University College Dublin
An Coláiste Ollscoile, Baile Átha Cliath

SEMESTER 2 EXAMINATION – 2007/2008

COMPUTER SCIENCE & INFORMATICS

Networks and Internet Systems
COMP30040

Dr. P. McCullagh
Dr. Joe Carthy
Dr. J. Murphy*

Time: 2 Hours

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

All questions carry equal marks.

READ EACH QUESTION CAREFULLY.

Question 1 **COMPULSORY**

(1-a) Briefly explain the terms ***connection-oriented*** and ***connectionless*** service as they apply to computer networks, mentioning the essential features of each type of service.

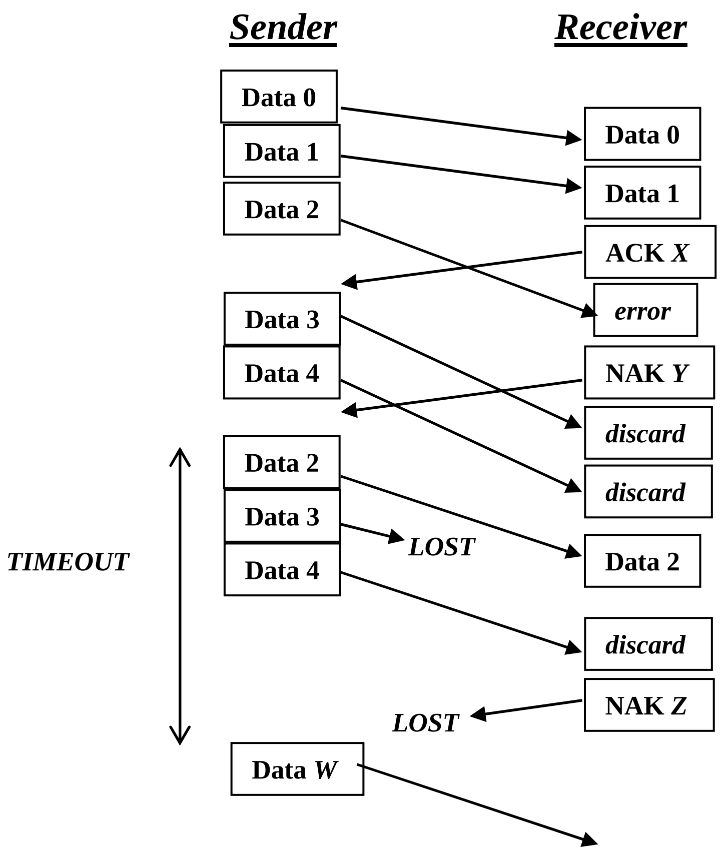
(1-b) In IP-based networks, a sending host can find the physical address which corresponds to the IP address of its intended destination by using the Address Resolution Protocol (ARP). Briefly explain how ARP works, mentioning the function of the ARP cache in each host.

(1-c) Ethernet uses Carrier Sense Multiple Access (CSMA) with Collision Detection (CD) as its channel access method. Briefly explain how ***CSMA*** and ***CD*** are implemented in Ethernet, and show why a ***minimum frame length*** is required.

(1-d) Suppose that a transmitter operating at 100 Mbps (where 1 Mbps = 1,000,000 bps) is connected to one end of a 230 km length of coaxial cable. The signal propagation speed in coaxial cable can be taken to be 230,000 km/sec. If packet-switching is used with a packet length of 2,000 bits, how many ***packets*** have been transmitted and are propagating along the cable when the first bit reaches the other end?

Question 2

(2-a) Consider the following timing diagram for a Go-back-n ARQ scheme with n = 3:



State the values for ***X***, ***Y***, ***Z*** and ***W*** in this diagram.

[Question 2 continues]

[Question 2 continued]

(2-b) 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 = 100 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 = 0.05

Assume that the TIMEOUT at the sender is chosen optimally. The average packet throughput in a Stop-and-wait ARQ scheme is given by the following formula:

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

1. Find the numerical value of the average packet throughput for Stop-and-wait ARQ in this case.

2. Briefly describe the advantages and disadvantages of using Go-back-n ARQ instead of Stop-and-wait.

Question 3

(3-a) The throughput of an Ethernet can be determined by the formula

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

where **PROP** is the one-way channel propagation delay and **TRANSF** is the average frame transmission time. Using this formula, state and explain the effect on Ethernet throughput of the following changes:

1. the length of the channel is <u>decreased</u> (everything else held constant);

2. the average frame length is <u>increased</u> (everything else held constant).

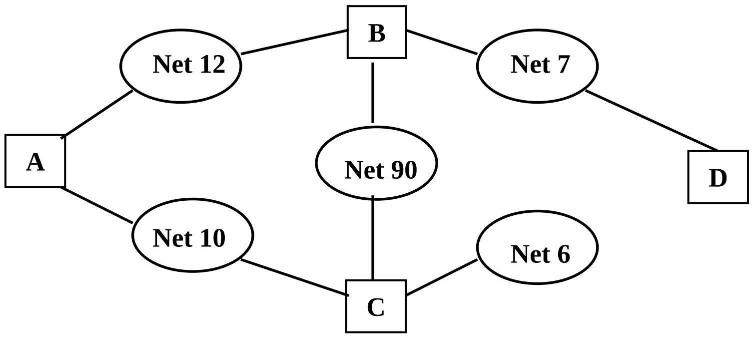
(3-b) Briefly describe ***datagram packet-switching*** and ***virtual circuit packet-switching***, mentioning

- their differences;

- the information required in the network routers in each case.

Question 4

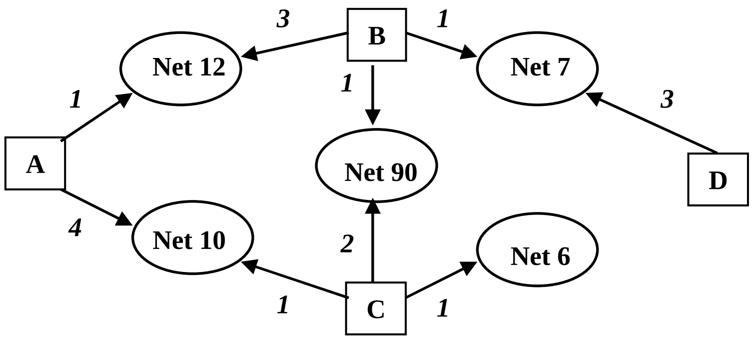
(4-a) In this diagram, A, B, C and D are routers. The ovals represent LANs, labeled with their network ID. The routers are using **DISTANCE-VECTOR** routing.



1. Show the ***initial routing tables*** exchanged by the routers.

2. Show how router A ***updates*** its routing table if it first receives B's initial routing table; and how A ***updates again*** if it then receives C's initial routing table.

(4-b) Suppose instead that **LINK-STATE** routing is being used. The following link costs have been determined:



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

2. Show all the steps used by router A to determine its ***shortest-path spanning tree*** after it has received link-state packets from all other routers.

Question 5

(5-a) Consider a TCP connection using the slow-start congestion control scheme with an initial THRESHOLD value of 64 kB and a Maximum Segment Size (MSS) of 2 kB. The receiver's advertised window is initially 32 kB. The first transmission attempt is numbered 0, and all transmission attempts are successful **except** for Timeouts on attempt numbers 4 and 10. In the ACKs for transmission attempt number 14 and subsequently, the receiver's advertised window is **reset** to 12 kB.

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

(5-b) The router connecting a company's network to the Internet applies the mask **`255.255.255.0`** to the destination addresses of incoming IP packets. Given a destination IP address of **`154.7.7.220`**, 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.

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