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

Doctoral Preliminary Examination

Computer Networks
Spring 2021

Name of the student: _____

Signature of the student: _____

1	40	
2	15	
3	30	
4	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.

(40pts) 1. Quick Answers
(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) Please give at least two technologies for (a) home Internet access and (b) Internet access in the Enterprise scenario, respectively.

(5 pts) (1.4) Why do we need hierarchical routing in Internet? What is an autonomous system (AS)?

(5pts) (1.5). For the following services, which could be provided by Internet Transport Protocols? Please briefly explain.

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

(5pts) (1.6). 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 2×10^8 m/s, and transmission rate 2Mbps?

(5pts) (1.7) 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?

(5pts) (1.8). For the following application protocols, please specify which transport protocol are used accordingly? Briefly explain why?

HTTP
FTP
SMTP
DNS
DHCP

(15 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.

(5 pts) (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>?

(5pts) (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?

(30 pts) 3.

(8 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 <u>company M</u> 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 <u>company M</u>, 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. (please put the assignment on the graph).
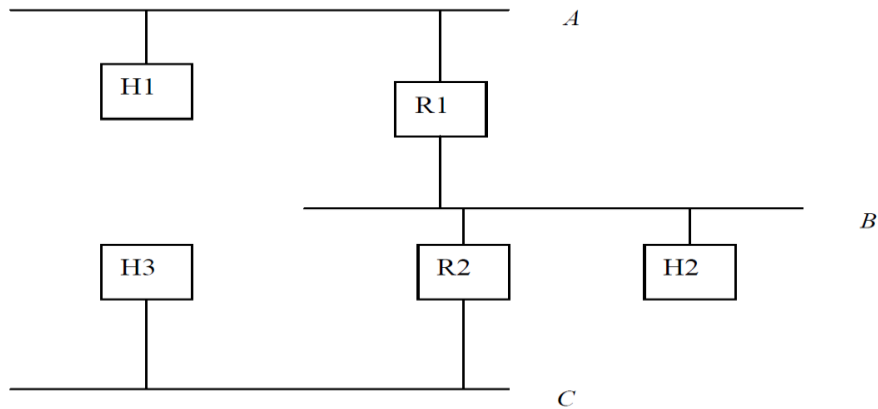
(10 pts) (3.2) Based on the IP addresses you assigned on the previous sub-problem (3.1), assume that we are using protocol IPv4 and the header format of IPv4 is shown as follows:

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)						

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

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

(4 pts) (iii) which fields in the header could be changed by a router? What fields in the IP header can be used to ensure that a packet is forwarded through no more than N routers?

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

(8pts) (3.4) What is NAT? Please Explain the difference of Private IP address vs. Public IP address.

(15 pts) 4. . Transport Layer
(5 pts) (4.1) please briefly explain the differencees between UDP and TCP.

(5 pts) (4.2) What is the difference between congestion control and flow control?

(5 pts) (4.3) Transport layer Multiplexing and DeMultiplexing (the graph below is only for reference).
Suppose a process in Host C has a UDP socket with port number 6428. Suppose both Host A and Host B each send a UDP segment to Host C with destination port number 6428. Will both of these segments be directed to the same socket at Host C(**same or different**)?

Suppose a process in Host C has a TCP socket with port number 5775. Suppose both Host A and Host B each send a TCP segment to Host C with destination port number 5775. Will both of these segments be directed to the same socket at Host C (**same or different**)?

(i)	(ii)