CITY UNIVERSITY OF HONG KONG

Course code & title : EE3009 Data Communications & Networking

Session : Semester B 2020/21

Time allowed : 2 hours and 15 minutes
(inclusive of 15 minutes for submission)

This paper has 7 pages (including this cover page).

Instructions:

Please make sure you follow all instructions from the University, ARRO, and EE. Please note the following:

1. This paper consists of **4** questions. The questions are ALL compulsory. Make sure that you attempt all of them. The total score is 100.

2. This is an **open-book exam**. Students can read the lecture notes and/or other materials available online.

3. You are responsible for receiving the questions on Canvas. Enter your name, student ID number, and the answers in a single MS Word file or a single PDF file. Name the file with your student ID number. **Submit the file by e-mail** (itklchan@cityu.edu.hk) **before the deadline** of the exam.

On the first page of your answer sheets, copy the following sentence and sign it: *I pledge to follow the Rules on Academic Honesty and understand that violations may lead to severe penalties. (*Signature) _____ (Date) _____

Contact Information

- Should you have any technical problem during the exam, contact your course leader or invigilator via Zoom private chat, email: itklchan@cityu.edu.hk or by phone call at 3442 7133.
- If you are not able to contact course leader/invigilator, you can reach the department via:
  (a) Departmental hotline at (+852) 3442-7740
  (b) Department Whatsapp phone: 9269-4066
  (c) Department WeChat ID: wxid_lly7yf5fzoj722 or scan the following QR Code

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Scan the QR Code to add me on WeChat.

Question 1 (20%)

Host A sends a packet of 1,518 bytes to host B via three routers. The distance between host A and the first router is 30 m. The distance between host B and the third router is 35 m. The distance between the router 1 and router 2 is 400 m. The distance between the router 2 and router 3 is 500 m. The propagation speed is 2×10^8 m/sec. The recommended transmission rates are: 120 Mbps between host A and the first router, and 90 Mbps between the third router and host B. The same physical medium is adopted between the routers. Each router spends 1.3 msec to perform error detection. If there is no congestion in the network, the recommended end-to-end delay for host A to send the packet to host B should not be longer than 4.3 msec.

(a)   At what time the last bit of the packet leaves host A?

[2 marks]

(b)   At what time the last bit of the packet reaches the first router?

[2 marks]

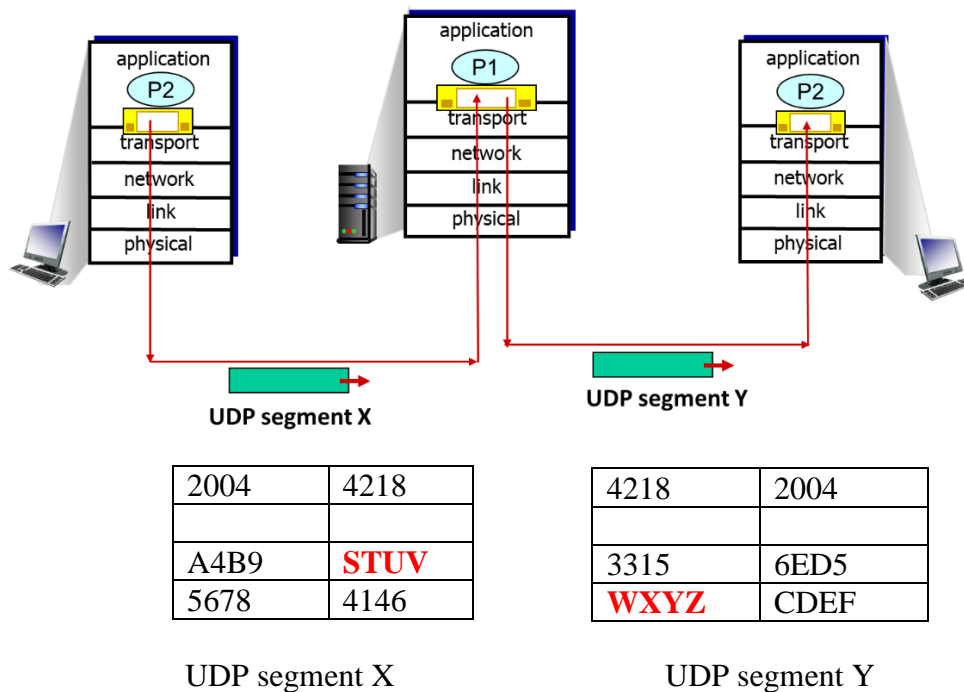(c)   At what time the first bit of the packet reaches the second router?

[4 marks]

(d)   Show your analysis and suggest the physical medium for the link between the routers.

[8 marks]

(e)   What are the pros and cons of the physical medium as suggested in part (d)?

[4 marks]

Question 2 (30%)

2004	4218
A4B9	**STUV**
5678	4146

UDP segment X

4218	2004
3315	6ED5
WXYZ	CDEF

UDP segment Y

(a)   Determine all the unknown fields of the UDP segment X. **STUVWXYZ** are the 8 digits of your student ID number (in hexadecimal). All other numbers are also in hexadecimal. Show all the steps in the calculation.

[8 marks]

(b)   Similarly, determine all the unknown fields of the UDP segment Y. Show all the steps in the calculation.

[8 marks]

Host A sends a file of 63,500 bytes to Host B over a TCP connection. Assume the maximum segment size (MSS) is 134 bytes. The segment has no options field. The transport layer, network layer, and data-link layer add headers of a total size of 66 bytes to each segment before the resulting packet is sent out over a 120 Mbps link.

(c)   What is the size of the first packet?

[2 marks]

(d)   What is the size of the last packet?

[2 marks]

(e)   What is the sequence number (in 8 hexadecimal digits) of the last segment?

[2 marks]

(f)   Assume no congestion, calculate the time (in msec, round to 3 decimal places) required to transmit the file.

[4 marks]

(g)   If congestion is possible, suggest and describe in detail two methods that can be used to handle congestion.

[4 marks]

Question 3 (20%)

A network contains 2 routers and a number of hosts. Router 1 links with a number of hosts and forms a subnet A, and also links with router 2 and forms a subnet B. Router 2 links with a number of hosts and forms a subnet C, and also links with router 1 and forms a subnet D.

(a)   Assign network addresses to each of these 4 subnets with the following constraints:

- all addresses must be allocated from 167.97.1**XY**/23 (**XY** are the last 2 digits of your student ID number in decimal)

- subnet A should have enough addresses to support 109 interfaces

- subnet B should have enough addresses to support 24 interfaces

- subnet C should have enough addresses to support 250 interfaces

- subnet D should have enough addresses to support 50 interfaces

[8 marks]

(b)   Using your answer in part (a), provide the forwarding tables for each of the 2 routers.

[4 marks]

Consider two LANs interconnected by router R.
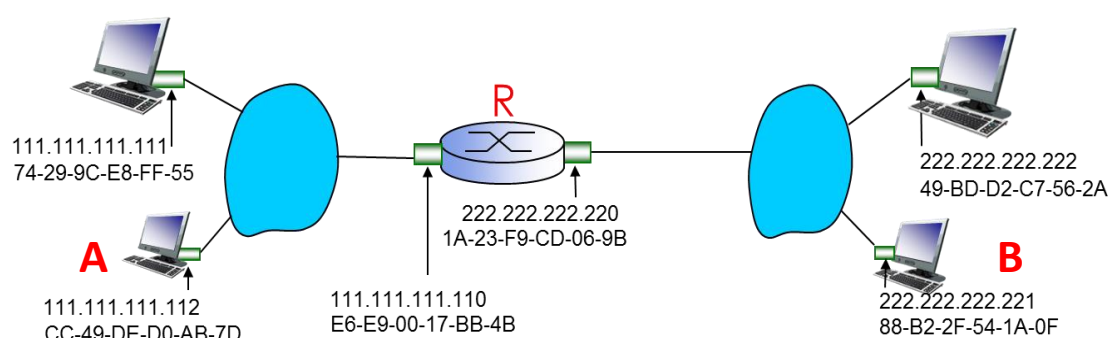
(c)   Host A would like to send an IP datagram to host B. What are the source and destination IP and MAC addresses in the datagram when it arrives at R?
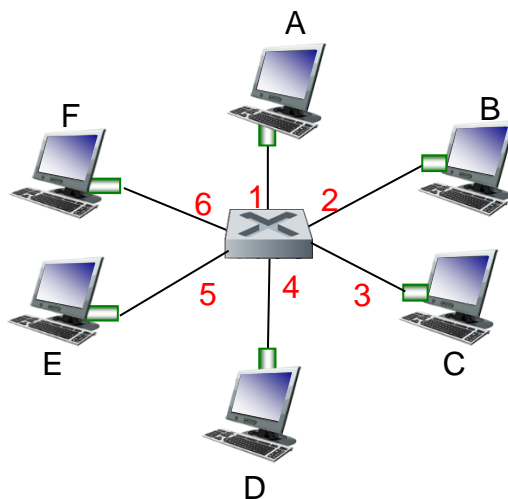
[4 marks]

(d)   What are the source and destination IP and MAC addresses in the datagram when it leaves R?

[4 marks]

Question 4 (30%)

(a)   Explain the differences between PPP and HDLC.

[6 marks]

(b)   A speech signal has a bandwidth of 8 KHz. If the speech signal is digitized and transmitted over a modem. What modem speed is needed if we require an SNR of 35 dB?

[4 marks]

(c)   An analogue transmission system has the source, the destination, and a number of repeaters. Each transmission segment adds noise to the signal. Assume that each repeater recovers the original signal without distortion but that the noise accumulates. At the first repeater, SNR = 30 dB. What is the SNR after 8 repeater links?

[4 marks]

The following network contains hosts A to F, and one switch. Initially, the switch table is empty.

(d)   Suppose host A sends a frame to host E. Describe how this frame reaches host E and show the switch table.

[6 marks]

(e)   Next, host E responds to host A. Describe how the respond frame reaches host A and show the switch table.

[10 marks]

- END -