UNIVERSITY COLLEGE DUBLIN

NATIONAL UNIVERSITY OF IRELAND, DUBLIN

An Colaiste Ollscoile Baile Atha Cliath

Ollscoil na hEireann, Baile Atha Cliath

WINTER EXAMINATIONS 2004

SCHDF0018 - HIGHER DIPLOMA IN COMPUTER SCIENCE EXAMINATION
ARBDF0015 – THIRD YEAR ARTS EXAMINATION

COMPUTER SCIENCE

COMPP303: Networks and Internet Systems
COMP3616: Networks and Internet Systems

Prof. J. Kramer
Prof. B. Smyth
Dr. J. Murphy*

Time: 2 hours

Answer Question 1 ***(COMPULSORY)*** and ***any TWO*** of Questions 2–5.

All questions carry equal marks.

Loose Rough Work sheets are not to be distributed or used.

READ EACH QUESTION CAREFULLY.

Question 1 (COMPULSORY)

(1-a) The router connecting a company's network to the Internet applies the mask **255.255.255.192** to the destination addresses of incoming IP packets. Given a destination IP address of **154.33.7.220**, show how the router determines which ***subnetwork*** this packet should be sent to, and state the ***Netid***, ***Subnetid***, and ***Hostid*** components of this IP address.

(1-b) Consider a route in a store-and-forward computer network going through 3 intermediate nodes. The packets contain 800 bits and are transmitted at 1 Mbps (in other words: 1,000,000 bits per second). Assume propagation delays over the links are negligible. As a packet travels along the route, it encounters an average of 3 packets when it arrives at each node. How long does it take on average for a packet to go from the sender to the receiver if the nodes transmit on a "first come first served" basis?

(1-c) In IP-based networks, a sending host can find the physical address which corresponds to the IP address of its intended destination by using the Address Resolution Protocol (ARP). Briefly explain how ARP works, mentioning the function of the ARP cache in each host.

(1-d) Draw a diagram of the TCP/IP Reference Model and show how its layers correspond to the seven layers of the ISO Reference Model for OSI.

Question 2

(2-a) Consider a Data Link Layer with the following measured parameters:

- frame transmission time at the sender is TRANSF = 400 microseconds
- ACK or NAK transmission time at the receiver is TRANSA = 40 microseconds
- link propagation delay is PROP = 20 microseconds
- frame processing time at sender and receiver is 0 (in other words, negligible)
- overall round-trip probability of frame error on the link is r = 0.2

Assume that for both the Stop-and-wait and Go-back-n ARQ schemes, the TIMEOUT at the sender is chosen optimally. The average packet throughput in each scheme is given by the following formulas:

$$\mathbf{throughput_{SW} = (1-r)/(TRANSF+TIMEOUT)}$$

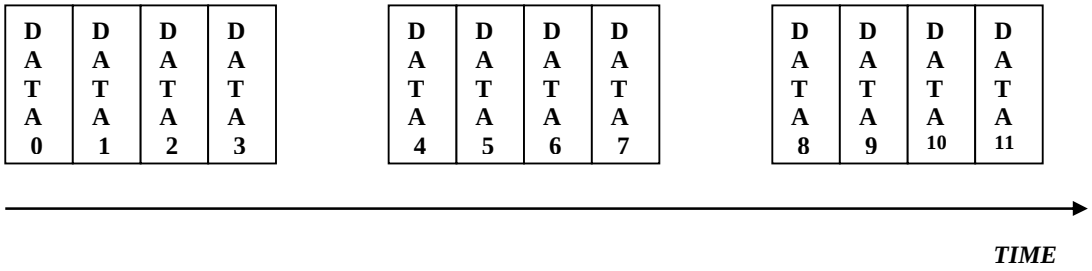
$$\mathbf{throughput_{GBN} = (1-r)/(TRANSF+(r \times TIMEOUT))}$$

If you want to ensure an average packet throughput of at least 1,600 packets per second, which of these ARQ schemes could you use? Justify your answers mathematically.

[QUESTION 2 Continues on the next page…]

[QUESTION 2 Continued…]

(2-b) Below is shown the frame transmission from a Sender node using Go-back-n. The delay between "Data 3" and "Data 4" is the same as between "Data 7" and "Data 8". This behavior is repeated again and again for this sender.



(i) Explain briefly what is the problem.

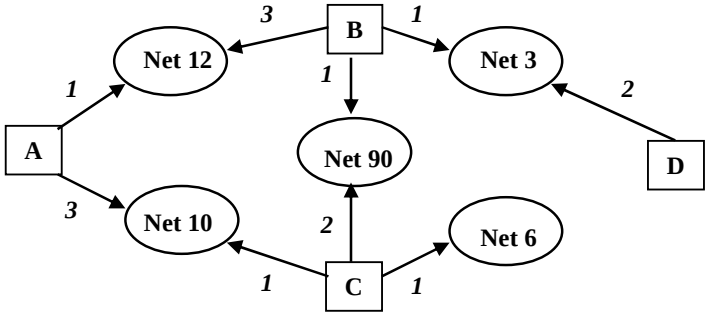
(ii) How would you fix this problem if the only parameter at your disposal was the frame size and explain briefly how this would work.

Question 3

(3-a) Briefly describe ***datagram packet-switching*** and ***virtual circuit packet-switching***, mentioning the information required in the network routers in each case.

(3-b) (i) The two most common types of routing algorithm are ***distance-vector*** and ***link-state***. Briefly describe their operation.

(ii) In this diagram, A, B, C and D are routers and the ovals represent LANs, labeled with their network ID. Suppose that **LINK-STATE** routing is being used and the following link costs have been determined:



Show the ***link-state packets*** each router floods to all other routers.

Question 4

(4-a) IEEE 802.5 Local Area Networks use a ***Token Ring*** mechanism to resolve contention for the channel. Briefly describe how this mechanism ensures no collisions among the nodes' transmissions.

(4-b) The throughput of an Ethernet can be determined by the formula

$$\mathbf{throughput = 1/(TRANSF + 5.4 \times PROP)}$$

where **PROP** is the one-way channel propagation delay and **TRANSF** is the average frame transmission time.

By reducing the frame size there is a reduction in the frame transmission time **TRANSF** and a corresponding increase in the throughput.

(i) Is there a limit on this way of improving the throughput?

(ii) Mention any possible shortcomings of this method. Explain your answer fully.

Question 5

(5-a) Briefly explain why, for multimedia delivery over IP-based networks, UDP is usually preferred to TCP as the transport protocol.

(5-b) Consider a TCP connection using the slow-start congestion control scheme with an initial THRESHOLD value of **50** kB and a Maximum Segment Size (MSS) of **3** kB. The receiver's advertised window is initially **64** kB. The first transmission attempt is numbered **0**, and all transmission attempts are successful **except** for Timeouts on attempt numbers **9** and **15**.

Find the size in kB of the ***sender's congestion window*** for its first **17** transmission attempts (that is, numbers **0 – 16**).

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