



UNIVERSITY OF COLOMBO, SRI LANKA

UNIVERSITY OF COLOMBO SCHOOL OF COMPUTING

DEGREE OF BACHELOR OF INFORMATION TECHNOLOGY (EXTERNAL)

Academic Year 2007/2008 – 2nd Year Examination – Semester 4

IT4503 : Data Communication and Networks
Part 2: Structured Question Paper

07th September, 2008
(ONE HOUR)

To be completed by the candidate

BIT Examination Index No:

Important Instructions:

- The duration of the paper is **1 (one) hour**.
- The medium of instruction and questions is English.
- This paper has **3 questions** and **12 pages**.
- **Answer all questions.**
- **Write your answers** in English using the space provided **in this question paper**.
- Do not tear off any part of this answer book.
- Under no circumstances may this book, used or unused, be removed from the Examination Hall by a candidate.
- Note that questions appear on both sides of the paper.
If a page is not printed, please inform the supervisor immediately.

Questions Answered

Indicate by a cross (X), (e.g.

X

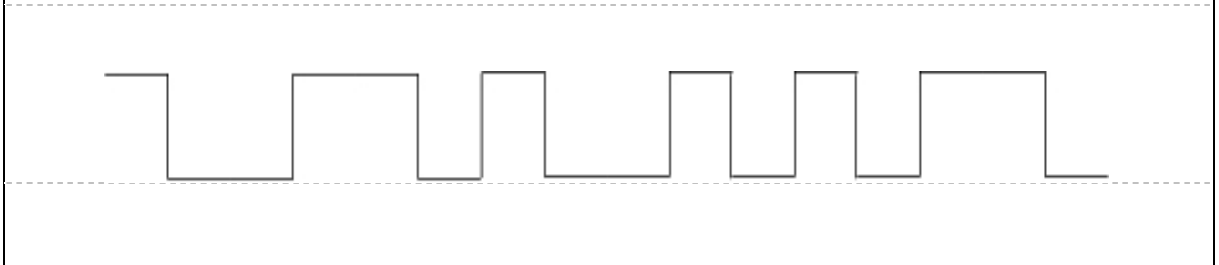
) the numbers of the questions answered.

To be completed by the candidate by marking a cross (X).	Question numbers		
	1	2	3
To be completed by the examiners:			

- 1) (a) The Physical layer of a communication system uses Manchester encoding. Assuming that the left most bit is sent first, draw a voltage - time graph of a signal that represents the following 8 bits of information. [3 marks]

01001110

ANSWER IN THIS BOX



- (b) Indicate whether the following statements are factually correct or not. Mark ✓ to indicate correct statements and X to indicate incorrect statements. [8 marks]

ANSWER IN THIS BOX

Statements	Correct/Incorrect
The data transmission rate measured as symbols per second (baud rate) can be higher than the equivalent data rate measured in bits per second.	✓
Fiber optic cabling is immune to electrical interference from lightning and similar E-M effects.	✓
It is not possible to modulate both the frequency and the amplitude of a carrier signal, using an information signal.	X
Wimax is an appropriate technology to be used in a LAN deployed within a small room.	X

- (c) (i) What is meant by character stuffing in data link layer framing? [2 marks]

ANSWER IN THIS BOX

Character stuffing refers to inserting a special character (ESC – escape character) before special control characters (including the ESC itself) in a frame.

- (ii) Using a simple sketch, show how character stuffing can be used on a message having two consecutive Escape characters. [3 marks]

ANSWER IN THIS BOX

Insert ESC before each ESC in the data.



- (d) Explain why packet switching is a more appropriate paradigm for data communication than circuit switching. [2 marks]

ANSWER IN THIS BOX

In circuit switching, a circuit is established between the sender and the receiver for the duration of the communication. However, if the circuit is not in continuous use, then it wastes the resources and usually data sources do not generate continuous flow of data. Therefore, packet switching, which does not establish a dedicated circuit between the sender and the receiver, is more suitable for data communication.

- (e) Explain why stop-and-wait is not a good flow control algorithm for a link with high latency between the two end points. [3 marks]

ANSWER IN THIS BOX

In stop and wait flow control, the source must wait till it gets acknowledgment for the last packet sent before sending the next packet. In a link with a high latency, the link would be idle for a long time since it takes a long time for the acknowledgment to reach the sender. Therefore, it is inefficient.

(f)

- (i) A data communication system uses 8 bit words where the least significant bit of a word is the parity bit. The system uses even parity. What is X in the following word transmitted by a sender in this system assuming that there were no bit errors? [2 marks]

110X1101

ANSWER IN THIS BOX

X= 1

- (ii) Describe one advantage and one disadvantage of Forward Error Control in comparison to Feedback Error Control. [4 marks]

ANSWER IN THIS BOX

advantage

(1) The probability of the receiver being able to correct errors in a frame it receives is high in FEC and therefore the sender has to retransmit fewer frames. However, in feedback error control, if there was an error in a frame, the sender has to resend the frame.

disadvantage

In FEC, the sender has to insert redundant bits into a frame and if the line is relatively free of errors, then this reduces the capacity available for the data. In this case, feedback error control is more efficient.

- (g) The left column of the following table gives the layers in the TCP/IP model. Write the corresponding layers from the ISO model in the column on the right. **[4 marks]**

ANSWER IN THIS BOX

TCP/IP	ISO
Application	Application, Presentation, Session
Transport	Transport
Internet	Network
Host-to-Network	Data link and Physical

(h)

(i) State four (4) key elements of SNMP.

[4 marks]

ANSWER IN THIS BOX

- 1. Management station, or manager**
- 2. Agent**
- 3. Management information base**
- 4. Network management protocol**

(ii) What is meant by a Trap in SNMP ?

[2 marks]

ANSWER IN THIS BOX

A trap is an unsolicited notification issued by an SNMP agent.

(i) A noiseless channel has a bandwidth of 1MHz. What is the maximum possible data rate over this channel ? Explain your answer.

[5 marks]

ANSWER IN THIS BOX

Maximum possible data rate is infinite. According to Nyquist, the maximum data rate of this channel is $2 \times 10^6 \times \log V$ where V is the number of levels of the signal. By increasing V , the data rate can be increased to an arbitrarily high value.

- (j) Nalin and Ajantha are two subscribers of the ADSL provider X. Nalin gets a better data rate over the ADSL link than Ajantha. Describe a possible reason for such a disparity.

[4 marks]

ANSWER IN THIS BOX

The bandwidth of an ADSL link reduces with the distance from the service provider. It is possible for Nalin to get a better data rate if he lives nearer to the service provider's exchange than Ajantha.

- (k) A data communication system uses the Token Bucket algorithm for traffic shaping. In this system, the maximum output rate is 25 MB/sec, the token arrival rate is 2 MB/Sec and the token bucket capacity is 250KBytes. What is the maximum burst length in seconds?

[4 marks]

ANSWER IN THIS BOX

$$(250 * 10^3) / ((25 - 2) * 10^6)$$

- 2) (a) Explain why Nagle's algorithm in TCP should be disabled for an application such as Telnet. [6 marks]

ANSWER IN THIS BOX

If Nagle's algorithm is enabled, then TCP waits until it receives a sufficient number of bytes before sending them to the other end. This behaviour is not suitable for an interactive application such as Telnet where each character entered by the user should be sent immediately to give a better response time to the user.

- (b) (i) A network is identified by the CIDR notation as 10.16.48.0/20. What is the broadcast address of this network? [4 marks]

ANSWER IN THIS BOX

10.16.63.255

- (ii) What is the aggregate IP block for the networks identified by the IP blocks ranging from 172.16.0.0/24 through 172.26.3.0/24 ? [6 marks]

ANSWER IN THIS BOX

172.16.0.0/22

(c)

(i) Explain the role of Address Resolution Protocol (ARP) in TCP/IP networks.

[4 marks]

ANSWER IN THIS BOX

ARP is used to find the Data Link Layer address of the host configured with a particular IP address. The Data link layer address of the receiver is required to send the packets to the receiver.

(ii) Describe a scenario that highlights a vulnerability of the ARP protocol.

[5 marks]

ANSWER IN THIS BOX

In ARP, a sender broadcasts a query into the LAN to find the data link layer address for an IP if that mapping is not its cache. A malicious host can announce from time to time its own data link address as the data link address of the other hosts in the LAN. This way, a malicious host can collect packets destined for other hosts.

- 3) (a) Explain the difference between the “persistent” CSMA and “non persistent” CSMA with respect to shared media access resolution. [5 marks]

ANSWER IN THIS BOX

In persistent CSMA, a station continues to listen to the channel until it is free and then transmits a frame. In non persistent CSMA, if a channel is busy, the station does not continuously sense the channel for the purpose of seizing it. Instead, it waits a random period of time and sense the channel and, if it is still busy, repeats this algorithm until the channel is free. Non persistent CSMA is less greedy than persistent CSMA.

- (b) What is meant by an “orthogonal code” with reference to CDMA ? [4 marks]

ANSWER IN THIS BOX

An orthogonal code has the property that the dot product of any two code words is zero. In CDMA, each station is assigned a chip sequence and the set of chip sequences assigned to stations is an orthogonal code.

(c)

- (i) Using an example of an application, describe the purpose of the ISM band in wireless communication. [4 marks]

ANSWER IN THIS BOX

Industrial, Scientific and Medical (ISM) bands are not allocated to any particular user or use. The power of the transmitters in this range is regulated to limit the range. Intention of reserving the ISM bands is to permit scientific and industrial experiments. Some products operate in this unlicensed band. An example of usage is microwave ovens. Even though they use a part of the electromagnetic spectrum, the users do not have to be licensed to use microwave ovens.

- (ii) State the frequency range of one such ISM band used in USA.

[3 marks]**ANSWER IN THIS BOX**

902 - 928 MHz
2.4 - 2.4845 Ghz
5.735 - 5.860 GHz

- (d) The maximum end-to-end propagation delay in a shared Ethernet is T seconds and the data rate is M bytes per second. What is the minimum frame length appropriate for this Ethernet ? [4 marks]

ANSWER IN THIS BOX

$2TM$ Bytes

- (e) The wireless stations A, B, C and D are arranged in a straight line in that order and they communicate without going through an access point. A is within the range of B but it is not in the range of C. C is within the range of B and D. D is not within the range of B. Is it possible for C to transmit to D while B is transmitting to A ? Explain your answer. [5 marks]

ANSWER IN THIS BOX

Yes.

When B is transmitting to A, C also gets the signal. Now if C transmits to D, C's signal collides at B, but this is not a problem since signals do not collide at the receivers (A and D).
