UNIVERSITY OF SWAZILAND

FACULTY OF SCIENCE

DEPARTMENT OF ELECTRICAL & ELECTRONIC ENGINEERING

MAIN EXAMINATION 2011

TITLE OF PAPER: COMPUTER NETWORKS & OPEN SYSTEMS INTERCONNECTIONS

COURSE CODE : ECO 520

TIME ALLOWED: THREE (3) HOURS

INSTRUCTIONS : ANSWER ANY FOUR (4) OUT OF THE FIVE QUESTIONS

EACH QUESTION CARRIES 25 MARKS

MARKS FOR DIFFERENT SECTIONS ARE SHOWN IN THE RIGHT HAND MARGIN

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QUESTION 1

(a) Differentiate between guided media and unguided media. Give one example of each medium. (2)

(b) Identify the subnet to which the IP address 150.215.17.9 belongs, given that the subnet mask is 255.255.240.0. (2)

(c) What is the main idea behind "Open System" in networking? (2)

(d) Sketch the Ethernet frame structure and discuss the functions of the fields. (7)

(e) How many bidirectional transmission lines does a mesh network with 40 nodes require? (2)

(f) What is the difference between ARP and RARP protocols? (2)

(g) Consider two hosts connected by a direct 1Mbps transmission link and separated by 1000 km. For a propagation speed of 2.5×10^8 m/s, calculate

(i) bandwidth-propagation delay product. (2)

(ii) the maximum number of bits that will be in the link at any given time, considering that an MP3 file of 400,000 bits is sent from one host to the other. (2)

(h) Consider sending a 3000 byte IP datagram into a link that has a maximum transfer unit of 500 bytes. Suppose the original datagram is stamped with the identification number 422. How many fragments are generated? What are their characteristics? (4)

QUESTION 2

(a) Give any three services that can be offered by a link-layer protocol. (3)

(b) How many subnets are in the following network? (2)
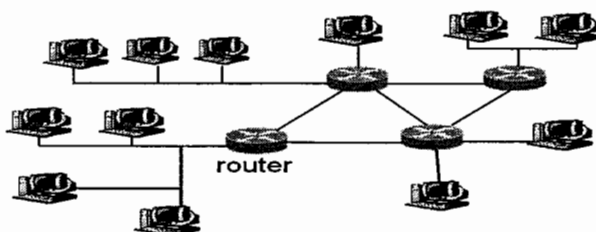
(c) An internet service provider uses the block of addresses, 240.240.242.0/25, to serve four organizations (Org 1, Org 2, Org 3, and Org 4) by dividing it equally among them. Assuming contiguous addresses,

(i) What are the subnet addresses of the four organizations? (4)

(ii) What is the subnet mask in the network of each organization? (2)

(iii) What is the maximum number of hosts in the network of each organization? (2)

(d) A 2.048 Mbps transmission link uses a 32-timeslot Time Division Multiplexing scheme to accommodate up to 32 users. A user is connected to another user through a circuit-switched connection. Determine the time it takes in sending a MP3 file of size 6.4 MB. (4)

(e) In packet-switched networks, the source host segments long application-layer messages into smaller packets and sends the packets into the network. The receiver then reassembles the packets back into the original message. This process is known as message segmentation. Consider a message that is 7.5×10^6 bits long that is to be sent from source to destination in the figure below. Suppose each link in the figure is 2.5 Mbps. Ignore queuing, propagation and processing delays. (1 Mbps = 2^{20} bps)
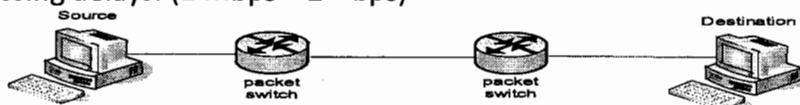
(i) Keeping in mind that each router uses store-and-forward switching, what is the total time to move the message from source host to destination host without message segmentation?(2)

(ii) Now suppose that a message is segmented into 5000 packets, with each packet being 1500 bits long. How long does it take to move the message from source host to destination host when message segmentation is used? (4)

(f) In what way is instant messaging a hybrid of client-server and P2P architectures? (2)

QUESTION 3

(a) A CRC is constructed to generate a 4-bit FCS for an 11-bit message. The generator polynomial is $X^4 + X^3 + 1$. Encode the data bit sequence 10011011100 using the generator polynomial and give the code word. (4)

(b) Distinguish between the **forwarding** and **routing** functions of the network layer. (4)

(c) A bit string, 0111000111110011111110111111, needs to be transmitted at the data link layer. What is the string actually transmitted after bit stuffing? (2)

(d) Suppose an application generates chunks of 40 bytes of data every 20 msec, and each chunk gets encapsulated in a TCP segment and then an IP datagram. What percentage of each datagram will be overhead, and what percentage will be application data? (3)

(e) Consider a TCP connection between Host A and Host B. Suppose that the TCP segments travelling from Host A to Host B have source port number X and destination port number Y. What are the source and destination port numbers for the segments travelling from Host B to Host A? (1)

(f) At what OSI layer does ICMP typically operate? (1)

(f) Differentiate between the Go-Back-N and Selective Repeat pipelining protocols. (6)

(g) Give four reasons why an application developer might choose to run an application over UDP rather than TCP. (4)

QUESTION 4

(a) What is the difference between **broadcasting** and **multicasting**? (2)

(b) Compare and contrast FTP and HTTP. (6)

(c) What is the difference between a destination IP address and a destination port number? (2)

(d) What are the data units at the transport layer and the link layer called? (1)

(e) A heavily loaded LAN with a bus delay of 16 μs exchanges 576 bit-long frames at a bit rate of 10 Mbps. Calculate the maximum utilization factor of the transmission medium. (4)

(f) A channel has a propagation delay of 20 ms and a bit rate of 4 kbps. For what range of frame size does stop-and-wait protocol give an efficiency of at least 50% ? (4)

(g) The IP address 196.24.64.32 has a broadcast address of 196.24.64.63. What is the network mask address? (3)

(h) A router maintains state information for each connection passing through it in a datagram network. Is this statement true or false? (1)

(i) What are the functions of the "identification" and "protocol" fields in an IPv4 header format? (2)
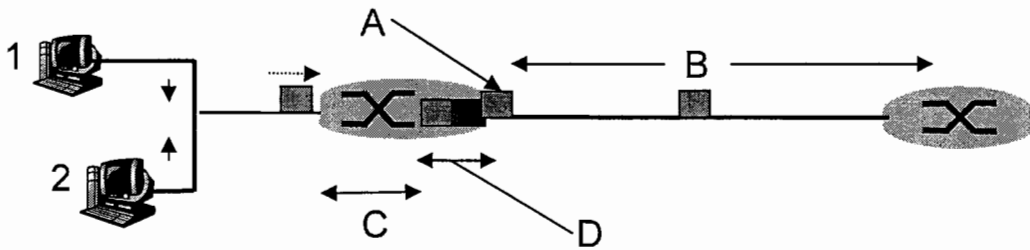
QUESTION 5

(a) State one benefit of ISDN to each of the following stake holders. (3)

- User

- Network provider

- manufacturer

(b) A pure ALOHA system uses a 56 kbps channel. On average, each terminal originates a 1024-bit packet every 30 seconds. How many terminals can the system accommodate? (4)

(c) Identify the four (4) sources of delay (A, B, C, D) in the following diagram. (4)

(d) Name and discuss the two (2) major classes of routing algorithms. (8)

(e) Using Classless Inter-Domain Routing (CIDR), an ISP is allocated addresses starting at 200.25.10.0. Allocate network masks (prefixes) and address ranges to two of its customers, Organization-1 and Organization-2 requiring 15 and 63 host addresses, respectively. (6)