



CS3201 0809A - past paper

Computer Networks (City University of Hong Kong)



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CITY UNIVERSITY OF HONG KONG

Course code & title : CS3201 Computer Networks

Session : Semester A, 2008/2009

Time allowed : Two hours

This paper has EIGHT pages (including this page).

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, 4, and 6, but you have a choice in sections 1, 3 and 5. Read the instructions for each section carefully.
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Materials, aids & instruments to be used during examination:

Approved Calculators

Section 1 (20 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 4 out of the 5 questions in this section.** Each question is worth 5 marks.

Question 1.1

A modulation scheme has 2 possible different amplitude levels and 8 possible frequency shifts. Suppose the bandwidth of a particular noiseless channel is 4 kHz, what is the maximum achievable data rate for the channel assuming the modulation scheme is designed for maximum coding efficiency? Explain whether it is possible to increase the maximum data rate if the transmission channel has a SNR of 20 dB.

Question 1.2

A simple TDM is used to multiplex data streams generated by eight users, each with a transmission rate of L bits/s. What is the required data rate of the high speed line?

Suppose a statistical TDM is used instead. The users are not active half of the time. What is the required data rate of the high speed line now?

Suppose the data on the high speed line is transmitted in blocks of M bits and the address attached to each data block is H bits. Now assume only one user is active and it is transmitting all the time, what is utilization of the high speed line for this case? Explain whether data overrun is likely or not.

Question 1.3

A commercial firm claims that it has invented a *lossless* process to digitize some analog signal and transmit the information over a digital network. Do you think such a process is possible?

Question 1.4

A sender wants to send a large number of small data blocks. Suppose the transmission delay d_t is twice the propagation delay d_p for a particular point to point link. The transmission delay of the acknowledgement is $d_t/2$. Assuming idle RQ is used, what is the link utilization? Explain whether idle RQ is suitable for this system.

Question 1.5

Suppose someone suggests using the existing voice network to transmit data traffic. Explain why this may not be a good idea.

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 ALL questions in this section.

Question 2.1

Using the hybrid 5 layer model as your framework, model the following network scenario using diagrams. You need to draw and name the layers (sub-layers not required) and protocols involved, and indicate protocol interactions using dotted lines.

System A is downloading some files from a server B using the FTP file transfer protocol, which in turn requires the TCP / IP protocols. There are two routers R1 and R2 between systems A and B. A is connected to router R1 through an Ethernet switch E1 and B is connected to router R2 through a second Ethernet switch E2. Unfortunately A does not support IP; instead it supports a protocol called XIP. So a protocol converter P1 that converts between XIP and IP is installed between E1 and R1.

(8 marks)

Question 2.2

Suppose two systems A and B are connected to each other and each system consists of three layers only: application layer, data link layer and the physical layer. A sent a single message to B. The data link layer implements a simple idle RQ protocol. Assume there is no transmission error. Complete the list of all resulting events that occurred at the service interface as well as the protocol interaction between peer layers:

Protocol Interaction: Application layer of A sends a message to application layer of B

Event 1: Application layer of A sends data to data link layer of A

Protocol Interaction: Data link layer of A sends a message to data link layer of B

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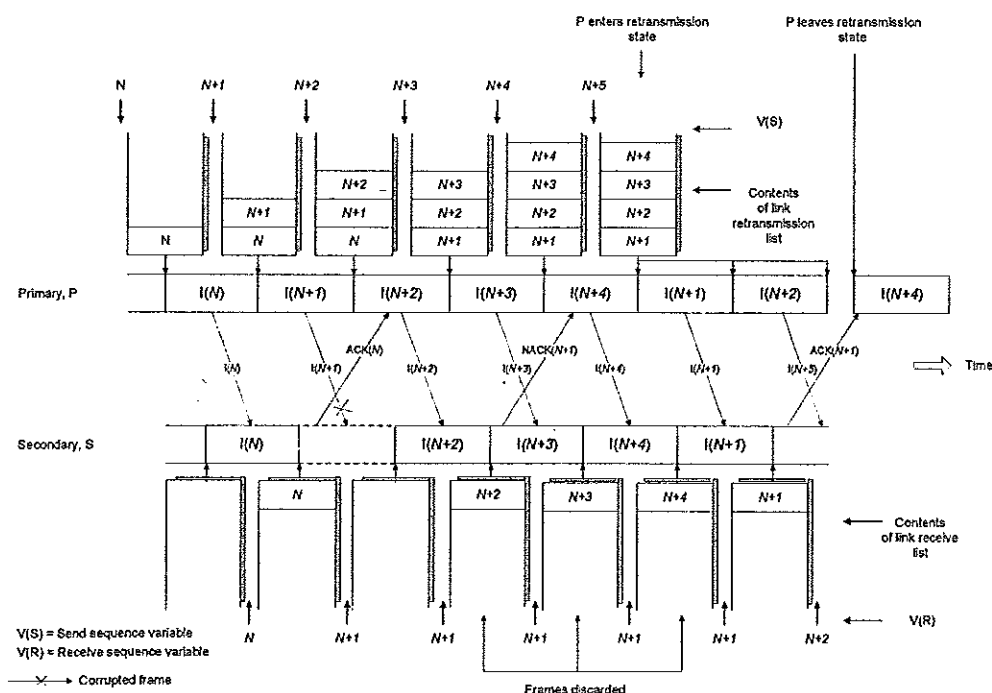
(7 marks)

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 3 out of 4 questions in this section. Each question is worth 5 marks.

Question 3.1

Identify the retransmission strategy used in the following diagram, and briefly explain your reasoning. Based on the diagram, explain what will happen if $I(N+3)$ is received but the error-checking code reveals that there is an error in the data.



Question 3.2

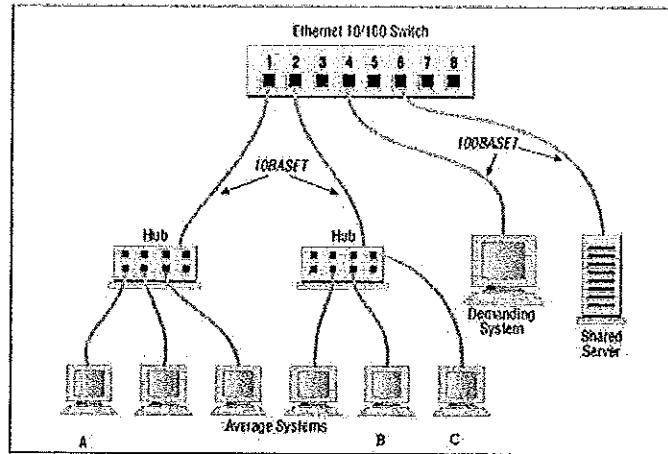
Draw a flow chart of the "forwarding" aspect of a LAN bridge

Question 3.3

In the following diagram, two 10 Mbps Ethernet hubs are connected to a 100 Mbps Ethernet switch together with a number of servers and high volume users. State whether the transmission is successful for the following cases. Assume inter-device links are configured to be full-duplex.

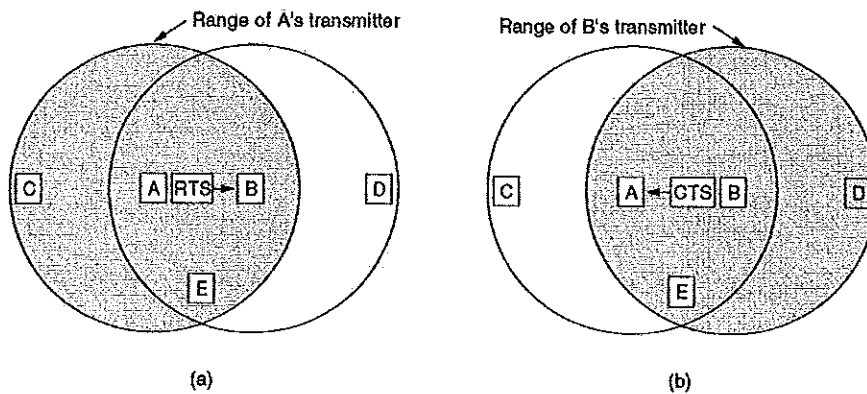
- A sends to B
- B and C both send to A at the same time

- (iii) A sends to B and B sends to C at the same time. For this scenario, what is the total transmission delay for if A's transmission to B is a block of 1000 bits? Ignore all propagation and queuing delays.



Question 3.4

The following diagram illustrates a wireless network which uses MACA for media access control. State whether stations C, D and E can safely send data without causing collisions with A's transmission to B. What would happen if E and A both send RTS messages at the same time?



Section 4 (25 marks)

In this section you are tested on CILO 4, which is to explain 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 **ALL** questions in this section.

Question 4.1

In what way does a hop by hop version improve on the basic version of the choke packet scheme? Someone claims that the hop by hop choke packet scheme does not work for datagram networks because all packets are routed independently and the choke packet will only travel through one of the many paths in the network. Explain whether you agree or not.

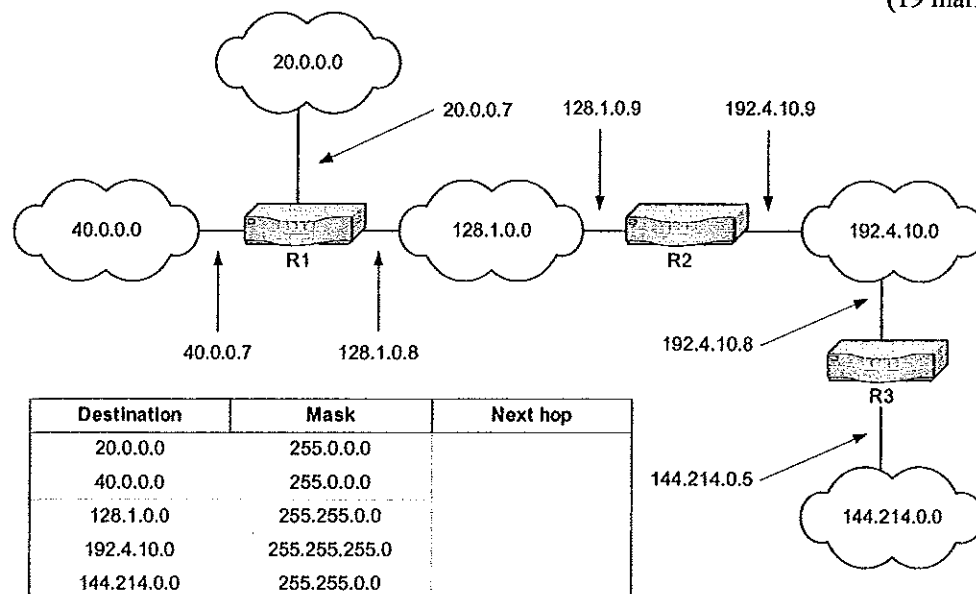
(6 marks)

Question 4.2

Answer the following questions using the attached network diagram

- Complete the routing table for R3 in the diagram below.
- Suppose network 144.214.0.0 wants to allocate 16 subnets to different internal departments. How many host addresses are available within each subnet?
- State the changes in the routing tables for R2 and R3 after the subnets are added.
- Suppose host A (IP address 144.214.12.2) wants to send a packet to host B (IP address 20.120.120.10) but does not know its physical address. Assume ARP is used for address resolution, list the steps taken before the packet can be sent successfully to B.
- Suppose the maximum packet size of all the networks is 1024 bytes, except for network 128.1.0.0 which is 576 bytes. Suppose A sends a packet of size 1000 bytes. Is fragmentation needed and if so where is the fragmentation and the subsequent reassembly done?

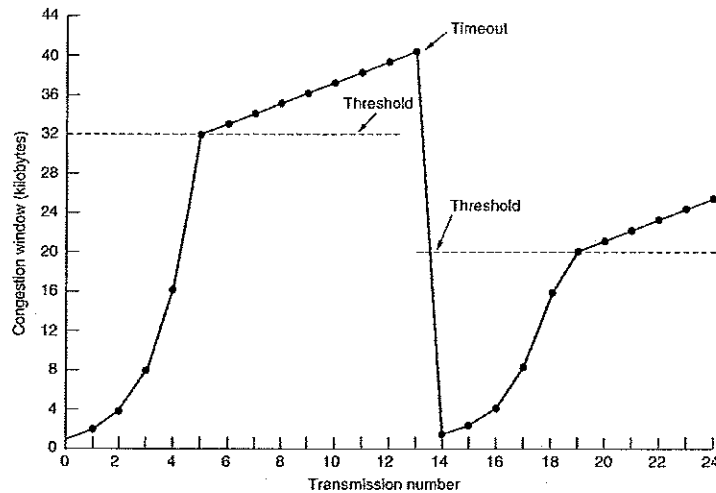
(19 marks)



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 2 out of 3 questions in this section.

Question 5.1



Explain what happens to the congestion window at transmission number 13.

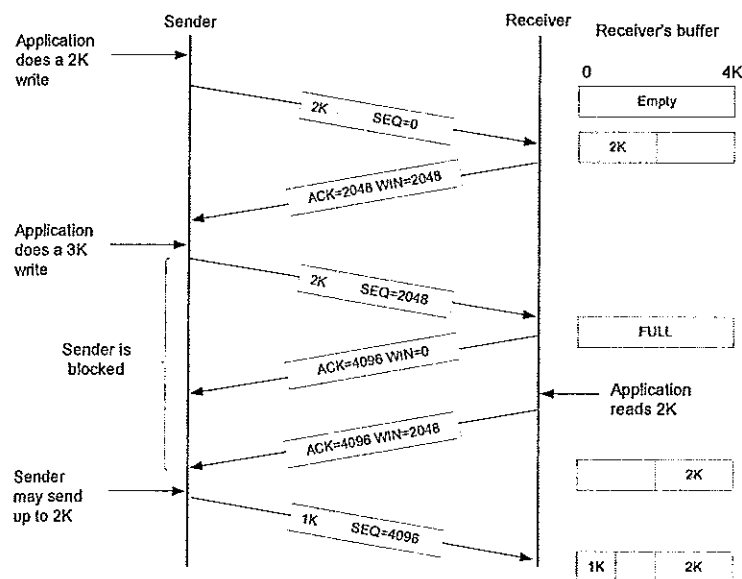
(5 marks)

Question 5.2

For the following diagram, assuming initial window size is 4K, explain what would happen if

- the first ACK is lost.
- the third ACK is lost.

(5 marks)



Question 5.3

A TCP machine is sending full windows of 65,535 bytes over a 1-Gbps channel that has a 10 msec one way delay. What is the maximum throughput achievable? What is the link utilization?

(5 marks)

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 CLO of this course.

Question 6.1

Suppose you need to support the FTP file transfer protocol over an IP network.

- (i) Describe the service requirement of file transfer based on reliability, delay, jitter and bandwidth.
- (ii) Discuss the service model provided by the IP network.
- (iii) Explain if there is any difficulty in supporting file transfer directly over the IP network. Will you use TCP or UDP over IP to solve this problem? Explain.
- (iv) It turns out the IP network is based on a wide area wireless network structure. Is there any impact on your answer in (iii)?

(15 marks)

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