UNIVERSITY COLLEGE DUBLIN

NATIONAL UNIVERSITY OF IRELAND, DUBLIN

An Colaiste Ollscoile Baile Atha Cliath

Ollscoil na hEireann, Baile Atha Cliath

SUMMER EXAMINATIONS 2003

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

COMPUTER SCIENCE

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

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Time: 1 hour and 45 minutes

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) The Hamming distance between 2 Datalink layer codewords is defined to be the number of bit positions in which the codewords differ. Briefly explain how this is used in the General Parity Check error-handling scheme, mentioning the limitations of the scheme for error detection and error correction.

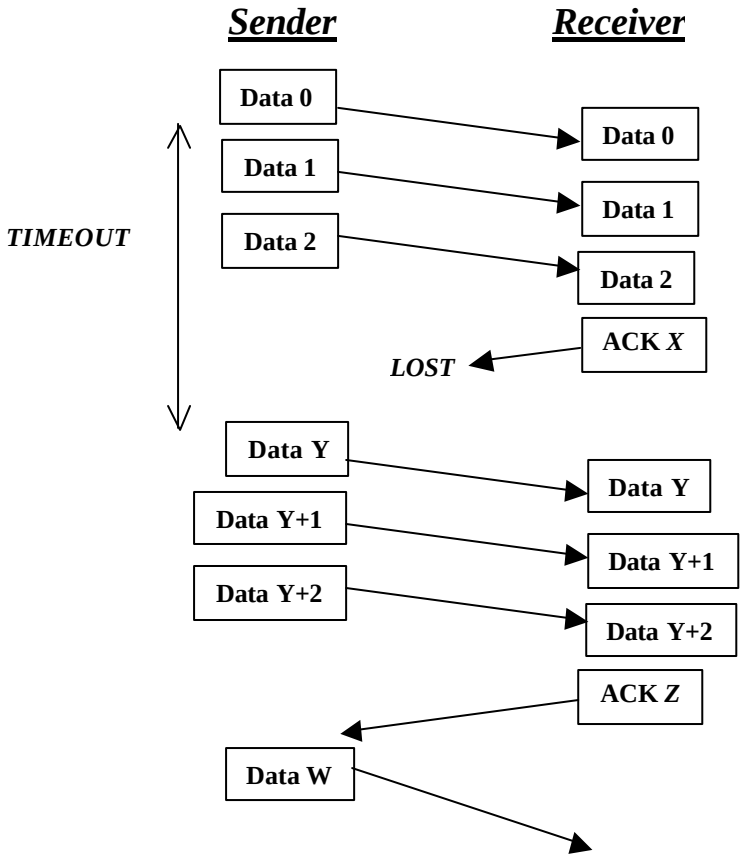
(1-b) Consider a route in a store-and-forward computer network going through 4 intermediate nodes. The packets contain 1,000 bits and are transmitted at 1 Mbps (in other words: 1,000,000 bits per second). Assume propagation delays over the links are negligible. As a packet travels along the route, it encounters an average of 2 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) Draw a diagram to illustrate the data transmission process in the ISO Reference Model for OSI, clearly specifying the *actual data transmission path* and which protocol layers are implemented in communication devices *within the network*.

(1-d) Both UDP and TCP use the concept of "ports". Briefly explain the purpose of ports and how they are used to make common applications (e.g. FTP, Telnet, HTTP) available.

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 = 200 microseconds
- ACK or NAK transmission time at the receiver is TRANSA = 40 microseconds
- link propagation delay is PROP = 10 microseconds
- frame processing time at sender or receiver is 10 microseconds
- overall round-trip probability of frame error on the link is r = 0.02

Assuming that the TIMEOUT at the sender is chosen optimally, the average packet throughput in a Go-back-n ARQ scheme is given by the following formula:

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

1. Find the numerical value of the average packet throughput for Go-back-n ARQ in this case.

2. The average packet throughput for the Stop-and-wait ARQ scheme is known to be lower than that of Go-back-n. State **one** reason for using Stop-and-wait despite this fact.

Question 3

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

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

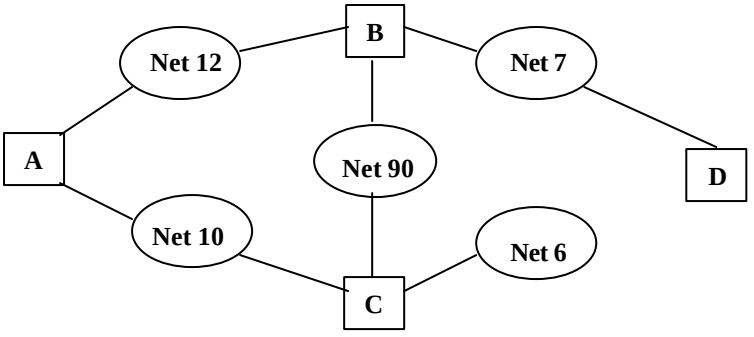
where **PROP** is the one-way channel propagation delay and **TRANSF** is the average frame transmission time.

If you want to ***increase*** this throughput, briefly explain what technologically feasible changes you should make to the current Ethernet configuration.

(3-b) Ethernet uses a *collision resolution* strategy to cope with contention among the nodes for the shared channel. State and briefly explain **two** other possible strategies for coping with this contention.

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.



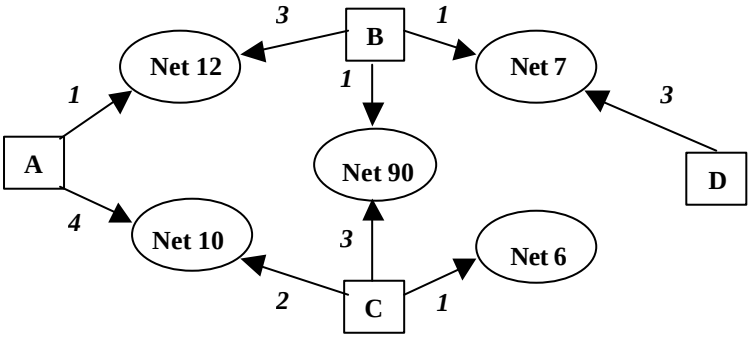
[Question 4 continues]

[Question 4 continued]

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

2. Show how router C ***updates*** its routing table if it first receives B's initial routing table; and how C ***updates again*** if it then receives A'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 the first **five** steps used by router C to determine its ***shortest-path spanning tree*** after it has received link-state packets from all other routers.

Question 5

(5-a) Briefly explain the essential elements of the TCP congestion control scheme, including the role of the **congestion window** and the **Threshold** value.

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

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