THE OPEN UNIVERSITY OF SRI LANKA
Faculty of Engineering Technology
Department of Electrical & Computer Engineering
Bachelor of Technology Honors in Engineering

ECX5234: Data Communications
Final Examination (2016/2017)   **CLOSED BOOK**

Date: 19th November 2017   Time: 9:30 a.m. – 12:30 p.m.

Answer any 5 questions.

Q1. (a)   "**Layered architecture** increases flexibility, maintainability, and scalability."

   (i)   Explain the meaning of 'Layered architecture' in data communication and show how two adjacent layers communicate in a layered network.
   [04]

   (ii)   Justify the above statement when applied to networking giving reasonable facts.   [03]

   (iii)   Data encapsulation is an important term when discussing about layered communication models. Briefly explain how they relate.   [03]

   (b)   An audio signal is recorded and stored digitally in an audio CD using Pulse Code Modulation at 44100 samples per second.

   (i)   Find the maximum bandwidth of the audio signal which can be correctly reproduced using this sampling rate.   [02]

   (ii)   If each sample is encoded as 16-bits, find the data rate for the recording.   [02]

   (iii)   If an audio CD can store up to 747 MB how many minutes of the above audio signal you can store in a CD?   [03]

   (iv)   If the above audio data file which was stored in the full CD is to be transmitted over a channel with 4 MHz bandwidth and a 35-dB signal-to-noise ratio. Find the capacity of the channel (Mbps).   [03]

Q2. (a)   Show, with justification, what type of errors that cannot be detected from the following error detecting schemes:

   (i)   Single parity check
   (ii)   Two dimensional parity check   [02]

(b) (i) In CRC error detection scheme, the polynomial is chosen as
$P(x) = x^4 + x + 1$. Encode the message 1 0 0 1 0 0 1 1 0 1 1 with this.
[03]

(ii) Suppose the received bit sequence is 1 1 0 1 1 0 1 1 0 1 1 1 1 0 0. Can the error be detected by using the above polynomial? [03]

(iii) Suppose the received bit sequence is 1 1 0 1 1 1 1 1 0 1 1 1 1 0 0. Can the error be detected by using the above polynomial? [03]

(iv) Comment on your answers in (ii) and (iii) explaining why the given polynomial cannot detect some error sequences. [03]

(c) Draw the encoded bit pattern of the data sequence 11001011101 for the following coding schemes:
  (i) Bipolar Return to Zero
  (ii) Manchester
  (iii) Differential Manchester [06]

Q3. (a) Explain the following:
  (i) CSMA/CD and the minimum frame size of Ethernet
  (ii) Collision domain and broadcast domain in switches
  (iii) Wireless LANs and Hidden station problem (CSMA/CA) [06]

(b) (i) Briefly describe how Little's Law is applied to M/M/1 queuing models. [02]

(ii) Consider a server that maintains a common database for a query application. It receives 20 requests per second. All requests and services are exponentially distributed. If the average service time is 20 ms, answer the following questions.

  i. Give Kendall's notation for this queuing system.
  ii. Calculate the utilization of the server.
  iii. What is the average time each request spends in the queue?
  iv. What is the number of requests waiting in the queue?
  v. Calculate the average response time a request spends in the system.
  vi. Calculate the number of requests waiting in the system.
  vii. Comment on the operation of the server if utilization is greater than 1.
[12]

Q4. (a) In modern data centers, the data rates used have gone up to 100Gbps and in time to come it will reach 400Gbps. The data that is transferred must be in such a way that there are no errors. Because of this accuracy requirement, the natural choice of transport protocol is TCP. However, TCP is considered not acceptable when operating at these data rates.

Explain why TCP is not considered as an ideal transport protocol for data centers. [Hint: Consider the features of UDP for your answer]

[08]

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(b) DNS is considered as the most critical service required for the operation of Internet related work. Answer the following questions related to DNS:

(i) Briefly explain the role of 'Root Server' in the name resolving process

(ii) Under what circumstances will a local DNS server not communicate with 'Root Server?

(iii) Under what circumstances will the situation in (ii) lead to a problem?

(iv) What do you understand by the term "Reverse Address Resolution"? Explain why is it important for today's Internet? [12]

Q5. (a) (i) Differentiate between Link State routing and Distance Vector routing protocols mentioning the main algorithm behind each. [04]

(ii) Consider the network shown in Figure Q5. With the indicated link costs, use Distance Vector routing algorithm to find the shortest path from X to all other nodes. Show your work by preparing a table indicating the cost and the path considered for each node at each iteration. [12]
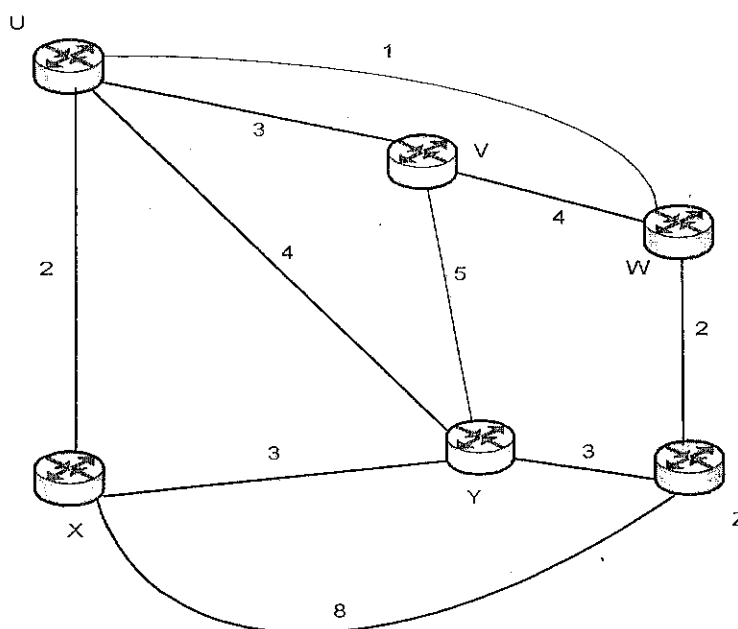
Fig, Q5

(b) When using Distance Vector Routing algorithm in some failure situations, the administrator notices that it takes an exceptionally long time for the routing protocol to stabilize in this network.

(i) Explain what problem with the distance vector protocol is the cause for this delay?

(ii) Suggest a method to avoid that problem. [04]

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Note: The scenario used in Q6 is applicable for Q7 as well.

Q6. ABC Company is a leading pharmaceutical manufacturing company which produces many types of pharmaceutical products. This Company has sales within Sri Lanka as well as in foreign countries. ABC Company's Head Office is at Colombo and its factory is located in Horana District which is about 35km away from Colombo. In the Head Office there are 4 sub divisions namely, Administration, Marketing, Accounts and Sales. In the Factory premises at Horana there are 2 main buildings: the office building and the factory building. Even though it is not divided physically, the factory area has 3 sub divisions to manufacture different types of products. Many of the machines are computer controlled but due to the heavy machinery used it is difficult to do the floor wiring. Presently, there is only a small network in the Administration division of the Head Office having a very limited number of users. Due to the increase of their production and marketing operations, there is a need to upgrade the existing network and expand it to the Factory at Horana too considering the following requirements.

- Head office needs 4 LANs for each of the 3 divisions;
  Administration – 50 users, Marketing – 25 users, Accounts – 10 users and Sales – 25 users

- Factory - needs separate LANs for Office and the factory area and the factory area should consist of 3 sub LANs. It should be able to identify the users belonged to each of the 3 groups in the factory area without a problem.

- Required number of ports for each division in the Horana factory is given below

  ➢ Factory Office – 25

  ➢ Factory Building – Group 1 - 30, Group 2 – 25 and Group 3 – 08

Suppose you are working as an engineer in this company and your supervisor asked you to design a network for the above requirements.

(a) Provide the IP address plan (Use IPv4) for this expansion with the above requirements. Suppose that your company buys an IP address block 192.128.128.0/23 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.

[12]

(b) If you are using IPv6 addressing, explain how you do the subnetting using the IPv6 address format (You do not need to actually work out the address assignment).

[06]

(c) What advantages would be there if the company migrates to IPv6?

[02]

Q7.(a) Study the scenario given in Q6 and draw a rough sketch for the given network showing each sub network clearly mentioning the technologies you are suggesting. You need to show the relevant network equipment as well. [06]

(b) What is the technology you propose for networking the users in Factory building? [02]

(c) Briefly explain a method you propose when assigning addresses for 3 groups in the factory building. [04]

(d) Write short notes on the following technologies highlighting what problems they are addressing related to the field of computer networking: [08]

(i) NAT (ii) ADSL (iii) SDN (iv) MPLS

Q8.(a) (i) Consider a Go-Back-N ARQ method with k-bit sequence numbers. Give the relationship between the maximum sequence number and the maximum window size. [02]

(ii) Explain with a scenario what would happen if the maximum number of sequence numbers were to be used as the window size. (Use a 3-bit sequence number.) [04]

(b) Fig. Q8 shows some observations you get when monitoring the sequence of packets that travel over a link from sender node A to receiver node B. The diagrams depict a continuous flow of sequence numbers starting from the sender. (node A).

Assume that there may be traffic from node B to node A, which is not depicted in the diagram. A gap between adjacent sequence numbers implies passage of time with no transmissions from the sender.

Deduce what protocols, could have generated the observed sequences in (a), (b) and (c) of Fig. Q8 from the following protocols:
   i. Stop and Wait protocol
   ii. Go back-n protocol
   iii. Selective Repeat
You need to justify why each protocol can/cannot be accommodated for each case by analyzing the scenario and give the value of window size if any. [14]
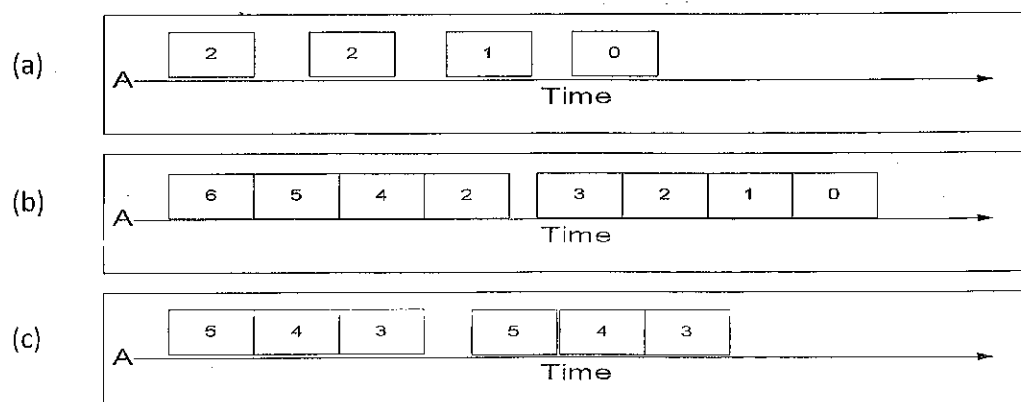

Fig. Q8

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