UNIVERSITY OF MORATUWA

FACULTY OF ENGINEERING

DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING

BSc Engineering Honours Degree

Semester 5 Examination

CS 3032 – COMPUTER NETWORKS

Time allowed: 2 hours   June 2019

INSTRUCTIONS TO CANDIDATES

- This paper consists of five (05) questions on 4 pages including this page.

- Question One (Q1) is compulsory. Answer **Question One (Q1) and any THREE (03)** questions from the remaining four questions.

- This examination accounts for 60% of the overall course module assessment. The total maximum mark attainable is 100. The marks assigned for each question and sections thereof are indicated in square brackets.

- This is a **closed book** examination.

- Mobile phones or any other communication devices are not permitted.

- Clearly state the assumptions you make. If you have any doubts regarding the interpretation of the wording of a question, make your own decision, but clearly state it on the script.

Q1 Compulsory question

Agri Products Promotional Services (Pvt.) Ltd., also known as AgriPro2, provides various agriculture related services to farmers as follows:

i. Disease identification and mitigation services
ii. Financial support channel coordination
iii. Transport service provider coordination
iv. Agriculture technology training and facilitation
v. Fertilizer and water resource management
vi. Help Desk with hotline and online support

Except the service number (vi) above, all other services are distributed, and have agricultural area based offices. For its own operations, AgriPro2 has the following divisions in the head office:

i. HR Division
ii. Accounts Division

AgriPro2 management is in the process of introducing IT systems to facilitate and improve its services. They intend introducing cloud based applications for the purpose of interaction and use by its employees as well as farmers. Farmer portals are mobile enabled. Due to intellectual property concerns, some IT systems will be hosted in a small yet reliable server farm set up internally at the head office and maintained by an IT services company. Server farm is mostly managed using a secure connection, and only essential maintenance tasks will be carried out in premises. Back-up and disaster recovery functions are carried out by the cloud service provider.

As all branches need to connect to the head office to access internal IT applications, no other separate Internet connections are given to branches, and they share the Internet connection of the head office provided by an ISP.

(a) Suggest meaningful fully qualified Internet domain names suitable for the given service units or divisions of AgriPro2, given that AgriPro2 has its own domain.

[4 marks]

(b) Draw a suitable network diagram for the entire AgriPro2 connectivity, considering all possible interconnections indicated in the given description, as follows:

i. Draw a network diagram with possible WAN, MAN and LAN connections, and the ISP and cloud access, focusing on access to IT services by different service units or divisions of AgriPro2 and farmers. Label the diagram appropriately. If all details cannot be given in one diagram, you may split it appropriately. [12 marks]

ii. Suggest an IPv4 subnetting plan for AgriPro2. You may use both public and private IP addressing with a justification. You do not need to consider IP addresses used by the cloud service provider. [7 marks]

iii. Assuming that AgriPro2 has got an IPv6 address block with /48 subnetting, show how you would assign it to relevant units of AgriPro2. [2 marks]

Q2 **(a)** Using OSI 7-layer model, illustrate the interactions between layers of relevant systems and devices in the following scenarios:

    i. Browsing the Internet from home using an ADSL connection, where the ISP performs an IP address translation at ISP's router   [3 marks]

    ii. Browsing the Internet from the office of an organisation using the WiFi connection that connects to the core switch of the organisation, which then connects to a router of an ISP link   [5 marks]

Consider all relevant nodes along the end to end connection.

(b) Content Management Systems (CMS) can have many URLs pointing to its own internally stored content as well as content in other external systems. When a user connects to such a CMS and access content using these URLs, different protocols/services are required to fulfill the request. Some of these protocols/services are transparent to the user and runs in the background. Some are of connection-oriented category and some are connection-less. Some protocols are at application layer and some are at lower layers.

List four (04) protocols used when a CMS is accessed as above, indicating the purpose, category and layer for each one of them.   [8 marks]

(c) ARQ scheme used by TCP is an improved version of the generic ARQ scheme with added flexibility and adaptation. Describe three (03) such improvements. Use diagrams.   [9 marks]

Q3 **(a)** Define five (05) parameters used by the Back-off algorithm of the original CSMA/CD protocol.   [5 marks]

(b) Outline the Back-off algorithm illustrating how it uses the parameters defined in part (a) above. You may use a flow-chart, pseudo code, circuit diagram or step-by-step statements.   [8 marks]

(c) An organisation has many divisions and branches, where many divisions are in the head office itself, and some divisions such as production, sales, etc., are spread across the branches in main cities of the country. Due to the increased use of IT systems in its business operations, the IT division proposed the following to improve the IT infrastructure of the organisation.

    1. to procure a high end Layer-3 managed switch with VLAN support and re-design the whole network of the head office with VLANs assigned for each division

    2. to design the branch network as several subnets and use low-end VLAN switches that they already have in each branch

    3. get the services of an ISPs with MPLS and Virtual Private LAN Services (VPLS) support to connect all the branches

Comment on each of the above planned steps, indicating pros and cons. You may suggest any improvements or changes if necessary.   [12 marks]

Q4 **(a)** Illustrate how the usage of IPv4 was extended beyond what it could provide in class-full addressing due to CIDR and VLSM. Explain, using an IP subnetting example. [8 marks]

(b) IPv6 is said to be efficient than IPv4 in several ways. Provide three (03) examples to support this statement, with a description or justification to illustrate why each one of them make IPv6 efficient than IPv4. [6 marks]

(c) A network administrator of an organisation is planning to transfer its IPv4 network to an IPv6 network. What precautions and steps should be taken to make this transformation successful? Provide a logical outline of the process that the network administrator should follow. [5 marks]

(d) Interior routing protocols such as OSPF, EIGRP, etc., would take the true status of the network into account to determine routing dynamically to provide the best routing solution at a given time. However, BGP, which is an exterior routing protocol, may not take the true network status into account. Outline the operation of BGP, and discuss why this situation may occur. [6 marks]

Q5 **(a)** As improvements to TCP behaviour, specifically when there is congestion, the following have been implemented.

    i. In addition to the receiver window size, congestion window is used at the sender's side.
    ii. Instead of pure slow-start with rapid increase, the concept of linear threshold have been introduced.
    iii. When 3 duplicate ACKs are observed, fast retransmission is activated with an increase of linear threshold up to 3 MSS.

Illustrate the above improvements using a suitable graph with necessary details of TCP behaviour. Label the graph appropriately. [6 marks]

(b) Using appropriate diagrams and/or brief descriptions, show how TCP solves the following problems:

    i. small packet problem,
    ii. silly window syndrome,
    iii. fluctuation of round trip time. [9 marks]

(c) ISO Network Management Model suggests five areas to be covered in managing networks. An organisation uses a network monitoring tool that uses only SNMP. What issues will the network administrator face? Briefly explain each. [5 marks]

(d) How would you determine whether to use Bluetooth Low Energy (BLE) or Zigbee for an industrial application that uses IoT devices? Provide a comparative analysis. [5 marks]

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