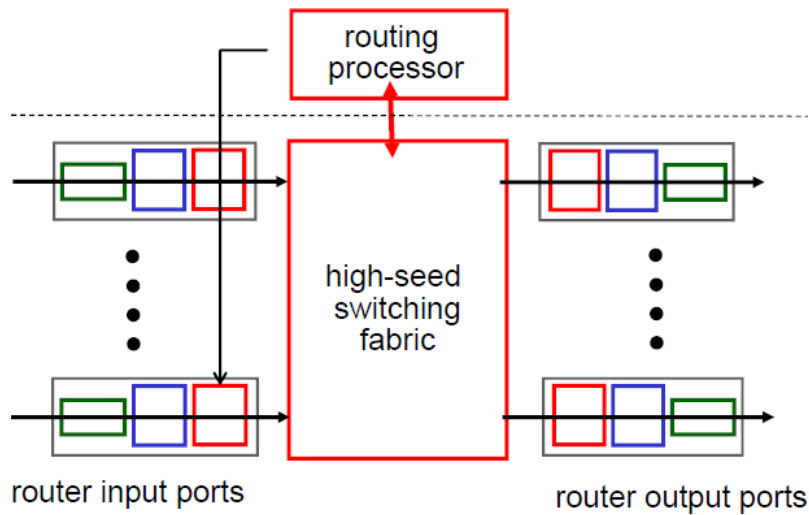
0	4	8	16	19	24	31
VERS	H. LEN	SERVICE TYPE	TOTAL LENGTH			
IDENTIFICATION			FLAGS	FRAGMENT OFFSET		
TIME TO LIVE		TYPE	HEADER CHECKSUM			
SOURCE IP ADDRESS						
DESTINATION IP ADDRESS						
IP OPTIONS (MAY BE OMITTED)					PADDING	
BEGINNING OF PAYLOAD (DATA BEING SENT)						
⋮						

(i) If Host H3 wants to send a packet to Host H2, what would be the SOURCE ADDRESS and DESTINATION ADDRESS for such packet?

(ii) Assume that the packet will be forwarded by router R2, will R2 change the header field SOURCE ADDRESS and DESTINATION ADDRESS?

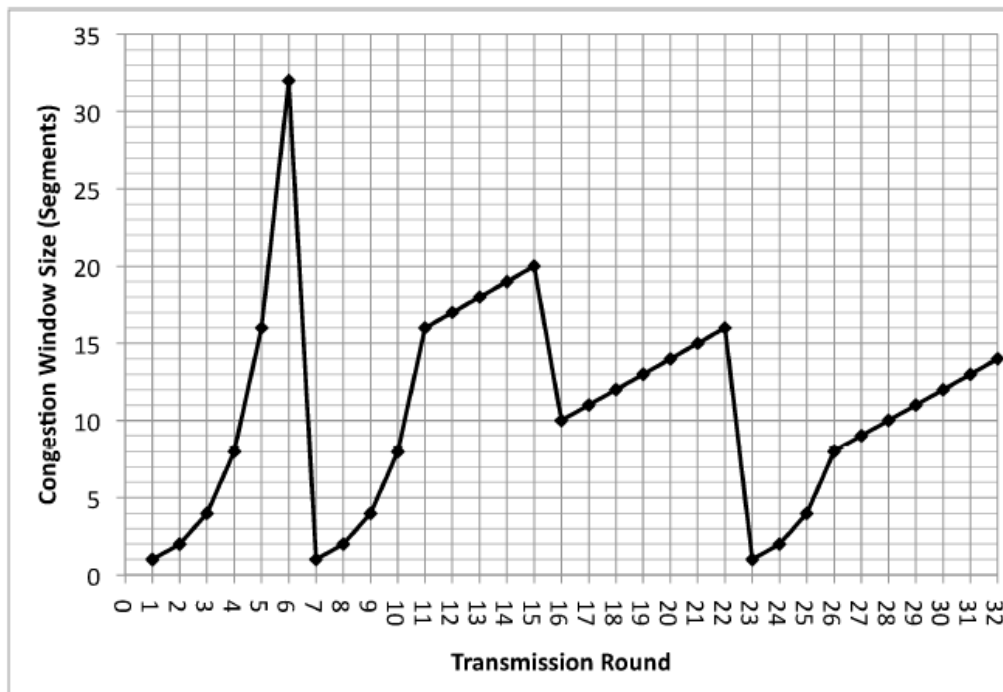
(4pts) (3.3) What are the two key functions of the network layer?

(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 ports.



(6pts) (3.5) What is NAT? Please Explain the difference of Private IP address vs. Public IP address.

(27 pts) 4. 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 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).



(4pts) (4.1). **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.

(4pts) (4.2). **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?

(4pts) (4.3). After the 15th transmission round, is segment loss detected by a triple duplicate ACK or by a timeout? Explain why?

.  
(5pts) (4.4). Could you summarize the mechanism used in TCP Congestion control and briefly explain it.

(5pts) (4.5). What are the differences between TCP and UDP if they both operate at the transport layer?

(5pts) (4.6). What three packets are exchanged between two hosts when establishing a TCP connection (Show the packet flows for TCP connection)?