CS3201-1314A - This is past paper

Computer Networks (City University of Hong Kong)

CITY UNIVERSITY OF HONG KONG

Course code & title	:	CS3201 Computer Networks
Session	:	Semester A, 2013/2014
Time allowed	:	Two hours

This paper has SEVEN pages (including this page).

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1. This paper has SIX different sections, each section corresponding to one Course Intended Learning Outcome.

2. You have to answer all questions in Sections 2 and 6, but you have some choices in Sections 1, 3, 4 and 5. Read the instructions for each section carefully.

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*This is a **closed book** examination.*

Candidates are allowed to use the following materials/aids:

Approved calculators

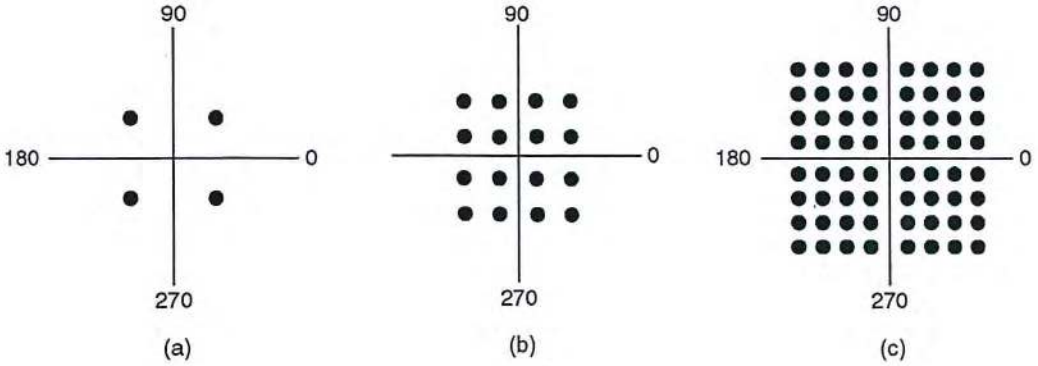
Materials/aids other than those stated above are not permitted. Candidates will be subject to disciplinary action if any unauthorized materials or aids are found on them.

Section 1 (15 marks)

This section examines you on the first CILO, which is to identify and describe the key transmission level technologies used in communication networks. **Answer any 3 questions in this section.** Each question is worth 5 marks.

Question 1.1

Consider the following diagram which shows the phase and amplitude changes in three different modulation schemes. Find the bit rate over a transmission line which can handle 2400 signals / s for each of these schemes. Which of the schemes is most easily affected by noise and why?

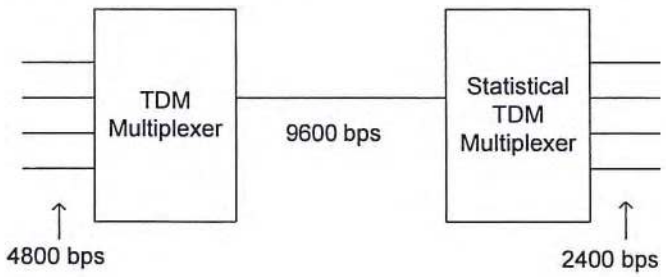


Question 1.2

A transmission system has a bandwidth of W. Suppose a digital signal with bandwidth X (where $X > W$) needs to be transmitted. What will happen to the signal after it has passed through the transmission system? Does it mean that this transmission system definitely cannot be used to transmit the signal?

Question 1.3

Two sites use a high speed transmission line and multiplexers for communication purposes. Use a diagram to show your redesign of the following network to minimize cost and fix any errors. Assume that the users prefer 4800 bps lines and the average link utilization of the low speed lines is 12.5%



Suppose the link utilization goes up to 25% for a short period of time. How can this be handled?

Question 1.4

A company needs to merge 4 low speed data streams on to a high speed data line. Each of the low speed lines can support a data rate of L bps, but none of the lines are fully utilized. The average utilization rates of the first three lines are *x, y,* and *z* respectively. The fourth low speed line is used to support a Web cam which is always active; the maximum frequency of the signal is *W* and the resolution of the PCM scheme used supports *S* discrete signal levels. One error correction bit is added to each sample.

State the condition for which statistical TDM is preferable to a simple TDM if the addresses in the statistical TDM take an additional 10% of the transmission capacity.

Section 2 (15 marks)

This section tests you on the second CILO, which is to apply the concepts of layered architecture in assessing the placement of network devices, protocols and services. **Answer <u>ALL</u> questions in this section.**

Question 2.1

Using the hybrid 5 layer model as your framework, model the following network scenario with a diagram. You need to draw and name the layers (sub-layers not required) and protocols involved, and indicate protocol interactions using dotted lines. Show also the actual path taken by the data between systems A and B.

System A is communicating with system B using the HTTP protocol, which in turn requires the TCP / IP protocols. A and B are both connected to a public data network with routers R1 and R2 which runs IPv4. A is connected to R1 through an Ethernet switch E, and B is connected to R2 directly. Both A and B runs IPv6 and hence need to tunnel through the public data network. R1 and R2 use a data link layer protocol X.

(10 marks)

Question 2.2

For the network in question 2.1, draw the correct protocol headers for a message in the physical link between R1 and R2 in the following format:

Protocol header 1	Protocol header 2	....	Protocol header n	Data

(5 marks)

Section 3 (15 marks)

This section tests you on the third CILO, which is to explain the working of error control and medium access control protocols in the data link layer and apply them to both wired and wireless local area networks. **Answer any 3 questions in this section.** Each question is worth 5 marks.

Question 3.1

Draw two diagrams to illustrate why idle RQ will fail when no sequence number is used for the following cases (i) lost ACK-frame (ii) no lost frame.

Question 3.2

Two systems use a sliding window protocol with selective repeat. Assume a three bit sequence number is used but that the sender and the receiver agree on a window size of 4.

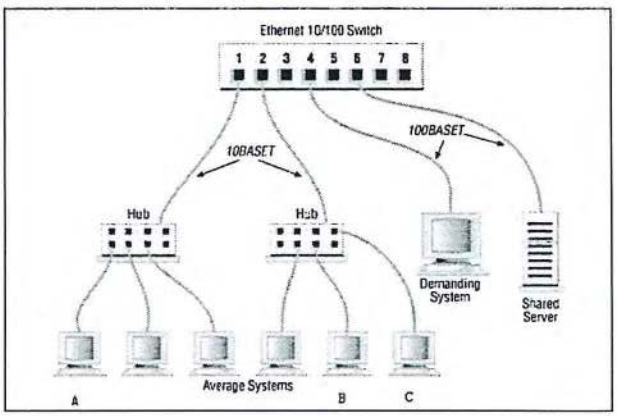
(i) How many buffers do the sender and the receiver each need?
(ii) What is the transmit window for the sender before any data is sent?
(iii) What is the receive window after the receiver has received the first four blocks of data?
(iv) What is the transmit window for the sender after the first acknowledgement has been received?
(v) What is the transmit window after the sender has received the first three acknowledgements but the fourth acknowledgment was lost?

Question 3.3

An Ethernet uses CSMA/CD. Why is a medium access control protocol such as CSMA/CD needed?

In the following diagram of an Ethernet-based network, state whether the transmission is successful for the following cases. Assume inter-device links are configured to be full-duplex.

(i) A sends to B
(ii) B and C both send to A at the same time
(iii) A and B sends to the shared server at the same time. For this scenario, give a brief explanation of what happens within the Ethernet switch when data from A and B arrives at roughly the same time.



Question 3.4

Suppose the transmission delay for a link is 20 times the propagation delay of a data frame. The processing delay of the receiver is abnormally long and is equal to the transmission delay. Will you use idle RQ for this system? Justify your answer using the link utilization of the system.

Section 4 (30 marks)

In this section you are tested on CILO 4, which is on the role of routing, congestion and flow control, naming and internetworking in the context of a global network, and the common protocols used to implement these functions. **Answer Question 4.1 and any two other questions in this section.**

Question 4.1

Answer the following questions using the attached network diagram

(i) Complete the routing table for R1 in the diagram below.

(ii) Suppose a user has just set up a home LAN with four hosts (Private IP addresses 192.168.0.1 to 192.168.0.4). The home LAN is connected to network 20.0.0.0 through an NAT router with IP address 20.1.2.4. Explain how this affects the routing table of R1.

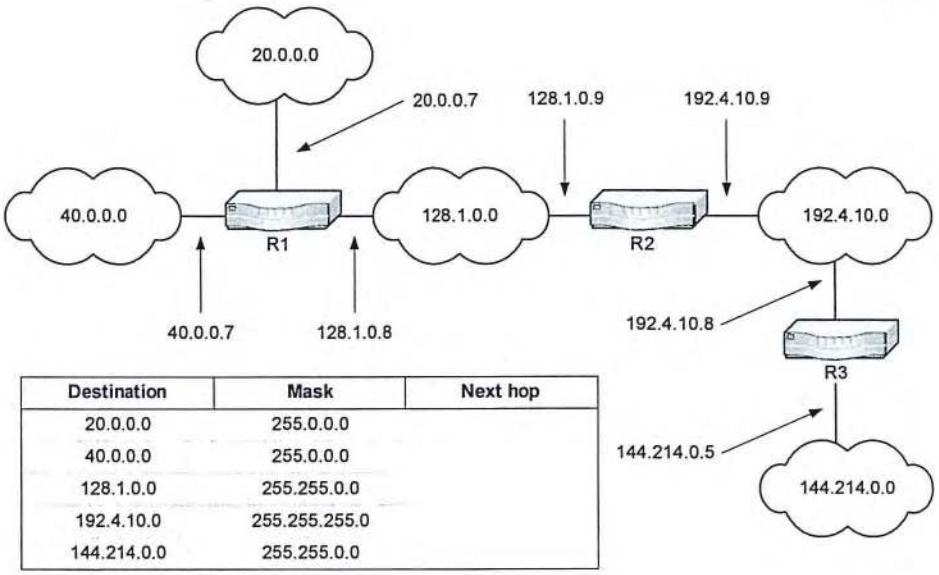
(iii) Suppose host *A* (IP address 192.168.0.1) is generating a lot of traffic to host *B* (IP address 128.1.0.10) that causes buffers in R1 to overflow. State the steps that would be taken if Explicit Congestion Notification is used to handle the congestion.

(iv) Suppose a new system *C* has just been added to network 128.1.0.0, which is an Ethernet. Assume *C* does not have an IP address yet, and it wants to transmit to *B*. There is a DHCP *D* attached to 128.1.0.0. List the steps that need to be taken before C can start sending packets to *B*.

(v) Suppose *C* remains idle for a long period of time. Then it tries to transmit data to *B* again. Explain whether the actions in (iv) need to be repeated again.

(vi) Suppose host *D* (IP address 144.214.12.2) has just sent a packet to host *C* (IP address 128.1.0.10). The packet was fragmented into three fragments F1, F2 and F3 when it passed through R3. Due to congestion F2 was discarded by R3. List what happens to these fragments subsequently at R2 and *C*.

(20 marks)



Destination	Mask	Next hop
20.0.0.0	255.0.0.0	
40.0.0.0	255.0.0.0	
128.1.0.0	255.255.0.0	
192.4.10.0	255.255.255.0	
144.214.0.0	255.255.0.0	

Question 4.2

An ISP is granted a block of addresses starting with 190.100.0.0/16. The ISP needs to distribute these addresses to three groups of customers as follows:

a. The first group has 64 customers, and each needs 256 addresses
b. The second group has 128 customers, and each needs 128 addresses.
c. The third group has 128 customers, and each needs 64 addresses.

What is the starting and ending address of the second data block assuming that addresses for the three groups of users are allocated sequentially? How many addresses are still available after these allocations?

(5 marks)

Question 4.3

Explain the role of the *Time to Live* field in the IP packet header and why it creates heavy loading on Internet routers.

(5 marks)

Question 4.4

A network using centralized hierarchical routing has N regions, each with m destinations. What is the number of entries in the routing table of each router? How many entries are required if hierarchical routing is not used?

What are the problems with a centralized routing scheme in which the routing tables are downloaded from a central control station.

(5 marks)

Section 5 (10 marks)

In this section you will be asked to compare the services provided by the UDP/TCP transport layer protocols and explain the mechanisms used to provide a reliable data transport service on an unreliable IP network, which is the 5th CILO of this course. **Answer any 2 questions in this section**. Each question is worth 5 marks.

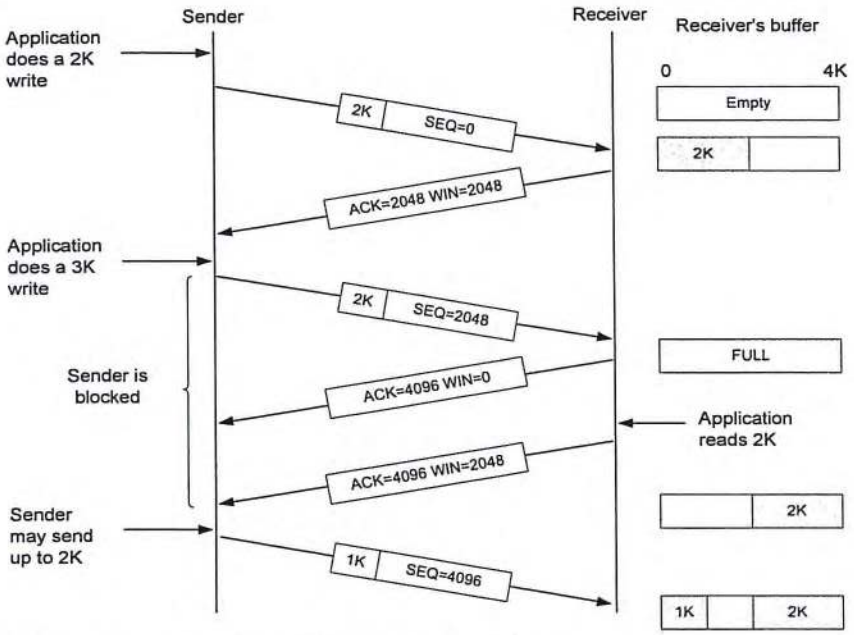
Question 5.1

"Since TCP is a reliable end to end protocol and has no knowledge of the intermediate systems, therefore it is only reasonable that it only receives data in sequence as the data is sent in sequence". Explain why this statement is wrong in the context of the Internet.

Question 5.2

IP already has some form of congestion control, why is it that TCP still has both flow and congestion control mechanisms?

Question 5.3



Answer the following questions based on the diagram above:

(i) Redraw the last part of the protocol interaction if the application reads 4K instead of 2K.
(ii) If the receiver's window is only 3K, what would the first message from the receiver be?

Section 6 (15 marks)

In this section you will be asked to analyze the application of network technologies in designated scenarios and explain how these technologies support the required Quality of Service requirements of real-life applications, which is the 6th CILO of this course. Answer ALL questions in this section.

Question 6.1

State the service requirements of voice conferencing based on reliability, delay, jitter and bandwidth.

(4 marks)

Question 6.2

Suppose you need to support an application in which the data need to be delivered in real-time, but reliability is not required. Jitter and bandwidth requirement are also low.

(i) Explain if there is any difficulty in supporting this application over an IP network.
(ii) Explain whether UDP or TCP is better for this application.
(iii) Will you change your answer in (ii) if the physical layer of the network is based on a satellite transmission system with a high error rate?
(iv) Explain whether adding a sliding window protocol (with a 3 bit sequence number) will improve performance of the system in (iii).

(11 marks)

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