Concordia University - Department of Electrical and Computer Engineering

Communication Protocols & Network Security - COEN 445
Quiz #2 - Solutions Fall 2003

Inst.: Ferhat Khendek
Total points: **35 points**

Time: **75 minutes.**
Closed book.

Question 1. [6 points]
Discuss the advantages and disadvantages of the *CSMA/CD* and *Token-Bus* medium access protocols. Specially address how conflicts (two machines wanting to transmit at same time) are handled; and how these protocols perform under light and heavy loads.

Ans.
Advantages and disadvantages: **[3 points]**
CSMA/CD is based on contention for medium access. No overhead for accessing the medium, it is a simple algorithm, fair access, but collisions can happen and therefore waste bandwidth.
Token-Bus uses a round-robin algorithm for accessing the medium, it is a complex algorithm. Only one machine (the one that has the token) can transmit at a time. There is an overhead for the token, but no collisions.

Performance: **[3 points]**
Light loads: CSMA/CD is better, will have less collision. Token-bus will waste bandwidth, because the round-robin access scheme. Some stations won't have anything to transmit, but will get the token that they will just pass on to the next station.
Heavy loads: Token-bus will be better, because of the round-robin. For CSMA/CD, there will be too many collisions. CSMA/CD does not perform well under heavy load.

Question 2. [4 points]
Consider the networks in Figure 1. Host A in Network A has to talk to Host B in Network B. We have to interconnect these two networks, which are using different protocol architectures: the first (lower) 3 layers are different, layers 4 and 5 are the same but layer 6, 7 are different again. We need a component to interconnect these networks. Describe the protocol architecture of this component. Explain.

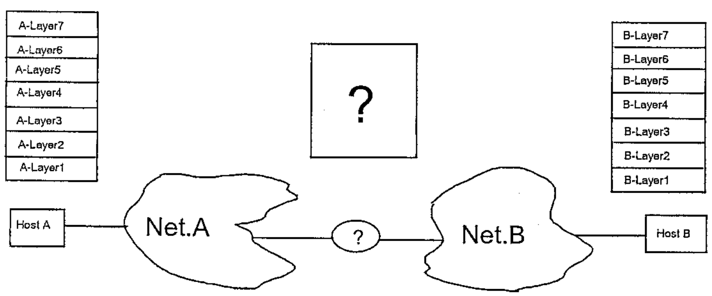
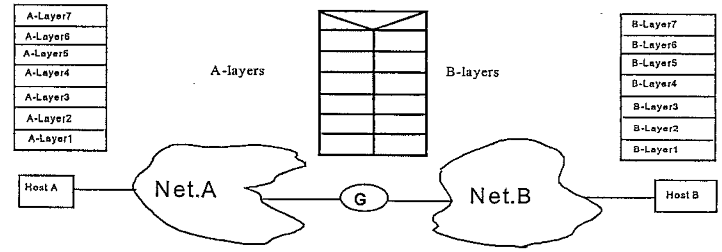


Figure 1

Ans. [4 points]



Even if layer 4 and 5 are the same, **the gateway has 7 layers and conversion will happen at Layer 7.**

Question 3. [8 points]
Consider the topology given in Figure 2. Net1 has a maximum packet size (including 20 bytes header) of 1500 bytes, while Net2 has a maximum packet size of 512 (including 20 bytes header) bytes and Net3a maximum packet size of 1000 bytes (including 20 bytes header). R1 and R2 are routers.

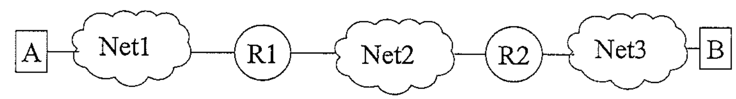


Figure 2

Host A sends ONE packet of size 1400 bytes (including a header of 20 bytes) to host B, explain clearly and show the fragments and their offsets in each of the following networks: (a) Net1, (b) Net2, (c) Net3. (Note: assume the Net1→ Net2 → Net3 is the only route we have from A to B)

Ans. [8 points]
- **(a)** Net1: The size of the packet sent by A is below the maximum size of Net1. So, the packet is conveyed through Net1 as sent. **[1.5 points]**
- (b) Net2 : Maximum packet size is 512 bytes. When the packet arrives to R1 it has to be fragmented into packets of maximum size 512 including header. But don't forget offset has to be measured in terms of 64 bits or 8 bytes. So the fragments are:
  1st is: 20 bytes + 488 bytes of payload, offset = 0, More = 1
  2nd : 20 bytes + 488 bytes of payload, offset = 61, More = 1
  3rd: 20 bytes + 404 bytes of payload, offset = 122, More = 0
  [4.5 points]
- **(c)** Net3: Nothing happens at router R2, the packets coming out of Network Net2 are smaller than maximum size allowed in Net3 and IP does not allow for reassembly in intermediary routers. **[2 points]**

Question 4. [7 points]
Consider the network given in Figure 3. Apply Dijkstra's algorithm to find the least-cost routes from Node A to each one of the other nodes in the network. Show clearly all your steps in a table. (Note: you should use Dijkstra's algorithm and show that usage in your table.)

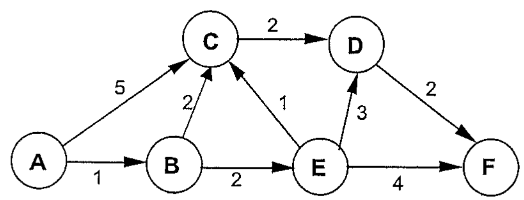


Figure 3

Ans. (Dijkstra's algorithm and its steps are more important than the final result) [7 points]

Iter.	M	D_B	Path	D_C	Path	D_E	Path	D_D	Path	D_F	Path
1	{A}	1	A-B	5	A-C	∞	--	∞	--	∞	--
2	{A, B}	1	A-B	3	A-B-C	3	A-B-E	∞	--	∞	--
3	{A,B,C}	1	A-B	3	A-B-C	3	A-B-E	5	A-B-C-D	∞	--
4	{A,B,C,E}	1	A-B	3	A-B-C	3	A-B-E	5	A-B-C-D	7	A-B-E-F
5	{A,B,C,E,D}	1	A-B	3	A-B-C	3	A-B-E	5	A-B-C-D	7	A-B-E-F
6	**{A,B,C,E,D,F}**	**1**	**A-B**	**3**	**A-B-C**	**3**	**A-B-E**	**5**	**A-B-C-D**	**7**	**A-B-E-F**

Least-cost routes from A to the other nodes:
A → B : 1
A → B → C: 3
A → B → E : 3
A → B → C → D : 5
A → B → E → F : 7

Question 5. [4 points] Explain briefly why two-way handshaking does not work in the case of TCP.

Ans.
Two-way handshaking does not work. In two-way handshaking when a passive TCP entity responds to an active TCP entity which sent SYN i it does not explicitly say which SYN it is responding to. This could be an obsolete SYN and both may not really start exchanging data because they will be desynchronized.
3-way is necessary because of the nature of Internet that can delay packets. Both sides need to know exactly which synchronization they have got an answer for and make sure both are synchronized in the same connection.

Question 6. [6 points]
What are the security mechanisms provided in IPv6? Explain briefly how it works.

Ans.
Two mechanisms provided by the extension headers:

1. Authentication Header to provide packet integrity and authentication **[2 points]**
2. Encapsulating Security Payload header for protecting the payload. **[2 points]**

Mechanism #1 allows for authentication of source and contents, while mechanism #2 allows for privacy using encryption and encapsulating the payload. **[2 points]**

Department of Electrical and Computer Engineering
Concordia University
Communication Networks and Protocols - COEN 445
Quiz #1-Solutions

Winter 2005
Time: **65 minutes**
Total points: **25 points**

Closed book.

Question 1. [6 points]
What is the Hamming distance of the following code ?
Take the ASCII code (a 7 bits code) and add 3 parity bits. The first parity bit p_0 is equal to $b_0 \oplus b_2 \oplus b_4 \oplus b_6$, the second parity bit p_1 is equal to $b_1 \oplus b_3 \oplus b_5$, and the last parity bit p_2 is equal to $p_0 \oplus p_1$.
Explain and prove it.

Ans. [6 points]
The Hamming distance of the new code is 2, because

- We cannot find two words with a Hamming distance less than 2. With the augmented code, the distance between two words cannot be 1. Let us take two consecutive words in the ASCII code, with the parity bits the Hamming distance becomes 1 + (p_0 or p_1 is different) 1 + (p_2 is therefore different) 1 = 3. Let us now consider two words from the ASCII code with a Hamming distance equal to 2, so the distance will be at least 2 when we add the parity bits. Let us consider two words from the ASCII code with a Hamming distance of 3, the distance when we add the parity bits can only increase, etc ...
- We have two words with a distance of 2. Let us consider two words in the ASCII code that have a Hamming distance of 2. For instance, they differ in b_0 and b_2, and are the same for all the other bits. Initially the Hamming distance is 2, when we add the parity bits the distance remains 2, because p_0, p_1 and p_2 will be the same for the two words.

<u>This concludes the proof where we have shown the distance cannot be 1, and **is exactly 2.**</u>

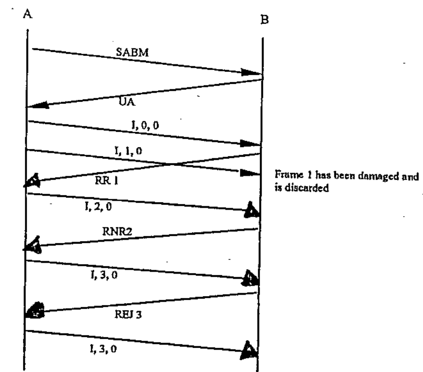
Question 2. [4 points]
Two nodes (A and B) use sliding-window protocol with a 3-bit sequence number. The ARQ mechanism, Go-Back-N is used with a window size of 5. Assuming A is transmitting and B is receiving, show the window positions for the following succession of events.

a. After A sends frames 0, 1, 2, 3; B has received all these frames, B acknowledges 0, 1, 2 by sending back RR3 and the RR3 is received by A.
b. After A sends frames 4, 5; B receives all of these frames, and sends RR6 and this is received by A.

Ans.

	A	B	
a.	3 | 4 5 6 7	3 | 4 5 6 7	(or just 4 if you are using window size for B) **[2 points]**
b.	6 7 0 1 2	6 7 0 1 2	(or just 6 if you are using window size for B) **[2 points]**

Question 3. [8 points]
(a) What is the role of frame FRMR in the HDLC protocol ? Explain.
(b) Find and explain all the errors in the following HDLC operations:



Note: do not worry about the disconnection phase. Assume it is there and it is correct.

Ans.

a. Frame FRMR is used by an HDLC entity to inform the other entity that the frame it has just received cannot be understood at all. It cannot be interpreted. The frame received is not part of the HDLC frames. Something bad has happened and both reinitialize. **[2 points]**

b. 3 errors:
   a. B is misbehaving when it sends RNR2. This frame means F, 1, 0 has been received and it is correct and I am acknowledging it. **[2 points]**
   b. A should not send I 3, 0 after receiving RNR. A should actually refrain from sending any Information frame. **[2 points]**
   c. B should not send REJ 3, because this means 2 and 1 have been received correctly, which is still not the case for 1. **[2 points].**

Question 4. [4 points] Consider k = 3 (3 bits for numbering the frames), explain briefly with one clear and concise example, why the Window size cannot exceed 4 with a Selective Repeat ARQ.

Ans. [4 points] Assume k = 3, and let us take a window size = $5 > 2^{3-1}$.
A is sending information frames and B is acknowledging them.
A sends *0, 1, 2, 3, 4* (the maximum it can send).
B sends *RR 5*, which is lost in transit. B now expects frames *5, 6, 7, 0, 1* in any order.
A times out and sends again all the frames *0, 1, 2, 3, 4*. Since in Selective-Repeat, frames can be accepted in disorder as long as they fall into the receiving window, *frames 0, 1* will be accepted as new frames. <u>This is wrong, since they are redundant and same as previous one received.</u>

Question 5. [3 points]
Six stations whose addresses are 10, 20, 30, 40, 50, 60 are connected to a <u>Token-Bus</u> LAN.
Give the scenario that would be normally followed when *Station 30* leaves the ring intentionally (when it has the token).

Ans. [3 points] *Station 30* has the token, and has therefore to inform *station 40* and *station 20.* It sends the frame *Set_Successor* to *Station 40*, where it informs it that *Station 20* is now its successor. *Station 20* is also informed that *Station 40* is now its predecessor.

Department of Electrical and Computer Engineering
Concordia University

Communications Networks and Protocols - COEN 445
Winter 2005
Assignment #3 Solutions

Inst: F. Khendek
Total points: 100

Question 1 [20 points]. A disadvantage of the contention approach for LANs is the capacity wasted dur to multiple stations attempting to access the channel at the same time. Suppose that time is divided into discrete slots with each of N stations attempting to transmit with probability p during each slot. What fraction of slots are wasted due to collisions ? (Hint: work with probabilities.)

Ans. The fraction of slots wasted due to multiple transmission attempts is equal to the probability that there will be 2 or more transmission attempts in a slot.

Pr[2 or more attempts] = 1 – Pr[no attempts] – Pr[exactly one attempt]
$= 1 - (1-p)^N - Np(1-p)^{N-1}$

Question 2 [15 points]. What are the advantages and disadvantages of backward learning routing technique ?

Ans.
Advantage: minimal node to node cooperation is needed → Minimal overhead.
Disadvantage: What if a line goes down or a node is overloaded ? This algorithm only records improvements and not changes for the worse.

Question 3 [15 points]. Suppose a routing table identifies paths that are "best" in the following sense: (1) minimum number of hops, (2) minimum delay, (3) maximum available bandwidth. Identify the conditions under which the paths produced by the different criteria are the same ? are different ?

Ans. Same hops (links are of the same technology) → these criteria are the same.
hops (links of different technologies) → different.

Question 4 [10 points]. When an X.25 DTE and the DCE to which it attaches both decide to put a call through using the same virtual circuit number, a call collision occurs and the incoming call is canceled. When both sides try to clear the same virtual circuit simultaneously, the clear collision is resolved without canceling either request; the virtual circuit in question is cleared. Do you think simulatneous resets in X.25 are handled like call collisions or clear collisions ? Explain.

Ans.
Reset collision is like clear collision. Since both sides know that the other wants to reset the circuit, they just reset their variables.

Question 5 [25 points]. A 6480-octet datagram is to be transmited and needs to be fragmented

because it will pass through an Ethernet with a maximum payload of 1620 octets. Show the total length, More Flag, and Fragment Offset values in each of the resulting fragments.

Ans. In that datagramm we have 6460 of data and 20 octets of header.
Each packet can carry up to 1600 of data and 20 octets of header.
(1600 is divisible by 8)
6460 = 4 * 1600 + 60 → 4 full packets and one packet with 60 data octets of data.
The packets are as follows:

- Total length : 1620
  More: 1
  Offset: 0
- Total length : 1620
  More: 1
  Offset: 200
- Total length : 1620
  More: 1
  Offset: 400
- Total length : 1620
  More: 1
  Offset: 600
- Total length : 80
  More: 0
  Offset: 800

Question 6 [15 points]. A TCP entity A is sending segments to another TCP entity B. Entity A is initially granted a credit of 2000 octets. A sends 9 segments of 200 octets each and receives acknowledgements for the first 6 segments and a credit of 800 octets. How many new segments of 200 octets is A allowed to send, at this point in time, before receiving other credits from B ? Explain.

Ans.
After sending 9 segments, the remaining credit for A is 1 segment of 200 octets.
When A receives the ack for the first 6 segments and 800 octets credit → means that after the first 6 segments A can send up to 4 segments. But A has laready send 3 of them → So, A can only send 1 more segment of 200 octets.

Question 7 A TCP entity opens a connection and uses slow start. Approximately how many round-trip times are required before TCP can send N segments ?

Ans. TCP initializes the congestion window to 1, sends an initial segment, and waits. When the ACK arrives, it increases the congestion window to 2, sends two segments, and waits. Then two ACKS arrive, each one will increase the window by 1, so that it can send 4 segments…So check this pattern: after one round trip it sends 2, after 2 round trips it sends 4, etc … Generally it takes $\log_2 N$ round trips before TCP can send N segments.

Concordia University
Department of Electrical and Computer Engineering (ECE)

Winter 2002

COEN445: Communication Protocols and Networks Security

Quiz # 1

February 14, 2002

Instructor: Abdeslam En-Nouaary.
Exam Duration: 1 hour.
Total Marks: 20.
Number of Pages: 2.

Instructions:

- Answer **briefly** all the questions in this exam.
- Place your answers in the exam book.
- Read carefully each question before answering it.
- Start with any question you want but indicate clearly its number.
- This exam is a closed book exam.
- The number of marks and suggested time to spend on each question is shown next to the question number.

Question 1 (6 marks, 15 minutes)

1) Explain the difference between a connectionless service and a connection-oriented service. Use two examples of distributed applications for each service to clarify your answer.
2) Compare and contrast Go-Back-N and Selective-Repeat error control techniques in terms of implementation complexity and link utilization efficiency.

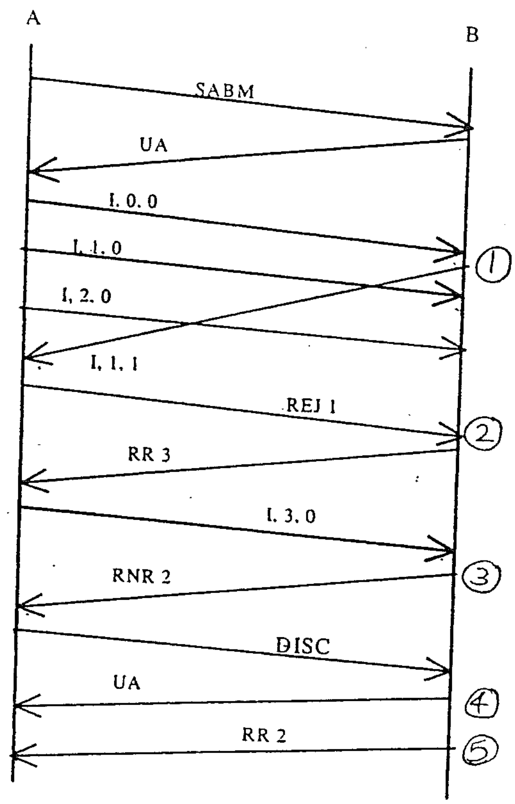
Question 2 (8 marks, 30 minutes)

The CRC method is a powerful technique used by communication systems to detect transmission errors in frames. Suppose that a primary station has to send the message $M = 11100011$ to a secondary station and that both stations use the generator $G(x) = 110011$ to detect errors.

1) Determine the *FCS* (Frame Check Sequence) the primary station would generate for *M* and give the transmitted frame *T*.
2) If the error pattern *E* is *0000011001000*, will the secondary station detect the errors? Explain without applying the algorithm.
3) Suppose now that the primary and secondary stations use a Hamming code with a distance $d = 5$. Will the secondary station detect and correct the transmission errors if the received message is $M' = 11111111$?
4) Determine the minimum Hamming distance to be used in order to detect and correct all transmission errors in *M*.

Question 3 (6 marks, 15 minutes)
HDLC is a data link layer protocol that uses the same frame structure to exchange data between two stations with different transmission modes. We distinguish between three types of HDLC frames (information frames, supervision frames and unnumbered frames).

1) Explain the difference between the UA and RR(N) frames.
2) Explain the difference between the REJ(N) and SREJ(N) frames.
3) Find and explain briefly all the errors in the following HDLC operations. You are not asked to fix the errors.



Good luck!