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The Open University of Sri Lanka
Department of Electrical & Computer Engineering
ECX5234 Data Communications
FINAL EXAMINATION– 2015/2016 (CLOSED BOOK)

DATE: 27th November 2016 **0930 hrs – 1230 hrs**

Answer any 5 questions.

Q1. (a) In a layered communication model, protocols at all layers add overhead to the data being transmitted.

(i) Write a single word for this process occurring in each layer.
(ii) What do you mean by 'protocol' and 'overhead' in the above statement?
(iii) For each of the following layers in OSI model, identify one component of this overhead information and describe its purpose.

- Data Link layer
- Network layer
- Transport layer [8]

(b) Match the following functions to one or more layer/s of OSI model:

(i) Showing a map of Galle Fort using Google maps in a web browser
(ii) Compression of a still image using JPEG
(iii) Finding the shortest path between two nodes separated by multiple hops
(iv) Error detection and correction [4]

(c) Suppose that a digitized TV picture that has a matrix of 720 x 576 picture elements (pixels) is to be transmitted from a source at a rate of 25 picture frames per second. (This digital source is roughly equivalent to broadcast TV standard (PAL) that is used in Sri Lanka.) Each pixel of the picture is a mixture of three primary colours Red, Green and Blue where each colour can take one of 256 intensity values.

(i) Find the data transmission rate at the source in Mbps.
(ii) Assume that the TV picture is to be transmitted over a channel with 4.5-MHz bandwidth and a 35-dB signal-to-noise ratio. Find the capacity of the channel (Mbps).

[8]

P.T.O

Q2. (a) Differentiate the following:

(i) Synchronous and asynchronous transmission

(ii) Line coding and block coding [4]

(b) Explain the reason of using modulo 2 arithmetic rather than binary arithmetic when computing a FCS in CRC method. [2]

(c) Use modulo 2 arithmetic to compute the FCS for message 101101110011 with a generator polynomial of $x^4 + x + 1$.

(i) Find the transmitted bit stream.

(ii) If the fourth and the fifth bit from the left are inverted in the received bit sequence, check whether these errors can be detected using above method. [6]

(d) Draw the encoded bit pattern of the data sequence 1110101001 for the following coding schemes:

(i) Return to Zero (RZ)

(ii) Manchester

(iii) Differential Manchester

(iv) AMI [8]

Q3. (a) Compare hubs, bridges, routers and switches in terms of the following:

(i) Operating layer

(ii) Number of ports

(iii) Function [8]

(b) ABC University runs a 10Mbit/s Ethernet between the NOC and all its lecture halls located in different places in university premises but within the maximum distance of an Ethernet. All of these hosts are in a single broadcast domain. The total size of an Ethernet can be about 2.5 kilometers and an Ethernet has a minimum frame size of 512 bits. Suppose this network is upgraded to 100Mbit/s Ethernet, and notices that when only one person sends at a time, or when he sends very large frames, this network works. But when many people send very small frames, things do not work at all.

(i) Explain how a minimum frame size can help to detect collisions in Ethernet. [4]

(ii) Compute the threshold of how big frame must be in order for things to work. [3]

(iii) One solution to the above problem is to raise the minimum frame size to the answer from part Q3(b)(i). Suppose that you cannot modify the minimum frame size, move the endpoints, lay new cable, or change the software or configuration on the endpoints. You may add new devices to the network. How could you change the topology to fix this problem? [5]

P.T.O

Q4. (a) (i) TCP is a stream delivery protocol running in Transport layer, providing two-way, reliable, end-to-end exchange of data. Show how the information provided in the TCP header makes it possible to satisfy the above requirements. [6]

(ii) Using a timing diagram show how the session establishment takes place in TCP and indicate what happens if a communication error occurs in either direction. [4]

(iii) Explain why TCP is not suited for Video Conferencing and describe a suitable transport layer protocol for that purpose. [4]

(b) Explain, using an appropriate example, how an IP address is resolved from a domain name. [6]

Q5. (a) (i) Differentiate between Link State routing and Distance Vector routing protocols.

(ii) Consider the network shown in Figure Q5(a). With the indicated link costs, use Link State routing algorithm to find the shortest path from X to all other nodes. Show your work by preparing a table. [14]

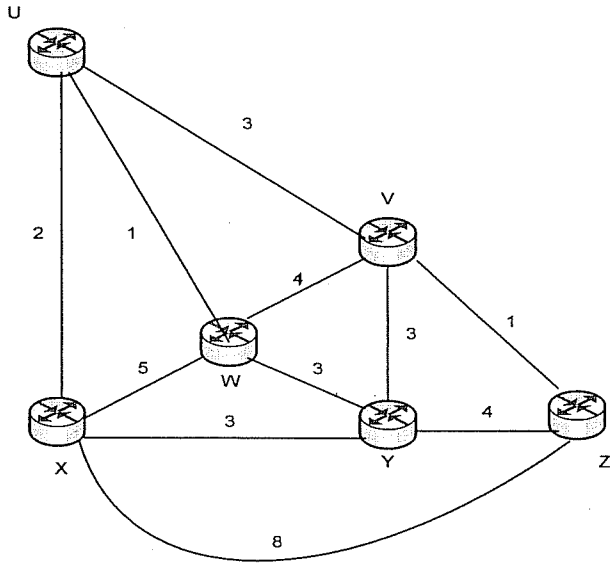

Figure Q5(a)

(b) "In distance vector routing good news travels fast but bad news travels slow." Justify the above statement using suitable examples. [6]

Q6. (a) Discuss how a hierarchical organization of the Internet has made it possible to scale to millions of users by using a diagram showing the internet architecture. [5]

(b) Explain the role of the exterior routing protocols in the Internet architecture in Q6(a) above. [6]

(c) Describe any 3 of the following highlighting the problem they try to address and their significance in today's context :

(i) ADSL (ii) VLAN (iii) MPLS (iv) SDN [9]

P.T.O

Q7. "Fruities" is a leading company which produces different kinds of fruit products in Sri Lanka. Its head office is located in Colombo City area and it has 4 factories located in Gampaha, Kalutara, Kandy and Nuwara Eliya. Each of these factories has separate groups of employees and they need to communicate with the head office as well as the other factories frequently to line up their production efficiently. Presently, only the head office is having a single Local Area computer network even though there are 3 main divisions; Administration, Marketing and Accounts. Due to the increase of their production and marketing operations, there is a need to upgrade the existing network and expand it to the 4 factories too considering the existing requirements. Suppose you are working as an engineer in this company and your supervisor asked you to make a network plan for this expansion. Requirements are as given below:

- Head office needs 3 LANs for each of the 3 divisions; Administration – 25 users, Marketing – 50 users and Accounts – 12 users
- Each factory needs a separate LAN; Gampaha – 40 users, Kalutara – 10 users , Kandy – 50 users and Nuwara Eliya – 20 users
- Each factory needs to connect with the Head Office as well as with other factories

(a) Suppose that your company buys an IP address block 203.128.128.0/23 from an ISP. Use this to make an IP address plan for the whole network. Your answer should include subnet address, subnet mask, broadcast address and host IP range for each subnet in this company network. [14]

(b) Briefly describe the WAN connectivity technology that can be used to have a single large virtual network. [2]

(c) If you need to transfer this network into IPv6 addressing, suggest 2 methods that you can follow. [4]

Q8. (a) Using a 5-bit sequence number, what is the maximum size of the send and receive windows for each of the following protocols:

(i) Stop-and-Wait (ii) Go-Back-N (iii) Selective-Repeat [3]

(b) (i) In a Go-Back-N ARQ protocol, the window size is 6. Frames with sequence numbers 1, 2, 3, 4 and 5 have been sent. The sender just received an ACK for frame 1. Frames 6, 7, 8, 9 and 10 are waiting to be sent. Draw the timing diagram showing this scenario. [4]

(ii) Which frame(s) can the sender send before it must wait for the next ACK from the receiver? Explain. [3]

(iii) Some time later, the sender transmitted frames 18, 19, 20, 21, 22, and 23; however, frame 20 got lost. If Go-Back-N is used, what frame(s) would the sender have to retransmit? Explain. [3]

(iv) Suppose the same situation as above but sender and receiver use Selective-Repeat ARQ. What frame(s) would the sender need to retransmit? Explain. [3]

(v) Discuss the trade offs between Go-back-N and Selective repeat methods. [4]