

Computer Communication

In this June, 2008 issue of the exam in computer communications, a total of 9 students had registered. Out of them, 8 students appeared and passed the exam in this subject. The examination format was similar to the previous run of the exam; there were two general questions (that did not relate to specific competencies) and three specific questions (that were based on competencies). Answers to these questions were satisfactory in most cases and hence all students were able to pass the subject. The specific questions asked in the exam and suggested way in which they should have been attempted is described below.

Section 1 General Questions.

Question One

- (a) (i) What is the difference between software development and software communication?
(ii) Name and describe in detail two commonly used communication protocols.
(10 marks)

Software development deals with the process of creating the software components and applications. Thus, software development is effectively analysis, design and coding. Software communication deals with the process and issues related to making the developed software available to other components and applications across variety of networks. The communication protocols play an important role in enabling software to communicate.

Commonly used communication protocols are:

TCP – Transmission Control Protocol establishes and manages the connection between the communication devices. TCP provides the connections and the delivery of the data, which is achieved by breaking data streams into packets and transmitting them.

SMTP – Simple Mail Transfer Protocol

IP – Internet Protocol is the layered network protocol that enables various communicating networks to talk with each other and results in a large network.

HTTP – Hypertext Transfer Protocol.

- (b) What is TCP/IP? Describe the importance of TCP/IP in developing Internet-based software applications. Please provide examples to justify your answer? **(10 marks)**

The TCP/IP stands for Transmission Control Protocol and Internet Protocol. TCP/IP is an industry standard protocol that supports routing and enables computers to communicate across network segments.

Layered protocols in software architectures ensure that the design and implementation of the corresponding software systems and networks is controlled and manageable. Layered architectures make the networks more modular and thereby enabling easier maintenance of the network as, with the layered protocols, it is easier to upgrade one layer without affecting other layers.

Typically, there can be many layers in an architecture including applications, presentation, session, security and data. Three specific layers of an architecture are as follows:

Application layer – consists of software applications and programs that help the user carry out their tasks. This layer contains all the business logic and the business processes and the interaction is meant to provide value to the users and customers. The application layer in

TCP/IP can be equalled with the combination of session, presentation and application layer of the OSI model.

Presentation layer – defines the representation and user interfaces. This layer does not deal with business logic but only with the sophistication and ease of use of presentation. This layer presents and also captures data from the user.

Session layer – deals with setting up of communication sessions on a network. This layer has become very important from the Internet usage viewpoint.

Question Two

(a) Are circuit switched networks faster than packet switched networks? How does the speed of these networks relate to the quality of data transmission on these networks? Your answer must contain examples. **(10 marks)**

Yes, circuit switched networks are faster than packet switched networks as they are dedicated networks used for communication. Circuit switching has been the first and most familiar technique used to build a communication network that is commonly utilized to make common phone calls. Circuit switching allows communications equipment to be shared amongst users. However, at the same time, bandwidth is guaranteed and circuit capacity is not reduced due to any reason. The circuit costs, though, remain independent of the amount of data being transmitted, resulting in some wastage. The advantage of the circuit switching is that there is low delay and less jitter.

Packet switching is based on creation of smaller packages from messages exceeding a network's defined maximum length. Packet switching is similar to message transmission using short message services (SMS) and in this case, bandwidth is dynamically allocated on a need basis. As a result, Packet switching uses concurrent transmission over physical channel and therefore can be cost effective. However, package switched networks may not have the same quality as the circuit switched networks due to the sharing occurring over the network. They can be cheap and efficient.

(b) The network layer protocol of the Internet is called IP. A 12,000-octet IP datagram is to be transmitted through the network. This transmission needs to be fragmented because it has to pass through an Ethernet with a maximum payload of 800 octets. (i) How many fragments are needed? (ii) Explain how these fragments can be reassembled into the original datagram at the destination. **(10 marks)**

- i) Each IP header is assumed to have 20 octets and hence 11980 octets are assumed to be comprising actual data. The payload of 800 octets is made up of headers worth 20 octets. Therefore, $11980/780$ indicates 15.35 fragments.
- ii) Each fragment of data transmitted will be made up of a starting points and an offset which indicates the length of the fragment. Furthermore, each fragment is also flagged at the end. Thus, by reading the start of each fragment, its data contents and its end-point can be ascertained. Together, this can be put back to recreate the original IP datagram.

[more explanations from students answering this question is expected]

Section 2 Questions testing Units of Competency. The following three questions are based on the ACS *Jobs For You* Workplace Scenario.

Question 3 - ICAA5144A Determine best fit topology for a local network (20 marks)

Jobs For You, the company in the published case study has 20 computer servers and desktop machines in the head office of the company, which is located in a two storey-building. These servers and desktop computers are interconnected via a local area network.

(a) If the required time to transfer an average file of 1.2 Mbytes from one computer to another is within 4 seconds, what is the required minimum effective bandwidth of the local area network? Explain your approach to the answer as well.

This answer requires standard calculations that put together file size and the time taken to transmit that file.

One suggested formula is :

$$(1.2 \times 1024 \times 1024 \times 8) / 4 = 2.51 \text{ MBPS}$$

(b) What topology and communication medium do you think the local area network for Jobs For You network architecture should use? You need to justify your recommendation.

The layout or topology of the network can be selected from either bus, ring or star network.

Bus topology – in which all the computers are connected to the central hub. All messages are sent and received via the hub.

Ring topology – wherein the computers are connected to each other via a loop. Here the messages may take a long time to pass.

Star topology – wherein the computers are again connected to a central point, which might be another computer or a hub.

[Either one of the above network topologies can be selected depending on the arguments]

[diagrams and explanations in detail of the above is required from students]

We need to consider the following factors in recommending a topology:

Costs

Scalability

Bandwidth capacity

Ease of Installation

Ease of fault finding and maintenance

(c) For your recommended network topology in (b), what is the most suitable medium access control (MAC) protocol? You need to briefly describe the operation principle of the recommended MAC protocol.

The bus topology is recommended for the Ethernet. The MAC protocol is the mechanism to manage the transmission and receipt of messages across the many computers that are connected on to the network.

One such protocol is CSMA/CD which stands for carrier sense multiple access with collision detection. This kind of MAC does the following:

- i) checks the status of the transmission media to see if it is busy and commences transmission only when the media is free
- ii) checks continue if the media is busy, until it is freed
- iii) on detection of a potential collision, a signal is sent to all stations to avoid collision and stop transmission
- iv) after a certain time, the transmission is attempted again

Question 4 - ICAA5145A Identify best fit topology for WAN network (10 Marks)

Assume a total of 8 offices for *Jobs For You*, the company in the case study. Each of these offices has a local area network (LAN). These 8 LANs are connected to form a wide area network (WAN) so that they can communicate with each other.

Describe the most appropriate technologies and protocols that should be used for the WAN. You are welcome to extend the information provided in the published scenario in order to justify your solution.

The best approach for providing this connectivity is a combination of LAN and WAN. A LAN with a router with enable easier connectivity through the Internet to the widely spread offices of JFY.

**Question 5 - ICAA5045A Produce network/communication Design and ICAA5145A Identify best fit topology for WAN network
(30 marks)**

(a) Draw a physical network diagram of the wide area network recommended in Question 4. You need to show the main segments of the WAN.

(b) List the main communication cost items including initial installation and ongoing charges.

Network installation – material and labour

Modems

ISP / Internet connection fees

Ongoing:

Monthly telephone connection fees

Monthly subscription for the ISP

Maintenance of equipment and network

(c) Confidential data are transmitted between offices and between customers of *Jobs For You*. (i) Describe the security requirements of the WAN for the case study (ii) Describe two common security measures/techniques that you would apply to the WAN.

The security requirements of the WAN can range from the physical security of access through to electronic security. These include the need to protect the network from unauthorized access by persons, and ability of unauthorized users to redirect the transmissions within the WAN.

It is recommended that the WAN be protected from physical unauthorised access, especially the hubs and servers. The electronic security can be managed through Public Key Infrastructure (PKI). Finally, firewalls can be installed in order to ensure only authorised access.