

UNIVERSITY COLLEGE DUBLIN

NATIONAL UNIVERSITY OF IRELAND, DUBLIN

An Colaiste Ollscoile Baile Atha Cliath  
Ollscoil na hEireann, Baile Atha Cliath

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AUTUMN EXAMINATIONS 2003

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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.

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

**READ EACH QUESTION CAREFULLY.**

### Question 1 (COMPULSORY)

(1-a) 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.

(1-b) 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.

(1-c) Briefly describe IPv4 address classes A, B, and C, and explain how a router can determine which class a given IPv4 address belongs to.

(1-d) 50 nodes are connected to a 1,000 metre length of coaxial cable. Using some protocol, each node can transmit 50 frames/second, where the average frame length is 2,000 bits. The transmission rate at each node is 10 Mbps (in other words: 10,000,000 bps). What is the numerical value for the *efficiency* of this protocol?

### 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 or receiver is  $PROC = 10$  microseconds
- overall round-trip probability of frame error on the link is  $r = 0.01$

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:

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

$$\text{throughput}_{GBN} = (1-r) / (TRANSF + (r \cdot TIMEOUT))$$

Find the numerical value of the average packet throughput for both the Stop-and-wait and Go-back-n ARQ schemes in this case.

(2-b) Draw example timing diagrams to show how a Stop-and-wait ARQ scheme copes with

1. a damaged data frame;
2. a lost data frame; and
3. a lost ACK.

### Question 3

(3-a) State whether the following statements are TRUE or FALSE (*no explanation required*):

1. In Ethernet, if the node transmission rate is increased while all other parameters are held constant, the throughput increases.
2. The IEEE 802.2 Logical Link Control protocol is specific to the technology being used in a particular broadcast Local Area Network, and therefore must be defined separately for Ethernet, Token Ring, Token Bus, etc.
3. The Single Parity Check can correct a single bit error in a transmitted codeword.

(3-b) Briefly describe *circuit switching* and *virtual circuit packet switching*, mentioning their principal differences.

### Question 4

(4-a) A *routing algorithm* provides the logic used by a router in a packet-switched network to decide, for each incoming packet, which output link the packet should be transmitted on. Briefly describe the desirable properties of a routing algorithm

(4-b) The two most common types of routing algorithm are *distance-vector* and *link-state*. Briefly describe their operation, mentioning which type is more widely used in practice and why.

### 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.

Find the size in kB of the *sender's congestion window* for its first 12 transmission attempts (that is, numbers 0 – 11).

(5-b) Briefly describe the steps carried out by a Web client retrieving a Web page, and by the Web server providing that Web page.

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